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Consolidation and Concentration in the U.S. Dairy Industry

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JEL Codes: L11, Q13, Q18

Consolidation of the U.S. dairy industry has occurred at every step in which raw farm milk is transformed into finished dairy products and made available to the final consumer. In addition to the usual public policy concerns associated with industry consolidation, there are some unique industry characteristics that make for special attention. These include the dominance of dairy cooperatives in the marketing of farm milk, daily production of the primary product, a formula based pricing system that determines minimum milk prices for a majority of the milk marketed in the United States and industry use of a thin market in the determination of a major component of this pricing system. This article provides an overview of recent consolidation trends of the U.S. dairy industry and highlights industry characteristics that differentiates dairy from other agricultural sub-sectors.

Consolidation in the U.S. Dairy Farm Sector

The average farm size is increasing, the number of dairy farms is decreasing and the location of production has shifted significantly to nontraditional production areas. The expansion of the dairy industry in such states as Idaho, Texas and New Mexico and concurrent reduction in production in traditional dairy states has resulted in the production by small farms in the historical producing areas being replaced by production originating from significantly larger operations (GAO, 2001).

Table 1 shows the change in the 10 largest dairy producing states since 1970. In 1970 only California (#4) and Texas (#10) were contained in this list. By 2008, there were five western states in the top ten with California producing the most milk and Idaho entering the top ten between 1980 and 1990 and by 2009 becoming the fourth largest milk producing state. Figure 1 shows the distribution of farms by herd size for a number of these key milk producing states in 2007. For the United States as a whole, the average herd size was 131 cows per operation. In comparison, for New Mexico (#8), the average herd size was 1,267 cows and for California (#1) the average herd size was 824 cows which is more than nine times the average herd size in Wisconsin (#2).

Table 1. Milk Production has Shifted to the West, Million Lbs

| Rank | 1970 | | 1980 | | 1990 | | 2000 | | 2008 | |
|------|-------|-----------------------|-------|-----------------------|-------|-----------------------|-------|-----------------------|-------|-----------------------|
| | State | Production (Mil. Lbs) | State | Production (Mil. Lbs) | State | Production (Mil. Lbs) | State | Production (Mil. Lbs) | State | Production (Mil. Lbs) |
| 1 | WI | 18,435 | WI | 22,380 | WI | 24,187 | CA | 32,245 | CA | 41,203 |
| 2 | NY | 10,341 | CA | 13,577 | CA | 20,947 | WI | 23,259 | WI | 24,472 |
| 3 | MN | 9,636 | NY | 10,974 | NY | 11,067 | NY | 11,921 | NY | 12,432 |
| 4 | CA | 9,457 | MN | 9,535 | MN | 10,030 | PA | 11,156 | ID | 12,315 |
| 5 | PA | 7,124 | PA | 8,496 | PA | 10,014 | MN | 9,493 | PA | 10,575 |
| 6 | IA | 4,670 | MI | 4,970 | TX | 5,539 | ID | 7,223 | MN | 8,782 |
| 7 | MI | 4,602 | OH | 4,310 | MI | 5,234 | TX | 5,743 | TX | 8,416 |
| 8 | OH | 4,420 | IA | 3,994 | OH | 4,667 | MI | 5,705 | NM | 7,865 |
| 9 | TX | 3,065 | TX | 3,625 | WA | 4,392 | WA | 5,593 | MI | 7,763 |
| 10 | MI | 3,012 | WA | 2,942 | IA | 4,233 | NM | 5,236 | WA | 5,696 |

(Source: NASS)

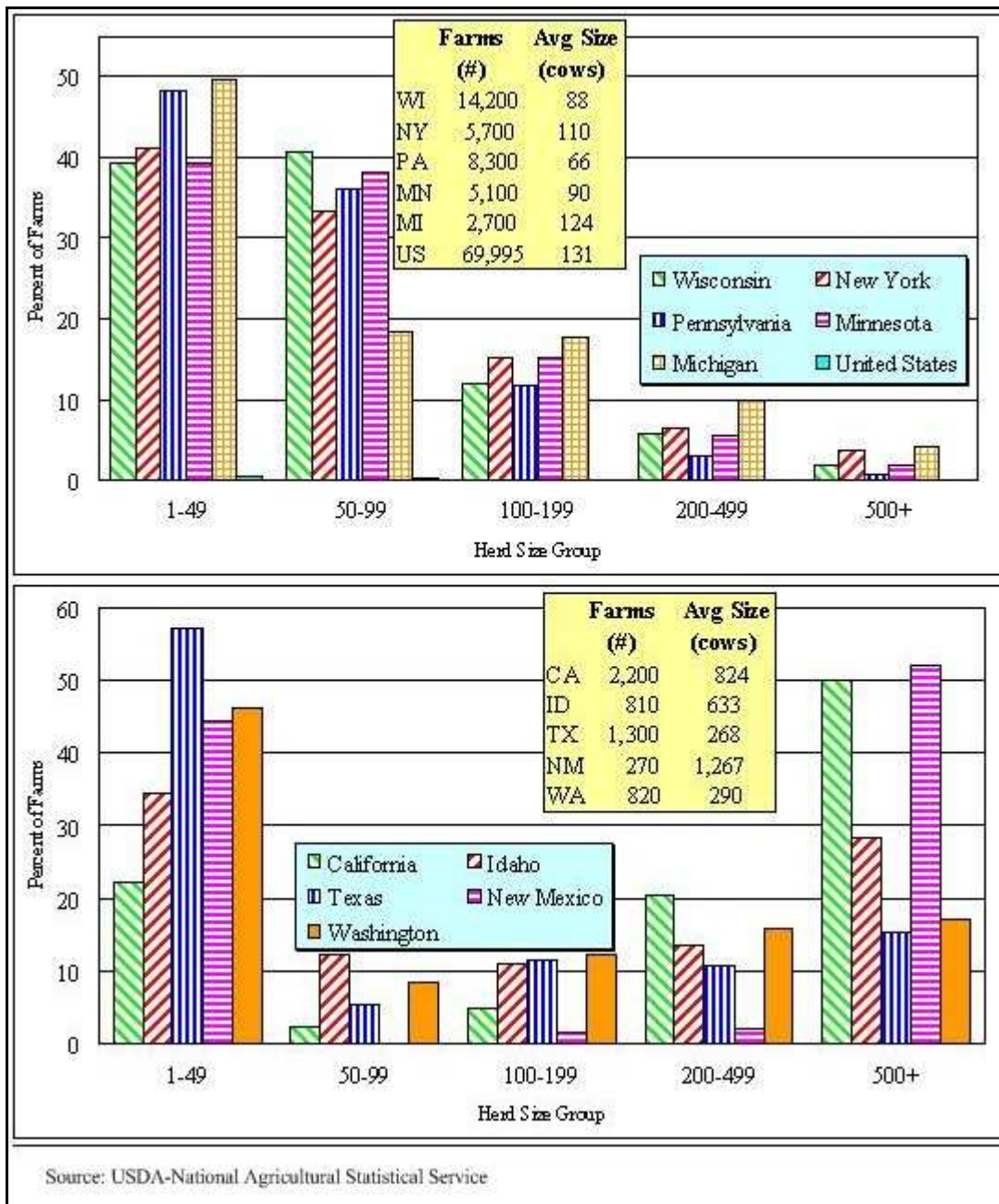


Figure 1. Distribution of Farms by Average Herd Size, Selected States, 2007

Between 1987 and 2007 the number of dairy farms in the United States decreased from 202,000 to 70,000 farms. In contrast to the decline in farm numbers, there has been a relatively constant increase in total U.S. milk production resulting from both the increase in average farm size and steady increase in yields. In 1980, 120.8 billion lbs of milk was produced. Total

production increased to 155.3 billion lbs in 1995, a 29% increase from 1980 and 189.3 billion lbs in 2009, a 22% increase from 1995.

Consolidation of Dairy Cooperatives

Dairy cooperatives have historically played an important role in the dairy industry. The importance of cooperatives as the source of marketed farm milk in the United States has increased over the last 50 years. For example, in 1957, less than 60% of U.S. milk was marketed by dairy cooperatives. By 2008, cooperatives accounted for 80% of U.S. marketed milk (Buske, 2009). There are significant regional differences in the importance of cooperatives as a milk source. For example, in 2007 approximately 75% of the farm milk marketed in the North Atlantic and Western regions originated from a dairy cooperative. In the West North Central Region, more than 97% of the milk was marketed by a cooperative (Ling, 2008, Figure 2).

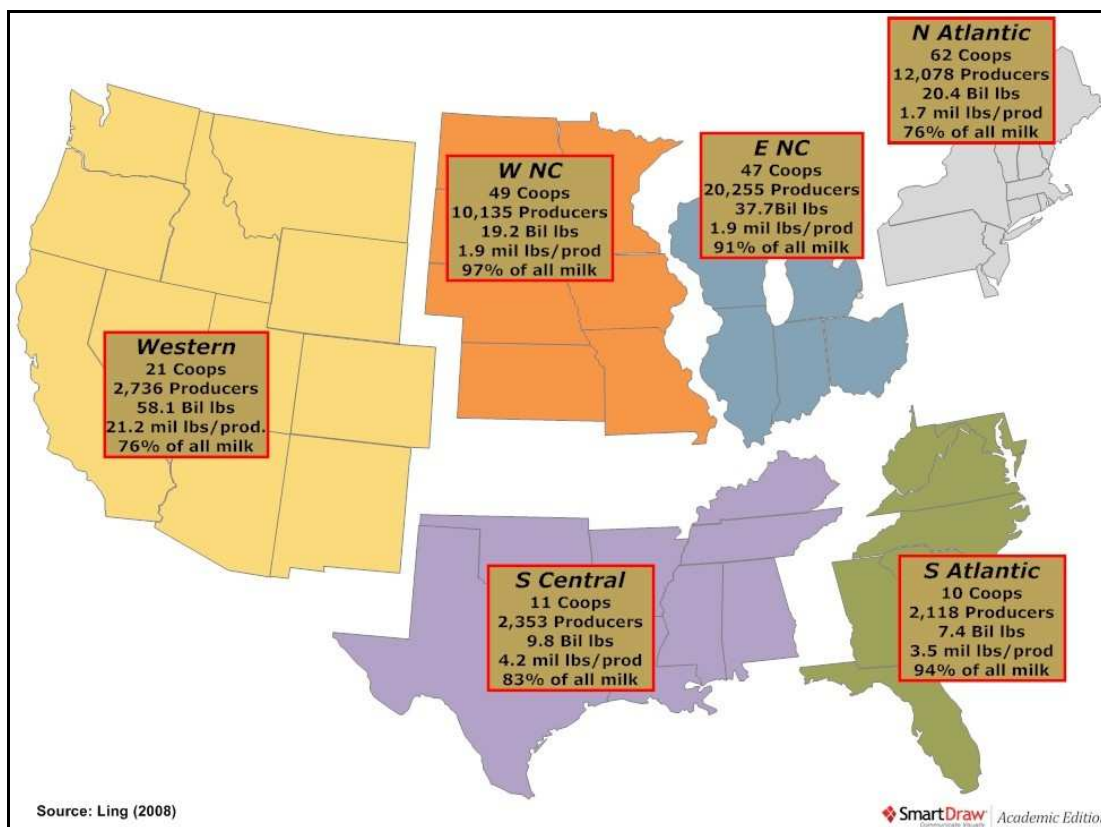


Figure 2. Regional Importance of Dairy Cooperatives in the Marketing of Farm Milk

Concurrent with the consolidation in the number of dairy farms, there has been significant consolidation of dairy cooperatives (Cropp, 2002). The evolution of cooperative mergers has moved from the creation of regional cooperatives in the 1960's and 1970's to multi-regional cooperatives such as Dairy Farmers of America formed in 1997 as a result of a merger of four regional cooperatives, AMPI-Southern region, Mid-America Dairyman, Inc (#2), Western Dairymen, Inc.(#14), and Milk Marketing, Inc. (#7) (GAO, 2001). In the year prior to the merger, these cooperatives accounted for 4.9% of the total value of sales of the 100 largest dairy processing firms and 21.1% of U.S. milk marketed. After merging, 18,543 farms were DFA cooperative members which represented 15% of U.S. farms and 26.2% of cooperative farms.

To quantify the degree of concentration in a particular industry economists have developed a number of measures. One measure of concentration is known as a *concentration ratio* (CR). For example, the CR4 is defined as the percent of the total industry's value of output represented by the four largest firms in that particular industry. A CR4 close to zero would indicate an extremely competitive industry since the four largest firms would not have any significant market share. In general, if the CR4 measure is less than about 40, then the industry is considered to be very competitive, with a number of other firms competing, but none owning a very large portion of the market.

We apply this measure to the market share of the 2, 4, 8, 10 and 20 largest dairy cooperatives with respect to the marketing of all U.S. farm milk (Figure 3). The major trend to obtain from these values is the pattern of increased market power of the largest cooperatives. The two largest cooperatives accounted for approximately 30% of U.S. milk marketed in 2008. This value was less than 20% in 1987. In 2008, the 10 largest cooperatives accounted for nearly 70%

of U.S. milk marketed compared to less than 50% in 1980. Using the critical CR4 of 40 as a guide, in 2008 the industry is just at the boundary of being considered very competitive. The above CR value should be considered in light of how one defines the extent of the market. The CR values reported here are national, but milk markets are regional in nature due to marketing order regulations and transportation costs. This implies that the regional CR values are likely to be much greater than the national values.

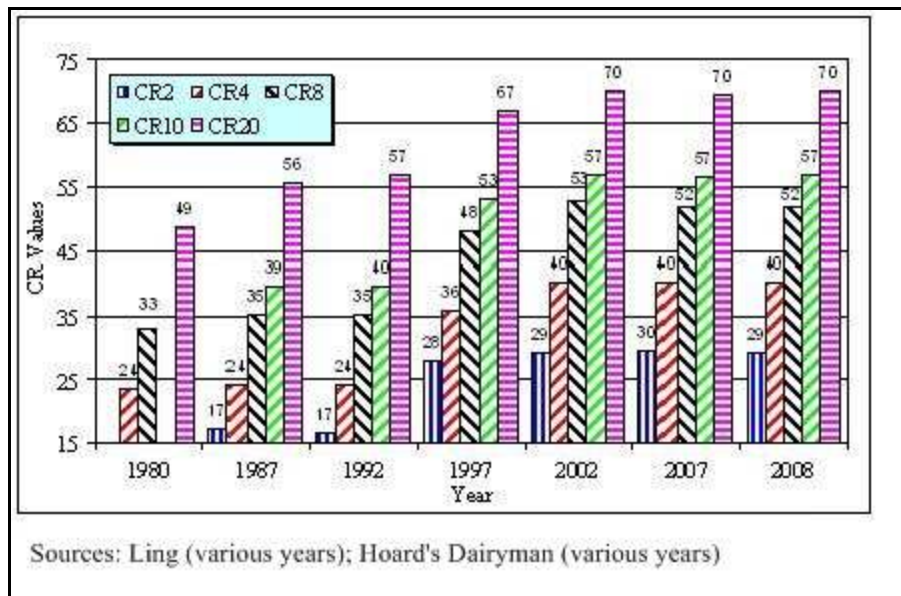


Figure 3. Cooperative CR Values of Total U.S. Milk Marketed

A second measure of industry concentration that has been developed by economists is known as the Herfindahl-Hirschman Index (HHI). Some believe that the HHI provides a more complete picture of industry concentration than does the CR statistic. The HHI uses the market shares of all the firms in the industry, and these market shares are squared in the calculation to place more weight on larger firms.

Unlike the CR value, the HHI will change if there is a shift in market share among the larger firms. Given the formulation of the HHI, if there were only one firm in the industry that firm would have 100% market share implying an HHI of 10,000 which is the monopoly HHI value. Alternatively, if there were a very large number of firms competing, each of which having

nearly zero market share, then the HHI would be close to zero, indicating nearly perfect competition. The U.S. Department of Justice (DOJ) uses the HHI in guidelines for evaluating mergers. An HHI of less than 1000 represents a relatively unconcentrated industry/market. The DOJ would usually not be concerned with a merger that leaves an industry with an HHI less than this value. The DOJ considers an HHI between 1000 and 1800 as representing a moderately concentrated market and the DOJ likely would closely evaluate the competitive impact of a merger that would result in an HHI in that range. Markets having an HHI greater than 1800 are considered to be highly concentrated. The DOJ considers a merger resulting in an HHI greater than this value as raising serious anti-trust concerns if the merger increases the HHI by more than 100 or 200 points.

Using the above HHI formula we examined the distribution of only milk marketed by cooperatives, in contrast to the CR values which were evaluated with respect to all farm milk produced in the United States.

Using data for the largest 50 cooperatives and the amount of farm milk marketed by all U.S. dairy cooperatives over the 1987-2008 period we obtained HHI values that increased from 472 in 1992 to 924.3 in 2008 (Figure 4). The 51st cooperative was an aggregate “other cooperative” representing all those not in the top 50. These cooperatives represented less than 4% of the milk marketed in 2008. The trend to observe from this figure is the significant increase between 1992 and 1997 due mainly to the creation of DFA in 1997.



Figure 4. Concentration in Cooperatively Marketed Milk as Represented by the HHI

The increased concentration of dairy cooperatives has occurred for a variety of reasons. These reasons include: improve bargaining position for members, improve ability to integrate operations to achieve economies of scale and scope, tight operating margins and capital constraints, rapid increases in information technology and increase in volatility of milk prices since the late 1980's (GAO, 2001; Cropp 2002).

Consolidation in Dairy Manufacturing

Similar to the marketing of farm milk, there has been significant consolidation in dairy manufacturing. During the 1990's a dominant method to expand was via the purchasing of regional manufacturing firms. For example, over 1997-2000 more than 60 dairy processors were purchased by Suiza and Dean Foods. From its founding in 1993, Suiza Foods became the largest fluid milk bottler in seven years (Siebert et al, 2000). Dean Foods was founded in 1925 in northwestern Illinois. Prior to its merger with Suiza Foods in April 2001, it represented the third largest dairy processing firms defined by the value of dairy products sold resulting from acquisition of a number of dairy processors. Between 1997 and 2000, Suiza Foods had purchased

regional processing firms with a cumulative sales value at the time of acquisition of \$3.3 billion while Dean Foods had purchased firms with a cumulative sales value of \$1.6 billion (Dairy Foods, various issues; GAO, 2001). In Table 2 we show the importance of these two firms over 1995-2000 in sales ranking. The combined company, under the Dean Foods name, processes 33% of the U.S. fluid milk and is included in the S&P 500 stock index.

Table 2. Share of the Value of Shipments by Top 100 Dairy Processors Represented by Dean Foods and Suiza

| | Suiza | | Dean Foods | |
|------|-------------|------|-------------|------|
| | \$Mil Sales | Rank | \$Mil Sales | Rank |
| 1995 | 379 | 40 | 1,400 | 5 |
| 1996 | 469 | 32 | 1,600 | 2 |
| 1997 | 1,720 | 4 | 2,100 | 3 |
| 1998 | 2,820 | 3 | 3,000 | 2 |
| 1999 | 4,237 | 2 | 3,200 | 3 |
| 2000 | 5,365 | 1 | 3,255 | 3 |

Source: GAO, 2001

Figure 5 shows CR statistics with respect to the total value of dairy products sold by the top 100 U.S. dairy processing firms. In 2008, approximately 19% of the total value of dairy products produced in the United States was accounted for by the two largest dairy firms, Dean Foods and Kraft Foods-North America (Dudileck, 2009). Over 1995-2008, the top 20 firms increased their market share from 55% to 67%. These national values tend to hide concentration within local areas and commodities. Although dated, Table 3 is used to show the percentage of fluid milk marketed by the four largest dairy processors in various metropolitan areas over a number of years (GAO, 2001). With the trend observed at the national level since 2000, it is reasonable to assume that the 1999 values can be considered minimum CR4 values.

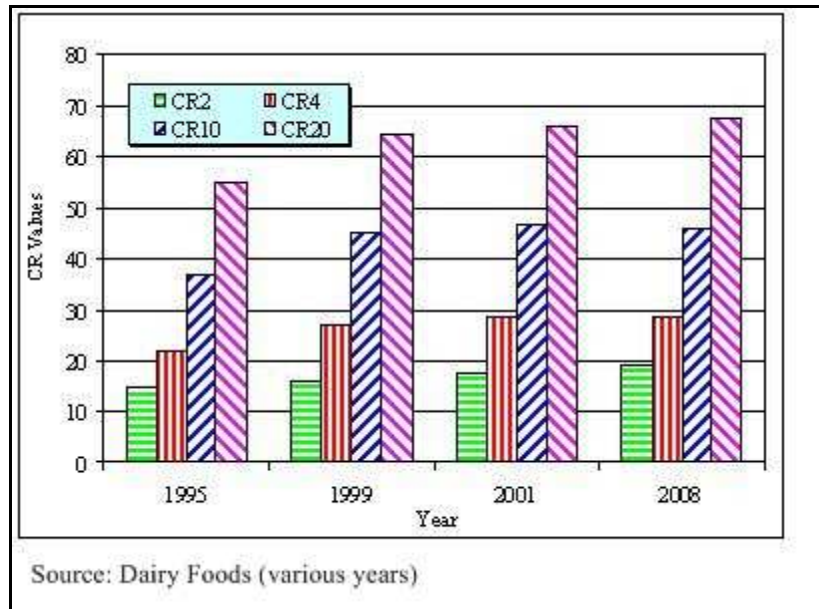


Figure 5. Concentration Ratios in Dairy Processing as Represented by CR Values

Table 3. Percentage of Fluid Milk Marketed by 4 Largest Processors Dec 1997–Dec 1999 by City

| Area | Dec '97 | Dec '98 | Dec '99 | Area | Dec '97 | Dec '98 | Dec '99 |
|---------------------|---------|---------|---------|----------------|---------|---------|---------|
| Atlanta | 38.5 | 47.8 | 52.4 | Atlanta | 81.6 | 80.3 | 75.9 |
| Boston | 66.2 | 85.4 | 88.1 | Boston | 84 | 89.3 | 83.4 |
| Charlotte | 64.4 | 74.7 | 73.9 | Charlotte | 38.5 | 47.8 | 52.4 |
| Cincinnati | 66.8 | 79.3 | 81.9 | Cincinnati | 90.3 | 87.6 | 97.4 |
| Dallas | 85 | 84.3 | 79.4 | Dallas | 87.7 | 90.4 | 92.5 |
| Denver | 69.3 | 68.1 | 66.9 | Denver | 59 | 63.4 | 63.3 |
| Miami | 89.4 | 96.5 | 96.3 | Miami | 45.7 | 43.7 | 54.5 |
| 1999 U.S. CR4: 26.8 | | | | 14-Market Avg. | 69 | 74.2 | 75.6 |

Source: GAO, 2001

Similar to our calculation of the concentration in the marketing of cooperative milk, we evaluated HHI values using the above data. The HHI value is much less than 1000 but shows a similar trend of becoming increasingly concentrated. In 1995, the top 100 processors generated an HHI index of 238. This increased to 382 by 2008, well below the critical 1000 level. Again it should be cautioned that the regional HHI values are likely to be much larger than the national values given, especially for bottled milk due to a market size that is regional in nature.

Pricing of Farm Milk and Concentration Implications

A majority of the milk produced in the United States is marketed under Federal and State milk marketing orders. Typically under these marketing orders, minimum prices for milk are determined via a series of formulas which relate the farm value of milk components—for example: fat, protein, other solids—to their value reflected in recent wholesale commodity prices. Once the component values are known then the farm value of milk can be determined.

The formulas used often vary depending on how milk is utilized. Under the Federal Milk Marketing Order system which in 2009 accounted for two-thirds of the milk marketed in the U.S., there are four classes of milk: Class I (beverage products), Class II (soft manufactured products), Class III (hard cheese and cream cheeses) and Class IV (butter and non-fat dry milk). Class specific minimum prices based on component values are used to establish minimum milk class prices. As an example, the value of Class III milk is determined by monthly average wholesale prices of cheddar cheese, butter, and dry whey. These monthly average cheese prices are obtained from weekly surveys of national dairy product sales data by the National Agricultural Statistics Service (NASS). For a review of milk pricing under the FMMO system refer to Jesse and Cropp (2008)

The following provides an example of how the uniqueness of the dairy industry makes it susceptible to undue market power.

“...Certain market conditions at the [Chicago Mercantile Exchange] spot cheese market continue to raise questions about the potential for price manipulation.”

[GAO report to Congress on the CME spot cheese market, June 2007, p. 1]

“During the period May 21 through June 23, 2004, DFA, Hanman and Bos attempted to manipulate the price of the [CME] June, July and August 2004 Class

III milk futures contract. DFA, Hanman and Bos attempted to manipulate Class III milk futures contract prices through purchases of cheddar cheese blocks on the CME Cheese Spot Call market in an effort to minimize potential losses from DFA's speculative long Class III milk futures positions" [Commodity Futures Trading CFTC Order, Dec. 16, 2008, p.2].

In 2008, DFA accounted for 20.1% of all farm milk deliveries in the United States (Buske, 2009). For a copy of the consent decree refer to the following URL:

<http://future.aae.wisc.edu/pubs/pubs/show/409>. This case provides a clear example of how a thinly traded commodity, a large supplier of farm milk to the U.S. dairy industry, and a formula-based milk pricing system create an environment where market manipulation can occur.

Related to the above, are several important characteristics of the U.S. cheese manufacturing industry that greatly facilitated manipulation of the cheese price and therefore the announced Class III price. First, it is a standard industry practice for cheese manufactures to price their product based on movements in the CME spot cheddar cheese market. This can be seen in Figure 6 where we show the NASS average cheddar block price and the weekly average CME spot block price lagged by two weeks. Over 99% of the variability in the NASS average block price is explained by movements in the CME spot block market.

The CME spot market is a thinly traded market where typically less than 2% of monthly U.S. cheddar cheese production is traded in this spot market. In addition there are very few participants in this market, mainly large companies and cooperatives. As an example, over Jan. 1, 1999 – Feb 2, 2007 the largest two buyers of cheddar blocks accounted for 74% of the transactions. The largest two sellers of cheddar barrels accounted for 68% of the transactions. In addition, over this same period, a majority of the closing prices are determined by unfilled bids

and uncovered offers (GAO, 2007). During the period covered by the CFTC order DFA was one of these few participants.

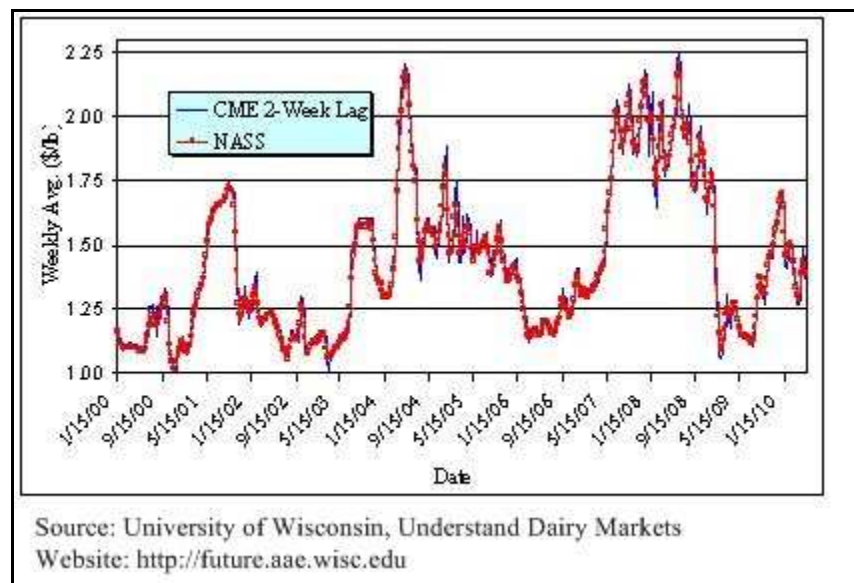


Figure 6. Relationship Between Weekly 2-Week Lagged CME Spot Cheddar Prices and NASS Average Cheddar Block Price

A second characteristic concerns the relationship between Class III futures contract settlement and the formula-based Class III milk price. The Class III futures contract is a cash-settle contract which means there is no delivery requirement associated with the purchase of a Class III futures contract.

Ongoing Industry Challenges

The dairy industry has had a history of significant structural change in the location, scale and number of participants. These changes are continuing to occur as a result of improved technologies at both the farm and processing levels, increased energy costs and increased milk price volatility.

There are a number of challenges facing the industry. It has been industry practice to use the CME spot price of cheese as a benchmark by which plants determine their sales price. This is a problem, given that this market has few participants and those participating undertake a limited

number of transactions. The question remains as to how the industry can move away from this reliance (Carstensen, 2010). There is considerable industry debate concerning elimination of the current formula based pricing system for farm milk to one based on plant surveys of prices paid for manufacturing milk instead of wholesale commodity prices.

There are local areas across the United States where a single dairy cooperative that markets a significant percentage of farm milk has entered into supply agreements with fluid milk bottlers that service a majority of local retail food establishments. Given the expected continued concentration of the marketing of farm milk, processing of that milk and retail distribution such arrangements are expected to become more common and thus requiring continued monitoring by the appropriate anti-trust and regulatory officials (Flagg, 2010; Carstensen, 2010).

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