MARKETING AND POLICY BRIEFING PAPER

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RETHINKING DAIRYLAND:
BACKGROUND FOR DECISIONS ABOUT WISCONSIN'S DAIRY INDUSTRY

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Preface

This is the first in a series of brief reports that document the current state of the Wisconsin dairy industry and evaluate factors that will influence its evolution. The series is intended to address a growing concern among Wisconsin dairy industry leaders about the viability of Wisconsin dairying. The concern can be summarized as follows: Wisconsin milk cow numbers have fallen sharply over the last 15 years and, despite increasing milk production per cow, total state milk production has been flat to decreasing since 1988. While Wisconsin milk production has languished, U.S. milk utilization, especially cheese consumption, have shown very strong growth. Despite paying higher prices for cheese milk than plants in the West, where milk production is escalating, Wisconsin cheese makers are finding it increasingly difficult to fill their vats. Some cheese manufacturers have relocated or expanded their operations to regions with an expanding and less expensive milk supply and others have threatened to do so. A significant loss of processing capacity could threaten the entire dairy infrastructure.

Enhancing the viability of Wisconsin dairying requires an aggressive collaborative effort among and between industry participants and state government. The university's role in this process – and the purpose of this series – is to promote a clear and common understanding of the challenges and opportunities involved.

The first report in the series outlines the general scope of the Wisconsin dairy industry and documents its contributions to the overall state economy. Subsequent reports to be issued over the next several months will focus on more specific issues related to competitiveness.

Wisconsin's Dairy Industry Today[1]

Historical Overview[2]

In the 50 years between 1875 and 1925, a number of events led to the emergence of Wisconsin as the unchallenged dairy state. Early in this period, the cinch bug, the opening of land in the west, and the vision of an aggressive and articulate small town newspaper editor were key elements in the emergence of Wisconsin dairying.

Before 1875, agriculture in Wisconsin was small in scope and subsistence in nature. The exception was commercial wheat production, which totaled 25-30 million bushels between 1856 and 1872, placing Wisconsin among the top wheat states in the union.[3] But growing wheat without fertilizer quickly depleted soils. So farmers moved further and further north to find virgin ground to cultivate. As they did, they incurred shorter growing seasons, increasing cinch bug infestations, and sharply lower yields. It became more profitable to grow wheat in Minnesota and the Dakotas, leaving abandoned, worn out farms in Wisconsin.

The newspaper editor was W.D. Hoard, who began preaching the gospel of dairying as the salvation of agriculture in Wisconsin from the pulpit of his *Jefferson County Union* and later his nationally distributed *Hoard's Dairyman*. Hoard traveled extensively throughout the state, promoting modern feeding and breeding methods and supporting collective marketing efforts of dairy farmers.

Hoard's ideas caught on, but nascent dairy farmers were faced with numerous production and marketing constraints. Chief among these were milk quality and herd health. These problems were effectively addressed by pioneer University of Wisconsin College of Agriculture faculty. Stephen Babcock's butterfat test (1890) allowed cheese and butter plants to price milk in reference to its value in products, and encouraged farmers to adopt better feeding and breeding practices. H.L. Henry brought sound science to the eventually successful battle against bovine tuberculosis. W.A. Henry conducted research that demonstrated the profitability of balanced dairy rations. F.H. King was instrumental in promoting the use of silos for winter feed storage. Benjamin Hibbard assisted in the creation of scores of dairy cooperatives to efficiently process and market milk.

In the early 1900's the University, especially its Agricultural Extension Service, took on the challenge of expanding dairying to the despoiled, cut-over lands of northern Wisconsin. University specialists developed and demonstrated effective land-clearing

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[1] Authored by Ed Jesse, Professor and Extension Marketing Specialist,. Department of Agricultural and Applied Economics, University of Wisconsin-Madison/Extension

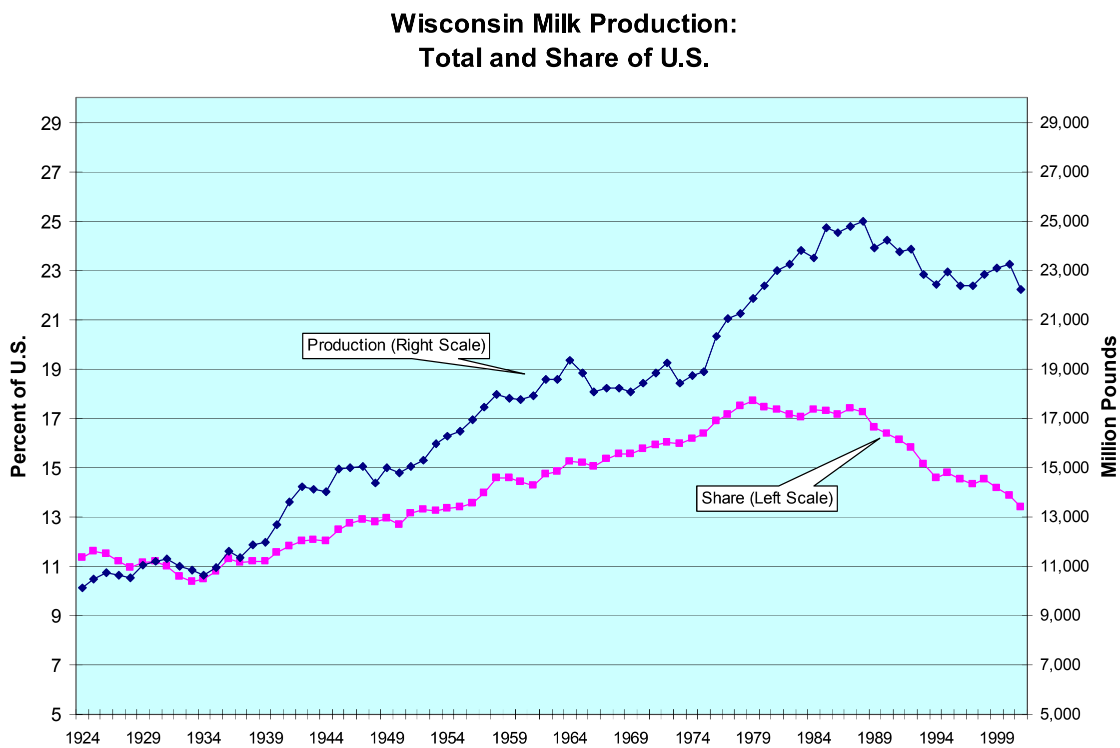
[2] This section draws heavily from *Wisconsin: A Guide to the Badger State*, New York: Duell, Sloan and Pearce, 1941, and Osman, Loren H., *W.D. Hoard: A Man for the Time*, Fort Atkinson: W.D. Hoard and Sons Company, 1985.

[3] By comparison, Wisconsin produced 8.7 million bushels of wheat in 2000.

techniques, cropping systems, and feeding and management practices tailored to conditions in the north.

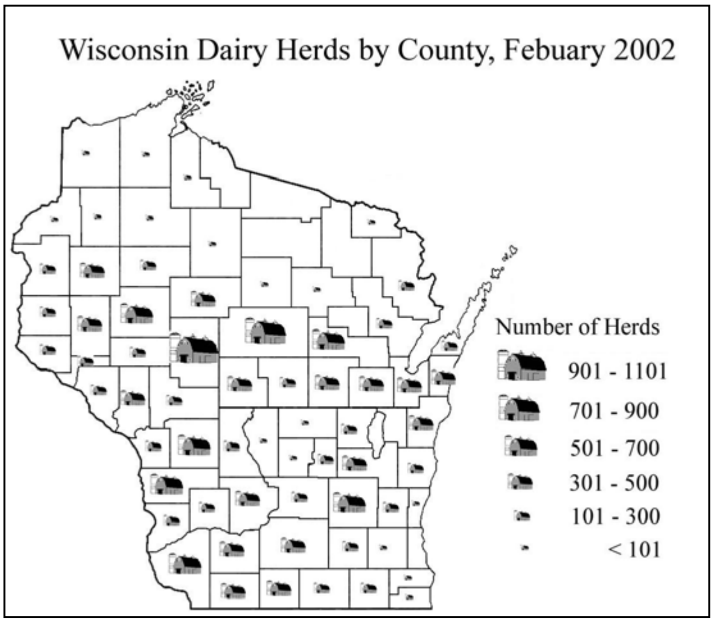
By 1925, dairy had reached the number 1 rank among commodity values in the state. Nearly 2 million Wisconsin dairy cows produced 10.6 billion pounds of milk that year. Wisconsin had long surpassed New York as the leading dairy, and accounted for 11.6 percent of U.S. milk production.

Both milk production and market share grew steadily for the next fifty years. In 1979, Wisconsin's share of U.S. milk production peaked at 17.7 percent, and then declined as milk production in the west mushroomed. Despite the fall-off in market share, milk production in Wisconsin continued to grow rapidly after 1979, peaking at 25 billion pounds in 1988. Since then, production has ranged between 22 and 24 billion pounds.

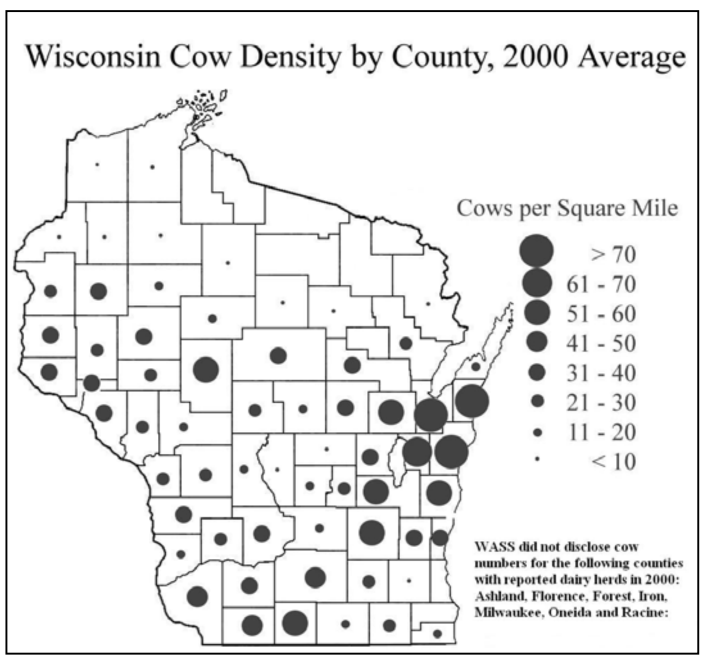


Wisconsin Dairy Farming in 2002

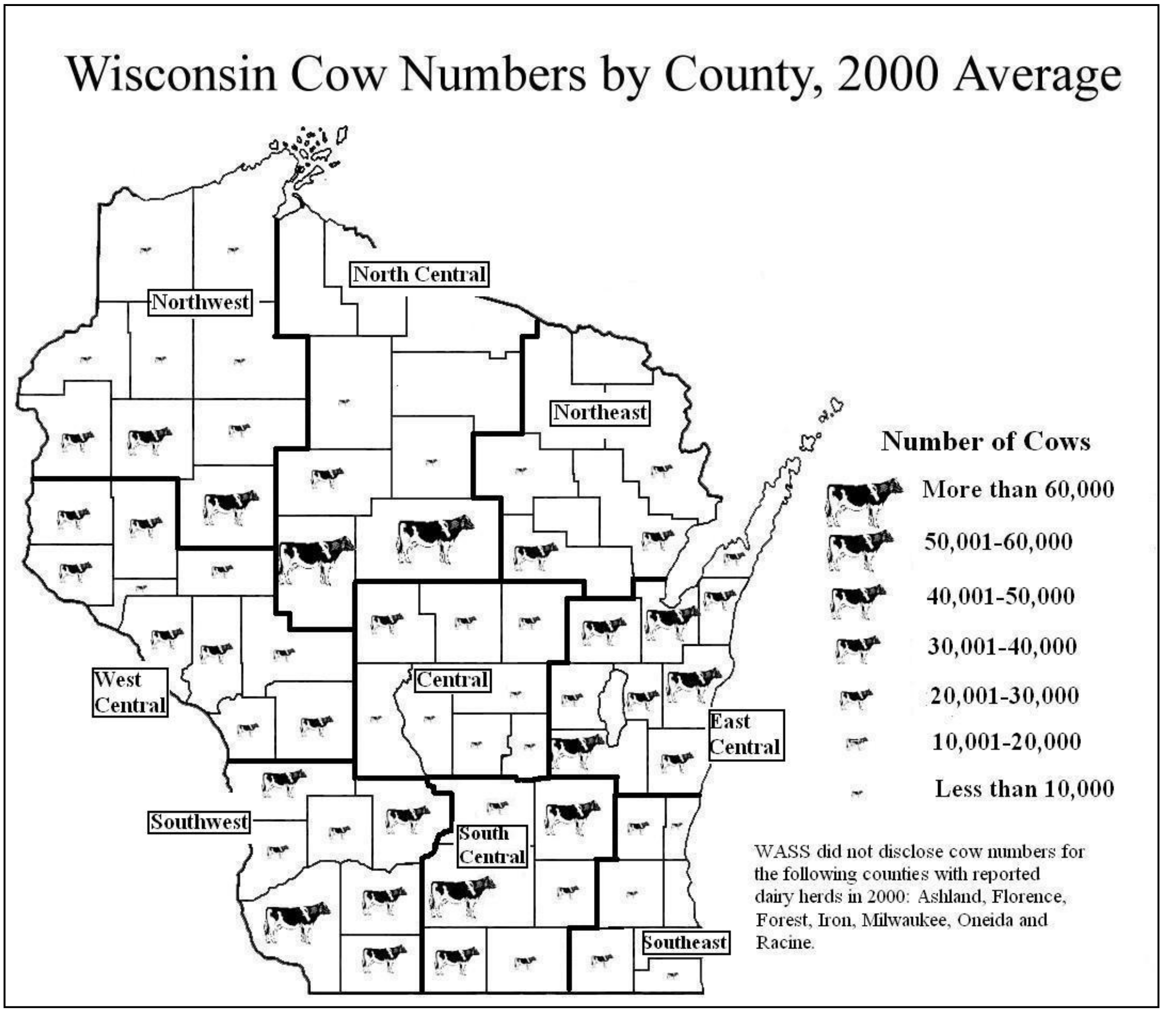
As of February 2002, there were 17,711 dairy farms in Wisconsin milking about 1.3 million cows. Dairying is widespread within the state – all but two counties (Vilas and Menominee) reported dairy farms in 2002. The top five dairy counties as measured by number of dairy herds were Clark, Marathon, Grant, Vernon and Chippewa, accounting for just over one-fifth of the state's herds (Appendix Table 1).



Eighty-five percent of Wisconsin dairy herds shipped Grade A milk in February 2002. There are nearly 3,000 Grade B herds, a number that has remained fairly constant in recent years. Grade B herds are concentrated in Western and North Central Wisconsin and in Green County. About 20 percent of Grade B producers cool and deliver milk in cans. This segment of the industry consists largely of Amish farmers whose religious beliefs forbid the use of electric-powered bulk cooling tanks.



Milk cow and milk production data by county are only available through 2000 (Appendix Tables 2 and 3). The latest dairy cow count shows a geographical pattern very similar to the 2002 herd data. However, the *density* of dairy farms or dairy cows (measured as the number of farms or cows per square mile) shows a somewhat different picture. The highest concentration of cows is in the East Central part of the state near Lake Winnebago and, to a lesser

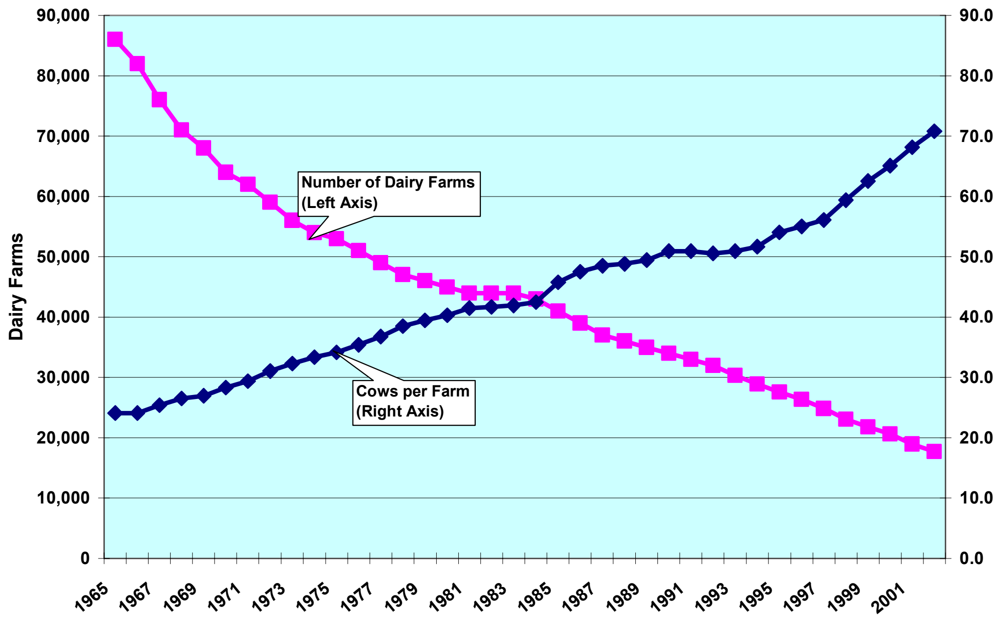


extent, in southwestern Wisconsin. Cow density in the East Central region, along with larger herd sizes in that region, suggest that growth in East Central Wisconsin may be more restricted than in some other parts of the state.

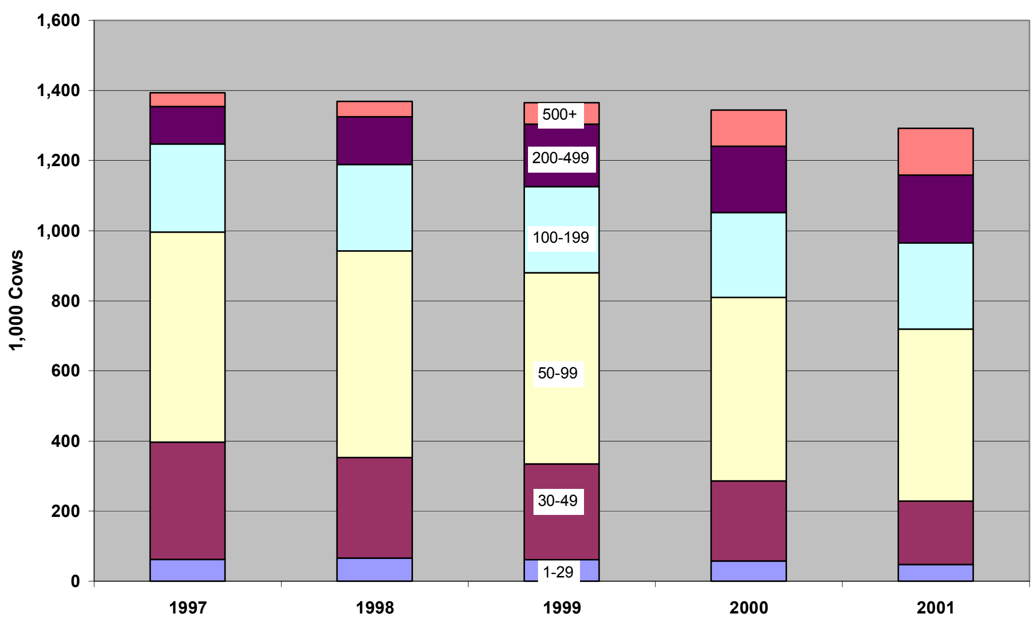
Over time, the number of dairy farms in Wisconsin has fallen steadily and the number of cows per farm has steadily increased as technological changes allowed family-sized farming units to handle more cows. Average herd size increased by less than one cow per year between 1965 and 1994, from 24.1 to 51.7. The average annual rate of change in herd size has accelerated to 2.4 cows per year since 1985. This reflects a rapidly-increasing proportion of the state's dairy cows in herds larger than 200 cows.

Changes in the dairy industry have not been uniform across the state. Total cow numbers fell by about one-half million or 26 percent between 1980 and 2000. The largest percentage losses were in the Northwest, Southeast, and Southwest regions, where cow numbers were down about a third. The East Central region was down only 16 percent.

Wisconsin Dairy Farms and Average Herd Size



Wisconsin Milk Cows by Herd Size



State milk production showed a four percent gain between 1980 and 2000. The Northwest and Southeast regions were down 7.4 and 6.1 percent, respectively, while the East Central region showed an increase of 19 percent. Changes in other regions were within 5 percentage points of the state average percentage change in milk production

Milk production per cow in Wisconsin increased 5,000 pounds, or 40 percent between 1980 and 2000 (Appendix Table 4). This represents an average annual gain of 250 pounds per year. Among Wisconsin counties, the percent change in milk yield between 1980 and 2000 ranged from 24 percent (Green County) to 53 percent (Marinette and Marquette). In 2000, Wisconsin milk cows produced an average 17,306 pounds. Yields were highest in the East Central region and lowest in the Northwest. Among counties, 2000 milk per cow ranged from 14,500 pounds to 18,700 pounds.

Other regional differences are in herd size and milk production per farm (Appendix Table 5). In 2000, dairy farms ranged in size from 41.5 cows in Crawford County to 109.2 cows in Brown County. The relative range in milk produced per farm was even greater, from 640,000 pounds in Crawford County to 2 million pounds in Brown County. Larger herds are concentrated in the East Central region. Of the 10 counties with the largest average herd size in 2000, five were in that region. The smallest herds were in the northern parts of the state.

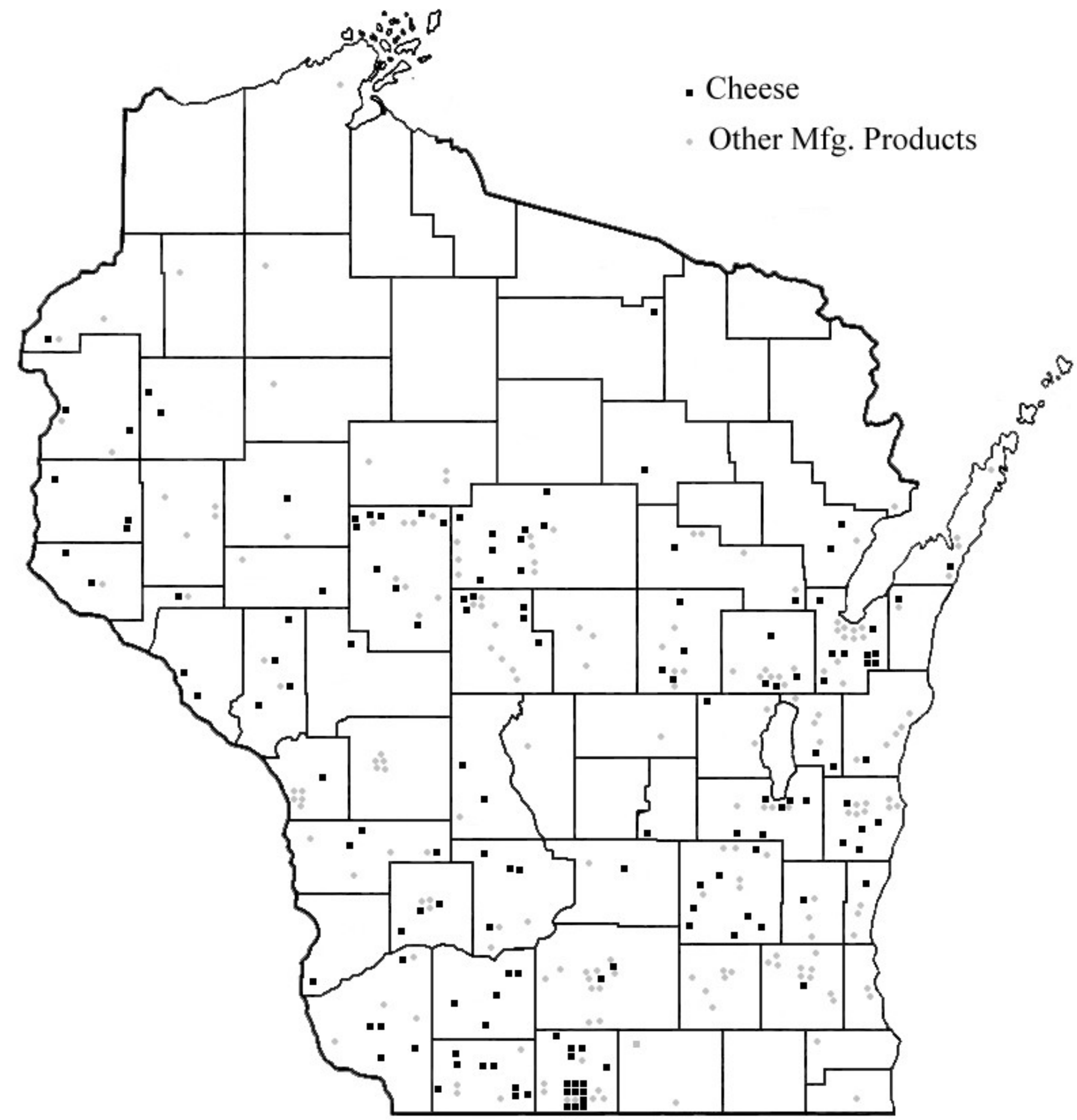
Wisconsin Dairy Manufacturing in 2002

Wisconsin Dairy Plants, 2001

Type of Plant	*No. of Plants*
Butter Factory	13
Cheese Factory	139
Cheese Cut, Wrap, Shred	119
Custard Mix	1
Cold Pack	23
Cream	2
Dairy Flavors	9
Cottage Cheese	4
Flavoring Cream Cheese	13
Powdering Operation	34
Processed Cheese	34
Ice Cream	27
Condensary	32
Powder Mixing/Blending	32
Retail Milk	11
Smoked Cheese	8
Sour Cream	5
Snack Dips	11
Soft Serve Yogurt	3
Whey Processing	42
Yogurt	3

While the dairy farming sector is the most visible element of the Wisconsin dairy industry, the dairy manufacturing sector is the element responsible for the largest value added. The Wisconsin Department of Agriculture, Trade and Consumer Protection dairy plant list for 2001 counted 364 dairy plants in the state making a wide variety of products. Dairy plants are widely-scattered throughout Wisconsin.

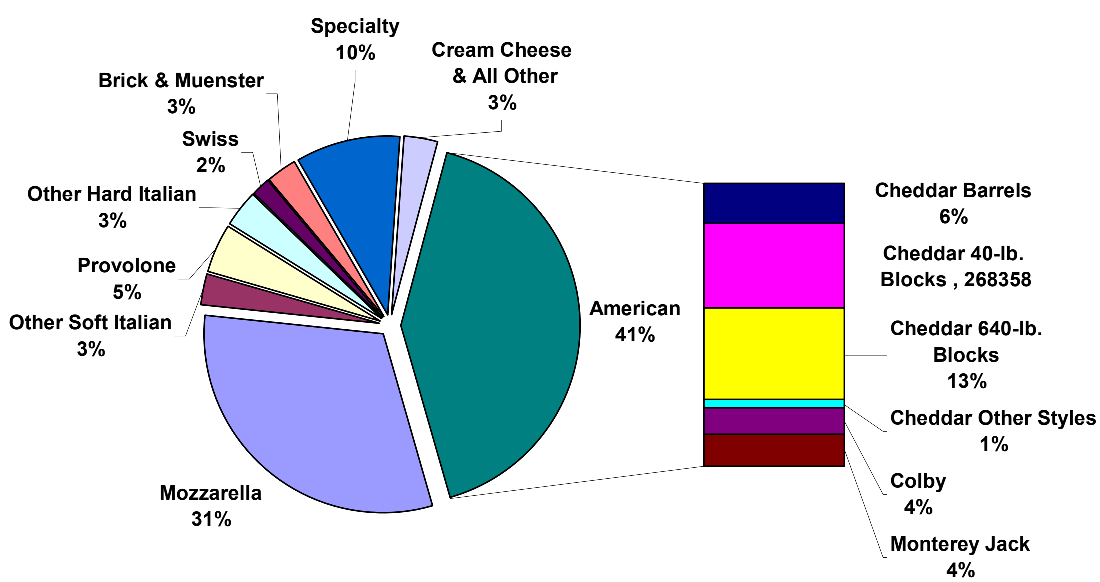
Wisconsin Dairy Plants, 2001



The principal use of Wisconsin milk is for cheese-making. It is impossible to derive a precise estimate of the fraction of the total state's milk supply going to cheese, but the percentage can be reasonably bracketed at 80-90 percent.[4] Other major manufactured dairy products include butter[5], cottage cheese, and whey products. Only about 6-8 percent of Wisconsin milk is used for fluid milk products.

In 2000, Wisconsin produced 2.2 billion pounds of natural cheese, about 27 percent of total U.S cheese production. Cheddar and Mozzarella accounted for about 2/3 of production. But at least 50 identifiable cheese varieties are produced commercially in the state. Specialty cheese production (defined generally as "value-added" varieties with annual production less than 40 million pounds) is growing rapidly. In 2000, more than 220 million pounds of specialty cheese varieties were manufactured in the state, 10 percent of total cheese production. This is up from 4 percent in 1993. Half of Wisconsin's cheese factories produce one or more specialty varieties. Wisconsin also produced just over 1 billion pounds of processed cheese products in 2000, about half of U.S. production.[6]

Wisconsin Cheese Production by Variety, 2000



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[4] Converting cheese production to milk equivalent is not straightforward because significant volumes of milk and milk products (e.g., nonfat dry milk) produced outside the state are used to make Wisconsin cheese.

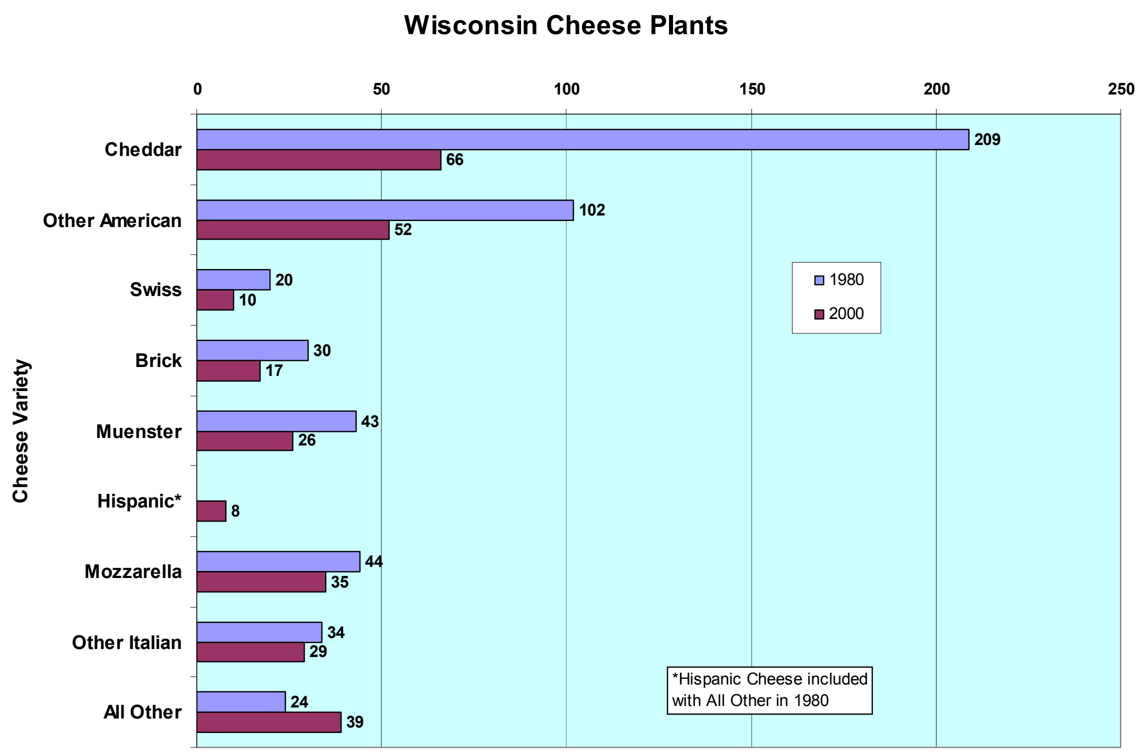
[5] Wisconsin is second to California in butter production, but little milk is used directly in butter-making. Most of the butter in the state is manufactured from cream obtained from standardizing milk for cheese-making or imported from other states.

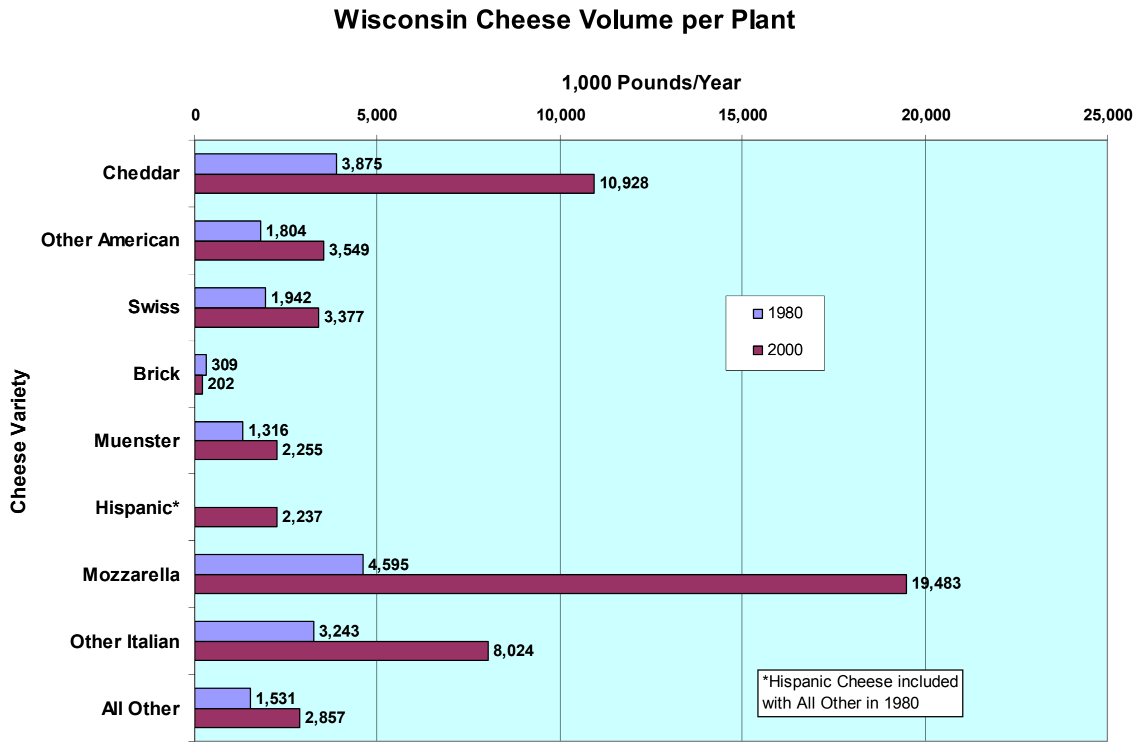
[6] Processed cheeses and cheese foods use natural cheeses as their exclusive or primary ingredient.

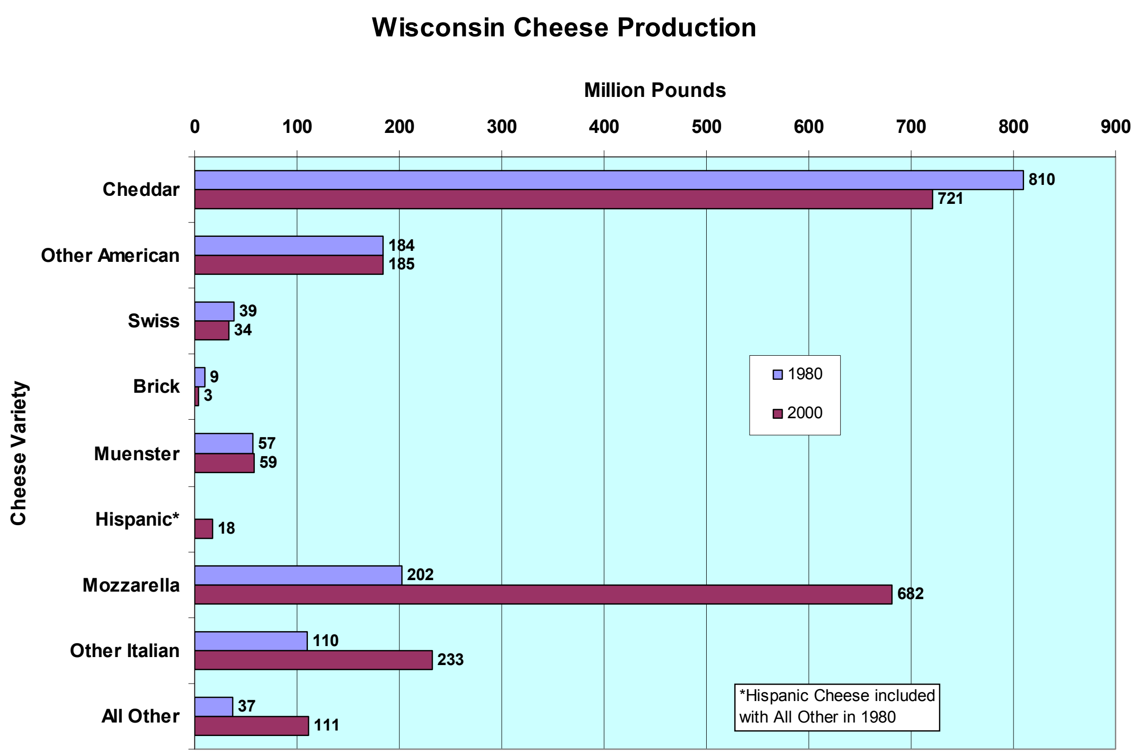
The number of cheese plants in Wisconsin fell by more than 60 percent between 1980 and 2000. By variety, the largest decline was in cheddar cheese plants. The number of plants making Mozzarella and other Italian cheese varieties remained relatively constant and plants making "other" varieties (mainly specialty cheeses) increased in number.

The consolidation in cheese making was accompanied by a substantial increase in average plant scale. Average volume per plant nearly tripled in cheddar factories and grew by more than 4 times in Mozzarella factories.

Wisconsin Mozzarella production in 2000 was 682 million pounds, second to Cheddar production of 721 million pounds. Cheddar production was down 11 percent from 1980, while Mozzarella was up 240 percent. Italian varieties as a group exceeded American cheese varieties in 2000. Demand for Mozzarella and other Italian cheeses has outpaced demand for cheddar cheese. Wisconsin cheese plants have altered production in response to these market signals.




Wisconsin Cheese Volume per Plant
1,000 Pounds/Year
0
5,000
10,000
15,000
20,000
25,000
Cheese Variety
Cheddar
Other American
Swiss
Brick
Muenster
Hispanic*
Mozzarella
Other Italian
All Other
3,875
10,928
1,804
3,549
1,942
3,377
309
202
1,316
2,255
2,237
4,595
19,483
3,243
8,024
1,531
2,857
1980
2000
*Hispanic Cheese included with All Other in 1980


Wisconsin Cheese Production
Million Pounds
0
100
200
300
400
500
600
700
800
900
Cheese Variety
Cheddar
Other American
Swiss
Brick
Muenster
Hispanic*
Mozzarella
Other Italian
All Other
810
721
184
185
39
34
9
3
57
59
18
202
682
110
233
37
111
1980
2000
*Hispanic Cheese included with All Other in 1980

Contribution of Dairy to the Wisconsin Economy[7]

Measuring Economic Impact

Dairy's contribution to the Wisconsin economy takes many forms. Most obvious is the *direct* or *initial* contribution through on-farm and processing employment and income generation. For 1999, the most current year for which complete income and employment data are data are available, dairy production, both on-farm and dairy processing, accounted for 80,500 jobs or about 2.6 percent of all employment in Wisconsin and $1.9 billion worth of income. Total industrial sales from dairy farms and dairy processors combined amounted to $11.7 billion, accounting for 1.3 percent of Wisconsin's total industrial sales.

But the direct contribution of dairy farming and processing to the Wisconsin economy is only part of the picture. Other industries are linked, through *indirect* and *induced* effects, to the dairy industry. These industries represent additional sources of economic activity, in essence multiplying the effects of the direct activity of dairy production and processing. The dairy industry impacts many parts of the larger Wisconsin economy through this *multiplier effect*.

The dairy industry uses machinery, trucks, fuel, financial and other businesses services and a range of inputs from other industries. These linkages, or *indirect* effects, create a network of interdependent industries, which in turn generate additional jobs and income in non-dairy industries. The income generated directly by dairy farms and processors also adds to this interdependency; on-farm and dairy processing employees spend their wages and salaries on groceries, housing, entertainment, and a range of other consumer goods and services. In turn employees in these industries spend their income on consumer goods and services. These additional linkages, beyond dairy and indirectly related sectors of the economy, create *induced* effects, which help to form a complex intertwining of industries within Wisconsin. So the relevant question to ask is not what dairy adds to the Wisconsin economy directly through income and employment generation, but rather how much does agriculture contribute to the Wisconsin economy through this complex networking of industries.

To answer this question it is necessary to use an empirical representation of the Wisconsin economy. While there are numerous methods of regional analysis that can capture linkages, the method adopted for the analysis reported here is centered around a social accounting matrix (SAM). A social accounting matrix representation of a regional economy (in this case, the state of Wisconsin) can be described as a "snapshot" of the

[7] Authored by Steven Deller, Professor and Extension Community Development Specialist, Department of Agricultural and Applied Economics, University of Wisconsin-Madison/Extension.

economy detailing the sales and purchases of goods and services between all sectors of the economy for a given period of time.

Industry output (sales) can be purchased by other industries as inputs, households for final consumption, or exported out of the state. Industry inputs (purchases) are obtained from other industries in the state, imported from outside the state, or purchased from households in the form of labor. The social accounting matrix approach to regional modeling allows these linkages to be described empirically. By examining expenditures by and sales from dairy firms, an assessment of the contribution of the dairy industry to Wisconsin's economy can be gained. In essence, by tracing the flow of dairy related dollars throughout the economy we can capture and measure the "multiplier effect."

A software package, IMPLAN (Impact PLANning),[8] was used to create the social accounting matrix for Wisconsin. All analyses reported here are for calendar year 1999, the most recent year for which the data are available. The model has detail for 486 business sectors and 17 institutional sectors (i.e., household groups, governments, etc.).

Empirical Results

Three levels of economic activity are examined: on-farm dairy production; off-farm dairy processing; and on- and off-farm dairy operations combined. The results of these analyses are presented in Tables 1-3.

After accounting for the multiplier affect, the Wisconsin dairy industry accounted for about 174,000 jobs, about 5.1 percent of all employment in Wisconsin; $5.7 billion income going to households, or about 3.6 percent of Wisconsin's gross state product; and $18.5 billion in industrial sales, or about 5.9 percent of total Wisconsin industrial sales. Separately, on-farm dairy production accounted for 90,700 jobs, $1.5 billion in household income and $4.9 billion in industrial sales. The Wisconsin dairy processing sector accounted for 99,700 jobs, $4.8 billion in household income (gross state product) and about $17 billion in industrial sales.

It is important to note that the sum of the two individual components of the combined dairy sector, on-farm production and off-farm processing, do not add to the combined effects. In other words, directly adding the summaries of Tables 1 and 2 will not result in Table 3. The whole is not equal to the sum of the parts because of "spillover" effects between the two components. Clearly on-farm production influences off-farm processing and the demand for raw milk by processors influences on-farm production. In that sense, on-farm production and off-farm processing are mutually interdependent. The analysis summarized in Table 1 captures the dependency going in one direction while the analysis in Table 2 captures the dependency going in the other direction. Adding Table 1 to Table 2 would double count those co-dependencies and thereby result in a double counting error.

[8] Minnesota IMPLAN Group, Inc., Stillwater, MN.

It is also important to that we *cannot* make the claim that if dairying were to cease to exist that total employment in Wisconsin would decline by 5.1 percent or gross state product (household income) would decline by $5.7 billion. Such an interpretation would require that all employees affected would pack up their families and belongings and move from Wisconsin. We would also need to assume that all other inputs used directly, such as land, and indirectly through the multiplier effect, would not be used for any other productive activity. Such an interpretation is clearly unrealistic. Rather, a more reasonable interpretation is that the dairy industry is "connected" to these dollars and jobs either directly or through the multiplier effect.

Looking at the contribution of the dairy industry to Wisconsin across different sectors of the economy shows that the Wisconsin economy is extremely intertwined and interdependent; nearly every sector in Wisconsin is linked to dairy. For example, the dairy industry affects the construction industry to the tune of almost 3,600 jobs annually. Retail and wholesale trade enjoys nearly $1.2 billion in household income from dairy. In terms of industrial sales, 36.5 percent of the total impact of dairy comes from sectors other than dairying itself. In terms of income, 66.8 percent of the total $5.7 billion impact comes from non-dairy sectors. The "rippling," or multiplier effect that dairying has on Wisconsin's economy is significant with the bulk of that impact coming from dairy processing.

The economic activity generated by dairy adds significantly to tax revenues at both the federal and state and local levels (Table 4). On-farm dairying creates almost $241 million in federal tax revenues while all of dairying generates in excess of $1 billion in federal taxes. On-farm dairy operations generate about $158 million in state and local taxes (not including support for K-12 public education) while all of dairying generates $688 million in state and local tax revenues. These tax revenue figures include taxes paid directly by dairy operators and employees and taxes from all the economic activity generated by the dairy industry.

Table 1: Economic Impact, On Farm Dairy, 1999 Wisconsin

Sector	*Jobs*	*Total Income $1,000*	*Industrial Output (Sales - $1,000)*
Dairy Farm Products	63,742	542,322	3,146,199
Agriculture	11,721	119,926	383,807
Mining	4	503	752
Construction	1,136	50,064	87,557
Manufacturing	665	44,946	143,880
TCPU*	1,864	149,792	273,886
Trade	5,170	256,209	357,539
FIRE**	1,919	185,603	267,539
Services	4,331	142,517	230,702
Government	197	12,154	28,670
Total	90,748	1,504,037	4,920,532
Implicit Multiplier	*1.424*	*2.773*	*1.564*
Wisconsin State Total	3,393,514	161,484,190	311,245,490
Percent of State Total	2.7%	0.9%	1.6%
Initial	63,742	542,322	3,146,199
Indirect	19,795	645,892	1,264,629
Induced	7,211	315,823	509,703
Total	90,748	1,504,037	4,920,531

* TCPU: Transportation, Communications, and Public Utilities
**FIRE: Finance, Insurance, and Real Estate

Table 2: Economic Impact, Off Farm Dairy Processing, 1999 Wisconsin

Sector	*Jobs*	*Total Income ($1,000)*	*Industrial Output (Sales-$1,000)*
Agriculture	29,610	677,352	3,843,834
Mining	11	1,683	2,507
Construction	2,486	109,314	193,401
Manufacturing	3,481	210,597	631,294
Dairy Processing	16,762	1,366,408	8,571,647
TCPU*	4,321	344,252	637,563
Trade	18,863	931,785	1,305,853
FIRE**	5,123	509,343	742,858
Services	18,397	592,585	948,925
Government	630	36,736	85,101
Total	99,685	4,780,056	16,962,985
Implicit Multiplier	*5.947*	*3.498*	*1.979*
Wisconsin State Total	3,393,514	161,484,190	311,245,490
Percent of State Total	2.9%	3.0%	5.5%
Initial	16,762	1,366,408	8,571,647
Indirect	60,456	2,431,086	6,811,614
Induced	22,467	982,562	1,579,724
Total	99,685	4,780,056	16,962,985

* TCPU: Transportation, Communications, and Public Utilities
**FIRE: Finance, Insurance, and Real Estate

Table 3: Economic Impact, Dairy Combined, 1999 Wisconsin

Sector	*Jobs*	*Total Income ($1,000)*	*Industrial Output (Sales-$1,000)*
Agriculture	88,422	797,278	3,959,781
Mining	15	2,186	3,260
Construction	3,622	159,378	280,958
Manufacturing	20,895	1,620,909	9,340,973
TCPU*	6,186	494,045	911,450
Trade	24,033	1,187,993	1,663,392
FIRE**	7,042	694,947	1,010,397
Services	22,728	735,102	1,179,628
Government	828	48,890	113,771
Total	173,770	5,740,729	18,463,609
Implicit Multiplier	*2.159*	*3.008*	*1.576*
Wisconsin State Total	3,393,514	161,484,190	311,245,490
Percent of State Total	5.1%	3.6%	5.9%
Initial	80,504	1,908,730	11,717,847
Indirect	63,599	2,534,594	4,668,158
Induced	29,666	1,297,405	2,077,604
Total	173,770	5,740,729	18,463,609

* TCPU: Transportation, Communications, and Public Utilities
**FIRE: Finance, Insurance, and Real Estate

Table 4: Federal, State and Local Tax Contribution of Wisconsin Dairying, 1999

Type of Tax	*On-Farm*	*Processing*	*Total*
		$	
Federal Taxes:			
Business Income Taxes	28,480,574	121,914,651	150,395,225
Indirect Business Taxes	13,446,168	45,676,151	59,122,319
Payroll Taxes- Employee Contribution	54,996,037	174,329,838	229,325,875
Payroll Taxes - Employer Contribution	45,178,406	161,705,032	206,883,438
Personal Tax: Income Tax	98,122,526	301,942,421	400,064,947
Other Personal Taxes and Fees	1,143,088	3,517,508	4,660,596
Total Federal	241,366,798	809,085,602	1,050,452,400
State/Local Taxes:			
Business Income Taxes	5,694,808	24,377,335	30,072,142
Indirect Business Taxes	106,991,186	363,537,117	470,528,303
Payroll Taxes- Employee Contribution	250,560	896,817	1,147,377
Payroll Taxes - Employer Contribution	1,015,427	3,634,471	4,649,898
Motor Vehicle License Fees	1,226,473	3,787,951	5,014,424
Personal Property Taxes	714,511	2,229,264	2,943,774
Personal Income Taxes	33,815,383	104,438,485	138,253,868
Other Personal Taxes	8,600,599	26,804,536	35,405,134
Total State and Local	158,308,946	529,705,974	688,014,920
Grand Total	399,675,744	1,338,791,576	1,738,467,320

Appendix: Reference Tables

Table 1: Wisconsin Dairy Herds by Grade of Milk, February 2002

County	Grade A		Grade B				Total Herds
	Herds	Percent of Total	Herds			Percent of Total	
			Bulk	Can	Total		
Adams	23	79%	6	0	6	21%	29
Ashland	18	82%	4	0	4	18%	22
Barron	423	88%	60	0	60	12%	483
Bayfied	36	72%	14	0	14	28%	50
Brown	269	86%	45	0	45	14%	314
Buffalo	235	85%	33	10	43	15%	278
Burnette	53	79%	14	0	14	21%	67
Calumet	232	94%	15	0	15	6%	247
Chippewa	538	91%	51	0	51	9%	589
Clark	820	74%	150	131	281	26%	1,101
Columbia	180	85%	17	15	32	15%	212
Crawford	179	76%	54	4	58	24%	237
Dane	433	95%	23	0	23	5%	456
Dodge	517	96%	22	0	22	4%	539
Door	114	79%	31	0	31	21%	145
Douglas	12	86%	2	0	2	14%	14
Dunn	320	92%	29	0	29	8%	349
Eau Claire	173	66%	27	63	90	34%	263
Florence	12	100%	0	0	0	0%	12
Fond du Lac	462	96%	21	0	21	4%	483
Forest	6	86%	1	0	1	14%	7
Grant	635	91%	63	0	63	9%	698
Green	307	67%	154	0	154	33%	461
Green Lake	94	73%	11	23	34	27%	128
Iowa	313	84%	58	0	58	16%	371
Iron	5	100%	0	0	0	0%	5
Jackson	180	80%	32	12	44	20%	224
Jefferson	191	95%	11	0	11	5%	202
Juneau	115	82%	25	1	26	18%	141
Kenosha	43	100%	0	0	0	0%	43
Kewaunee	255	80%	63	0	63	20%	318
La Crosse	150	96%	6	0	6	4%	156
Lafayette	309	79%	83	0	83	21%	392
Langlade	77	91%	8	0	8	9%	85
Lincoln	80	81%	19	0	19	19%	99

County	Grade A		Grade B				Total Herds
	Herds	Percent of Total	Herds			Percent of Total	
			Bulk	Can	Total		
Manitowoc	349	87%	52	0	52	13%	401
Marathon	734	76%	230	0	230	24%	964
Marinette	120	92%	10	0	10	8%	130
Marquette	53	77%	11	5	16	23%	69
Milwaukee	3	100%	0	0	0	0%	3
Monroe	334	64%	44	140	184	36%	518
Oconto	228	87%	32	1	33	13%	261
Oneida	0	0%	1	0	1	100%	1
Outagamie	318	91%	33	0	33	9%	351
Ozaukee	86	92%	7	0	7	8%	93
Pepin	107	90%	11	1	12	10%	119
Pierce	246	93%	19	0	19	7%	265
Polk	231	93%	16	2	18	7%	249
Portage	178	82%	38	0	38	18%	216
Price	60	67%	29	0	29	33%	89
Racine	51	100%	0	0	0	0%	51
Richland	206	76%	61	3	64	24%	270
Rock	156	93%	12	0	12	7%	168
Rusk	186	84%	36	0	36	16%	222
St. Croix	234	92%	19	0	19	8%	253
Sauk	306	85%	54	0	54	15%	360
Sawyer	31	89%	4	0	4	11%	35
Shawano	472	87%	71	0	71	13%	543
Sheboygan	226	90%	25	0	25	10%	251
Taylor	300	82%	60	4	64	18%	364
Trempealeau	267	87%	41	0	41	13%	308
Vernon	343	56%	99	167	266	44%	609
Walworth	135	100%	0	0	0	0%	135
Washburn	38	90%	4	0	4	10%	42
Washington	169	93%	12	0	12	7%	181
Waukesha	49	100%	0	0	0	0%	49
Waupaca	278	84%	51	0	51	16%	329
Waushara	79	86%	13	0	13	14%	92
Winnebago	146	85%	26	0	26	15%	172
Wood	271	83%	57	0	57	17%	328
State Total	***14,799***	***84%***	***2,330***	***582***	***2,912***	***16%***	***17,711***

Based on data from the Dairy Producer License list as of February 1, 2002, Division of Food Safety, Wisconsin Department of Agriculture, Trade and Consumer Protection.

Table 2: Wisconsin Milk Cows, 1980 and 2000

County	No. of Milk Cows		Change in Cows	
	1980	2000	No.	%
Adams	3,700	1,700	-2,000	-54.1
Ashland	3,600	ND*		
Barron	47,800	32,500	-15,300	-32.0
Bayfield	5,600	3,000	-2,600	-46.4
Brown	39,000	39,000	0	0.0
Buffalo	29,200	23,000	-6,200	-21.2
Burnett	7,100	3,800	-3,300	-46.5
Calumet	30,700	22,500	-8,200	-26.7
Chippewa	50,800	39,500	-11,300	-22.2
Clark	67,900	63,500	-4,400	-6.5
Columbia	23,400	16,000	-7,400	-31.6
Crawford	19,100	11,700	-7,400	-38.7
Dane	65,000	50,500	-14,500	-22.3
Dodge	63,100	45,000	-18,100	-28.7
Door	15,500	10,300	-5,200	-33.5
Douglas	2,400	900	-1,500	-62.5
Dunn	41,000	25,000	-16,000	-39.0
Eau Claire	22,100	13,100	-9,000	-40.7
Florence	1,200	ND		
Fond Du Lac	50,500	42,500	-8,000	-15.8
Forest	1,600	ND		
Grant	56,800	52,000	-4,800	-8.5
Green	50,200	36,000	-14,200	-28.3
Green Lake	14,600	9,100	-5,500	-37.7
Iowa	37,900	28,000	-9,900	-26.1
Iron	600	ND		
Jackson	19,000	15,000	-4,000	-21.1
Jefferson	28,800	17,000	-11,800	-41.0
Juneau	14,500	9,800	-4,700	-32.4
Kenosha	6,900	3,600	-3,300	-47.8
Kewaunee	30,400	27,500	-2,900	-9.5
La Crosse	20,100	12,700	-7,400	-36.8
Lafayette	42,100	33,000	-9,100	-21.6
Langlade	13,300	7,700	-5,600	-42.1
Lincoln	11,500	6,100	-5,400	-47.0
Manitowoc	44,900	44,000	-900	-2.0
Marathon	85,900	64,000	-21,900	-25.5
Marinette	14,200	11,500	-2,700	-19.0
Marquette	7,300	5,700	-1,600	-21.9
Milwaukee	100	ND		
Monroe	37,700	27,900	-9,800	-26.0
Oconto	30,400	21,500	-8,900	-29.3

County	No. of Milk Cows		Change in Cows	
	1980	2000	No.	%
Oneida	300	ND		
Outagamie	46,200	36,000	-10,200	-22.1
Ozaukee	10,300	9,100	-1,200	-11.7
Pepin	10,100	8,500	-1,600	-15.8
Pierce	25,900	19,200	-6,700	-25.9
Polk	34,000	19,300	-14,700	-43.2
Portage	17,200	14,400	-2,800	-16.3
Price	9,300	4,400	-4,900	-52.7
Racine	7,000	ND		
Richland	27,700	17,300	-10,400	-37.5
Rock	27,500	14,500	-13,000	-47.3
Rusk	18,600	13,400	-5,200	-28.0
St. Croix	35,600	25,100	-10,500	-29.5
Sauk	38,400	29,000	-9,400	-24.5
Sawyer	3,200	3,100	-100	-3.1
Shawano	47,700	36,400	-11,300	-23.7
Sheboygan	32,400	26,300	-6,100	-18.8
Taylor	30,100	19,600	-10,500	-34.9
Trempealeau	35,600	25,500	-10,100	-28.4
Vernon	44,800	30,000	-14,800	-33.0
Vilas	100	ND		
Walworth	21,000	13,800	-7,200	-34.3
Washburn	5,900	3,500	-2,400	-40.7
Washington	22,500	16,000	-6,500	-28.9
Waukesha	10,200	4,700	-5,500	-53.9
Waupaca	33,800	25,400	-8,400	-24.9
Waushara	12,200	6,400	-5,800	-47.5
Winnebago	24,000	15,900	-8,100	-33.8
Wood	25,900	23,500	-2,400	-9.3
Regional Summary				
Northwest	175,400	119,000	-56,400	-32.2
North Central	209,300	160,000	-49,300	-23.6
Northeast	108,400	78,000	-30,400	-28.0
West Central	276,300	195,000	-81,300	-29.4
Central	129,200	96,000	-33,200	-25.7
East Central	313,600	264,000	-49,600	-15.8
Southwest	266,800	179,000	-87,800	-32.9
South Central	258,000	201,000	-57,000	-22.1
Southeast	78,000	52,000	-26,000	-33.3
State Total	1,815,000	1,344,000	-471,000	-26.0

*ND = Not Disclosed. Included in regional summary and state totals.

Source: Wisconsin Agricultural Statistics Service

Table 3: Wisconsin Annual Milk Production, 1980 and 2000

County	Total Milk, 1,000 Pounds		Change in Milk	
	1980	2000	1,000 Lbs	%
Adams	44,030	26,860	-17,170	-39.0
Ashland	41,040	ND*		
Barron	587,940	559,000	-28,940	-4.9
Bayfield	65,520	48,000	-17,520	-26.7
Brown	503,100	721,500	218,400	43.4
Buffalo	350,400	391,000	40,600	11.6
Burnett	80,940	60,420	-20,520	-25.4
Calumet	396,030	411,750	15,720	4.0
Chippewa	619,760	632,000	12,240	2.0
Clark	841,960	1,098,550	256,590	30.5
Columbia	301,860	280,000	-21,860	-7.2
Crawford	217,740	180,180	-37,560	-17.2
Dane	845,000	954,450	109,450	13.0
Dodge	820,300	769,500	-50,800	-6.2
Door	193,750	172,010	-21,740	-11.2
Douglas	27,120	13,050	-14,070	-51.9
Dunn	496,100	425,000	-71,100	-14.3
Eau Claire	262,990	220,080	-42,910	-16.3
Florence	14,640	ND		
Fond Du Lac	651,450	782,000	130,550	20.0
Forest	17,600	ND		
Grant	670,240	894,400	224,160	33.4
Green	647,580	576,000	-71,580	-11.1
Green Lake	179,580	151,970	-27,610	-15.4
Iowa	451,010	478,800	27,790	6.2
Iron	6,720	ND		
Jackson	226,100	247,500	21,400	9.5
Jefferson	374,400	287,300	-87,100	-23.3
Juneau	174,000	164,640	-9,360	-5.4
Kenosha	88,320	62,280	-26,040	-29.5
Kewaunee	383,040	497,750	114,710	29.9
La Crosse	245,220	214,630	-30,590	-12.5
Lafayette	496,780	508,200	11,420	2.3
Langlade	155,610	129,360	-26,250	-16.9
Lincoln	134,550	99,430	-35,120	-26.1
Manitowoc	574,720	814,000	239,280	41.6
Marathon	1,073,750	1,081,600	7,850	0.7
Marinette	166,140	205,850	39,710	23.9
Marquette	85,410	102,030	16,620	19.5
Milwaukee	1,220	ND		
Monroe	448,630	463,140	14,510	3.2
Oconto	355,680	380,550	24,870	7.0
Oneida	3,210	ND		
Outagamie	595,980	644,400	48,420	8.1

County	Total Milk, 1,000 Pounds		Change in Milk	
	1980	2000	1,000 Lbs	%
Ozaukee	129,780	164,710	34,930	26.9
Pepin	120,190	149,600	29,410	24.5
Pierce	318,570	341,760	23,190	7.3
Polk	418,200	322,310	-95,890	-22.9
Portage	208,120	237,600	29,480	14.2
Price	101,370	70,400	-30,970	-30.6
Racine	90,300	ND		
Richland	324,090	290,640	-33,450	-10.3
Rock	354,750	256,650	-98,100	-27.7
Rusk	204,600	211,720	7,120	3.5
St. Croix	441,440	469,370	27,930	6.3
Sauk	460,800	504,600	43,800	9.5
Sawyer	36,160	50,530	14,370	39.7
Shawano	591,480	644,280	52,800	8.9
Sheboygan	421,200	489,180	67,980	16.1
Taylor	361,200	323,400	-37,800	-10.5
Trempealeau	430,760	441,150	10,390	2.4
Vernon	506,240	465,000	-41,240	-8.1
Vilas	1,060	ND		
Walworth	268,800	247,020	-21,780	-8.1
Washburn	69,620	57,050	-12,570	-18.1
Washington	290,250	288,000	-2,250	-0.8
Waukesha	126,480	86,010	-40,470	-32.0
Waupaca	415,740	452,120	36,380	8.8
Waushara	148,840	113,280	-35,560	-23.9
Winnebago	312,000	271,890	-40,110	-12.9
Wood	310,800	418,300	107,500	34.6
Regional Summary				
Northwest	2,109,860	1,954,080	-155,780	-7.4
North Central	2,564,860	2,714,900	150,040	5.8
Northeast	1,301,150	1,374,890	73,740	5.7
West Central	3,340,400	3,363,230	22,830	0.7
Central	1,566,520	1,666,800	100,280	6.4
East Central	4,031,270	4,804,480	773,210	19.2
Southwest	3,126,900	3,123,900	-3,000	-0.1
South Central	3,343,890	3,321,820	-22,070	-0.7
Southeast	995,150	934,900	-60,250	-6.1
State Totals	22,380,000	23,259,000	879,000	3.9

*ND = Not disclosed. Included in regional summary and state totals.

Source: Wisconsin Agricultural Statistics Service

Table 4: Wisconsin Annual Milk Production per Cow, 1980 and 2000

County	Annual Milk per Cow		Change		2000 Dev. From State Avg., Pounds
	1980	2000	Pounds	%	
Adams	11,900	15,800	3,900	32.8	-1,506
Ashland	11,400	ND*			
Barron	12,300	17,200	4,900	39.8	-106
Bayfield	11,700	16,000	4,300	36.8	-1,306
Brown	12,900	18,500	5,600	43.4	1,194
Buffalo	12,000	17,000	5,000	41.7	-306
Burnett	11,400	15,900	4,500	39.5	-1,406
Calumet	12,900	18,300	5,400	41.9	994
Chippewa	12,200	16,000	3,800	31.1	-1,306
Clark	12,400	17,300	4,900	39.5	-6
Columbia	12,900	17,500	4,600	35.7	194
Crawford	11,400	15,400	4,000	35.1	-1,906
Dane	13,000	18,900	5,900	45.4	1,594
Dodge	13,000	17,100	4,100	31.5	-206
Door	12,500	16,700	4,200	33.6	-606
Douglas	11,300	14,500	3,200	28.3	-2,806
Dunn	12,100	17,000	4,900	40.5	-306
Eau Claire	11,900	16,800	4,900	41.2	-506
Florence	12,200	ND			
Fond Du Lac	12,900	18,400	5,500	42.6	1,094
Forest	11,000	ND			
Grant	11,800	17,200	5,400	45.8	-106
Green	12,900	16,000	3,100	24.0	-1,306
Green Lake	12,300	16,700	4,400	35.8	-606
Iowa	11,900	17,100	5,200	43.7	-206
Iron	11,200	ND			
Jackson	11,900	16,500	4,600	38.7	-806
Jefferson	13,000	16,900	3,900	30.0	-406
Juneau	12,000	16,800	4,800	40.0	-506
Kenosha	12,800	17,300	4,500	35.2	-6
Kewaunee	12,600	18,100	5,500	43.7	794
La Crosse	12,200	16,900	4,700	38.5	-406
Lafayette	11,800	15,400	3,600	30.5	-1,906
Langlade	11,700	16,800	5,100	43.6	-506
Lincoln	11,700	16,300	4,600	39.3	-1,006
Manitowoc	12,800	18,500	5,700	44.5	1,194
Marathon	12,500	16,900	4,400	35.2	-406
Marinette	11,700	17,900	6,200	53.0	594
Marquette	11,700	17,900	6,200	53.0	594
Milwaukee	12,200	ND			
Monroe	11,900	16,600	4,700	39.5	-706
Oconto	11,700	17,700	6,000	51.3	394
Oneida	10,700	ND			
Outagamie	12,900	17,900	5,000	38.8	594

County	Annual Milk per Cow		Change		2000 Dev. From State Avg., Pounds
	1980	2000	Pounds	%	
Ozaukee	12,600	18,100	5,500	43.7	794
Pepin	11,900	17,600	5,700	47.9	294
Pierce	12,300	17,800	5,500	44.7	494
Polk	12,300	16,700	4,400	35.8	-606
Portage	12,100	16,500	4,400	36.4	-806
Price	10,900	16,000	5,100	46.8	-1,306
Racine	12,900	ND			
Richland	11,700	16,800	5,100	43.6	-506
Rock	12,900	17,700	4,800	37.2	394
Rusk	11,000	15,800	4,800	43.6	-1,506
St. Croix	12,400	18,700	6,300	50.8	1,394
Sauk	12,000	17,400	5,400	45.0	94
Sawyer	11,300	16,300	5,000	44.2	-1,006
Shawano	12,400	17,700	5,300	42.7	394
Sheboygan	13,000	18,600	5,600	43.1	1,294
Taylor	12,000	16,500	4,500	37.5	-806
Trempealeau	12,100	17,300	5,200	43.0	-6
Vernon	11,300	15,500	4,200	37.2	-1,806
Vilas	10,600	ND			
Walworth	12,800	17,900	5,100	39.8	594
Washburn	11,800	16,300	4,500	38.1	-1,006
Washington	12,900	18,000	5,100	39.5	694
Waukesha	12,400	18,300	5,900	47.6	994
Waupaca	12,300	17,800	5,500	44.7	494
Waushara	12,200	17,700	5,500	45.1	394
Winnebago	13,000	17,100	4,100	31.5	-206
Wood	12,000	17,800	5,800	48.3	494
Regional Summary					
Northwest	12,029	16,421	4,392	36.5	-885
North Central	12,254	16,968	4,714	38.5	-338
Northeast	12,003	17,627	5,624	46.9	321
West Central	12,090	17,247	5,157	42.7	-59
Central	12,125	17,363	5,238	43.2	57
East Central	12,855	18,199	5,344	41.6	893
Southwest	11,720	17,452	5,732	48.9	146
South Central	12,961	16,526	3,565	27.5	-780
Southeast	12,758	17,979	5,221	40.9	673
State Averages	12,331	17,306	4,975	40.3	0

*ND = Not disclosed. Included in regional summary and state averages.

Source: Wisconsin Agricultural Statistics Service

Table 5: Estimated Wisconsin Dairy Herd Size and Milk per Farm, 2000

County	July 2000 Herds	Annual Avg. 2000 Cows	Cows per Herd	Annual 2000 Milk, 1,000 Lbs.	Milk per Herd, Pounds
Adams	36	1,700	47.2	26,860	746,111
Ashland	28	ND*			
Barron	552	32,500	58.9	559,000	1,012,681
Bayfield	60	3,000	50.0	48,000	800,000
Brown	357	39,000	109.2	721,500	2,021,008
Buffalo	316	23,000	72.8	391,000	1,237,342
Burnett	74	3,800	51.4	60,420	816,486
Calumet	283	22,500	79.5	411,750	1,454,947
Chippewa	677	39,500	58.3	632,000	933,530
Clark	1,162	63,500	54.6	1,098,550	945,396
Columbia	249	16,000	64.3	280,000	1,124,498
Crawford	282	11,700	41.5	180,180	638,936
Dane	515	50,500	98.1	954,450	1,853,301
Dodge	608	45,000	74.0	769,500	1,265,625
Door	167	10,300	61.7	172,010	1,030,000
Douglas	20	900	45.0	13,050	652,500
Dunn	409	25,000	61.1	425,000	1,039,120
Eau Claire	295	13,100	44.4	220,080	746,034
Florence	11	ND			
Fond Du Lac	546	42,500	77.8	782,000	1,432,234
Forest	7	ND			
Grant	783	52,000	66.4	894,400	1,142,273
Green	527	36,000	68.3	576,000	1,092,979
Green Lake	142	9,100	64.1	151,970	1,070,211
Iowa	418	28,000	67.0	478,800	1,145,455
Iron	5	ND			
Jackson	258	15,000	58.1	247,500	959,302
Jefferson	228	17,000	74.6	287,300	1,260,088
Juneau	165	9,800	59.4	164,640	997,818
Kenosha	48	3,600	75.0	62,280	1,297,500
Kewaunee	358	27,500	76.8	497,750	1,390,363
La Crosse	175	12,700	72.6	214,630	1,226,457
Lafayette	428	33,000	77.1	508,200	1,187,383
Langlade	94	7,700	81.9	129,360	1,376,170
Lincoln	105	6,100	58.1	99,430	946,952
Manitowoc	453	44,000	97.1	814,000	1,796,909
Marathon	1,030	64,000	62.1	1,081,600	1,050,097
Marinette	148	11,500	77.7	205,850	1,390,878
Marquette	76	5,700	75.0	102,030	1,342,500
Milwaukee	2	ND			
Monroe	561	27,900	49.7	463,140	825,561
Oconto	291	21,500	73.9	380,550	1,307,732
Oneida	1	ND			
Outagamie	394	36,000	91.4	644,400	1,635,533
Ozaukee	94	9,100	96.8	164,710	1,752,234
Pepin	135	8,500	63.0	149,600	1,108,148
Pierce	299	19,200	64.2	341,760	1,143,010
Polk	291	19,300	66.3	322,310	1,107,595
Portage	238	14,400	60.5	237,600	998,319

County	July 2000 Herds	Annual Avg. 2000 Cows	Cows per Herd	Annual 2000 Milk, 1,000 Lbs.	Milk per Herd, Pounds
Price	103	4,400	42.7	70,400	683,495
Racine	55	ND			
Richland	307	17,300	56.4	290,640	946,710
Rock	194	14,500	74.7	256,650	1,322,938
Rusk	254	13,400	52.8	211,720	833,543
St. Croix	303	25,100	82.8	469,370	1,549,076
Sauk	405	29,000	71.6	504,600	1,245,926
Sawyer	42	3,100	73.8	50,530	1,203,095
Shawano	591	36,400	61.6	644,280	1,090,152
Sheboygan	285	26,300	92.3	489,180	1,716,421
Taylor	401	19,600	48.9	323,400	806,484
Trempealeau	357	25,500	71.4	441,150	1,235,714
Vernon	689	30,000	43.5	465,000	674,891
Walworth	153	13,800	90.2	247,020	1,614,510
Washburn	48	3,500	72.9	57,050	1,188,542
Washington	205	16,000	78.0	288,000	1,404,878
Waukesha	62	4,700	75.8	86,010	1,387,258
Waupaca	367	25,400	69.2	452,120	1,231,935
Waushara	105	6,400	61.0	113,280	1,078,857
Winnebago	209	15,900	76.1	271,890	1,300,909
Wood	358	23,500	65.6	418,300	1,168,436
State Totals/Averages	19,897	1,344,000	67.5	23,259,000	1,168,970

*ND = Not disclosed.

Source: Wisconsin Agricultural Statistics Service (cows and milk) and Dairy Producer License list as of July 1, 2000, Division of Food Safety, Wisconsin Department of Agriculture, Trade and Consumer Protection (herds).

MARKETING AND POLICY BRIEFING PAPER

Department of Agricultural and Applied Economics, College of Agricultural and Life Sciences, University of Wisconsin-Madison
Cooperative Extension, University of Wisconsin-Extension

Paper No. 78B
September 2002

RETHINKING DAIRYLAND

Chapter 2

Wisconsin and U.S. Dairy Industry Trends[1]

This is the second in a series of brief reports that document the current state of the Wisconsin dairy industry and evaluate factors that will influence its evolution. In this installment, we discuss changes in cow numbers and milk production per cow in Wisconsin and compare these changes with what has occurred in other regions. We review what happened to alter relative regional growth rates and speculate on whether these conditions will continue. We then examine trends within the state with respect to the structure of the production sector and the emergence of new production systems.

Regional Milk Production Trends

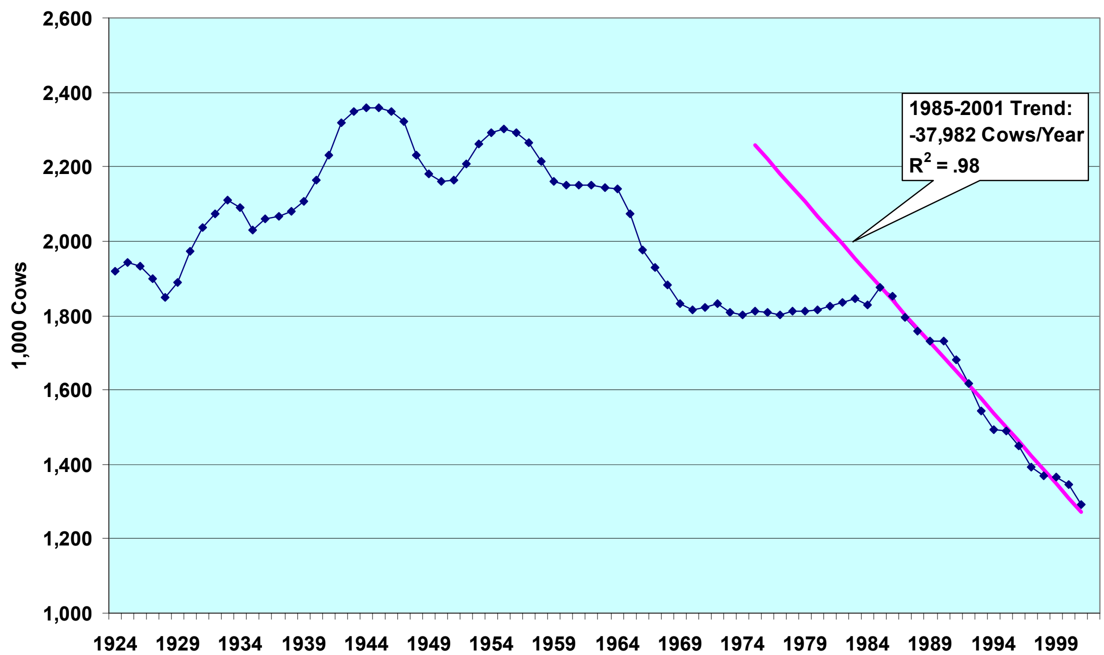
Wisconsin milk production peaked in 1988 at 25 billion pounds after increasing more or less steadily at an average rate of 232 million pounds per year for the previous 65 years. Since 1988, annual milk production has varied within a narrow range of 22 to 24 billion pounds.

The recent stagnation in milk production is due entirely to a reduction in cow numbers that has sharply exceeded historical rates. Between 1985 and 2001, Wisconsin milk cow numbers fell from 1.876 million to 1.292 million, a loss of 31 percent. Fitting a linear trend over this period shows a rate of loss of 38,000 cows per year.

[1] Contributors to this Chapter are Ed Jesse, Brad Barham, and Bruce Jones, Department of Agricultural and Applied Economics, University of Wisconsin-Madison

The views expressed are those of the author(s). Comments are welcome and should be sent to: Marketing and Policy Briefing Paper, Department of Agricultural and Applied Economics, University of Wisconsin-Madison, Madison, WI 53706.

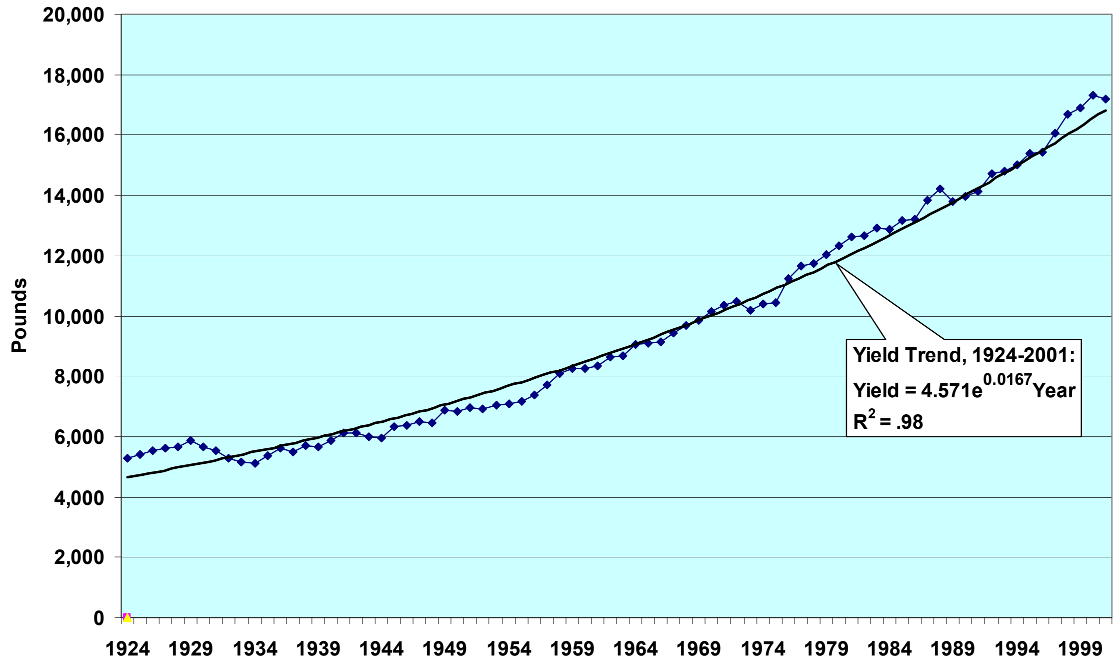
Wisconsin Milk Cows, 1924-2002



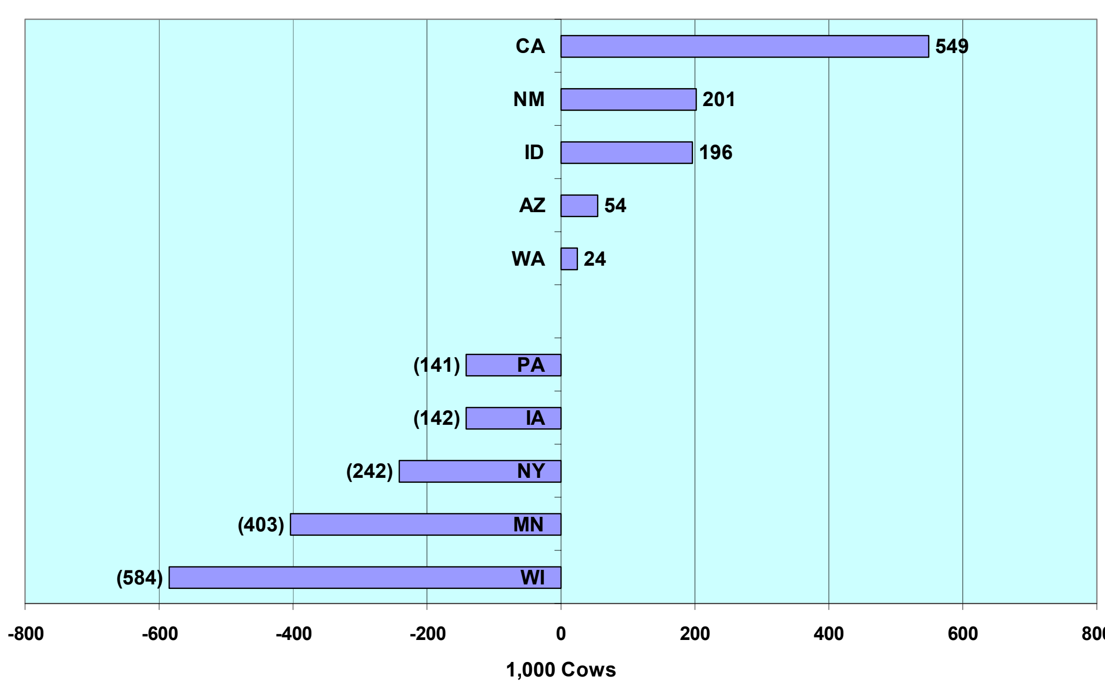
Wisconsin milk production per cow increased over the 1985-2001 period at a rate that was somewhat higher than average annual gains in earlier years. This yield gain offset part of the cow loss, keeping total milk production relatively constant. The long-term trend in milk per cow can best be depicted as an exponential growth rate – milk per cow is increasing at an increasing rate. This is encouraging, but at the same time, Wisconsin milk per cow continues to lag behind the U.S. average. For 2001, Wisconsin's per cow yield was 17,182 pounds. This ranks 25th among states, nearly 1,000 pounds below the U.S. weighted average annual yield, more than 5,000 pounds less than Washington, the leading state in milk per cow, and 3,700 pounds less than California, the leading dairy state.

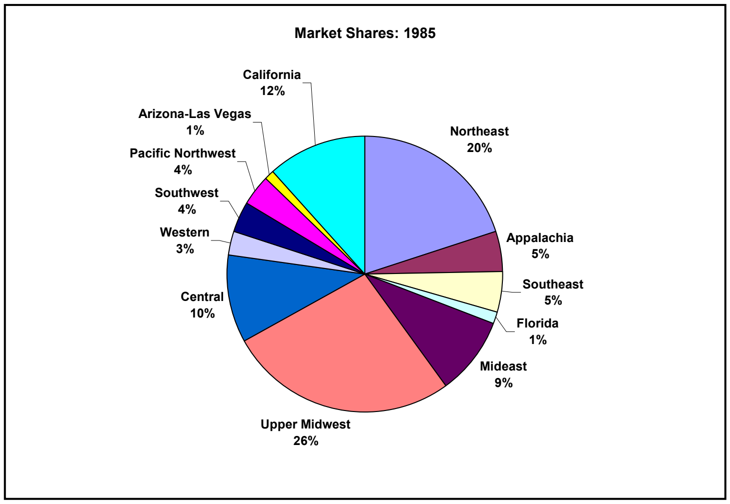
The sharp reduction in Wisconsin cow numbers since the mid-1980's is consistent with other Eastern and Midwestern states, but contrasts with generally positive rates of growth in the west. The five states showing the largest decreases in cow numbers between 1985 and 2001 were in the "traditional" lake states dairy region. The nine states showing an increase in cow numbers were all in the west. California gained almost as many cows as Wisconsin lost.

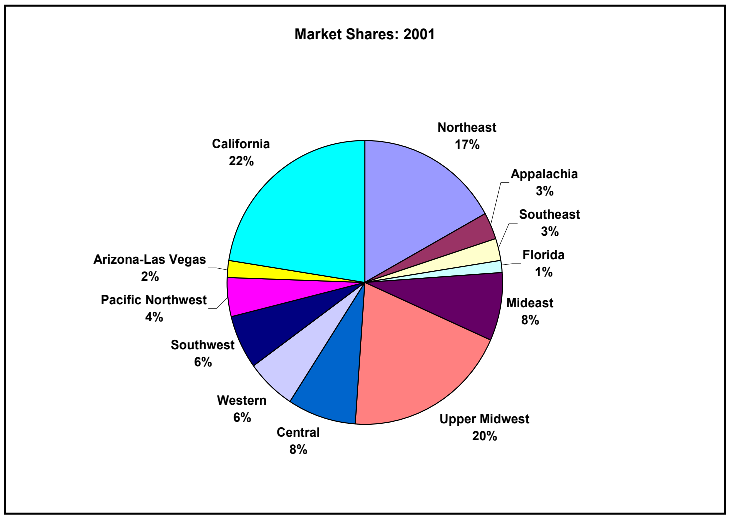
Wisconsin Milk per Cow

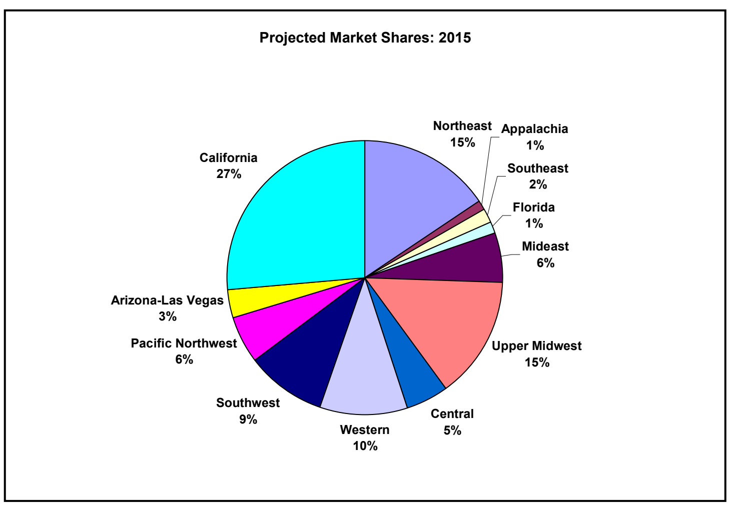


Change in Milk Cows, 1985-2001









Divergent regional rates of growth in milk production have substantially altered regional shares of total U.S. milk. In 1985, states in regions west of the Rocky Mountains accounted for 24 percent of the U.S. milk supply.[2] States within the Northeast, Upper Midwest, and Central regions – the traditional U.S. milkshed – accounted for 56 percent.

By 2001, the western regions had increased market share to 40 percent, while the traditional regions had declined to 45 percent. Projecting these recent trends in regional cow numbers and milk per cow suggests that the west could be producing 55 percent of U.S. milk in 2015, with the Northeast, Upper Midwest, and Central regions at 35 percent.[3]

Projecting Wisconsin cow number and yield per cow trends to 2015 shows state milk production at about 16 billion pounds, about 8 billion pounds less than 2001. Cutting the annual cow loss in half, to 19,000 cows per year, would still result in 2015 milk production about 1 billion pounds less than 2001. If cow numbers held steady at the 2001 level, milk production in 2015 would be about 5 billion

[2] Regions shown in the charts correspond approximately to current federal milk marketing order areas.
[3] Projections based on Jesse, E.V. and Jacob Schuelke, *Regional Trends in U.S. Milk Production: Analysis and Projections,* Marketing and Policy Briefing Paper #74, Dept. of Ag. And Applied Economics, University of Wisconsin-Madison, December 2001.

pounds higher than 2001. Yield increases above trend would not materially alter these projections – reducing the decline in cow numbers is much more important than increasing yield as a means of growing Wisconsin milk production. Stated differently, a continuation of the annual loss in dairy cows that has been experienced since 1985 cannot be offset by even very optimistic gains in milk per cow.

Projected 2015 Wisconsin Milk Production (Million Pounds) Under Varying Milk per Cow and Cow Number Assumptions

Yield increase Above Trend	*Annual Change in Cow Numbers*		
	*Trend (-38,000) (742,000 Cows)**	*½ Trend (-19,000) (1,006,000 Cows)*	*Constant @ 2001 (1,292,000 Cows)*
0% (21,264 Pounds)*	15,772	21,396	27,473
5% (22,327 Pounds)	16,561	22,466	28,847
10% (23,391 Pounds)	17,349	23,536	30,221

*Numbers in parentheses are projected 2015 values for milk cows and milk per cow under the indicated assumptions.

These are sobering projections. However, they are presented only to suggest what *could* happen; not necessarily what *will* happen. The rates of growth in cow numbers and milk yield per cow observed in the western U.S. over the last 15 years do not appear to be sustainable. And projected erosion of market share for Wisconsin is inconsistent with other evidence that indicates a possible rebound.

Will the West Continue to Grow?

The expansion of dairying in the West is the result of several factors. The western expansion began in California, where strong population growth created robust demand for fluid milk and, later, manufactured dairy products. A favorable climate encouraged large-scale drylot dairying with related economies to scale. Dairy plant investment was encouraged by California's milk pricing regulations, which granted manufacturing allowances that guaranteed cheese and butter-nonfat dry milk plants a dependable and profitable return on investment. County governments offered special incentives for farms and plants to invest.

Tax laws related to capital gains also spurred dairy expansion in California. Urban encroachment in southern California allowed dairies there to sell their land to real estate developers at very high prices and reinvest in higher-valued like property – larger dairies – in the Central Valley of California and in other western states.

From the mid-1970's to the mid-1980's, the dairy price support program was altered to mandate semi-annual changes in the support price to maintain the support level at 80 percent of parity. This change occurred during an inflationary period, and the resulting elevation in milk prices combined with reduced risk prompted accelerated new investment in California dairying. Between 1965 and 1975, the California dairy herd grew by only 17,000 cows. During the next 10 years, 200,000 cows were added.

Dairy growth in Idaho and New Mexico started later than in California, but for some of the same reasons. In particular, these states were capable of supporting large-scale drylot dairy systems that had proven to be profitable in California. Indeed, some of the dairy investors in Idaho and New Mexico migrated from California dairies. Land was inexpensive and capable of growing high quality forages. Concentrates were readily available and made inexpensive by federal feed grain programs that increasingly relied on direct payments rather than acreage restrictions to maintain grower returns. The use of direct payments decoupled planting decisions from market prices, frequently causing market prices for corn and soybeans to fall below costs of production.

The West will continue to show gains in milk production. The growth factors noted above are not expected to change very much in the years ahead. And state and local governments in western states have been very supportive of their dairy industries. But continued dairy growth in the West at the rate demonstrated in recent years seems unlikely for several reasons:

- Relative milk prices are falling, especially in Idaho and New Mexico, as the utilization of the milk supply in higher-valued use classes declines. The California state milk pricing program has cushioned the effect of declining utilization by raising Class I differentials, but adjustments are limited by the need to align Class I prices with adjacent regulated areas.[4] And California continues to maintain low manufacturing class prices as a means of encouraging plant investment.

- Competition for land is intensifying with the increasing demand for forage to feed the expanding western dairy herd. The extent to which this represents a constraint on dairy growth is hard to judge. The land base is fixed, and adding acres of alfalfa comes at the cost of taking land out of other crops or growing alfalfa on less-productive ground. In either case, alfalfa prices increase. But greater substitution of corn silage for hay could reduce the amount of land required for forage production. And a reduction in direct federal payments to corn and soybean producers could reduce land values and make alfalfa production more competitive with these crops.

[4] However, California has been able so far to prevent fluid milk imports that do not meet the state's higher minimum standards for nonfat solids. This raises the cost to out-of-state processors marketing milk in California.

- Urban encroachment is an issue in California and, to a lesser extent, Idaho. But dairies can usually still be isolated from people in all regions. Encroachment does not seem to pose an especially serious threat to dairy expansion, at least directly. However, more people means more demand for water. This will intensify competition between municipalities and agricultural irrigation water districts. As population grows, the availability of irrigation water will decrease and its cost will increase.

- Environmental restraints on dairying are becoming more common. State and local environmental agency permitting is a fact of life in nearly every dairy state. Environmental restrictions are likely to be fairly uniform across regions. Larger dairies (CAFOs) are more visible and more heavily targeted. Thus, they may be more likely to be constrained by current and expected non-point pollution, air quality, and other environmental standards. Indeed, both California and Idaho have moratoriums on new dairies in some counties based on environmental considerations. On the other hand, there are economies to scale in meeting some environmental standards, and they may be easier to meet in dry, warm weather areas. Thus, the regional effect is hard to predict.

- There are biological constraints to increased milk production per cow. Put simply, it is harder to increase milk yield from 25,000 pounds per cow than from 18,000 pounds. Major technological breakthroughs like rBST are not foreseen. The same dairy genetics are available in every region. Thus, it is likely that Wisconsin will close the gap with western states in milk per cow.

Will Wisconsin continue to shrink?

Some of the factors that could limit dairy growth in the West might favor growth in Wisconsin.

- Utilization of Wisconsin milk for higher-valued fluid purposes has increased recently, at least on paper. More liberal pooling provisions under federal milk orders have allowed plants to associate Wisconsin milk with distant markets that have relatively high Class I utilization. This means more Wisconsin milk receives the benefit of higher Class I prices.[5]

- Wisconsin is capable of producing high-quality forages without irrigation. With fewer dairy cows and slower population growth, the state is not facing the same competition for land that is being experienced in the west. While urban encroachment is an issue in a few parts of the state, there is plenty of room for growth in predominantly rural areas.

[5] Liberalized pooling has become a contentious issue, eliciting strong objections from regions where outside milk has reduced Class I utilization and prices. The decisions from recent federal milk marketing order hearings will likely restrict the ability of Wisconsin plants to pool milk on distant markets.

- The same dairy genetics are available in Wisconsin as elsewhere. Wisconsin's milk per cow ranks 25th among states. Adoption of superior genetics along with improved herd feeding and management practices can substantially improve milk yields in the state. Looking at Dairy Herd Improvement Association records shows that improvement is clearly happening. The 30 percent of Wisconsin dairy cows on official test averaged 20,000 pounds of milk in 2001, 860 pounds more than the average for all U.S. cows on official test. This demonstrates the ability of Wisconsin's better herds to match or exceed milk yields experienced in the West.

- Winter conditions preclude full adoption of western-style drylot dairy systems in Wisconsin. But many cost-saving elements of drylot dairy systems can be adopted in Wisconsin. And many western dairies are moving away from drylot systems toward free stall housing that is already used extensively in Wisconsin. The state's moderate climate is generally favorable to dairying. In particular, Wisconsin does not experience California's yield-reducing high temperatures or periodic heavy rains.

- More generally, there are no obvious impediments to Wisconsin dairy farmers achieving costs of production comparable to or lower than those experienced in the west. Published cost of production estimates do not permit a comparison between operations of similar size and management. California Department of Food and Agriculture dairy producer cost surveys for 2001 show statewide average costs ranging from $12.40 to $13.25 per hundredweight for the year.[6] This is an easily achievable cost of production goal for Wisconsin dairy farmers.

Despite the alarming reduction in Wisconsin dairy cows since the mid-1980s, there are signs of a turnaround in the production sector. Dairy farmers who are willing to make changes are adopting new production strategies to increase their competitiveness.

One of these strategies is larger-scale milking parlor/free stall housing systems. These operations typically involve 200 cows or more. Herd size distribution data (available only since 1993) suggest fairly rapid adoption of this model in Wisconsin. In 1993, 300 Wisconsin herds exceeded 200 cows. In 2001, there were 850, including 170 with more than 500 cows. The 200+ herd size accounted for 5.7 percent of total Wisconsin milk production in 1993 and 29 percent in 2001.

The growth in larger-scale dairy farms is significant because these farms achieve higher milk yields per cow than smaller farms. Average 1997-2001 milk per cow for the 1-29 cow category was 12,000 pounds versus 19,600 pounds for 500+ herds. Stated differently, one cow added to the 500+ herd size class offsets a loss of 1.6 cows from herds in the smallest size class.

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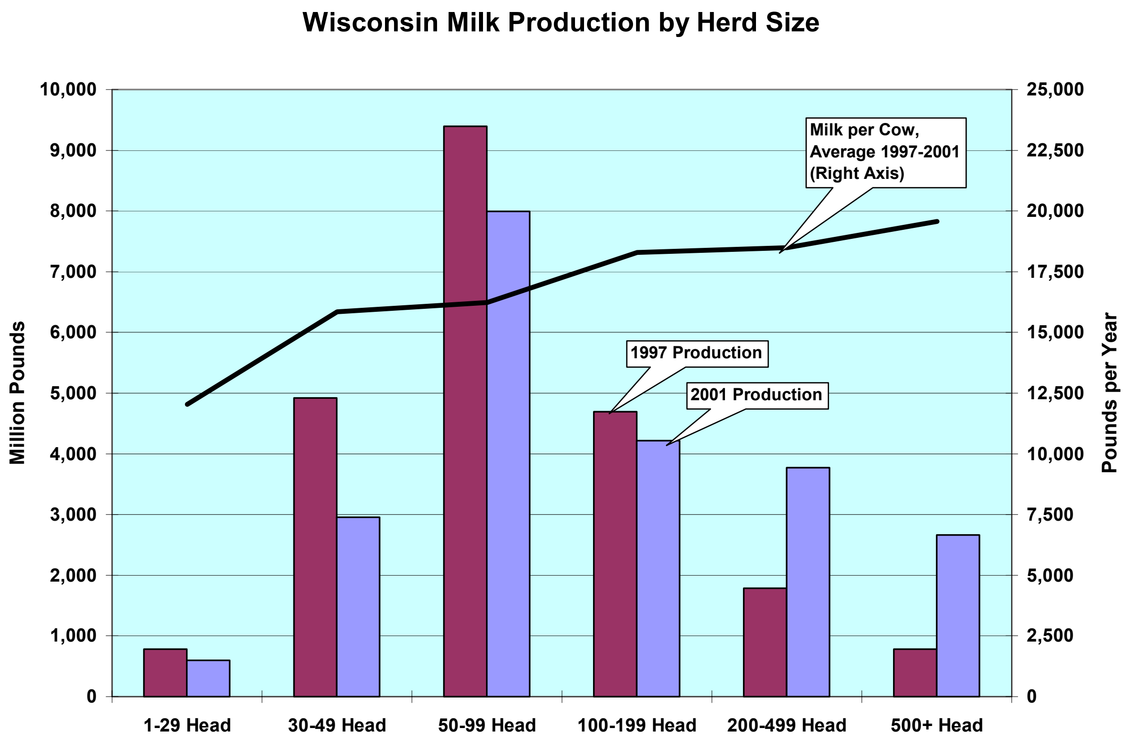
[6] California Department of Food and Agriculture, *California Dairy Statistics and Trends, 2001*, Division of Marketing Services, Dairy Marketing Branch, Sacramento: March 2002.

It is also noteworthy that the total number of Wisconsin dairy farms in the 100-199 herd category has held steady over the past five years at nearly 2,000. These farms were responsible for 19% of total production in 2001. Thus, while farm numbers and cow numbers have declined substantially in Wisconsin with the exit of farms, this is not the case for herds with over 100 cows.



Using recent growth rates segregated by herd size to project future milk production gives a much more optimistic outlook than using overall trends in cow numbers and milk per cow:

Wisconsin Milk Production Forecasts by Herd Size Class

Size Class	***Cow Numbers***	***Milk per Cow***	***Total Milk***
2001 Actual Values	*Number*	*Pounds*	*Bil. Lbs.*
Less than 50 Cows	229,000	15,532	3.55
50-99 Cows	491,000	16,278	7.99
100 or More Cows	572,000	18,617	10.66
State Totals	1,292,000	--	22.20
Annual Percent Change, 1993-2001:	*%*	*%*	*%*
Less than 50 Cows	–9.58	2.15	–7.64
50-99 Cows	-3.85	1.33	-2.57
100 or More Cows	7.34	1.54	8.99
2010 Forecasts:	*Number*	*Pounds*	*Bil. Lbs.*
Less than 50 Cows	92,388	18,809	1.74
	(74,440-144,807)*	(17,179-21,025)	(1.28-3.04)
50-99 Cows	344,818	18,333	6.32
	(323,219-390,185)	(17,305-20,308)	(5.59-7.92)
100 or More Cows	1,082,731	21,368	23.14
	(830,144-1,316,293)	(19,963-24,231)	(16.57-31.90)
State Totals	1,519,937	--	31.20
	(1,227,803-1,851,285)		(23.44-42.86)

*Numbers in parentheses are the low and high values of the 95 percent confidence range of the forecasts

These forecasts indicate nearly a doubling of the number of Wisconsin cows in herds of more than 100 cows by 2010. However, sustaining growth in the larger herd size classes at rates experienced since the mid-1990s is questionable for several reasons. Most important, the increased number of larger herd sizes has come largely from growth in smaller and medium-sized farms. The size of that base has declined substantially in recent years. Thus, maintaining recent rates of growth in the number of larger herds would require a higher proportion of those remaining herds under 100 cows to expand their operations.

The larger-scale model is not the only blueprint for growth and viability in Wisconsin dairying. Indeed, during the 1990s, a significant proportion of Wisconsin dairy farms, especially in the Western and North Central regions of the state, have successfully pursued "low-input" strategies that reduce both labor and capital use in an effort to produce milk at lower cost. One example of this approach is management-intensive rotational grazing, wherein farmers seek to produce high quality forage through improvement and careful use of pastures. Having cows harvest their own food reduces labor and machinery costs. Another low-input strategy that recent entrants have pursued is to rent a barn, buy feed and forage, and concentrate their labor and financial resources on milking cows rather than buying or working land.

Both of these approaches can be combined with a household income strategy that mixes dairy farming with other enterprise or off-farm labor activities. They can also be combined with a low-cost parlor in order to pursue more efficiency in milking and growth in herd size. In fact, it is important to point out that these "low-input" approaches are not mutually exclusive with the larger-scale model mentioned above, as some farmers pursuing a "low-input" strategy may do so in order to grow their herd more quickly than they might otherwise be able to do so because of financial or labor constraints.

The viability of dairy farms pursuing low-input strategies is quite strong. Recent research by the Program on Agricultural Technology Studies shows that these sorts of operations were just as likely to survive as the larger-scale model mentioned above, and more likely to survive than the traditional semi-confinement operation. At the same time, it is important to note that, *on average*, farms pursuing low-input strategies grow their herds at a much less dynamic rate than farmers pursuing a large-scale model. They also tend to have somewhat lower herd production averages, especially if they are using management rotational grazing as a major component of their production strategy. Thus, in terms of their contribution to the overall vitality of the Wisconsin dairy industry (adding cows and milk), they are not as "dynamic" as the large-scale model. Nonetheless, to the extent that low-input strategies may be more accessible alternatives to a significant proportion of moderate-sized operations, they could play a vital role in stemming the loss of dairy farms in Wisconsin.

Reversing the Trend

If the Wisconsin dairy industry is to thrive, then the sharp annual reduction in dairy cows seen since the mid-1980s must be substantially reduced. Milk volume is essential to maintaining the strength of the state's processing sector. We expect large gains in milk production per cow over the next few years. But even if gains in milk per cow are well above trend, that will not prevent further losses in milk production if cow numbers continue to drop at their current clip.

While the key to maintaining vitality in Wisconsin dairying is stopping the freefall in cow numbers, there is no single avenue to achieving that goal. Producers have demonstrated that several dairy system options can increase profitability and encourage growth: Management intensive rotational grazing, incremental modernization/expansion, and large-scale intensive management are all viable options. What is NOT an option is resisting change. Wisconsin dairy farmers must be willing to embrace changes in their operations that allow them to be competitive with dairy farmers in other regions.

MARKETING AND POLICY BRIEFING PAPER

Department of Agricultural and Applied Economics, College of Agricultural and Life Sciences, University of Wisconsin-Madison
Cooperative Extension, University of Wisconsin-Extension

Paper No. 78C
September 2002

RETHINKING DAIRYLAND

Chapter 3

The Effects of Federal Dairy Programs on the Competitiveness of Dairying in Wisconsin[1]

This is the third in a series of brief reports that document the current state of the Wisconsin dairy industry and evaluate factors that will influence its evolution.

This installment addresses the Dairy Price Support Program and Federal Milk Marketing Orders, which are the primary methods of direct federal intervention in dairy markets. These longstanding programs are described and evaluated, both generally and more narrowly from the perspective of their effects on Wisconsin dairy farmers and processors. We end the paper by offering a set of policy guidelines that, in our judgment, would promote market orientation and enhance the competitive environment for Wisconsin dairying.

Dairy Price Supports

Method of Operation

The Federal Dairy Price Support Program (DPSP) has been used continuously since 1949 to place a flexible floor under the price of milk used to produce non-perishable manufactured dairy products. Unlike most federal agricultural programs, the DPSP functions in the background of markets for milk and dairy products – producers do not receive "green checks," but they indirectly benefit from the program when milk supply and demand are out of balance.

[1] Principal contributors to this chapter are Ed Jesse, Tom Cox, Bob Cropp, and Randy Fortenbery, Department of Agricultural and Applied Economics, University of Wisconsin-Madison.

The DPSP operates through a standing offer by USDA's Commodity Credit Corporation (CCC) to purchase unlimited quantities of three dairy products – butter, nonfat dry milk, and cheddar cheese – at announced purchase prices. The *milk* support price, currently \$9.90 per hundredweight for milk of average butterfat test (3.67 percent) and \$9.80 for milk testing 3.5 percent, is specified in federal legislation. The purchase prices for eligible *products* are calculated by USDA using assumed yields of products per hundredweight of milk and manufacturing or "make" allowances reflecting processing costs.

In theory, the resulting purchase prices provide reasonably efficient plants making the eligible products with enough money to pay farmers the announced support price. In practice, manufacturing milk prices sometimes fall under the announced support price.[2] This is mainly because products sold to the CCC must meet special packaging and inspection requirements, which raises the cost of selling to the CCC relative to other buyers.

Depending on how far prices fall, the CCC may eventually represent a more lucrative market than commercial outlets for some plants.

Because of inter-plant competition for the supply of milk for manufacturing, the impact of the DPSP extends to markets beyond those for the products purchased by the CCC. For example, if cheddar cheese plants are able to pay their patrons the support price because of their ability to sell cheddar cheese to the CCC, then mozzarella plants will need to match that price in order to retain their milk supply.

As surpluses ease and prices improve, the CCC may sell products purchased under the support program at not less than 110 percent of the purchase price. These sales are referred to as unrestricted sales. Besides making unrestricted sales, the CCC makes surplus dairy products available for use in several domestic and foreign food programs. However, most of these special programs only provide dairy products on an "as available" basis. That is, donations are made only if there are stocks available to donate.

Major Effects on Interregional Competition

From its inception in 1949 until the mid 1970s, the DPSP operated essentially as a buffer stock/price stabilization program. From 1949 until 1981, the support price was based upon a parity formula.[3] Congress gave USDA discretion in establishing the support price between 75 and 90 percent of parity to conform to supply and demand conditions, and

[2] In 2000, the Class III milk price was less than \$9.80 for seven months, falling as much as \$1.23 below support in November. This unusually large variance was generally attributed to a shortage of USDA cheese inspectors and a related inability of cheese plants to sell cheese to the CCC. The Class III price was below \$9.80 in July (-47 cents) and August (-26 cents) of 2002.

[3] Parity is a (variously-defined) ratio of farm price and farm cost indices. It was used in price support programs purportedly to maintain the purchasing power of farm commodities.

changes were infrequent and small. Excess supplies of cheese, butter, and nonfat dry milk were removed from the market when milk supplies were burdensome, usually during the spring milk flush. Accumulated stocks were placed back on the commercial market through unrestricted CCC sales when milk supplies tightened and prices rose in the fall. Government stock management kept milk prices from both falling as low or rising as high as they otherwise would have. Manufacturing milk prices were very stable within a few cents per hundredweight of the support price.

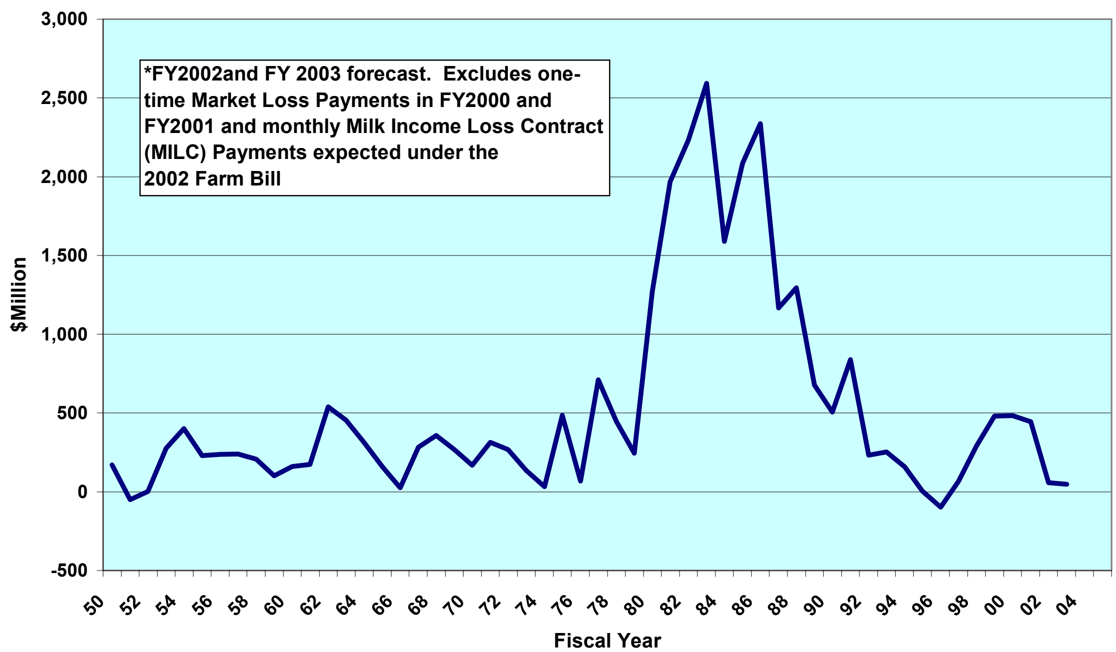
As part of the 1977 farm bill, Congress raised the support price to 80 percent of "parity" and mandated semiannual adjustments. USDA lost its ability to fine tune the support price. Rapid inflation caused large semiannual increases in the support price. High support prices combined with swift adoption of cost-reducing dairy technology elevated dairy farm profit margins and stimulated large increases in supply.

In 1981, Congress recognized the serious supply-demand imbalance caused by the 1977 Farm Bill and began a series of corrective actions that lasted until 1990. These actions included decoupling the support price from parity and tying it to actual or projected program costs, dairy farmer assessments (milk taxes) to offset DPSP expenditures, and voluntary supply control programs (Milk Diversion Program and Whole-Herd Buyout).

These corrective actions were mostly too little and came too late.[4] The damage from high price supports without accompanying supply controls had already been done. From a national dairy perspective, the damage was twofold: (1) Large surpluses – CCC costs reached as high as $2.6 billion in 1983, and (2) badly-distorted markets for dairy products – annual CCC purchases of butter and cheddar cheese were as much as one-third of total production, and 70 percent for nonfat dry milk.

[4] An exception is the Whole-Herd Buyout (Dairy Termination Program) in 1986-87, which required participating dairy farmers to slaughter of dairy cows and remain out of dairy farming for at least five years. The buyout was followed by a severe drought in 1988, bringing milk supply in line with demand for the first time in more than 10 years.

Annual Cost of Dairy Price Support Program*

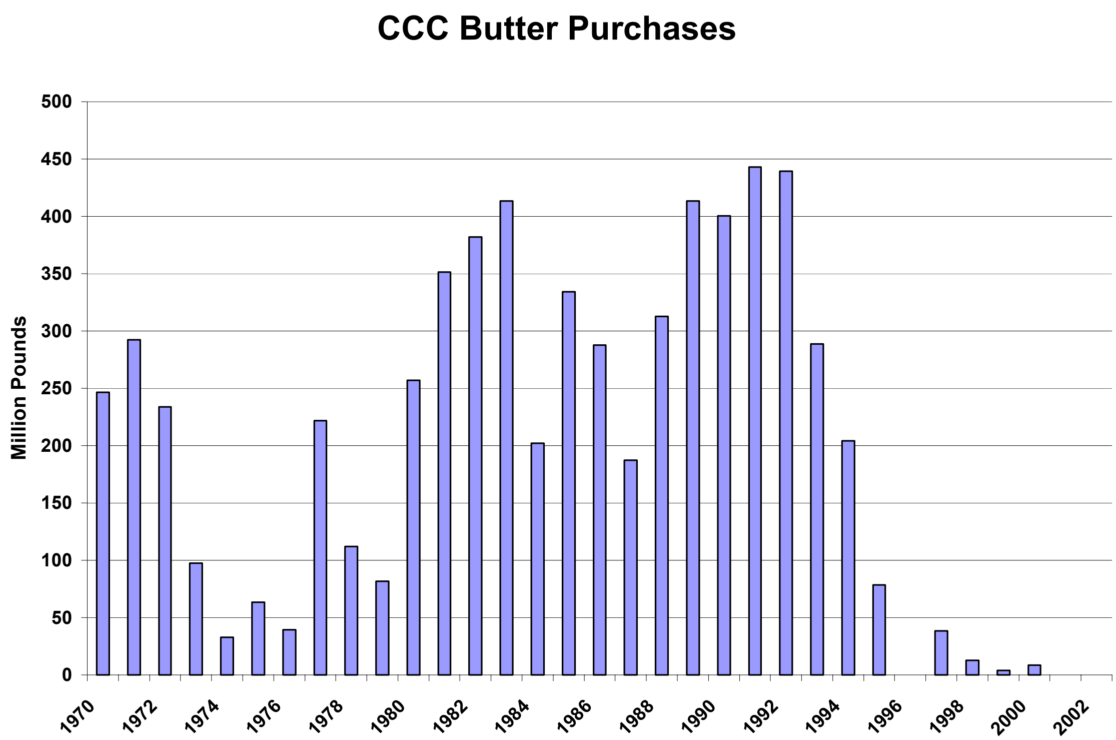


From a Wisconsin perspective, further damage was in stimulating the rapid development of the California dairy industry. In 1975, California had 800,000 dairy cows, 50,000 fewer than in 1953. By 1990, cow numbers in California had risen to 1,135,000 and milk production was double the 1975 level. Expansion of dairy in California was induced not only by the high and predictable support price for milk, but also by the ready market for manufactured dairy products in the form of the CCC. Substantial investment in California butter-powder manufacturing capacity was encouraged by predictable CCC prices along with profitable manufacturing allowances offered by the California state milk pricing program.

When the support price had been reduced to $10.10 in 1990, it was below the full cost of production for most dairy farms. Consequently, the support price no longer consistently drove market prices. Further, farm level milk prices became highly volatile and uncertain, subjecting dairy farmers to considerable milk price risk.

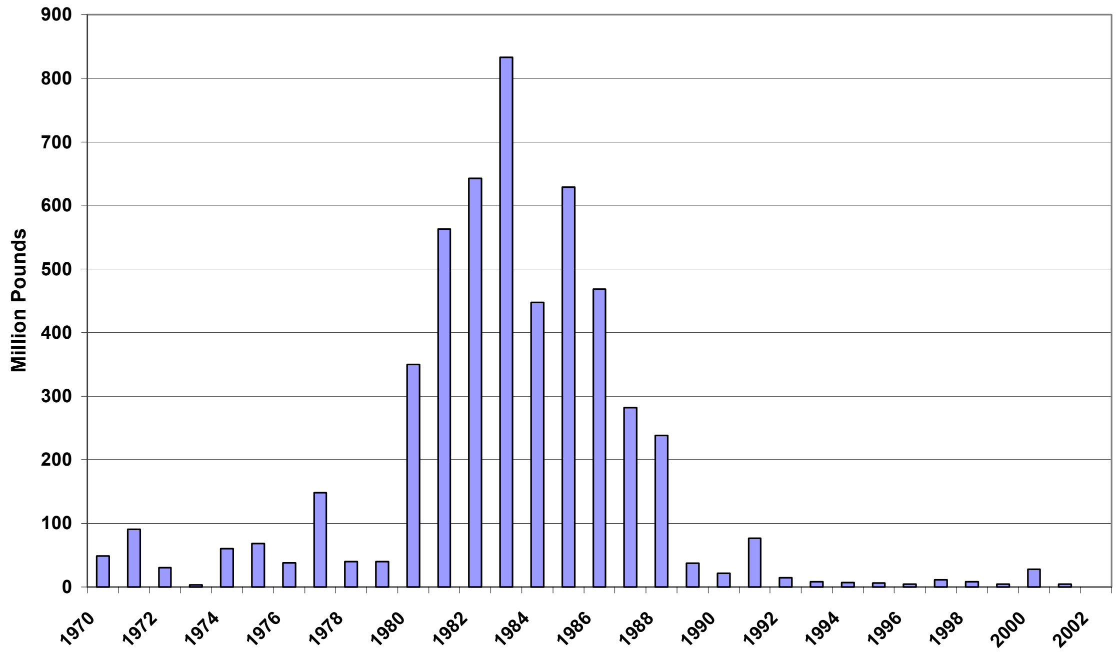
But product price distortions continued. During the early 1990s, the CCC purchased 30-40 percent of all butter produced in the U.S., fictitiously encouraging investment in butter plants and sending faulty economic signals to producers to increase butterfat production. This situation was eventually corrected by altering the relative prices of butter and nonfat dry milk in the CCC price calculations – lowering the butter price and raising the nonfat dry milk price.[5] But the reverse problem emerged in the late 1990s when the CCC began purchasing as much as half of total nonfat dry milk production. This had especially serious consequences for Wisconsin given the manner in which federal milk order prices for Class I (fluid) milk were set beginning in 2000 (see discussion on federal orders).

While distortions existed between butter and nonfat dry milk support prices, market prices for cheese since 1990 have been above the relatively low support price for cheese most of the time. Consequently, very little cheese has been purchased by the CCC under the support program. Since Wisconsin utilizes nearly 90 percent of its milk for cheese and produces very little nonfat dry milk, Wisconsin has not depended upon the government for a market outlet for its milk production. But, since almost 75 percent of the nonfat dry milk is produced in the West (California with about 50 percent), the West continues to rely on government sales for a significant share of its milk production.

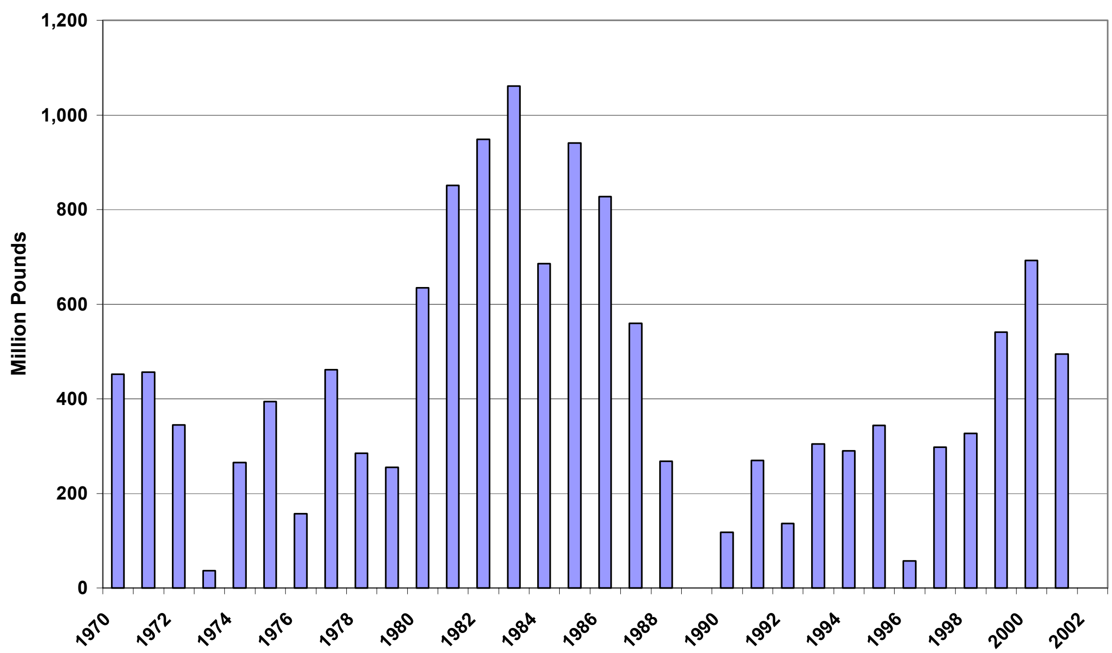


[5] Changes in relative CCC purchase prices for butter and nonfat dry milk are called "butter-powder tilts." Under the assumption that butter and nonfat dry milk are joint products, USDA can lower the price of one product and increase the price of the other to achieve the same net value of butter and nonfat dry milk in a hundredweight of milk. Current legislation authorizes the Secretary of Agriculture to use tilts as necessary (up to twice per year) to minimize CCC purchase prices. If one product is being purchased in volume by the CCC and the other is not, USDA lowers the purchase price of the product being purchased. The last tilt was in May 2001, when the purchase price for nonfat dry milk (unfortified) was reduced from $1.0032 to $.90 per pound and the purchase price for butter was raised from $.6558 to $.8548 per pound. For further information, see Jesse and Cropp, *The Butter-Powder Tilt*, Marketing and policy Briefing Paper No. 72, Department of Agricultural and Applied Economics, University of Wisconsin-Madison/Extension, June 2001.

CCC Cheese Purchases

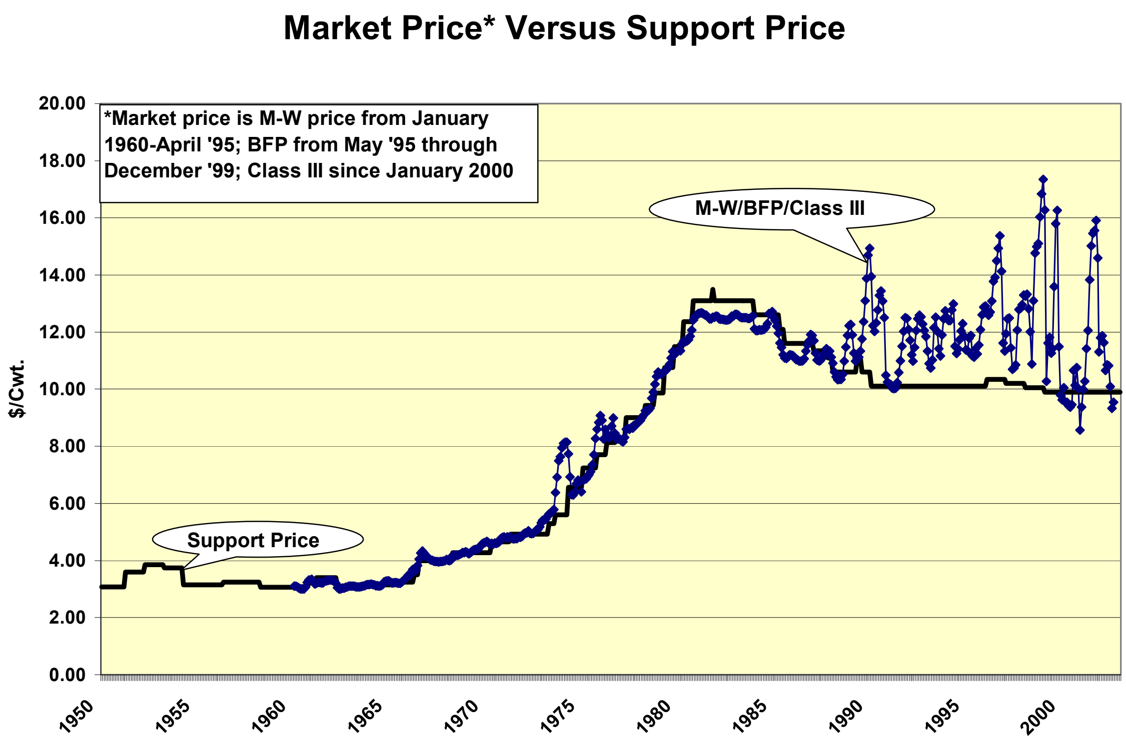


CCC Nonfat Dry Milk Purchases



Lessons from more than 50 years of experience stress the need for *flexibility* and *market orientation* in administering the dairy price support program. The Secretary of Agriculture must have discretion to alter the support level to prevent milk surpluses and to change relative product prices when market distortions are apparent.

The support program can be and has been used effectively to establish a safety net. But, without supply management, it cannot be used to keep prices above market-clearing levels. If supporting dairy farmer income rather than maintaining a safety net is the political goal, then direct payments distort markets less than raising support prices.[6]



Effects of Terminating Dairy Price Supports

In the 1996 Farm Bill, the DPSP was slated for termination on December 31, 1999. Subsequent legislation retained the program with a support price of $9.90 per hundredweight, and the 2002 Farm Bill extended the DPSP until December 31, 2007.

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[6] But direct payments can also distort economic incentives. See Jesse and Cropp, Dairy Title: Farm Security and Rural Investment Act of 2002, Marketing and policy Briefing Paper No. 76, Department of Agricultural and Applied Economics, University of Wisconsin-Madison/Extension, May 2002.

So while questions of whether the DPSP operates to the net benefit of Wisconsin farmers may be moot for the present, they still need to be asked: Does the dairy price support program contribute positively to the competitiveness of Wisconsin's dairy sector? How would Wisconsin be affected by elimination of the program?

On average, the DPSP serves to elevate milk prices nationally by cutting price troughs. And by elevating average prices, the program increases milk supply above what it otherwise would be. So termination would have the opposite effects – prices would be lower on average and milk supply would be less.

To measure the price and supply effect of the DPSP, we used an interregional competition model to simulate what would happen if the program were terminated. The model generates results for 12 regions conforming roughly to the current alignment of federal milk marketing order areas plus California. Initial conditions were based on 2000, when farm milk prices and commodity prices were historically low.[7] The CCC bought large quantities of nonfat dry milk in 2000, but only a small volume of cheese and no butter. The 2000 base was altered slightly by incorporating the butter-powder tilt that was implemented in May 2001. In other words, the base solution replicates 2000 conditions except that CCC purchase prices for butter and nonfat dry milk are mid-2001 values. This puts the CCC purchase price for nonfat dry milk closer to market-clearing levels than actually existed in 2000. In order to compare apples with apples, all model results are compared with the base simulation, not actual 2000 values

Depending on assumptions pertaining to farm-level supply response, the model suggests that terminating the DPSP in 2000 would have reduced the national average farm milk price \$0.42-0.70 per hundredweight. U.S. milk production would have been 3-4 billion pounds less because of lower prices, and milk revenues would have lower by \$1.1-1.6 billion.

Farm milk prices are projected to fall in all regions with termination of price supports, even in regions where manufacturing is not significant. In the Upper Midwest, farm prices drop by about the national average \$0.41-0.57 per hundredweight. Losses are larger in the Southeast and most of the West and smaller in the Northeast and California.

Among product markets, terminating supports has the largest effect on markets for butter and nonfat dry milk. Without the CCC to buy powder, its wholesale price drops to equivalent world market levels. This causes nonfat dry milk production to drop by nearly 1/3. Milk is diverted to production of higher-valued products, mainly cheese, lowering cheese prices by about 5 percent. Butter production is sharply lower because of lower production of nonfat dry milk, which is a principal joint product with nonfat dry milk.[8]

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[7] Since cheese and nonfat dry milk prices were already at or close to CCC purchase prices, using 2000 as a base in the simulations magnifies the price impact of terminating the support program.

[8] While butter is jointly produced with nonfat dry milk, most butter manufactured in the U.S. comes from cream skimmed from milk destined for lower-fat fluid products and low-fat cheeses.

Lower cheese and nonfat dry milk prices result in lower federal milk marketing order formula values for fluid milk and soft manufacturing products.

Besides its effect on milk price levels, the DPSP also promotes price stability by limiting down-side price movements. That stability would be lost if the program were terminated. However, the stability provided by the current program is minimal, as evidenced by the volatility in milk prices since 1990. The support price is low compared to recent average price levels and milk production costs. Thus, the likelihood of milk prices falling to support is smaller than it was prior to the mid-1980s. And with the exception of nonfat dry milk, government-held stocks of dairy products are too small to buffer up-side price movements.

The effect of any instability caused by terminating the DPSP would likely be ameliorated by the further development of private storage capacity to replace government storage. Futures markets for manufactured dairy products would likely see expanded use without the DPSP.

The market for nonfat dry milk would be especially disrupted in the short term if the DPSP were eliminated. Many specialized butter-powder operations would fold or convert to cheese production, putting downward pressure on cheese prices. Balancing costs for cooperatives servicing fluid handlers would be higher because variable milk volume is more costly in cheese production than in butter/powder production.

After initial adjustments, manufactured product prices would better reflect commercial demand than currently. The spread between butter and powder prices would likely widen. Use of nonfat dry milk to standardize cheese milk would increase and could increase butter prices relative to cheese prices. Lower powder prices would encourage "reverse substitution" of powder for milk protein concentrates in some applications.

In the long-run, would Wisconsin be better off without the Dairy Price Support Program? The answer is, probably not. The answer would have been different 20 years ago, when the support program was being used for price enhancement and promoting dairy investment in the West. It might be different in the future if the Secretary of Agriculture fails to use butter-powder tilts to maintain a rational economic relationship between product prices.

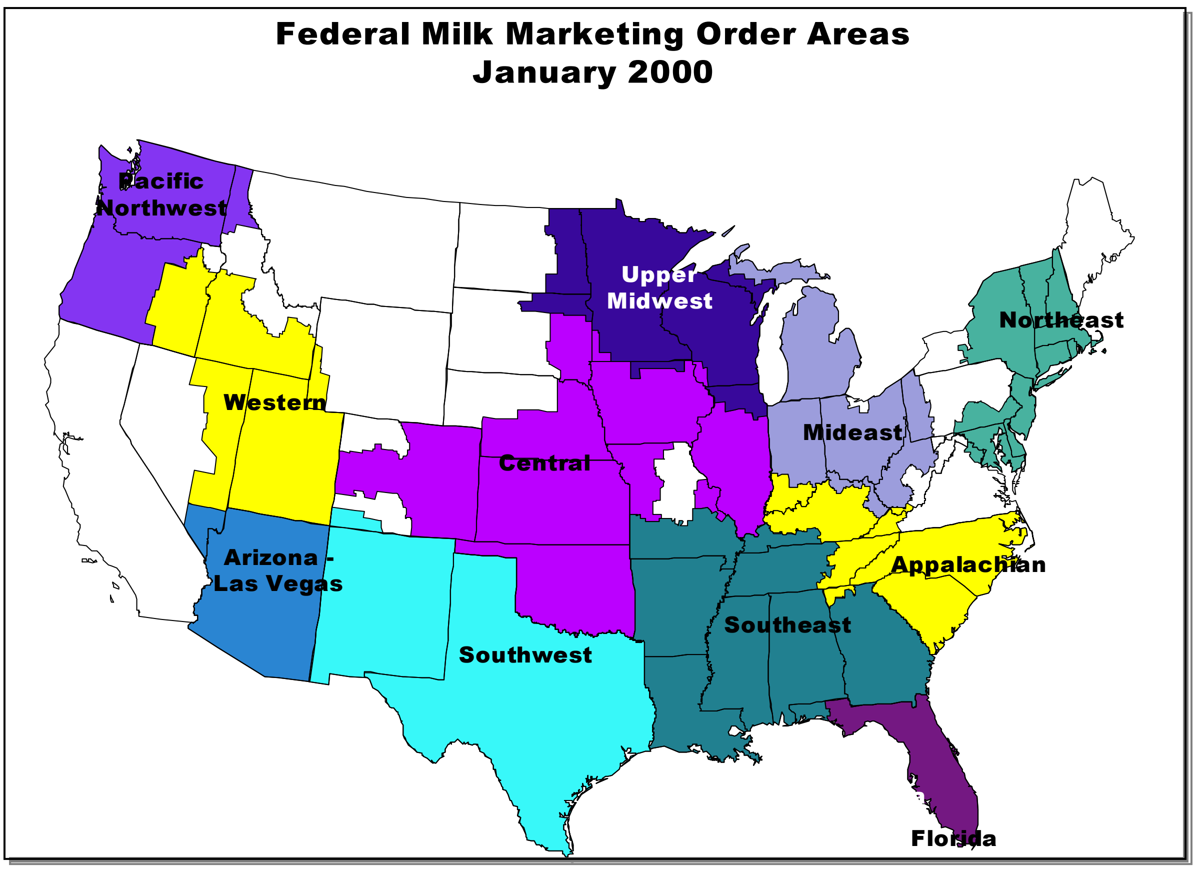
But as currently authorized under the Farm Security and Rural Investment Act of 2002, the Dairy Price Support Program represents a reasonable safety net for dairy farmers in Wisconsin and elsewhere. The current level of support is low enough so that it does not artificially enhance milk prices. At the same time, it is high enough to prevent price catastrophes and industry over-adjustment. The regional effects are fairly uniform, as evidenced by the simulated effects of terminating price supports. If tilts are used as authorized, price supports are not likely to artificially prop federal order prices.

Federal Milk Marketing Orders

Method of Operation

Federal milk marketing orders regulate dairy plants (handlers) that market Grade A milk. Grade A milk is produced under monitored dairy farm sanitary conditions that qualify the milk for use in fluid dairy products. While Grade A milk is *eligible* for use in fluid products, most is used to produce manufactured products. Grade B milk, which is not regulated by federal orders, can only be used to make certain manufactured dairy products. About 98 percent of U.S. milk and 94 percent of Wisconsin milk is Grade A.

There are 11 federal milk orders covering most of the United States. The major exception is the state of California. California has its own state milk pricing program, which operates much like federal orders. Each order covers a specific geographical region, known as a marketing area, corresponding to a common distribution area for fluid milk.



Milk orders use *classified pricing* to establish minimum prices for milk and milk components to be paid by milk plants and *market-wide pooling* to establish minimum pay prices for dairy farmers. Classified pricing means that handlers pay different prices for milk depending on how it is used. The orders uniformly define four classes of milk: Class I is milk used for beverage or fluid purposes. Class II is milk used for designated perishable dairy products like cottage cheese, yogurt, and ice cream. Class III is milk used for "hard" cheeses. Class IV is milk used to make butter and nonfat dry milk.

Under milk order regulations, minimum class prices for milk and milk components are announced each month. Regulated handlers cannot pay less than the announced prices. The minimum class prices are derived mathematically using a set of formulas that tie the class prices to market prices for four manufactured products: cheddar cheese, butter, nonfat dry milk, and dry whey.

The derivation process is complex. To calculate the four monthly Class prices for both skim milk and butterfat, monthly and “advanced” prices are calculated for four milk components (butterfat, protein, nonfat solids, and other (nonfat/non-protein) solids). We will summarize the derivation process by noting that:

- The advanced and monthly Class IV prices are linked to the prices of butter and nonfat dry milk.

- The advanced and monthly Class III prices are linked to the prices of butter, cheddar cheese, and dry whey.

- The Class II skim milk price per hundredweight is the *advanced* Class IV skim milk price plus 70 cents per hundredweight. The Class II butterfat price per pound is the *monthly* Class III/IV butterfat price plus 0.7 cents ($0.007) per pound.

- The Class I skim milk price per hundredweight is the higher of the *advanced* Class III or Class IV skim milk price plus a market specific Class I differential. The Class I butterfat price per pound is the *advanced* Class III/IV butterfat price plus the market-specific Class I differential divided by 100.

Class IV, Class III and Class II prices are the same in all markets. Class I prices vary by market according to the market-specific Class I differentials.

Federal orders differ not only with respect to Class I differentials, but also with respect to utilization of milk, the amount of milk pooled, and the average size of producers. Utilization of milk in Class I varied in 2000 from a low of 17.5 percent in the Upper Midwest to a high of 88 percent in Florida. The Upper Midwest had the highest Class III utilization and the lowest Class II and Class IV utilization.

The Northeast and Upper Midwest orders are the largest, each pooling nearly 24 billion pounds of milk in 2000. The Florida and Arizona-Las Vegas orders pool only about 3 billion pounds annually. Producers affiliated with the Arizona-Las Vegas order numbered 122 in 2000 and produced an average 70,000 pounds of milk per day. This contrasts with more than 19,000 producers delivering 3,350 pounds per day in the Upper Midwest.

Federal Milk Marketing Order Statistics, 2000

Federal Milk Order Marketing Area	*No. of Producers*	*Daily Deliveries*	*Total Deliveries*	*Utilization by Class*			
				Class I	*Class II*	*Class III*	*Class IV*
		Lbs.	Mil #			%	
Northeast	17,279	3,799	23,970	43.86	17.40	29.02	9.73
Appalachian	4,213	4,107	6,318	68.75	14.07	6.42	10.77
Southeast	5,066	4,055	7,487	65.01	10.70	16.32	7.97
Florida	305	26,186	2,867	88.09	6.75	2.22	2.93
Mideast	10,030	3,877	14,181	47.36	14.95	31.40	6.29
Upper Midwest	19,147	3,347	23,415	17.47	3.55	78.14	0.83
Central	10,709	4,119	16,037	30.40	7.43	58.57	3.59
Southwest	930	25,867	8,712	45.57	9.01	38.29	7.13
Arizona-Las Vegas	122	69,946	3,110	31.30	4.46	36.10	28.14
Western	743	14,987	4,048	25.05	9.01	57.33	8.62
Pacific Northwest	1,047	17,886	6,776	30.99	6.87	34.67	27.47
All Markets Combined	69,590	4,590	116,920	39.33	10.22	42.69	7.75

Source: Dairy Division, Agricultural Marketing Service, U.S. Department of Agriculture

The *pooling* part of federal milk orders refers to how dairy farmers are paid. Dairy farmers marketing their milk through regulated handlers receive, as a minimum price, the pooled, or weighted average value of all milk in the marketing area based on the class prices and utilization. Stated simply, all revenues from milk sales valued at the minimum class prices are summed across all regulated handlers in the marketing area and the resulting total value is divided by producer deliveries to determine value per hundredweight.

Seven of the eleven orders use *multiple component pricing* (MCP) in paying farmers. Under MCP, farmers are paid for pounds of butterfat, protein, and other solids at the Class III values for these components. Four of the seven MCP orders also add or subtract a somatic cell count adjustment per hundredweight of milk, which is based on the value of cheese. In addition to MCP payments, farmers in MCP markets also receive a *producer price differential* (PPD) expressed on a per hundredweight basis. The PPD represents the difference between the pool value per hundredweight (denoted the uniform price) and the Class III value.[9]

The four federal orders that do not use MCP are characterized by relatively high utilization of milk for Class I. In these orders, farmers are paid for milk on the basis of the pooled values of skim milk and butterfat.

The reconciliation between a handler's obligation based on its utilization of milk and its obligation based on the uniform price is through a *producer settlement fund.* The producer settlement fund balances handlers' pool obligations and what they must pay to producers. Handlers who use most of their milk for Class I products have a pool obligation per hundredweight of milk that is higher than the uniform price and pay into the producer settlement fund. Handlers who use all or most of their milk for Class III purposes have a pool obligation that is less than the uniform price and draw from the producer settlement fund. This pool draw is particularly important to cheese makers. It allows them to pay their producers more than what they could if their revenue were derived entirely from cheese sales. Because of the pool draw, cheese makers in areas with high Class I use are not penalized by high uniform federal order prices.

Uniform federal order prices vary across markets mainly due to (1) Class I differentials and (2) Class I utilization. Class I differentials are established for each county and range from $1.60 to $4.30 per hundredweight. The differentials apply to the county where the receiving milk plant milk plant is located, not where the dairy producer is located. Class I utilization ranges from less than 20 percent to almost 90 percent. In general, Class I utilization is highest in the southeastern U.S. and lowest in the Midwest and Northwest.

Producer price differentials provide a rough measure of how much Class I sales in a market contribute to the uniform price received by farmers. For 2001, PPDs (actual and imputed) ranged from $0.64 per hundredweight in the Upper Midwest (17.6 percent Class I Utilization/$1.80 base Class I differential) to $4.66 in Florida (88 percent Class I utilization/$4.00 base Class I differential.[10]

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[9] Calculating the PPD actually involves several other adjustments for various pool payments and deductions. Depending on net adjustments, the PPD may be higher or lower than the difference between the uniform price and the Class III price.
[10] The imputed PPD in Florida exceeds the highest Class I differential in the Florida market because of relatively high utilization in Classes II and IV, which were both priced higher than Class III in 2001.

Federal Milk Marketing Order Prices and Class I Utilization, 2001

Federal Milk Order Marketing Area	*Principal Pricing Point/Major City*	*Class I Differential**	*Class I Utilization*	*Uniform Price*	*Producer Price Differential*
		$/Cwt.	**Percent**	**$/Cwt.**	**$/Cwt.**
Northeast	Suffolk Co., MA/Boston	3.25	43.86	15.68	2.56
Appalachian**	Mecklenburg, Co., NC/Charlotte	3.10	68.75	16.31	3.21
Southeast**	Fulton Co., GA/Atlanta	3.10	65.01	16.07	2.97
Florida**	Hillsborough, Co., FL/Tampa	4.00	88.09	17.76	4.66
Mideast	Cuyahoga Co., OH/Cleveland	2.00	47.36	14.58	1.38
Upper Midwest	Cook Co., IL/Chicago	1.80	17.47	13.70	0.64
Central	Jackson Co., MO/Kansas City	2.00	30.40	14.21	1.05
Southwest	Dallas Co., TX/Dallas	3.00	45.57	15.48	2.35
Arizona-Las Vegas**	Maricopa Co., AZ/Phoenix	2.35	31.30	14.43	1.33
Western	Salt Lake Co., UT/Salt Lake City	1.90	25.05	14.16	0.87
Pacific Northwest	King Co., WA/Seattle	1.90	30.99	14.32	1.13
All Markets Combined			39.33	14.90	1.51

*Class I differentials at other locations in the marketing area may be higher or lower than the Class I differential at the principal pricing point.
**Markets use skim milk-butterfat pricing and do not report a PPD. The imputed PPD value shown is the difference between the order uniform price and the annual average Class III price for 2001.

Major Effects on Interregional Competition

Federal orders have been used to price Grade A milk in the United States for more than 60 years. Enabling legislation followed a long period of disruptive pricing practices in the fluid milk industry. Processors often expanded and contracted their procurement areas in accordance with counter-cyclical seasonal milk production and consumption patterns. Producers, especially those on the fringes of city milk-sheds, would be enticed by relatively high prices to supply milk to fluid bottlers during deficit periods, only to be cut off during periods of ample milk supplies. Retail price wars often resulted in volatile and unprofitable farm milk prices. Cooperative efforts to bring about stability in prices and market access were frustrated by a lack of bargaining power vis a vis large processors and by free riders, dairy farmers who benefited from the cooperative's efforts by remaining outside the cooperative.

Federal orders achieved more "orderly marketing" through classified pricing and pooling provisions. Minimum prices prevented processors from passing the effects of their price wars on to farmers. Producers supplying the fluid market received the same price (adjusted for location and composition), whether their milk was consistently needed to meet fluid needs or needed only during periods of short supply.

Federal milk marketing orders have continued to promote equity and stability in fluid milk markets. Dairy farmers have unquestionably benefited from reduced market risks. They have also achieved some degree of income enhancement, since order pricing capitalizes on the difference in elasticity of demand between fluid and manufactured milk products through price discrimination. Following initial opposition, handlers have generally become supporters of orders because they ensure equal raw product costs among competitors.

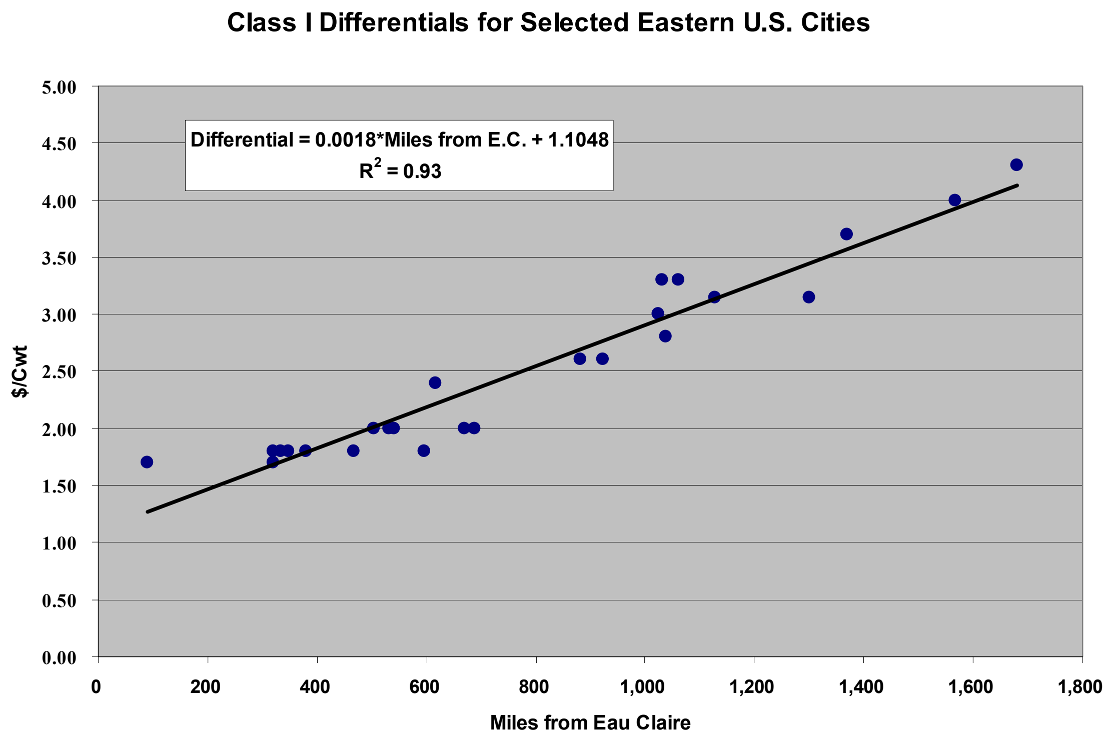
Despite widespread industry support, there is growing concern that milk marketing orders have not evolved to conform to changes in milk production and marketing practices. Orders induce and perpetuate inefficient milk production, procurement, and distribution patterns. Orders bestow differential benefits on some producers and impose related costs on others. By creating haves and have nots, orders create political supporters and opponents. The administration of federal orders in recent years has reflected political pressure more than economic rationale.

Criticism of federal orders stems mainly from methods used to establish minimum prices for Class I, or fluid milk. These methods include using single basing point pricing to set differentials and using the higher of advanced Class III or Class IV skim milk prices to set the Class I mover.

Single Basing Point Pricing

For markets east of the Rocky Mountains, the Class I differentials reflect a system of *single basing point pricing* – Class I differentials increase in a linear fashion with distance from the Upper Midwest.[11] Currently, differentials increase at the rate of about 18 cents per hundredweight per100 miles distance from Eau Claire.

[11] Class I differentials in western markets do not follow the single basing point pattern. They appear to be set in reference to local supply and demand conditions.



Single basing point pricing was adopted during the 1960s, when the Minnesota-Wisconsin price series gradually replaced local supply-demand adjusters as the Class I price "mover" in federal order markets. With markets using a common Class I price mover, Class I prices needed to be geographically aligned in a manner than encouraged efficient milk movements. USDA justified using the Upper Midwest as a pricing base on grounds that the Upper Midwest had a large reserve supply of Grade A milk. So while deficit markets would acquire milk from the closest market that had excess supplies, markets that gave up milk for fluid purposes would ultimately have to replace that milk from the Upper Midwest.

This logic may have made sense in the 1960s, even though single basing point pricing ignored the fact that many markets distant from the Upper Midwest were amply supplied with milk and never had to procure supplementary supplies.[12] With the passage of time, however, the assumption that the Upper Midwest was the sole source of supplementary milk supplies became increasingly invalid. In fact, single basing point pricing created high producer milk prices that not only encouraged local self-sufficiency in fluid milk, but also induced expansion of manufacturing milk production in many areas. The single basing point concept actually created new fluid milk supply sources, but it was not altered to attract milk from these areas to deficit regions.

The situation was exacerbated in 1986 when, as part of the 1985 Farm Bill, Class I differentials were increased in many regions that were experiencing lower relative costs of milk production and already expanding milk production. This contrary action yielded producer

[12] For example, northeastern markets were at no time short of milk for fluid purposes. But these markets enjoyed the benefit of Class I differentials that assumed they regularly moved milk from the Upper Midwest.

prices that enhanced excess profitability and created even stronger incentives to expand production. Because Class I prices were raised by the increase in Class I differentials, fluid milk consumption generally declined in markets that were granted large increases in Class I differentials. Consequently, the volume of milk utilized for manufactured dairy products increased even more than milk production increased.

Since Class I differentials were fixed, the only restraint on milk production in this situation was an erosion of the weighted average milk price through a reduction in Class I utilization. Additional Grade A milk production not used in Class I did reduce Class I utilization and uniform prices in many markets where Class I differentials were increased. But at the same time, the added production augmented the national supply of milk for manufacturing, reducing manufacturing milk prices.

Balancing local supply and demand by reducing prices for milk used for manufacturing is particularly punitive to producers in Wisconsin. That is because Class I differentials in Wisconsin are among the lowest in the U.S. because of its vicinity to the Upper Midwest basing point and because most of the Grade A milk in Wisconsin is utilized for making cheese. Consequently, a reduction in Class III prices more directly affects the uniform federal order price applicable to Wisconsin.

The effect of single basing point pricing on prices of milk used for manufacturing was mirrored by the Northeast Interstate Dairy Compact, which expired in 2001 – fluid milk prices higher than can be justified by market conditions lead to induced production of milk for manufacturing. Since the area covered by the Northeast Compact was small, the effects were minimal. But proposed expansion of the compact region would likely have significantly increased the supply of milk for cheese to the detriment of Wisconsin and other major cheese states.

The Class I Price Mover

Class I prices represent, in part, added costs and value associated with providing milk for fluid markets versus milk for manufacturing. The theory is that manufactured milk prices reflect national supply and demand conditions and the differential reflects marginal Class I value in specific local markets. So Class I prices are moved by manufacturing milk values.

From the mid-1960s until 1995, the mover for Class I prices was the Minnesota-Wisconsin Manufacturing Grade Price Series (M-W price), which was an estimate of what Grade B milk plants paid for milk in the two states. During the life of the M-W price, an estimated 75-95 percent of Grade B milk in Minnesota and Wisconsin was used to make cheese. In May 1995, the M-W Price was replaced as the Class I mover by the Basic Formula Price (BFP). The BFP was based on the M-W price, but modified by month-to-month changes in prices for cheddar cheese and nonfat dry milk weighted by the relative proportion of milk in Minnesota and Wisconsin used for these products. The cheese weight typically exceeded 95 percent, so the mover remained closely tied to cheese prices.

In January 2000, the Class I price mover was changed to the higher of the advanced Class III or Class IV skim milk price. Since the Class IV skim milk price is tied exclusively to the price of nonfat dry milk, this change allowed for Class I prices to be disassociated from cheese prices for the first time since adoption of the M-W price as the mover.

Since the volume of milk used to make nonfat dry milk is less than 1/5 the volume used to make cheese, it would be irrational to consistently use Class IV to move Class I. Use of the higher of mover was intended to give an infrequent, temporary "bump" to Class I prices when nonfat dry milk was in relatively tight supply compared to cheese. When the mover change was adopted, nonfat dry milk prices had been resting at the CCC purchase price for nearly a year, and CCC stocks were building rapidly. Few saw the possibility of Class IV being the mover except under those rare occasions when cheese prices were severely depressed.

Contrary to expectations, Class IV was the Class I price mover every month from January 2000 until August 2001. This occurred for two reasons. First, cheese prices were depressed during all of 2000 and the early part of 2001. Second, butter prices were high relative to cheese prices. The Class III pricing formula involves a negative relationship between butter prices and the Class III skim milk price – higher butter prices depress the Class III skim milk price, making it more likely that Class IV will be the higher of mover.[13]

The effect of Class IV consistently moving Class I prices was to widen the difference between Class I prices and Class III prices beyond what is indicated by the Class I differential. In 2000, the advanced Class IV skim milk price exceeded the Class III skim milk price by an average $1.76 per hundredweight. In effect, the Class I differential was elevated by $1.76 measured relative to using a cheese-based mover.

These higher effective Class I differentials created sharply conflicting market signals to dairy farmers in 2000. Using the higher of the advanced Class IV or Class III skim milk price de-coupled the Class I (and Class II) segments of the dairy industry from the cheese market. Dairy producers in high Class I markets were substantially isolated from milk surpluses and low cheese prices. The burden of milk surpluses fell predominately on Class III use markets. Thus, producers in all regions of the country did not receive the same price signal from the marketplace to reduce milk production. This slowed necessary milk supply adjustments and prolonged the period of low milk prices.

The butter-powder tilt implemented May 2001 partially reduced the problem of the higher of mover. Nonfat dry milk prices fell, lowering the advanced Class IV skim milk value. Since the tilt, Class III and Class IV have shared about equal time as the Class I mover. A second tilt is expected shortly because of large surpluses of nonfat dry milk. This will make it even less likely that Class IV would move Class I except when cheese prices were very low.

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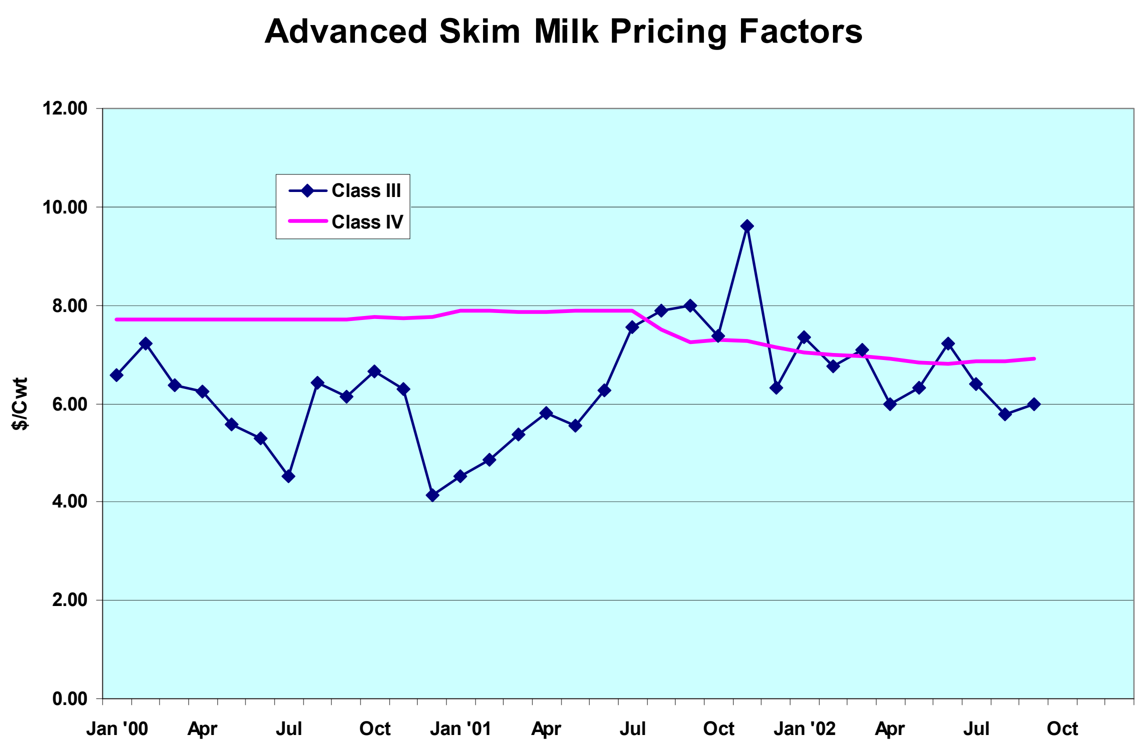
[13] In October 2001, USDA issued a preliminary decision to alter the protein price formula in a manner that would eliminate the negative effect of the butter price on the Class III skim milk price. A final decision has not yet been issued.

Many dairy leaders, especially those representing dairy farmers in high Class I utilization markets, strongly opposed the May 2002 tilt. This opposition may be understandable from the parochial standpoint of wanting to insulate some farmers from the effects of low cheese prices. But federal milk marketing orders are not designed to be used as a price support mechanism. And they certainly should not be used to provide differential levels of support to various regions depending on their milk utilization.



The Effect of Terminating Orders

Because of low Class I utilization and low Class I prices, Wisconsin would appear to have little to lose from terminating orders and, perhaps, much to gain. Without marketing orders, fluid milk prices would be expected to fall, reducing farm milk prices and stimulating fluid milk consumption in areas where orders are currently propping Class I prices above competitive levels. The combined effect of less farm milk in response to lower farm prices and more milk consumed as fluid would be a reduction in milk for manufacturing and a corresponding increase in price. Manufacturing regions would be expected to gain and fluid regions would likely lose.

We simulated the effects of eliminating both federal orders and the similar California state pricing and pooling plan using the interregional competition model noted earlier. The same base for comparison was used – 2000 conditions except for post-tilt CCC purchase prices for butter and nonfat dry milk. A number of scenarios with respect to supply response and arbitrary minimum prices for fluid milk were simulated and compared with the adjusted 2000 base.

The simulated effect of terminating marketing orders is small in the aggregate; U.S. average prices are about 5-10 cents per hundredweight lower, and milk production is reduced by less than 1 percent. As expected, the effects vary across regions. In general, regions with high Class I use show farm price reductions, as fluid milk prices fall from order minimum prices. Regions where manufacturing is important tend to show price gains, as expanded fluid milk consumption pulls milk from manufacturing uses and raises prices for hard dairy products.

Fluid milk prices fall by around 3 percent on average with order termination. Prices for products designated Class II (soft manufacturing and frozen) fall by about 7 percent. Cheese prices increase 5-7 percent. Butter prices fall 4-5 percent with larger production, as more cream is generated from expanded fluid milk sales.[14] There is little change in production or prices for nonfat dry milk

The Upper Midwest shows modest farm milk price gains of about 20 cents per hundredweight with termination of marketing orders, comparable to other major manufacturing regions. This is a much smaller effect than measured from earlier simulations using the interregional competition model, which showed farm milk price gains of 8-10 percent for the Upper Midwest region. This diminished effect is partly due to using 2000 as the base year. Milk was in surplus in 2000, so the simulated impact of the reduced supply of milk for manufacturing was less than in years when milk supply and demand were in closer balance.

The small impact of terminating orders on the Upper Midwest is also attributable to the base solution incorporating the liberalized pooling rules that became effective with federal order reform implemented in January 2000. Under the new rules, regulated handlers in the Upper Midwest order affiliate large numbers of producers and volumes of milk with other orders that have higher Class I prices and higher Class I utilization. Only a fraction of the milk pooled on other orders has to be physically transported to qualify for pooling. So the plants receive the full benefit of a higher producer price differential without incurring hauling costs on the associated pooled volume of milk. These net benefits, included in the base model solution, disappear when federal orders are terminated.

Besides the effect on milk and dairy product prices and production, terminating federal orders would yield other outcomes that are more difficult to quantify. Farm milk prices might be more unstable without orders. In Wisconsin, competition between fluid processors and cheese plants could cause prices to be higher in the fall (when fluid demand is seasonally high and milk production is seasonally low) and lower in the spring (when "giving up" cheese milk for fluid use is less costly).

Both the level and stability of farm milk prices would depend on the ability of dairy cooperatives to maintain classified pricing without orders. In Wisconsin, cooperatives

[14] The average butterfat content of U.S. fluid milk is less than 2 percent. So conversion of 100 pounds of milk to fluid yields about 1.7 pounds of butterfat for use in other dairy products.

operating through a federation are able to negotiate fluid milk prices significantly higher than order minimum prices for Class I and Class II milk. How much that ability is related to the existence of order price floors is unknown. But since much of the over-order premium consists of service costs (e.g., balancing, or accommodating bottling schedules), it is unlikely that premiums would be markedly smaller without orders.

Orders use mandatory reporting and auditing to assure accurate accounting of milk and milk component use and enforce timely and complete payments by handlers. Orders collect and disseminate comprehensive market information. Some of these market service functions would be lost if orders were terminated. Others would be picked up by the private sector, but at a cost to dairy farmers.

On net, would Wisconsin benefit from terminating federal marketing orders? The answer is, "it's hard to say." There is no question that federal orders created and continue to maintain regional and product class milk price differences that are not consistent with what would be observed in a competitive market. Federal orders promoted regional shifts in milk production during the late 1970s and 1980s. Orders continue to define fluid milk markets as local in nature when, in fact, fluid milk does not need to be produced locally in light of contemporary processing, packaging, and distribution technology.

But competition has operated both within and outside the orders to mitigate the effect of these pricing distortions. For example, low Class I differentials in Wisconsin are augmented by large over-order Class I price premiums negotiated by cooperatives. Cooperative premiums are relatively low in other markets and nonexistent in some. This tends to equilibrate *effective* Class I prices, even though the order *minimum* prices may be distorted. Similarly, liberal pooling has tended to increase Class I use and producer returns in Wisconsin while decreasing them in destination markets.[15] This serves to equalize uniform prices across markets with similar production characteristics.

The ground rules set by orders are, in many cases, being superceded by forces of competition – the invisible hand is alive and operating. This by no means suggests that order reforms should not be aggressively pursued. The pricing system needs to reflect current market conditions, not political interests. But while terminating federal orders would promote market orientation, it would not result in huge price gains to Wisconsin, guaranteeing the prosperity or even viability of the state's dairy industry. Wisconsin needs to look at what it can do for itself in order to ensure its long term wellbeing.

[15]Several federal order hearings have been held to review pooling requirements in specific orders. Administrative decisions from these hearings will limit distant pooling.

A Blueprint for Federal Policy Changes

Federal agricultural programs have influenced regional competitiveness in dairying by differentially affecting farm level profitability. Dairy price supports and federal milk marketing order have affected dairy product and farm milk prices. Federal commodity programs for grain and oilseeds have affected dairy feed costs (see Appendix). These programs have enormous support among farmers and their elected federal legislators because they bestow large federal payments and more indirect benefits on farmer-voters. They have created production and marketing inefficiencies and distorted regional production incentives, but they have proven largely immune to changes that would alter the regional distribution of benefits.

Despite repeated frustration, the Wisconsin Congressional delegation has been aggressive in seeking changes in federal dairy policies and has shown modest success. Former Congressman Steve Gunderson was instrumental in forcing federal order consolidation and obligating USDA to rethink the structure of Class I differentials in the 1996 farm bill. Senators Kohl and Feingold and several Wisconsin House delegates played an active role in ending the Northeast Interstate Dairy Compact, which threatened to further Balkanize the dairy industry. Though it comes hard, change is possible.

In defining a blueprint for change from the perspective of Wisconsin, the fundamental objective is simple: eliminate or at least minimize artificial (non-market) milk production incentives. For the future viability of its dairy industry, it is essential that Wisconsin be permitted to exploit its natural competitive advantages in producing milk. That means market orientation. Market orientation will not guarantee the state's dairy sector will grow or even stabilize. But it will allow economic forces to determine its fate, and there is good evidence that economic forces will treat Wisconsin dairy farmers and processors more favorably than political forces.

Elements of the blueprint for change include:

- Ensure that the dairy price support program is used to provide a safety net and not to consistently raise prices above market-clearing levels. If there is reason to provide income support to dairy farmers, direct payments are preferable to elevated support prices.[16] If supply management is used, avoid programs that unduly penalize dairy farmers who want to modernize or expand their facilities or that confine benefits to those who plan to exit in a few years.

[16] While direct payments do not distort markets in the same way as elevated support prices, they can lead to expanded milk supply if they are perceived by dairy farmers as part of the market price for milk and if the payments provide more than safety net price protection. Dairy Market Loss Payments under the newly-enacted 2002 farm bill will expand milk supply and reduce market prices.

- Prevent CCC purchase prices from distorting market-based allocation of milk to dairy products. If the dairy price support is to be effective as a safety net, then there will be periodic purchases of one or more of the eligible dairy products. But when the CCC becomes the primary market outlet for a product for an extended period, processors are receiving bad signals and milk is being inefficiently allocated. Large government stocks of nonfat dry milk combined with butter prices above support should trigger butter-powder tilts. Large CCC cheese purchases along with no purchases of butter and powder require a reduction in the cheese purchase price relative to butter and powder.

- Maintain minimum fluid milk prices at levels that:

  - Encourage fluid milk consumption. Per capita consumption of beverage milk continues to slide. Administered minimum prices higher than can be justified by costs of supplying fluid milk can contribute to this problem by reducing consumer sales and stifling development of new beverage products. Taxing fluid milk consumers to raise farm milk prices is a short-sighted strategy.

  - Minimize the cost of providing fluid milk to deficit markets. Setting minimum prices at levels that promote year-round local fluid milk self-sufficiency is inefficient relative to setting prices that result in a combination of local production and shipments from other markets.

  - Recognize the national scope of fluid milk markets. Policies need to recognize that dairy products – including fluid milk – trade in national markets. The concept of a local milkshed became obsolete when grocery chains began to maintain national distribution systems for both perishable and nonperishable items.

  - Allow competitive forces to determine effective prices. Administered federal order prices are designated as minimum prices. If the cost of supplying fluid milk relative to supplying manufacturing markets is greater than the Class I differential, then cooperatives can and do obtain premiums to cover the difference and raise the effective Class I price to a competitive level. If the differential exceeds the marginal cost of supplying fluid milk, then the Class I price cannot fall to the competitive level and will encourage excess milk production.

  - Are tied closely to the competitively-determined prices for milk used for manufacturing. Class I milk prices are administered prices and do not reflect supply and demand for fluid milk. Their only link to national supply and demand conditions is through the Class I price mover. So if the price mover is divorced from national market conditions, so too will be the Class I price. The Class IV skim milk price is based exclusively on the price of nonfat dry milk. When the price of nonfat dry milk is the CCC purchase price, it is not related to the marketplace.

    - Do not encourage excess production of milk for manufacturing. Dairy farmers respond to average milk prices, which are a function of federal order class prices and utilization by class. If Class I prices are too high compared to what would prevail under competitive conditions, then fluid milk consumption is too low and milk production is too high. The result is too much milk for manufacturing purposes. This lowers farm milk prices everywhere, but especially in regions that are heavily dependent on manufacturing.

- Prevent subsidization of dairy feed costs. The need for market orientation applies to feed prices as well as milk prices. Cheap feed means cheap milk. Incentives to plant feed grains and oilseeds should be based on expected market returns, not on government payments tied directly to levels of production (e.g., market loss payments, loan deficiency payments). If income support to crop farmers is deemed appropriate, eligibility should not be linked to current production.

Appendix

Federal Feed Grain and Soybean Programs

Federal programs for major grains and oilseeds have evolved over time from price and income support programs to exclusively income support mechanisms. From the late 1970's through early 1990's, producers received *income support* in the form of deficiency payments. These payments were based on the difference between some target price and the loan rate for a given program crop. To receive deficiency payments, producers had to establish crop base acres, and commit to protecting these bases by planting only the associated program crop on them. This often included keeping some base acres out of production altogether (Acreage Reduction Programs), and did not allow base acres for one crop to be planted to another program crop.

Price support was maintained through the loan rate program. The loan rate was an established price below the target price. When the market price approached the loan rate, producers could deliver their crop into the loan program, and receive the equivalent of the loan rate. If prices later rose, they could pay off their loan, redeem the crop, and sell at the higher market price. If prices did not rise over the loan period, the producer forfeited the crop to the government and did not pay back the loan. The government would then market the crop once prices rose above a certain trigger.[17]

The 1996 "Freedom to Farm" Agricultural Act eliminated the old deficiency payments associated with target prices, and restructured the loan program to encourage farmers to sell their crop in the cash market regardless of price. Farmers who sold their crop for a price below the loan rate could then receive a *loan deficiency payment* to make up the difference between the market price and the loan rate. In addition to loan deficiency payments (not to be confused with the old deficiency payments tied to target prices) the 1996 legislation introduced other direct payments in the form of *transition payments* (AMTA) and *market loss payments*, and eliminated base acreage management as condition of eligibility for receiving payments. Farmers were eligible for program benefits regardless of how they allocated their acres among crops, and except for those enrolled in the Conservation Reserve Program, there was no requirement to take acres out of production when grain stocks were high.

Despite early arguments that the "Freedom to Farm" act would increase farmers' incentives to respond to market signals, the effect of the legislation has been a continued de-coupling of planting decisions from market incentives. The 1996 farm program continued to encourage planting decisions that are contrary to economic logic. In a true market environment, low corn and soybean prices would induce producers to cut back production of corn and soybeans, substituting more profitable crops or leaving their land lay idle. But the guarantee of loan deficiency payments and the virtual promise of market loss payments have provided a strong incentive to continue to plant program crops, even though expected market returns are less than full costs of production and, for many

[17] While the basic grain program provisions did not change much over this time period, individual target prices, loan rates, and specific base acre management options did change from farm bill to farm bill.

growers, less than variable costs. Grain and soybean producers are not producing with the expectation of profitable market prices; they are producing in order to receive auxiliary payments associated with production.

This same incentive existed to some extent under older farm legislation. But two things generally prevented stock buildups and related depressed prices. First, when stocks became burdensome, the government would absorb excess production through the old nonrecourse loan program and hold it off the market until prices recovered. That meant stocks available to trade in the cash market were only a part of total physical stocks. This government activity artificially constrained the supply and propped prices. Under the current program, the government does not control any of the tradable supply – the entire stock of any grain is available to the cash market regardless of price or stocks levels.

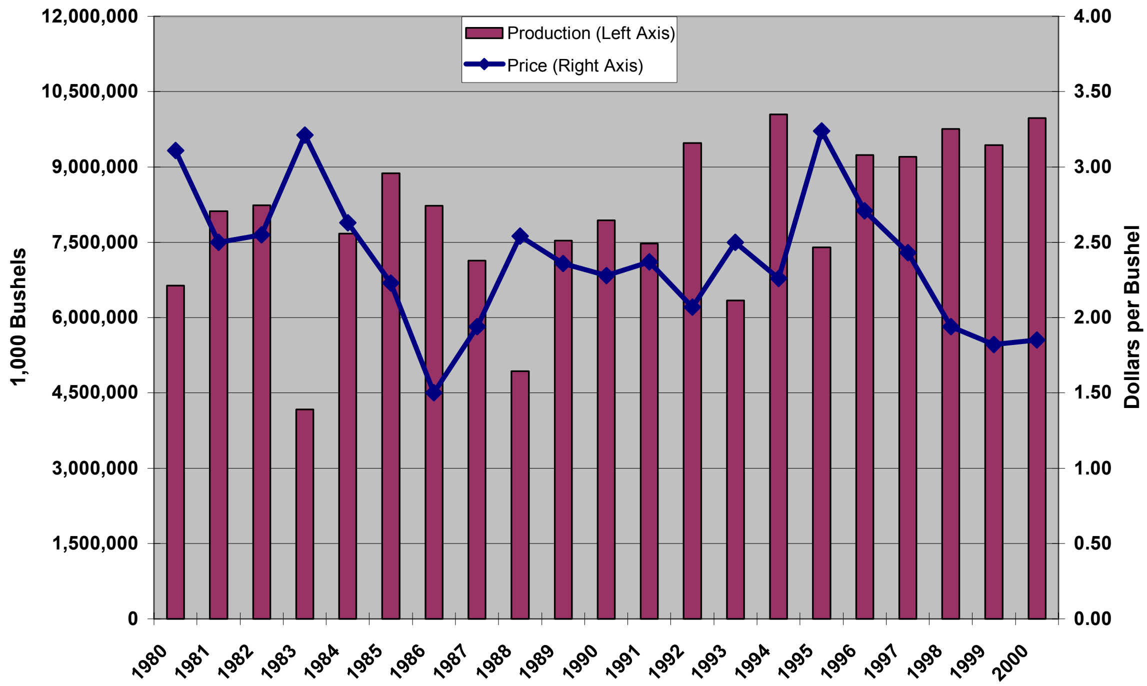
Second, until 1996, the US experienced a significant production problem (i.e., drought) with almost predictable regularity. As a result, total demand was greater than current production in some years, and the government could release stocks that had been accumulated during periods of low prices. Since 1996, however, the combination of supplies always being on the market and no significant crop disasters has resulted in a chronic surplus of grain and soybeans. Crop prices have been consistently depressed.

Corn production since 1998 has been near record high while season-average prices have been under \$2 per bushel. Soybean production set records in 4 of the last 5 crop years. Soybean prices over this time have consistently been under \$5 per bushel. USDA's estimates of national average costs of production for corn and soybeans in 2000 were \$2.72 and \$6.19 per bushel, respectively.

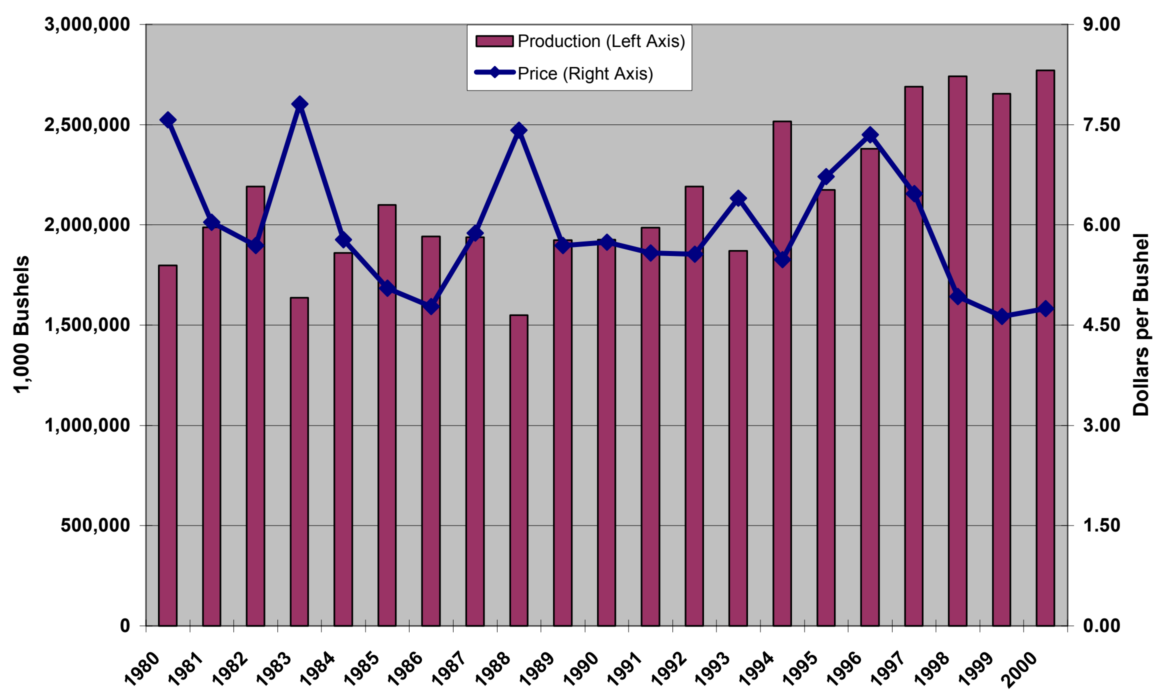
Federal feed grain and soybean payments have a spillover effect on the dairy sector. Low feed prices generally create low milk prices. Dairy farmers respond to low unit concentrate costs by feeding more concentrates and increasing milk production per cow.

While low feed prices since 1996 have generally contributed to lower milk prices, there is no strong evidence that dairy production regions have been differentially affected. Market prices below costs of production might, on the surface, appear to benefit dairy farmers who buy all their feed and penalize those who grow their own. But dairy farmers who produce their own feed grains and soybeans are eligible to receive direct payments. Even corn harvested for silage qualifies for some benefits.

U.S. Corn Production and Season Average Prices



U.S. Soybean Production and Season-Average Prices



MARKETING AND POLICY BRIEFING PAPER

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RETHINKING DAIRYLAND

Farm Level Milk Prices: Is Wisconsin Competitive?[1]

This paper supports leaflet No. 5 in the ***Rethinking Dairyland***, series of brief reports authored by faculty and staff in the University of Wisconsin College of Agricultural and Life Sciences. These reports document the current state of the Wisconsin dairy industry and evaluate factors that will influence its evolution. In this installment, we address the level of milk prices in Wisconsin, discussing a number of factors that may – or may not – justify higher milk prices in Wisconsin than in other states. We focus on whether the state's cheese industry may be losing its competitive advantage to the West, where milk prices are lower and milk production is growing, or whether there are economic reasons to support higher milk prices in Wisconsin.

Cheese consumption in the U.S. continues to increase. Per capita consumption reached nearly 30 pounds in 2000, up 21 percent since 1990. With rising population, total cheese sales were up 37 percent. More U.S. milk was used for cheese than for beverage purposes in 2001, 33 percent for beverage milk versus 37 percent for cheese on a milk equivalent, butterfat basis.

Wisconsin is the leading cheese producing state. But milk production in 2001 was 2 billion pounds less than it was in 1990. Greater cheese demand with no growth in milk production makes it increasingly difficult for cheese plants to procure enough milk to honor cheese customer orders and to operate their facilities at the most efficient capacity.

[1] Principal contributors to this paper are Bob Cropp and Ed Jesse, Department of Agricultural Economics, University of Wisconsin-Madison.

Excess capacity creates a highly competitive milk procurement market in Wisconsin. Dairy farmers benefit in the short run from higher milk prices. But scrambling for a limited supply of milk may also encourage Wisconsin cheese plants to relocate in other states where the milk supply is growing and milk prices are lower. This raises the question, “Is the cost of Wisconsin milk too high for cheese manufacturers to competitively market cheese nationally and to generate adequate plant operating margins for long term viability?

That question is not easy to answer. First, it is difficult to directly compare the cost of milk used for cheese across regions. Second, higher prices for cheese milk in Wisconsin may reflect higher values relative to other regions. In what follows, we look at various means of comparing milk costs between Wisconsin and California and Idaho, the fastest-growing states with respect to both milk and cheese production. We then examine factors that may enhance the ability of Wisconsin cheese plants to out-pay those in other regions.

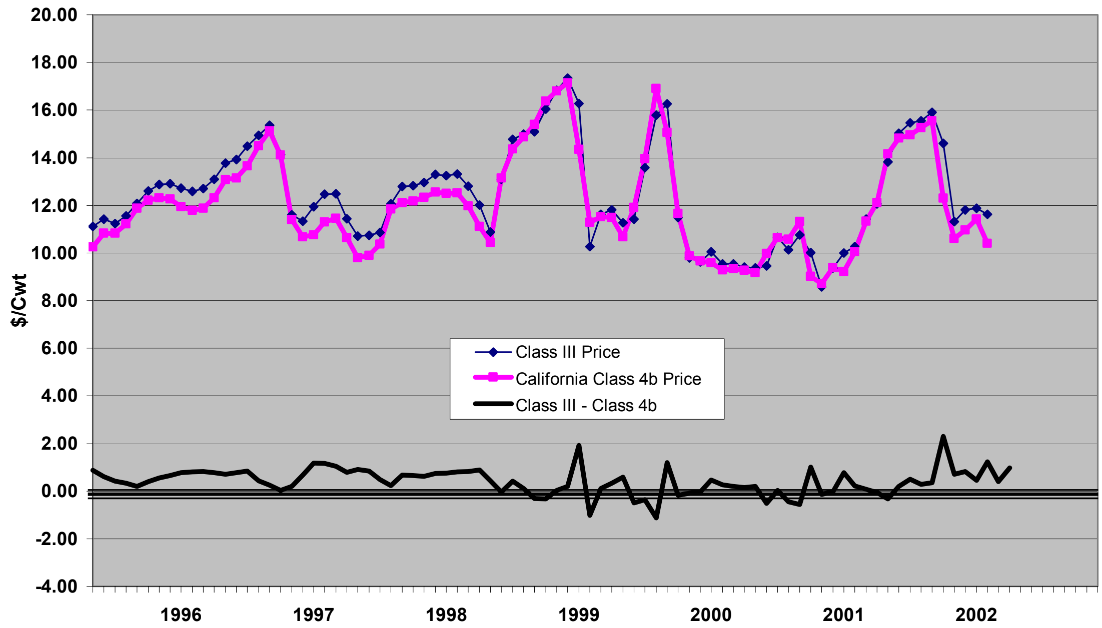
Regional cost of milk used for cheese

Most of the milk used to make cheese in the U.S. is priced administratively. Outside of California, federal milk marketing orders set minimum prices for Grade A milk according to use class – what products are made from the milk. Federal orders uniformly designate Class III as milk used for making hard cheeses. Since January 2000, the Class III price has been derived using a product price formula based on prices for cheddar cheese, butter, and dry whey. From May 1995 through December 1999, the Class III price was the Basic Formula Price, which was derived from the price of Grade B milk paid by manufacturing plants – principally cheese factories – in Minnesota and Wisconsin.

California uses a state milk pricing order that also uses classified pricing. Under the California order, milk used to make cheese is designated Class 4b. The Class 4b price is determined by a product price formula similar to what is currently used to determine the federal order Class III price.

For the period May 1995 through March 2002, the California Class 4b price was less than the Class III price in 63 months and higher in 20 months. For the entire 83 months, the 4b price averaged $0.37 per hundredweight less than the Class III price. The annual average difference was as high as $0.78 in 1997 and as low as $0.05 in 2000. It appears that the difference between the Class III price and California’s 4b price may have narrowed since 1999. However, the average difference increased to almost $1.00 per hundredweight during the six months ending March 2002.

Federal Order Class III Price
versus California Class 4b Price



The BFP used to set Class III prices prior to January 2000 was a competitive pay price for Grade B milk while the 4b price was a component formula derived price. This distinction explains some of the differences between the two series in earlier years. Specifically, cheese plants in Minnesota and Wisconsin tended to pay more for Grade B milk than could be justified by cheese prices.

Now that both the Class III price and California's 4b price are derived from product price formulas, differences reflect the specific product prices, yields, and make allowances used in the formulas. Most notable, California uses Chicago Mercantile Exchange (CME) cheese prices in the 4b formula while federal orders use National Agricultural Statistics Service (NASS) survey cheese prices in the Class III formula. The NASS cheese prices average a few cents per pound higher than CME prices. Moreover, Class III accounts for the value of whey solids recovered in cheese making while 4b does not.

While it is instructive to compare the BFP/Class III prices with California's 4b price, the comparison understates the differences in pay prices. About 95 percent of Wisconsin's milk supply is Grade A, and Wisconsin cheese plants pay premiums for Grade A milk above the Class III price. California plants do not, in general, pay more than the 4b price for milk used for cheese.[2]

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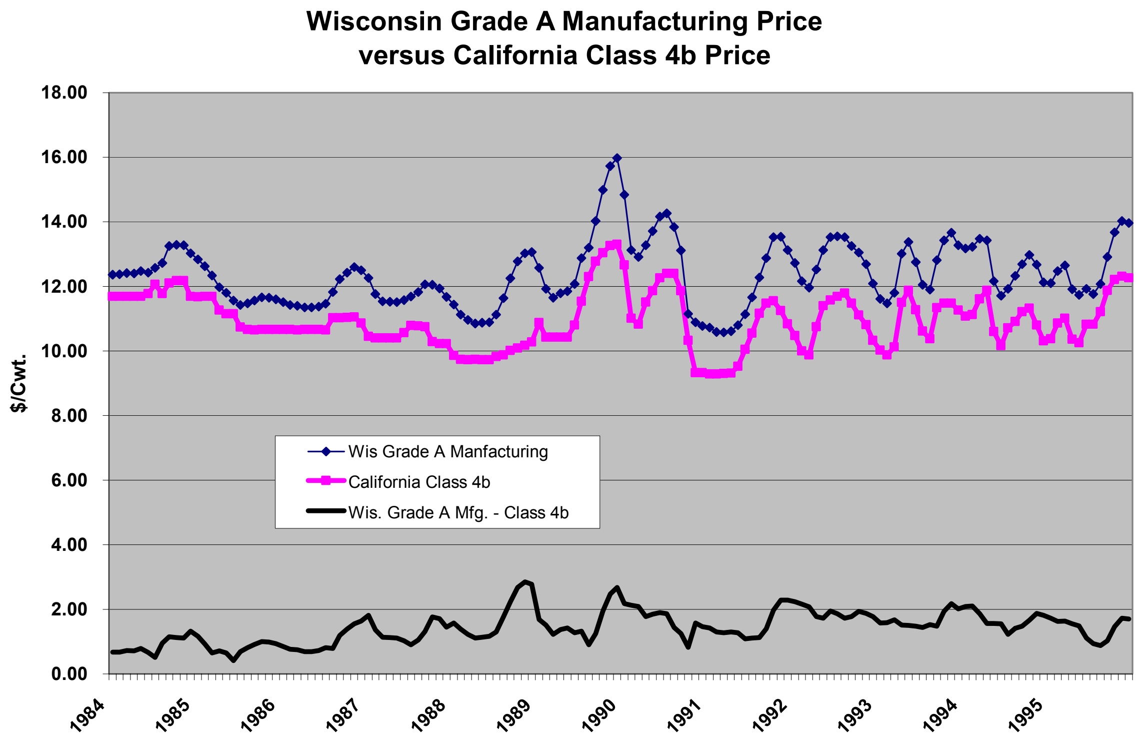
[2] In the future, as planned California cheese plant capacity comes on line faster than its growth in milk production, some premiums are likely to surface in the state.

Part of the enhanced value of Grade A milk used for cheese relative to the Class III price is attributable to federal order pool "draws." Pooled manufacturing plants that use all of their milk in Class III receive payments from their order's producer settlement fund to account for the difference between the weighted average value of all milk in the pool (uniform price) and the lower Class III value. Adjusting for this draw yields an estimate of the cost of Grade A milk used for manufacturing.

The Agricultural Marketing Service of USDA (AMS) estimated a Grade A Manufacturing Price series for Wisconsin for 1984-1995. The series was calculated by subtracting the pool draw from the actual monthly pay prices for plants that used all or most of their milk for Class III. Since the amount of milk used in classes other than Class III was very small for these plants, the effect of over-order premiums (see below) on the plants' pay prices was minimal.

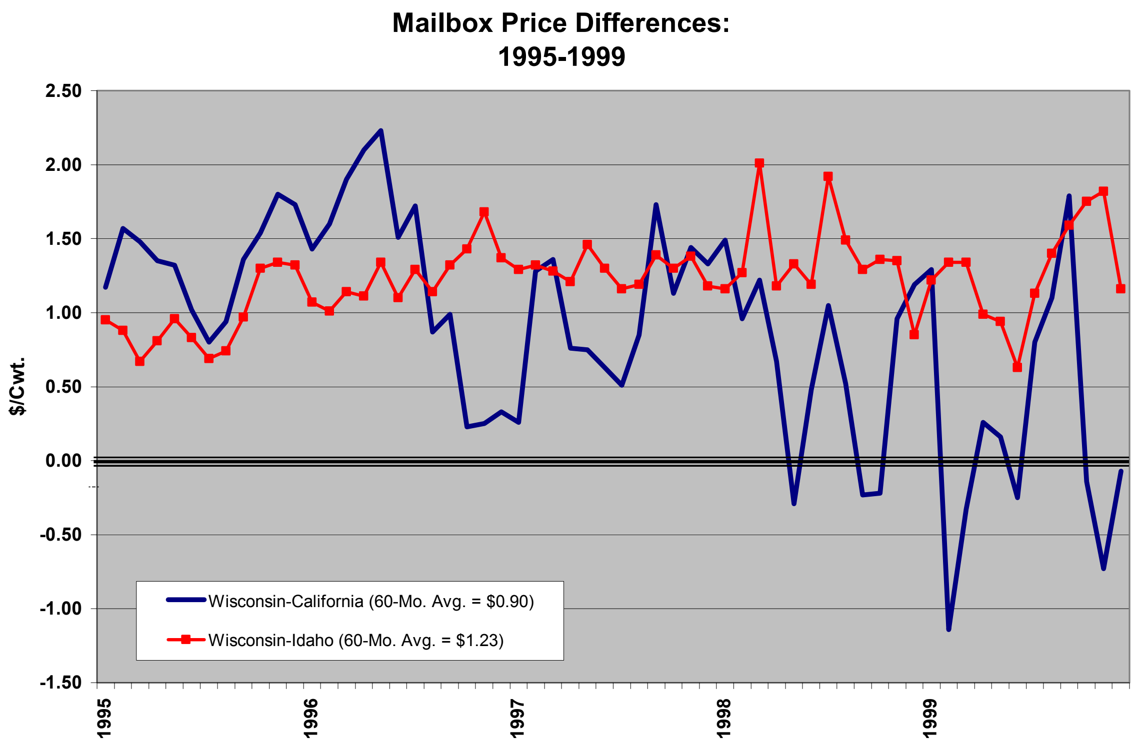
The Wisconsin Grade A Manufacturing Price was consistently higher than the 4b price. The difference averaged $1.43 per hundredweight over the 12-year period during which the series was published. While dated, the comparison emphasizes that Wisconsin milk for cheese commands a premium relative to California cheese milk.



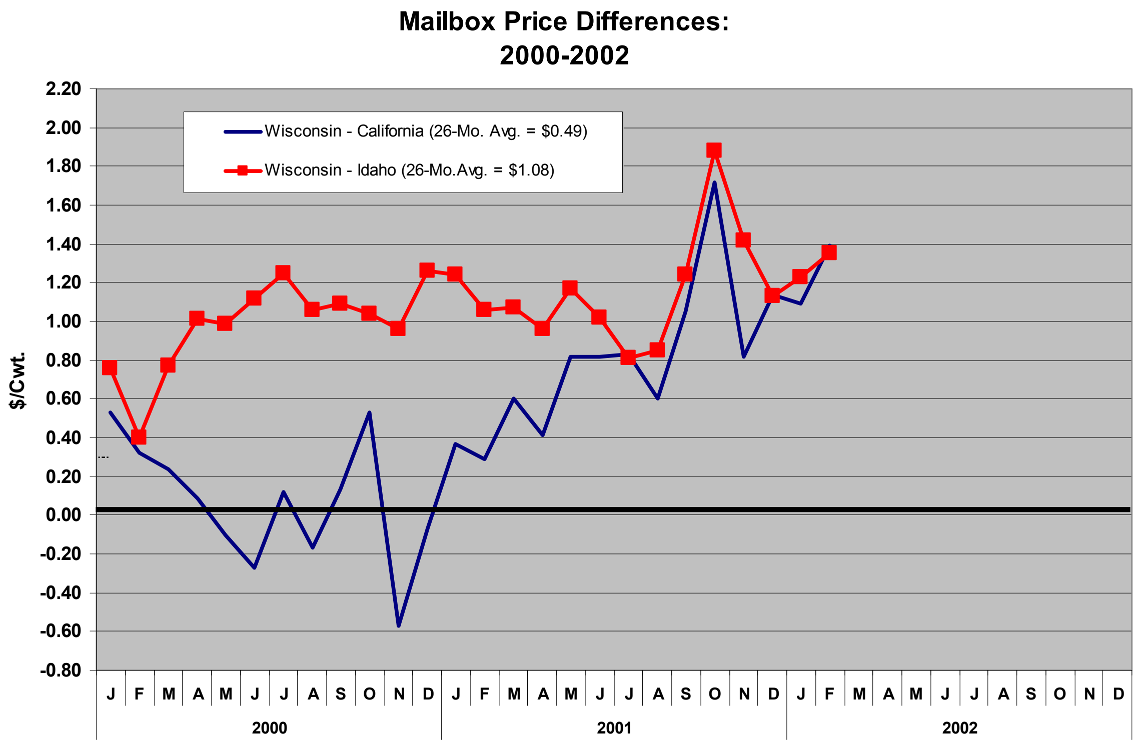
Another way to compare the cost of cheese milk is by using "mailbox" milk prices, which have been reported by AMS since 1995 for federal milk order markets and for the state of California. Mailbox prices account for all of the premiums and deductions that apply to dairy producers' milk checks (with the exception of cooperative patronage refunds). Consequently, they represent a net milk value at the farm. Mailbox prices are not adjusted for marketing order pool draws. Thus, they do not accurately reflect the cost of milk to cheese makers. But they do allow a consistent comparison of farmer pay prices across regions.

Wisconsin, California and Idaho have similar milk utilization patterns, so mailbox prices contain roughly equivalent values for milk used for higher-priced uses relative to Class III or Class 4b. From 1995 through 1999, AMS reported mailbox prices for 23-24 federal orders plus California. Wisconsin was the principal supply state for the Chicago order, and Idaho for the Southwest Idaho-Eastern Oregon order. During this 60-month period, mailbox prices in California were lower than the Chicago order for all but 9 months. The higher California prices occurred when cheese and milk prices were extremely volatile during 1998 and 1999.

Mailbox prices for the S.W. Idaho-E.-Oregon order were lower than the Chicago order for all 60 months. For the entire period, California mailbox prices averaged $0.90 per hundredweight lower than the Chicago order. Mailbox prices for the S.W. Idaho-E. Oregon order averaged even lower, $1.23 per hundredweight under the Chicago order.



In January 2000, several changes to federal orders were implemented. The number of orders was reduced from 31 to 11 through consolidation of marketing areas. Wisconsin became the major source of milk for the Upper Midwest order and Idaho for the Western order. The BFP was eliminated as the Class I price mover and replaced by the "higher of" the advanced Class III or Class IV price. Component pricing formulas for Class III and Class IV prices were adopted that closely resembled formulas used to derive California's 4a and 4b prices.



Mailbox price relationships following these change were somewhat different from before. For the period January 2000 through February 2002, the California mailbox price was higher than Wisconsin for 5 months, all in 2000. Cheese prices were severely depressed relative to butter and nonfat dry milk prices in 2000, making California's manufactured product mix (more butter and nonfat dry milk than Wisconsin) relatively more valuable. Since 2001, the spread between Wisconsin and California mailbox prices has been growing. In part, this reflects the May 2001 butter-nonfat dry milk "tilt" in Commodity Credit Corporation purchase prices, which devalued nonfat dry milk relative to cheese. Since January 2000, California mailbox prices have averaged $0.49 per hundredweight under Wisconsin.

Idaho milk is utilized in about the same way as Wisconsin milk. The order changes in 2000 did not alter relative mailbox prices for the two states. Since January 2000, Idaho mailbox prices have been consistently lower than Wisconsin, averaging $1.08 per hundredweight under through February 2002.

Milk Prices versus Milk Value

Regardless of the method of comparison, milk costs to Wisconsin cheese plants appear higher than for cheese plants in California and Idaho. Higher prices could be offset by higher values. Do Wisconsin cheese plants enjoy some unique operating advantages that enable them to pay higher prices for milk than milk prices in the West? We will look at several possible factors in an attempt to answer this question.

Reputation, Quality, and Variety

Wisconsin has a long tradition as the cheese state. Cheese carrying the Wisconsin label could command a higher retail price. Wisconsin continues to enjoy a high reputation for quality cheese. However, with 60 percent of the cheese now being used either in foodservice (43 percent) or in food processing (17 percent), this advantage is diminished somewhat. Most of the food service and food processing use is commodity cheeses – Cheddar and Mozzarella. Customers for commodity cheese demand a competitive price for reliable quantities of high quality cheese that meets unique needs. Wisconsin is no longer the chief supplier of commodity cheeses.

Wisconsin cheese makers need to compete with high-volume western cheese plants for wholesale commodity cheese accounts. Wisconsin's reputation as a reliable supplier of quality cheese in quantities demanded by relatively large food service and food processing firms will be threatened unless the state's milk supply increases and allows an expansion in cheese production.

Wisconsin produces more cheese varieties than any other state. The state's specialty cheese business is growing rapidly. Specialty cheese plants are able to capture higher valued markets that generate favorable plant operating margins. This enables them to pay dairy producers very competitive prices. But it is unlikely that production of higher-valued specialty cheeses will increase to the point of absorbing more than 5-7 billion pounds of Wisconsin milk. If Wisconsin is to continue to be a major player in U.S. cheese markets, the bulk of the state's production will likely be in the form of commodity cheeses.

Cheese Yields

A second factor underlying higher value for Wisconsin milk could be higher cheese yields per hundredweight of milk. Cheese yields are related to milk composition, principally butterfat and protein, and milk quality as measured by somatic cell count.

Federal milk marketing order data for 2001 show a true protein test of 3.02 percent for the Upper Midwest order, exactly equal to the average for all orders. However, Upper Midwest protein was lower than the Western order (3.06 percent) and California (3.08).

The Upper Midwest average butterfat test in 2001 was 3.72 percent compared to 3.67 percent for all orders, 3.61 percent for the Western order, and 3.65 percent for California. Milk quality is similar with an average somatic cell count of 344,333 for the Upper Midwest order versus 349,563 for all orders that used somatic cell premiums/penalties.

Looking only at raw milk composition, Wisconsin has a slight advantage in cheese yields over Idaho and California. The table below uses the Van Slyke cheese yield formula for cheddar cheese with varying moisture content.[3] The 34 percent moisture content would represent barrel cheddar cheese destined for processed cheese products, while 38 percent would be common for "table" cheddar. Butterfat recovery is fixed at 93 percent, and true protein recovery at 82 percent (casein equivalent to 82 percent of true protein).

The relatively higher butterfat in Wisconsin milk more than compensates for relatively lower protein in the cheddar cheese formula. The yield advantage for Wisconsin milk is 0.03 pounds per hundredweight over California milk and 0.12 over Idaho milk

Theoretical Cheese Yields for Milk Based on State Milk Compositions

State (Marketing Order)	*Percent Protein*	*Percent Butterfat*	*Casein to Fat Ratio*	*Cheddar Cheese Yield, Lbs/Cwt.*		
				34% Moisture	*36% Moisture*	*38% Moisture*
Wisconsin (Upper Midwest)	3.02	3.72	0.67	9.64	9.94	10.26
Idaho (Western)	3.06	3.61	0.70	9.52	9.82	10.14
California	3.08	3.65	0.69	9.61	9.91	10.23

The ideal casein-to-fat ratio for high-quality cheddar cheese is about 0.70. Average Wisconsin milk is borderline low (0.67), indicating the need to either remove fat or add protein to achieve an optimal ratio. Such "standardization" of cheese milk with nonfat dry milk or condensed skim milk is common in Wisconsin. But this does not necessarily suggest a competitive disadvantage. Supplemental protein in the form of nonfat dry milk is currently in abundant supply and inexpensive because the dairy price support program encourages excess production of nonfat dry milk.

Further tilts in relative purchase prices of butter and nonfat dry milk could make standardization even less expensive. However, nonfat dry milk production capacity in the West is being rapidly replaced by cheese processing capacity. It is questionable whether favorably priced out-of-state milk protein will continue to be available to Wisconsin cheese makers as planned Western cheese expansion comes on line.

[3] The specific formula is:
Yield/Cwt. = 1.09*(.93Butterfat % + .82True Protein % - 0.1)/(1-% Moisture/100).

Whey Values

The value of milk used for cheese is enhanced by additional milk value from the by-products of cheese making, mainly whey proteins and lactose. Plants that do not standardize their cheese milk with skim milk solids may also produce whey cream as a byproduct.

Larger Wisconsin cheese manufacturers typically process all of their whey. Small cheese plants usually do not process their own whey, but market it to larger cheese plants or specialized whey processing facilities. A decreasing number of plants dispose of their whey by land spreading.

Less is known about whey processing in Idaho or California. USDA does not report whey production in Idaho separate from the western region. California produces a substantial volume of whey products. But the California state milk pricing order does not include a net value to cheese plants for the nonfat solids in whey in calculating the 4b price on grounds that most California cheese plants do not derive value from whey.

Data on the proportion of whey that is processed into value-added by-products by state or region are not readily available. Some estimates can be derived from data complied in USDA, NASS, *2000 Dairy Products Summary*.[4] Comparing relative market shares of cheese production to corresponding shares of dry whey production indicates that Wisconsin cheese plants are processing more of their whey than plants. It is also apparent from the data that California is processing whey in higher valued forms.

Market Shares of Cheese and Whey Products, 2000 (Percent of U.S. market)

State or region	Cheese Production			Dry Whey		Whey protein concentrate	Lactose
	Total	American	Italian	Human use	Animal use		
California	18.1%	17.4%	22.6%	12.1%	NA	29.7%	NA
Wisconsin	26.6%	24.9%	27.6%	27.1%	36.6%	17.2%	18.5%

Source: USDA,NASS, *Dairy Products 2000 Summary*, April 2001.

Wisconsin accounted for 27.1 percent of the dry whey for human use compared to only 12.1 percent for California. But Wisconsin's share of dry whey for animal use was 36.6 percent. California's share of whey protein concentrates was 29.7 percent compared to just 17.2 percent for Wisconsin.

[4] The summary for 2001 does not report production of whey derivatives (whey protein concentrate and lactose) by state or region.

Very little whey is discarded in Wisconsin compared to other states. But Wisconsin's processed whey products tend to be in low value added forms, especially dry whey. Western cheese plants do not process as large a percentage of their whey, but their whey products tend to be higher-valued. So in conclusion, it is doubtful whether whey product values give Wisconsin cheese plants more revenue than their western competitors.

Plant Operating Costs

Do Wisconsin cheese plants have lower plant operating costs than cheese plants in the West? That's hard to say because regional cheese plant operating cost data are not readily available. Some information was made public in the hearings conducted by USDA to formulate a pricing formula for Class III milk. Those hearings relied on two plant cost surveys to set make allowances – the Rural Business Cooperative Service survey of 6 cheese plants operated by dairy cooperatives and the California Department of Agriculture's audited cheese plant survey. Unfortunately, the wide range in operating costs shown in the surveys and different accounting methods make it impossible to discern regional differences.

Wisconsin cheese plants very likely have, on the average, low plant investment costs per unit of milk received or product sold. That is because no major new cheese plants have been built in the state since about 1986. In contrast, many plants have invested in modern processing and packaging technologies that reduce variable operating costs. So in the short run, cheese plants with depreciated facilities could experience relatively low processing costs. But in the long run, Wisconsin needs to invest in new cheese plants to capture economies to scale and remain competitive with other regions.

There are indications that Wisconsin cheese plants may have lower energy, utility, and labor costs than the West, especially California. A 1991 study concluded that Wisconsin enjoyed about a $2.00 per hour advantage in hourly labor costs. Electricity rates were about 70 percent higher in California and natural gas rates were 50 percent higher. Water costs were comparable, but California had much higher sewage rates.[5]

Representative Cheese Plant costs

	Wisconsin	California
Labor, $/Hr.	9.28	11.40
Electricity, $/Kwh	.0430	.0719
Nat. Gas, $/Therm	.330	.445
Water, $/1,000g.	.84	.93
Sewage, $/1,000g.	.58	1.46

[5] Buekeboom, Ronald and E.V. Jesse, *Regional Competitive Advantage in the U.S. Cheddar Cheese Market*, Marketing and Policy Briefing Paper No. 38, Department of Agricultural Economics, University of Wisconsin-Madison, November 1991.

There are substantial economies to scale in cheese making. The 1991 study noted above indicated that cheese manufacturing costs for plants with daily capacity of 500,000 pounds of milk were $1.00 per hundredweight (about 10 cents per pound of cheese) higher than plants with daily capacity of 1 million pounds of milk. Western plants are, on average, significantly larger than Wisconsin plants. Consequently, operating cost advantages due to lower labor and utility costs may be more than offset by scale-related disadvantages.

Cheese Volume per Plant, 2000

	Wisconsin	California	Idaho
Mozzarella:			
Plants	35	25	NA
Prod. (Mil. Lbs.)	681.9	634.2	
Mil. Lbs./Plant	19.5	24.4	
Cheddar:			
Plants	66	21	8
Prod. (Mil. Lbs,)	721.3	468.5	268.9
Mil. Lbs./Plant	10.9	22.3	33.6

Source: USDA,NASS, *Dairy Products 2000 Summary*, April 2001.

Comparing apples to apples, cheese plants of similar size and age located in Wisconsin would appear to have some operating cost advantages over western plants. But an apples to apples comparison is not valid given that cheese plants in the west are larger and newer.

Milk Utilization

Class prices and utilization determine the amount of money in a federal order pool available to pay out to dairy producers. The higher the percentage of Class I sales and the higher the Class I price, the more money available. Through market-wide pooling, dairy farmers shipping to order-regulated plants benefit from market-wide Class I sales even though their milk may be used exclusively for manufacturing. Regulated cheese plants are accountable to the federal order pool for the Class III value, and receive a payment per hundredweight from the pool for the difference between the market-wide average value of milk (uniform price) and the Class III value. So Wisconsin cheese plants could pay a higher price for milk if the Class I prices and utilization applicable to Wisconsin were higher than competing cheese states.

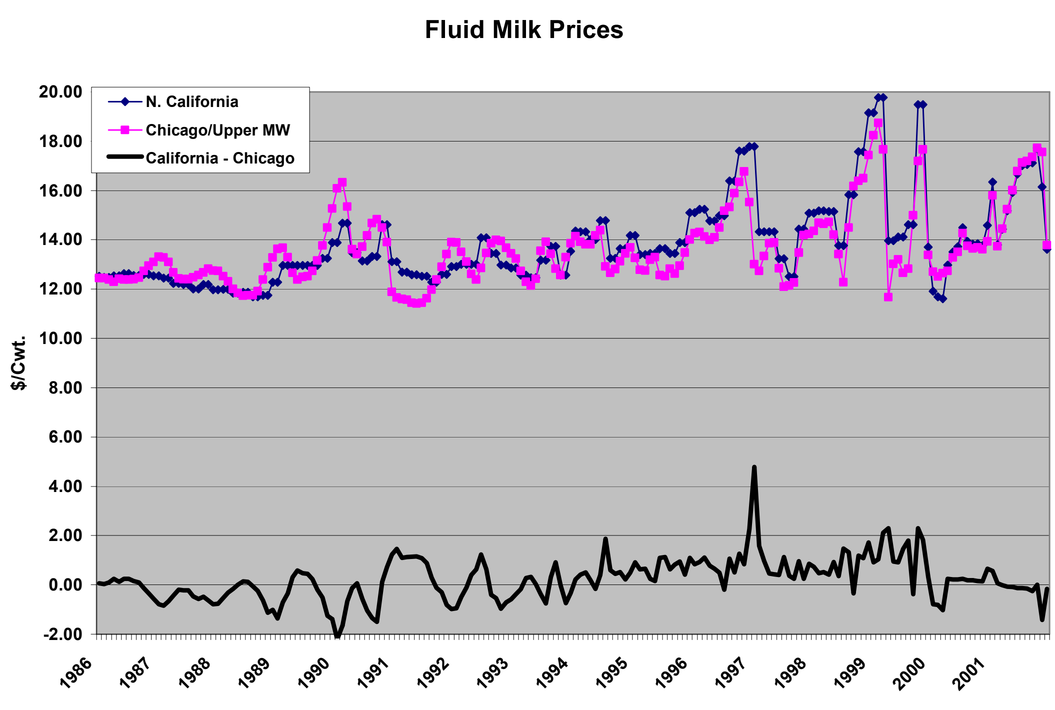
All federal milk marketing orders have the same Class IV, Class III and Class II prices. Different Class I differentials added to the same Class I mover makes for different Class I prices among orders.

Class I differentials are specified for each county in the U.S. In the Upper Midwest order, Class I differentials decrease with distance from Chicago, and range from $1.60

per hundredweight in northern Minnesota to $1.80 per hundredweight near Chicago. Class I differentials in the Western order range from $1.60 per hundredweight in most of Idaho to $1.90 per hundredweight in Utah. So the federal order system provides Idaho with a slightly higher Class I price, at least in the principal consumption areas.[6] But Class I utilization in the Upper Midwest and the Western orders is about the same (17.5 and 25.1 percent, respectively, in 2000). Therefore, this slight price difference is not significant in affecting the ability of cheese plants to pay dairy producers.

California's milk pricing and pooling system works similarly to the federal order system. However, California uses a quota arrangement to allocate pooled receipts from the higher-valued use classes. Only quota holders are eligible to receive pool revenues for Class 1, which elevates their average returns relative to the market-wide pooling used in federal orders.

Since 1986, the California Class 1 price has averaged 22 cents per hundredweight higher than the federal order Class I price applicable to Wisconsin (Chicago from 1986 to 1999 and Upper Midwest since 2000). California's fluid milk utilization is also quite close to that of the Upper Midwest, 19.0 percent versus 17.5 percent in 2000. So neither higher fluid milk prices nor higher fluid milk utilization appear to underlie higher producer pay prices in Wisconsin compared to California.



[6] The principal consumption points are Chicago for the Upper Midwest order ($1.80 Class I differential) and Salt Lake City for the Western order ($1.90 Class I differential). Information is not available to calculate weighted average differentials that reflect handler receipts in each "zone" (areas of the marketing area with different Class I differentials). But the difference in the weighted average differentials would be less than the 10 cents per hundredweight indicated for the base differentials.

Over-Order Premiums

Over order premiums are payments for milk above minimum federal order prices that are negotiated between a group of dairy cooperatives (marketing agency-in-common) and milk buyers (handlers). These premiums are mainly on Class I milk, but some premiums may be negotiated on Class II milk.

Significant over order premiums are negotiated by cooperatives in the Upper Midwest order. From 1998 through 2001, annual Class I premiums averaged \$1.75 to \$1.88 per hundredweight for Chicago and \$0.89 to \$1.33 per hundredweight for Minneapolis. For the Western order (Salt Lake City) Class I over order premiums averaged less than \$0.30 per hundredweight over this period. According to the California State Department of Agriculture, negotiated premiums above the state order prices are rare.

Over-order premiums can benefit dairy farmers affiliated with participating cooperatives by providing additional Class I milk revenues over and above the pool draws received by the cooperatives. But premiums may also harm nonparticipating cheese plants who compete with those cooperatives. Nonparticipating cheese plants must pay comparable milk prices to maintain their supply, but they do not have access to the participating cooperatives' over-order premium revenue.

For several reasons, it is not clear how much over-order premiums enhance the pay price of Wisconsin cooperatives.

- Premiums cannot be directly compared between or even within markets. For example, transportation credits are included in the over order premiums in the Chicago market to compensate for milk transportation costs. These credits are not included in the Minneapolis premium. Also, over-order premiums may decline with distance from the center of the market.

- Dairy cooperatives not only negotiate an over order premium on Class I milk, but also commit themselves to "full-supply" contracts with handlers. That means the cooperative agrees to accommodate the daily milk needs of the handler, delivering different volumes of Grade A milk on different days of the week and during different seasons of the year and diverting any Grade A milk in excess of the handler's needs to manufacturing use. Variation in delivery volumes disrupt manufacturing schedules and may increase operating costs within milk plants operated by cooperatives.

- Over-order premiums are paid out only to those dairy cooperatives that perform, that is, actually ship Grade A milk for Class I purposes. Some dairy cooperatives in the Chicago market do not participate in the marketing agency-in-common claiming that compensation for performance returns less net value to the milk than keeping the milk to make cheese in their own plants.

- In addition to balancing fluid milk needs, cooperatives provide other services to fluid processors. These services include milk quality assurance, milk testing and writing producer milk checks. Costs for these types of service activities vary but can easily total $0.30 to $0.50 per hundredweight.

- Dairy cooperatives do not control 100 percent of the Class I market needs and not all handlers agree to the negotiated price. There are Grade A milk suppliers who may offer handlers Grade A milk at a price lower than the negotiated price. Some handlers may also procure Grade A milk directly from dairy producers at a premium, but yet at a lower price than the cooperatives' negotiated price. These handlers are then in a position to offer packaged milk at a very competitive price to retail stores and other outlets. Handlers that agreed to the over order premium are now at a disadvantage in competing for these outlets. This practice forces the cooperatives to pay back to handlers as competitive credits a portion of premiums collected. Competitive credits vary from year to year, but have been as high as $0.25 to $0.30 per hundredweight.

After subtracting costs for services and competitive credits from the over order premium, the net premium is then pooled among all of the member-producers of a given cooperative. These cooperatives may have no more than 20 to 30 percent of their members' milk allocated to the Class I market. Pooling across all milk receipts may reduce the amount of the premium actually paid out to producers to a few cents per hundredweight. For the Western order, where over order premiums are small, all of the premiums are likely applied against service costs incurred by the cooperatives.

Pooling on Distant Markets

The amended federal orders that took effect at the beginning of 2000 made it easier for milk handlers regulated under one order to affiliate some of their producers with another order. This allows handlers in a market with low Class I utilization and a low Class I price to garner the benefits of a higher weighted average price in another market. Moreover, these benefits can be had without incurring much additional transportation costs, as most of this pooled milk does not have to be actually shipped to qualify for the higher price.

Wisconsin dairy cooperatives and some investor owned firms pooled their producers' milk on six different federal orders during 2000. The Upper Midwest order was the principal market, absorbing 15.4 billion pounds or about 74 percent of Wisconsin's Grade A milk. Another 4.4 billion pounds, or 21 percent, was associated with the Central order. In fact, Wisconsin accounted for 27 percent of the milk in that order, more than any other state. The third most important order for Wisconsin's milk was the Mideast order accounting for 1.0 billion pounds of milk or about 5 percent of Wisconsin's Grade A supply.

Pooling in distant orders adds revenue to Wisconsin's milk because of different Class I differentials and Class I milk utilization among the orders. Using the principal pricing points in each order, the Class I differentials in the Central and Mideast orders are $2.00 per hundredweight, just $0.20 higher than the $1.80 per hundredweight for the Upper Midwest order. But, the Class I utilization in 2000 for the Mideast order was 47.4 percent and for the Central order 30.4 percent compared to just 17.5 percent for the Upper Midwest order.

With these differences in utilization, the weighted average milk value across all classes was $12.09 per hundredweight for the Mideast order in 2000, and $11.28 per hundredweight for the Central order. This compares to $10.55 for the Upper Midwest order. Thus, Wisconsin plants can obtain a larger pool draw by affiliating producers with the Mideast and Central orders than by affiliating all of their producers with the Upper Midwest order. They will incur limited hauling costs to "qualify" their producers' milk, and they can keep most of it home to make cheese.

Some Wisconsin dairy processors have added value to their producers' milk via distant order pooling. But many smaller firms are not in a position to pool milk outside their order, and thus may be at a pay price disadvantage to those who are.

Whether distant pooling underlies higher producer pay prices in Wisconsin as compared to other states is hard to judge. Dairy cooperatives in other states are also pooling milk in distant orders. Producer milk in California and Idaho has been pooled under the Upper Midwest order.

Further, it is uncertain whether these rather liberal pooling provisions will continue. Federal order hearings have been held to address pooling provisions.[7] Proposals have been introduced that would require more producer milk associated with another order to be actually shipped to the order. This would make it less attractive for Wisconsin to associate milk in distant orders because the milk is needed to make cheese to meet customer obligations.

In addition, the incentive for distant pooling was greater during 2000 and up until the butter/powder tilt effective May 31, 2001 than since then. During 2000, while cheese prices were severely depressed and generating low Class III prices, the relatively high support price on nonfat dry milk along with favorable butter prices maintained a relatively high Class IV price. The advanced Class IV price was the mover of Class I prices all of 2000 and early 2001. Class I prices were isolated from surplus milk production and depressed cheese prices. This situation provided a major incentive for Wisconsin dairy cooperatives and some cheese plants to associate some of its producers with distant orders. The 2001 butter/powder tilt, along with improved cheese prices moved Class III and Class IV prices closer together and increased the possibility of the advanced Class III price being the mover of Class I. If another butter/tilt is implemented, the incentive for distant pooling may be further reduced.

[7] Based on one such hearing, USDA recently ruled that California milk, which is priced under its state order, can no longer be pooled under a federal order.

Summary

There is clear evidence that cooperatives and investor owned firms that operate cheese plants in Wisconsin pay higher prices for Grade A milk than do Western cheese plants. Unless Wisconsin cheese plants are able to either generate higher revenues from the sale of cheese or operate their plants at greater efficiency than their Western competitors, these higher producer pay prices are not sustainable in the long run. Wisconsin cheese plants must generate competitive net operating margins in order to invest in modern plant and equipment.

Wisconsin cheese plants have been able to obtain some premiums that reflect their long-standing reputation as a reliable supplier of high quality cheese. But these premiums have diminished as a greater proportion of cheese moves as commodity cheese via food service and food processors, and as tight milk supplies have made it difficult for the state's cheese plants to honor customer orders. An exception is the growing specialty cheese sector in the state, which serves unique and higher-valued markets.

Wisconsin cheese plants do not enjoy better milk composition or higher milk quality when compared to the national average and are at a disadvantage to western states with respect to average protein in milk. Whether milk composition puts Wisconsin at a serious disadvantage to the West is debatable. Cheese makers in the state have been able to exploit large supplies of low-priced nonfat dry milk to balance low protein with high butterfat.

In the long run, Wisconsin dairy farmers must produce the composition and quality of milk required for efficient cheese production. Milk composition influences cheese yield per hundredweight of milk and associated cheese making cost. Therefore, improved milk composition and milk quality will enhance both the value of producer's milk and the efficiency of cheese plants.

Wisconsin cheese plants in the short run may be experiencing competitive operating costs due to fully-depreciated brick and mortar and lower energy and labor costs as compared to the West. But new investment in brick and mortar will be required to be competitive in the long run.

Neither higher federal milk marketing order Class I prices nor higher Class I milk utilization give Wisconsin cheese plants additional revenue to pay higher prices for milk as compared to the West. Class I over-order premiums in the Upper Midwest may slightly enhance the ability of some cooperatives to pay higher milk prices than indicated by cheese values. But because of the very competitive nature of milk procurement in the state, cheese plants who do not have access to over-order premium revenue need to match the pay prices of those that do. Therefore, over order premiums may actually raise milk costs to these cheese plants but without any additional revenue from their cheese operation. Dairy producers benefit in the short run from these competitive pay prices, but the long run viability of the state's cheese manufacturing industry may be jeopardized by low operating margins.

MARKETING AND POLICY BRIEFING PAPER

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RETHINKING DAIRYLAND:
BACKGROUND FOR DECISIONS ABOUT WISCONSIN'S DAIRY INDUSTRY

Growing Wisconsin Dairying: Is Liberalized International Dairy Trade the Answer?

William D. Dobson[1]

Abstract:

The Uruguay Round World Trade Organization (URWTO) agreement and the North American Free Trade Agreement (NAFTA) created both benefits and costs for dairy farmers. The URWTO agreement benefits include border protection that helped to keep U.S. prices for cheddar cheese, butter, and nonfat dry milk 40 percent, 78 percent and 36 percent, respectively, higher than world prices during 1995-2001. Wisconsin's dairy industry benefited from expansion of dry whey and lactose exports under the URWTO agreement. Costs under the complex agreement included an unanticipated increase in milk protein concentrate (MPC) imports. Benefits under the NAFTA include the scheduled elimination of Mexico's tariffs on major imports of U.S. dairy products by 2003.

Over the longer-run, the more important benefits and costs produced by trade agreements may be those related to changes in the business environment for the U.S. and Wisconsin dairy industries. The URWTO agreement has encouraged U.S. dairy exporters to focus on (a) products not priced out of international markets by border protection and the USDA's dairy price support program and (b) highly differentiated products. Because the changed environment provides incentives for expanded exports of dry whey, lactose, and specialty cheeses, it should generate benefits for Wisconsin's dairy industry.

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Much as predicted by proponents of free trade, the NAFTA has made Mexico's dairy companies stronger competitors. This will limit gains in dairy product market share by U.S. firms. However, this development will create opportunities for U.S. and Wisconsin companies to supply genetics, dairy equipment, and technical services for Mexico's dairy industry.

Is Trade Good? It Depends.

Benjamin Franklin spoke cautiously about the benefits of international trade, arguing that "No nation was ever ruined by trade [13]." Many economists and business analysts speak more positively about the benefits from free trade. Using techniques ranging from simple comparative advantage notions to sophisticated econometric models, economists have shown potential gains from trade. Economic studies frequently find that the cost of saving domestic jobs by erecting barriers to imports runs high--sometimes as much as $1 million per job [11, p. 60]. To jog policymakers' memories about dangers of protectionism, economic historians point out that the Smoot-Hawley legislation of 1930, which raised U.S. tariffs sharply, helped to push the U.S. economy into the Great Depression. Economic studies also show that consumers in most countries and producers in low-cost producing countries are frequently big beneficiaries from free trade. Business analysts point out that subjecting domestic firms to foreign competition will--over the longer-run--produce stronger, more competitive firms.

Testimonials lauding the benefits of trade, however, do little to reduce the contentiousness of trade issues. It is not surprising that controversies have arisen in the U.S. over how to ensure that the diverse interests of agriculture, nonagricultural businesses, labor, and environmentalists are satisfied in trade pacts developed under the World Trade Organization (WTO). But controversies also have emerged in connection with actions taken under Section 201 of the Trade Reform Act of 1975. The Bush Administration's decision to raise steel tariffs temporarily in March 2002 as part of a Section 201 action provides an example.

While the Bush Administration's Section 201 steel decision attracted widespread criticism because it was regarded by many as protectionist and politically motivated, similar actions frequently receive less attention. This happens, in part, because the benefits of trade protection are usually concentrated and the costs are diffuse. In other cases, trade policy decisions attract little notice because the complexity of the actions makes the impacts difficult to foresee. Indeed, the complexity of trade policy actions is sometimes described in the clichéd term, "the devil is in the details." This is certainly true of trade agreements affecting the U.S. dairy industry. So it is no surprise that the most prominent of the recent agreements, the URWTO agreement and the NAFTA, have produced both benefits and costs for the U.S. and Wisconsin dairy industries.

Measuring the Effects of Dairy Trade Agreements

This paper analyzes benefits and costs for the U.S. and Wisconsin dairy industries stemming from international trade in dairy products. The focus is on the URWTO agreement and the NAFTA, and on benefits and costs as commonly perceived by dairy industry participants – not on broader economic efficiency and welfare impacts. This more narrow focus provides a suitable time frame for the analysis and also shows how the URWTO agreement and NAFTA have had an important influence on the economic environment in which the U.S. and Wisconsin dairy industries operate.

Trade agreement provisions that have larger or different effects on Wisconsin's dairy industry than on the U.S. industry as a whole are noted in the paper. However, there are few instances where Wisconsin's dairy industry fares differently from the U.S. dairy industry as a whole under a trade agreement. The adage, "A rising (falling) tide lifts (lowers) all boats," applies generally to the impacts of dairy trade agreements on individual dairy states. Hence, the emphasis is on the impacts of international dairy trade on the U.S. as a whole.

International trade provisions (e.g., tariffs, quotas, and non-tariff barriers) affecting U.S. dairy trade have a long history. Many of those provisions – in forms reflecting their current evolution – can be found in the URWTO agreement and the NAFTA. Key provisions of these agreements are outlined to provide background for the analysis.

The Uruguay Round World Trade Organization Agreement

Prior to the 1995 URWTO agreement, U.S. dairy markets were protected by Section 22 of the Agricultural Adjustment Act of 1933, as amended. Among other things, the border protection provided by the Section 22 quotas made the USDA's dairy price support program workable. In the absence of the quotas or other border measures, the U.S. would have been placed in the untenable position of supporting world prices of nonfat dry milk (NFDM), butter and cheese.

The URWTO agreement included the following provisions that affect the U.S. dairy industry, Wisconsin's dairy industry, and world agriculture [20]:

- Countries were required to reduce internal support for agriculture (selected price supports, selected input subsidies, etc.) by 20 percent from 1986-88 base levels.

- All non-tariff barriers (quotas, import licenses, etc.) were converted to tariffs and scheduled to be reduced by an average of 36 percent over six years with a minimum reduction for individual products of at least 15 percent from 1986-88 base levels.

- Countries were required to ensure that current access opportunities were maintained, and they were instructed to enlarge minimum access opportunities in cases where there has been little or no trade. Where current access was less than 3 percent for a product (based on estimated consumption during a 1986-90 base period), countries were required to open up the market to a minimum amount of access.

- The amounts of agricultural products exported with subsidy and budget outlays for export subsidies were scheduled to be reduced by 21 percent and 36 percent, respectively, from base period (1986-90) amounts.

- Sanitary measures were revised to ensure that they are imposed only to the extent necessary to protect human, animal or plant health, according to scientific criteria.

- A new dispute settlement mechanism was adopted to expedite the settlement of trade disputes.

Provisions Affecting Dairy Imports

The tariff rate quotas (TRQs) established under the URWTO agreement for dairy products are two-tiered tariffs that establish one duty for imports within the quota and a higher duty for over-quota imports. Within quota tariffs are frequently low enough to encourage commercial imports for the quota amount. The higher tariffs for over-quota imports were expected to produce border protection for over-quota imports approximately comparable to that provided under the Section 22 quotas. The over-quota TRQs established in the URWTO agreement for U.S. imports of NFDM, butter, and cheese are as follows [20]:

Product	Over-Quota Tariff, 1995	Over-Quota Tariff, 2000
NFDM	46.2 cents/lb.	39.2 cents/lb.
Butter	82.2 cents/lb.	69.9 cents/lb.
Cheese	65.4 cents/lb	55.6 cents/lb.

The over-quota tariffs for 2000 will remain in effect until any new tariffs are established in the Doha, Qatar Round of WTO negotiations.

Benefit: The TRQs under the URWTO agreement provided substantial border protection and helped the U.S. to maintain domestic dairy product prices higher than world prices (Table 1). Of course some of the difference between U.S. domestic prices and world dairy product prices must be attributed to the USDA's dairy price support program and differences between U.S. and international supply-demand conditions. But in several periods in the URWTO agreement era (1995-2001), U.S. price support purchases of dairy products were small or nonexistent. Therefore, at such times only a limited amount of the price differences can be attributed to effects of the dairy price support program. It is no exaggeration to conclude that the TRQs were instrumental in keeping U.S. bulk dairy product prices from falling to levels that, at times, would approximate New Zealand prices (or Australia or Argentina prices) plus freight and handling charges for shipping dairy products to the U.S.

Table 1. Percentages by Which U.S. Central Market Prices for Cheddar Cheese, Butter and Nonfat Dry Milk Exceeded World Prices, 1990-2001.*

Year	Percent by Which U.S. Central Market Prices Exceeded World Prices		
	Cheddar Cheese	Butter	Nonfat Dry Milk
Pre-URWTO Agreement			
1990	71.4%	58.3%	53.1%
1991	56.8	59.5	51.8
1992	41.6	20.5	39.2
1993	60.3	21.1	60.7
1994	56.0	20.2	55.9
1990-1994 Avg.	57.2%	35.9%	52.1%
Post-URWTO Agreement			
1995	29.4	-18.0	13.6
1996	33.8	42.6	39.4
1997	18.9	48.3	38.1
1998	55.4	111.0	61.2
1999	61.7	89.6	75.8
2000	36.2	97.2	19.3
2001	45.6	174.7	7.8
1995-2001 Avg.	40.1%	77.9%	36.50%

*Source: USDA, "Dairy: World Markets and Trade," various issues 1991-2002 [19]. World prices are represented by the mid-point of high and low prices fob Northern European ports.

How much the border protection provided by the URWTO agreement, non-tariff barriers to trade, and other developments limited access to U.S. cheese and butter markets is suggested by Table 2. U.S. cheese imports changed relatively little as a percentage of consumption from the pre-URWTO agreement period to the URWTO agreement. However, the average annual tonnage of cheese imports increased by 21 percent from 1990-1994 to 1995-2001. Butter imports stayed relatively small as a percentage of consumption through 1997. After that year, U.S. butter imports became larger – especially during 1998 and 2001 when U.S. domestic butter prices were high. At times in those years, butter was imported into the U.S. profitably despite the relatively high over-quota tariffs of the URWTO agreement. Tillison points out that in recent years U.S.

firms have tended to import butter when the U.S. butter prices exceeded the world prices by $.80 per pound or more [14]. This suggests that U.S. firms had incentives to import butter from 1998 through 2001.

Figures for NFDM are not included in Table 2 because NFDM imports remained small during 1990 to 2001--ranging from 0.0 percent to 1.4 percent of U.S. annual consumption during this period.

Table 2. U.S. Cheese and Butter Imports, 1990 to 2001.*

Year	Cheese Imports		Butter Imports	
	1,000 mt	% of Consumption	1,000 mt	% of Consumption
Pre-URWTO Agreement				
1990	135	4.8%	2	0.4%
1991	135	4.7	2	0.4
1992	129	4.2	2	0.4
1993	145	4.7	2	0.4
1994	151	4.7	1	0.2
1990-1994 Average	139	4.6%	1.8	0.4%
URWTO Agreement Period				
1995	153	4.7	2	0.4%
1996	152	4.5	5	1.0
1997	141	4.1	5	1.0
1998	156	4.5	30	5.4
1999	195	5.3	18	3.0
2000	186	4.8	15	2.6
2001 (P)	198	5.1	34	5.8
1995-2001 Average	169	4.7	15.6	2.7

*Source: USDA: Dairy: World Markets and Trade, Various Issues, 1995-2002 [19].
P= Preliminary.

An Unanticipated Cost: An unanticipated cost mostly borne to date by the U.S. government and to a lesser extent by producers and milk processors has arisen in connection with expanded imports of MPCs under the URWTO agreement. When the URWTO agreement was negotiated, it was widely thought that U.S. MPC imports would be small and posed little threat to the domestic dairy industry. Accordingly, a small tariff ($.0017 per pound) was set and no quotas on MPC were established. However, in the late 1990s, MPCs became increasingly attractive to food processors as a way to source cheaper milk solids (and often increased functionality) from off-shore sources [8, p.3].

Reflecting these developments, U.S. imports of MPCs rose from 7,288 metric tons in 1995 to 44,878 metric tons in 1999 [22, p.4]. Imports of the product nearly doubled between 1998 and 1999 [22, p.4]. The National Milk Producers Federation (NMPF) presented USDA, Commerce, Treasury and U.S. International Trade Commission figures showing that U.S. MPC imports increased by over 600 percent from 1995 to 2000 [10, p.14].

Complaints lodged by the NMPF claim that imported MPCs displace domestically produced NFDM (and exacerbate the structural surplus of the product) and displace domestic ingredients used for cheese production. (Imported MPCs can be used in non-standardized cheeses – such as pizza cheese – for which no standards of identity are specified by the Food and Drug Administration.) Claims also have been made that MPCs enter the U.S. in the form of mixtures containing NFDM, whey powder, and other dairy products that should be subject to tariffs applicable to NFDM or other products carrying higher tariffs.

The appropriate tariff treatment for the product has become contentious partly because of uncertainties relating to the nature of the imported product, uses made of the imported product, and how much domestic output the product displaces. Bailey, for example, points out that data are lacking on the protein content of MPC imports and on how MPC imports have been used in the U.S. dairy industry [5]. Given this state of knowledge, it is difficult to make a case for higher protection for a particular industry segment since it is not fully clear whether and how much the industry segment is harmed by imports.

Bailey, the U.S. General Accounting Office (GAO), and the NMPF have estimated the relative size of the MPC imports (Table 3) to give general figures on displacement. But drawing unambiguous implications from the figures in Table 3 is impossible.

It is evident that imported MPCs displace some substantial amount of domestically-produced NFDM and increase USDA price support purchases of domestically-produced NFDM. The costs of additional NFDM price support purchases have been borne largely by the U.S. government. However, Tillison argues that MPC imports and the resultant expanded NFDM purchases by the government caused the USDA to lower the U.S. support price for NFDM in June 2001 [15]. If this reasoning is correct, producers have borne part of the cost of additional MPC imports via lower milk prices. The use of imported MPC also increases domestic cheese production and depresses U.S. cheese prices and U.S. farm milk prices by some unknown amount.

The NMPF is concerned about the impacts of MPC imports and has proposed to levy higher tariffs on the product. Many processors oppose such initiatives, saying that the functionality of some imported MPCs differs from that of the domestically produced MPCs. Thus, it is argued, the larger tariffs would penalize firms importing products that are not close substitutes for U.S. products.

Table 3. Estimates of the Relative Size of U.S. MPC Imports.

Source	Relative Size of U.S. MPC Imports
Bailey [5]	MPC imports in 2000 were equivalent to 3.7 percent to 4.4 percent of the casein contained in U.S. cheese production for 2000. MPC imports in 2000 were equivalent to 18 percent to 21 percent of the casein contained in U.S. NFDM production for 2000.
GAO [22]	MPC imports in 1999 were equivalent to 0.8 percent to 1.8 percent of U.S. milk protein production in 1999.
NMPF [10]	MPC imports in 2000 were equivalent to 210 million pounds to 370 million pounds of U.S.-produced NFDM in terms of milk protein content.

Opting for a different strategy, Dairy Farmers of America (DFA) has de-emphasized lobbying for higher tariffs in favor of import substitution. Allied with Fonterra of New Zealand, the 25 thousand-member DFA cooperative has launched plans to produce high-end MPC products in a Portales, New Mexico plant to compete with imports.

How the unanticipated costs associated with larger MPC imports will be dealt with is uncertain. Processors will argue that the different functionality of imported MPCs warrants continuing the minimal tariff on the product. They also can be counted upon to argue that the USDA's dairy price support program has driven production of MPCs offshore by making NFDM more profitable to produce than MPCs. According to this argument, it would be inappropriate to levy a larger tariff on imports of the product forced offshore. A related argument is that the U.S. does not normally raise tariffs on products for which there is no competing domestic industry. Processors and other opponents of the higher tariff also may argue that compensation would be due exporters if a higher tariff were imposed on imported MPCs.

Whether processors and other opponents of a higher tariff for MPCs will prevail using these arguments is unclear. They have succeeded in preventing quotas or tariffs from being applied to casein imports. However, producers will correctly point out that EU exporters, in particular, frequently receive export subsidies for shipments of MPCs and casein to the U.S.--in essence forcing the U.S. industry to bear part of the cost of EU dairy product surplus disposal.

Provisions Affecting U.S. Dairy Exports

How did the URWTO agreement affect U.S. dairy exports? The answer can be inferred, in part, from information in Table 1 on U.S. domestic prices for bulk cheese, butter, and NFDM. U.S. exports of bulk cheese, butter, and NFDM normally remain at low levels because these items typically are priced out of international markets. Moreover, as discussed later, the constraints on export subsidies under the URWTO agreement sharply limit the use of USDA Dairy Export Incentive Program (DEIP) subsidies to pump up exports of these products. However, U.S. NFDM periodically can be exported without subsidies.

Most action regarding U.S. exports of cheese, butter, and NFDM in the pre-URWTO agreement period and the URWTO agreement era occurred in the butter and NFDM categories (Table 4). U.S. cheese exports did increase from an annual average of 17 thousand metric tons during 1990-94 to 39 thousand metric tons in 1995-2001. However, this represented an increase from 0.5 percent of production during 1990-94 to 1.1 percent of production in 1995-2001.

Table 4. U.S. Exports of Butter and NFDM, 1990-2001.*

Year	Butter Exports		NFDM Exports	
	1,000 mt.	% of Production	1,000 mt	% of Production
Pre-URWTO Agreement				
1990	31	5.2%	10	2.5%
1991	49	8.1	68	17.1
1992	139	22.5	118	29.8
1993	145	24.3	138	31.9
1994	94	16.0	123	22.0
Average 1990-94	92	15.2	91	20.7
URWTO Agreement Period				
1995	64	11.2	170	30.4
1996	19	3.6	32	6.6
1997	18	3.4	117	21.2
1998	3	0.6	104	20.2
1999	2	0.4	217	35.2
2000	4	0.7	142	21.6
2001 (P)	0	0.0	96	15.0
Average 1995-2001	16	2.8	125	21.5

*Source: USDA, Dairy: World Markets and Trade, Various Issues, 1995-2002 [19].
P=Preliminary

A Dearth of Short-Term Benefits. It appears that the URWTO agreement did little to increase U.S. dairy exports in the short-run. There is, of course, some anecdotal evidence of expanded U.S. cheese exports resulting from increases in other countries' minimum access commitments and associated lower within-quota tariffs. For example, Vermont-based Cabot Creamery developed cheddar cheese exports to the UK with the benefit of the low 10.5 cent per pound within quota tariff that applied to the first 7,800 metric tons of cheese sold in the UK or other EU countries under the URWTO agreement. However, Cabot officials noted that the licenses that grant the importer access to the lower tariffs were "extremely difficult to acquire [6. p. 22]." It also can be argued that the agreement created an economic environment in the U.S. that favored expanded exports of differentiated (value-added) dairy products such as specialty cheeses and premium ice cream. In the longer-run, the latter development may contribute to larger revenues from U.S. dairy exports.

Positive Impacts on Wisconsin's Dairy Industry. Much as in the rest of the U.S. dairy industry, bulk butter, cheese, and NFDM products produced in Wisconsin have not been competitive in international markets in the URWTO agreement era. However, a positive impact on Wisconsin's dairy industry stemmed from developments affecting dry whey and lactose. U.S. exports of dry whey (a product not priced out of international market by U.S. border protection or price supports) have grown substantially in recent years, making the U.S. a leading world dry whey exporter. U.S. dry whey exports increased in value from $60 million in 1992 to 171 million in 2000 or 185 percent. Since about 85 percent of Wisconsin's milk goes into cheese production – generating large amounts of dry whey and lactose as byproducts – the state's dairy industry has differentially benefited from the development of foreign markets and expansion of exports of these products that has occurred under the URWTO agreement.

The importance of dry whey and lactose exports for Wisconsin's dairy industry is suggested by figures in Table 5. If Wisconsin firms' share of U.S. exports of these products is similar to their share of production, they account for about a quarter of U.S. exports of these items.

Wisconsin's specialty cheese exporters may have gained an edge over the average U.S. cheese exporter as a result of impediments to bulk cheese exports that persisted under the URWTO agreement. This is because portions of the differentiated, specialty cheese produced in the state likely can be exported competitively despite raw product costs that are higher than in Oceania and Argentina. However, collectively neither U.S. nor Wisconsin firms have become big exporters of cheese under the URWTO agreement. Thus, URWTO agreement-induced impacts on Wisconsin's specialty cheese exporters clearly are smaller than those affecting the state's dried whey and lactose producers.

Table 5. Production of Butter, Cheese, Dry Whey, and Lactose, Wisconsin, 1995-2001.*

Product	Average Annual Production for Wisconsin, 1995-2001 (1,000 metric tons)	% of U.S. Production, 1995-2001
Butter	135	24.8%
Cheese (excluding cottage cheese)	965	28.0
Dry Whey	150	27.5
Lactose**	44	23.0

*Sources: Wisconsin Department of Agriculture, Trade & Consumer Protection, Wisconsin Agricultural Statistics, Various Issues, 1996-2001 [23] and USDA, NASS, Dairy Products 2001 Annual Summary [21].
**Based on figures for 1995-2000.

Impact of the URWTO Agreement Limits on Subsidized Dairy Exports. The URWTO agreement limited DEIP exports for cheese, butter and NFDM to the tonnages shown in Table 6 for 1995/96 to 2000/01. The limits will remain at the 2000/01 level until any new limits are established under the Doha, Qatar WTO negotiating round.

Table 6. URWTO Agreement Limits on U.S. DEIP Export Subsidies, 1995/96 to 2000/01.*

Year**	Limits on Subsidized Exports		
	Cheese	Butter (1,000 metric tons)	NFDM
1995/96	3.8	43.0	108.2
1996/97	3.7	38.6	100.2
1997/98	3.5	34.2	92.2
1998/99	3.4	29.9	84.2
1999/00	3.2	25.5	76.2
2000/01	3.0	21.1	68.2

*Source: USDA, GATT/WTO and Dairy [20].
**Physical tonnage limits on subsidized exports apply for the July1/June 30 year.

The reduction in U.S. butter production, the tight U.S. supply-demand situation, and limits on DEIP exports reduced U.S. butter exports from 15 percent of production during 1990-94 to 2.9 percent of production in 1995-2001. Indeed, the U.S. shifted from being a net butter exporter to a net butter importer in the latter half of the 1990s. Surprisingly, U.S. NFDM exports increased on average between the pre-URWTO period and the URWTO agreement era. In part, this occurred because, at times, U.S. firms exported NFDM without subsidies. In 2001, for example, U.S. dairy companies made about a quarter of NFDM exports without export subsidies [4].

The impacts of the limits on DEIP exports described in Table 6 are most important for NFDM. As noted earlier, there is a structural surplus of NFDM in the U.S. In mid 2002, there was approximately $1 billion of NFDM in Commodity Credit Corporation (CCC) inventories acquired as a result of price support purchases during the past three years [1]. CCC officials are finding it difficult to dispose of the surplus product before it goes out of condition.

Costs of URWTO Limits on Subsidized U.S. Dairy Exports: Dan Colacicco, Director of the Dairy and Sweetener Analysis Group of the USDA's Farm Service Agency, described how limits on DEIP exports and other developments have made disposal of U.S. surpluses of NFDM more costly, as follows [12]:

> "In 1987, we sold 850 million pounds (of NFDM) for restricted use; 500 million pounds (227 thousand metric tons) of that product went to export sales at world prices. That's an option we don't have anymore. (Under) the trade treaties that were signed in the '90s, we can no longer buy product at 90 cents per pound and sell it into the world market for 70 cents a pound….It's a clear violation of trade treaties."

After 2000/01, U.S. firms will be permitted to export with subsidy a maximum of 68.2 thousand metric tons of NFDM under the DEIP each year (Table 6). This figure is only about 30 percent as large as the 227 thousand metric ton figure for 1987 referred to by Colacicco.

Tillison describes costs of the URWTO agreement limits on DEIP subsidies for the U.S. dairy industry in the following terms [16]:

> "…The U.S. dairy industry was 'had' in the GATT negotiating round. Our negotiators agreed to percentage reductions in subsidies when the United States had almost no historical base to reduce from. The result: a country with a subsidy base of a billion pounds (like the European Union) takes a 25 percent reduction and can still subsidize 750 million pounds of product. The United States, on the other hand, starts with a million pound base and is left with just 750,000 pounds of product it can subsidize. What a good deal that was!"

Table 7. URWTO Agreement Limits on EU Dairy Export Subsidies, Base Period and 2000/01.*

Year	Limits on Subsidized Exports		
	Cheese	Butter	NFDM
	(1,000 metric tons)		
Original EU Base Quantity (1986-90):	386.2	463.4	308.0
Maximum Quantity that can be Exported with Subsidy under the URWTO Agreement: 2000/01	321.3	272.3	272.5

*Source: USDA, "Dairy: World Markets and Trade, FD 1-94, March 1994 [19] and U.S. Dairy Export Council [18].

Tillison raises a point about the preference enjoyed by the EU regarding permitted export subsidies. Because of the larger size of the export subsidy base obtained by the EU (Table 7), that group of countries is presently permitted to export with subsidy about four times as much NFDM per year as the U.S. The differences are greater for cheese and butter. The most binding of the constraints on the EU applies to cheese exports. EU butter and NFDM exports--most of which are exported with subsidy--rarely bump up against the URWTO agreement limit on those exports.

Failure of the WTO Dispute Settlement Mechanism to Provide a Timely Resolution to Claims that Canada Exceeded WTO Export Subsidy Limits. In 1997, U.S. and New Zealand dairy groups challenged Canada's Class 5 dairy export subsidy program, claiming that Canada exceeded limits on subsidized dairy exports agreed to under the URWTO agreement. After initial findings by a WTO panel that the Class 5 system was contrary to Canada's WTO export subsidy commitments, the Canadian government transferred certain provisions of the system to provincial authorities. U.S. and New Zealand groups challenged the new provincially-based program, arguing that nothing much had changed. After time-consuming appeals, the issue appears likely to be resolved late in 2002. However, the lengthy delays remind dairy industry groups that they should not count on the WTO dispute settlement mechanism to provide timely resolutions to disputes affecting dairy exports and other agricultural trade issues.

Beneficiaries of the URWTO Limits on Subsidized Exports. The main beneficiaries of the URWTO limits on subsidized dairy exports are dairy exporting firms in countries that export with little or no subsidies--e.g., New Zealand, Australia, and Argentina. For instance, Mr. Hamish Smith, an analyst with the New Zealand Ministry of Agriculture and Forestry, estimated that New Zealand's dairy industry gained NZ$346.6 million (about US$157 million) in 2000 as a result of URWTO negotiated outcomes. Smith attributed part of this gain for the New Zealanders to limits on export subsidy use, noting that [2]:

> "Without the UR disciplines on export subsidy use, the EU and the United States (to a lesser extent) would have been able to increase their use of this type of trade-distorting mechanism in order to dispose of surplus production."

While the U.S. dairy industry operates at a disadvantage to the EU in terms of permitted dairy export subsidies, the U.S. is unlikely to get authorization for larger subsidized dairy exports. Indeed, the opening bid of the U.S. in the Doha Qatar WTO negotiations calls for eliminating all agricultural export subsidies.

The North American Free Trade Agreement

The NAFTA – which became effective on January 1, 1994 – included changes that gradually opened the Mexican market to larger U.S. dairy imports. Prior to the NAFTA, Mexico employed licenses and tariffs to limit access to Mexico's dairy markets.

When the NAFTA became effective, Mexico converted its import licensing arrangements for milk powder (the country's most important dairy import) into a tariff rate quota (TRQ) that would operate as follows [9]:

- The TRQ for milk powder was scheduled to remain in effect during a 15-year transition period.
- Initially duty-free access to the Mexican market was provided for 40,000 metric tons of U.S. NFDM and whole milk powder. The amount of U.S. milk powder entering Mexico duty free was scheduled to grow at an annual compounded rate over the 15-year transition period.
- For the first year of the agreement, U.S. exports of milk powder in excess of 40,000 metric tons were subject to a 139 percent tariff. During the first six years of the NAFTA, 24 percent of the tariff was scheduled to be eliminated and the remainder of the tariff was scheduled to be phased out during the remainder of the 15-year transition period.
- Mexico's over-quota tariff on milk powder imports from the U.S. is scheduled to go to zero in 2008.

For cheese, Mexico converted its import licensing arrangement to tariffs under the following arrangement:

- Imports of cheese that were subject to import licensing prior to the NAFTA initially were assigned a 20 percent tariff was that was scheduled to be reduced to zero during a 10-year transition period.

- Imports of fresh cheeses were subjected to a 40 percent tariff that was scheduled to be reduced to zero during a 10-year period.

Tariffs on most other dairy items imported from the U.S. are scheduled to be phased out over a 10-year period. Thus, in 2003 tariffs for fluid milk and cheeses imported from the U.S. will go to zero.

Benefits

Under the NAFTA tariff reductions scheduled to be completed in 2003, major parts of the Mexican dairy market will be open to U.S. exporters at zero tariff. This situation led some analysts – including the author – to suggest that the Mexican market will soon represent "low hanging fruit" for U.S. dairy exporters. This was an excessively sanguine forecast. But the zeroing out of tariffs for major dairy exports (except for milk powder) to Mexico by 2003 clearly represents an important benefit for the U.S. dairy industry. While some expected larger gains in market share, U.S. firms did obtain about a 30 percent share of Mexico's U.S.$548 million of dairy imports in 2000[17].

However, Mexico's dairy market has matured under the NAFTA, creating a more competitive environment in Mexico for U.S. dairy exporters. As part of this change, strong domestic firms have emerged and powerful European multinationals have increased their sales. The maturing of the Mexican market has a number of important implications for U.S. dairy firms, including the following:

- Mexico's cheese imports as a percentage of consumption in 2001 differed little from the 1994 figure. Moreover, the competition facing U.S. exporters for these sales is strong, especially from European firms.

- U.S. firms' shares of Mexican imports of fluid milk, yogurt, whey and lactose have been large--over 85 percent for all four products in 1999. Expanded U.S. exports of these products will be otained mainly through the gradual expansion of the Mexican market through income growth, population growth, and development of new, demand-expanding uses for the products.

- Margins on exports of bulk dairy products to Mexico have become "razor thin." This is no surprise and it means that suppliers of bulk commodities to Mexico must be low-cost exporters to be profitable.

- While Mexico promises to remain only about 75 percent ($\pm$5 percent) self-sufficient in milk production for the next several years, price incentives and other developments will foster additional milk production in Northern Mexico.

Why Benefits Didn't Increase as Much as Expected. At times before the NAFTA Mexico was the world's largest importer of NFDM, substantial quantities of which were used for reconstitution into fluid milk for sale to low income people at subsidized prices in Mexico. The presence of pervasive and persistent poverty in Mexico suggests that NFDM will continue to be an important dairy import for Mexico. In addition, Mexican processors use the product to make a host of other dairy products, which should add to import demand.

U.S. firms will maintain substantial NFDM exports to Mexico in the years ahead, probably averaging about 60 thousand metric tons per year. However, this figure is not as large as anticipated by many partly because of Mexico's movement toward greater self-sufficiency in NFDM production. As shown in Table 8, Mexico's imports of NFDM fell from about 91 percent of consumption in 1994 to about 49 percent of consumption in 2001.

It is not clear why Mexico has increased self-sufficiency levels for NFDM. It might be supposed that increases in milk production in Mexico would be channeled into higher-valued uses than NFDM. However, for Mexican processors NFDM is a versatile product that can be used to produce a number of dairy products (reconstituted fluid milk, ice cream, cheese, etc.), some of which are high-valued. Presumably, economic incentives exist for Mexican firms to channel domestically-produced NFDM into these higher-valued products.

Table 8. Mexico's Imports of NFDM as a Percentage of Consumption, 1994-2001.*

Year	Imports (1,000 mt)	Consumption (1,000 mt)	Imports as % of Consumption
1994	200	220	90.9%
1995	180	205	87.8
1996	127	251	50.6
1997	133	250	53.2
1998	93	234	39.7
1999	123	256	48.0
2000	117	273	42.9
2001 (P)	140	285	49.1

*Source: USDA: Dairy: World Markets and Trade [19]. P=Preliminary.

U.S. exports of NFDM to Mexico also were reduced by the decision of LICONSA--a government agency that imports NFDM for production of reconstituted fluid milk--to diversify sources of milk powder imports among countries.

Positive Impacts on Wisconsin's Dairy Industry. Under the NAFTA, Mexico has become a large importer of dried whey and lactose. As noted earlier, these are important export items for Wisconsin firms, including Foremost Farms of Baraboo, Wisconsin; Century Foods International of Sparta, Wisconsin; and Schreiber Foods International of Green Bay, Wisconsin, all of which have recorded exports of these and other dairy products to Mexico in the NAFTA era.

However, Cox's research on the effects of the NAFTA on Wisconsin's farm milk prices suggests that the impacts would be small – only about $.01 per hundredweight increase [9]. This figure probably understates the impact on Wisconsin farm milk prices by a limited but unknown amount since Cox made the estimate before the expansion in dry whey and lactose exports to Mexico had fully materialized.

An Imperfectly Anticipated Cost of the NAFTA.

U.S. firms can scarcely complain that they have received an unfavorable deal under the NAFTA. Getting many of Mexico's dairy import tariffs to zero is a favorable deal for U.S. companies. However, the NAFTA has changed the economic environment in Mexico, making it a more competitive market. In this environment, Mexican firms have geared up for tougher competition from U.S. firms. For example, the Mexican dairy cooperatives, Alpura and Lala, now represent strong competitors for U.S. and other foreign firms. It is doubtful whether they would have achieved this level of competitiveness in the absence of foreign competition.

Mexico's dairy industry also is pushing for a greater self-sufficiency in milk production. The country will not soon become self-sufficient in milk production but the threat of imports has fostered increases in milk production, particularly in Northern Mexico. Mexico's quest for self-sufficiency in milk production is hampered by low milk production per cow, especially on the many semi-confined and dual-purpose farms in the country. Partly as a result of this problem, milk production per cow in Mexico was only about 16 percent of the comparable U.S. figure in 2000 [9]. Mexico could approach self-sufficiency more quickly if current efforts succeed in increasing increase milk production per cow on the semi-confined and dual-purpose farms.

Nor will Mexico's efforts to deal with U.S. competition be confined exclusively to bolstering competitiveness. Mexican firms have already used regulations to thwart U.S. competitors. For example, in the Mexicali/Tijuana area, local milk producers have made imports of U.S. milk unsaleable through local supermarkets with the help of regional government regulations that require local stores to sell all locally-produced milk first [9]. We may witness efforts by Mexican firms to thwart U.S. exports of milk powder to Mexico prior to when the tariff on this product reaches zero in 2008.

Implications

From the standpoint of dairy industry participants, the big benefit of the URWTO agreement is that it provided border protection that helped to keep U.S. prices for cheddar cheese, butter, and NFDM 40 percent, 78 percent, and 36 percent, respectively, higher than world prices for these products during 1995 to 2001. The main short-term cost was an unanticipated increase in MPC imports. A longer-term cost associated with the agreement may be more important. Benefits to the industry from border protection may prevent the U.S. dairy industry from gaining early mover advantages and delay for years the time when U.S. firms collectively become major players in international dairy markets.

Cox's world trade model shows that the U.S. dairy industry will have few incentives in the near term to deal with this potential cost by deregulating to facilitate expanded dairy exports [7]. Cox analyzed two scenarios that are of interest regarding this point. The first portrays a continuation of measures to open world dairy markets during 2000-2005 at the same rate that the markets were opened during 1995-2000. The second simulates free trade.

While there was some expansion in the physical volume of U.S. dairy exports under the two scenarios, both showed little change in U.S. farm milk prices. Under both scenarios, most of the upward adjustment in farm milk prices occurred in Oceania and Argentina and most of the downward adjustment occurred in Western Europe, Japan and Canada. Cox's findings help to explain why U.S. producer groups show little interest in giving up existing benefits from border protection and associated dairy price supports in hopes of expanding dairy exports.

The NAFTA will reduce tariffs on most U.S. dairy products (except for milk powder) exported to Mexico to zero in 2003. This is a significant benefit for the U.S. dairy industry.

Important longer-term changes in the business environment were created for U.S. dairy exporters by the URWTO agreement and the NAFTA. The URWTO agreement has channeled U.S. dairy exporting activity into products not priced out of international markets by border protection and the price support program and into differentiated products. Wisconsin companies have benefited from these changes. In particular, whey and lactose exports--important products for the state's dairy industry--have expanded as a result of this change. Wisconsin's producers of differentiated specialty cheeses also are likely to gain from this change in the exporting environment. For some firms, the profit gains from expanding exports of differentiated dairy products are likely to be important.

The change in the economic environment produced by the NAFTA is different. Almost according to a free-trade advocates script, the NAFTA has made Mexico's dairy firms tougher competitors. It also has triggered adjustments in Mexico's dairy industry to bring about import substitution – especially for NFDM. These changes in Mexico's dairy industry likely will limit gains by U.S. firms in market share over the longer-run.

However, simultaneously these developments will expand opportunities for U.S. and Wisconsin firms for supplying genetics, dairy equipment, and technical services to Mexico's dairy industry.

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MARKETING AND POLICY BRIEFING PAPER

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RETHINKING DAIRYLAND:

MILK COMPOSITION, QUALITY AND PRODUCTION EFFICIENCY: WHERE DOES WISCONSIN STAND?[1]

What is the ideal milk composition for cheese manufacture? How close is Wisconsin milk to that ideal, and how does it compare with milk from other leading dairy states? What can Wisconsin's dairy farmers and cheese processors do to ensure that milk produced in the state improves the state's cheese industry from farm to wholesale product? These questions are addressed in this report, which supports ***Rethinking Dairyland*** leaflet No. 7.

WHAT COMPOSITION AND QUALITY OF MILK DO CHEESE PROCESSORS NEED?

The ideal milk for making a whole milk cheese, e.g. Cheddar, would contain 14-15 percent total solids and have a casein-to-fat ratio of about 0.7. This would typically be milk with about 4.2 percent fat and about 3.6 percent true protein. Few, if any, cows produce milk of this composition. So cheese makers standardize their milk using a variety of processes. Fat content may be reduced through cream separation. Solids content may be increased through vacuum pasteurization or by adding additional nonfat milk solids to the raw milk in the form of condensed skim milk, nonfat dry milk or ultrafiltered milk concentrate.

Basically, the two main ingredients of milk that a cheese maker needs are casein and fat. The amount of fat that can be used in a cheese make procedure is limited by the amount of casein present to hold the fat in a stable system. Thus, the casein to fat ratio is a critical one determining the cheese making potential of a milk supply. The final composition of a cheese will dictate what amount of casein and fat are required to make that cheese. Ideal casein to fat ratios (based on recommendations from the WI Center for Dairy Research) for some varieties of cheese are shown in Table 1.

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[1] The authors are G. E. Shook, R.D. Shaver and P.L. Ruegg, Department of Dairy Science, and W.L. Wendorff, Department of Food Science.

Table 1. Ideal casein to fat ratios for selected varieties of cheese	
Cheese variety	***Casein: Fat Ratio***
Cheddar	.70
Low Moisture Part Skim Mozzarella	1.05
Swiss	.85
Parmesan	1.10
Havarti	.60
Brick, Muenster	.70
Gouda	.70

The most realistic goal for milk composition would be to have a casein to fat ratio of 0.70 which would be ideal for Cheddar, Brick, Muenster, Gouda and several other varieties of whole milk cheese. Milk would then only have to be standardized for other varieties of cheese with fat in the dry matter specifications of less than 50 percent.

In 1997, Wisconsin was reported to be 8.6 percent "deficient" in total protein for cheese manufacture (Natzke, 2000). What this means is that the total amount of cheese made in the state contained 8.6 percent more protein than the milk used to produce it — the "deficit" was made up in added protein, mostly from out-of-state sources. This amounted to over 50 million pounds of casein needed to balance out the surplus fat that the cheese plants purchased.

Up to now, cheese makers have mostly used nonfat dry milk, condensed skim milk, or UF milk concentrate to supply the additional casein. Milk protein concentrate (MPC) has recently been used as a source of functional casein for standardizing milk for cheese that does not have a Food and Drug Administration (FDA) Standard of Identity. Rennet casein and acid casein are not acceptable sources of functional casein for standardizing cheese milk.

Cheese makers sometimes complain about poor cheese yield from milk coming from southern and southwestern states. This is especially true when the milk is produced during a period of heat stress. Typically, for every 10°F above 70°F, the fat content of milk will drop .2 percent and protein will show a proportionate drop. During the summer hot spells in Wisconsin, cheese makers see as much as a 10-15 percent drop in milk protein and a corresponding drop in cheese yield.

WHAT IS THE COMPOSITION AND QUALITY OF WISCONSIN MILK?

Milk Composition

Sources of information about milk composition vary according to comprehensiveness and method of collection. The most comprehensive source is Federal Milk Marketing Orders, which collect and report composition and quality for all milk "pooled" within orders. Table 2 shows federal order data for the marketing order areas that encompass part or all of the top ten dairy states except California (which is not included in any federal order).

Table 2. Characteristics of producer milk by federal milk order marketing area, 2001

Marketing Area	Top Ten States included in Marketing Area	Butterfat	True Protein	Other Nonfat Solids	Somatic Cell Count
			percent		*1,000/ml*
Upper Midwest	WI, MN	3.72	3.02	5.70	344
Northeast	NY, Southeastern PA	3.68	3.00	5.69	NA
Mideast	MI, Western PA	3.68	3.02	5.70	359
Western	ID	3.61	3.06	5.71	NA
Pacific Northwest	WA	3.66	3.04	5.70	NA
Southwest	TX, NM	3.62	3.05	5.67	354

NA - Not available; producer payments are not adjusted for somatic cell count in these markets.
Source: Milk Marketing Order Statistics, Agricultural Marketing Service, USDA, http://www.ams.usda.gov/dyfmos/mib/rcpts_milk_ytd.htm

The federal milk order data show that milk in the Upper Midwest market has the highest butterfat test among the 6 orders, more than a point (tenth of one percent) above the lowest ranking Western order. Protein tests exhibit smaller variability among orders. But the Upper Midwest lags the three orders in the west by .02 to .04 percentage points. Other (nonfat) solids are practically the same across orders. Differences in somatic cell count are also small.

The Dairy Herd Improvement (DHI) program reports average milk composition by state for all herds enrolled in DHI testing. These data allow more direct comparison across states than the federal marketing order data and also include California. Their deficiency is in their coverage and representativeness — not all dairy farmers subscribe to DHI testing and those that do tend to be higher technology producers.[2]

DHI data related to milk composition in the top ten U.S. dairy states are shown in Table 3.[3] These data represent only a subset of all cows in the DHI program: Only cows whose records include sire identification or otherwise qualify for the national genetic evaluation program are represented. The percentages of all cows in the respective states included in these DHI data are shown in the right-hand column of the table.

Table 3. Milk composition for the ten leading dairy states, DHI, 2000-01 [1/]

State	Rank[2/]	Fat	True Protein percent	Protein breeds [3/]	All cows [4/]
				percent	
California	1	3.63	3.07	8.0	22.5
Wisconsin	2	3.71	2.99	3.6	16.8
New York	3	3.71	2.98	3.8	24.3
Pennsylvania	4	3.67	2.98	4.4	28.9
Minnesota	5	3.71	2.99	2.4	26.1
Idaho	6	3.62	3.10	10.0	8.5
Texas	7	3.69	3.12	16.4	10.1
Michigan	8	3.80	2.98	3.2	21.0
Washington	9	3.65	3.03	6.1	15.0
New Mexico	10	3.57	3.03	1.5	5.0
US		***3.69***	***3.02***	***7.0***	***19.0***

[1/] Powell, R. L., and A. H. Sanders. 2002. State and national standardized lactation averages by breed for cows calving in 2000. Animal Improvement Programs Laboratory, Agricultural Research Service, US Department of Agriculture. http://aipl.arsusda.gov/docs/dhi/current/2.html.
[2/] Rank based on total milk production.
[3/] Brown Swiss and Jersey cows as percent of cows among the three leading breeds in the USDA–DHI genetic evaluation program.
[5/] Cows of the three leading breeds included in the USDA–DHI genetic evaluation program as percent of all dairy cows in the state.

[2] A third source of information on milk composition by state is USDA's National Agricultural Statistics Service (NASS). NASS only reports butterfat content.
[3] Milk composition averages for DHI herds in the leading dairy counties of Wisconsin are in Appendix Table A1.

The DHI data tell a somewhat different story than the federal milk marketing order data. Butterfat tests in Wisconsin rank high, but are exceeded by nearly a point in Michigan and tied in New York and Minnesota. Compared to California, Wisconsin's chief rival in cheese production, Wisconsin milk has about .07 percent higher fat content

The DHI data show a larger spread among states with respect to protein percentages. Wisconsin is among five states with protein content just below 3 percent. All of these five states are in the great lakes and northeast regions. The western and southwestern states have protein percentages above 3.0 percent and ranging up to 3.12 percent.

Protein differences among states appear to be due in part to the higher prevalence of high protein breeds (Jersey and Brown Swiss) in the western and southwestern states. The one exception to this is New Mexico, which has the lowest percentage of Jersey and Brown Swiss cows, but has an intermediate protein content. Among Holstein cows in the ten leading dairy states, protein content ranges from 3.03 to 3.06 in the western and southwestern states, and from 2.96 to 2.98 in the great lakes and northeastern states (data not shown). Apparently Holstein producers in the western and southwestern states have given somewhat greater emphasis in sire selection to protein than producers in the great lakes and northeastern states. Compared to California, Wisconsin is .08 percent protein lower for all milk and .06 percent lower for milk from Holsteins.

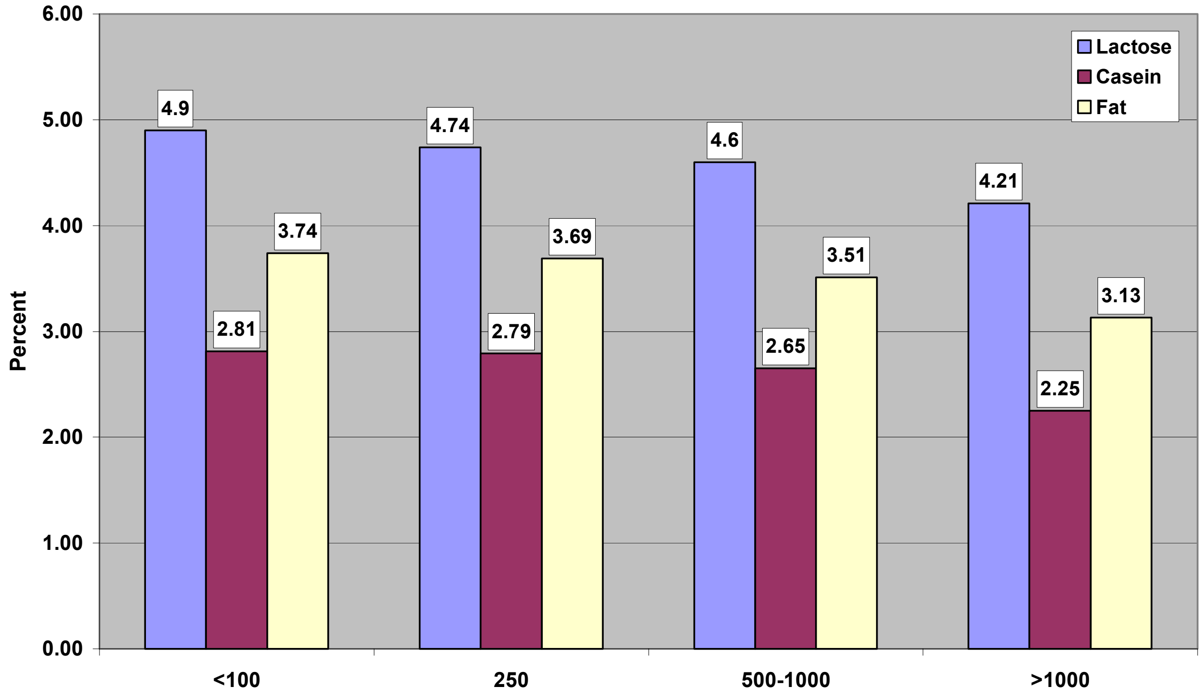
These small differences in fat and protein percentage do not indicate Wisconsin milk is inferior for cheese production compared to California milk. Although Wisconsin milk is slightly lower in protein content, it is slightly higher in fat content than California milk. Using milk from the two states to produce cheddar cheese (without standardization) results in almost exactly the same yield.

Milk Quality and Food Safety

Milk quality is usually defined by the *somatic cell count (SCC)* and the *bacterial count* of pre-pasteurized bulk tank milk. The largest factor that influences the SCC of milk is mastitis (Harmon, 2001). The SCC of a cow that is not infected with mastitis is usually less than 200,000 cells/ml and many cows maintain SCC values of less than 100,000 cells/ml. A SCC of greater than 200,000 cells/ml is almost always caused by mastitis.

Milk processors prefer milk with low SCC and many processors offer financial incentives to producers for high quality milk. High SCC milk reduces the shelf life of dairy products and diminishes the quality and quantity of milk protein, thereby reducing cheese yields (Barbano, et al., 1991). Even modest increases in individual cow SCC (>100,000/ml) have been shown to reduce cheese yields (Figure 1; Schallibaum, 2001). Infection with a mastitis pathogen causes injury to secretory cells and reduces the synthesis of lactose, fat and protein.

Figure 1: Effect of SCC on Milk Composition*



* From Schallibaum, 2001

Subclinical and clinical mastitis infections also increase the permeability of cell membranes and allow the leakage of blood components into milk, further reducing product yields and quality.

Milk quality data are available from three of the federal milk marketing orders (Table 2) and from DHI (Table 4). DHI herd average SCC by county in Wisconsin are in Appendix Table A1. SCC results are reported only in milk marketing orders that provide increased producer payments for milk with lower SCC. Market order SCCs include all herds in the order area. The SCC summary from DHI includes only cows whose records are used in the national genetic evaluation program. It has been shown that the SCC from these cows does not differ from cows in DHI herds that are not in the genetic evaluation system. The SCC in DHI herds is lower, on average, than all herds.

Differences in SCC among the milk marketing areas are small and of no practical significance. Two milk quality measures are reported from the DHI summary (Table 4): Average SCC and percent of herd test days with SCC >400,000 cells per ml. The percentage of DHI herds >400,000 is likely higher than the percentage of DHI bulk tanks above the 400,000 cells/ ml threshold: Milk of individual cows with high SCC is included in the DHI statistics, but milk from some of these cows is withheld from the bulk tank. Herds with SCC above 400,000 cells/ml should focus greater attention to managing for lower SCC. These herds are losing significant milk quality premiums and reduced milk production due to a large percentage of infected cows.

Table 4. Milk quality in the ten leading dairy states[1/]

State	Somatic Cell Count	Herd test days with SCC >400,000
	1,000 cells/ ml	*percent*
California	298	21.0
Wisconsin	297	25.4
New York	280	22.7
Pennsylvania	317	27.2
Minnesota	420	48.5
Idaho	320	24.7
Texas	342	32.0
Michigan	287	23.4
Washington	275	13.5
New Mexico	311	29.5
US	***322***	***31.1***

[1] Miller, R. H., and H. D. Norman. 2002. Somatic cell counts of milk from Dairy Herd Improvement herds during 2001. Animal Improvement Programs Laboratory, Agricultural Research Service, USDA. http://aipl.arsusda.gov/docs/dhi/dhi01/ scc01.htm.

The state of Washington clearly sets the pace for producing high quality milk. California and Wisconsin are both intermediate for average SCC, but California has a slightly smaller percentage of herds in the undesirable, high SCC ranges. Overall, Wisconsin milk is similar to California milk in terms of milk quality, but a higher percentage of Wisconsin herds are in need of special attention for improving milk quality. We conclude that Wisconsin cheese makers are neither disadvantaged nor are they favored in terms of milk quality.

Dairy product safety is an additional concern related to milk quality (Ruegg, 2002). There is ample evidence that increased prevalence of subclinical mastitis in a dairy herd (as demonstrated by high SCC) is indicative of management practices associated with reduced food safety. Monthly BTSCC values were higher in herds where verotoxigenic *E. coli* and *Listeria monocytogenes* were cultured from bulk tanks as compared to herds negative for these pathogens (Steele, et al., 1997). Hygienic practices on herds with higher SCC values are generally poorer than hygienic practices on herds with lower SCC values (Barkema, et al., 1998). Milking facilities, cow housing areas, and the udders of cows from herds with higher SCC values have been demonstrated to be dirtier and more soiled with manure as compared to cows and facilities from herds with lower SCC values (Barkema, et al., 1998). High SCC have also been linked to the occurrence of other indicators of poorer milking management. The risk of incurring a violative antibiotic residue is 2 to 7 times higher for herds with SCC values above 400,000 cells per ml as compared to herds with SCC values of less than 250,000 cells per ml (Ruegg and Tabone, 2000).

HOW CAN WISCONSIN IMPROVE THE COMPOSITION AND QUALITY OF MILK FOR CHEESE?

First, it should be noted that no cow produces the ideal milk for cheese in terms of the casein: fat ratio. Cheeses vary in their composition, so the ideal milk for one cheese would not be ideal for another. Fat content relative to casein is higher in milk than in nearly all cheese. The disparity is small for high fat varieties of cheese such as cheddar, but it is magnified for the low fat cheeses like mozzarella. Matching casein:fat ratios in milk to ideal levels in cheese is economically beneficial to cheesemakers.

Second, the leftovers from cheese production include whey proteins, lactose and minerals. The economic well being and competitiveness of the cheese industry, therefore, depends in part on capturing as much value as possible from each of these non-cheese components of milk.
That Wisconsin is regarded as deficient in milk protein has little to do with the protein content of the milk produced here. Rather, Wisconsin's protein deficit is due to the fact that nearly all milk has an excess of fat for cheese making and over 80 percent of the state's milk is converted to cheese. Furthermore, milk fat sold in the form of cheese usually has a higher value than fat sold in butter other commercial butterfat products. Cheesemakers attempt to balance milk composition by adding dry milk powder or other dairy protein sources to capture as much fat as possible in the form of cheese. It's simply in the nature of milk and in the nature of cheese that fat is in excess for milk made into cheese.

In addition, it must be recognized that protein, whether for the human diet or animal diet, is the most costly of the macro-nutrients. High energy feeds, such as shelled corn and forage, are comparatively lower in cost than protein-rich feeds. A study of the cost of feeds to support marginal increases in the yields of the milk components illustrates the point (Dado et al., 1994): Feed cost per pound of milk protein production was twice the cost for milk fat production and four times the cost for lactose production. Protein synthesis by the cow requires that she be fed protein-rich feeds that are higher in cost than energy-rich feeds. Synthesis by the cow of milk fat and lactose demands very little protein from the diet, but does require energy-rich feeds. Cheese is a protein-rich food. It is inescapable that milk used for cheese production must compensate producers for the higher cost of producing protein.

When consumers buy a package of cheese in the grocery store, they buy it by the pound and they have no concern about whether that pound of cheese was derived from 9 lbs or 11 lbs of milk. The implications for cheese processors are that the benefit of higher milk component percentages occurs in the manufacturing process and that processing efficiencies in milk with high component percentages should be shared with producers as an incentive toward producing milk with high component levels. The implication for producers is that management should focus on producing pounds of protein and fat rather than percentages of the components. While higher component percentages result in higher prices per hundred pounds of milk, the milk check depends both on how much milk is shipped and how much fat and protein is in the milk. Milk price per 100 lbs is meaningless until it is multiplied by the amount of milk shipped. This message is made more clearly to producers when milk payments are shown in the form of price per pound of protein, fat, and milk volume or 'other solids' multiplied by the pounds of protein, fat, and milk or shipped.

What Can Cheese Processors Do?

Because raw milk accounts for 85-90 percent of the cost of manufacturing cheese, cheesemakers are extremely interested in milk composition and especially the concentration of fat and casein in the milk. With whole milk cheeses, e.g., Cheddar, the primary concern is recovering the maximum amount of cheese per cwt. of milk. With reduced-fat cheeses, e.g., Mozzarella, the cheesemaker must determine if it is more profitable to sell the surplus fat (cream) to creameries for butter production or to purchase additional casein in the form of NDM or condensed skim milk to recover the fat in the form of additional cheese. The ultimate decision as to where the milk components go is determined by prices in the butter and cheese markets.

Producers are very responsive to premiums added to milk prices. Premiums for milk with low somatic cell count have driven improvement in milk quality more than any other single factor. Producers are keen to take advantage of any opportunity to increase revenue and will manage their herds accordingly. To the extent that higher protein and fat contents reduce the cost of cheese manufacture, premiums for higher levels of milk components must be offered. The benefits of higher percentages of milk components must be shared between the processor and producer. These premiums are a tangible mechanism for processors to communicate to producers what they want in milk composition.

Premiums are often paid to producers based on the volume of milk shipped. Changing the payment system from volume of milk to pounds of cheese or pounds of protein would continue to reward the high volume producers, but also provide incentive to produce milk with higher cheese solids content. This strategy would also more often reward producers with high protein breeds of cattle.

One problem the cheese plants in Wisconsin have had in the past is the structure of the milk pricing system that is influenced by the federal milk pricing system. In the past, this system was heavily influenced by the fluid market. Prior to January 1996, dairy producers were not paid on a component basis, but rather on a fat-skim milk basis (Cropp et al., 1999). On average, 60 percent of the milk value was based on water (volume), 34 percent on butterfat, 2 percent on protein, and 4 percent on other solids.

From 1996 through 1999, a multiple component pricing (MCP) system was put in place. Under MCP pricing, the average value of protein represented 44 percent of the value of milk , butterfat 34 percent, and other solids 22 percent. In January 2000, further changes were made to the MCP and protein then represented an average of 58 percent of the value of milk, butterfat 39 percent and other solids 3 percent. However, with the fat value being tied to the butter market and protein to the cheese market, sometimes the value of fat could be equal to or greater than the value of protein. This sends mixed signals to the producers as to the overall value of each of the milk components. If cheese plants wish to encourage producers to produce milk with an ideal composition for cheesemaking, they will need to establish a milk pricing system based on cheese yield that provides a consistent signal for production of higher protein milk.

What Can Producers Do?

Three areas of herd management are considered as ways that producers might improve the composition and quality of milk for cheese production: Dairy cattle feeding and nutrition can affect milk composition with almost immediate gains. Animal health can impact both milk quality and milk composition, also with immediate results. The best long term strategy for effecting changes is through genetics.

Dairy Cattle Feeding and Nutrition

The cow's diet can have a major impact on milk yield, composition, and component yields. The multiple-component pricing (MCP) system is based on absolute yields of fat, protein and other solids, and not on individual component percentages per se. Therefore, a change in a cow's diet that increases component percentages, but also reduces milk yield, may or may not increase component yields or gross income depending on the relative magnitudes of change. An example of this scenario would be the feeding of lower grain diets with the aim of increasing milk fat test. On the other-hand, a slight depression in component percentages due to a change in the cow's diet could be favorable for the dairy producer if offset by enough of an increase in milk yield. An example of this scenario would be the feeding of supplemental fat with the aim of increasing milk yield, while knowing that a depression in milk protein test is to be expected.
Finally, a change in a cow's diet that increases milk yield while maintaining component percentages will increase the yields of all components and gross income. An example of this scenario would be the feeding of a more highly digestible forage source that allows for a higher intake of the diet by the cow.

Dairy producers are being paid for yields of components — not to produce milk of a specific composition most favorable for producing a specific type of cheese. Despite all the concern and discussion about a protein deficit for cheese manufacturing, pay prices per pound of protein at or below the pay price per pound of fat does not send the right economic signal to dairy producers or their nutritionists to focus on milk protein percentage or yield, especially if it were to compromise fat percentage or yield. The recent interest in cheese yield pricing systems may be a step toward providing the proper economic signals at the producer level.

Milk protein yield can be increased through increases in milk yield or increases in milk protein percentage. The latter, unless depressed by feeding an unbalanced diet, is difficult to increase more than 0.10 to 0.15 percentage units by a change in diet. Moreover, this small change in protein percentage usually comes at a high cost, for example by using lysine formulations or ruminally-protected methionine).

Relatively low grain and byproduct prices experienced recently have made the feeding of minimum forage diets common. Over the last decade corn silage has increasingly replaced alfalfa silage in milking cow diets. These trends, along with a "yield" based milk-pricing system, continue to drive us, from a feeding standpoint, toward the high-volume production of milk that is right at the point of fat test depression. In fact, the NRC (2001) fiber "requirements" are merely minimum guidelines aimed at maintaining normal ruminal pH and fiber digestion and milk fat test above 3.4 percent in Holstein cows, and preventing digestive upsets (i.e. subacute ruminal acidosis/laminitis and left displaced abomasums). The good news is that these types of diets do, from a level of carbohydrate standpoint, maximize milk protein percentage and yield.

Thus, we will explore how milk protein might be increased for diets where the production of protein and energy (volatile fatty acids) by ruminal microbes and milk protein has been maximized from a level of dietary carbohydrate standpoint.

Forage and TMR Particle Size. Finely-chopped forages and (or) finely-processed total mixed rations (TMR) have the effect of increasing milk yield and milk protein percentage and yield, but milk fat test depression is a problem. Further, without sufficient coarse fiber to maintain chewing activity digestive upsets may develop. Because of the feeding of chopped silages with minimal hay in relatively low forage diets, there is little opportunity for the industry as a whole to further exploit this avenue for increasing milk protein. However, many individual producers could benefit from adopting this practice.

Supplemental Fat. Supplementation of milking cow diets with 1 to 2 lb. per cow per day of added fat is a common practice with the aim of improved body condition, fertility, and milk production. Assuming that some of the energy goes to body condition and that the added fat displaces some starch from grain in the diet, we expect a 3 to 4 lb. increase in milk yield per pound of supplemental fat. Since we supplement with whole oilseeds rather than free oils, relatively saturated animal tallow and (or) rumen-inert fats, milk fat test is usually not altered appreciably. However, feeding supplemental fat reduces milk protein percentage about 0.1 percentage units per pound of added fat. The reasons for this fairly consistent protein depression in response to feeding supplemental fat is not fully understood and therefore cannot be alleviated at this point.

Why would a dairy producer supplement fat when it reduces milk protein[4] percentage, which isn't positive for the cheese maker? Because fat supplementation increases milk fat and other solids yields with no change in milk protein yield due to the increase in milk volume. Combined with similar pay prices per pound of milk protein or fat, this makes this feeding strategy profitable for the producer. Better body condition (i.e. improved milk persistency and/or fertility) is an extra potential benefit of supplemental fat feeding.

From the perspective of cheesemakers, farmers' use of supplemental fat reduces the amount of protein per hundredweight of milk. In turn, this requires more protein added to the cheese vat to achieve optimal casein-to-fat ratios. Cheesemakers could capture an extra 0.10 to 0.20 units of milk protein *percentage* at the same milk fat *percentage* if farmers eliminated supplemental fat

[4] The term, protein, in this paper refers to true protein (non-nitrogen) as opposed to total milk protein.

feeding . But to capture this added protein, cheesemakers would need to provide an economic incentive in the form of relatively higher protein payments compared to butterfat payments.

Dietary Protein. Underfeeding dietary protein relative to the cow's requirement reduces milk yield and milk protein percentage and yield (National Research Council [NRC] 1989, 2001) There is a major economic disincentive to under-feeding protein, especially at the low to moderate protein supplement prices experienced recently. Overfeeding dietary protein relative to the cow's requirement (NRC, 2001) does not increase milk yield or milk protein percentage or yield. Consequently, there is both an economic and an environmental disincentive to over-feeding dietary protein.

The NRC (1989; 2001) has provided rumen degradable and non-degradable protein guidelines for milking cow diets and tabular values for protein degradability of feedstuffs. Using these guidelines, diets can be formulated to meet the protein needs of the ruminal microbes for production of protein and energy (volatile fatty acids) and the cow's production of milk protein. Because this area has been a major focus of the feed industry and consulting nutritionists for the last two decades, there is little opportunity for the industry as a whole to further exploit this avenue for increasing milk protein. However, there are many individual producers who could benefit economically from adhering to NRC guidelines.

The NRC (2001) has provided amino acid guidelines for lysine and methionine to maximize milk protein percentage and has also distributed computer software to estimate dietary amino acid status. The formulation of dairy cattle diets for amino acids is very much in its infancy stage. Dietary lysine status can be improved in a reasonably cost effective fashion by formulating diets for rumen non-degradable protein using high-lysine protein supplements such as ruminally-protected soy products and blood meal, rather than low-lysine supplements, such as distillers-dried grains or corn gluten meal.

To achieve maximum milk protein percentage, the NRC (2001) guidelines for methionine and lysine:methionine ratio must also be addressed. This is difficult to do unless ruminally-protected methionine products are supplemented at a cost of about 10 to 20 cents per cow per day. The expected benefit of this feeding practice is a 0.10 to 0.15 percentage unit increase in milk protein percentage with no change in milk yield or other components. Assuming a milk protein pay price of $2.00 per lb., the gross returns from this sort of milk protein percentage response is 15 to 20 cents per cow per day at 70 to 80 lb./cow/day milk production levels. Consequently, the profit potential for the dairy producer is marginal, especially since there is a risk that the anticipated milk protein percentage response may not be observed in all situations. An extra 0.10 to 0.15 percentage units of milk protein at the same milk fat percentage can be captured by cheese manufacturers if milk protein were given a sufficient economic value to promote routine feeding of ruminally-protected methionine. This feeding practice would result in an increase in milk protein yield.

Milk Quality and Animal Health

Multiple benefits accrue to improving milk quality. Among them are improved cheese yield, improved dairy food safety, and improved production per cow. Dairy product safety and milk quality are closely related (Ruegg, 2002). There is ample evidence that increased prevalence of subclinical mastitis in a dairy herd (as demonstrated by high SCC) is indicative of management practices associated with reduced food safety. Monthly bulk tank SCC values were higher in herds where verotoxigenic *E. coli* and *Listeria monocytogenes* were cultured from bulk tanks as compared to herds negative for those pathogens (Steele, et al., 1997). Hygienic practices on herds with higher SCC values are generally poorer than hygienic practices on herds with lower SCC values (Barkema, et al., 1998). Milking facilities, cow housing areas, and the udders of cows from herds with higher SCC values have been demonstrated to be dirtier and more soiled with manure as compared to cows and facilities from herds with lower SCC values (Barkema, et al., 1998). High SCC have also been linked to the occurrence of other indicators of poorer milking management. The risk of incurring a violative antibiotic residue is 2 to 7 times higher for herds with SCC values above 400,000 cells per ml as compared to herds with SCC values of less than 250,000 cells per ml (Ruegg and Tabone, 2000).

Improvements in milk quality relate directly to improved production efficiency. Production losses due to subclinical mastitis on U.S. dairy farms have been estimated to cost the US dairy industry $1 billion dollars annually (Ott, 1999). Milk quality (as measured by the SCC) is important to the dairy producer because of the well-documented relationship between subclinical mastitis (as measured by SCC) and milk yield. A recent review concluded that each 2-fold increase in SCC above 50,000 cells/ml resulted in a loss of 0.9 and 1.3 lb of milk per day in primiparous and multiparous cows respectively (Hortet and Peeler, 1998). It is estimated that total lactational milk yield is reduced by 180 lb for primiparous and 260 lb for multiparous cows for each 2-fold increase in the lactation geometric mean SCC over 50,000 cells/ml. Wisconsin research has estimated that these losses are 200 lb for primiparous and 400 lb for multiparous cows (Raubertas and Shook, 1982).

Dairy Cattle Genetics

Casein Genotypes. Early studies on the impact of genetic variants of κ-casein on cheese yield indicated as much as a 10 percent increase in cheese yield with the BB variant of κ-casein (Aleandri et al., 1990; Marziali and Ng-Kwai-Hang, 1986). Initial reports credited the increase in cheese yield to an increase in protein in the BB milk. Australian researchers (McLean at al., 1984) also reported a slight increase in casein in BB milk but further characterized a major increase in the κ-casein content of BB milk as shown in Table 5.

Table 5. Milk composition for κ-Casein genotypes

Component	*AA κ-Casein*	*AB κ-Casein*	*BB κ-Casein*
Fat [g/L]	48.9	47.6	47.5
Crude protein [g/L]	36.3	36.3	36.2
Casein [g/L]	28.1	28.3	28.5
Casein: Fat Ratio	.575	.595	.600
κ-Casein [g/L]	3.0	3.6	3.7

More recent studies have shown only small yield differences between the AA and BB variants (Bremel et al., 1998; Gibson, 1989; Stasio et al., 2000). The casein to fat ratio of the milk from BB cows was higher than the AA cows and there was a better protein recovery from the BB milk (Bremel et al., 1998). However, AA cows produced more fat and slightly more protein than BB cows. Results of Cheddar cheese trials at the Wisconsin Center for Dairy Research are shown in Table 6. Fat retention was higher in cheese made from milk from BB genotype cows which translated into cheese with higher fat in the dry matter (FDM). Milk from the BB cows clotted faster and reached desired firmness at cutting much quicker than milk from AA cows (19 vs. 33 minutes). Only in high throughput, highly automated cheese plants running around the clock would this difference in clotting time result in an economically worthwhile increase in production efficiency. There were no significant sensory or melt differences between cheeses from the two milk genotypes.

Table 6. Milk Composition and Cheddar Cheese Yields for κ-Casein Genotypes

Component	*AA κ-Casein*	*BB κ-Casein*
Fat percent	3.59	3.39
True protein percent	3.06	2.96
Casein percent	2.49	2.42
Casein: Fat Ratio	.69	.72
Cheese yield percent	9.89	9.60
Fat recovery in cheese percent	88.50	91.30

Low moisture, part-skim (LMPS) Mozzarella cheese was also made from AA and BB milk. The milk from AA cows clotted slower than milk from BB cows similar to the Cheddar cheese trials. Other researchers have also reported faster coagulation by rennet in the milk from BB cows (Schaar, 1984; Horne et al., 1997). The primary reason for increased cheese yields from BB milk was a higher fat retention in the cheese (Bremel et al., 1998; Nuyts-Petit, et al., 1997). With higher fat retention, the FDM in cheese will increase and the body of the cheese will become softer. If the FDMs are too high, the cheese may be too soft to shred or slice. In such a case, the increased fat retention of the BB milk would not provide any significant advantage over AA milk.

At the present time, there does not seem to be a significant advantage in selecting BB milk since the BB cows tend to produce milk with slightly lower fat and total solids content that contributes to cheese yield. If the fat and casein levels of BB milk could be increased to match the AA milk, the BB milk would be preferred for cheese making because of the faster renneting time and increased fat retention. However, at present there would no advantage in including milk protein genetic variants among selection criteria for producers (Bremel et al., 1998; Gibson, 1989; Stasio et al., 2000).

<u>Cattle Breeding</u>. The opportunity to manipulate milk composition through breeding is limited by the biological associations among the milk traits. Two examples are the relationships of protein percentage with fat percent (Figure 2) and with milk yield (Figure 3). Each point in these figures depicts the genetic values for two traits of an individual bull or small group of similar bulls. In Figure 2 it is shown that bulls with high PTAs for protein percent also tend to have high PTAs for fat percent. Relatively few bulls fall into the quadrant with high protein percent and low fat percent. Because of this association, breeding cattle with high protein to fat ratios is practically impossible. Progress toward such a goal would be slow and economically undesirable.

The association between milk yield and protein percent is moderately negative; i. e., bulls with high genetic values for milk yield tend to have low values for protein percent (Figure 3). This makes it difficult to simultaneously increase milk production (necessary for profitable dairy farming) and the percentages of the milk components (desirable for cheese manufacture). The balance between genetic improvement for milk yield and protein percent is dictated by the prices paid for milk volume and protein. In fact, a penalty for milk volume would be necessary to favor selection for protein content over milk yield. Later it will be shown that selection indexes are widely used in the industry to facilitate the choices between bulls with high protein compared to high milk.

Figure 2. Scatter plot of Predicted Transmitting Ability (PTA) for protein percent and fat percent for AI Holstein bulls available August 2002

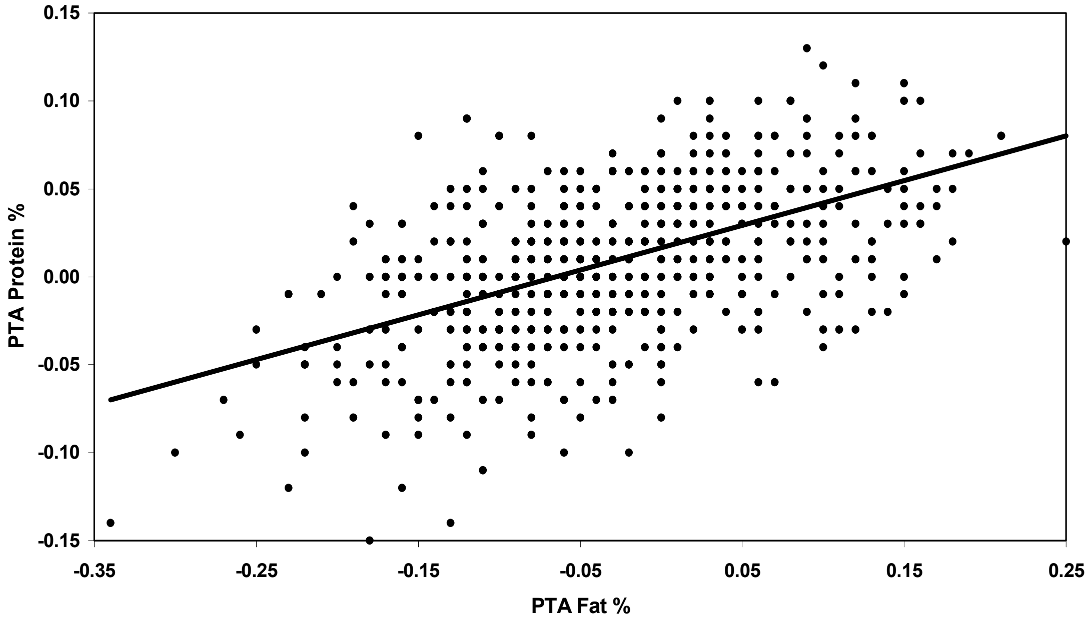
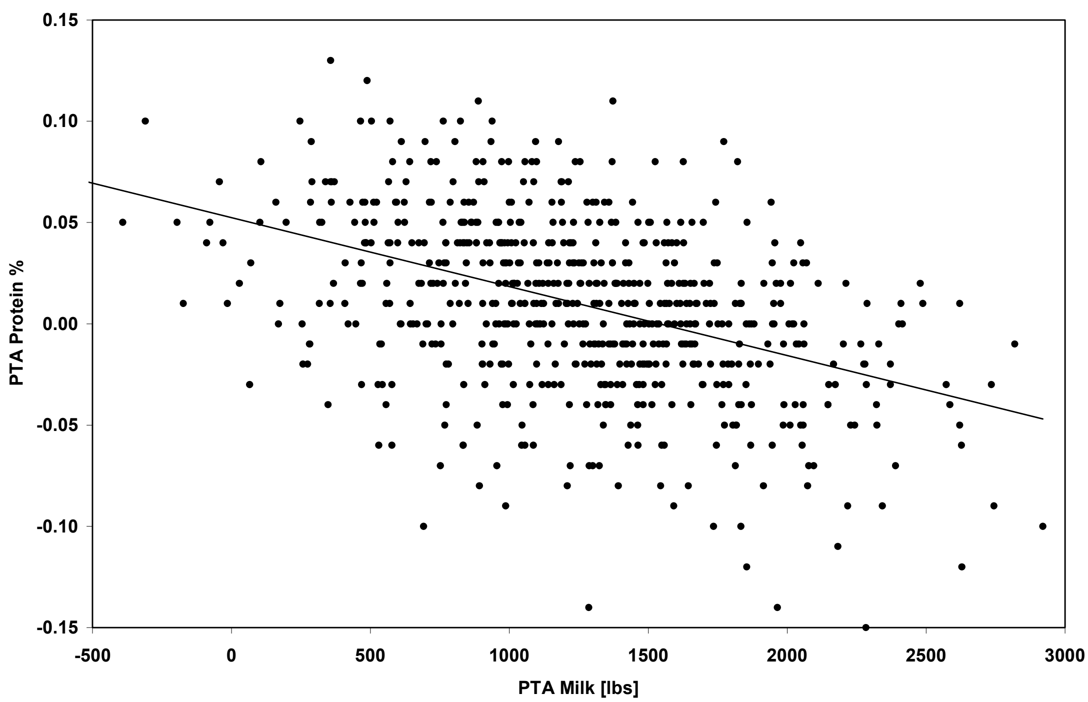


Figure 3. . Scatter plot of Predicted Transmitting Ability (PTA) for protein percent and milk yield for AI Holstein bulls available August 2002



The two primary opportunities to change milk composition by breeding are the selection of sires within breed and by changing breed composition of the dairy cow population. Dairy cattle genetic resources are truly national because breed improvement programs, genetic evaluation of animals, and semen distribution are all conducted nationally. This discussion will take a national perspective.

Sire Selection. About 50 percent of the yearly increase in production per cow is due to genetics. And more than 90 percent of genetic improvement is due to the selection of sires. Within a breed, the greatest opportunity for changing milk composition is by sire selection. The USDA Animal Improvement Programs Laboratory (AIPL) computes and distributes genetic evaluations of bulls and their daughters from data gathered through the Dairy Herd Improvement program. The measure of genetic merit is called Predicted Transmitting Ability (PTA). The difference between the PTAs of two bulls or two groups of bulls is a prediction of the difference in performance of their future daughters.

Selection indexes are recommended as a means of identifying bulls whose daughters are expected to be most profitable. A bull's index value predicts the milking lifetime net income over feed and health costs for an average daughter when the bull is mated to a breed average cow. The AIPL publishes three selection indexes: Cheese Merit, Net Merit, and Fluid Merit. Producer payment prices assumed for these indexes are shown in Table 7. The index weights for these indexes are shown in Table 8. The indexes differ only in the relative emphasis given to milk volume and protein yield. All three indexes assume a fat price of $1.15/ lb and milk price of $12.70 per 100 lbs. for milk with 3.0 percent protein and 3.5 percent fat.

Table 7. Producer milk and milk component prices assumed for US sire selection indices

Index	Milk price	Fat price	Protein price
		$/lb	
Cheese Merit	-0.008	1.15	3.17
Net Merit	0.010	1.15	2.55
Fluid Merit	.087	1.15	0.0

Table 8. Selection index weights for Holstein bulls in the US [1].								
	Predicted Transmitting Ability Traits							
Index	**Milk**	**Fat**	**Protein**	**Productive Life**	**Somatic Cell Score**	**Body Size**	**Udder**	**Feet and Legs**
	----lbs----			*months*		*points*	*points*	*points*
Cheese Merit	–.029	2.14	6.42	28	–154	–14	29	15
Net Merit	.018	2.14	4.76	28	–154	–14	29	15
Fluid Merit	.224	2.14	–2.06	28	–154	–14	29	15

[1] From VanRaden, P. M. 2000. Net merit as a measure of lifetime profit. Animal Improvement Programs Laboratory, ARS-USDA, Beltsville, MD. http://aipl.arsusda.gov/docs/nm2000.html (Accessed June 13, 2002).

The choice of index depends on the producer's price received per pound of protein. At protein prices above $2.85/ lb the Cheese Merit index is recommended. At protein prices below $1.25/ lb the Fluid Merit index is most appropriate. The Net Merit index is best for intermediate protein prices. During the 36 months of 2000 – 2002, the federal order protein price fell below $1.25/ lb for only two months, and it never exceeded $2.70/ lb. Therefore, producers should choose sires using the Net Merit index. Protein prices would need to run consistently at least $1.00 to 1.25/ lb higher than they have during the past three years to make the cheese merit index an appropriate sire selection criterion.
Notice that the cheese merit index places a negative value on milk volume and the fluid merit index places a negative value on protein yield (Table 8). The weights on somatic cell score and body size are negative because cows with lower values for these traits are more profitable.

Table 9 shows the average Predicted Transmitting Abilities for various groups of Holstein AI bulls available in Fall 2002. Values in the first six rows are the average PTAs of the top 100 bulls chosen on the trait shown in the first column of the table. The last row is the average of all 649 active AI bulls; this serves as a benchmark for comparison for the groups of top 100 bulls shown in the previous rows. Comparisons should be made between rows; comparisons between columns are not valid. Comparisons between rows indicate the expected differences in daughter performance for the different bull selection criteria. For example, compare the rows Protein (lbs) and Protein percent: Daughters of the top 100 bulls selected for protein yield will produce, on average, 1103 lbs more milk, 19 lbs more protein, and $120 more lifetime net merit, than daughters of the top 100 bulls selected for protein percent.

Table 9. Average Predicted Transmitting Ability of the top 100 Holstein bulls when selection is based on various traits, and average of all active AI Holstein bulls [August 2002 data].

Selection Trait	*Average Predicted Transmitting Ability*								
	Milk	*Fat*		*Protein*		*Protein: Fat Ratio*	*Cheese Merit*	*Net Merit*	*Fluid Merit*
	Lbs	*Lbs*	*%*	*Lbs*	*%*		*$*	*$*	*$*
Protein pounds	1960	57	–.05	62	.015	.017	501	491	473
Protein percent	857	42	.05	43	.073	.010	402	371	253
Protein: Fat Ratio	1564	19	–.15	47	.005	.037	364	359	358
Cheese Merit $	1695	59	–.01	57	.029	.010	535	520	478
Net Merit $	1776	60	–.02	58	.020	.010	533	521	495
Fluid Merit $	2000	55	–.07	54	–.020	.010	484	489	535
All AI Bulls	1230	38	–.03	38	.009	.009	345	339	330

With respect to improving milk composition for cheese manufacture and dairy herd profitability, the following conclusions can be drawn from Table 9:

- Selecting bulls using the Cheese Merit index or the Net Merit index produces the highest returns in lifetime profit per animal. The two indexes are essentially equivalent in lifetime profit whether producer payment for protein is similar to that assumed for net merit or cheese merit. Between these two indexes, cheese merit provides slightly more gain in protein percentage; this is due to a lower response in milk yield rather than a higher response in protein yield.

- Selecting bulls using the Fluid Merit index is clearly inappropriate for a cheese market, i. e. if the protein price is greater than 1.25 per pound. Doing so results in substantially lower lifetime profit per animal [as measured by the responses in Cheese Merit and Net Merit], and lower fat and protein percentages.

- Selecting bulls strictly on protein percent, while it produces the greatest gain in that trait, results in substantially lower yields of milk, fat and protein and lower lifetime profit per animal.

- Selecting bulls for protein: fat ratio would result in the greatest improvement in protein: fat ratio but the least improvement in lifetime profit per animal. The high ratios are accomplished more by selecting for low fat yields and percentages than by attaining high yields and percentages of protein. This occurs because the yield and percentage of fat is more variable than the yield and percentage of protein. In other words, the greater variation in fat causes it to have a greater influence than protein on the protein: fat ratio.

<u>The contrast between US and Dutch Holsteins</u>. Table 10 shows mature age Holstein, Brown Swiss, and Jersey breed averages for DHI cows in the US. Shown in the last column is the breed average [at actual age of calving] for Holsteins of North American ancestry in The Netherlands. This comparison is interesting because The Netherlands has a substantial cheese industry and, on average, more than 90 percent of the genes in this sub-population of Dutch Holsteins descend from North American cattle.

The Dutch were highly selective in their choice of North American sires, and their criteria for selecting bulls were quite different from the criteria used by US producers. The Dutch experience illustrates the possibilities for changing a breed from within. Beginning in the 1970s and continuing into the 1990s, Dutch dairy genetics organizations collaborated in an aggressive importation of semen and embryos. Animals with 87.5 percent or higher of North American genes are registered separately in the Dutch Holstein registry.

Dutch Holsteins are about 0.7 percent higher in fat percent, 0.2 percent higher in protein content, and 6,000 lbs lower in milk yield than US Holsteins. These differences are due to differences in the way the yields are expressed and to diet in addition to genetics. Yields in the US averages are adjusted to a mature age basis, while Dutch yield averages are at the actual age of calving. The Dutch yields should be increased by around 5 percent to make them comparable to US yields. The age adjustment has only a small effect on milk component percentages.

Table 10. Average milk, cheese, and component yields and percentages for US Holsteins, Brown Swiss, and Jerseys[1/] and Dutch Holsteins of North American ancestry [2/]

	United States			Dutch Holsteins[2/]
	Holstein	Brown Swiss	Jersey	
US records (count)	1,624,058	15,704	106,837	634,568
Wisconsin records (%) [3/]	13.4	16.7	5.2	--
Milk (lbs)	24,517	20,300	17,038	18,447
Fat (lbs)	893	814	784	796
Fat percent	3.64	4.01	4.60	4.32
True Protein (lbs)	733	672	610	592
True Protein percent	3.00	3.31	3.58	3.21
Casein percent[4/]	2.49	2.75	2.97	2.66
Casein: Fat Ratio	0.68	0.69	0.65	.62
Cheddar Cheese				
Cheese Yield [5/]	10.00	11.04	11.83	10.55
30%Cream (lbs)	0.30	0.30	1.33	1.91
Milk value [6/]($/100 lb milk)	13.24	14.61	15.89	14.33
Total value [6/]($/ cow/ year)	3,246	2,966	2,707	2,643
LMPS Mozzarella Cheese				
Cheese yield [7]	9.09	10.00	10.68	9.57
30 percent cream (lbs)	4.49	4.95	6.34	6.35
Milk value [6/]($/100 lb milk)	13.06	14.38	15.60	14.12
Total value [6/]($/ cow/ year)	3,202	2,919	2,658	2,605

[1] Powell, R. L., and A. H. Sanders. 2002. State and National standardized lactation averages by breed for cows calving in 2000, Animal Improvement Programs Laboratory, Agricultural Research Service, US Department of Agriculture http://aipl.arsusda.gov/docs/dhi/current/k2.html.
[2] Wilmink, Hans. Cooperatie Rundveeverbetering Delta, Arnhem, The Netherlands. Personal communication, November 19, 2002.
[3] Percentage of US records that were from Wisconsin
[4] Assumes casein is .83 times true protein.
[5] Cheese yield [pounds of cheese per 100 lbs milk] is based on Cheddar cheese at 38.0 percent moisture; assumes 96 percent casein retention and 93 percent fat retention in the cheese.
[6] Milk value assumes cheese at $1.30/ lb, cream at $0.75/ lb and whey cream at $0.70/ lb.
[7] Cheese yield [pounds of cheese per 100 lbs milk] is based on Mozzarella cheese at 47.0 percent moisture; assumes 96 percent casein retention and 85 percent fat retention in the cheese.

Due to the high cost of concentrate feeds in The Netherlands, dairy rations there are higher in forage content and lower in concentrates than US dairy rations. This dietary difference explains a substantial portion of the difference in milk yield and a moderate portion of the difference in fat percent between the two countries. This dietary difference contributes little to the difference in protein percent. We anticipate that if the Dutch Holsteins were placed in US production systems, that milk yield would increase substantially, fat percent would decrease moderately, and protein percent would remain about the same.

The Dutch sire selection index for milk production is –0.08 x milk yield + 6 x protein yield + 1 x fat yield (Hamming, 2002). This index places a negative economic value on milk volume to the extent that decreasing milk production by 75 lb has the same benefit as increasing protein production by one pound; therefore, it favors high percentages of the milk components, especially protein. Also, an increase of 6 lbs of fat has the same advantage as an increase of one pound of protein. The index places a strong emphasis in favor of high protein percentage, a moderate emphasis on high fat percent and a tendency to favor bulls with low milk yield. Dairy producers in The Netherlands, which is a member of the European Union, fall under quotas based on fat production, so the emphasis on milk protein content is driven more by that fact than by any attempt to match production with the milk composition needs of the cheese industry.

The Van Slyke-Price cheese yield formula was used to determine cheddar cheese yield per cow for each of the breeds (Table 10). The volumes of surplus fat in the form of 30 percent cream are also shown. Cheese and butter market prices will dictate which of the breeds would be the most profitable from the combination of cheese yield plus additional cream for butter production. High solids milk, e.g., Dutch Holstein and Jersey, generates a significant volume of excess cream that traditionally would go to butter production. If we were only interested in cheese production, additional casein would have to be purchased to standardize the fat in cream in order to incorporate that into the cheese make procedure.

Since Mozzarella cheese is becoming the major commodity cheese, with production greater than Cheddar, we also calculated low moisture-part skim (LMPS) Mozzarella cheese yields for each of the breeds (Table 10). By using cream removal to standardize the milk for manufacture of LMPS Mozzarella cheese, there is a significant increase in the amount of excess fat that needs to be handled. Generally, cheese makers would purchase additional casein in the form of nonfat dry milk (NDM) or condensed skim milk to standardize the milk to recover the extra fat in the form of additional cheese. However, if the butter market price is high, it may be more profitable for the cheese maker to sell the cream to a creamery for butter production. Here we have assumed the cream would be sold rather than adding a casein source.

The value of cheese and 30 percent cream derived from 100 lbs milk is more than $1.00 greater for Dutch than US Holsteins (Table 10). This advantage exists for both cheddar and mozzarella cheese. Should the US dairy genetics industry import breeding stock from the Dutch Holstein breed? The answer is yes, if it's done rationally. Semen from Dutch AI bulls is readily available in the US, and many of these bulls are competitive with US AI bulls. Alternatively, the selection strategy used by Dutch geneticists is available to US geneticists and producers. If the economic signals were correct, it would be possible to produce a sub-population of US Holsteins with cheese yields even greater than Dutch Holsteins. The advantages in milk composition for Dutch

Holsteins were attained at some sacrifice in milk yield and cheese yield per cow (Table 10). Therefore, the choice to use Dutch bulls should consider milk and cheese yield per cow in addition to cheese yield per 100 lbs milk. Finally, it should be observed that US Brown Swiss and Jersey cattle produce more cheese value per 100 lbs milk than the Dutch Holstein. Perhaps a better strategy would be breed crossing among the US breeds.

Breed Selection and Crossbreeding. The most rapid and radical genetic change in milk composition could be accomplished by changing breed composition in commercial, i. e., non-registered, dairy herds. Producers of registered cattle should continue pure breeding in order to continue genetic improvement of the breeds. The 85 percent of herds that do not register their cattle may want to consider crossbreeding. The three breeds with largest cow populations and highest average protein and fat yields are Holstein, Jersey, and Brown Swiss; this discussion will be limited to these breeds.

Crossbreeding has not been widely practiced by dairy producers, but they are showing increased interest in breed crossing. The main advantages of crossbreeding are to utilize the strengths of two or more breeds and to gain the advantage of hybrid vigor. Dairy is the only livestock industry that does not exploit the genetic phenomenon of hybrid vigor. Many herds maintain cows of two breeds, but less often do these mixed breed herds produce crossbred animals.

More than 95 percent of Wisconsin dairy cows are Holsteins. Changing the breed composition of the Wisconsin dairy herd would most likely involve breeding Holstein cows to Brown Swiss or Jersey bulls. Another choice would be to replace Holsteins with purebreds of another breed, but this would be more costly and less profitable in most herds. In producing milk for cheese manufacture, the principal advantages of the Holstein are high yields of milk, fat, and protein per cow and the comparatively high ratio of casein to fat. The Jersey breed has the highest protein and fat percentages, but the lowest casein to fat ratio and lowest component yields per cow. A ranking of the breeds for economically important non-yield traits is shown in Table 11.

Table 11. Comparison of breeds for economically important non-yield traits.

Trait	Holstein	Brown Swiss	Jersey
Calving difficulty	High	Medium	Low
Herd life	Low	Medium	High
Mastitis	Medium	Medium	High
Fertility	Low	Medium	High
Maturity rate [1/]	Medium	Low	High
Rearing feed cost	High	High	Low
Feed for body maintenance	High	High	Low

[1/] Based on first lactation milk yield as a percentage of mature yield

What would be the outcome of having a crossbred herd compared to a herd that is half and half purebred with two breeds? The half and half purebred herd would get the average milk yield and composition of the two pure breeds. The crossbred herd would also expect to get the two-breed average but with an additional benefit due to hybrid vigor. Hybrid vigor is about 5 to 6 percent for lactation milk and component yields, i. e. those measured by weight. There appears to be little hybrid vigor for the milk component percentages. The big news on crossbreeding is that hybrid vigor for survival, herd life, lifetime production, and lifetime net return is 15 to 20 percent above the average of the purebreds. It is for these reasons that producers will begin to practice crossbreeding.

Table 12 compares the lactation production of herds composed of half and half purebred cows against crossbred cows. These calculations assume 5 percent hybrid vigor and are based on the US breed averages in Table 10. The results show the clear advantage for a crossbred herd compared to a herd that is half and half purebred. In most cases the crossbred animals will not exceed Holsteins for lactation production. However, when the benefits of improved fertility, longer herd life, and higher lifetime yield are considered, profitability of crossbred animals may often equal or exceed purebred Holsteins. It remains for individual producers to consider their milk markets and other factors when deciding whether to use crossbreeding.
Whether one is pure breeding or crossbreeding, it is most important to select bulls of high genetic value.

Table 12. A theoretical comparison of half and half purebred herds with crossbred herds for Holstein-Jersey and Holstein-Brown Swiss breed combinations [1/]

Breed composition	Milk	Fat		Protein		Casein	Casein:Fat Ratio
	lbs	*lbs*	*%*	*lbs*	*%*	*%*	
.5H + .5J	20,777	838	4.03	672	3.23	2.68	.665
H x J cross	21,816	880	4.03	705	3.23	2.68	.665
.5H + .5BS	22,408	854	3.81	702	3.13	2.60	.682
H x BS cross	23,529	896	3.81	738	3.14	2.60	.684

[1/] Based on the US breed averages in Table 10. Breed cross averages assume hybrid vigor is 5 percent for yield traits and 0 for percentage traits.

HOW CAN WISCONSIN PRODUCE MORE MILK?

The shrinking milk supply in Wisconsin has resulted in an under-utilization of cheese processing facilities. This makes it difficult for cheese processors to compete economically with processors in other regions that operate closer to full capacity. The two obvious strategies for increasing milk production are increasing the number of cows and increasing production per cow. The number of cows is determined by economic and social factors that are beyond the purview of these authors. Therefore, we focus on production per cow.

Table 13 shows average production per cow for the ten leading dairy states. Milk yields are from two sources: National Agricultural Statistics Service and DHI. Milk production averages by county in Wisconsin are in Appendix Table A2. Among the states, Washington sets the pace by a wide margin in production per cow. The western states lead the northern states. Only Michigan, among the northern states, is among the top half of these ten states. Wisconsin, Minnesota, New York, and Pennsylvania are among the bottom half of these states. Among DHI herds, Wisconsin is near the US average. Of greater concern are the 54 percent of Wisconsin cows in non-DHI herds; their average is substantially below the national average and ninth among the ten leading states.

Table 13. Milk production per cow per year for the ten leading dairy states.

State	All cows[1/]	DHI cows[2/]	Non DHI cows[3/]	Percentage of cows in DHI[4/]
		---lbs milk---		
Wisconsin	17,306	20,944	14,207	46
Minnesota	17,777	20,137	15,116	53
New York	17,376	20,841	14,047	49
Pennsylvania	18,081	20,651	14,533	58
Michigan	19,017	22,158	15,747	51
California	21,169	22,150	19,920	56
Idaho	20,816	22,677	19,980	31
Washington	22,644	24,115	22,043	29
Texas	16,480	19,602	14,646	37
New Mexico	20,944	21,961	20,721	18
United States	18,204	20,727	16,055	46

[1/]Wisconsin Agricultural Statistics Service. 2001. Wisconsin Agricultural Statistics, 2001. Wisconsin Department of Agriculture, Trade and Consumer Protection.
[2/]These are DHI Rolling Herd Averages and are a good approximation of actual milk produced per cow. Animal Improvement Programs Laboratory. 2002. USDA Summary of 2001 Herd Averages. Agricultural Research Service, US Department of Agriculture http://aipl.arsusda.gov/docs/dhi/dhi02/k3.shtml.
[3/]Calculated from other data in the table.
[4/]Animal Improvement Programs Laboratory. 2002. DHI Participation as of January 1, 2002. Agricultural Research Service, US Department of Agriculture http://aipl.arsusda.gov/docs/dhi/dhi02/k1.shtml.

There is good news in production per cow for Wisconsin. Nearly 10 percent of Wisconsin DHI Holstein herds produce more than 25,000 lbs milk per cow per year (Table 14). These herds account for 20 percent of the milk produced by DHI Holstein herds, and they compete favorably with leading herds anywhere. The table provides other useful insights: Milk quality, measured by somatic cell count, is substantially better in higher producing herds (Table 14). This underscores the point that high producing herds do a better job of managing virtually every aspect of the operation; there is greater specialization and attention to detail. Also, the milk from higher producing herds has lower fat and protein content. This is a well known, almost unavoidable phenomenon: Individual cows, sire daughter groups, and herds with higher milk yield tend to have lower milk composition values, but pounds of the milk components and the cheese derived from those components are higher. In addition, protein: fat ratio increases with production level; this is due the fact that the decline in fat percent is greater than the decrease in protein content as herd average increases.

The higher producing herds tend to be larger (Table 14). But larger, per se, is not the issue. These herds use more technology; more of them milk three times daily; they more often employ herd management, crop management, and other kinds of consultants; their managers and workers are more specialized in their skills and responsibilities. One size does not fit all when it comes to selection of the most profitable technologies. For example, three times daily milking does not fit the management style or labor situation on every farm even though it invariably results in higher production per cow.

It is obvious that a herd averaging 28,000 lbs per cow per year has many economic advantages over a herd that averages 14,000 lbs. Most obvious is that only half as many cows are needed to produce a given amount of milk. A 100 cow herd that averages 28,000 lbs per cow will sell 2.8 million pounds of milk per year. Two hundred 14,000 lb cows would be needed to produce that same quantity. More feed per cow and labor per cow will be used in the higher producing herd. Because fewer cows are needed, less total feed and total labor for the herd is needed to produce the same total amount of milk. Housing and milking costs, also, are substantially less for the higher producing herd. Because revenues are the same for these two herds and costs are lower for the high producing herd, it is clear that a high producing herd is generally more profitable.

This point, while it is so obvious here, seems too often to be overlooked by some producers, their creditors, and perhaps other advisors. We continue to see examples in which herds are advised to increase the number of cows at an unprofitable level of production rather than find ways to increase production per cow. The producer and the creditor in these situations would be well served by solving the fundamental cow management problems before increasing herd size.

Table 14. Distribution and characteristics of Wisconsin DHI Holstein herds by level of milk production[1/]							
Herd average milk/cow	**Frequency**	**No. of milking and dry cows**	**Fat**	**True Protein**	**Prot:Fat Ratio**	**Somatic cell count[2/]**	**% of milk produced[3/]**
1,000#	**%**		**%**	**%**			**%**
>27	2.9	163	3.66	3.01	.822	88	7.3
25-27	6.2	153	3.68	3.03	.823	93	13.0
23-25	13.3	123	3.72	3.03	.815	94	20.8
21-23	20.8	93	3.75	3.04	.811	101	22.6
19-21	22.9	74	3.82	3.05	.798	110	18.0
17-19	17.9	65	3.86	3.06	.793	122	11.2
15-17	10.2	57	3.93	3.07	.781	143	5.0
13-15	4.2	52	3.94	3.07	.779	162	1.7
<13	1.7	48	3.99	3.05	.764	189	0.5

[1/]AgSource Cooperative Services. 2002. Herd Summary Averages: Holsteins by Production Level, December 2001. http://www.agsource.com/hsmavg.htm.
[2/]Geometric mean of individual cow SCC which is near the median value and is typically less than bulk tank SCC.
[3/]Percentage of all milk produced by Holstein cows in DHI herds. Calculated from other data in the table.

The differences in production per cow – whether between states, between DHI and non-DHI herds, or between neighboring herds – are due to the same herd management factors. These include cow health, mastitis control, sire selection, forage quality, ration nutrient balance, reproductive management, cow comfort, milkings per day, and more.

High production per cow is consistent with other measures of efficiency, but by itself is not an adequate measure. A specific production per cow cannot be recommended as most profitable for every herd. We use production per cow here because it is commonly used and readily available. A better measure is cost of production per 100 lbs of milk. In the Wisconsin cheese market, we recommend that the best measure would be cost per pound of cheese – or per 10 lbs cheese because its value would be similar to cost per 100 lbs milk. Cost of production per pound of cheese is appropriate for all breeds of cows and production systems. Each producer must evaluate their individual circumstances to determine their best strategy in reducing production cost per pound of milk or pound of cheese.

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APPENDIX: MILK COMPOSITION, MILK QUALITY, AND MILK PRODUCTION LEVELS BY COUNTY FOR WISCONSIN'S 50 LEADING DAIRY COUNTIES

Milk Composition and Milk Quality

Milk composition and milk quality measures are from DHI herds, so these results do not characterize the entire milk supply from a county or district. Results are shown in Table A1 for the 50 leading dairy counties based on total milk production from all herds.

Variations in milk composition among counties and regions are rather small. Herds with high or low milk composition are not clustered in specific counties. Based on DHI herds, six counties have average protein tests of 3.1 percent or higher and only one county has protein below 3.0 percent. Three of the high protein counties are in the Northwestern district. Average fat test is 3.9 percent or higher in only two counties and less than 3.7 percent in five counties.

Milk quality, as measured by somatic cell count (SCC), is somewhat more variable than milk composition. The standard for high quality milk is set by four counties with SCC below 250,000 cells/ ml. Counties in the south central and southeast districts are uniformly lower than other districts. The 31 counties with SCC above 300,000 indicate that wide regions of the state need improvement in milk quality efforts.

Table A1. Milk composition and milk quality measures by district and county for the 50 leading Wisconsin dairy counties.

District/ County	Total Production[1/]	Dairy Herd Improvement Herd Averages[2/]		
		Butterfat	Protein	Somatic Cell Count
	1,000 lb	*%*	*%*	
Northwest				
Barron	472,700	3.86	3.12	355
Chippewa	553,000	3.85	3.08	334
Polk	302,270	3.84	3.11	323
Rusk	199,390	3.84	3.15	317
North Central				
Clark	1,051,650	3.84	3.03	333
Marathon	1,027,050	3.76	3.05	301
Taylor	293,560	3.86	3.07	353
Northeast				
Marinette	213,600	3.80	3.03	329
Oconto	382,700	3.73	3.03	311
Shawano	628,350	3.72	3.04	331
West Central				
Buffalo	330,000	3.75	3.02	299
Dunn	349,800	3.76	3.05	339
Eau Claire	177,120	3.89	3.09	348
Jackson	220,570	3.79	3.09	306
LaCrosse	195,880	3.83	3.05	323

Table A1. Milk composition and milk quality measures by district and county for the 50 leading Wisconsin dairy counties.				
		Dairy Herd Improvement Herd Averages[2/]		
District/ County	Total Production[1/]	Butterfat	Protein	Somatic Cell Count
	1,000 lb	***%***	***%***	
Monroe	421,200	3.89	3.10	308
Pepin	154,000	3.87	3.06	259
Pierce	320,050	3.75	3.04	256
St. Croix	447,700	3.76	3.03	309
Trempealeau	425,000	3.75	3.02	318
Central				
Green Lake	155,100	3.90	3.04	262
Juneau	161,990	3.76	3.09	195
Portage	228,200	3.99	3.06	319
Waupaca	448,560	3.70	3.06	299
Wood	440,000	3.79	3.07	342
East Central				
Brown	777,000	3.63	3.01	333
Calumet	411,320	3.75	3.01	335
Door	153,640	3.66	3.03	267
Fond du Lac	754,400	3.77	2.99	294
Kewaunee	501,370	3.64	3.01	260
Manitowoc	828,000	3.67	3.03	278
Outagamie	693,230	3.78	3.04	334
Sheboygan	489,180	3.82	3.01	312
Winnebago	251,810	3.74	3.07	372
Southwest				
Crawford	163,300	3.79	3.06	323
Grant	889,200	3.82	3.06	334
Iowa	442,000	3.75	3.05	289
Lafayette	477,400	3.76	3.06	305
Richland	249,000	3.87	3.08	341
Sauk	490,000	3.79	3.10	242
Vernon	397,800	3.87	3.11	319
South Central				
Columbia	278,400	3.74	3.08	222
Dane	930,600	3.73	3.02	263
Dodge	726,700	3.79	3.06	223
Green	507,000	3.74	3.06	284
Jefferson	302,400	3.78	3.07	282
Rock	224,900	3.80	3.09	308
Southeast				
Ozaukee	163,800	3.83	3.00	301
Walworth	219,480	3.68	3.04	293
Washington	274,120	3.85	3.07	262

[1]Data from Wisconsin Agricultural Statistics Service
[2]Data from AgSource Cooperative Services, Verona, WI and Dairy Records Management Systems, Raleigh, NC

Milk Production Levels and DHI Participation

The adage that you can't manage things you don't measure is clearly illustrated in milk production per cow. The motto should go on to say that you can't improve things you don't measure. Table A2 shows production levels and DHI participation by county for the 50 leading dairy counties in Wisconsin. Production per cow per year is around 7,000 lbs higher in DHI herds than non-DHI herds. The data provided by DHI and other production recording programs enables producers to manage for higher levels of production.

The county averages for DHI herds range from a low of 19,194 lbs to a high of 23,092 lbs per cow. The range among county averages is much larger for non-DHI herds with a low of 11,139 to a high of 16,940. Management information such as provided by DHI also leads to a more uniform level of management.

Rates of participation in DHI differ widely among counties. Four of the 50 leading dairy counties have fewer that 25% of cows on DHI programs. Eight counties have 55% or more of cows on DHI, and three of these are above 60%. The use of on-farm computers linked to automated milk weight equipment in the milking parlor has displaced DHI records on some farms. The number of farms using this approach to record keeping has not been documented. Nevertheless, it is clear that increasing the use of performance records on individual cows is an excellent opportunity for Wisconsin herds to increase production and profitability and for the state to recapture lost market share in total production.

Table A2. Milk production levels, Dairy Herd Improvement participation and herd size by district and county for the 50 leading dairy counties

District/ County	Milk production per cow per year			DHI Cows per Herd[2]	Cows on DHI [3/]
	All herds[1/]	DHI herds[2/]	Non-DHI herds[3]		
		---Lbs---		No.	%
Northwest					
Barron	16,300	21,281	15,138	61	19
Chippewa	15,800	20,185	13,571	69	34
Polk	16,700	20,748	11,649	79	56
Rusk	15,700	19,370	14,494	59	25
North Central					
Clark	17,100	21,195	14,499	65	39
Marathon	16,700	21,770	12,929	76	43
Taylor	16,400	20,827	13,966	60	35
Northeast					
Marinette	17,800	20,533	16,061	120	39
Oconto	17,800	21,924	15,040	108	40
Shawano	17,700	22,359	14,001	93	44
West Central					
Buffalo	16,500	21,094	13,570	89	39
Dunn	16,500	20,623	11,213	75	56

Table A2. Milk production levels, Dairy Herd Improvement participation and herd size by district and county for the 50 leading dairy counties					
District/ County	Milk production per cow per year			DHI Cows per Herd[2]	Cows on DHI [3/]
	All herds[1/]	DHI herds[2/]	Non-DHI herds[3]		
		---Lbs---		No.	%
Eau Claire	16,400	20,402	12,707	62	48
Jackson	16,100	20,030	14,454	64	30
LaCrosse	16,600	19,194	13,698	68	53
Monroe	16,200	20,158	13,072	75	44
Pepin	17,500	19,882	16,408	66	31
Pierce	17,300	21,271	13,542	70	49
St. Croix	18,500	21,615	16,304	79	41
Trempealeau	17,000	20,776	14,437	84	40
Central					
Green Lake	16,500	21,692	14,904	85	24
Juneau	16,700	20,602	13,493	93	45
Portage	16,300	20,389	15,049	73	23
Waupaca	17,800	21,382	13,076	102	57
Wood	17,600	19,823	16,940	67	23
East Central					
Brown	18,500	23,003	13,757	141	51
Calumet	18,200	22,662	15,506	91	38
Door	16,700	21,580	11,730	69	50
Fond du Lac	18,400	22,174	13,276	98	58
Kewaunee	18,100	23,092	14,710	113	40
Manitowoc	18,400	21,889	14,187	113	55
Outagamie	18,100	21,260	15,746	92	43
Sheboygan	18,600	22,002	11,958	105	66
Winnebago	16,900	20,111	13,474	92	52
Southwest					
Crawford	15,300	19,219	13,667	52	29
Grant	17,100	19,579	15,472	74	40
Iowa	17,000	20,632	12,924	74	53
Lafayette	15,400	20,209	12,064	84	41
Richland	16,600	19,784	14,241	66	43
Sauk	17,500	21,545	13,943	83	47
Vernon	15,300	19,818	12,463	68	39
South Central					
Columbia	17,400	21,285	13,291	86	51
Dane	18,800	21,912	16,338	91	44
Dodge	16,900	20,713	13,516	76	47
Green	15,600	20,031	11,139	73	50
Jefferson	16,800	20,932	13,322	78	46
Rock	17,300	21,649	10,075	90	62
Southeast					
Ozaukee	18,200	21,541	14,426	116	53
Walworth	17,700	21,516	11,837	93	61
Washington	17,800	19,697	16,730	82	36

[1/]Data from Wisconsin Agricultural Statistics Service
[2/]Data from AgSource Cooperative Services, Verona, WI and Dairy Records Management Systems, Raleigh, NC
[3/]Calculated from WASS and DHI data.