

## Tracking Milk Prices and Feed Costs

**M**ilk and feed prices are extremely volatile from one month to the next and can have an adverse impact on a dairy farm's gross profitability. If milk prices fall and feed costs rise, farm profits can be squeezed. In some years, milk prices can be very low, resulting in a need to more carefully monitor feed costs to maintain profits. In other years, milk prices could increase as a result of market spikes in feed costs, which also requires careful monitoring since milk prices may not rise fast enough to keep up with higher feed costs.

Despite common knowledge, dairy producers control milk prices and feed costs. Both milk prices and feed costs can be forward contracted through a milk cooperative and a feed grain supplier. Farms that are large enough can also directly contract for milk and feed costs through a commodity broker. In addition, dairy producers are responsible for developing a feed budget, purchasing feed inputs, and delivering that feed to their herd in an economically efficient manner. Thus, feed costs, which are between 40 and 60 percent of the total cost of producing milk, are clearly controlled by the dairy farm manager. The key is to develop a system to monitor and budget milk prices and feed costs in order to have some degree of control over gross profits.

In this report, two measures are developed to monitor milk prices and feed costs. One is called *income over feed costs* (IOFC), which is measured in dollars per cow per

day. The other is called the *milk margin* (MM), which is measured in dollars per hundredweight (cwt) per day. Both reflect the difference between the price of milk and the cost of the feed to make that milk. While IOFC is on a per-cow, per-day basis, the milk margin is on a per-cwt basis. Dairy producers probably will be more inclined to monitor and measure IOFC, whereas other market participants (e.g., those trading futures contracts in Chicago, processors, government) will be more interested in the milk margin. That said, one is simply a mathematical transformation of the other; when one goes up, so will the other. Thus, for purposes of exposition, the rest of this publication will focus on IOFC.

### Measuring Milk and Feed Costs

There are various ways to measure milk and feed costs. USDA has a measure called the *milk-feed ratio*. According to USDA, the milk-feed ratio is the number of pounds of 16 percent protein-mixed dairy feed equal in value to 1 pound of whole milk. The methodology uses major raw feed component prices from *Agricultural Prices*, published by USDA's National Agricultural Statistics Service (NASS). The major feed components of corn and soybeans account for 83–91 percent of the total ingredients in the rations. The formal definition for this formula is as follows:

$$FV = (51/56) \times PCorn + (8/60) \times PSoy + (41/2000) \times PHay$$

$$\text{Milk-feed ratio} = PMilk/FV$$

FV is feed value (\$/cwt), PCorn is the price of corn (\$/bu), PSoy is the price of soybeans (\$/bu), PHay is the price of alfalfa hay (\$/ton), and PMilk is the U.S. all-milk price (\$/cwt).

The problem with this ratio is that it is not very intuitive. As an index, it is simply a ratio of two numbers. But how can milk producers relate this index to their operations? It does not reflect dollars and cents but rather a ratio that is equal to something that can't be readily identified. For example, feed costs during the first quarter of 2007 were rising, as was the price of milk. So what does it mean when USDA reports that the milk-feed price ratio rose from 2.42 in January 2007 to 2.54 in April 2007? How does this relate to a milk producers' bottom line or gross profitability? Will dairy farmers make more or less money in 2007 when both milk and feed costs are rising rapidly? This is an important concern since the entire dairy market, including those who trade futures contracts on the Chicago Mercantile Exchange, want to know if milk producers are making more or less money in the current market environment.

An alternative is to simply take the price of milk and subtract the cost of the feed required to produce that milk. In other words, if a milk producer makes 85 pounds of milk per day, what is the farm price of that milk and what are the costs of producing it? The result is a

dollar figure that represents gross profitability for the dairy farm. From this figure, you can pay other costs such as hauling, labor, veterinary expenses, interest, depreciation, and so forth. If this figure rises, so will profitability, and vice versa. It can be measured on a per-cow, per-day basis or on a per-cwt basis as explained earlier.

IOFC is measured on a per-cow basis and is defined as follows:

$$\text{IOFC } (\$/\text{cow}/\text{day}) = P_{\text{milk}} \times (\text{DAMP}/100) - \text{DFC}$$

$P_{\text{milk}}$  is the all-milk price (\$/cwt), DAMP is daily average milk production (lbs/cow/day), and DFC is daily feed costs (\$/cow/day). DFC is the daily cost of feedstuffs required to produce the amount of milk reflected in DAMP. Essentially, the all-milk price is being converted from dollars per cwt to dollars per pound of milk produced, and then the cost of producing that milk is subtracted.

The milk margin is measured in dollars per cwt and is defined as follows:

$$\text{MM } (\$/\text{cwt}) = P_{\text{milk}} - \text{DFC} \times 100/\text{DAMP}$$

Feed costs are converted from a cost-per-cow to a cost-per-cwt basis.

As indicated, these measures of gross profitability (both IOFC and MM) are very different from USDA's measure of the milk margin because the latter reflects the cost of 100 pounds of feed—not the feed cost of producing milk. One limitation with the measure of gross profit (both IOFC and MM) is that it only reflects the feed costs for the milking cow, which is roughly 34 percent of the milk's value. This does not include feed for dry cows and dairy replacements. If these feed costs were included, the cost of feed would represent 45–60 percent of the value of milk.

### Feed Rations

The concept of IOFC seems reasonable: develop a dollar-and-cents measure of gross profitability for the milk producer. All market participants, including milk producers, coop managers, processors, milk futures traders, retailers, and so on, will be able to relate to this simple measure of profitability. But how much detail is necessary when developing a way to measure feed costs? Dairy feed rations basically consist of three parts: forages (hay, corn silage, haylage), concentrates (corn, soybean meal, minerals), and by-products (wheat midds, distillers grains). Rations are balanced to produce a certain level of milk production and milk components (milk fat, protein, lactose/minerals). Thus, many combinations of feedstuffs can be used to produce a balanced ration.

The USDA ration used to compute the milk-feed ratio is very simple. It uses monthly USDA NASS reported prices for corn, soybeans, and alfalfa hay to compute the cost of 100 pounds of a 16 percent protein dairy feed ration. NASS used *Morrison's Feed and Feeding Manual* and computed that 100 pounds of 16 percent feed should contain 51 pounds of corn, 8 pounds of soybeans, and 41 pounds of alfalfa hay. The problem with this ration is that while it is very simple, it is not representative of an actual dairy ration since most milk producers feed soybean meal, not just soybeans (some use roasted soybeans), and most rations also consist of by-products.

For this study we designed a feed ration for a Pennsylvania farm that purchases alfalfa/grass haylage, corn silage, corn grain, 48 percent soybean meal, distillers grain, soybean hulls, roasted soybeans, and a mineral mix. This ration was called the *PA Complex* ration (Table 1). Rations were formulated for cows averaging

65, 75, or 85 pounds of milk with a 3.7 percent milk fat and 3.0 percent milk protein. Dry matter intake was estimated using the 2001 National Research Council (NRC) model. All rations contained approximately 50 percent forage and 50 percent concentrate on a dry matter basis. Historical feed prices were obtained from the Penn State feed price list, which is published monthly. This list compiles prices from the grain market summary of the Pennsylvania Department of Agriculture, *Feedstuffs* magazine, and the *Keystone Dairy Digest*. The IOFC measure uses both the price of milk and the cost of feed. The Pennsylvania all-milk price used was reported by NASS. The measure IOFC is simply the Pennsylvania all-milk price less the cost of feed.

Next we designed a Pennsylvania ration for the same levels of milk production and milk components but instead used just alfalfa hay, corn, and 48 percent soybean meal (Table 1). The idea was to compare the IOFC for this very simple ration to the more complex ration. We called this the *PA Simple* ration.

Finally, a ration was designed to mimic the USDA's milk-feed ratio. This ration was designed to use Chicago prices for corn, soybean meal, and alfalfa hay. On an "as fed basis" this ration used 22.22 pounds of corn grain, 2.52 pounds of 48 percent soybean meal, and 25.5 pounds of alfalfa hay to produce 65 pounds of milk. For the milk price we used the U.S. all-milk price. This was called the *US Simple* ration. Again, IOFC was computed using the ration costs and the U.S. all-milk price.

Thus, three measures of IOFC were computed for this study using the feed rations identified above. The first is *PA Complex*, which is equal to the Pennsylvania all-milk price less the *PA Complex* feed ration. The second is *PA Simple*, which uses the Pennsylvania all-milk price less the *PA Simple* feed ration. The last is *US*

**Table 1. Pennsylvania complex and simple rations (65 pounds of milk).**

	Complex DM lbs		Simple DM lbs
Alfalfa/grass haylage	11.5	Alfalfa hay	22.95
Corn silage	11.5	Corn grain	20.07
Corn grain	12.8	48% SBM	2.27
48% SBM	3.1		
Distillers, dk	2.7		
Soyhulls	2		
Roasted beans	1.5		
Min-vit mix	0.85		
<b>Total</b>	<b>45.95</b>	<b>Total</b>	<b>45.29</b>

**Table 2. Correlation measures for the milk-feed ratio and IOFC.**

	Milk-Feed Ratio	PA IOFC Simple (65 pounds)	PA IOFC Complex (65 pounds)
Milk-feed ratio	1		
PA IOFC Simple (65 pounds)	0.864749066	1	
PA IOFC Complex (65 pounds)	0.861574173	0.996351949	1
US IOFC Simple (65 pounds)	0.842164518	0.972726177	0.969092499

Simple, which uses the U.S. all-milk price less the US Simple feed ration.

**Reliability of IOFC**

As stated earlier, three rations were developed for this study: PA Complex, PA Simple, and US Simple. Each ration was balanced for three levels of milk production: 65 pounds, 75 pounds, and 85 pounds. All the graphs and analyses that follow are for the 65-pound rations. The 65-pound level was used because it most closely matches the average milk production in Pennsylvania. For 2006, NASS reported the average milk production for Pennsylvania at 19,390 pounds. Each ration was paired with a measure of the milk price to determine a unique estimate of IOFC. The following questions are to be answered. First, how does IOFC computed from the more complex Pennsylvania feed ration compare to the simple Pennsylvania feed ration? Second, how do the Pennsylvania measures of IOFC compare to the IOFC computed from the US Simple

ration? Finally, how do all three rations compare to the USDA's milk-feed ratio?

These comparisons are made in Figure 1. The rations used were balanced for 65 pounds of milk. Thus, all measures of IOFC are for 65 pounds of milk. Two conclusions are reached. First, all three measures of IOFC are highly correlated. In other words, when one goes up, so do the other two, and vice versa. The two Pennsylvania measures of IOFC are very similar, and the US Simple measure is very close to the two Pennsylvania measures in dollar terms. The only difference is a matter of basis. Second, the USDA's milk-feed ratio is highly correlated with the measures of IOFC in most months, but not all (note the divergence in 2007).

The last comparison to be made is the degree of correlation of the four time series. IOFC for the two Pennsylvania rations and for the U.S. ration were compared to the time series for the milk-feed ratio. The

estimated correlation coefficients are presented in Table 2. The results indicate that the three measures of IOFC for Pennsylvania and the United States are highly correlated, having estimated correlation coefficients greater than 97 percent. The milk-feed ratio is also highly correlated with our measures of IOFC, having correlation coefficient estimates of 84 to 86 percent.

**Benchmarking IOFC**

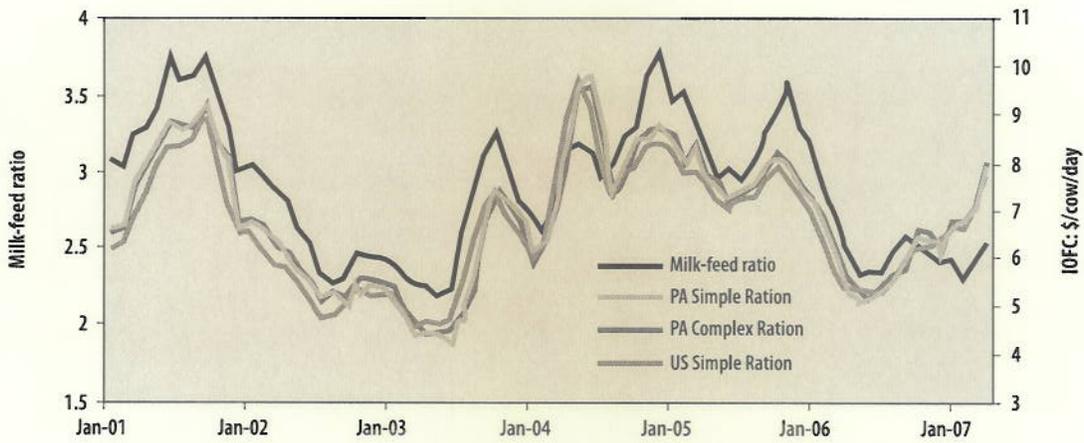
In order to operate a profitable business and make sound business decisions, IOFC is an easy benchmark to monitor. It is affected by feed expense, milk production, and milk price. The goal should be to maximize IOFC. This does not mean the answer is to focus strictly on reducing feed costs when feed costs are high. If milk production is compromised due to low out-of-pocket feed costs, IOFC can be further reduced, lowering overall farm profitability. Maximizing IOFC may require evaluating different feeding strategies and following the expertise of a nutritionist to make good decisions.

An achievable goal for IOFC at 65 pounds of milk per day is \$6.00 or higher. In cases where milk prices are low and feed costs high, a range of \$5.00 to \$5.50 should be attainable. Profitable dairy producers can achieve IOFC measures of greater than \$7.00. Because each farm is different and has varying debt loads, the IOFC to maintain a farm's profitability may need to be higher than the benchmarks. Producers should carefully calculate IOFC each month as milk production, milk price, and feed costs change. Benchmarking this measure against past performance and future goals will help the producer make favorable, economically beneficial decisions for the dairy.

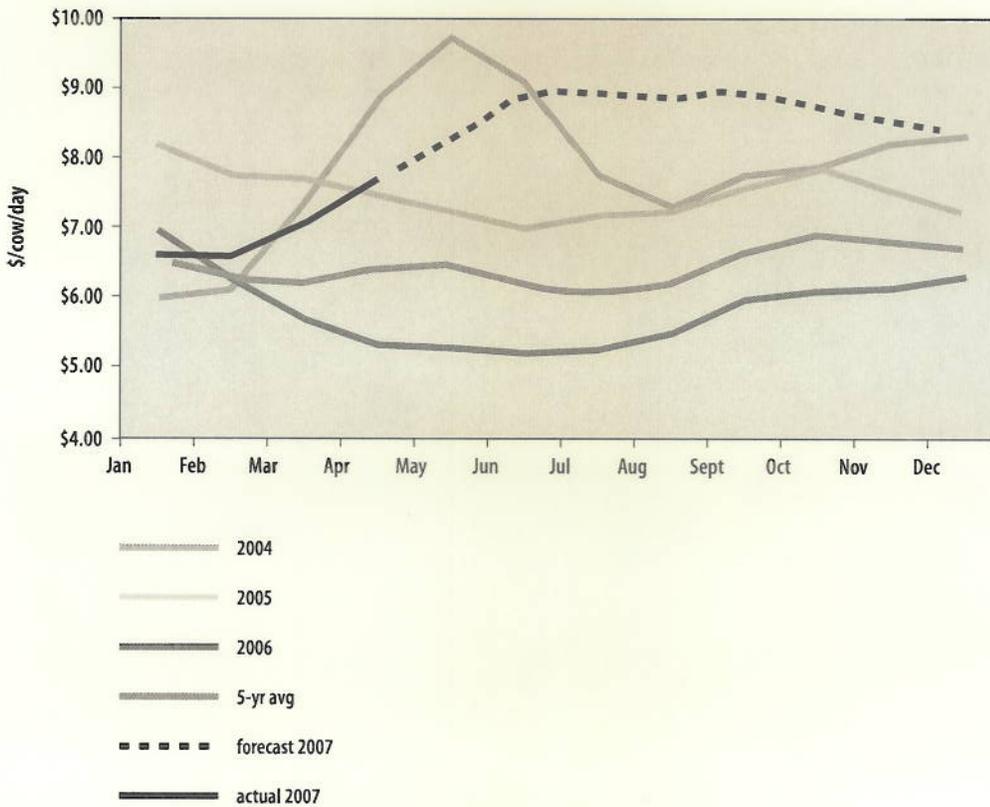
**Using the Futures Markets**

One of the benefits of using the US Simple IOFC measure is that the

**Figure 1. Comparison of USDA's milk-feed price ratio and IOFC.**



**Figure 2. U.S. income over feed costs: 65-pound cows.**



formula and data requirements are very simple. Thus, you can easily compute this index monthly, compare it to different time periods, and draw rough conclusions regarding past and future gross profitability for U.S. dairy producers. For the US Simple measure of IOFC, the feed basis is in Chicago, and the basis for the milk price is simply the difference between the U.S. all-milk price and the Class III price. Since there are futures contracts for Class III milk (Chicago Mercantile Exchange) and corn and soybean meal (Chicago Board of Trade), you can use these contract prices to forecast IOFC or make hedging decisions. You can then compare this monthly forecast to a long-term average and decide whether forward contracting or hedging these milk and feed prices would be profitable.

A practical example of using the futures markets and this measure of IOFC is provided in Figure 2. Here futures data as of April 5, 2007, is used to forecast the IOFC. Despite USDA's measure of the milk-feed ratio, which indicates relatively flat levels of profits in 2007, our measure of IOFC shows rising profits. This forecast of IOFC can be compared to the previous year (2006) as well as a five-year average. Clearly, gross profits are expected to be healthy for the months of May through December 2007. Therefore, it would be advisable to lock in these futures prices and manage the dairy to achieve these levels of IOFC.

### Conclusions

We have constructed a very simple measure of gross profitability. IOFC measures gross profits on a per-cow, per-day basis, whereas the milk margin measures gross profitability on a per-cwt, per-day basis. One measure focuses on the cow and the other on 100 pounds of milk. Both are identical in that one is a simple transformation of the other.

IOFC is an alternative measure of milk and feed prices to USDA's milk-feed ratio. There are a number of advantages. First, it is more apparent what is being measured when using IOFC. IOFC measures gross profitability on the basis of dollar and cents. Milk producers will better understand this estimate. Also, it is a better measure to use for management purposes since milk producers can track their monthly measures of IOFC and compute monthly averages, develop plans and budgets, and manage their operations to hit these monthly targets. Also, IOFC can be used in conjunction with the futures markets to help milk producers make better decisions regarding when to lock in milk prices and feed costs. Finally, the IOFC measure is superior to USDA's milk-feed ratio in times of rising feed costs. USDA's milk-feed ratio appears to be very flat during the first half of 2007 because of rising feed costs despite industry expectation that milk prices are rising faster than feed costs. It would appear that USDA's cost of 100 pounds of feed used in the denominator of the milk-feed index may distort its true representation as a measure of gross farm profitability.

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