

Program on Dairy Markets and Policy

Briefing Paper Series

Measures of Dairy Farm Financial Performance Using the Prices of Milk and Feed Inputs: Implications for Market Analysis

Briefing Paper Number 12-04

March 2012

Andrew M. Novakovic, PhD*

Introduction

Dairy farmers have always known that the cost of feeding their herd is the single largest component of their overall cost of production, whether feeds are entirely purchased, entirely home-grown, or some combination of the two. Nevertheless, the explosion in feed prices over the last few years has made it vividly clear that one really can't tell if the dairy sector is doing well, poorly, or in between by just looking at the price of milk. Whether it is in terms of thinking about the outlook for milk production in a coming year or thinking about new dairy policy, we are talking more about margins and less about just the price of milk.

Although the current focus on margins is somewhat new, there have been ways of looking at the relationship between the price of milk and the prices of feed and/or other inputs for decades. Since the 1930s, the US Department of Agriculture has been collecting data on the prices farmers receive for the commodities they sell and the prices they pay for the inputs they buy. These are routinely reported in the form of prices received and price paid indices.¹ Once prices are converted to an index, it is simple to calculate ratios and plot graphs to examine how one is changing compared to another. This is precisely what was done in the old price support policy days of parity pricing. The parity ratio, which is still reported, is simply the ratio of prices received divided by the prices paid.

Probably the most common of these calculations is the ratios that have been reported for livestock products relative to the prices of feeds. NASS began reporting these ratios in 1960. The methodology for surveying prices and calculating the ratios was changed in 1995 and the

*Andrew M. Novakovic is the E.V. Baker Professor of Agricultural Economics in the Charles H. Dyson School of Applied Economics and Management at Cornell University. The author claims copyrights, but permission is granted to quote from the paper or use figures and tables, provided appropriate attribution is made.

¹ *Agricultural Prices* is published monthly and annually by the National Agricultural Statistics Service of USDA. The monthly editions are available here:

<http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do;jsessionid=F154BA78C7C50C021C8CA924EDB72FD5?documentID=1002>

ratios were re-calculated back to 1985. Any earlier data will look a bit different because of the change in methodology.

The Milk-Feed Price Ratio (M-F) is simply the Price of All Milk divided by a weighted average index of the prices received (by their growers) for corn, soybeans and alfalfa hay. It is assumed that the prices received by crop growers is a sufficient general indication of the prices paid by livestock users of those feeds. Specifically, the formula for the M-F is as follows:

$$\begin{aligned} \text{All Milk Price} = & .51 \times \text{Corn Price per bu.} / 56 \text{ lbs./bu.} + \\ & .08 \times \text{Soybean Price per bu.} / 60 \text{ lbs./bu.} + \\ & .41 \times \text{Alfalfa Hay Price per ton} / 2000 \end{aligned}$$

Note that this calculation is a weighted average price, not a cost. The weights (51%, 8%, and 41%) are determined as an approximation of the relative importance of each feed in the cost of feed for a dairy cow, but this does not imply that 100 pounds of milk is typically made from 29 pounds of corn, 5 pounds of soybeans, and 820 pounds of alfalfa hay.

A cost of feed is calculated by determining how much of each feed input is used to produce a unit of milk. The amount of each feed is multiplied by the corresponding price to get a dollar value, which is the expenditure for each feed input. Each input expenditure can be summed to get a total (or sub-total) expenditure required to produce a unit of milk. If that unit is 100 pounds, then we can compare the price received for 100 pounds of milk to the dollars spent to acquire the feed used to produce 100 pounds of milk. Output price minus input expenditure is a margin, sometimes referred to as Income Over Feed Costs (IOFC) or milk returns over feed costs (MROFC). In doing these sorts of calculations, it is possible to include all dairy farm revenue or just income from the sale of milk, just as it is possible to look at a subset of inputs, like feed, or all purchased inputs, or cash and non-cash inputs. In the current discussion, led by the National Milk Producers Federation proposal, the margin is gross milk returns over feed costs, where the feeds that are measured are corn, corn silage, soybean meal and alfalfa hay, with the corn silage price being determined by the price of corn. Let's call it MROFC as a reminder that the income is just that from milk and the costs are just those from the selected feeds.

Milk and Feed Prices as Measures of Profitability

With feed, either purchased or homegrown, representing the largest share of the costs of milk production, it is not surprising that simple measures based on prices of milk and various feeds provide some approximate indications of farm profitability. There are two obvious and major limitations.

One, price indices and even benchmark cost calculations do not reflect changes in input usage. Input usage will change for two primary reasons. The first is improvements in management and technology that increase yield. Thus, the same bushel of corn or ton of hay results in more milk production today than before. The second might be changes in the ration that farmers feed in response to changing prices, availability, or other reasons. A complete cost calculation involves measuring how much of an input is purchased and used in production as well as the unit price of that input.

Profitability can be measured in numerous ways. One of the calculations approved by the Farm Financial Standards Council that correlates most closely with returns and expenditures calculations is Net Farm Income. The “net” in NFI can also vary depending on whether one wants to look at, say, (cash) purchased inputs or all inputs, including items like family labor, equity, and family management for which there is often not an explicit cash payment. Net Cash Farm Income is a likely measure of profitability one could compare to M-F or MROFC. Unfortunately, there is not a consistent publicly available series of the NCFI for dairy farmers nationally to allow us to compare with these other time series over more than a few years.

In a recent paper, Professor Chris Wolf, at Michigan State University, illustrates how the M-F ratio compares to 1) an IOFC measure based on the same three prices used for the M-F, and 2) dairy farm profitability using annual average Returns on Assets from the MSU Dairy Farm Business Analysis Summary.² Dr. Wolf shows that M-F and an IOFC using the same prices results in a nearly identical pattern of annual averages from 1985 to 2009. There is at least one year when his IOFC increased when the NASS M-F decreased (1996); illustrating that it is more than theoretically possible that they might move in different directions. A similar result is observed with Michigan voluntary farm records data on ROA. The basic patterns between 1996 and 2009 are almost identical, but there is at least one year when reported ROA declines while the US M-F and a MI M-F increase. A MI IOFC based on Michigan prices essentially declines slightly in this calculation.

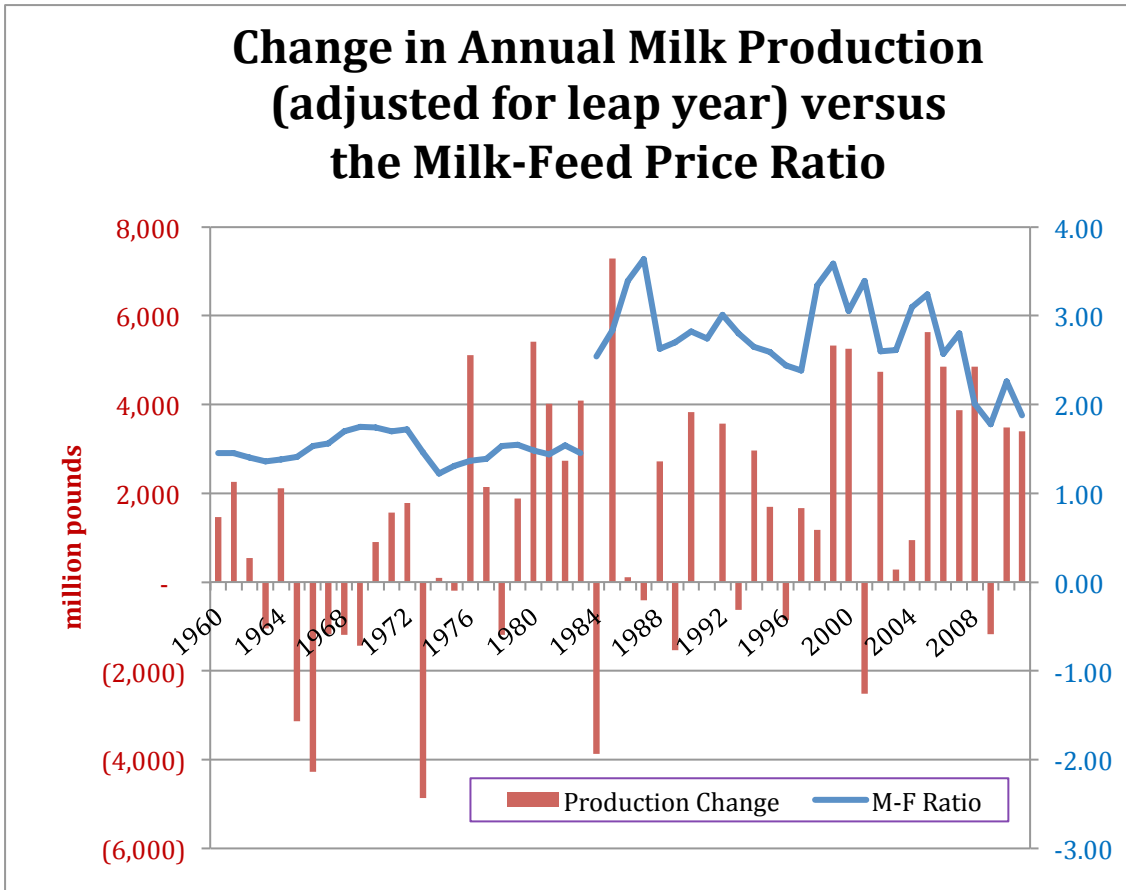
Calculating true profitability measures from a nationally representative sample of dairy farms is simply not feasible on a national basis even annually, much less monthly.³ Therefore, Dr. Wolf argues that calculating an IOFC, or margin, is feasible and is more likely to provide a true or fair indication of profitability than a M-F ratio.

Milk and Feed Prices as Indicators of Production Expansion or Contraction

For 40 years, dairy market analysts used the M-F as a quick and easy indicator of profitability in the dairy sector. A high M-F was regarded as an indicator of likely expansion in milk production, with the reverse being true as well. As illustrated in the chart below, connecting M-F with the annual change in production in one year or the following year is an inexact science at best. Even setting aside 1984-87, when the Milk Diversion Program and Dairy Termination Program provided cash incentives to reduce production, beyond whatever price signals there were, there is a general indication to changes in milk production from the M-F, but it is inexact in terms of both magnitude and timing.

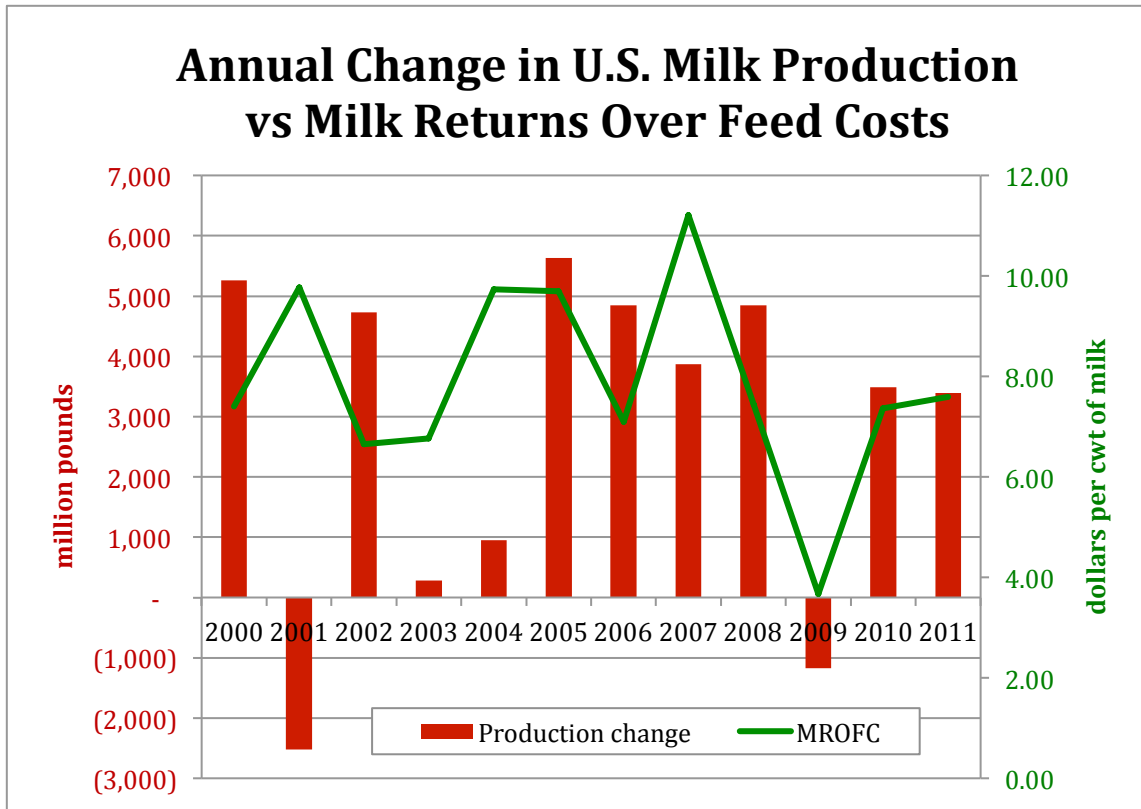
² Wolf, Christopher A. 2010. *Understanding the milk-to-feed price ratio as a proxy for dairy farm profitability.* Journal of Dairy Science 93: 4942-4948.

³ *The Economics Research Service, in collaboration with the National Agricultural Statistics Service, of USDA does collect farm level financial data that is nationally representative and provides annual estimates of Net Farm Income. These data do not include balance sheet information, such as assets or equity. Additionally, data are collected to give a statistically reliable estimate of dairy farms, per se, only every 5 years. In the years in between, ERS updates cost estimates with changes in prices. Amounts purchased and yields are only updated in the survey years.*



The relationship between the new margin proposed by NMPF and annual production changes is illustrated for the last 10 years, below.

Again, there are certain indications – a low margin in 2000 is followed by a decline in milk production in 2001. Low margins in 2002 and 2003 are followed by very small production increases in 2003 and 2004. The low margin of 2006 seems to have moderated growth in 2007, but by nowhere near the amounts in 2001, 2003, and 2004. The precipitous drop in margin in 2009 did not require another year before the production effect is witnessed. Of course, some of this is simply the fact that margin or production changes don't begin neatly on January and end on December. The decline in margins shown here by the 2009 average actually began in late 2008, for example.



Using Milk and Feed Prices to Predict Future Milk Production

Forecasts of milk production are part science and part art. Mathematical models can be helpful, but few forecasters will simply take the result of a model and call it a forecast. The art comes in by allowing the analyst to study and interpret data and information that isn't or cannot be incorporated into a mathematical model. Both the art and science of forecasting has and can use milk and feed prices, either separately or in combinations like the M-F ratio or the MROFC.

It is not unusual for a dairy market analyst to refer to levels of changes of one or the other of these two variables to justify a prediction of milk production in the coming months or year. Consider the following examples.

The official USDA estimates of sources and uses of agricultural commodities are published by the World Agricultural Outlook Board in a monthly publication called *World Agricultural Supply and Demand Estimates* (WASDE).⁴ These estimates reflect a consensus of opinion by various sector experts and analysts throughout USDA. This group also publishes the annual *USDA Agricultural Projections to [10 years from now]*.⁵ The table published by WAOB

⁴

<http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do;jsessionid=D4C0DFC9AFC395745CF62B6375AAB148?documentID=1194>

⁵ http://www.usda.gov/oce/commodity/archive_projections/USDAgriculturalProjections2021.pdf

shows milk supply and utilization and prices for farm milk and key wholesale dairy commodities. Their monthly narrative generally summarizes the numbers but doesn't provide much insight into the factors they consider. However, they frequently refer to changes in "returns" in relation to supply projections.

The Economic Research Service of USDA provides a more detailed monthly outlook report that includes the supply and utilization information from the WAOB but also presents other data on a monthly or periodic basis.⁶ The ERS analysts also provide a narrative to discuss their market analysis. The August 2011 Livestock, Dairy, and Poultry Outlook included this:

*Production in 2012 is forecast at 198.8 billion pounds, reflecting a larger expected herd size. The larger herd size is offset a by lower forecast of milk per cow as feed prices will keep growth in output per cow below trend.*⁷

Dairy economist and University of Wisconsin Professor Emeritus Bob Cropp has done a monthly dairy outlook report for years. In his February 2012 analysis he writes:

*Slaughter cow prices are favorable and with higher feed prices coupled with lower milk prices more milk cows may head to slaughter.*⁸

While these reports do not detail the thought processes of the analysts, it is certainly the case that they think about the economic and other factors that are likely to shape future production. As the format of the WASDE reports implies, the historical mindset was to relate changes in production to expected milk prices, with the understanding that unusual changes in feed prices would warrant an additional look, but that this wouldn't normally be required. More recently it has become more common to think about milk and feed prices together, but the easily accessed data that combines all this price information continues to be the M-F ratio.

The current market situation provides an excellent example of when the variable or metric one uses to assess the financial condition of dairy farms could lead to very different conclusions about where milk production is headed. Consider the following table showing both the M-F ratio and the MROFC margin.

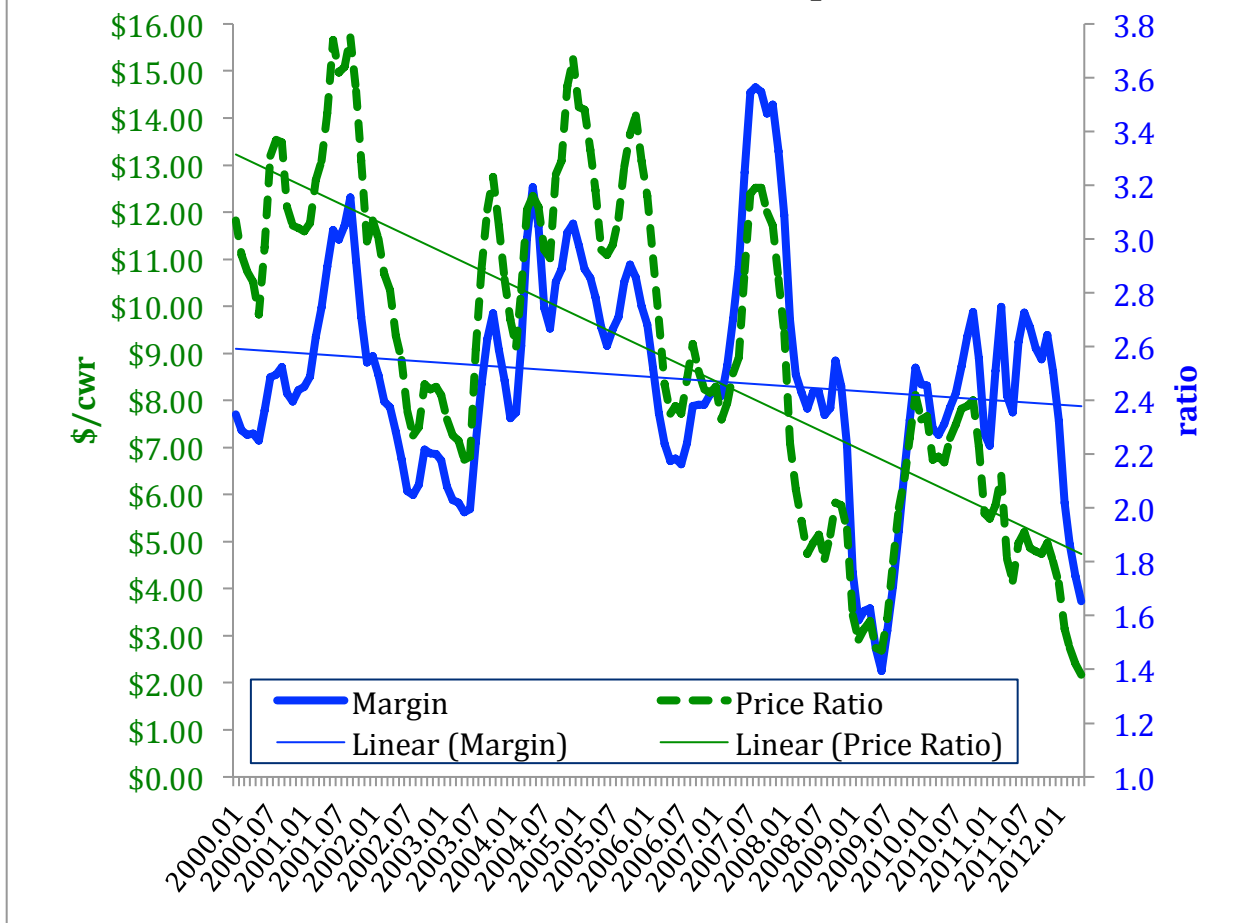
In the main, these two lines appear more similar than different, at least until 2010-11. Take careful note. There are two other differences that are a bit subtler. First, the M-F is somewhat rotated clockwise relative to the margin graph. It starts higher and ends lower. Simple trend lines are imposed on each line and show that the M-F is declining at a faster rate over this time period.

⁶ <http://www.ers.usda.gov/Publications/ldp/>

⁷ *Livestock, Dairy, & Poultry Outlook/LDP-M-206/August 17, 2011 Economic Research Service, USDA, p. 8*

⁸ http://future.aae.wisc.edu/dairy_situation.html

Milk Income over Feed Cost (Margin) vs. Milk-Feed Price Ratio, 2000 to present



The second item to note is related to the first but slightly different. Both lines have nearly identical highs and lows, but look carefully at 2007. If an analyst were looking at the M-F ratio in 2007, she might write something like this:

Early indications in 2007 are that milk prices are rising relative to feed prices, following the difficult milk-feed price relationships caused by unusually low milk prices in 2006. However, the recovery in 2007 so far is well below the recoveries enjoyed in 2001 and 2004. Indeed, 2007 is starting only a bit better than the average since 2000. Milk production should recover in 2007 but at a sluggish rate.

On the other, our intrepid analyst might write something like this if she looked at the MROFC data instead:

Early results for 2007 indicate that the price-cost squeeze dairy farmers endured in 2006 is not only over but conditions on the nation's dairy farms are better than ever. Margin estimates for early 2007 are well above the previous high in 2004 and even the record high of 2001. We can expect a robust recovery in milk production as the year unfolds.

Of course, I am making this up, but I think the scenario is not so far-fetched.

Consider now the far more dramatic departure in these two measures during 2010 and 2011. Starting in January 2010, the M-F drops from a high that was on par with the low points of 2006 and 2002-03 and then declines through 2011 to levels comparable to 2009. The MROFC measure starts from a comparable spot in January 2010. By that measure, the farm situation is below average but well above the lows of 2006 and 2002-03. From there the margin meanders up and down, rising to a bit above the 10 year average to lows that rival the previous two cyclical low points.

It is hard to explain the increases in milk production that occurred in 2011 when looking at the M-F ratio. Although the margin data do not indicate high levels of profitability, they are certainly more consistent with increases in milk production.

In 2012, the MROFC and M-F are both strongly negative. If one compares to previous years, the M-F paints a more negative picture than the MROFC measure. The M-F ratio is on par with the lowest levels of 2009, but the MROFC is above that disastrous low, although to close for comfort.

Conclusions?

Dr. Wolf is probably right to suggest that dairy farmers and market analysts would be better served by consistent reporting of a MROFC type of measure as a rough indication of farm profitability or liquidity. It is time to retire the Milk-Feed Price Ratio as an indicator of dairy farm financial conditions. It tells us something about the rates of inflation for the price of milk versus a group of feeds, but that information isn't particularly helpful when analyzing either farm profitability or assessing factors that influence near-term milk production changes.