



## Basis and Its Importance in Risk Management

**P**ennsylvania dairy producers interested in locking in milk prices for a portion of a future delivery of milk must find a financial instrument to protect their milk price. This means looking for a market of buyers and sellers who are willing to take positions in the market regarding a future price of milk, cheese, or even butter. At the present time no markets exist to hedge farm-gate milk prices. In other words, a dairy producer located in Lancaster, Pennsylvania, would not be able to find someone who would be willing to guarantee a price on a future delivery of milk at the local milk price.

However, there is an active market at the Chicago Mercantile Exchange for a contract called the Class III milk futures. Pennsylvania dairy producers, or managers at a dairy cooperative or cheese processing plant, can use this futures market to indirectly lock in or protect milk prices. If the Class III cash market (USDA's federal order Class III price) generally rises and falls with the local milk price in Pennsylvania, then protecting a Class III price would be similar to protecting a local Pennsylvania farm-gate price.

The objective of this report is to study the relationship between cheese, butter, and Class III prices and local Pennsylvania farm milk prices. This relationship is called basis.

### What Is Basis?

Basis is the month-to-month difference between an individual dairy producer's gross milk price and the USDA-announced Class

III price. We are interested in the USDA Class III price since there is a corresponding futures market at the Chicago Mercantile Exchange. Figure 1 shows the relationship between the Pennsylvania all-milk price and the Class III price. While not a perfect relationship, the all-milk price generally rises and falls with changes in the Class III price. The difference between these two prices is thus a "basis."

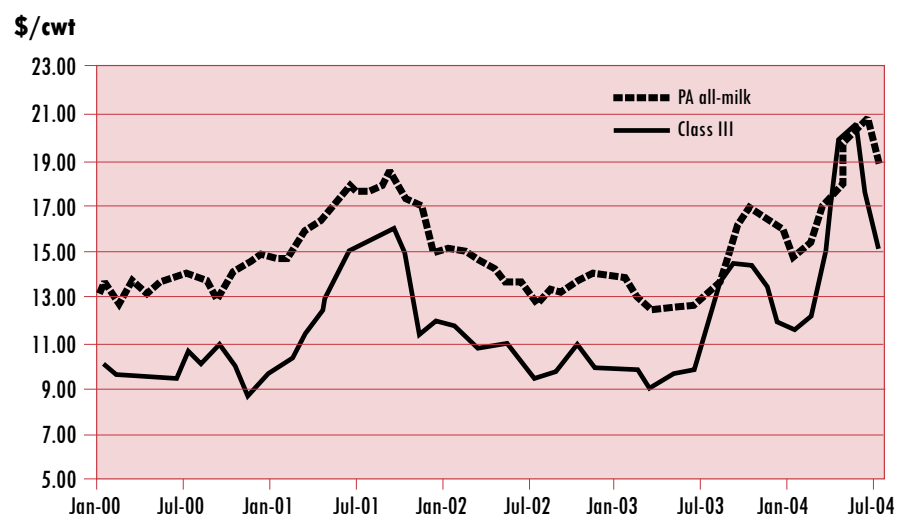
The basis in Figure 1 has a mean value of \$3.17 per cwt, a maximum value of \$5.83, and a minimum value of -\$1.66 over the period January 2000 to July 2004. In other words, the choice to use the Class III price for computing the basis is not a perfect choice. This is because it is unstable from month to month, as seen in Figure 2. However, most of the volatility in the observed basis

occurred after June 2003, and in our case, limited alternatives may be available to the Class III milk futures for use in forward pricing milk.

Some cooperatives doing business in Pennsylvania have offered their members the opportunity to forward price a portion of their milk relative to the cash price of block cheese. Producers are told that if the cash price of cheese rises above a preset level in a given month, the producer will have a deduction taken from the milk check. On the other hand, if the cash price of cheese falls below the preset level, then dollars will be added to the milk check. In order to compare the milk check to the cheese price, the cheese price is multiplied by a factor of 10.<sup>1</sup> In

1. Approximately 10 pounds of milk are needed to make 1 pound of cheddar cheese.

**Figure 1. Basis for Pennsylvania all-milk price.**



many cases the cheese price may make an excellent alternative to the Class III price. This is because the cheese price is a major driver of the Class III price. The latter is defined under federal orders as the price of milk used to make cheese. From Figure 3 one can see that the cheese price (multiplied by a factor of 10) is very closely associated with the Class III price.

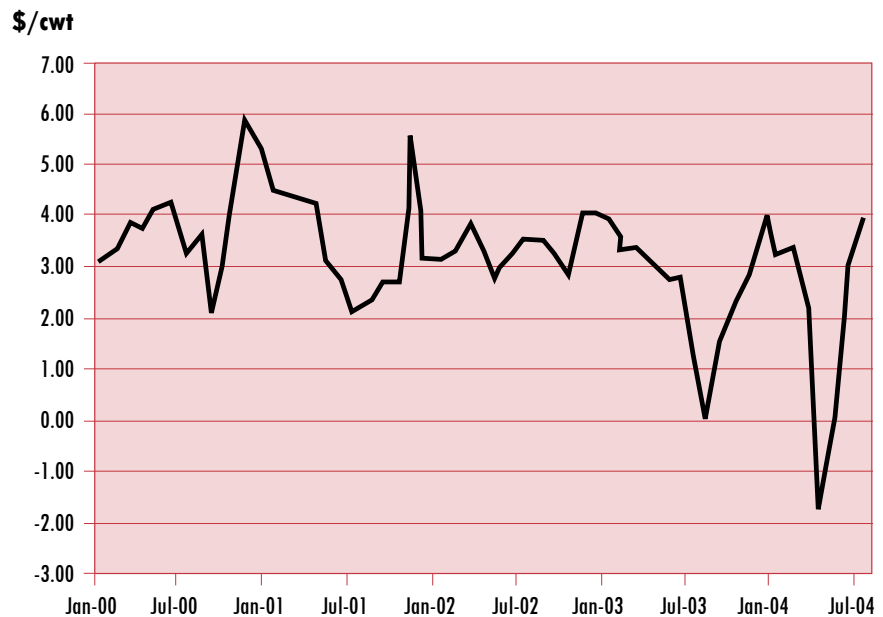
As stated earlier, the use of the cheese price or the Class III price may not be a perfect choice in computing the local basis. The basis varies each month from the local milk price due to the following factors:

- Over-order premiums. Many farmers receive over-order premiums, which depend on local market factors that change from month to month.
- Producer price differential (PPD). The PPD for the local federal order accounts for much of the monthly basis. It is equal to the statistical uniform price computed by the federal market administrator less the Class III price. The PPD also explains why the basis is sometimes negative.
- Component levels. The PPD is calculated at standard component levels (see discussion below). An individual dairy producer may consistently produce above this level, which will inflate the basis.

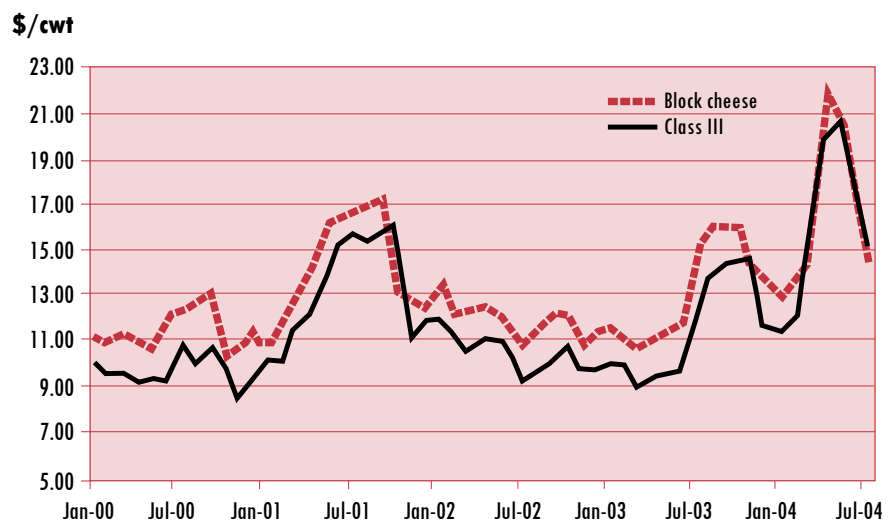
### Relationship to Federal Orders

Federal and state milk marketing orders have a large impact on the basis calculation. Dairy producers who are located in high Class I federal orders that sell a majority of their milk for beverage purposes should have the highest basis in the country (e.g., Northeast, Southeast, and Florida federal orders). For example, the Class I utilization rate (percent of milk used in the order for beverage purposes) in the Northeast order 1 is typically around 45 percent. Thus, Pennsylvania dairy producers should expect a basis calculation of around \$2

**Figure 2. Basis for the Pennsylvania all-milk price relative to Class III.**



**Figure 3. Block cheese vs. Class III.**



**Note: Block cheese price is multiplied by a factor of 10.**

to \$3 per cwt. The Class I utilization, and therefore the basis calculation, is much lower in the Upper Midwest (around \$1 to \$2 per cwt). The basis could be zero in other parts of the United States where there is no federal order and most milk is used for cheese purposes (e.g., Idaho).

### Milk Components

The formula used by the USDA for computing the Class III price of milk each month is as follows:

$$\text{Class III} = P_{bf} * 3.5 + P_{pr} * 2.9915 + P_{os} * 5.6935$$

$P_{bf}$  is the price of butterfat (\$/lb),  $P_{pr}$  is the price of protein (\$/lb), and  $P_{os}$  is the price of other dairy solids (\$/lb).

The numbers multiplied by the prices are component levels in percentage.

**Table 1. How to estimate the value of components in your basis calculation: Example farm.**

Month	Farm Component Levels			Component Prices			Class III Value		
	Butterfat %	Protein %	Other %	Butterfat \$/lb	Protein \$/lb	Other \$/lb	Your Farm \$/cwt	Federal Order \$/cwt	Premium \$/cwt
Jan	3.833	3.095	5.635	1.1856	1.8164	0.0339	10.36	9.78	0.58
Feb	3.812	3.090	5.651	1.1373	1.8538	0.0240	10.20	9.66	0.54
Mar	3.794	3.083	5.664	1.1459	1.6648	0.0206	9.60	9.11	0.49
Apr	3.751	3.045	5.683	1.1503	1.8006	-0.0008	9.79	9.41	0.38
May	3.654	2.982	5.696	1.1512	1.9275	-0.0144	9.87	9.71	0.16
Jun	3.610	2.941	5.680	1.1576	1.9434	-0.0200	9.78	9.75	0.03
Jul	3.558	2.902	5.664	1.2055	2.5480	-0.0124	11.61	11.78	-0.17
Aug	3.569	2.922	5.641	1.2514	3.1438	0.0026	13.67	13.80	-0.13
Sep	3.653	3.004	5.630	1.2218	3.3180	0.0170	14.53	14.30	0.23
Oct	3.768	3.080	5.631	1.2553	3.2815	0.0311	15.01	14.39	0.62
Nov	3.816	3.101	5.629	1.2877	2.9267	0.0368	14.20	13.47	0.73
Dec	3.829	3.084	5.636	1.3688	2.2997	0.0362	12.54	11.87	0.67
<b>Annual</b>	<b>3.721</b>	<b>3.028</b>	<b>5.653</b>	<b>1.2099</b>	<b>2.3770</b>	<b>0.0129</b>	<b>11.76</b>	<b>11.42</b>	<b>0.34</b>

Thus, the Class III price as announced by the USDA each month is effectively quoted using standard component levels of 3.5 percent butterfat, 2.99 percent protein, and 5.69 percent other dairy solids.

But what if your farm consistently produces components above these minimum levels each month? In that case, your components would add a premium to your milk check. An example for 2003 is provided in Table 1. In this example, federal order data was used for component prices and the Class III price. An example farm provided data for component levels. A monthly Class III farm value was computed by multiplying the component levels (in percentage) by the component prices (\$/lb) and summing across all three components. This value represents the contribution components are making to the milk check. Subtract from this the announced Class III price to estimate the component premium. In the example in Table 1, the farm earned an average \$0.34 per cwt just from components above the announced Class III price.

### How to Compute Your Basis

Table 2 provides a simple way to compute your basis for 2003 and 2004. Simply take the gross price of milk from the milk check and subtract the announced Class III price each month. Then, for the annual average, add the monthly basis calculations together and divide by 12.

One question often asked is which price should one use from the milk check when computing the basis? The gross price is suggested since it does not reflect marketing costs and other deductions. The gross price is simply the component values plus the PPD and any other premiums. We do not recommend using deductions to calculate the basis since (1) these deductions have nothing to do with your basis and decisions to forward price milk, and (2) the basis is used to compute a figure (the planning price) that is then compared to the cost of production, which should already reflect these deductions.

### Use in Planning and Forward Contracting

So, why compute the basis in the first place and how should it be used? For one thing, the basis is very important for planning purposes. An example is provided in Table 3. Our example farm computed an average basis of \$2.47 per cwt for the first 6 months of 2004. The basis is noticeably unstable. Therefore, we used the mean calculated during the prior 6 months plus and minus \$0.50 per cwt to provide a range. This range of mean, high, and low is then added to the prevailing Class III futures price (as of August 24, 2004) to forecast an average, high, and low gross milk price for August to December 2004.

The basis information can also be used in deciding whether a particular futures offering on a particular day is worth locking in. For example, the Class III futures price in Table 3 for December 2004 is \$12.06 per cwt. Given the range in the basis, this would result in a gross milk price, or a planning price of \$14.03 to \$15.03 per cwt (Class III plus basis). One could then compare this planning

**Table 2. Worksheet for computing your basis, 2003–2004.**

	2003			2004		
	Gross Milk Price	Class III	Basis	Gross Milk Price	Class III	Basis
	(a) \$/cwt	(b) \$/cwt	(c) \$/cwt	(d) \$/cwt	(e) \$/cwt	(f) \$/cwt
		(a) – (b)			(d) – (e)	
Jan		9.78			11.61	
Feb		9.66			11.89	
Mar		9.11			14.49	
Apr		9.41			19.66	
May		9.71			20.58	
Jun		9.75			17.68	
Jul		11.78			14.85	
Aug		13.80			14.04	
Sep		14.30			14.72	
Oct		14.39			14.16	
Nov		13.47			14.89	
Dec		11.87			16.14	
<b>Annual</b>		<b>11.42</b>			<b>15.39</b>	

**Table 3. Using the basis calculation for planning purposes, 2004, \$/cwt.**

	Gross Milk Price			Class III	Average	Basis	
	Actual/Average	High	Low	Cash/Futures		High	Low
Jan	14.86			11.61	3.25		
Feb	14.64			11.89	2.75		
Mar	15.99			14.49	1.50		
Apr	21.51			19.66	1.85		
May	22.94			20.58	2.36		
Jun	20.17			17.68	2.49		
Jul	17.95			14.85	3.10		
Aug 1 <sup>1</sup>	16.57	17.07	16.07	14.10	2.47	2.97	1.97
Sep 1 <sup>1</sup>	16.81	17.31	16.31	14.34	2.47	2.97	1.97
Oct 1 <sup>1</sup>	15.43	15.93	14.93	12.96	2.47	2.97	1.97
Nov 1 <sup>1</sup>	14.66	15.16	14.16	12.19	2.47	2.97	1.97
Dec 1 <sup>1</sup>	14.53	15.03	14.03	12.06	2.47	2.97	1.97

Note: The difference between “high” and “low” relative to the mean is \$0.50/cwt.

1. Forecast is from August to December. The Class III milk futures as of August 24, 2004, was used during the forecast period.

price to their cost of production and to the December gross milk prices in previous years in order to decide whether to lock in this particular contract price.

### **Basis Risk**

There is one problem in using the basis for computing a planning price: It may not be very accurate! Using the Class III price of milk to compute the basis may result in a less than perfect basis calculation for prediction purposes. In other words, your basis may vary significantly from month to month. A better alternative would be to use some combination of cheese and butter for computing the basis. However, good futures instruments do not exist at the present time for cheese and butter, so Class III futures is our best alternative.

One way of dealing with this degree of uncertainty is to compute a mean basis for a period of time (6-12 months) and then use a range (plus or minus \$.50 per cwt) when computing a planning price or making a forecast. This will at least provide some range for analysis that may be more realistic. Again, this was the procedure used in the example provided in Table 3.

### **Conclusions**

Knowing your basis is key to understanding how to use futures contracts to forward price milk. The basis can be used to forecast your gross milk price given a forecast of the Class III price of milk or cheese and butter prices. Also, basis can be used to compute a planning price when making a decision whether to forward price milk. Basis is risky, however, when using the cheese price or Class III price as a reference point. Thus, some assumption must be made regarding how much your estimate will vary from the average that was calculated from historical data. We suggest taking the average of the basis over a 6- to 12-month period of time and then setting a range of plus and minus \$0.50 per cwt. This should provide a reasonable range for the forecast of the actual basis.

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