PART FOUR

RISK MANAGEMENT

CHAPTER 10
RISK MANAGEMENT CONCEPTS

The US dairy industry is characterized by volatile price movements that are not only evident in the basic dairy commodities, but also fresh products and farm milk prices. In many ways, these basic dairy commodities behave similarly to other commodities such as corn, soybeans, coffee, etc. Storable dairy commodities such as cheese, butter, nonfat dry milk (NFDM) and dry whey have established cash (also called spot) and futures markets. Information such as weather, global supply and demand, policy impacts, etc. are all channeled into these markets. In addition, speculative behavior can also affect pricing since perfect knowledge of the forward curve is not available on a day-to-day basis.

The volatility of basic dairy commodities is illustrated in figure 10.1. Volatility was calculated using the trailing 20 days of daily futures observations (the number of trading days in a month) and annualized using the square root of 252 (the number of trading days in a year). This created a very isolated snap shot of dairy volatility since specific futures contacts were used, and the historical period was limited. That said, the results clearly show that dairy commodities in the US are volatile.

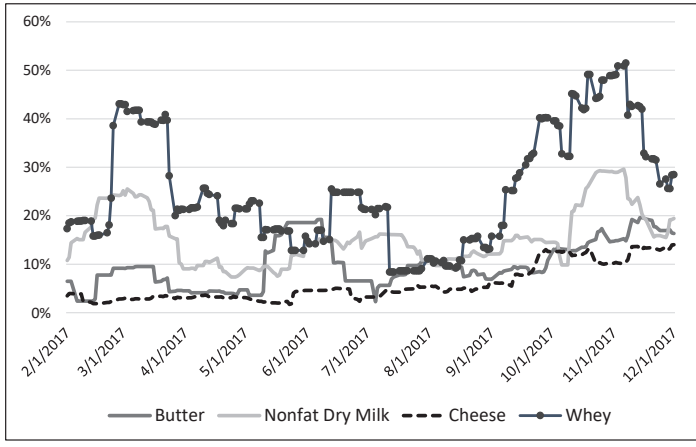

FIGURE 10.1
Annualized estimates of 30-day volatility of January 2018 dairy futures contract prices over the period February - November 2017.

Volatility is defined as follows,[1]

$$\text{Volatility} = \sqrt{252} \times \sqrt{\left(\frac{1}{20}\right)\sum_{t=1}^{20}(X_t - \bar{X})^2} \tag{10.1}$$

$$X_t = ln\left(\frac{P_t}{P_{t-1}}\right) \tag{10.2}$$

where t is daily observations, and *P* is the price of the underlying market.

Equation 10.2 calculates the percentage change in daily prices from t-1 to t. The square root of 252 in equation 10.1 converts a monthly measure of volatility into an annualized number. The rest of the equation estimates the standard deviation of the price change over 20 trading days. The result illustrates the degree of dispersion of prices around the mean. The methodology then advances to the next observation and back calculates volatility over the next 20 trading day period.

From figure 10.1 we see that whey futures prices had the highest degree of volatility, followed by nonfat dry milk, and then butter and cheese. Overall volatility for these key dairy commodities ranged from 2-50%. The point is, dairy commodities are as volatile as other key commodities. This is demonstrated in table 10.1. Nonfat dry milk and dry whey are as volatile as corn, wheat, soybeans, live cattle, crude oil, and coffee. For the observations selected, cheese and butter are clearly less volatile. As a result, Class III and IV prices have a mean volatility measure of 7.5% and 7.9%, respectively, since these prices are derived from cheese and butter prices via federal order formulas.

It's important to note that the results are also dependent on the period selected. For example, the whey market was very volatile in 2017. The January 2018 CME dry whey futures contract had daily settlement values that ranged from 49 cents per pound in January and February 2017 to 28 cents per pound by November. This is illustrated in the daily settlements in figure 10.2.

[1] See Labuszewski, "Volatility Monitor."

TABLE 10.1
COMPARISON OF ANNUALIZED VOLATILITY MEASURES FOR DAIRY AND OTHER COMMODITIES

	Contract	Mean	High	Low
Butter	JAN 2018	9.9%	19.6%	2.3%
NFDM	JAN 2019	15.6%	29.6%	7.4%
Cheese	JAN 2020	5.9%	14.0%	1.7%
Whey	JAN 2021	25.4%	51.5%	8.4%
Class III	JAN 2022	7.5%	17.9%	1.8%
Class IV	JAN 2023	7.9%	13.2%	1.5%
Corn	MAR 2024	16.3%	30.2%	7.9%
Wheat	MAR 2025	19.1%	40.3%	11.0%
Soybeans	JAN 2026	13.8%	27.2%	7.2%
Live Cattle	FEB 2027	22.1%	45.6%	11.9%
Crude Oil	JAN 2028	24.7%	33.7%	15.4%
Coffee	JAN 2029	25.7%	38.2%	16.1%

Note: annualized volatility calculations based on a rolling 20 business days. Calculated using data from January 4, 2017 to November 30, 2017. NFDM=nonfat dry milk.
Sources: CME Group and Intercontinental Exchange.

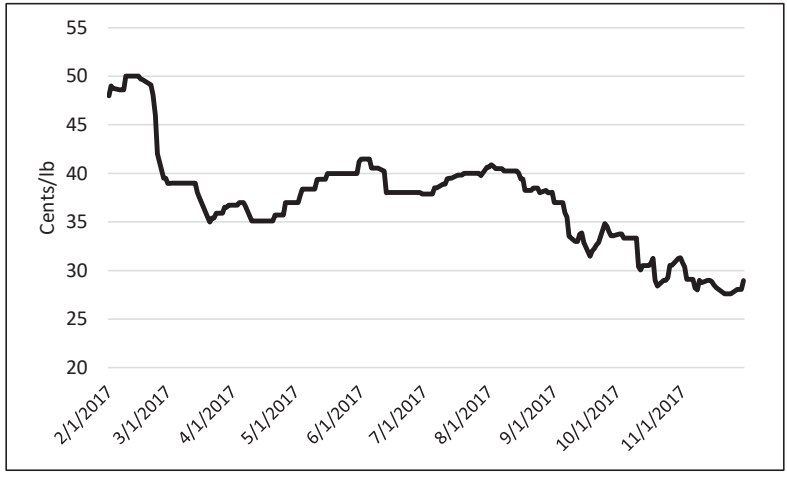

FIGURE 10.2
January 2018 CME dry whey futures contract, daily settlements.

IMPACT OF VOLATILITY ON PRICES

The volatility observed in dairy commodity prices has a direct impact on buyers and sellers of these products, and it also directly impacts federal order prices. The volatility in cheese, butter, nonfat dry milk and dry whey prices impacts the farm price of milk, as well as what buyers pay for fluid milk products (Class I), and yogurt, ice cream, and sour cream (Class II). For example, one can derive the reduced form Class III equation as a function of these commodity prices. The Class III prices from equations 7.21 and 7.22 are as follows:

$$Class\ III\ Price = 3.5 \times CP_{bf} + 0.965 \times Class\ III\ SP \tag{10.3}$$

$$Class\ III\ SP = 3.1 \times CP_{pr} + 5.9 \times CP_{os} \tag{10.4}$$

$$CP_{pr} = 3.2222 \times WP_c - 1.2752 \times WP_b - 0.4267 \tag{10.5}$$

where the Class III price and the Class III Skim Milk Prices (*SP*) are measured in dollars per 100 pounds of milk, the butterfat (CP_{bf}), protein (CP_{pr}), and other solids (CP_{os}) component prices are measured in dollars per pound,[2] and the cheese (WP_c) and butter (WP_b) wholesale prices are measured in dollars per pound. Equation 10.5 was derived by taking the original protein price formula in federal orders, substituting the butterfat price with the butterfat formula, and solving for the reduced form. Substituting the reduced form protein price (equation 10.5) and the butterfat and Other Solids formulas into equations 10.3 and 10.4, and solving for the reduced form yields the following:

$$Class\ III\ Price = 0.4237 \times WP_b + 9.6392 \times WP_c + 5.8643 \times WP_w - 3.171 \tag{10.6}$$

In this reduced form equation, the Class III price of milk is now a function of the wholesale prices of cheese, butter, and dry whey (WP_w). Note, that the coefficients in equation 10.6 reflect the assumed product yields from 100 pounds of milk.[3] In other words, it assumes a yield of

[2] See Chapter 7 for the butterfat and Other Solids equations.

[3] Derived yields are conditioned in part on the component levels in the Class III formula which are 3.5% butterfat, 2.99% protein, and 5.7% other dairy solids.