Basic Milk Pricing Concepts for Dairy Farmers

Ed Jesse and Bob Cropp

Milk pricing is complicated. Historically, most dairy farmers have understandably been quite content to worry about making milk and to let their dairy plant worry about marketing their milk.

This was a sound strategy until the 1990s. Until then, milk prices were quite stable and predictable, seldom moving more than a few cents per hundredweight (cwt) from the announced support price under the federal dairy price support program. Stability meant little need for dairy farmers to worry about pricing milk beyond selecting a plant that offered the best price and other incentives. Moreover, even if dairy farmers wanted to be more actively involved

in pricing their milk, there were no practical risk management tools to allow them to do so.

But marketing milk at the farm level has fundamentally changed. First, milk prices have become much more volatile. Month-to-month price changes of $2–$3 per hundredweight and year-to-year average price changes of $5–$6 have become common (figure 1). These extreme price movements provide producers a strong incentive to practice price risk management.
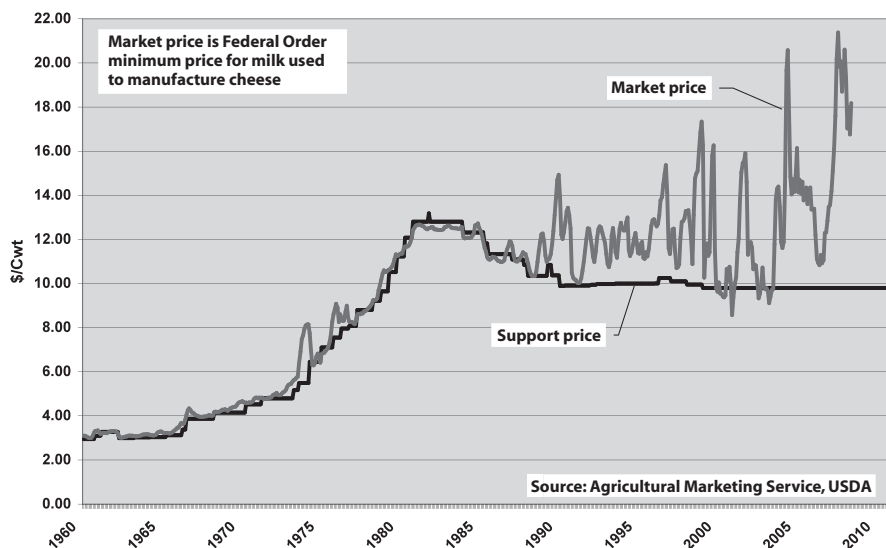
Second, dairy farm managers now have the opportunity to protect price and profit objectives through the use of futures, options, and forward price contracts — something their grain and livestock compatriots have been able to do for many years.[1]

So matters that were previously understood by only a few people, such as product formula make allowances, advanced higher-of Class I pricing, and producer price differentials, now make a difference to individual farmers who can use this information in futures-based price risk management strategies.

In this publication, we explain milk pricing concepts for dairy farmers and others who don't need to know all of the intricate details but seek a basic understanding of how milk is priced — in particular, how federal milk marketing order prices are derived and how orders and other federal milk pricing rules affect dairy farmers' farm-level milk prices.

We begin by discussing how markets for manufactured dairy products operate, since minimum federal order prices have been based exclusively on these markets since 2000. That discussion includes a brief review of the federal Dairy Product Price Support Program. Next, we describe the federal order system. We cover basic principals of classified pricing and pooling, show how milk component and class prices are derived, and demonstrate the calculation of pool values and producer pay prices. Finally, we discuss some controversial issues surrounding milk pricing — issues that have occupied economists and politicians for several decades.

Figure 1. Market and support prices for milk

Market price is Federal Order minimum price for milk used to manufacture cheese

Market price

Support price

Source: Agricultural Marketing Service, USDA

[1] For details regarding dairy price risk management options and strategies, see E.V. Jesse and R.A. Cropp, *Futures and Options Trading in Milk and Dairy Products: A Guidebook for Dairy Producers*, Cooperative Extension, University of Wisconsin-Extension, Bulletin A3732.

Markets for dairy products

Utilization of milk

Farm milk prices are the outcome of the interaction of supply and demand for hundreds of dairy products. These products vary according to how they are ultimately consumed. Some, such as homogenized 2% (reduced fat) milk in gallon plastic jugs and yogurt in six-ounce plastic containers, are purchased in grocery stores and other outlets for at-home family consumption. Some, such as wheels of Swiss cheese and bulk containers of ice cream, are distributed to consumers after some preparation through delis, restaurants, and cafeterias.

Other dairy products, including most of the mozzarella cheese produced in the United States, reach consumers as primary or secondary ingredients in other foods such as pizza. And other products, such as nonfat dry milk, whey products, and dried cheeses, are all but hidden in the long list of ingredients for bakery items, snack foods, and other processed food products.

For the purpose of discussing markets and prices, it is useful to separate dairy products into fluid and manufactured categories because prices for these products are determined in different ways. Prices for storable manufactured dairy products such as butter, cheese, whey, and nonfat dry milk are market determined. That is, these prices are established by product supply and demand conditions except when the dairy product price support program is active. These market-determined manufactured product prices then set the minimum prices for milk used to make the products through federal and state milk marketing order pricing formulas, which are discussed later in this report. In other words, competitive conditions in these manufactured dairy product markets determine the minimum amount that manufacturers are required to pay for their raw product.

In contrast, minimum prices for milk used to produce beverage milk products (and some perishable manufactured products) are not based on supply conditions for these products. Instead, federal and state milk marketing orders administratively set minimum fluid milk prices by linking them directly to the prices for milk used for manufacturing. In other words, prices for fluid milk are not based on supply and demand conditions for fluid milk; they are based on supply and demand conditions for manufactured dairy products. This is an important distinction that we will revisit later.
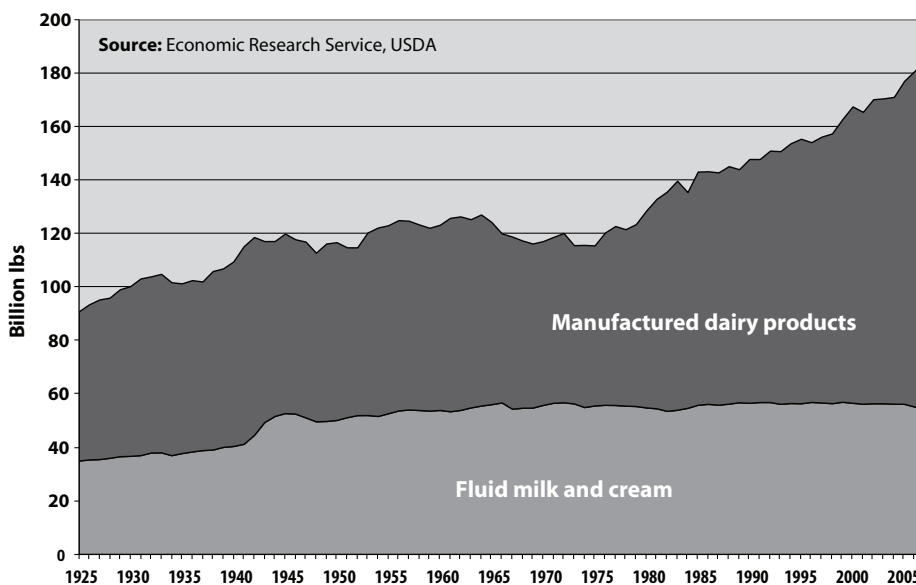
Over the last 50 years, milk use in the United States has shifted gradually from fluid forms to manufactured products (figure 2). In 1950, fluid milk and cream took about half of the milk supply, compared to 30% in 2007.[2] Note that fluid milk took an increasing share of the milk supply from the 1920s until the mid-1970s. This trend was due to two factors — the increasing use of home refrigeration, which made bottled milk a mainstay in the American diet, and the rapid displacement of butter by margarine, which reduced the amount of milk used for manufacturing.

Since the mid-1970s, total use of milk for fluid milk and cream has increased slowly while growth in manufacturing use has accelerated. Most of this growth has been in cheese. On a per capita basis, fluid milk consumption decreased 20% between 1975 and 2006 (table 1).[3] Per capita cheese consumption more than doubled over that period, with the largest growth in "other" varieties — mostly mozzarella and other Italian cheeses. Per capita butter consumption was stable and other categories showed a decline in per capita usage.

Figure 2. Utilization of U.S. milk for fluid and manufacturing purposes

[2]Milk utilization noted here is based on receipts of fluid milk handlers and manufacturers as reported by the Economic Research Service, USDA; that is, the volume of raw milk used for fluid and manufacturing. As demonstrated later, utilization based on the butterfat and nonfat solids contained in milk yields a different utilization pattern since beverage milk is standardized to achieve a fat content less than the content of milk as it comes from the cow.

[3]Population growth slightly offset lower fluid milk use per capita, yielding larger total consumption.

Table 1. U.S. Per capita consumption of selected dairy products, in pounds

Year	Fluid*	Butter	American cheese	Other cheese	Evaporated and condensed	Ice cream and frozen desserts	Dry products	All products, milk equiv., fat basis
1975	261	4.7	8.4	6.1	8.9	28.7	5.8	539
1976	260	4.3	9.0	6.7	8.6	27.5	6.3	540
1977	258	4.3	9.3	6.8	8.2	27.4	6.2	540
1978	254	4.4	9.6	7.4	7.6	27.3	6.0	544
1979	251	4.5	9.6	7.6	7.4	26.3	6.5	548
1980	246	4.5	9.6	7.9	7.1	26.2	6.2	543
1981	242	4.2	10.2	8.0	7.3	26.3	5.4	541
1982	236	4.4	11.3	8.6	7.0	26.1	5.6	555
1983	236	4.9	11.6	8.9	7.0	26.9	5.9	573
1984	238	4.9	11.9	9.6	7.4	27.1	6.3	582
1985	241	4.9	12.2	10.4	7.4	27.6	6.4	594
1986	240	4.6	12.1	11.0	7.9	27.8	6.8	592
1987	237	4.7	12.4	11.7	7.9	28.1	6.8	601
1988	237	4.5	11.5	12.2	7.7	27.6	6.9	583
1989	237	4.4	11.0	12.8	7.8	28.6	6.3	564
1990	233	4.4	11.1	13.5	8.0	28.6	7.4	568
1991	232	4.3	11.0	13.9	8.1	29.3	6.8	564
1992	229	4.3	11.3	14.6	8.4	28.8	7.3	563
1993	224	4.6	11.3	14.7	8.1	29.1	6.8	569
1994	223	4.8	11.4	15.1	8.1	29.6	7.9	580
1995	221	4.4	11.7	15.2	6.8	29.0	7.3	576
1996	220	4.3	11.8	15.5	6.3	28.2	7.5	566
1997	216	4.1	11.8	15.7	6.4	28.3	7.1	567
1998	213	4.4	11.9	15.9	6.1	29.0	7.0	572
1999	213	4.7	12.6	16.4	6.5	28.6	6.5	584
2000	210	4.5	12.7	17.1	5.8	28.0	6.8	593
2001	208	4.4	12.8	17.2	5.5	27.0	7.3	587
2002	207	4.4	12.8	17.6	6.0	26.6	7.2	587
2003	208	4.5	12.5	18.0	5.9	27.2	7.3	595
2004	206	4.6	12.9	18.3	5.4	24.2	7.8	594
2005	205	4.6	12.6	18.9	5.9	24.4	6.3	597
2006**	208	4.7	13.0	19.4	6.4	24.3	5.2	606
% Change, 1975–2006	-20.3%	0.6%	55.3%	218.6%	-27.9%	-15.4%	-10.6%	12.4%

*Includes sour cream, eggnog, and yogurt, **Preliminary* 　　　　*Source: USDA/ERS, Livestock, Dairy, and Poultry Situation & Outlook.*

Determining how the U.S. milk supply is allocated to various dairy products is not a straightforward process. Few dairy products are produced independently of others. For example, butter, nonfat dry milk, and buttermilk powder are joint products in a butter-powder plant. So adding up the pounds of milk used to make butter, nonfat dry milk, and buttermilk powder would involve triple counting of the milk used. Similarly, cheese, whey powder, and whey cream are produced together. Cream skimmed from lower-fat fluid milk products flows freely among several products such as whipping cream, ice cream, and butter.

It is easier and more instructive to show how milk *components* are allocated among dairy products. Doing so also emphasizes that milk is not a homogeneous good — it is a bundle of physical components and other characteristics that have different values in different dairy products.

USDA annually calculates total availability of butterfat and nonfat milk solids and the use of these components across products.[4] Utilization for 2007 is shown in figure 3.

Note that 80% of the butterfat produced in the United States in 2007 was used in three products: butter, cheese, and fluid milk and cream. These same three products absorbed 45% of nonfat solids production, with butter accounting for only 0.1% of nonfat solids use. Ice cream and other frozen products and cultured dairy products represented other significant outlets for butterfat, while whey and nonfat dry milk accounted for about 20% of nonfat solids usage.

Looking at how milk components are used within product categories helps us understand how changes in demand for dairy products can bring about relative shortages and surpluses of milk components. For example, a reduction in demand for fluid milk, which uses about 32% of nonfat milk solids production but only 23% of butterfat production, would mean relatively more nonfat solids than butterfat would need to find a home in different products. In a similar sense, expanded demand for cheese would increase butterfat usage relative to nonfat solids.

Aggregate utilization of milk components masks major differences across regions of the United States. Using milk utilization by product class as reported by federal milk marketing orders, figure 4 shows differences in utilization between the Northeast federal order (primarily New York and Pennsylvania) and the Upper Midwest order (primarily Wisconsin and Minnesota).

Given its proximity to large East Coast population centers, the Northeast order supplies a relatively large proportion of its milk for fluid and soft manufactured products (67% in 2007). The use of milk for butter and nonfat dry milk in this order is also relatively high because butter-powder plants serve as an outlet for "balancing" fluid milk bottlers' needs with the available milk supply.

In contrast, the Upper Midwest order is located further from dense population centers. Consequently, only 22% of its milk supply was allocated to Class I and Class II in 2007, and three-quarters was used to make cheese.

Figure 3. Utilization of U.S. butterfat and nonfat milk solids by product, 2007
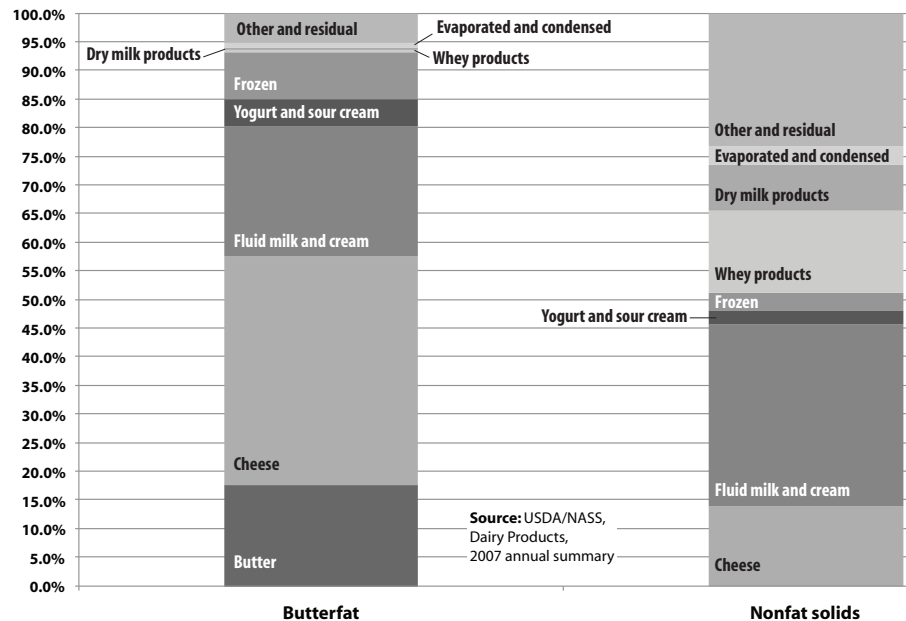
[4]National Agricultural Statistics Service, U.S. Department of Agriculture, *Dairy Products, Annual Summary*, 2007.

Wholesale dairy product markets

The manner in which producer milk is utilized in various products emphasizes the importance of markets for butter, cheese, nonfat dry milk, and whey in determining farm milk prices. Organized wholesale cheese and butter markets, operated through the Chicago Mercantile Exchange (CME), are especially important in milk pricing, since they serve as pricing bases for products that utilize the bulk of manufactured milk volume.
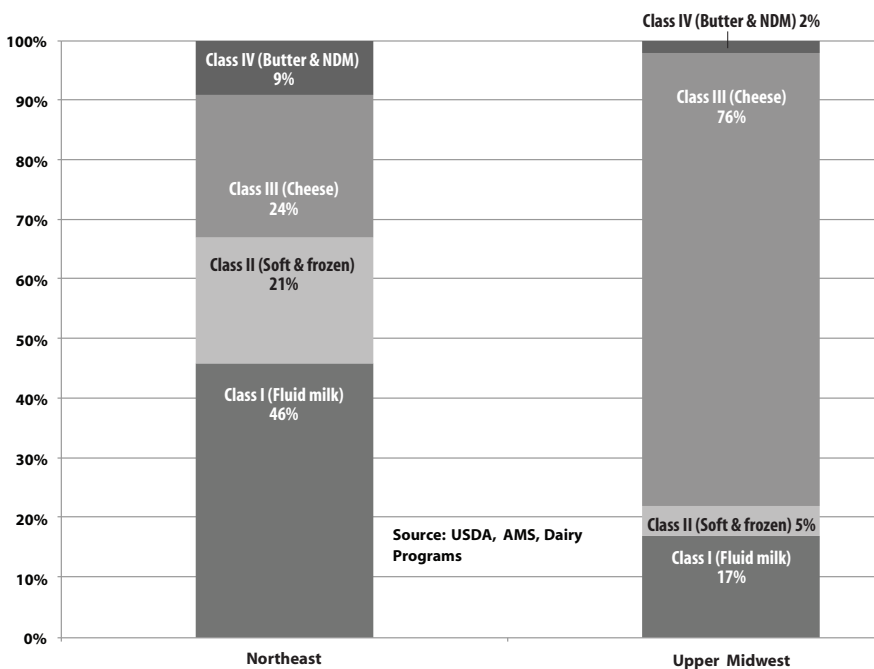
Butter

Brokers representing butter buyers and sellers trade Grade AA butter on the CME each non-holiday weekday of the year. The trading session usually lasts only five minutes, but it may be extended if the market is active. While very little butter changes hands on the CME butter market, the price established at the end of the trading day becomes a reference price used for selling butter throughout the United States under various contractual arrangements.

The Exchange operates as an auction market with offers to sell and bids to buy butter. But unlike an auction, there may or may not be any actual transactions during a particular trading session. The reported price at the end of a trading session can change from the previous session with a *sale*, an *uncovered offer*, or an *unfilled bid*. An uncovered offer occurs when butter is offered at a price lower than the last transaction price or offer and there is no buyer. Since nobody wants to buy at the lower price, the assumption is that the market-clearing butter price is no higher than the offer. An unfilled bid is a bid that is higher than the last transaction price or bid that attracts no seller. An unfilled bid suggests that the market-clearing butter price is at least as high as the bid.

In 2007, 630 carlots (40–43 thousand pounds/carlot) of Grade AA butter were traded on the CME. This amount represented about 1.7% of total 2007 butter production. Despite the limited volume of CME butter trading relative to production, the reported price is viewed by butter industry participants as an accurate price barometer. The argument goes like this: The larger butter traders participating on the CME through their brokers account for most of the butter production and use in the United States. These traders only offer to sell butter on the Exchange if they are unable to sell butter on the regular commercial market at the going price, and they only bid to buy butter if they are unable to obtain sufficient quantities of butter elsewhere. This marginal selling and buying activity on the CME is perceived to reflect the overall commercial supply and demand situation.

Because of this trade confidence, most butter manufacturers sell butter under contracts that peg the price to the CME quote. Since the value of cream is largely in the butterfat it contains, cream prices are also tied to the CME butter price. And since cream is the primary ingredient in ice cream and other frozen dairy products, wholesale prices for these dairy products are also tied closely to the CME butter price. Because of its extensive use as a reference price, the CME butter market has an influence on butterfat prices that is much larger than suggested by the trading volume.

Figure 4. Percent of milk utilized by class: Northeast and Upper Midwest federal orders, 2007

Source: USDA, AMS, Dairy Programs

Northeast:
- Class IV (Butter & NDM) 9%
- Class III (Cheese) 24%
- Class II (Soft & frozen) 21%
- Class I (Fluid milk) 46%

Upper Midwest:
- Class IV (Butter & NDM) 2%
- Class III (Cheese) 76%
- Class II (Soft & frozen) 5%
- Class I (Fluid milk) 17%

Cheddar cheese

The CME operates a daily wholesale market for cheddar cheese in two styles — 40-pound blocks and 500-pound barrels. The cheese market operates the same as the butter market and for the same five-minute length of time unless trading is extended. Prices can change from the previous trading session with an actual sale, an unfilled bid, or an uncovered offer.

In 2007, 451 carlots (40–44 thousand pounds/carlot) of block cheddar cheese and 485 carlots of barrel cheddar cheese were traded on the CME. The combined volume of trading represented about 1.3% of cheddar cheese production and 0.4% of the production of all cheese in 2007.

Like the CME butter price and for the same reasons, the CME cheddar cheese prices serve as reference prices for other cheese trades. The prices established at the end of the daily trading session are used in formula pricing of most of the cheese made in the United States, cheddar as well as other varieties.

The "thinness" of the central wholesale markets for butter and cheese has long been a source of concern in the dairy industry. Unusually large session-to-session variability in cheese prices in 2007 intensified concerns and raised questions about whether trading legitimately reflects supply and demand conditions. If the CME prices applied only to the small volumes traded on the butter and cheese exchanges, these questions may not be relevant. But in light of the great extent to which formula pricing is tied to the exchange prices, what happens on the exchanges gains considerable prominence — the small volume of trading influences an enormous volume of cheese and butter sales.

Controversy over charges that cheddar cheese prices had been manipulated on the National Cheese Exchange (NCE), the predecessor of the CME, led to the shifting of the central cheese market to the CME in 1997. The NCE had previously been the subject of several investigations, none of which yielded a legal finding of price fixing. A 2007 report by the Government Accounting Office acknowledged industry concerns that the CME spot cheese market was subject to manipulation. Yet the report went on to recommend that USDA should use the CME prices directly in setting federal order prices rather than using average sales prices collected and reported by the National Agricultural Statistics Service.[5]

For better or worse, the exchanges continue to play a very large role in pricing butter and cheese, and, through federal order pricing formulas discussed later, farm-level milk.

Nonfat dry milk and dry whey

The CME maintains wholesale cash markets for Extra Grade and Grade A nonfat dry milk, but there has been little activity on these markets and they do not play the same role in pricing as the CME butter and cheese markets. There were no trades in Extra Grade and one trade in Grade A nonfat dry milk in 2007.

Until about 2004, prices for nonfat dry milk were heavily influenced by the Commodity Credit Corporation (CCC) as a major purchaser of nonfat dry milk under the Milk Price Support Program. Except for brief periods, the CCC purchase price for nonfat dry milk set the commercial market price. Starting in 2005, U.S. exports of nonfat dry milk grew rapidly as a result of a worldwide shortage of dry milk proteins. World market prices, which

were well above the CCC purchase price, became instrumental in setting the value of nonfat dry milk.

Most U.S. nonfat dry milk is produced by cooperatives, and most of these cooperatives are members of Dairy America, a federated cooperative created to collectively market nonfat dry milk exports. Through a joint venture, Fonterra, a large New Zealand-based dairy cooperative with extensive international sales, handles Dairy America's exports. This consolidated marketing of nonfat dry milk overseas is likely a major reason that the CME spot market is inactive — the uncommitted volume of nonfat dry milk may not be large enough to support a wholesale market.

There is no central spot market for dry whey products. There are few dry whey manufacturers relative to cheese plants, as most cheese plants divert their liquid whey to specialized dryers. Prices are established through individual negotiations between buyers and sellers, often through brokers and other middlemen firms. An increasing proportion of U.S. dry whey production has been sold in export markets, and as a result, world market prices have a significant influence on U.S. prices for whey.

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[5]U.S. Government Accountability Office, *Spot Cheese Market: Market Oversight Has Increased, but Concerns Remain about Potential Manipulation*, GAO-07-707, June 2007.

The dairy product price support program[6]

From time to time, prices for butter, cheese, and nonfat dry milk — and consequently milk prices — are affected by federal price supports. The Dairy Product Price Support Program operates through a standing offer by the CCC to purchase unlimited quantities of butter, nonfat dry milk, and cheddar cheese at specified purchase prices.

The purchase prices are detailed in the Food, Conservation, and Energy Act of 2008: butter–$1.05 per pound; block cheddar cheese–$1.13 per pound; barrel cheddar cheese–$1.10 per pound; and nonfat dry milk–$0.80 per pound. These prices may be reduced if CCC net removals of product exceed specified levels for 12 consecutive months.[7] These trigger inventory levels are very large compared to recent net removals and are not expected to alter purchase prices during the life of the Act.

Prior to passage of the 2008 Act, Congress specified the support price for milk used for manufacturing purposes. Using product price formulas, USDA then translated the support level for milk into associated CCC purchase prices for the eligible dairy products. The product purchase prices currently in place under the 2008 Act are the same as those associated with a $9.90 milk support price under previous legislation. So while milk price objectives are no longer directly relevant in setting product purchase prices, plants selling products at the CCC purchase prices would be expected to earn sufficient revenue to pay producers $9.90 per hundredweight of milk at average butterfat test.

The Dairy Product Price Support Program operates in the background of the commercial markets for the supported dairy products. If milk supply and demand are in good balance or if milk supplies are tight relative to demand, then production of hard manufactured products will be correspondingly low and product prices will be above the CCC levels. Products will move to commercial outlets and the support program will be inactive.

If milk supplies are large relative to demand, then the supply of milk not needed for perishable products will increasingly be diverted to the manufacture of storable products. Prices for these products will fall with increased supply. At some point, the CCC

purchase prices will represent a more profitable market for some plants than commercial outlets.[8] Because of interplant competition for the available supply of milk for manufacturing, the CCC prices will also buttress prices for other manufactured products that are not 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, mozzarella plants will need to pay at least as much in order to retain their milk supply.

The CCC may sell back to commercial markets products purchased under the support program at not less than 110% of the purchase price.[9] These sales are referred to as unrestricted sales. As surplus milk production eases, prices for butter, cheese, and nonfat dry milk will increase, enabling the CCC to reduce stocks through commercial market sales.

Besides making unrestricted sales, the CCC makes surplus dairy products available for use in several domestic and foreign food programs. 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. The CCC has also held fire sales of nonfat dry milk for cattle feed and for manufacturing milk protein concentrate when stocks were especially burdensome.

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[6]The Food, Conservation, and Energy Act of 2008 changed the name of the federal dairy price support program from the Milk Price Support Program to the Dairy Product Price Support Program. The Act also reauthorized and modified the Milk Income Loss Contract (MILC) program, which pays dairy producers when milk prices fall below a specified level. MILC is an income support program, not a price support program. Consequently, we do not discuss MILC in this report, which focuses on milk pricing.

[7]Net removals under the 2008 Act are defined as purchases plus Dairy Export Incentive Program (DEIP) removals minus unrestricted sales.

[8]The market price for commodities purchased by the CCC may fall below the CCC purchase price because selling to the CCC involves additional costs relative to selling to commercial buyers. These costs include special packaging requirements, mandatory inspections and grading, and delayed payment. In early 2003, the CME price for block and barrel cheese fell as much as 12 cents per pound below the CCC purchase prices.

[9]The percentage markup over CCC cost for unrestricted sales is occasionally altered.

The effect of the federal dairy price support program on milk prices has been substantially reduced over the years. Once tied to parity,[10] the announced support price reached $13.10 per hundredweight in the early 1980s. Milk production increased rapidly in response to rapidly increasing prices, and surpluses mounted (figure 5). High government costs induced Congress to decouple the support price from parity and gradually lower it from $13.10 per hundredweight in 1981 to $10.10 in 1990, where it remained through 1995.

Since the $10.10 level was below the full cost of production for most dairy farmers, government purchases, with the exception of nonfat dry milk, essentially dried up. CCC purchases of both butter and cheese in calendar years 1996–2007 averaged less than 0.5% of production. And CCC stocks of nonfat dry milk disappeared in 2006 with escalating world market prices.

The 1996 Farm Bill increased the support price to $10.35 per hundredweight for 1996, with three scheduled reductions of 15 cents each to bring the level down to $9.90. The Bill required termination of the program on December 31, 1999. Subsequent legislation extended the program until May 2002, when the 2002 Farm Bill reinstated the program at the $9.90 support level for milk.

The $9.90 milk price objective and the related dairy product prices specified in the Food, Conservation, and Energy Act of 2008 are very low relative to market prices. There have been no government purchases of butter, cheese, or nonfat dry milk since 2004. Given current dairy production input costs, especially for feed, large losses would be incurred by dairy farmers if the manufacturing milk price fell to $9.90.

The extended dormancy of dairy price supports has raised questions as to whether the program can be justified. Some dairy market observers argue that the program has outlived its usefulness and should be discarded or replaced. Critics also point to the large contribution of the program to the United States' "Aggregate Measure of Support" under the Uruguay Round of the World Trade Organization (WTO), and question the viability of the program under a new agreement that would likely cut permitted levels of domestic price support.[11]

Others involved in the dairy industry, including most dairy cooperatives, strongly defend the support program as an effective, inexpensive way to provide a floor on the prices of principal dairy products—albeit a very low floor. Supporters argue that eliminating the support program would lead to even greater milk price volatility, since down-side price movements would be unconstrained. There is considerable fear about how low prices might fall without the price support program safety net.

Figure 5. Government purchases of dairy products

Source: Economic Research Service, USDA
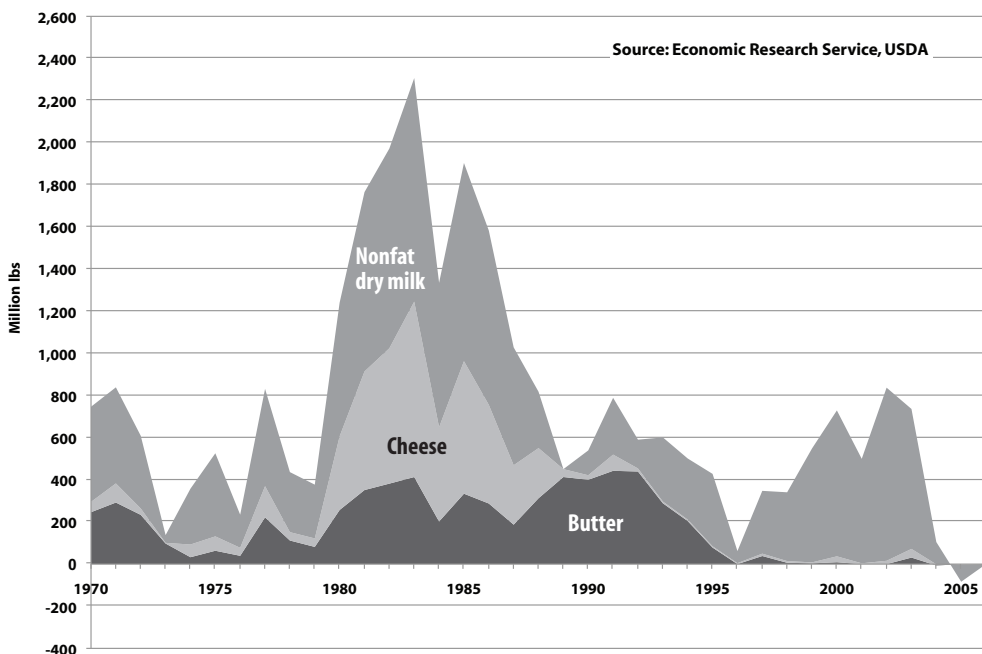
[10]Parity milk price does not reflect the cost to produce milk but rather maintains the same purchasing power of milk as it had in the base years of 1910–1914.

[11]The Milk Price Support Program accounted for about 25% of the total annual level of domestic support ($19.1 billion) permitted by the United States under the Uruguay WTO Round. The 2008 Farm Bill change to supporting product prices instead of the milk price is expected to reduce the contribution of dairy because the volume of production used in the calculation will presumably be the production of butter, cheese, and nonfat dry milk instead of total U.S. milk production.

Federal milk marketing orders

Federal milk marketing orders set minimum prices for about 70% of the Grade A milk produced in the United States, and Grade A milk constitutes 99% of all U.S. milk (see sidebar: Grade A and Grade B milk). California, which accounts for more than 20% of U.S. milk production, uses a state pricing system that is very similar to federal order pricing.

Federal orders are authorized under the Agricultural Marketing Agreement Act of 1937, as amended. The Act is enabling legislation; that is, federal orders are not mandated. Dairy producers must request and approve an order through a hearing and referendum process.

USDA cites three major objectives of federal milk orders:

1. To assure consumers of an adequate supply of wholesome milk for beverage purposes, at a reasonable price

2. To promote greater producer price stability and orderly marketing

3. To provide adequate producer prices to assure an adequate current and future Grade A milk supply

These objectives are achieved through the following methods:

- **Classified pricing:** Minimum pay prices are established for milk and milk components according to what dairy products they are used to produce.

- **Pooling:** Within each order, producers receive a uniform price for their milk (of equal quality and composition) or milk components, regardless of how their milk is used.

While producers approve orders, the orders regulate milk plants (called **handlers**), which acquire milk from producers or dairy cooperatives. Regulated handlers are required to account to the federal order pool at the established minimum class and component prices.

There are three types of regulated handlers:

1. **Distributing plants:** Plants that process, package, and sell beverage milk products within designated marketing areas. Distributing plants may procure milk directly from producers or (more likely) from supply plants and cooperatives.

2. **Supply plants:** Plants that supply raw milk to distributing plants. These are manufacturing milk plants, such as cheese plants. While engaged primarily in manufacturing, supply plants help assure an adequate supply of milk for fluid purposes by carrying fluid milk reserves. When milk is needed for fluid purposes, supply plants are required to ship milk to fluid processors rather than use the milk to make manufactured dairy products. Supply plants also provide a "balancing" service by manufacturing milk that is not needed for fluid purposes on days when bottling plants are not operating.

3. **Dairy cooperatives:** Some dairy cooperatives bottle milk, and others have manufacturing facilities. Still others are involved exclusively in representing their members in negotiations with proprietary firms and do not process milk. Dairy cooperatives provide a number of market-wide services that enable federal orders to operate more efficiently. These include such services as milk procurement from producers, full-supply arrangements to

milk bottlers (supplying specific volumes of milk on an as-needed basis), moving milk to the highest and best uses, and providing milk quality testing services.

Dairy cooperatives are obligated to the federal order pool for the established minimum prices. But dairy cooperatives are not obligated to pay their members the order minimum producer prices. This is because dairy cooperatives are viewed under the orders as being

an extension of their members' farm firms. Cooperatives often "re-blend" the proceeds from milk sales across federal order markets and pay their members a common price. Of course, dairy cooperatives need to pay producers competitive prices in order to attract and keep producers as members.

Each milk order represents a defined market area (figure 6). This is a geographical region where fluid (beverage) milk is sold to consumers, not necessarily where milk is produced. Each order has performance standards, which establish the minimum amount of fluid milk that must be sold within the market area before a milk plant is regulated by that order. If a milk plant sells milk into more than one federal order marketing area, then it will be regulated under the order having the largest share of the plant's fluid milk sales. So whether a dairy producer receives the order prices does not depend on where the producer is located (inside or outside the market area), but rather on whether or not the producer's milk plant meets the minimum performance standards within the order.

Currently there are 10 federal orders. Under Congressional mandate, orders were consolidated from 31 to 11 on January 1, 2000. In April 2005, the Western order was terminated. The number of orders peaked in 1962 at 82, and the number gradually fell through mergers (table 2). These mergers were motivated by evolving improvements in packaging and transportation that enabled milk to be moved greater distances and encouraged larger marketing areas.

Table 2. Evolution of federal milk orders

	1960	1970	1980	1990	2000	2006
Orders (no.)	80	62	47	42	11	10
Producers (no.)	189,816	143,411	117,490	100,397	69,590	52,725
Producer milk (mil. lbs.)	44,812	65.104	83,998	102.396	116,920	120,618
% of U.S. milk:						
Grade A	64	79	80	77	72	68
All Milk	43	59	67	70	70	67

Figure 6. Marketing areas for current federal milk marketing orders
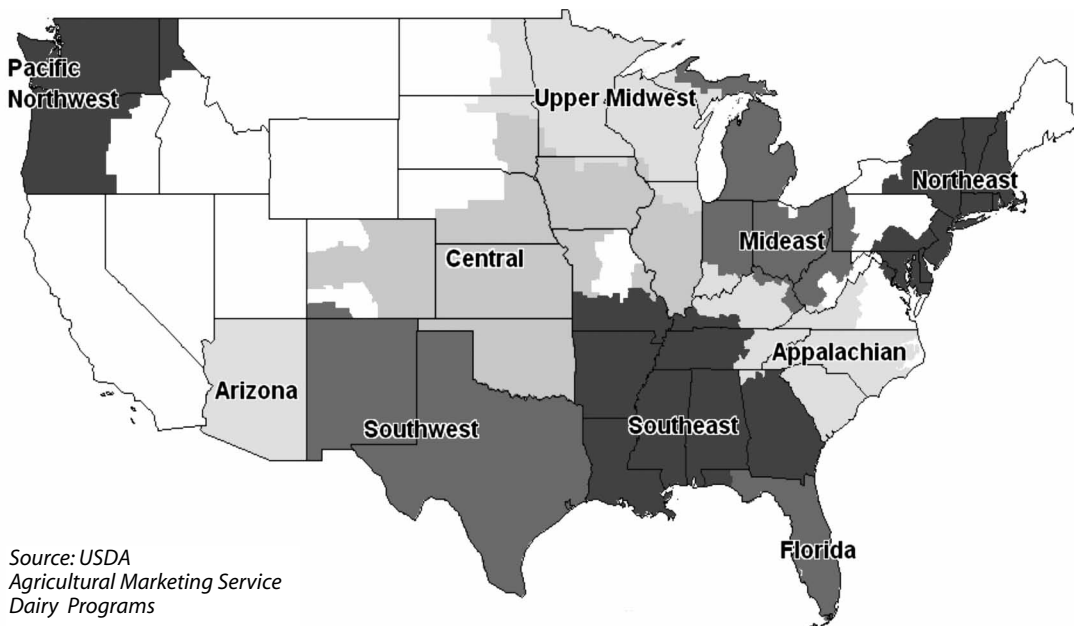
Source: USDA
Agricultural Marketing Service
Dairy Programs

Classified pricing

The current set of federal orders uniformly define the following four classes of milk, from highest to lowest value (under most circumstances):

- Class I is milk used for beverage products. This includes "white" whole, low-fat, and skim milk in all container sizes; chocolate and other flavored milks; liquid buttermilk; and eggnog.

- Class II is milk used for soft manufactured products such as ice cream and other frozen dairy desserts, cottage cheese, and creams (sour cream, aerosol whipped cream and whipping cream, half and half, and coffee cream).

- Class III is milk used to manufacture cream cheese and hard cheeses.

- Class IV is milk used to make butter and dry milk products — principally nonfat dry milk.

The orders specify minimum prices for milk and milk components according to Class. These are minimum prices to *handlers*; minimum prices to *producers* are derived differently, as noted later.

For manufactured product classes — Classes II, III, and IV — the specified minimum prices are the same for each of the ten orders. Prices for Class I skim milk and butterfat differ by order.

Minimum prices for the hard manufactured classes — Classes III and IV — and for the butterfat portion of Class II are announced monthly on the Friday on or before the fifth of the month *following* the month to which they apply (e.g., October prices are announced on the Friday on or before November 5).

Minimum prices for Class I skim milk and butterfat and Class II skim milk are announced on the Friday on or before the 23rd of the month *prior* to the month to which they apply (e.g., the October Class I price is announced on the Friday in September that falls on or before September 23).

Calculation of Class III and Class IV prices[12]

Federal order Class III and IV prices are set using a three-stage process. In the first stage, product price formulas are used to set prices for four milk components: butterfat, protein, nonfat milk solids, and other (nonfat and non-protein) milk solids.

The general form of the product price formulas is as follows:
Component price/lb = (Product price/lb – Make allowance/lb) X Yield

The priced Class IV milk components are nonfat milk solids and butterfat. Nonfat milk solids make up nonfat dry milk, and butterfat is the primary ingredient in butter. The Class III components are butterfat, protein, and other solids. Butterfat and protein are the principal constituents of cheese, and other solids (mainly lactose), along with residual protein from the cheese-making process, make up dry whey.

Dairy *product prices* are monthly averages of USDA's National Agricultural Statistics Service (NASS) weekly survey of wholesale prices for Grade AA butter, block and barrel cheddar cheese, nonfat dry milk, and dry whey. NASS collects weekly sales prices and associated volumes sold from major manufacturers of these products. Prices reported on Friday of each week represent the weekly averages for the preceding week.

The NASS product prices used in the formulas are weighted averages of the reported weekly product prices for the month that are available on the day of the Class III and IV price announcement. The weights are the reported total volume of sales associated with each weekly price. The monthly price announcement may average prices from either four or five weekly reports, depending on the particular month.

The NASS prices for butter and cheese are highly correlated with the CME prices lagged one week, emphasizing the extensive use of reference pricing at the wholesale level and the related influence of the CME cash markets on all milk prices.[13]

Make allowances are the assumed cost per pound to manufacture the products (not counting the cost of milk). Subtracting the make allowances from the product prices yields a net value of the milk components to the manufacturer. Note that the higher the make allowance, the lower the component price. So in setting the make allowance, USDA needs to strike a balance between processor and producer economic interests. If the make allowance is set too high, then processors obtain excess profits at the expense of producers. If the make allowance is set too low, then some processors lose money and may be unwilling to accept producer milk.

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[12]The precise formulas used to calculate minimum prices for all classes of milk and milk components are presented in Appendix II.

[13]From September 1998, when NASS began reporting wholesale butter prices, through March 2008, the regression of NASS weekly butter prices on lagged (one week) CME prices yielded an R^2 value of 0.99. The comparable R^2 value for the regression of NASS weekly block cheddar cheese prices (reported by NASS since April 1997) on lagged CME prices was 0.98.

The *yield* factor in the product price formulas generally indicates how many pounds of product can be made from a pound of the associated milk component. For example, the yield factor in the butterfat product price formula is 1.2, which is the number of pounds of butter that can be made from a pound of butterfat if the butter contains 80% butterfat (the U.S. commercial standard). Yields are adjusted to reflect normal losses in milk volume between farm and plant (e.g., spillage). Some yields are also adjusted for other factors. For example, the nonfat solids formula yield is adjusted to reflect the value of buttermilk powder, which is typically produced as a co-product with butter and nonfat dry milk in butter-powder plants but which is not separately priced in deriving the Class IV price.

The second stage in the three-stage process for deriving Class III and Class IV prices links skim milk prices to the component prices calculated in the first stage.

This calculation requires composition standards for skim milk. A hundredweight of Class IV skim milk is assumed to contain 9 pounds of nonfat milk solids. So the Class IV skim milk price is expressed as 9 times the nonfat solids price.

A hundredweight of Class III skim milk is assumed to contain 3.1 pounds of protein and 5.9 pounds of other solids. So the Class III skim milk price is expressed as 3.1 times the protein price plus 5.9 times the other solids price.

Finally, the third stage calculates the Class III and Class IV prices at 3.5% butterfat content. This calculation involves multiplying the applicable skim milk price calculated in the second stage by 0.965 and adding 3.5 times the butterfat price calculated in the first stage.
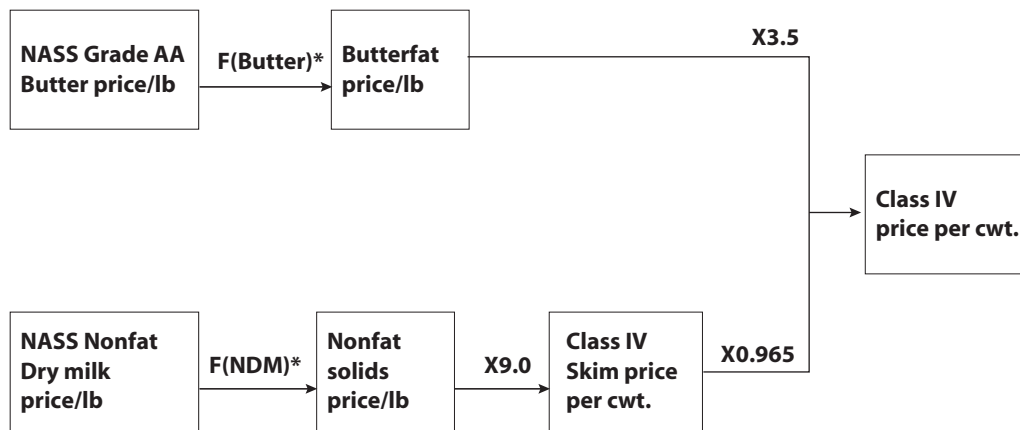
The derivation of the Class IV price is illustrated schematically in figure 7.

The Class IV price is linked to the NASS prices for butter and nonfat dry milk through formulas that contain only constant terms. This relationship allows the Class IV price to be expressed directly in terms of the two product prices as follows:

Class IV price/cwt = 4.2000 X NASS butter price/lb + 8.5982 X NASS nonfat dry milk price/lb – 1.8547

This formula emphasizes the effect changes in the underlying product prices have on the Class IV price. A 10-cent-per-pound increase (decrease) in the butter price will increase (decrease) the Class IV price 42 cents per hundredweight. A 10-cent-per-pound increase (decrease) in the nonfat dry milk price will increase (decrease) the Class IV price 86 cents per hundredweight. The constant value (1.8547) can be interpreted as the combined butter and nonfat dry milk make allowance expressed per hundredweight of milk used to produce these products.

Figure 7. Deriving the Class IV price

*F denotes a product price formula (see appendix II).

The Class III derivation process is illustrated in figure 8.

Expressing the Class III price in terms of its constituent product values yields:

Class III price/cwt = 9.6393 X NASS cheese price/lb + 0.4199 X NASS butter price/lb + 5.8643 X NASS dry whey price/lb – 2.8189

The formula indicates that 10-cent-per-pound increases (decreases) in cheese, butter, and dry whey prices increase (decrease) the Class III price by 96.4, 42.0, and 58.6 cents per hundredweight, respectively. The combined make allowance for cheese plants is $2.82 per hundredweight of milk used to make cheese.

Calculation of Class I and Class II prices

Federal orders use advanced pricing for Class I and Class II. In contrast to announced Class III and Class IV prices, which apply to milk that has already been used to produce manufactured products, prices per hundredweight for the skim milk portion of Class I and Class II are announced before the milk will be processed. Class I butterfat is also advanced-priced. The price announcements are made on the Friday on or before the 23rd of the month preceding the month to which the prices apply.

Advanced-pricing of Class I and Class II milk is often justified on grounds that raw milk made into fluid and fresh products moves into retail channels within a few days of when it is produced. Therefore, it is claimed, Class I and Class II milk plants need to know the cost of raw milk prior to making and moving these products into retail channels.
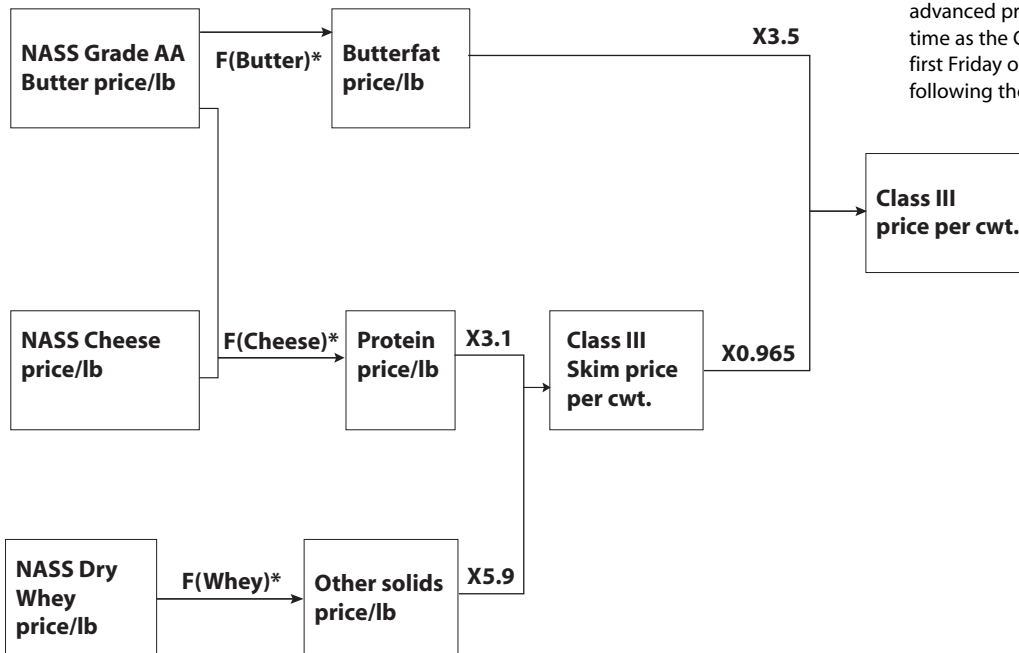
The Class I and Class II prices are derived from *exactly* the same product price formulas used to derive Class III and Class IV component values. But since advanced prices are announced 6–7 weeks before Class III and Class IV prices, a different time period must be used to compute average product prices. For Classes I and II, USDA averages only the last two weeks of NASS prices that are available on the Friday on or before the 23rd of the month. Usually, these are the first two weeks of the month.

Advanced pricing results in a set of advanced *product* prices that, in turn, yield a set of advanced *component* prices using the formulas outlined earlier in reference to the first stage in deriving Class III and Class IV prices.

For Class II, an *advanced Class IV skim milk pricing factor* is calculated by multiplying the advanced nonfat solids price by 9.0. Note that the advanced Class IV skim milk pricing factor is calculated in the same way as the Class IV skim milk price but uses a nonfat solids price from a shorter time period. A value of 70 cents per hundredweight is then added to the advanced Class IV skim milk pricing factor to derive the Class II skim milk price. The Class II butterfat price is the Class III/IV butterfat price plus 0.7 cents per pound.[14] Finally, the Class II price is 0.965 times the Class II skim milk price plus 3.5 times the Class II butterfat price.

[14]Note that the Class II butterfat price is *not* advanced priced — it is announced at the same time as the Class III and IV prices, that is, on the first Friday on or before the fifth of the month following the month to which it applies.

Figure 8. Deriving the Class III price

*F denotes a product price formula (see appendix II).

Calculation of the Class I price is similar but a bit more complex. As for Class II, an *advanced Class IV skim milk pricing factor* is calculated, and also an *advanced Class III skim milk pricing factor*, which combines the advanced protein, butterfat, and other solids prices in the same fashion as used to calculate the Class III skim milk price.

The Class I skim milk price is the higher of the two advanced skim milk pricing factors plus a Class I differential that is specific to the location of the plant receiving the milk. The Class I butterfat price is the advanced Class III/IV butterfat plus the Class I differential divided by 100. Finally, the Class I price is 0.965 times the Class I skim milk price plus 3.5 times the Class I butterfat price.

Class I differentials are specified for each county within a marketing area. In general, differentials decrease with distance from the major consumption location within the order marketing area. Differentials for the Upper Midwest order (figure 9) are highest near Chicago (base differential of $1.80 per hundredweight) and lowest in northwestern Minnesota and north-eastern North Dakota.

Among marketing orders, Class I differentials in the eight markets east of the Rocky Mountains generally increase with distance from the Upper Midwest. This alignment of prices was originally designed to attract milk from the direction of the large Upper Midwest milkshed when supplies were short in other regions. At one time, the difference in Class I differentials approximated bulk milk hauling costs. So milk would move in response to the price differences. Over time, hauling costs increased and there were no compensating changes in the geographical Class I price alignment. But at the same time, the need for supplemental milk supplies also diminished.

Figure 9. Class I Differentials: Upper Midwest Federal Milk Marketing Order
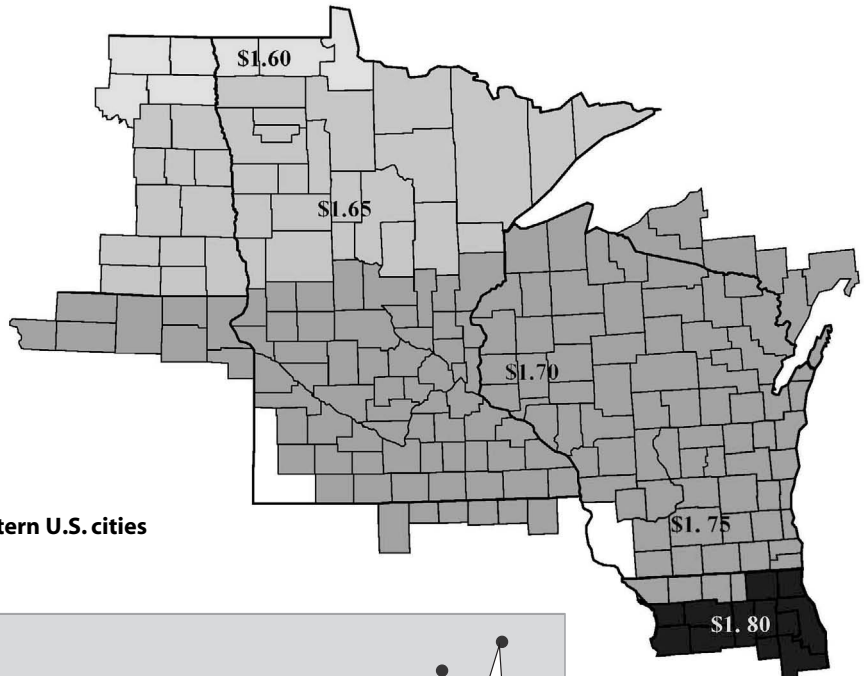
Figure 10. Class I differentials for selected eastern U.S. cities (effective May 1, 2008)

Class I differential = 0.0026 x miles from Eau Claire + 0.6756
R^2 = 0.8647
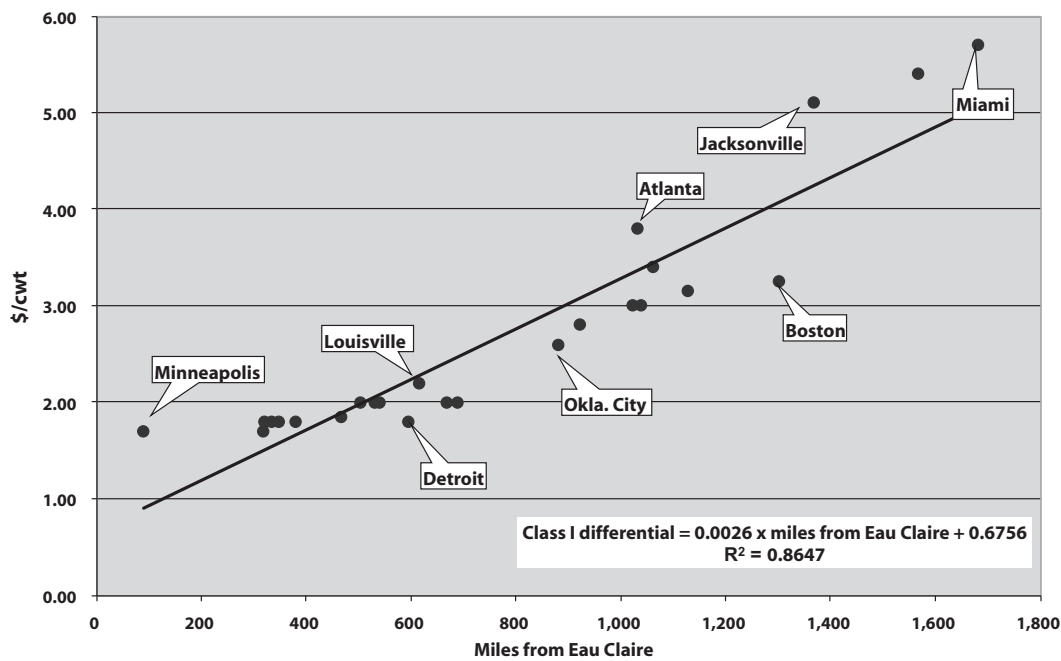
Class I differentials in the two markets west of the Rocky Mountains are not aligned with eastern differentials. The base differentials in the Pacific Northwest are $1.90 per hundred-weight, 10 cents higher than the base Class I differential in the Upper Midwest. The base Class I differential for the Arizona order is $2.45.

Pooling

Pooling is accomplished under federal milk orders by obligating each regulated handler to account for their milk receipts according to class. Handlers pay into or draw from a producer settlement fund depending on the value of their milk receipts, priced at order minimum prices relative to the market-wide average value. Handlers' price obligation to their producers is at the market-wide average value of milk, called the **uniform price**.

The pool obligations by class are detailed in table 3.

The following items are deducted from the gross value of each handler's milk (determined as shown in table 3) to derive the net handler obligation to the pool:

- Producer price differential
- Producer location adjustment
- Protein value
- Other solids value
- Butterfat value
- Somatic cell count adjustment value

If the result of subtracting these deductions from gross milk value is positive, the handler pays the difference into the producer settlement fund. If the result is negative, the handler draws the difference from the fund.

The deductions noted above introduce some new terminology that needs explanation.

Conceptually, the producer price differential (often abbreviated PPD) is a measure of how much the average value of handler receipts over the entire market exceeds the average value if all milk were priced at Class III. Under federal orders using multiple component pricing, minimum prices

to producers for milk components — butterfat, protein, and other milk solids — are the same prices used to derive the Class III price.[15] Hence, the producer price differential indicates the value of milk in excess of the value of the Class III components. In other words, the PPD measures the relative value of class prices that exceed (or fall short of) Class III.

Among markets, the PPD varies positively with the percent Class I utilization and the Class I differential. Within any market, Class I utilization varies seasonally, resulting in a distinct seasonal pattern in the PPD.

The Class I price mover is the higher of *advanced* Class III or Class IV skim milk prices. In rapidly moving markets, the *monthly* Class III and Class IV skim milk prices — which are announced six weeks after advanced prices — may move substantially above or below the advanced values. In an extreme situation, the Class I mover could be less than the monthly Class III price by more than the Class I differential. This situation results in a negative PPD.

In simple terms, the order-specific PPD is the sum of the following calculations:

(Class I price – Class III price) X Class I utilization

(Class II price – Class III price) X Class II utilization

(Class IV price – Class III price) X Class IV utilization

The actual PPD will differ from this sum due to other adjustments in the order pool. Handlers' producer settlement fund payments or receipts may be adjusted by transportation credits and assembly credits. Transportation and assembly credits for the entire marketing area are subtracted from total pool proceeds in the process of calculating the producer price differential.

Table 3. Handler pool obligations under federal milk marketing orders

Milk use class	Handler obligation to the producer settlement fund
Class I	• Skim milk price at location X skim milk pounds • Butterfat price at location X butterfat pounds
Class II*	• Nonfat solids price X nonfat solids pounds • Butterfat price X butterfat pounds
Class III*	• Protein price X protein pounds • Other solids price X other solids pounds • Butterfat price X butterfat pounds
Class IV*	• Nonfat solids price X nonfat solids pounds • Butterfat price X butterfat pounds

*Pool obligations in these classes are adjusted for somatic cell count of milk receipts in most orders that use multiple component pricing.

[15]Six of the ten federal orders use multiple component pricing for establishing milk value and producer pay prices. The remaining four orders use skim milk-butterfat accounting (described later) and do not have a PPD.

Transportation credits apply to shipments of milk for Class I use from supply plants to distributing plants. In the Upper Midwest order, the credits are paid to distributing plants at the rate of 28 cents per hundredweight per mile to help defray the cost of moving milk to the Class I market. Transportation credits are adjusted for differences in the Class I differential between the shipping and receiving plants.

Assembly credits are paid to pool plants (distributing plants, supply plants, and cooperatives) on producer milk that is used for Class I purposes. Assembly credits provide an additional incentive to "give up" milk for Class I use when it may otherwise be destined for manufacturing.

Producer price differentials for the Upper Midwest order for 2000 through 2007 are shown in figure 11. The PPD has ranged has from -$4.11 per hundredweight (April 2004) to $1.43 per hundredweight (November 2000). The overall average PPD from its inception through December 2007
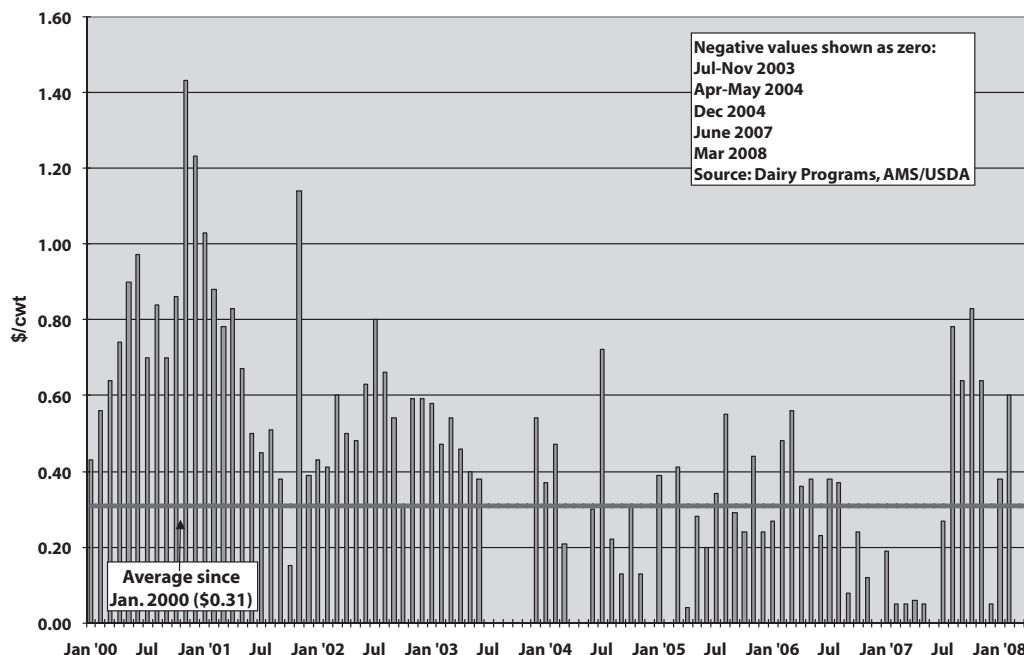
was 31 cents per hundredweight. Over that span of 96 months, the Upper Midwest PPD was negative in 10 months, and zero in one.

The **producer location adjustment** accounts for differences in the Class I differential at the base location for the order (Cook County, Illinois for the Upper Midwest order) and the differential at the location of the receiving plant.

The **somatic cell value** relates to price adjustments for quality at the producer level for milk used in Class II, Class III, and Class IV. The adjustment applies in four of the six federal orders that employ multiple component pricing (Central, Mideast, Southwest and Upper Midwest). Quality is measured by somatic cell count of producer milk relative to a base level of 350,000 cells per ml. A rate per 1,000 cell count above or below the base is derived by multiplying the cheese price used in the protein price formula by 0.0005. For February 2008, the rate was 0.0005 X $1.8164 = $0.00091 per thousand.

The price adjustment per hundredweight is calculated by subtracting the producer somatic cell count in thousands from 350 and multiplying the result by the rate per 1,000. A producer with a February 2008 cell count of 120,000 would receive a premium of (350 – 120) = 230 X $0.00091 = $0.21 per hundredweight. A producer with a 500,000 cell count would receive a deduction of (350 – 500) = -150 X $0.00091 = -$0.14 per hundredweight.

Figure 11. Producer price differential, Upper Midwest order

Negative values shown as zero:
Jul-Nov 2003
Apr-May 2004
Dec 2004
June 2007
Mar 2008
Source: Dairy Programs, AMS/USDA

Average since Jan. 2000 ($0.31)

Producer prices

With federal order pooling, producers receive a common price for their milk components regardless of how their milk is used. For producers shipping to handlers regulated under multiple component pricing orders, total monthly producer milk value under the order is the sum of the following elements:[16]

- Total milk (cwt) X Producer price differential (at handler location)[17]
- Protein pounds X Protein price
- Other solids pounds X Other solids price
- Butterfat pounds X Butterfat price
- Total milk (cwt) X Somatic cell adjustment

The protein, other solids, and butterfat prices that are applied to producer pounds of these components are exactly the same as the prices derived above for Class III milk that apply to regulated handlers.

Producer prices expressed per hundredweight of milk will differ according to three factors: milk composition, milk quality, and the location of the receiving plant. To illustrate extremes, consider two producers, each shipping 100,000 pounds of Grade A milk to a handler regulated under the Upper Midwest federal milk marketing order during the month of February 2008. The PPD at the base zone for February was 60 cents per hundredweight, decreasing to 40 cents in the outermost zone. The somatic cell adjustment per 1,000 was 0.091 cents.

Producer A ships to a plant in Harvard, IL (Class I differential = $1.80; PPD = $0.60). Producer A milks Jersey cows with February herd tests of 4.5% butterfat, 3.7% protein, and 6.0% other solids. The herd somatic cell count was 110,000.

Producer B milks Holsteins and ships to a plant in Grand Forks, ND (Class I differential = $1.60; PPD = $0.40). Producer B's February 2008 tests were 3.2% butterfat, 2.8% protein, and 5.7% other solids. The somatic cell count was 420,000.

Under these conditions, Upper Midwest federal order milk values for Producer A would be calculated as shown in table 5.

Producer B's milk value as determined from the federal order pricing elements would be calculated as shown in table 6.

While the rates of payment for milk components are the same for each producer, the federal order payment per hundredweight differs because of different milk composition, quality, and location. Producer B actually receives 82 cents per hundredweight less than the $17.03 Class III price for February 2008. This occurs mainly because lower butterfat and protein values relative to the values used to compute the Class III price more than offset the producer price differential.

Table 5. Producer A order price calculation

Pricing element	Units	Rate/unit ($)	Value ($)
Producer price differential	1,000 cwt	0.60	600.00
Protein	3,700 lbs	4.0180	14,866.60
Other solids	6,000 lbs	0.0803	481.80
Butterfat	4,500 lbs	1.3010	5,854.50
Somatic cell adjustment	1,000 cwt	0.2184	218.40
TOTAL VALUE:			22,021.30
VALUE PER CWT:			22.02

Table 6. Producer B order price calculation

Pricing element	Units	Rate	Value
Producer price differential	1,000 cwt	0.40	400.00
Protein	2,800 lbs	4.0180	11,250.40
Other solids	5,700 lbs	0.0803	457.71
Butterfat	3,200 lbs	1.3010	4,163.20
Somatic cell adjustment	1,000 cwt	(0.0637)	(63.70)
TOTAL VALUE:			16,207.61
VALUE PER CWT:			16.21

[16]Note that producers may receive "extra-order" payments: premiums for other milk characteristics (e.g., volume premiums) or payments for milk quality or protein beyond what is required by federal order pricing rules. Producers may also be paid under a different pricing arrangement (e.g., via a cheese yield formula). However, the total producer payment cannot be less than what would be calculated using the federal order pricing elements. An exception is producer payments by a dairy cooperative.

[17]Producer price differentials are reported at the base, or highest Class I differential zone, and are adjusted downward by the difference between the base zone differential and the differential applicable to the location of the receiving handler.

Producer prices in fat/skim milk markets

Four federal milk marketing orders use fat/skim milk pricing for setting producer prices (Arizona, Appalachian, Southeast, and Florida). Dairy producers in these markets are not paid for milk components other than butterfat. Instead, they are paid a *uniform skim milk price* per hundredweight for the volume of skim milk marketed, plus a *uniform butterfat price* per pound times the total butterfat pounds marketed.

The uniform skim milk price is the weighted average skim milk price from each of the four classes of milk, where the weights are the percentage utilization by class. The uniform butterfat price in fat/skim milk markets is the weighted average butterfat price from the four classes of milk. These four orders also have a plant location adjustment per hundredweight of milk marketed that may be positive or negative depending upon the location of the milk plant.

Other milk check components

What dairy producers receive in their monthly milk checks from their milk plants is usually different from the federal order calculation. That's because of various premiums and deductions, some uniform across all plants and some plant-specific.

In the former category is the 15 cents per hundredweight National Dairy Promotion and Research Board "check-off" for state and national generic promotion of dairy products.

Plant-specific premiums and deductions are often associated with milk characteristics. Many plants have quality payment schedules that reward or penalize producers according to standard plate count (SPC) and somatic cell count (SCC). The SCC premiums or penalties are in addition to what is required by the federal order schedules. Some plants pay protein premiums on top of the federal order protein payment.

Other premiums and deductions are related to producer characteristics, principally scale. In Wisconsin and Minnesota, volume premiums are common. Most volume premium programs contain daily or monthly milk shipment "brackets" and associated payments per hundredweight. Other programs indirectly pay volume premiums through varying hauling subsidies or by imposing a fixed monthly hauling charge regardless of volume.

Another class of premiums, commonly called *plant premiums*, is unrelated to either milk or producer characteristics. Plant premiums result from the ability or willingness of a plant to out-pay minimum federal order prices. The source of additional revenue may be better plant efficiency or higher

product prices than indicated in the pricing formulas used to derive component and class prices.

For many cooperatives, particularly in the Upper Midwest, another source of revenue to support plant premiums is over-order premiums for Class I and Class II milk sales. Dairy cooperatives organize marketing agencies-in-common to negotiate with milk handlers for a premium above federal order minimum Class I and Class II prices. These premiums are called *over order premiums* or *super-pool premiums*. A portion of the premium is reimbursement for services that cooperatives perform, such as full-supply commitments to handlers, transportation of milk, balancing functions (e.g., coordinating milk deliveries with processing schedules), and the like. The excess over the out-of-pocket costs to provide these services is paid out to producers.

As an example, Central Milk Producers Cooperative (CMPC) is the federated bargaining cooperative for a group of Upper Midwest dairy cooperatives that supply fluid milk to distributing plants operating in the Chicago area. Each month, CMPC negotiates a price for Class I deliveries from its member cooperatives that exceeds the announced federal order price. A typical premium, or over-order charge, on Class I milk is $1.50 per hundredweight. Class I utilization in the Upper Midwest market is about 20%. Suppose a member of CMPC incurs out-of-pocket costs of 25 cents per hundredweight in supplying Class I milk. In that case, the cooperative would have ($1.50 – $0.25) X 0.20 = $0.25 per hundredweight in additional revenue to distribute to its members. This additional revenue would likely be included as part of a plant premium in members' milk checks.

Some states have state-controlled over-order pricing of Class I milk. Pennsylvania, for example, requires distributing plants to make a separate payment for milk for the amount in excess of the minimum federal order price. These over-order revenues are pooled at the plant level and paid out to Pennsylvania producers.

In 1997, the Northeast Interstate Dairy Compact was implemented, creating a different form of over-order pricing. The compact established a minimum price for all fluid milk sold in the compact region (the six New England states). Fluid milk handlers made payments to a compact pool (separate from the federal order pool) equal to any positive difference between the minimum compact price and the announced federal order price. Pool payments were then made to producers supplying milk to New England bottlers. Since the compact would have otherwise violated interstate commerce laws, its creation required Congressional and presidential approval.

The Northeast Compact was controversial for several reasons. Consumer groups objected to the high and inflexible fluid milk price. Producers in nearby markets objected to being effectively closed out of the compact area. Producer groups in the Midwest objected to the compact's potential for stimulating production of milk for manufacturing uses.

The Northeast Compact did provide substantial revenue enhancement to dairy farmers in the New England states. Consequently, farmers in many other states successfully lobbied their state legislatures to pass legislation authorizing their joining the Northeast Compact or creating new compact regions. A bill was submitted to Congress in 2001 that would have expanded the Northeast Compact to include six additional states and authorized the creation of several new compacts. The bill was defeated along with several efforts to extend the existing Northeast Compact, and the Compact expired on September 30, 2001.

There were attempts to resurrect the Northeast Compact during debate over the Dairy Title of the Farm Security and Rural Investment Act of 2002. While these attempts were not successful, the Milk Income Loss Contract (MILC) program contains remnants of the Compact. Specifically, deficiency payments were initially set equal to 45% of the monthly difference between $16.94 and the Boston Class I price. These values match the payment rate and target price used under the Compact.

Milk pricing issues

The dairy industry is extensively regulated, with much of the regulation directly affecting prices. Contentious issues often arise because of perceived or actual differences in how regulations affect prices for dairy products or farm milk prices. In what follows, we provide a brief overview of some of these issues.

Dairy price supports

After nearly 60 years of continuous operation, the dairy price support program has provided several lessons. One lesson is that the program cannot consistently enhance milk prices above market-clearing levels without some kind of supply control. That lesson came in the late 1970s, when Congress raised the support level to 80% of parity, mandated semi-annual adjustments in the support price, and prevented the Secretary of Agriculture from interceding to reduce the support price.

The support price was ratcheted up $5.00 per hundredweight between April 1977 and October 1980. Dairy farming became unusually profitable, setting in motion a rapid expansion in milk production, much of it in new dry lot western dairies. Commercial sales were stagnant, leading to large CCC purchases and annual government costs as high as $2.7 billion. A bad policy in place for only five years created a surplus situation that took ten years to rectify.

Another dairy price support program lesson is that fixed relative prices for products purchased by the CCC can distort product markets and the allocation of milk among products. During much of the 1980s, the CCC was the primary market outlet for nonfat dry milk. Much nonfat dry milk use was displaced by whey solids and imported casein, both of which were a cheaper source of milk protein. Fixed CCC prices for nonfat dry milk prevented appropriate market adjustments to this displacement.

In the early 1990s, the CCC purchase price for butter dictated the U.S. price for butterfat. Consumers were demanding lower-fat products, leading to conflicting signals in the marketplace. Butter surpluses and CCC stocks mounted. The price of butterfat was not permitted to change in accordance with consumer preferences until butter-powder tilts were mandated by Congress in 1990.[18] The industry responded to these tilts by producing less butter and using more butterfat in other dairy products.

These lessons are often forgotten. Many dairy groups consistently lobby for an increase in the support price. Few proposals include a corresponding method for controlling supply, and those that do typically favor weak

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[18]Butter-powder tilts involved the Secretary of Agriculture altering the relative purchase prices for butter and nonfat dry milk by reducing the price for the product in surplus and increasing the price for the other product to keep the value of milk used for making butter and nonfat dry milk constant.

systems that pay bonuses to producers who do not expand production rather than penalize those who do.

The negative effects of misaligned product prices due to inflexible CCC purchase prices were also soon forgotten. The high nonfat dry milk-butter price ratio problem of the 1980s was repeated starting in the late 1990s and early 2000s, when the CCC once again began purchasing large volumes of nonfat dry milk. By early 2003, CCC nonfat dry milk stocks exceeded 1.2 billion pounds, about 80% of annual nonfat dry milk production. Some dairy trade associations complained about expanding imports of milk protein concentrates, which were a direct result of nonfat dry milk prices clearly out of line with market conditions.

In 2001 and 2002, most of the industry strenuously fought the butter-powder tilts that eventually addressed the problem, at least in part. Strong opposition to altering CCC purchase prices occurred because, at the time, the advanced Class IV price was the mover of the Class I milk price, even though the market price for nonfat dry milk was at the CCC purchase price.[19] Consequently, lowering the CCC purchase price for nonfat dry milk would have simultaneously lowered the Class I mover and the entire structure of Class I prices. In this case, economic interests related to the operation of federal milk marketing orders interfered with the effective operation of the price support program.

These lessons stress the need for *flexibility* and *market orientation* in administering the dairy price supports. 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 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 payment programs like the MILC program distort markets less than raising support prices.

Federal milk marketing orders

Structure of Class I differentials

One of the most contentious aspects of federal orders is the setting of Class I differentials in reference to location. As noted earlier, Class I differentials in eastern markets increase with distance from the Upper Midwest. This geographical Class I pricing pattern is known in economics as single basing point pricing.[20]

Single basing point pricing occurs naturally only when there is either only one producing area for a commodity or only one producing area that possesses a surplus. These conditions do not apply in the case of fluid milk. Some markets are deficit in fluid milk during some parts of the year, and the cost of acquiring supplementary milk would be a major factor in determining the local milk price. But in most markets, milk production is far in excess of fluid milk needs plus a reserve. Consequently, there is no reason to expect that the fluid milk price in those markets would be related to the cost of hauling milk from another market.

Administered prices using the single basing point structure distorts fluid milk shipment patterns and increases hauling costs. For example, fluid milk processors in deficit Florida markets

would logically draw milk from the closest surplus market to minimize transportation costs. But single basing point pricing makes it less costly to procure milk from the direction of the basing point regardless of where the surplus milk might be located. Single basing point pricing may also encourage production of unneeded milk for manufacturing. Class I differentials that are higher than necessary to attract an adequate supply of milk for fluid purposes can lead to expanded milk production.

In 1985, Congress passed legislation that increased Class I differentials with distance from the Upper Midwest. Since then, producer groups and others in the Upper Midwest have attempted in several different ways to eliminate single basing point pricing. A suit challenging the legality of Class I differentials was filed by the Minnesota Milk Producers Association in early 1990. The suit was ultimately dismissed in 1999 after several appeals, reversals, and remands. Also in 1990, the Secretary of Agriculture held a nation-wide hearing to review Class I pricing. Following 43 days of testimony in five locations, the Secretary issued a decision that retained the existing structure of Class I differentials.

In 1996, Congress mandated federal order reform, including a review of the structure of Class I differentials. USDA recommended a substantially "flattened" Class I price structure. The final rule was approved by producers in an August 1999 referendum. But before the modified price surface could be implemented, Congress passed legislation requiring USDA to adopt a price surface very similar to the status quo.

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[19]Relatively high market prices for butter kept the Class IV price above the $9.90 support price and above the Class III price.

[20]We should note that USDA has repeatedly and strenuously denied that the geographical pattern of Class I differentials represents single basing point pricing. USDA's position is that the alignment of Class I prices is coincidental.

These actions emphasize the difficulties in changing federal order provisions that bestow economic benefits on certain regions, even though those benefits may come at the expense of other regions. The process of change becomes politicized, and changes are determined by numbers of votes rather than efficiency or equity considerations.

Class I price mover

Since the 1960s, Class I prices have been set in reference to prices for milk used for manufacturing by adding a Class I differential to a manufacturing price "mover." The Minnesota-Wisconsin Price Series, or M-W Price, was the Class I price mover until 1995. The M-W Price was an estimate of the Grade B milk price paid to producers in Minnesota and Wisconsin. Most of the Grade B milk in the two states was and is used to make cheese.

Declining Grade B milk production led USDA to adopt the Basic Formula Price, or BFP, as the Class I price mover in May 1995. The BFP used the M-W Price as a base, but adjusted the previous month's value by weighted average month-to-month changes in manufactured product prices. Since cheese absorbed the majority of milk used for manufacturing, the BFP continued to closely link fluid milk prices to cheese prices.

As part of the federal order reform package implemented on January 1, 2000, the BFP was replaced by a new Class I price mover. The current mover is the "higher of" the advanced Class III or Class IV skim milk values. Use of the "higher of" mover was intended to give a temporary "bump" to Class I prices if and when nonfat dry milk was in relatively tight supply compared to cheese. For most of the year, the Class III skim milk value was expected to exceed the Class IV skim milk value, and Class I prices were expected to move with changes in the price of cheese.

To the surprise of most dairy observers, Class IV was the "higher of" in most months in 2000 and 2001. Nonfat dry milk prices were practically constant at just above the CCC support price prior to USDA's "tilt" in relative butter and nonfat dry milk prices in May 2001. Following that price adjustment, the nonfat dry milk price remained steady at near the new support level of 90 cents per pound. This yielded Class IV skim milk prices in a narrow range of $6.85 to $7.90 per hundredweight. But butter prices were high relative to cheese prices during much of this period. And since the butterfat price negatively affected the protein price in the formula used then, the Class III skim milk price was often lower than the Class IV skim milk price. The gap reached as much as $3.61 for December 2000.

With the Class IV skim milk price as the mover of Class I milk prices every month during 2000, the Class I price exceeded the Class III price by the applicable Class I differential plus an additional amount averaging $1.76 per hundredweight for the year. In effect, order reform increased the Class I differential by $1.76 and made the CCC purchase price for nonfat dry milk a floor for fluid milk prices. The decoupling of Class I milk prices from cheese prices resulted in conflicting market signals. Producers in high Class III use markets felt the full brunt of lower cheese prices while those in high Class I use markets were partially insulated.

The November 2002 tilt reduced the CCC purchase price for nonfat dry milk to 80 cents per pound, where it stands in 2008. The Class IV skim milk price associated with the 80 cents per pound CCC nonfat dry milk price is $5.88 per hundredweight. Thus, the tilt makes it less likely that the advanced Class IV price will consistently move

Class I. In fact, since 2003 the advanced Class III price has been the mover most months.

Pricing formulas

The "higher of" problem noted above illustrates a larger issue of how effectively the federal order pricing formulas capture supply and demand conditions for producer milk. For many years, federal milk orders tied minimum prices by class of milk to competitively-determined prices for manufacturing milk. There was a certain sense of confidence associated with that linkage, as competition for the milk supply tended to dictate plant margins, profitability, and viability. Efficient plants attracted milk away from those that were less efficient. Plants making products with strong demand attracted milk away from those making products with weak demand.

That confidence was weakened when federal order reform moved to product price formulas. Milk component values and prices are now derived through mathematical equations that employ assumed yields and manufacturing costs. Assumptions do not replicate reality very well. Plants vary significantly with respect to manufacturing costs and efficiency. Plant manufacturing costs can change quickly with changes in energy, labor, and other costs. The fixed manufacturing margins built into the formulas can only be changed through a lengthy administrative process. Plants cannot offset higher manufacturing costs by increasing their selling price of cheese, butter, or nonfat dry milk — any price increases are immediately reflected in higher NASS product prices and elevate minimum pay prices for Class III and Class IV milk through the formulas.

Product price formulas require reliable, representative product prices to derive accurate component values. NASS summarizes actual sales prices for reporting companies. But the extensive use of reference pricing for butter and cheese tied to the thinly traded CME spot market prices leads to considerable uneasiness. Do the spot markets consistently and appropriately reflect broad market conditions for cheese and butter? Do they over-react? Are they subject to manipulation?

Another issue is whether the correct dairy products are used in the product price formulas. This issue came to a head when dry whey prices increased dramatically in 2007. Dry whey is used to derive the other solids price in the Class III price formula, and higher whey/other solids prices were responsible for a large part of the elevated Class III price in 2007. The problem is that most cheese plants do not process dry whey and thus did not experience the increased value assumed by the other solids formula. Many cheese plants experienced unfavorable operating margins as a result.

Increasingly larger volumes of whey are being processed into value-added products such as whey protein concentrates, de-mineralized and reduced-lactose whey, and whey-protein isolates. Prices for these whey-based products do not move in lock step with dry whey prices, meaning that dry whey prices may be an increasingly deficient indicator of the value of other solids.

A similar situation is occurring with nonfat dry milk. With expanding U.S. export opportunities, an increasing proportion of dry milk powder production is in the form of skim milk powder (SMP). SMP has a different composition (lower protein content; higher lactose) than nonfat dry milk, and SMP prices are influenced by different factors.

Amending orders

Amending federal milk marketing orders has become a lengthy and often frustrating process for dairy farmers and dairy processors. Years can pass between the time a request for a hearing is received by USDA and the time a decision is rendered. This lag can lead to situations where the decision no longer addresses the conditions that existed when the hearing was requested.

The Agricultural Marketing Service, the USDA agency responsible for administering federal orders, has attempted to address industry concerns by expediting those parts of the order amendment process under its control. But delays are often due to inaction at higher levels of the Department. The 2008 Farm Bill requires USDA to adopt rules of practice that would expedite the amendment process. How successful this mandate will be remains to be seen.

Appendix I. Recent history of federal milk marketing order reform

Federal milk marketing orders have been in an almost constant state of amendment since 1996, when the Federal Agriculture Improvement and Reform Act of 1996 instructed USDA to consolidate orders and modify procedures for setting minimum class prices. Following passage of this legislation, USDA commissioned several studies relating to the Class I price structure and alternative methods of establishing prices for milk used to produce non-perishable manufactured products (Classes III and IV). Based on these studies and internal analyses, USDA issued preliminary decisions, which were debated among dairy interests and within Congress. Indeed, Congress intervened in the reform process by rejecting USDA's preferred Class I geographical price structure and requiring Class I price alignment more similar to the status quo and by requiring that USDA revisit the product price formulas initially put in place.

What emerged from this process on January 1, 2000 was a set of 11 "standardized" orders, each including four classes of milk identical across orders with minimum class prices set using product price formulas. Seven of the 11 orders used a common method of multiple component pricing (MCP) for paying dairy farmers — minimum pay prices were established for butterfat, protein, and other milk solids instead of for milk. Four of the seven MCP orders included a price adjustment for milk quality as measured by somatic cell count; three did not. Four orders used "fat/skim" pricing, setting producer prices for butterfat and skim

milk instead of skim milk components. The reforms made in the year 2000 also modified the timing of Class I price announcements to shorten the time between when the price was announced and when it became effective.

Shortly after implementation of the amended orders, USDA called a hearing to adjust Class III and Class IV pricing formulas to conform to Congressional mandate. Resulting amendments in response to the hearing were implemented on January 1, 2001. Changes were minor, except for a proposed separation of Class III and Class IV butterfat prices, which was enjoined by a federal court before it could be implemented.

In late 2001, USDA issued a recommended decision to address the injunction, reverting to a common price for butterfat in Classes III and IV. USDA also altered the protein price formula and made small changes in some product formula make allowances and yields.

USDA issued a final decision in November 2002 that adopted the changes proposed in 2001 and made a few other minor changes in the Class III and Class IV formulas. A subsequent request for an injunction was denied, and the final decision was implemented for milk priced in April 2003.

The orders implemented in 2000 made it easier for "outside" milk (from plants located outside a marketing area) to be pooled on distant orders. In the ensuing years, several orders were amended to address what some referred to critically as "paper pooling" — delivering a small volume of milk in order to become eligible to receive the PPD on a much larger volume. These amendments tightened delivery qualification standards and restricted

how milk in excess of that needed to qualify could be diverted to manufacturing in the originating market.

In June 2005, a hearing was held to consider proposals seeking to amend the Class I fluid milk product definition in all federal orders. Dairy Farmers of America, Inc. (DFA) asked USDA to reconsider which dairy products should be classified as Class I products, arguing that some "drinkable" milk products were currently classified as Class II products that should legitimately be Class I products. In May 2006, USDA issued a recommended decision to amend the Class I fluid product definition to incorporate a 2.25% true protein criteria in determining whether a product meets the fluid milk product definition. A final decision has not been issued.

In the fall of 2005, Agri-Mark, a major Northeastern dairy cooperative, petitioned USDA to hold an emergency hearing on Class III and Class IV make allowances. The petition argued that rapidly rising fuel and energy costs had rendered the allowances put in place in April 2003 obsolete. The request was endorsed by several other cooperatives, and USDA responded by holding a hearing in January 2006 that was reconvened in September 2006. USDA issued an interim final rule that raised all Class III and Class IV make allowances effective February 2007.

In December 2006, USDA heard proposals from the National Milk Producers Federation (NMPF) to amend order pricing of Class I and Class II milk. Among other things, NMPF proposed that Class I prices be increased in all markets by 73 cents per hundredweight and that Class I and Class II prices be "decoupled" from the advanced Class III and Class IV formulas. There has been no decision from this hearing.

An initial hearing was held in February 2007 to further amend the Class III and Class IV product price formulas. USDA received eighteen separate proposals addressing issues such as sources of product prices, product yields, and representative manufacturing costs. Unable to hear all testimony at the February hearing, USDA called two more hearings, one in April 2007 and one in July 2007. In June 2008 USDA issued a tentative partial decision on make allowances for cheese, dry whey, butter, and nonfat dry milk. The decision was partial because some proposals to further modify Class III and Class IV product pricing formulas were addressed in a separate interim final rule issued in July 2008.

Finally, a hearing was held in May 2007 to consider proposals to temporarily raise Class I differentials in three federal orders — Florida, Southeast, and Appalachian. Just 10 months later, USDA issued an interim final rule granting the proposed increases. Since the elevated differentials in the three markets change the geographical alignment of Class I prices in eastern federal order markets, requests to increase differentials in other markets can be expected.

Appendix II. Current federal order pricing formulas

In this appendix, we display and interpret the actual formulas used by USDA to calculate minimum federal milk marketing order prices for milk and milk components. These are the formulas that were in effect on July 1, 2008. They are subject to change based on pending decisions from previous amendatory hearings and decisions from new hearings.[21] For the most current formulas, access the University of Wisconsin-Madison Understanding Dairy Markets website (http://future.aae.wisc.edu). Navigate to *Dairy Data, Federal Order Class Prices and Related Information*, and then click on the most recent year under *Summary of Federal Order Classified Pricing Formulas*.

Understanding Dairy Markets is also an excellent "one-stop" internet source for current federal order prices and weekly NASS product prices used in deriving order prices. The site is updated daily as price information is released. Spreadsheets containing the formulas that are outlined in this appendix are also available on the website.

Class IV price

The Class IV price is composed of the value of nonfat milk solids and butterfat contained in a hundredweight of milk. The price of nonfat milk solids is linked to the price of nonfat dry milk (NDM), and the price of butterfat is linked to the price of butter.

Butterfat prices are the same for Class III and Class IV. The butterfat price formula is:

(1) Butterfat price/lb = (NASS monthly AA butter price – 0.1202) X 1.20

The butter make allowance is 12.02 cents per pound of butter and the yield factor of 1.2 pounds of butter per pound of butterfat assumes butter containing 80% butterfat.

The Class IV nonfat milk solids formula is:

(2) Nonfat solids price/lb = (NASS monthly NDM price – 0.157) X 0.99

The product price in this formula is the monthly weighted average of NASS national weekly survey prices for nonfat dry milk. The nonfat solids make allowance is 15.7 cents per pound, and the assumed yield is 0.99 pound of nonfat dry milk per pound of nonfat milk solids.[22]

The Class IV skim milk price per hundredweight is calculated by multiplying the nonfat solids price by 9.0, the assumed number of pounds of nonfat milk solids in 100 pounds of skim milk of standard composition:

(3) Class IV skim milk price = 9.0 X Nonfat solids price

Finally, the Class IV price (at 3.5% butterfat) is expressed as:

(4) Class IV price = 3.5 X Butterfat price + 0.965 X Class IV skim milk price

The Class IV price accounts for all of the value of a hundredweight of milk testing 3.5% butterfat and 8.685% total nonfat solids[23] that is used to make butter and nonfat dry milk. The 100 pounds of milk consists of 3.5 pounds of butterfat valued at the Class IV/III butterfat price (linked to the price of butter) and 96.5 pounds of skim milk valued at the Class IV skim milk price (linked to the price of nonfat dry milk).

Class III price

The Class III price per hundredweight consists of the combined value of butterfat in butter and in cheese, protein in cheese, and other (nonfat/non-protein) milk solids in whey. Therefore, three related product price formulas link butterfat prices to butter prices, protein prices to cheese and butterfat prices, and other solids prices to dry whey prices.

The Class III butterfat formula is the same as used in Class IV. Class III and IV butterfat values are identical but are not the same as the butterfat values for Class II and Class I.

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[21]The formulas shown in the appendix do not include changes in the interim final rule issued by USDA in July 2008. While these changes were approved by producers, their effective date has been delayed by an injunction.

[22]More than one pound of nonfat dry milk is normally recovered from one pound of nonfat milk solids because NDM contains some moisture. However, the production of nonfat dry milk also yields a small amount of buttermilk powder, which is not priced in the Class IV formula. The implicit formula yield factor adjusts the value of nonfat milk solids to account for the net value of buttermilk powder.

[23]Note that the skim milk portion of Class IV milk is assumed to contain 9% total solids. Since whole milk is assumed to contain 96.5% skim milk (plus 3.5% butterfat), the assumed nonfat solids composition of whole milk is 0.965 X 9%, or 8.685%.

The formula for other solids is relatively straightforward:

(5) Other solids price/lb = (NASS monthly dry whey price – 0.1956) X 1.03

The NASS monthly survey price for dry whey is constructed in the same way as the butter and nonfat dry milk prices as demonstrated for Class IV. The other solids price formula uses a higher make allowance (0.1956) than the nonfat solids formula for Class IV. The yield factor (1.03) accounts for the moisture content of dry whey, meaning that a pound of other solids yields more than one pound of dry whey. The other solids price is not floored (or "snubbed") at zero. This means that if the NASS dry whey price is less than 19.56 cents per pound, the other solids price is negative.

The protein formula in the Class III price derivation is complex:

(6) Protein price/lb = (NASS monthly cheese price – 0.1682) X 1.383 + {[(NASS monthly cheese price – 0.1682) X 1.572] – 0.9 X Butterfat price} X 1.17

The first line of the equation is in the same form as the other product price equations. It represents the net value of protein in cheese-making (cheese price less make allowance times pounds of cheese per pound of protein). The NASS cheese price is for 40-pound blocks and 500-pound barrels of cheddar cheese. It is constructed like the other NASS prices except (1) it is a weighted average of the two cheddar cheese styles with weights based on relative sales, (2) the 500-pound barrel price is adjusted to represent 38% moisture content, and (3) the barrel price is augmented by 3 cents per pound (the assumed difference in manufacturing costs between blocks and barrels). The cheese yield (1.383 pounds cheese per pound

protein) is from the Van Slyke cheese yield formula using true protein and adjusting for farm-to-plant losses in protein.[24] The cheese make allowance is 16.82 cents per pound of cheese.

The second line of the protein price equation attempts to account for the value of butterfat in cheese in excess of the value of butterfat in butter. Without getting into the physiological basis for the formula, it recognizes that protein has value in cheese over and above its contribution to the cheese itself. That added value is attributable to the fact that the casein in protein allows retention of butterfat in cheese.

Given the values of the Class III components — butterfat, protein, and other solids — the Class III skim milk price is:

(7) Class III skim milk price = 3.1 X Protein price + 5.9 X Other solids price

This formula assumes that skim milk contains 9% total nonfat solids consisting of 3.1% true protein and 5.9% other (nonfat/non-protein) solids.

Finally, the Class III price is expressed as:

(8) Class III price = 3.5 X Butterfat price + 0.965 X Class III skim milk price

The Class III price formula accounts for all of the value of a hundredweight of milk testing 3.5% butterfat, 2.99% true protein (3.1 X 0.965), and 5.69% other solids (5.9 X 0.965) that is used to make cheese and whey. The 100 pounds of milk consists of 3.5 pounds of butterfat valued at the Class III/IV butterfat price and 96.5 pounds of skim milk valued at the Class III skim milk price, which is directly linked to the prices for protein and other solids.

Class II price

The Class II butterfat price is the *monthly* butterfat price plus a constant differential of 0.7 cents per pound.

(9) Class II butterfat price = Butterfat price + $0.007

Since the Class II butterfat price is linked to the monthly butterfat price for Classes III and IV, it is not announced until as late as the fifth of the month following the month it applies. In contrast, the Class II skim milk price is announced no later than the 23rd of the month before it applies. In other words, there is advanced pricing of the skim milk portion of Class II but not the butterfat portion.

The Class II skim milk price is based on the advanced nonfat solids price:

(10) Advanced nonfat solids price/lb = (NASS 2-week NDM price – 0.157) X 0.99

This is the same formula used for the Class IV nonfat solids price (equation 2), except it uses an abbreviated two-week weighted average of monthly nonfat dry milk prices from the preceding month — the two weeks of NASS price reports available on the Friday of the month on or before the 23rd. Note that the two weeks used in the advanced price formula for the following month always appear in the Class IV formula for the current month, but the latter formula always includes later weeks and may include earlier weeks.

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[24]True protein is crude or total protein less non-protein nitrogen. Prior to January 1, 2000, federal order protein prices were based on crude protein tests.

The advanced Class IV skim milk price factor calculation is equivalent to the Class IV skim milk price:

(11) Advanced Class IV skim milk pricing factor/cwt = 9.0 X Advanced nonfat solids price

The Class II skim milk price adds a differential of 70 cents per hundredweight to the advanced skim milk price:

(12) Class II skim milk price/cwt = Advanced Class IV skim milk price factor + $0.70

Class II handlers must account to their federal order pool for pounds of nonfat milk solids rather than hundredweight of skim milk. Therefore, another formula translates the Class II skim milk price back to a per pound value for nonfat solids by dividing by the yield of nonfat solids per hundredweight of skim milk:

(13) Class II nonfat solids price/lb = Class II skim milk price/cwt ÷ 9.0

Finally, the Class II price combines the skim milk and butterfat values:

(14) Class II price/cwt = 0.965 X Class II advanced skim milk price + 3.5 X Class II butterfat price

Class I Price

Both the skim milk and butterfat portions of the Class I price are advanced-priced and announced on the Friday on or before the 23rd of the month before the month to which they apply. The skim milk value of Class I is based on the advanced Class III or Class IV skim milk pricing factors, whichever is higher. [25]

Derivation of the advanced Class IV skim milk pricing factor is shown above in equation 11. The advanced Class III skim milk pricing factor is based on advanced product price formulas for butterfat, protein, and other solids:

(15) Advanced butterfat price/lb = (NASS 2-week AA butter price – 0.1202) X 1.20

(16) Advanced protein price/lb = (NASS 2-week cheese price – 0.1682) X 1.383 + {[(NASS 2-week cheese price – 0.1682) X 1.572] – 0.9 X Advanced butterfat price} X 1.17

(17) Advanced other solids price/lb = (NASS 2-week dry whey price – 0.1956) X 1.03

(18) Advanced Class III skim milk price factor = 3.1 X Advanced protein price + 5.9 X Advanced other solids price

The Class I skim milk price is the higher of the values obtained in equations 11 and 18 plus a Class I differential:

(19) Class I skim milk price = Higher of: (Advanced Class III skim milk price factor) or (Advanced Class IV skim milk pricing factor) + Class I differential

The Class I butterfat price also varies by market. It is based on the advanced butterfat price from equation 15:

(20) Class I butterfat price/lb = Advanced butterfat price + (Class I differential ÷ 100)

And the Class I price formula applies standard milk composition weights to Class I skim milk and butterfat prices:

(21) Class I price/cwt = 0.965 X Class I skim milk price + 3.5 X Class I butterfat price

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[25] Technically, the Class I skim milk price is based on the higher of the advanced Class III or Class IV milk price at standard composition (the value of 3.5 pounds of butterfat and 96.5 pounds of skim milk). But since advanced Class III and Class IV butterfat values are identical, the advanced skim milk pricing factors determine whether the Class III or Class IV whole milk pricing factor is higher.

Illustration of class price calculations[26]

It is instructive to use an example of price calculations for the various components and classes of milk. Appendix table 1 shows the two-week and monthly average product prices from the relevant weekly NASS price surveys applicable to federal order prices announced for the month of February 2008.

Advanced prices applying to milk and milk components procured by handlers regulated under the Upper Midwest order during February 2008 were reported on January 18, 2008 (the Friday on or before the 23rd of January) as shown in appendix table 2.

Appendix table 1. Two-week and monthly averages, NASS survey prices ($/lb)

	2-Week—Jan. 18, 2008 (Average of prices for 2 weeks ending Jan. 11)	Monthly—Feb. 29, 2008 (Average of prices for 4 wks ending Feb. 22)
	——————————$/lb.—————————	
Butter	1.2585	1.2044
Cheese	2.0126	1.8403
Dry whey	0.4380	0.2736
Nonfat dry milk	1.6931	1.3331

Appendix table 2. Advanced-priced component and milk price calculations, February 2008

Component/Class Price	Eq. number	Equation	Equation value
Advanced butterfat ($/lb)	15	(1.2585 − 0.1202) X 1.20	1.3660
Advanced protein ($/lb)	16	(2.0126 − 0.1682) X 1.383 + {[(2.0126 − 0.1682) X 1.572] − 0.9 X 1.3660} X 1.17	4.5047
Advanced other solids ($/lb)	17	(0.4380 − 0.1956) X 1.03	0.2497
Advanced nonfat milk solids ($/lb)	10	(1.6931 − 0.157) X 0.99	1.5207
Class IV skim milk price factor ($/cwt)	11	9.0 X 1.5207	13.69
Class II skim milk ($/cwt)	12	13.69 + 0.70	14.39
Class II nonfat solids ($/lb)	13	14.39 ÷ 9.0	1.5989
Class III skim milk price factor ($/cwt)	18	3.1 X 4.5047 + 5.9 X 0.2497	15.44
Class I skim milk (@ base zone, $/cwt)	19	15.44 + 1.80	17.24
Class I butterfat (@ base zone, $/cwt)	20	1.3660 + (1.80 ÷ 100)	1.3840
Class I @ test (@ base zone, $/cwt)	21	(0.965 X 17.24) + (3.5 X 1.3840)	21.48

[26]Spreadsheet files showing these calculations for each month since adoption of product price formulas in federal orders are accessible at the Understanding Dairy Markets website (http://future.aae.wisc.edu).

February 2008 Class III and Class IV milk and component prices were announced on February 29 (the Friday on or before the fifth of March). Class II prices that involved butterfat values were announced on the same date. For the Upper Midwest order, these announced prices were calculated as shown in appendix table 3.

Appendix table 3. Monthly component and milk price calculations

Component/Class Price	Eq. number	Equation	Equation value
Butterfat ($/lb)	1	(1.2044 – 0.1202) X 1.20	1.3010
Protein ($/lb)	6	(1.8403 – 0.1682) X 1.383 + {[(1.8403 – 0.1682 X 1.572] – 0.9 X 1.3010} X 1.17	4.0180
Other solids ($/lb)	5	(0.2736 – 0.1956) X 1.03	0.0803
Nonfat milk solids ($/lb)	2	(1.3331 – 0.157) X 0.99	1.1643
Class IV skim milk ($/cwt)	3	9.0 X 1.1643	10.48
Class IV milk @ std. test ($/cwt)	4	(3.5 X 1.3010) + (0.965 X 10.48)	14.67
Class III skim milk ($/cwt)	7	(3.1 X 4.0180) + (5.9 X 0.0803)	12.93
Class III milk @ std. test ($/cwt)	8	(3.5 X 1.3010) + (0.965 X 12.93)	17.03
Class II butterfat price ($/lb)	9	1.3010 + 0.007	1.3080
Class II milk @ std. test ($/cwt)	14	(0.965 X 14.39) + (3.5 X 1.3080)	18.46

EXTENSION

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