Economic Value of Milk Components

Normand St-Pierre[1] and William P. Weiss
Department of Animal Sciences
The Ohio State University

Summary

When assessing the value of milk components, it is important to factor in the nutritional costs associated with the production of each component and not just their gross unit prices. In this paper, we used component prices in the Federal Milk Marketing Orders between January 2005 and February 2012, the nutritional requirements to produce each component from the NRC (2001) system, and the cost of the nutrients using market prices of 27 feed commodities in the Mideast area of the United States (IN, MI, and OH). At a typical level of milk production and composition, the value of the approximately 87.5 lb of water and 5.7 lb of other solids in a hundredweight of milk has generally been pretty close to zero. Most of the value comes from the production of protein and fat, with protein having on an average a much greater effect on income over nutrient costs (a proxy for income over feed costs) than milk fat. On an average, 38.9% of the economic value in a hundredweight of milk comes from fat, 60.4% from protein, and 0.7% from other solids and water. The net value of the protein in milk exceeded that of the fat in 77 months out of the 88 months covered by the study.

Introduction

Most of the milk produced in the United States is now priced according to its content in major milk components: fat, (true) protein, and other solids (consisting primarily of lactose and minerals). In the Federal Milk Marketing Orders (**FMMO**) with component pricing, the price of the components is determined from a survey of wholesale prices of 4 dairy products (butter, cheese, nonfat dried milk, and dry whey) and formulas established by the United States Department of Agriculture (**USDA**). Relative prices of milk components change through time, creating variable opportunities to change short and long-term dairy farm profitability by modifying the composition of the milk being produced. In this paper, we review historical prices of milk components and of nutrients required for their production in the Mideast region (Indiana, Michigan, Ohio). We then calculate the relative profitability associated with the production of each component and the net economic value of modifying concentration or production of milk components at the farm level.

Methods

Reference cow and nutrient requirements

The reference cow used for the analysis weighs 1,500 lb and produces 70 lb/day of milk with 3.6% fat, 3.0% protein, and 5.7% other solids. Nutrient requirements for net energy lactation (**NE_L**), metabolizable protein (**MP**), effective neutral detergent fiber (**eNDF**), and non-effective neutral detergent fiber (**neNDF**) were calculated using the equations reported by St-Pierre (2008), which were derived from NRC (2001).

[1]Contact at: 2029 Fyffe Court, 221A Animal Science Building, Columbus, OH 43210-1095, (614) 292-6507, FAX: (614) 292-1515, Email: st-pierre.8@osu.edu.

Prices

Component prices used were the minimum monthly prices in effect in the FMMO between January 2005 and February 2012, as reported by USDA Agricultural Marketing Service. Prices were adjusted to account for a quality premium of $0.15/cwt, a marketing assessment of $0.15/cwt, a producer price differential of $0.75/cwt (i.e., a $2.50/cwt Class I differential with a 30% utilization), and a $0.75/cwt hauling cost, resulting in a (convenient) net adjustment of $0.00/cwt.

For the marginality analyses, we assumed that changes in components have no effect on costs other than feed (nutrient) costs. Nutrient prices were calculated monthly from the market prices of 27 feed commodities traded in the Mideast area (farm delivered basis) using the method of St-Pierre and Glamocic (2000) and implemented in the software *Sesame* V3.5 (http://www.sesamesoft.com).

Component Pricing

Statistics for component prices in FMMO over the 86 months from January 2005 to February 2012 are reported in Table 1. Prices of all components have shown dramatic variability, with ranges close to or even exceeding average prices. The evolution across time of the same component prices is shown in Figure 1. The very high milk prices experienced in '07 and '08 were primarily caused by very high milk protein prices and also, but to a much lesser extent, by high other solids prices. The dismal milk prices of '09 were primarily due to the dreadful milk protein prices. In late '10 and early '11, milk fat prices rebounded to such an extent that they approached protein prices, even exceeding milk protein price in January '11. The high milk prices experienced in the second half of '11 were due to sustained high fat prices, combined with high protein prices and very high other solids prices. In fact, other solids prices have been above their long-term average of $0.20/lb since February 2011. This is the result of relatively high powdered whey prices to dried skim milk prices.

Nutrient Costs

Statistics for unit costs of NE_L, MP, eNDF and neNDF between January 2005 and February 2012 are reported in Table 2. As for component prices, nutrient prices exhibited considerable variation during the period of time under consideration. This variation is even more evident in Figure 2. It is noteworthy that NE_L prices averaged just 7¢ per Mcal in 2005 and 2006 compared to 16.2 ¢ per Mcal in 2011. As we shall see, this increase had a profound effect on feed costs associated with milk production.

Income Over Nutrient Costs

Table 3 reports the average gross income, nutrient costs and income over nutrient costs **(IONC)** for the reference cow. Figure 3 shows the evolution of the same variables between January 2005 and February 2012. Nutrient cost is a very good proxy to feed cost for dairy farms. This way of estimating feed costs is not myopically bound to the corn and soybean markets as well as a fixed diet as done by USDA in its calculation of the milk-to-feed ratio. When we exclude the negative IONC associated with the maintenance of the animal because it is essentially a fixed cost in regards to production of milk components, of the remaining $7.28/cow/day of IONC, an average of 38.9% came from fat production, 60.4% from protein production, and 0.7% from other solids production during the January 2005 to February 2012 period. Because of the assumptions used for pricing milk volume (i.e., a net of $0.00/cwt), the water component of milk implicitly accounted for 0.0% of the IONC.

Marginality Analysis

Table 5 reports mean changes in gross income, nutrient costs, and IONC from a one-pound increment in production of each milk component during the January 2005 to February 2012 period. On average, the gross income from a pound of protein was 1.7 times greater than the gross income from one pound of fat. The average nutrient cost to produce a pound of milk protein was $0.18 more than that of producing an additional pound of fat. The IONC from producing an additional pound of protein averaged over 1.8 times greater than that from producing an additional pound of fat. The IONC from protein was, however, much more variable (SD = $0.80) than that of fat (SD = $0.30). Over the period from January 2005 to February 2012, producing an additional pound of protein was more profitable than producing an additional pound of fat in 77 out of 86 months: the exceptional 9 months were 6/09, 7/09, 5/10, 7/10, 9/10, 10/10, 11/10, 1/11, and 5/11.

Producing an additional pound of other solids was considerably less profitable than producing an additional pound of either fat or protein, yielding only $0.07/lb in additional IONC on an average.

The economic value of a change in milk components can also be expressed as a response per point of change (a point of milk component is equal to 0.1%, as in changing milk fat from 3.6 to 3.7%). Table 6 and Figure 4 report some statistics on the change in IONC per 100 cows and per day from a one-point change in each component. The overall conclusions are very similar to those from the previous analysis where we looked at the marginal effect of one additional pound. In short, a one point change in protein is on an average nearly twice as profitable as a one point change in fat, but it is also much more variable.

Some would argue that it is considerably more difficult to increase milk protein than milk fat. This is probably true, especially in those instances of severe milk fat depression caused by dietary factors. Table 7 reports the effect of a 5% change in each milk component on IONC per day in a herd of 100 cows. It is noteworthy that a 5% increase in other solids is equivalent to increasing milk yield by 5% without any increase in the yield of fat and protein. In other words, the effect on IONC from increasing the other solids by 5% could equivalently be worded as the effect of changing the reference cow from 70 lb/day of milk at 3.6% fat, 3.0% protein and 5.7% other solids to 73.5 lb/day at 3.43% fat, 2.86% protein, and 5.7% other solids. In general, increasing water and other solids production of dairy cows without an associated increase in the production of fat and/or protein has very little effect on IONC. Put differently, a cow that would produce 2.52 lb/day of fat and 2.10 lb/day of protein, but 0 lb/day of other solids and water (i.e., total daily yield of 4.62/lb/day), would be nearly as profitable as the standard cow used in this paper, i.e., a cow that produces 2.52 lb/day of fat, 2.10 lb/day of protein, 3.99 lb/day of other solids, and 61.4 lb/day of water.

Conclusions

The value of the approximately 87.5 lb of water in a hundredweight of milk is null for the bulk of milk produced in the USA. The value of the other solids (lactose and minerals; approximately 5.7 lb/cwt) is also on an average close to null. Increasing milk yield without increasing fat and/or protein yield makes little economic sense. On average, increasing protein test by 1 point is worth over 1.8 times more than raising fat test by 1 point (range of 0.6 to 5.4 times more). One should NOT just look at the prices of components to "guestimate" their values. The nutritional cost of producing the additional components must be considered.

References

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Table 1. Mean, standard deviation, minimum, and maximum prices ($/lb) for fat, protein, and other solids in the Federal Milk Marketing Orders between January 2005 and February 2012.

Components	Mean	SD	Minimum	Maximum
Fat	1.62	0.34	1.09	2.44
Protein	2.77	0.79	1.70	4.72
Other solids	0.20	0.15	-0.04	0.60

Table 2. Mean, standard deviation, minimum, and maximum unit prices for net energy lactation (**NE_L**; ¢/Mcal), metabolizable protein (**MP**; (¢/lb), effective neutral detergent fiber (**eNDF**; ¢/lb), and non-effective neutral detergent fiber (**neNDF**; ¢/lb) in the Mideast (IN, MI, and OH) between January 2005 and February 2012.

Nutrients	Mean	SD	Minimum	Maximum
NE_L	10.6	4.1	5.2	20.8
MP	27.2	12.3	6.5	53.8
eNDF	-3.2	3.3	-2.9	13.2
neNDF	-9.0	4.3	-23.5	-2.6

Table 3. Average gross income, nutrient costs, and income over nutrient costs (**IONC**) for the reference cow between January 2005 and February 2012.[1]

Item	Maintenance	Fat	Protein	Other Solids	Total
	$/cow per day				
Gross income	0.00	4.09	5.82	0.79	10.70
Nutrient costs	1.44	1.26	1.42	0.74	4.86
IONC	-1.44	2.83	4.40	0.05	5.84

[1]Reference cow: 1,500 lb and 70 lb/day of milk at 3.6% fat, 3.0% protein and 5.7% other solids.

Table 4. Mean revenues and nutritional costs ($) from one additional pound of components between January 2005 and February 2012.

		Nutrient Costs				
Components	Income	NE_L [1]	MP	NDF	Total	IONC[2]
Fat	1.62	0.45	0.05	0.00	0.50	1.12
Protein	2.77	0.27	0.40	0.00	0.68	2.09
Other solids	0.20	0.12	0.01	0.00	0.13	0.07

[1]NE_L = net energy lactation, MP = metabolizable protein, NDF = neutral detergent fiber; NDF is the sum of the effective NDF and non-effective NDF.
[2]IONC = Income over nutrient costs.

Table 5. Mean revenues and nutritional costs ($) from one additional pound of components in February 2012.

		Nutrient Costs[1]				
Components	Income	NE_L	MP	NDF	Total	IONC[2]
Fat	1.62	0.45	0.05	0.00	0.50	1.12
Protein	2.77	0.27	0.41	0.00	0.68	2.09
Other solids	0.20	0.12	0.01	0.00	0.13	0.07

[1]NE_L = net energy lactation, MP = metabolizable protein, and NDF = neutral detergent fiber; NDF is the sum of the effective NDF and non-effective NDF.
[2]IONC = Income over nutrient costs.

Table 6. Effect of a one-point change in milk components on income over nutrient costs ($/100 cows/day) between January 2005 and February 2012.[1]

Components	Mean	SD	Minimum	Maximum
Fat	7.85	2.08	4.43	13.08
Protein	14.65	5.58	4.82	27.92
Other solids	0.48	1.04	-1.14	3.45

[1]Reference cow: 1,500 lb and 70 lb/day of milk at 3.6% fat, 3.0% protein and 5.7% other solids.

Table 7. Effect of a 5% change in milk components on income over nutrient costs ($/100 cows/day) between January 2005 and February 2012.[1]

Components	Mean	SD	Minimum	Maximum
Fat	14.13	3.74	7.97	23.54
Protein	21.98	8.37	7.23	41.88
Other solids	1.37	2.96	-3.24	9.83

[1]Milk fat from 3.60 to 3.78%, milk protein from 3.00 to 3.15%, and milk other solids from 5.70 to 5.99%.

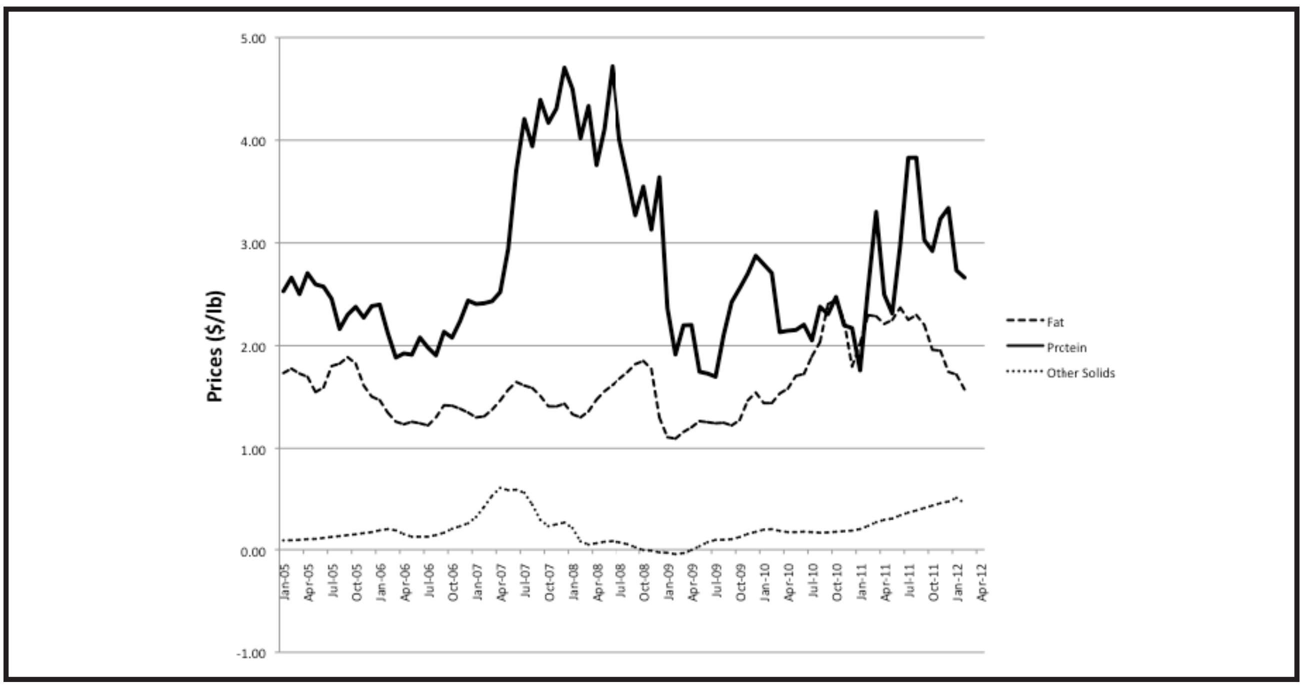

Figure 1. Evolution of milk component prices ($/lb) in the Federal Milk Marketing Orders between January 2005 and February 2012.

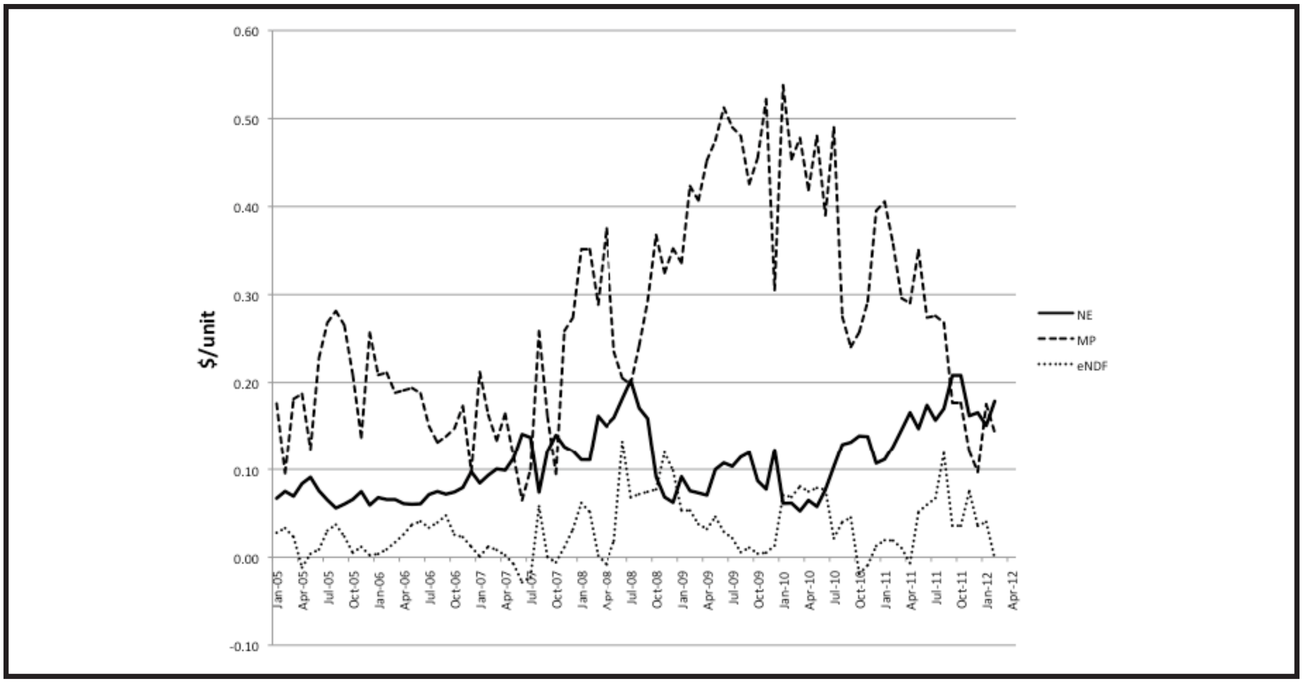

Figure 2. Evolution of nutrient unit prices in the Mideast (IN, MI, and OH) between January 2005 and February 2012.[1]

[1]Unit prices are expressed in $/Mcal for net energy lactation (NE_L), and $/lb for metabolizable protein (MP) and effective neutral detergent fiber (eNDF).

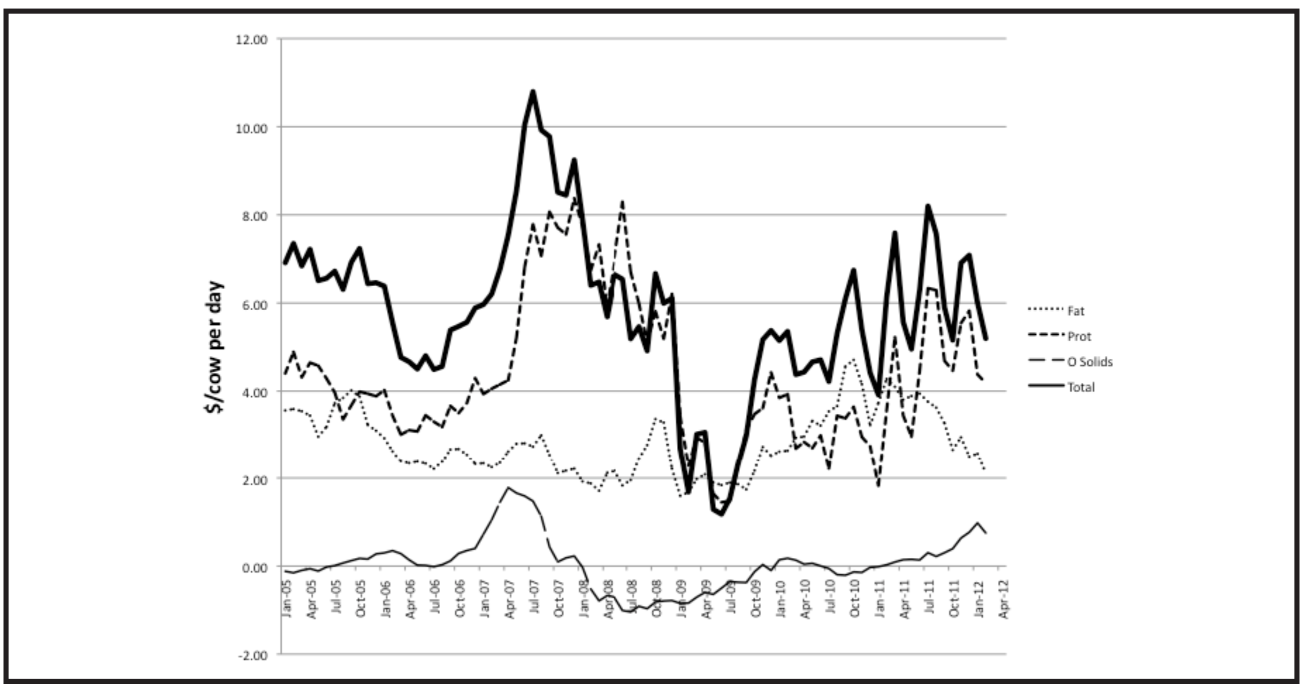

Figure 3. Income over nutrient costs ($/cow/day) for fat, protein, other solids, and total for the reference cow between January 2005 and February 2012.[1]

[1]Reference cow: 1,500 lb and 70 lb/day of milk at 3.6% fat, 3.0% protein and 5.7% other solids.

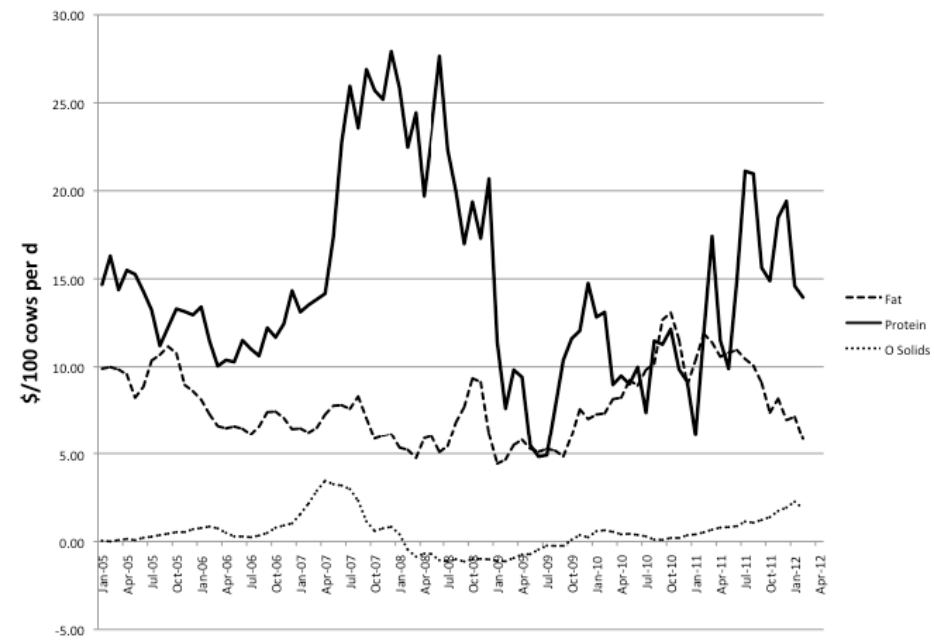

Figure 4. Effect of a one-point change in milk components on income over nutrient costs ($/100 cows/day) between January 2005 and February 2012.[1]

[1]Reference cow: 1,500 lb and 70 lb/day of milk at 3.6% fat, 3.0% protein and 5.7% other solids.