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Basic Milk Pricing Concepts for Dairy Farmers

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Marketing milk at the farm level has fundamentally changed.

Milk pricing is complicated. Most dairy farmers have understandably been quite content to worry about producing milk and let the dairy plant worry about marketing it. And until the late 1990s, there wasn't much dairy farmers could to about pricing or marketing their milk beyond selecting a plant to handle marketing.

But marketing milk at the farm level has fundamentally changed. Dairy managers now have an 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. So such arcane matters as product formula make allowances, advanced higher-of Class I pricing, butter-powder tilts and producer price differentials now make a difference to individual farmers who engage in futures-based risk management.

In this publication, we attempt to explain milk pricing concepts for dairy farmers and others who don't need to know all of the intricate aspects, but who do need to have a basic understanding of how federal milk marketing order prices are derived and how orders and other federal milk pricing rules affect their farm-level milk prices.

We begin by discussing how markets for manufactured dairy products operate, since they are now the only basis for minimum federal order prices. That discussion includes a brief review of the federal dairy 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.

Markets for dairy products

Farm milk prices are the final outcome of the interaction of supply and demand for hundreds of dairy products. These products vary according to how they are ultimately consumed. Some, like homogenized 2% (reduced fat) milk in gallon plastic jugs and yogurt in 6-ounce plastic containers, are purchased in grocery stores and other outlets for at-home family consumption. Some, like wheels of Swiss cheese and bulk containers of ice cream, are distributed after some preparation to consumers through delis, restaurants and cafeterias.

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

For the purpose of discussing markets and prices, it is useful to separate dairy products into **fluid** and **manufactured** categories. Minimum prices for milk used to produce beverage milk products (and some perishable manufactured products) are set administratively through federal and state milk marketing orders, which are discussed later.[1] Hence, processor and retail prices for fluid milk are tied closely to federal order prices. In contrast, prices for storable manufactured dairy products are market-determined except when the dairy price support program is active. These product prices then set the minimum prices for the milk used to make them through federal order pricing formulas.

Over the last 50 years, milk use in the U.S. has shifted gradually from fluid forms to manufactured products (see figure 1). In 1950, fluid milk and cream took about half of the milk supply compared to less than one-third in 2000.[2]

There have been even larger changes within the manufactured product category (figure 2). The proportion of milk used for cheese has expanded rapidly, while the relative amount used for butter has declined. The relative volume of milk used for ice cream has been stable, and milk used for other products (mainly evaporated and condensed milk) has gone down. In 2000, more than 56% of milk used for manufacturing went into cheese. Together, cheese and butter absorbed more than 82% of manufacturing milk supplies in 2000.

Figure 1. Utilization of U.S. milk

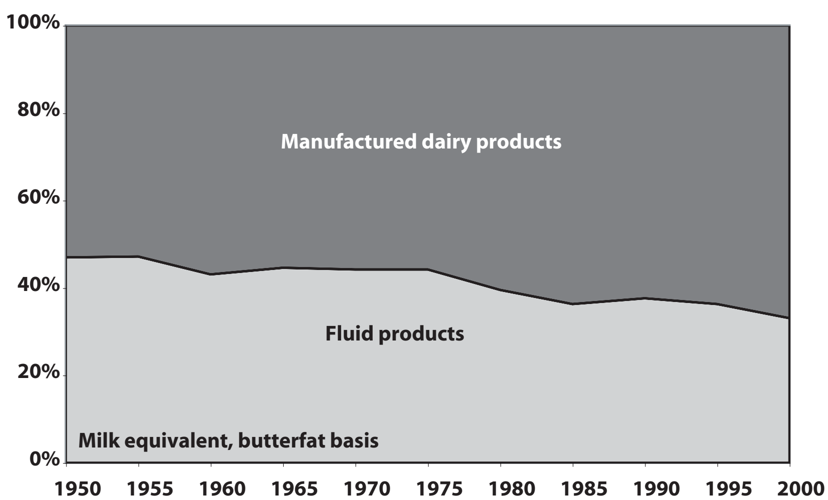
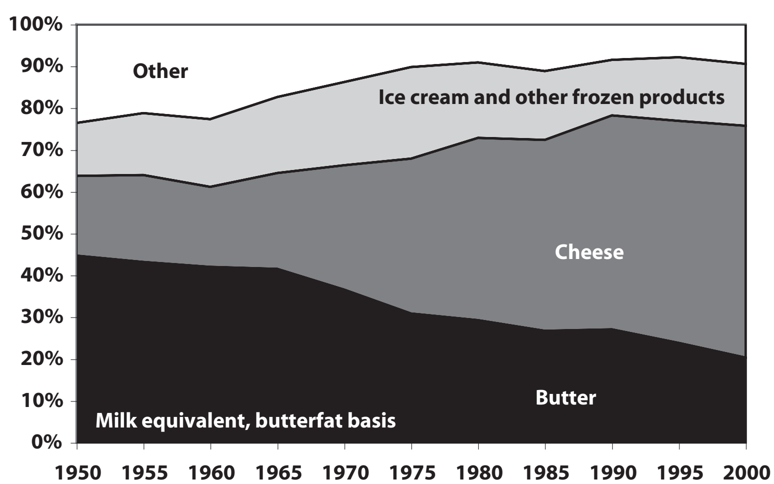


Figure 2. Utilization of U.S. milk for manufactured dairy products



[1] *Fluid milk handlers who purchase raw milk from dairy cooperatives typically pay more than the order price in the form of an "over-order premium," which includes a service charge for providing certain services such as supplying milk as needed to meet processing schedules.*

[2] *Milk utilization noted here is based on accounting for the amount of milk in dairy products using the butterfat content of the products. See the box on page 4 (Fat and Skim Accounting 101) for a discussion of this and alternative methods of converting products to milk equivalent.*

Milk use in the U.S. masks major differences among regions. Given its proximity to large East Coast population centers, New York State supplies a relatively large proportion of its milk to fluid markets—53% in 2002. The composition of manufactured products in New York also reflects the state's location. "Other" cheese, principally mozzarella and other semi-perishable varieties used for pizza, makes up almost 60% of manufacturing milk use in New York (figure 3).

Wisconsin produces about twice as much milk as New York and is located further from dense populations. Consequently, less than 10% of Wisconsin's milk supply is used for fluid products (see figure 4). The composition of Wisconsin manufactured products runs heavily to nonperishable products.[3]

The manner in which producer milk is utilized in various products emphasizes the importance of markets for butter and cheese in determining farm milk prices. The 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.

Figure 3. Utilization of milk in New York, 2002.

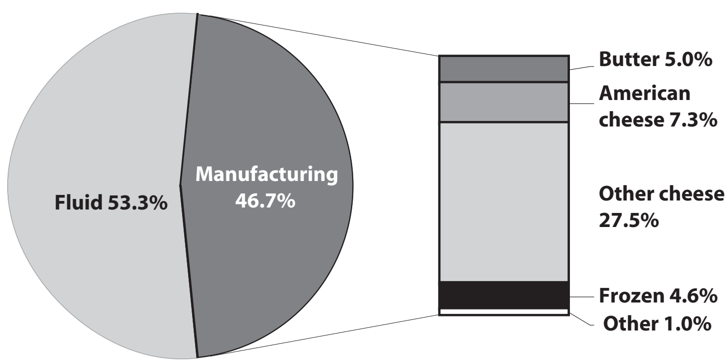
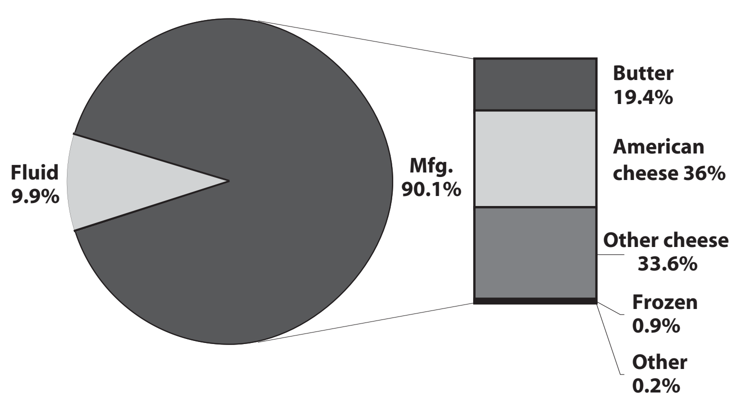


Figure 4. Utilization of milk in Wisconsin, 2002.



[3] *State-level milk utilization is derived from dairy products made in the state and does not conform to actual usage of milk produced within the state. The most serious discrepancy relates to butter, much of which is made from sweet and whey cream rather than milk. For example, most of the butter manufactured in Wisconsin is made from cream, and most of that cream comes from other states.*

Fat and Skim Accounting 101

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 frequently 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 like whipping cream, ice cream and butter.

Most USDA milk supply and use statistics employ fat-based accounting to get around the joint product problem. Utilization of milk for products is derived by converting the weight of the product to a milk equivalent weight using the butterfat content of the product relative to the average butterfat in milk. For example, the butterfat content of Grade AA butter is 80%, so a pound of butter contains 0.80 pound of butterfat. The national average butterfat test of raw milk is about 3.67%. So a pound of butter converts to 21.8 pounds of milk using fat-based accounting.

This method accounts for all of the butterfat in whole milk, but grossly understates milk use in lower fat products. Nonfat dry milk contains little or no fat, so under fat-based accounting, the use of milk to make nonfat dry milk is practically zero. Milk utilized for cottage cheese and condensed skim milk is also understated. Under fat-based accounting, the reported utilization of milk for fluid products is less than the volume of fluid milk sales since the average butterfat content of fluid milk is lower than the butterfat content of raw milk.

An alternative to fat-based accounting is skim-based accounting, which converts products to milk equivalent using the nonfat solids content of products relative to the solids-not-fat in raw milk. Skim-based accounting grossly understates use of milk in butter and frozen dairy products. It also understates milk in cheese because most of the nonfat solids in cheese are protein, which represents only about a third of the solids-not-fat in milk. USDA reports milk utilization for a few dairy products in milk equivalent, skim milk basis. In 2000, for example, the combined production of cottage cheese curd, condensed skim milk, dried buttermilk powder and nonfat dry milk was reported to represent 22.7 billion pounds milk equivalent, skim milk basis.

For a short time, USDA reported milk use on a total solids basis. This method used a weighted average of the fat (40%) and skim (60%) equivalent values. It was used in the 1980s when the department was obligated by law to estimate government purchases of dairy products on a total solids basis to determine changes in the price support level. USDA does not currently report milk used for individual products on a total solids basis, even though this method more accurately accounts for total milk use across all dairy products.

Butter

Brokers representing butter buyers and sellers trade butter on the CME three days per week (Monday, Wednesday and Friday). Only Grade AA butter is traded on the CME. The price established at the end of the trading day becomes the reference price for selling butter throughout the U.S. 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 trade, 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, it is assumed to indicate that the market-clearing butter price is no higher than the offer. An unfilled bid is one that is higher than the last transaction price or that attracts no seller. An unfilled bid suggests that the market-clearing butter price is at least as high as the bid.

In 2002, 1,353 carlots (40,000-43,000 pounds/carlot) of Grade AA butter were traded on the CME. This represented about 4.1% of total 2002 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 U.S. These traders offer to sell butter on the Exchange only if they are unable to sell it on the regular commercial market at the going price.

They bid to buy butter only if they are unable to obtain sufficient quantities 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.

Cheddar cheese

The CME operates a daily wholesale market for cheddar cheese in two styles—40-pound blocks and 500-pound barrels. Except for meeting each business day instead of only three times per week, the cheese market operates the same as the butter market. In particular, prices can change from the previous trading session with an actual sale, an unfilled bid, or an uncovered offer.

In 2002, 644 carlots (40,000-44,000 pounds/carlot) of block cheddar cheese and 194 carlots of barrel cheddar cheese were traded on the CME. The combined volume of trading represented about 1.2% of cheddar cheese production and 0.4% of the production of all cheese in 2002.

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 U.S., cheddar as well as other varieties.

The "thinness" of the central wholesale markets for butter and cheese has long been a source of concern. Some have questioned 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, this question may not be relevant. But in light of the extensive nature of formula pricing 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 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. 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 also maintains a wholesale cash market for nonfat dry milk, but it has been essentially dormant. There were only 20 trades in 2002. This lack of trading activity relates to the importance of the Commodity Credit Corporation (CCC) as a buyer of nonfat dry milk under the dairy price support program. Except for brief periods, the CCC purchase price for nonfat dry milk has set the commercial market price since the early 1990s.

There is no central market for dry whey products. Prices are established through individual negotiations between buyers and sellers, often through brokers and other middlemen firms. There are few dry whey manufacturers relative to cheese plants, as most cheese plants divert their liquid whey to specialized dryers.

The dairy price support program

From time to time, prices for butter, cheese and nonfat dry milk are affected by the federal dairy price support program. The support program operates through a standing offer by USDA's Commodity Credit Corporation (CCC) to purchase unlimited quantities of butter, nonfat dry milk and cheddar cheese at specified purchase prices. The purchase prices are derived from the announced support price for milk, currently $9.90 per hundredweight for milk of average butterfat test (3.67%) and $9.80 for milk testing 3.5% butterfat. The milk support level is specified in federal legislation.

Formulas involving product yields and make allowances are used to mathematically translate the support level for milk into associated CCC purchase prices for the dairy products eligible for purchase. These formulas use roughly the same yields and make allowances as the formulas used to price milk under federal milk marketing orders, thus linking the two federal programs. The resulting purchase prices should financially allow a reasonably efficient plant making the eligible products to pay farmers the announced support price.

The mechanics of setting purchase prices are illustrated below. The calculations are for the purchase prices established for products made on or after November 15, 2002.

The process of deriving CCC purchase prices from a specified milk support price is fairly straightforward for block and barrel cheese. But in deriving purchase prices for butter and nonfat dry milk, the two products are assumed to be jointly produced.[4] So to calculate the price for one product, the price of the other product must be specified. For the November 15, 2002, price announcement, the nonfat dry milk price was specified at $0.80 per pound, and the butter price calculated (table 1).

Note that the butter and nonfat dry milk prices can be altered as long as the combined value of butter and nonfat dry milk per hundredweight of raw milk stays the same. A relative change in product prices is popularly known as a butter-powder "tilt"—if one price goes down, then the other must go up to offset the lower value.

The 1990 farm bill instructed the Secretary of Agriculture to use butter-powder tilts to minimize the public cost of the dairy price support program. In the early 1990s, butter was in surplus relative to nonfat dry milk. Four tilts were made between April 1990 and July 1993, when the milk support price was constant at $10.10 per hundredweight. The butter purchase price was decreased from $1.0925 to $0.65 per pound and the nonfat dry milk price was increased from $0.79 to $1.034.

Butter-powder tilts were re-authorized by subsequent farm bills passed in 1996 and 2002. As under the 1990 Act, the Secretary of Agriculture was permitted to tilt butter-powder prices—as often as twice a year—as necessary to minimize purchase and storage costs. Despite rising CCC stocks of nonfat dry milk along with commercial butter prices well above the CCC butter price, no tilts were made until May 31, 2001, when the CCC purchase price for (non-fortified) nonfat dry milk was reduced from $1.0032 to $0.90 per pound and the purchase price for butter was increased from $0.6558 to $0.8548 per pound. Another tilt lowering the nonfat dry milk price to $0.80 and raising the butter price to $1.05 was announced on November 15, 2002. As amplified later, these tilts were controversial because of their potential effect on fluid milk prices.

Given CCC purchase prices for butter, cheese and nonfat dry milk, how is the dairy price support program implemented? If milk supplies are relatively tight, production of hard manufactured products will be correspondingly low and 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, the supply of milk not needed for perishable products will be increasingly 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.[5] Because of inter-plant competition for the available supply of milk for manufacturing, the CCC prices will also

Table 1. Derivation of CCC purchase prices

Cheddar cheese		**Butter/nonfat dry milk**	
Milk Support Price/Cwt	$9.9000	Milk Support Price/Cwt	$9.9000
+ Make Allowance/Cwt	1.6500	+ Make Allowance/Cwt	1.7747
= Processor Returns/Cwt	11.5500	= Processor Returns/Cwt	11.6747
- Net Whey Value/Cwt*	.2888	- NDM Value/Cwt***	6.9360
= Value of Cheese/Cwt	11.2612	= Value of Butter/Cwt	4.7387
÷ # Cheese/Cwt	9.9533	÷ #Butter/Cwt	4.5130
= Cheese price/Lb**	1.1314	= Butter price/Lb	1.0500

** 0.275 pounds of whey cream butter valued at purchase price for butter.*

*** 40-lb. block price. 500-lb. barrel price is $0.03 lower.*

**** Value at $0.80 per pound and 8.67 pounds per hundredweight.*

[4] *This is not a valid assumption. Most of the butter manufactured in the U.S. is produced independent of nonfat dry milk, coming from excess cream skimmed in fluid milk processing and lower-fat cheese manufacturing. However, the assumption correctly implies that the relative price relationship between butter and nonfat dry milk must conform to relative yields from raw milk.*

[5] *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 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 $0.12 per pound under the CCC purchase prices.*

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 to retain their milk supply.

The CCC may sell back to commercial markets products purchased under the support program at not less than the purchase price. 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 effect of the federal dairy price support program on milk prices has been substantially reduced over the years. Once tied to parity, 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. 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 (figure 5).

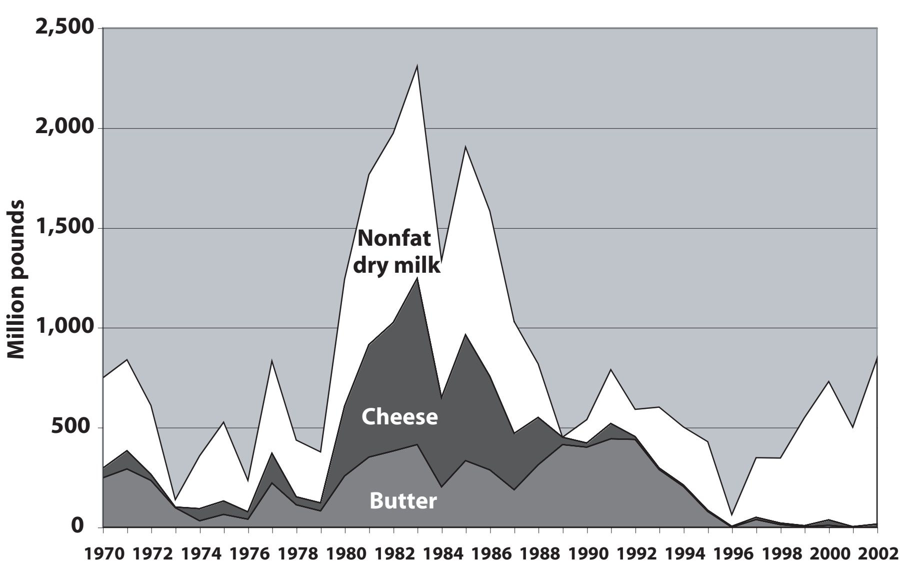
Since the $10.10 level was below the full cost of production for most dairy farmers, government purchases, with the recent exception of nonfat dry milk, essentially dried up. CCC purchases of both butter and cheese in calendar years 1999–2002 averaged less than 0.5% of production.

The 1996 Farm Bill increased the support price to $10.35 per hundredweight for 1996, with subsequent reductions of $0.15 each January 1 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 through 2007 at the $9.90 support level.

Would elimination of the dairy price support program significantly affect the level and volatility of farm milk prices? The program as currently implemented does not consistently enhance milk prices to dairy producers, but it does provide a price floor. Since 1990, market forces, not the government price support program, have largely determined farm level milk prices.

With markets driving prices, volatility has increased markedly. Volatility could increase even more if the price support program were terminated, since downside price movements for butter, cheese, and nonfat dry milk would no longer be limited by the CCC purchase prices.

Figure 5. Government purchases of dairy products.



Grade A and Grade B Milk

In 2002, Grade A milk represented 98% of the milk produced in the U.S. and 96% of the Wisconsin milk supply. Federal milk orders apply only to Grade A milk. Grade A milk is defined as milk that is eligible for use as beverage (fluid) milk, but most Grade A milk is converted to manufactured dairy products. Grade B milk can only be used for manufactured dairy products.

The grade of milk is determined from quality standards and production standards. Somatic cell count and bacteria count are the principal quality standards. Production standards pertain to conditions in and around the milking facility.

Because high quality milk is required for both manufacturing and beverage purposes, the quality of Grade B and Grade A milk being produced today is much closer than years ago. Most milk that is Grade B is so classified because of producers' inability to meet production, rather than quality, standards.

Federal milk marketing orders

Federal milk marketing orders set minimum prices for more than 70% of the Grade A milk produced in the U.S. and Grade A milk constitutes more than 95% of all U.S. milk (see box: *Grade A and Grade B Milk*). California, with about 20% of U.S. milk production, uses a state pricing system that is similar to federal order pricing.

Federal orders are authorized under the Agricultural Marketing Agreement Act of 1937. The Act is enabling legislation—federal orders are not mandated. Rather, dairy producers must request and approve an order through a referendum.

USDA cites three major objectives of federal milk orders:

1) To assure consumers of an adequate supply of wholesome milk at a reasonable price.
2) To promote greater producer price stability and orderly marketing.
3) To provide adequate producer prices to ensure an adequate current and future Grade A milk supply.

These objectives are achieved through:

- *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, who 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 from supply plants and cooperatives.
2) Supply plants: Plants that supply raw milk to distributing plants. These are manufacturing milk plants, like 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 to use the milk in their own plants 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. Dairy cooperatives provide a number of market-wide services that enable federal orders to operate more efficiently. These include such services as milk procurement at the producer level, full supply arrangements to milk bottlers (supplying the milk bottlers need for fluid purposes and handling what is not needed),

moving milk to the highest use and best use, and providing milk quality testing services.

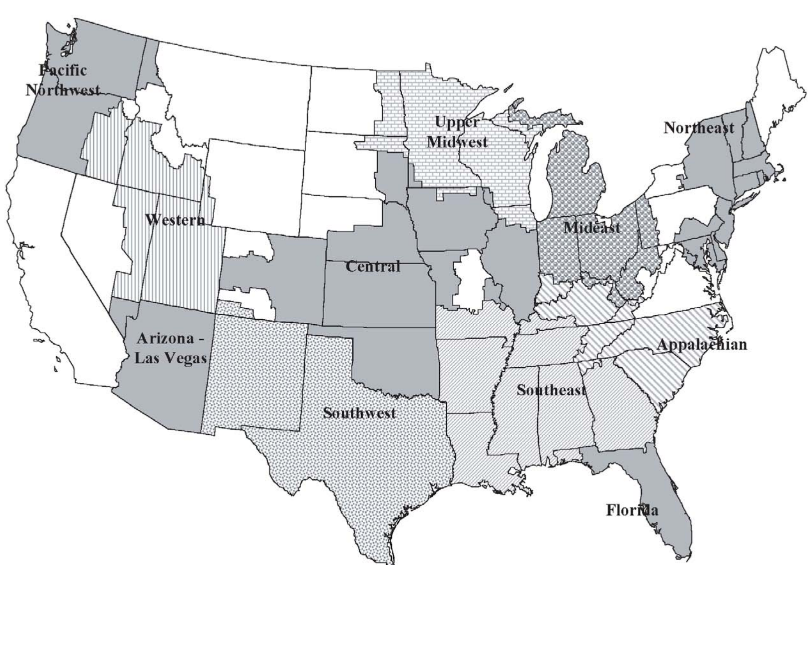
Dairy cooperatives are obligated to the federal order pool for the established minimum prices. But dairy cooperatives are not obligated to pay their members the order minimum producer prices. This is because dairy cooperatives are viewed under the orders as being an extension of their members' farm firms. 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 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 that 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 greatest share of the plant's milk. So whether a dairy producer receives the order prices does not depend upon where the producer is located (within or outside the market area), but rather whether or not its milk plant meets the minimum performance standards within the order.

Table 2. Evolution of federal milk orders

	1960	1970	1980	1990	2002
Orders (No.)	80	62	47	42	11
Producers (No.)	189,816	143,411	117,490	100,397	63,856
Producer deliveries (mil. lbs.)	44,812	65.104	83,998	102.396	125,546
% of U.S. Milk:					
Grade A	64	79	80	77	77
All Milk	43	59	67	70	76

Figure 6. Federal milk marketing order areas: January 1, 2001



Currently there are 11 federal orders, down from 31 prior to the order consolidation that occurred on January 1, 2000 (table 2). There were as many as 81 orders in the mid-1960s. The number was gradually reduced through mergers as packaging and transportation technologies enabled milk to move greater distances and expanded marketing areas.

Classified pricing

Federal orders define the following four classes of milk, from highest to lowest value (under most circumstances):

1) 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.
2) Class II is milk used for soft manufactured products like 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).
3) Class III is milk used to manufacture cream cheese and hard cheeses.
4) Class IV is milk used to make butter and dry milk products—principally nonfat dry milk.

Minimum prices for the hard manufactured classes—Classes III and IV—are announced monthly on the Friday on or before the fifth of the month following the month to which they apply (for example, October prices are announced on the Friday on or before November 5). They are based on product price formulas that relate milk component values to: 1) wholesale dairy product prices; 2) the yield of the finished products in terms of the milk components used to produce them; and 3) assumed manufacturing costs, or make allowances. The volume of components per 100 pounds of milk at standard composition is then multiplied by the component values to derive the Class III and Class IV prices per hundredweight.

Minimum prices for Class I skim milk and butterfat and Class II skim milk are related to Class III and IV prices that are calculated for a different and shorter time period. They are announced on the Friday on or before the 23rd of the month prior to the month to which they apply; for example, the October Class I price is announced on the Friday on or before September 23.

The formula-based procedure for setting minimum class prices ties all federal order milk prices directly and mechanically to the wholesale prices of four dairy products: Grade AA butter, cheddar cheese, nonfat dry milk and dry whey. The formulas use wholesale prices collected from sellers and reported weekly by the National Agricultural Statistics Service (NASS). The NASS prices for butter and cheese are highly correlated with the CME prices, emphasizing the extensive use of reference pricing at the wholesale level and the related influence of the CME cash markets on all milk prices.[6]

Class IV price

The Class IV price is tied to the values of nonfat milk solids and butterfat. Nonfat solids make up nonfat dry milk, and butterfat is the principal constituent of butter. The Class IV (and Class III) butterfat price formula is:

(1) Class IV/III Butterfat Price/Lb. = (NASS monthly AA butter price – 0.115) X 1.20

The NASS butter price is a weighted average of the reported weekly butter prices for the month that are available on the day of the Class IV price announcement. The weights are the reported volume of sales associated with the weekly prices. NASS reports weekly butter prices each Friday for the week ending the previous Friday. Therefore, prices are lagged one week and the monthly price announcement may average either four or five weekly reports, depending on the particular month.

The formula value, 0.115, is the butter **make allowance**—USDA's estimate of the national average cost of manufacturing a pound of butter. The value, 1.20, is the assumed pounds of butter that can be made from one pound of butterfat.[7]

In words, the butterfat price formula says that the value of butterfat to a plant making butter is the price of butter less the cost of manufacturing multiplied by the number of pounds of butter that can be made from a pound of butterfat. **This is the general structure of all of the milk component price formulas.**

The Class IV nonfat milk solids formula is:

(2) Nonfat Solids Price/Lb. = (NASS Monthly NDM Price – 0.14) 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 $0.14 per pound, and the assumed yield is 0.99 pound of nonfat dry milk per pound of nonfat milk solids.[8]

A Class IV skim milk price per hundredweight is calculated by multiplying the nonfat solids price by 9.0, the assumed 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[9] 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).

By mathematically substituting product price formulas for component values, the Class IV price can be expressed directly in terms of butter and nonfat dry milk prices. This relationship is:

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[6] From September 1998, when NASS began reporting wholesale butter prices, through late 2002, the regression of NASS weekly butter prices on lagged (one week) CME prices yielded an R^2 value of 0.935. 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 0.969.

[7] Butter produced in the U.S. is usually 80% butterfat, which would imply a yield factor of 1.25. The 1.20 yield factor assumes some losses of butterfat in manufacturing and during farm-to-plant transportation.

[8] 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.

[9] 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%.

(5) Class IV Price = 4.20 X NASS Butter Price + 8.60 X NASS Nonfat Dry Milk Price – 1.69

Expressing the Class IV price in this way shows the direct effect of month-to-month changes in product prices on the Class IV price. A 10-cent/pound change in the butter price will change the Class IV price by 42 cents/Cwt. in the same direction. A 10-cent/pound increase/decrease in the nonfat dry milk price will increase/decrease the Class IV price by 86 cents per hundredweight.

The derivation of the Class IV price can be illustrated schematically as shown in figure 7.

Class III price

The Class III price is composed of the combined value per hundredweight 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 (see Equation 1). Class III and IV butterfat values are identical, but not the same as the butterfat values for Class II and Class I.

The formula for other solids is relatively straightforward:

(6) Other Solids Price/Lb. = (NASS Monthly Dry Whey Price – 0.159) X 1.03

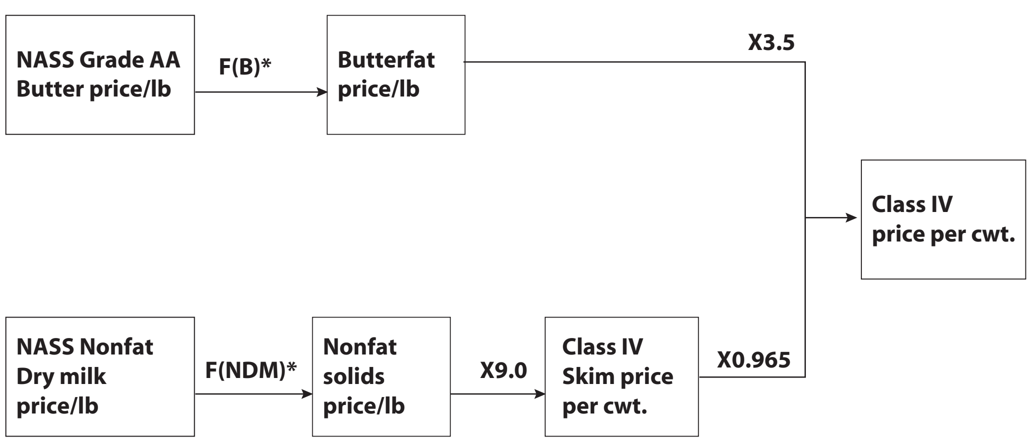
The NASS monthly survey price for dry whey is constructed in the same way as the butter and nonfat dry milk prices as demonstrated for Class IV. The other solids price formula uses a larger make allowance (0.159) than the nonfat solids formula for Class IV. The yield factor (1.03) accounts for the moisture content of dry whey, meaning that a pound of other solids yields more that one pound of dry whey. The Other Solids price is not floored at zero. In other words, if the dry whey price is less than 15.9 cents per pound, the Other Solids price is negative.

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

(7) Protein Price/Lb. = (NASS Monthly Cheese Price – 0.165) X 1.383 +{[(NASS Monthly Cheese Price – 0.165) X 1.572] – 0.9 X Butterfat Price} X 1.17

The first part 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.[10]

Figure 7. Deriving the Class IV price



** denotes a product price formula.*

[10] *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 second part 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:

(8) Class III Skim Milk Price = 3.1 X Protein Price + 5.9 X Other Solids Price

The composition of "average" skim milk is assumed to be 3.1% true protein and 5.9% other (nonfat/non-protein) solids.

Finally, the Class III price is expressed as:

(9) Class III Price = 3.5 X Class IV/III 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 IV/III 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.

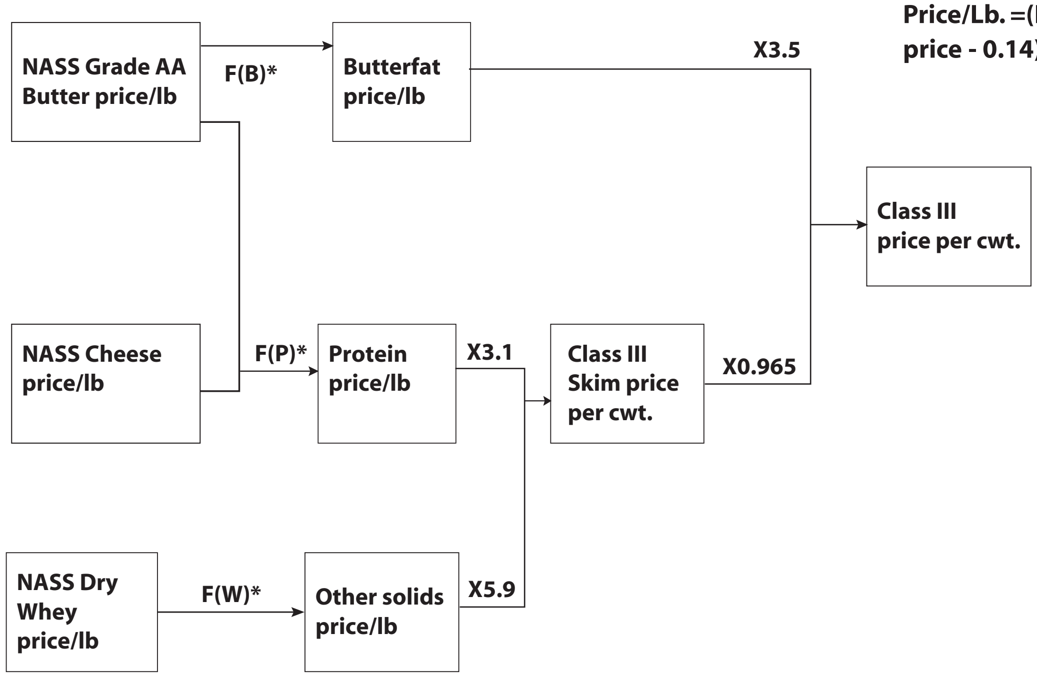
Expressing the Class III price directly in terms of product prices yields:

(10) Class III Price = 9.64 X NASS Cheese Price+0.42 X NASS Butter Price+5.86 X NASS Dry Whey Price-2.57

Increases of $0.10 per pound in cheese, butter and dry whey prices increase the Class III price by $0.964 , $0.042 and $0.586 per hundredweight, respectively.

The derivation of the Class III price can illustrated schematically as follows (figure 8).

Figure 8. Deriving the Class III price



Class II price

Minimum prices for milk used for Class II and Class I products are set in a different fashion from the hard manufactured classes. For both Class II and Class I, prices per hundredweight for the skim milk portion are announced in advance of the month to which they apply. The price announcements are made on the Friday on or before the 23rd of the preceding month. The class prices are derived from the same product price formulas used to derive Class IV and Class III component values. But the weighted average product prices in the formulas average only the last two weekly prices that are available in the NASS report issued on the Friday on or before the 23rd of the month. Usually, these are the first two weeks of the month.

The Class II butterfat price is the *monthly* Class IV/III butterfat price plus a constant differential. The Class I butterfat price is the *advanced* (two-week) Class IV/III butterfat price plus a differential that varies by market.

Derivation of the Class II price begins with the advanced nonfat solids price:

(11) Advanced Nonfat Solids Price/Lb. =(NASS Two-Week NDM price - 0.14) X 0.99

This is the same formula used for the Class IV nonfat solids price (Equation 2) except that 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 and may include earlier weeks.

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

(12) Advanced Class IV Skim Milk Price 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:

(13) 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:

(**14) Class II Nonfat Solids Price/Lb. = Class II Skim Milk Price/Cwt. ÷ 9.0**

The butterfat portion of Class II milk is priced at the Class IV/III butterfat price plus a constant differential:

(15) Class II Butterfat Price/Lb. = Class IV/III Butterfat Price + $0.007

Since the Class II butterfat price is linked to the monthly Class IV/III butterfat price, 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 advance pricing of the skim portion of Class II but not the butterfat portion.

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

(**16) 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.[11]

Derivation of the advanced Class IV skim milk pricing factor is shown in equations 11 and 12. The advanced Class III skim milk pricing factor is based on advanced product price formulas for butterfat, protein and other solids:

(17) Advanced Butterfat Price/Lb. = (NASS 2-Week AA Butter Price – 0.115) x 1.20

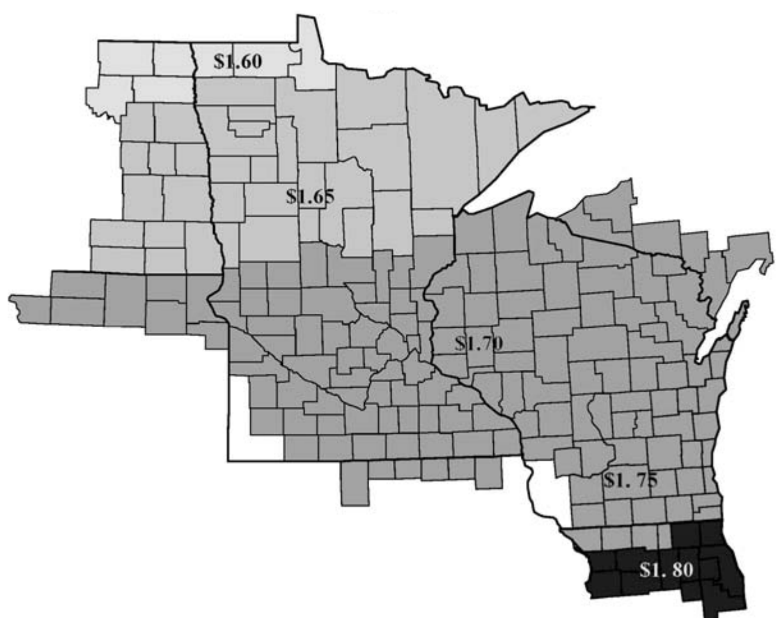
(18) Advanced Protein Price/Lb. = (NASS 2-Week Cheese Price – 0.165) X 1.383 + {[(NASS 2-Week Cheese Price – 0.165) x 1.572] – 0.9 x Advanced Butterfat Price} x 1.17

(**19) Advanced Other Solids Price/Lb. = (NASS 2-Week Dry Whey Price – 0.159) x 1.03**

(20) 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 12 and 20, plus a Class I differential:

Figure 9. Class I differentials—Upper Midwest Federal Order



[11] *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.*

(21) Class I Skim Milk Price = Higher of: (Advanced Class III Skim Milk Price Factor) or (Class IV Skim Milk Pricing Factor) + Class I Differential

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 northeastern North Dakota.

Among marketing orders, Class I differentials in the eight markets east of the Rocky Mountains increase with distance from the Upper Midwest (figure 10). 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 was no compensating change in the geographical Class I price alignment. But at the same time, the need for supplemental milk supplies diminished.

Class I differentials in the three markets west of the Rocky Mountains are not aligned with eastern differentials. The base differentials in the Northwest (Western and Pacific Northwest orders) are $1.90 per hundredweight, $0.10 higher than the base Class I differential in the Upper Midwest. The base Class I differential for the Arizona-Las Vegas order is $2.45.

The Class I butterfat price also varies by market. It is based on the advanced butterfat price from equation 17:

(22) 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:

(23) Class I Price/Cwt. = 0.965 x Class I Skim Milk Price + 3.5 x Class I Butterfat Price

Table 3. NASS survey prices used for deriving April 2003 federal order prices

	2-Week—Mar. 21, 2003 (Average of prices for 2 wks ending Mar. 14)	Monthly—May 2, 2003 (Average of prices for 4 wks ending April 25)
	——————$/lb.——————	
Butter	1.0506	1.0736
Cheese	1.0697	1.0997
Dry whey	.1594	.1582
Nonfat dry milk	.8048	.8030

Figure 10. Class I differentials for selected U.S. Eastern cities (January 1, 2000)

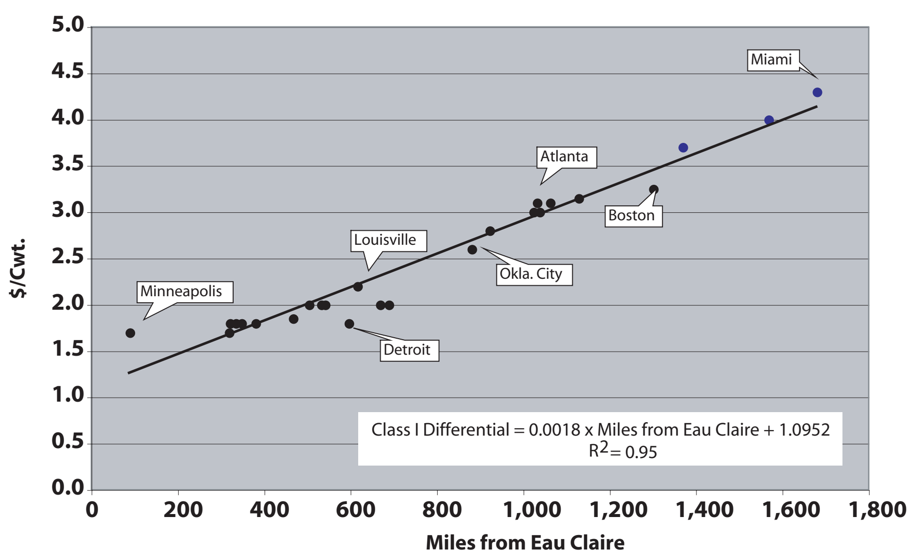


Illustration of class prices

An example of price calculations for the various components and classes of milk follows. Table 3 shows the average product prices from the relevant weekly NASS price surveys applicable to federal order prices announced for the month of April 2003.

Advanced prices applying to milk and milk components procured by handlers regulated under the Upper Midwest order during April 2003 were reported on March 21, 2003 (the Friday on or before March 23) as shown in table 4.

April 2003 Class III and IV milk and component prices were announced on May 2 (the Friday on or before May 5). 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 table 5.

Pooling

Pooling is accomplished under federal milk orders by obligating each regulated handler to account for 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, or the uniform price.

Table 4. Derivation of advanced federal order prices for April 2003

Component/Class Price	Eq. number	Equation	Equation value
Advanced butterfat ($/Lb)	17	(1.0506 – 0.115) X 1.20	1.1227
Advanced protein ($/Lb)	18	(1.0697 – 0.165) X 1.383 + {[(1.0697 – 0.165) X 1.582] – 0.9 X 1.1227} X 1.17	1.7330
Advanced other solids ($/Lb)	19	(0.1594 – 0.159) X 1.03	0.0004
Advanced nonfat milk solids ($/Lb)	11	(.8048 – 0.14) X 0.99	0.6582
Class IV skim milk price factor ($/Cwt)	12	9.0 X 0.6582	5.92
Class II skim milk ($/Cwt)	13	5.92 + 0.70	6.62
Class II nonfat solids ($/Lb)	14	6.62 ÷ 9.0	.7356
Class III skim milk price factor ($/Cwt)	20	3.1 X 1.7330 + 5.9 X 0.0004	5.37
Class I skim milk (@ base zone, $/Cwt)	21	5.92 + 1.80	7.72
Class I Butterfat (@ base zone, $/Cwt)	22	1.1227 + (1.80 ÷ 100)	1.1407
Class I @ test (@ base zone, $/Cwt)	23	(0.965 X 7.72) + (3.5 X 1.1407)	11.44

Table 5. Derivation of monthly federal order prices for April 2003

Component/Class Price	Eq. number	Equation number	Equation value
Butterfat ($/Lb)	1	(1.0736– 0.115) X 1.20	1.1503
Protein ($/Lb)	7	(1.0997 – 0.165) X 1.383 + {[(1.0997 – 0.165) X 1.582] – 0.9 X 1.1503} X 1.17	1.8006
Other solids ($/Lb)*	6	(0.1582 – 0.159) X 1.03	-.0008
Nonfat milk solids ($/Lb)	2	(.8030 – 0.14) X 0.99	.6564
Class IV skim milk ($/Cwt)	3	9.0 X 0.6564	5.91
Class IV milk @ Std. Test ($/Cwt)	4	(3.5 X 1.1503) + (0.965 X 5.91)	9.73
Class III skim milk ($/Cwt)	8	(3.1 X 1.8006) + (5.9 X -0.0008)	5.58
Class III milk @ std. test ($/Cwt)	9	(3.5 X 1.1503) + (0.965 X 5.58)	9.41
Class II butterfat price ($/Lb)	15	1.1503 + 0.007	1.1573
Class II milk @ std. test ($/Cwt)	16	(0.965 X 6.62) + (3.5 X 1.1573)	10.44

**With the Class III pricing formulas effective April 2003, the Other Solids price is not "snubbed" at zero, and is negative whenever the NASS dry whey price is less than $0.159 cents per pound.*

The pool obligations by class are noted in table 6.

Table 6. Pool obligations by class

Milk use class	Handler obligation to the producer settlement fund
Class I	Class I skim milk price at location x skim milk pounds Class I butterfat price at location x butterfat pounds
Class II*	Class II nonfat solids price x nonfat solids pounds Class II 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 four of the seven orders that use multiple component pricing.*

The following items are deducted from the gross value of each handler's milk based on the table above to derive the net handler obligation to the pool:

- Producer price differential
- Producer location adjustment
- Protein value
- Other solids value
- Producer 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.

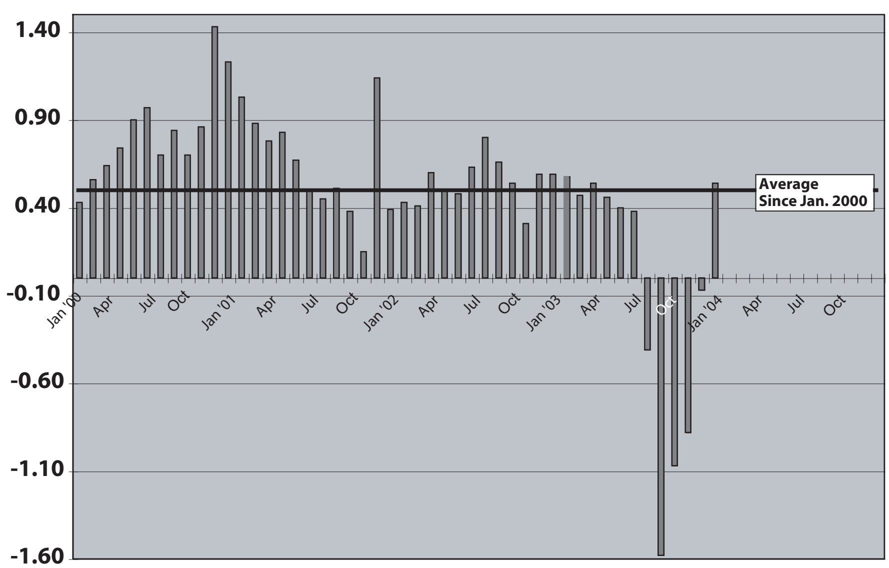
The deductions noted introduce some new terminology that needs explanation. Conceptually, the **producer price differential** (often abbreviated, PPD) is a measure of how much the average value of handler receipts over the entire market exceeds the average value if all milk were priced at Class III. Under most federal orders, producers are paid for milk components—butterfat, protein and other milk solids—at the same prices used to derive the Class III price. 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 or Class IV skim price may move substantially above or below the advanced values. In the extreme, the Class I mover can be less than the monthly counterpart by more than the Class I differential. This results in a negative PPD.

Producer price differentials for the Upper Midwest order since the consolidated order was created in January 2000 are shown in figure 11. The PPD range has been $3.01 per hundred-

Figure 11. Producer price differential, Upper Midwest



[12] *Seven of the 11 federal orders use multiple component pricing for establishing milk value and producer pay prices. The remaining four orders, in areas where milk is predominantly utilized for Class I, use skim milk-butterfat accounting*

weight, from $-1.58 to $1.43. Negative Producer Price Differentials were experienced in four months during 2003.

The **producer location adjustment** accounts for differences in the Class I differential at the receiving plant and the differential at the location of the supply 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. 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 (equation 7) by 0.0005. For April 2003, the rate was 0.0005 x $1.0997 = $.00055 per thousand.

Calculate the somatic cell adjustment per hundredweight by subtracting the producer somatic cell count in thousands from 350 and multiplying the result by the rate per 1,000. A producer with an April 2003 cell count of 120,000 would receive a premium of (350-120) = 230 X $0.00055 = $0.13 per hundredweight. A producer with a 500,000 cell count would receive a deduct of (350-500) = -150 X $0.00055 = - $0.08 per hundredweight.

Table 7 illustrates a hypothetical producer settlement accounting for two handlers regulated under the Upper Midwest order for April 2003. Handler 1 is a pool distributing plant that packages beverage milk and soft manufactured (Class II) products. Handler 2 is a supply plant that ships 10% of its milk receipts to a distributing plant and manufactures cheese with the remaining milk. Each handler is assumed to receive 1 million pounds of milk during April 2003 of identical composition: 3.7% butterfat, 3.0% protein and 5.8% other solids. The producer price differential applying to both plants is $0.46 per hundredweight. Both plants receive milk that has an average somatic cell count of 350,000, so the somatic cell adjustment is zero.

Handlers' producer settlement fund payments or receipts may be adjusted by transportation credits and assembly credits. 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 that may otherwise be destined for manufacturing.

Transportation and assembly credits for the entire marketing area are subtracted from total pool proceeds in the process of calculating the producer price differential. In other words, the total Class I value is reduced by the amount of these credits.

Table 7. Illustration of producer settlement fund accounting (April 2003 prices)

	Rate per pound	Handler 1 Pounds	Handler 1 Value	Handler 2 Pounds	Handler 2 Value
Class I: Skim Milk	.0772	770,400	59,475	96,300	7,434
Butterfat	1.1407	33,765	30,890	3,700	4,221
Class II: Nonfat Solids	.7356	18,000	13,241		
Butterfat	1.1573	7,400	8,564		
Class III: Protein	1.8006			27,000	48,616
Other Solids	-.0008			52,200	(42)
Butterfat	1.1503			33,300	38,305
Class IV: Nonfat Solids	.6564				
Butterfat	1.1503				
Less:					
Prod. Price Differential	0.0046	1,000,000	4,600	1,000,000	4,600
Prod. Location Adj.					
Protein	1.8006	30,000	54,018	30,000	54,018
Other solids	-.0008	58,000	(46)	58,000	(46)
Butterfat	1.1503	37,000	42,561	37,000	42,561
Somatic Cell Value					
Net to/from fund[13]			11,037		(2,599)

[13] *The pool does not balance because the combined utilization of the two plants does not match the market utilization of milk as reflected by the producer price differential. The producer price differential is also affected by assembly and transportation credits on Class I milk, which are not included in the example.*

Producer prices

With federal order pooling, producers receive a common price for their milk components regardless of how their milk is used. Total producer milk value under the order is the sum of the following elements:[14]

- Total hundredweight milk X Producer Price Differential (@ location)[15]
- Protein pounds X Protein Price
- Other Solids pounds X Other Solids Price
- Butterfat pounds X Class IV/III Butterfat Price
- Total hundredweight milk X Somatic Cell Adjustment

Expressed in terms of hundredweights of milk, producer prices will differ according to 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 April 2003. The PPD at the base zone for April 2003 was $0.46 per hundredweight, decreasing to $0.26 in the outermost zone.

Producer A ships to a plant in Harvard, IL (Class I differential = $1.80; PPD = $0.46). A operates a Jersey herd with April 2003 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 = $0.26); B's April 2003 tests were 3.2% butterfat, 2.8% protein and 5.7% other solids. 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 8.

Producer B's milk value as determined from the federal order pricing elements would be calculated as shown in table 9.

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 and different locations. Producer B actually receives $0.47 per hundredweight less than the Class III price for April 2003, mainly because lower butterfat and protein values relative to the standards used to compute the Class III price more than offset the producer price differential.

Other milk check components

What dairy producers receive from their milk plants is usually different from the federal order calculation. Most producers receive various premiums and deductions.

Some premiums and deductions are associated with specific 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

Table 8. Federal order producer price calculation—Producer A

Pricing element	Units	Rate	Value
Producer Price Differential	1,000 Cwt.	0.46	460.00
Protein	3,700 Lbs.	1.8006	6,662.22
Other Solids	6,000 Lbs.	(.0008)	(4.80)
Butterfat	4,500 Lbs.	1.1503	5,176.35
Somatic Cell Adjustment	1,000 Cwt.	.1320	132.00
TOTAL VALUE:			12,425.77
VALUE PER CWT.			12.43

Table 9. Federal order producer price calculation—Producer B

Pricing element	Units	Rate	Value
Producer Price Differential	1,000 Cwt.	0.26	260.00
Protein	2,800 Lbs.	1.8006	5,041.68
Other Solids	5,700 Lbs.	(.0008)	(4.56)
Butterfat	3,200 Lbs.	1.1503	3,680.96
Somatic Cell Adjustment	1,000 Cwt.	(.0392)	(39.20)
TOTAL VALUE:			8,938.88
VALUE PER CWT.			8.94

[14] *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, for example via a cheese yield formula. However, the total producer payment cannot be less than what would be calculated using the federal order pricing elements.*

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

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, 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.

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, 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 prices and, sometimes, Class II prices. These premiums are called "over order" or "super-pool" premiums. A portion of the premium is reimbursement for services that cooperatives perform such as full supply agreements with handlers, transportation of milk, balancing functions and the like. The excess beyond 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 $0.25 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 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 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 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 them to join the Northeast Compact or create 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 Compact in debate over the Dairy Title of the Farm Security and Rural Investment Act of 2002. While these were not successful, the new dairy legislation contains remnants of the Compact in the National Dairy Market Loss program, slated to operate from December 2001 through September 2005. Specifically, deficiency payments are equal to 45% of the monthly difference between $16.94 and the Boston Class I price. This is the same payment rate used under the Compact, but payments are made nationally on eligible production.

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 more than 50 years of continuous operation, the dairy price support program has provided several lessons. One 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 lower 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 10 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. 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 systems that pay bonuses to producers who do not expand production rather than penalize those who do.

The negative effects of misaligned product prices because of 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, 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 percent 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. And most of the industry strenuously fought butter-powder tilts in 2001 and 2002 that eventually addressed the problem, at least in part.

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

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

Federal Milk Marketing Orders

Structure of Class I Differentials: Perhaps the most contentious aspect 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.[16]

Single basing point pricing occurs naturally only when there is either a single producing area for a commodity or a single 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 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

[16] *We should note that the 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.*

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.

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 number 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 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 link fluid milk prices closely 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 (see equation #21). 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 value was expected to exceed the Class IV skim 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" every month from January 2000 through July 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 $0.90 per pound. This yielded Class IV skim milk prices in a narrow range of $6.85 to $7.90 per hundredweight.[17] 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 (figure 12).

[17] *The November 15, 2002, tilt reduced the CCC purchase price for nonfat dry milk to $0.80 per pound. The Class IV skim milk price associated with this new CCC price is $5.88 per hundredweight. Thus, the tilt has reduced the odds of Class IV being the Class I mover.*

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.

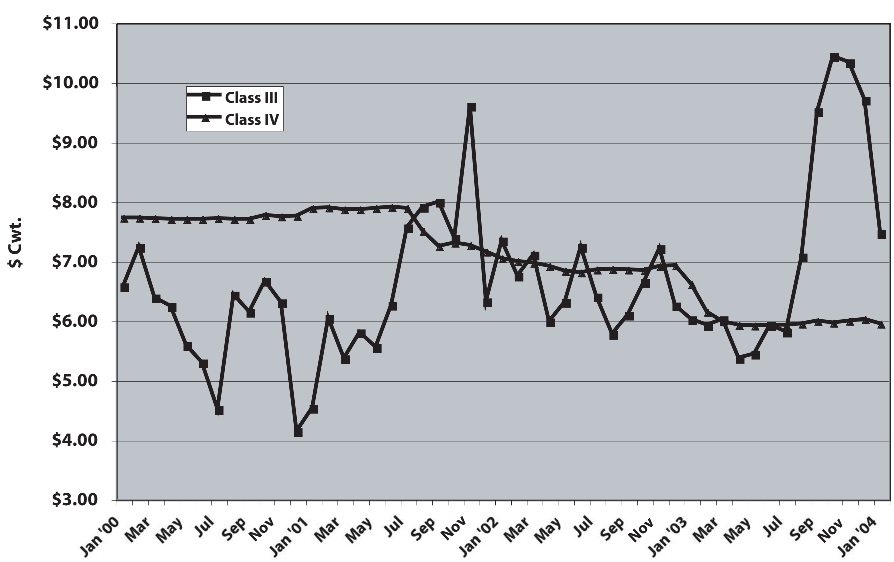
Pricing formulas: The "higher of" problem noted here illustrates a larger issue of how effectively the federal order pricing formulas capture supply and demand conditions for producer milk. For many years, federal milk orders tied minimum prices by class of milk to competitively determined prices for 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 would attract milk away from those that were less efficient. Plants making products with strong demand would attract 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.

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

Pooling issues: Federal order reform not only consolidated markets but also made it easier and more attractive for cooperatives to pool their members' milk on orders distant from where their members are located. Some orders permitted milk to be pooled without being regularly shipped to a plant regulated by the order.

Figure 12. Advanced skim milk pricing factors



For example, a cooperative operating in the Upper Midwest order might identify several producers to affiliate with the Central order. The cooperative would ship the milk of those producers to a plant in the Central order often enough to meet the Central order's shipping (qualification) requirements, which may be only once a month. All of the monthly milk deliveries of the designated producers would then be priced under the Central order even though only one day's production was actually shipped. This would be advantageous to the cooperative as long as the difference in the PPDs between the Central and Upper Midwest orders was more than enough to offset the hauling costs necessary to qualify the milk on the Central order.

Unregulated Grade A milk is also being pooled in certain orders. Much of this milk is from California and has already been priced under the California state order. This has led to charges of "double-dipping"—the California milk enjoys the pool benefits of both the California pricing system and the federal order pricing system.

Liberal pooling has created winners and losers. The winners are producers in low Class I use markets. They gain in two ways. First, the cooperative whose members are pooled on other markets get the receiving market Producer Price Differential on milk pooled on the receiving market. Second, the Class I utilization in the shipping market is elevated because some milk is removed from the shipping market pool. This raises the Producer Price Differential in the shipping market.

The losers from liberal pooling are producers in the receiving market, who experience lower Class I utilization. This reduces the Producer Price Differential.

A number of federal order hearings were held in 2001 and 2002 to tighten shipping requirements and reduce the incentive for distant pooling. A hearing in the Upper Midwest order led to a ruling that prohibited pooling milk on the order that was priced under a state order. Other hearings resulted in major restrictions on cooperatives affiliated with other orders pooling member milk on the Central and Mideast orders, and similar restrictions are expected from USDA's analyses of the records from other hearings.

At issue in the pooling debate is whether Class I revenues should be restricted to local producers or shared more broadly with more distant producers who are equally capable of supplying milk for fluid use if needed.

Opponents of liberal pooling stress the need to generate a producer price differential high enough to encourage local self-sufficiency. Supporters of liberal pooling argue that with current transportation methods, reserve milk supplies can be located practically anywhere in the United States. For the time being, local interests have held sway in the debate.

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