BALANCED DAIRYING
-Economics-

Texas Agricultural Extension Service
The Texas A&M University System

Volume 21, No.
June 21, 2001

In This Issue: Understanding Milk Prices and Basis

Milk Pricing

by
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Milk is a unique commodity. It is a perishable, bulky, heavy liquid. Milk is composed of butterfat, protein, and other solids, mostly minerals, salts, and natural sweeteners. Most of these components can be removed individually from milk through both physical and chemical processes. However, there are also some serum proteins that are more difficult to remove. Milk established itself as an important human food because it is so versatile. It is consumed as an unadulterated beverage, as an ingredient in other beverages, and as any number of products derived from all or part of its components.

Its perishable nature and its susceptibility as a disease carrying agent influenced the development of the institutions that emerged in the milk marketing chain. Most of the hard products (cheese, butter, non fat dry milk) allowed milk to be preserved and stored over time. Despite the fact that cheese and butter have been around for nearly as long as man has collected the milk of animals for his own use, it has only been within the last century that the marketing and pricing of milk in this country developed into the system familiar to us. Only since 1937 has the United States developed and operated the Federal Order system, and to a lesser extent the initiation of some State operated milk orders. About 64 percent of the milk produced and marketed in the United States moves through a Federal milk marketing order[2], and an additional 18 to 20 percent is marketed through state marketing orders. The largest of the state orders is the California system. California produces almost 19 percent of the nation's milk[3].

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[2]**Federal Milk Order Market Statistics, 1999 Annual Summary**, AMS, USDA, September, 2000.

[3]Derived from **Milk Production**, NASS, USDA, Washington, DC , February 16, 2001.

[1] Asst. Prof., Asst. Prof, Extension Asst., Professor, respectively, Ag. Econ. Dept., Texas A&M Univ.

Pooling

Order development over the last four decades has been influenced in large part by the cooperatives marketing beverage milk, but the cooperative movement in dairy really came into being to market the main products derived from milk, butter and cheese. About eighty percent of the milk marketed today moves through cooperatives[4]. It is through the cooperative movement in milk that pooling developed. Pooling is at the heart of the milk cooperative and both the federal and state order systems. Pooling is the term used for combining and sharing all revenues from the sale of milk. Each producer contributing milk into the pool receives an average price that is derived from the pool. In the order system this average price is referred to as the uniform blend price. The order determines a minimum uniform price for milk to be paid by all regulated processors. Both cooperative and non-cooperative members receive this minimum uniform price set by the order plus any premiums the milk processor may pay milk suppliers.

Cooperatives represent their members so processors deal directly with the cooperative rather than individual producers. Order regulations recognize cooperatives to be treated as a single milk supplier[5]. Cooperatives may sell milk to processors across many regions and regulated by many orders. Each order requires the cooperative to receive that order's uniform producer price. Cooperatives develop their own pool price to determine an uniform cooperative pay price to members from the coops total receipts.

Location and Form

Milk pricing developed a location aspect early in its evolution. This location aspect was related to its perishable nature. Processors had to offer prices that would draw milk to their plant docks. Because milk prices were FOB (Free On Board) at the dock, those dock prices had to be high enough to encourage a supplier to deliver milk to the dock. Product characteristics and local supply-demand conditions led to a natural pricing differentiation for raw milk.

Milk had alternative uses, and processors tended to specialize in different milk products. Beverage milk was the most perishable form. Its market was the most localized, and producer deliveries subject to weekly and seasonal demand. Beverage milk processors often had to pay higher prices to lure milk into their plants. Processors manufacturing other products had the advantage of being able to store their manufactured products. Their products were less perishable and in some instances less subject to weekly and seasonal demand variability. Their product inventory was also slower to turn over. These non-fluid processors tended to locate in areas where milk supplies were substantial, so no location differential developed for milk used in manufacturing.

Classified Pricing

The concept of classified pricing developed informally, but was made part of the order regulations. All milk associated with a Federal order is eligible for beverage use, but not all eligible milk is bottled. Some milk is used for other products. Only Grade A

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[4]**Marketing Operations of Dairy Cooperatives, Research Report 173**, RBS, USDA, Washington, DC, June 1999.

[5] CFR Title 7, Chapter X, Part 1126; CFR Title7, Chapter X, Part 1000.

milk is regulated through a Federal Order. Classified pricing requires that Grade A milk, marketed to a processor regulated by an order, be valued as it is used. Milk sellers and beverage processors choose to keep this milk that goes into other products associated with the order so its value goes into the pool and payment for it to producers is the uniform price. The uniform price paid producers is the weighted average of the class prices. The weights are the amounts of milk associated with each use class. A very simple example (Table 1) will illustrate.

In this example, 10 million pounds of milk is marketed and its total value is $1,407,000. The uniform price is $14.07 per hundredweight.

Class I Prices

In the Federal Order program, Class I milk is used as a beverage. Regulated Class I milk processors pay the Class I price for the milk they bottle. Since the federal order regulations are written to assure an adequate supply of beverage eligible milk, the Class I price has a location differential added to both the skim portion and the butterfat portion of the Class I price. The Class I price is announced in advance of the month to which it applies.

Table 1:The Uniform Price

Class	Price	Thousand Cwts.	Thousand Dollars
I	$16.00	50	$ 800
II	$14.00	15	$ 210
III	$11.00	29	$ 319
IV	$13.00	6	$ 78
Total		100	$1,407
Uniform Average Price	$14.07		

The Class I skim price is either the higher of an advanced Class III skim price or an advanced Class IV skim price. The advanced Class III skim price is based on a USDA survey of cheese prices and whey prices. The Class IV skim price is based on a USDA survey of non-fat dry milk prices. The Class I butterfat price is based on a USDA survey of butter prices. The Class II and IV advanced skim prices and the Class I butter price surveys are conducted during the first two weeks of the preceding month.

Class II Prices

In the Federal Order program, Class II milk is used to manufacture soft products such as frozen desserts, and yogurt. Regulated Class II milk processors pay the Class II price for the milk they convert to these soft products. The Class II price is announced in advance of the month to which it applies. The Class II price is based on a USDA survey of non-fat dry milk prices and butter prices conducted during the first two weeks of the preceding month. There is a quality adjustment added or subtracted based on somatic cell count.

Class III Prices

In the Federal Order program, Class III milk is used to manufacture cheese. Regulated Class III milk processors pay the Class III price for the milk they convert to these hard products. The Class III price is announced around the 5th of the month following the month to which the Class III price pertains. For example, on May 5th the April Class III prices is announced. The Class III price is based on a USDA survey of cheddar cheese, butter, and dry whey prices. The survey covers the entire month to which the Class III price pertains.

The Class III price is the price linked to the Milk Futures contract traded on the Chicago Mercantile Exchange[6]. At the expiration of each contract the contract close out price is forced to the announced Class III price. This process of forcing the closeout price to the Class III price is referred to as cash settling. Cash settlement takes the place of settling an open contract through performance of the contract obligation. As with Class II milk, there is a quality adjustment added or subtracted based on somatic cell count.

Class IV Prices

In the Federal Order program, Class IV milk is used to manufacture non fat dry milk and butter. Regulated Class IV milk processors pay the Class IV price for the milk they convert to these products. The Class IV price is announced around the 5th of the month following the month two which the Class IV price pertains. The Class IV price is based on a USDA survey of non-fat dry milk prices and butter prices. The survey covers the entire month to which the Class IV price pertains. The Class II price is adjusted based on somatic cell count. The Class IV price is linked to the Class IV Futures contract traded on the Chicago Mercantile Exchange[7].

Producer Price

Of the eleven Federal Orders, four orders pay producers based on a uniform butterfat skim price that is essentially derived in the manner illustrated above in the discussion of classified pricing. Seven orders pay producers based on Class III component prices. The Class III component prices for butterfat, true protein, and other solids are derived from USDA price surveys. (See the discussion on Class III prices above). In the component markets, producers receive a butterfat price for the pounds of butterfat sold, a true protein price for pounds of true protein sold, and an other solids price for the pounds of other solids sold. Additionally, producers receive a producer price differential (PPD). The PPD is quoted on a hundredweight basis and is paid on all the milk sold . The PPD captures the value of location and is the sum of milk used in Class I, Class II, and Class IV multiplied by the difference between the Class I price, the Class II price, the Class III price and the Class IV price. A quality adjustment based on somatic cell count is added to the price if the cell count is below 350,000 and subtracted if the count is above 350 thousand. The example in Table 1 above is used to illustrate the producer price. Table 2 illustrates The calculation of the producer pay price using the information in Table 1.

Summary

The key elements to remember about current milk pricing are that most Grade A milk is marketed and priced with in a regulated system. In a regulated marketing system milk is Classified and priced by use, not quality. The class prices are based on USDA product prices. Milk is pooled and a uniform price is paid to dairy producers.

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[6]See Milk Futures, Options, and Basis in this series.

[7]Ibid.

Table 2: Producer Price

Component Portion of The Producer Price

Component	Price	Quantity	Value
Butterfat	$ 1.590	3.5	$ 5.57
True Protein	$ 1.630	2.99	$ 4.87
Other Solids	$ 0.099	5.69	$ 0.56
			$ 11.00

PPD Portion of the Producer Price

Class	Price	Difference	Class Use
Class III	$ 11.00	$ -	29%
Class I	$ 16.00	$ 5.00	50%
Class II	$ 14.00	$ 3.00	15%
Class IV	$ 13.00	$ 2.00	6%

Quality Premium

Producer SCC	Standard	Difference	Rate	Value
200	350	150	0.00064	$ 0.10

Producer Pay Price per Cwt.

	Component	$ 11.00
	PPD	$ 3.07
	Quality	$ 0.10
	Cwt. Price	$ 14.17

Milk Futures, Options and Basis

By

Michael Haigh, Matthew Stockton, David Anderson and Robert Schwart[1]

Dairy producers confronted with uncertainty associated with the future price of milk have several methods of limiting that risk. One simple alternative may be the use of a forward contract agreement with a cooperative locking in an agreed upon price for a certain quantity to be delivered. However, another alternative may be to hedge the price uncertainty by using either futures or options contracts traded at a commodity exchange. These methods of risk reduction have unique characteristics that lend themselves to differing producer price objectives, risk preferences and market conditions. Although producers may use different strategies for different goals at different levels of risk, having a sound understanding of basis is paramount.

Price Risk

Uncertainty associated with the future cash price received or to be paid for a commodity is simply known as price risk. For instance, common to both the dairy producer and processor is lack of knowledge of the direction of future prices. For instance, a dairy producer would enjoy an increase in prices and a dairy processor would enjoy a decrease in prices. On the other hand a

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decrease in prices would be considered to be unfavorable to the dairy producer and favorable to a processor. For both of these parties there is uncertainty associated with these potential outcomes. Fortunately the existence of a milk futures and options market enables both parties to better manage these unfavorable price changes known as price risk.

Milk Futures and Options

Two milk futures and options contracts are currently traded on the CME (Chicago Mercantile Exchange). One milk contract corresponds to the USDA Class III price, and the other corresponds to the Class IV price[2]. The standardized futures contracts are for delivery of 200,000 lbs. of milk Grade A milk testing 3.5 percent butterfat. Futures contracts for both Class III and Class IV milk, trade every month and can be traded up to 18 months in advance. Futures and options prices are quoted in dollars per hundredweight (cwt). For every one cent change in a futures contract price single the value of the futures contract changes $20.00. One option equals one futures contract in size.

At expiration, no milk is actually delivered or received. At expiration, contract prices are forced to the corresponding announced Class III or Class IV price for that month. Cash is exchanged to reconcile differences in contract values. This process of forcing reconciliation to announced prices is called "cash settlement". In contrast, most agricultural commodity futures contracts require the futures market participants to take or make delivery at expiration. A unique characteristic of the milk market is the announcing of prices for the previous month on or around the 5th of the following month. There is a spot market for milk other than Grade A and some Grade A milk not associated with a regulated market. However for milk associated with a regulated market, prices are announced monthly. Monthly price announcements stand in contrast to daily grain and livestock prices.

Hedging

Hedging is the process of laying off risk to some one willing to assume that risk. Hedgers may use the futures market to lock in a price. Product producers hedge to prevent a loss associated with a price decline, while product users are trying to prevent a loss associated with a price rise. Hedgers in the futures market hold one of two positions depending on their position in the underlying milk cash market. Producers selling milk sell futures contracts. Those buying milk buy futures contracts.

Margins

All participants that buy or sell futures contracts are required to maintain a margin account as long as he or she holds a position in the market. The margin account is also known as a performance bond, and the initial margin requirement varies depending on the type of trader (speculator or hedger) and the contract. Each contract is compared to the closing price at the end of each trading day. A contract that is profitable will result in money being added to the margin account. For instance if the price of the contract being held by a hedger in a short position (sold a contract) is above the closing futures price, the contact is profitable because the hedger can close out his or her position at a profit by buying a contract for the same month. The profit is the difference between the price the futures contract sold for and the price the futures contract was purchased for. This difference is added to the margin account. For

[2] For a description of milk prices see "Milk Pricing" in this series of articles.

example, imagine a November contract was sold for $13.27 The next day the market closes at $12.87. The seller could buy the $12.87 contract and earn $.40/ hundredweight or $800 per contract.

A contract that is not profitable will result in money being subtracted from the margin account. A participant holding the opposite position, being long would have money taken away from the margin account for falling prices, and money added for rising prices. To maintain the contract the maintenance level must be maintained, and if the margin account falls below the maintenance level, the hedger will receive a margin call. Figure 1 illustrates

Figure 1. Example Margin Account Activity

Futures Activity				Margin Account Activity		
Day	Action	Value	Gain	Profit or Loss	Initial Deposit or Margin Call.	Account Balance
1	Sell 1 Nov.	$13.27			Deposit $1,500	$1,500
2	Market close	$12.87	+ 40 cents			$2,300
3	Market close	$13.27	- 40 cents	-$800		$1,500
4	Market close	$13.57	- 30 cents	-$600		$ 900
5	Market close	$13.67	- 10 cents	-$200		$ 700
5					Call for $ 800	$1,500

Basis

Basis is the defined as the difference between the cash price and the futures price. The simplicity of the formula does not reflect the complexity of its application.
The basis formula is:

Cash Price – Futures Price = Basis (1)

If this basis calculation yields a negative number we say the market is 'normal', and with a positive number we say that the market is 'inverted'.

The basis formula can be rewritten as:

Basis + Futures Price = (Expected) Cash Price (2)

The basis can be determined using either a gross price or a "mailbox" price. The mailbox price is the gross price minus hauling, promotion and marketing charges. The mailbox price is sometimes called the net price. Some cooperatives print the gross price on the check printout, while others print the net price. Preliminary research suggests that either the net price or the gross price can be used to calculate the basis, with little adverse consequence[3].

Milk basis calculations also differ from basis calculations for other commodities such as livestock and grain, because milk is not strictly based on grade or transportation. Milk prices reflect season, market location quality differences, and milk use. These designations and destination differences determine the pool price[4]. For example, a producer whose milk is associated with a market pool composed primarily of Class I (beverage) milk receives a higher price than a producer whose milk is primarily associated with a pool dominated by Class III (cheese) milk. Their milk quality may be identical, but the end use of their milk determines their price. Except for Grade B milk and some unregulated milk, prices are announced after the product has been delivered and used. These announced prices hold for a whole month. There are no cash market prices quoted or published on a daily basis for Grade A milk. Except for some spot market transactions, and some transactions involving

[3] Stockton, Mathew. "Texas Dairy Farm Price Risk" Term Paper for Agricultural Economics 601, Dr. M. Haigh, Instructor, Texas A&M University, College Station, Spring 2001.
[4] See footnote 2, above.

Grade B milk or unregulated milk, milk prices are based on USDA formula prices.

Tracking Basis

Tracking basis is a simple process because futures prices are cash settled to announced milk prices. The process involves the dairy producer subtracting the price for the futures contract for which he or she wants to determine the basis from the pay price printed on the milk check: Table 1 illustrates. Suppose the producer wants to determine the basis for each month of the year 2000. The January pay price for the dairy producer's milk was $11.46. The announced Class III price for January 2000 was $10.05. This producer's basis for January 2000 is $1.41. This producer's basis varies 38 percent over the year 2000. Figure 2 presents a graph of this variation in basis.

Table 1. Basis Calculation for Central Texas Dairy for 2000

	Cash	-	Futures	=	Basis
Month or Contract	Pay Price		Class III $		Basis
January	$11.46		$10.05		$1.41
February	$11.09		$9.54		$1.55
March	$11.22		$9.54		$1.68
April	$10.89		$9.41		$1.48
May	$10.25		$9.37		$0.88
June	$11.35		$9.46		$1.89
July	$11.84		$10.66		$1.18
August	$11.93		$10.13		$1.80
September	$11.99		$10.76		$1.23
October	$12.16		$10.02		$2.14
November	$11.92		$8.57		$3.35
December	$11.84		$9.37		$2.47

If the basis is to be of use to the producer he or she should determine it for each month over at least three years. To estimate a monthly basis, the producer could average the bases for each month. Table 2 illustrates this process of estimating basis. Adding the latest year's data and dropping the earliest years creates a running average monthly basis.

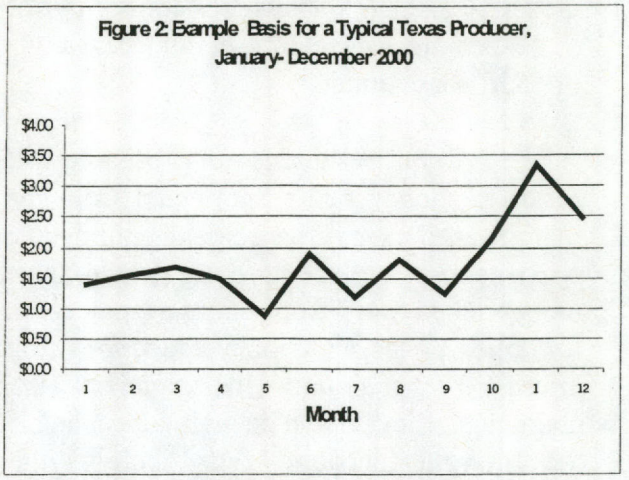

Table 2: Three Year Average Basis Calculation for Central Texas Dairy

	1998	1999	2000	3-Year Avg.
Jan	$1.72	$1.76	$1.41	$1.63
Feb	$1.68	$6.00	$1.55	$3.08
Mar	$1.81	$4.14	$1.68	$2.54
Apr	$2.45	$0.71	$1.48	$1.55
May	$3.05	$1.61	$0.88	$1.85
Jun	$1.01	$2.28	$1.89	$1.73
Jul	($1.55)	$2.08	$1.18	$0.57
Aug	$0.51	$1.77	$1.80	$1.36
Sep	$1.71	$3.30	$1.23	$2.08
Oct	$1.25	$3.14	$2.14	$2.18
Nov	$0.60	$2.82	$3.35	$2.26
Dec	$0.51	$0.07	$2.47	$1.02

Using the Basis

By knowing the basis, the hedger can estimate a potential cash price for the point in the future when milk will be sold. Dairy producers hedge to protect themselves against a decline in prices by the time of milk delivery. Dairy producers want to assure themselves they will receive a milk price at least high enough to cover all cash out flows for the period. Adding an estimate of basis to a futures price being considered gives the producer an estimate of his or her cash price at

the time milk is sold if the producer sells the futures contract or buys a put option (the right but not the obligation to sell) using the futures price.

Figure 3 illustrates the importance of the basis. Suppose that the current month is January, and the current milk futures contract price is $12.15 for a June milk contract. Suppose that June historically has a basis of $1.63. The expected June cash price would be $13.78. In this example the producer hedges June milk in January by selling a June contract in January.

Now suppose it is July 5. The June Class III is announced to be $10.05. The Futures exchange cash settles the June Milk contract at $10.05. Suppose the cash price received is $11.68. In this example the basis remains constant. At expiration of the June futures contract , the producer buys a June contract at $10.05, and gains $2.10. ($12.15 - $10.05 = $2.10).

Figure 3: Example Hedge; Basis Remains Unchanged

Date	Action	Futures Market	Cash Market
15-Jan	Sell 1 June Futures Contract	$12.15	
	Expected Basis		$1.63
	Expected Hedged Cash Price		$13.78
5-Jul	Buy 1 June Futures Contract	$10.05	
	Class III Cash Price from Milk Sales		$10.05
	Cash Price on Milk Check		$11.68
	Basis (cash - futures)		$1.63
	Gain in the Futures Market	$2.10	
	Net Price Received (futures gain + milk check cash price)		$13.78

The net price received by this producer is $13.78, which is the $11.68 received from selling milk plus the $2.10 gained buying back the June futures contract.

Basis Risk

From the previous example it is evident that basis determines the outcome of the expected price and the actual price received. If basis can be predicted perfectly, future cash price can be known with certainty and all risk can be eliminated. Unfortunately no one knows exactly what the basis in the future will be. Indeed, the relationship between cash and futures prices can occasionally be quite unpredictable, and occasionally the cash and futures prices can move in opposite directions. This uncertainty is known as basis risk. To reduce basis risk or at least to understand its nature and proprieties requires knowledge of the factors that can alter it. Any number of factors can affect basis. The most obvious factors are milk quality, milk utilization, producer market location, and milk components. The Producer Price Differential (PPD)[5] is one part of the basis. It reflects the utilization of Class I, Class II, and Class IV relative to Class III, and the locations of the Class I plants receiving producer milk. Producers can influence quality, and component content. Producers can move and in some instances, producers can choose the handler receiving the producer's milk. Figures 4 and 5 illustrate the effect on producer prices when the basis changes with an inverted market.

[5] See "Milk Pricing"

Figure 4: Example Hedge; Basis Narrows

Date	Action	Futures Market	Cash Market
15-Jan	Sell 1 June Futures Contract	$12.15	
	Expected Basis		$1.63
	Expected Hedged Cash Price		$13.78
5-Jul	Buy 1 June Futures Contract	$10.05	
	Class III Cash Price from Milk Sales		$10.05
	Cash Price on Milk Check		$11.58
	Basis (cash - futures)		$1.53
	Gain in the Futures Market	$2.10	
	Net Price Received (futures gain + milk check cash price)		$13.68

Figure 5: Example Hedge; Basis Widens

Date	Action	Futures Market	Cash Market
15-Jan	Sell 1 June Futures Contract	$12.15	
	Expected Basis		$1.63
	Expected Hedged Cash Price		$13.78
5-Jul	Buy 1 June Futures Contract	$10.05	
	Class III Cash Price from Milk Sales		$10.05
	Basis (cash - futures)		$1.73
	Cash Price on Milk Check		$11.78
	Gain in the Futures Market	$2.10	
	Net Price Received (futures gain + milk check cash price)		$13.88

The producer with a highly predictable basis faces less basis risk and can eliminate more risk. An effective hedge is one where basis risk is less than the original price risk. Even though a basis change may be 'bad' for the producer, a hedge is better than no hedge in most situations. Ultimately, whether prices increase or decrease, whether the hedger is short or long, whether the market is inverted or normal, and whether the basis narrows or widens is going to determine how effective the hedge is.

Summary

The futures and options markets are viable tools to those producers who have large enough quantities of milk to hedge. Basis is fundamental to the use of the futures and options market for risk management. Every producer has a unique basis. Basis is not only affected by both overall market conditions but on individual producer conditions, and the classes of milk being produced. Each producer should determine historical bases. Basis has some inherent risk and futures and options contracts should not be used if the basis risk is greater than the underlying milk price risk. However understanding basis will reveal the nature of risk and can help the producer to decide if futures and options are tools that can reduce risk.