Producer-Level Hedging Effectiveness of Class III Milk Futures

By Ira J. Altman, Dwight Sanders, and Jonathan Schneider

Abstract

Mailbox milk prices from a representative dairy operation in Illinois are used to gauge the farm-level hedging effectiveness of Class III milk futures traded on the Chicago Mercantile Exchange. Predominantly used by manufacturers and end users to price cheese, the Class III milk futures are not frequently utilized by producers. The presented analysis shows that the Class III milk futures do provide an effective producer-level hedge: a hedge ratio of 0.85 can reduce price risk by over 90 percent. The importance of seasonal basis components for individual producers is highlighted.

Introduction

Low farm gate prices and substantial price volatility combined with reduced levels of government participation have resulted in a business environment where dairy producers need to find ways to manage price risk (Fortenbery, Cropp, & Zapata, 1997). Milk prices can be volatile due to seasonally fluctuating consumer demand and supply. Dairy producers need a way to make the prices more stable which will help them in budgeting and securing operating capital (Thraen, 2002). Milk Income Loss Contracts (MILC) are publicly funded risk management tools for dairy producers. However, they offer limited protection, and there is ongoing legislative uncertainty in regards to the renewal and funding for the program. Under these circumstances, futures hedging provides one possible avenue for dairy farmers to manage their milk price risk (Ibrahim & Maynard, 2004).

Ira Altman, Ph.D., is an Assistant Professor in Rural and Regional Economics, Department of Agribusiness Economics at Southern Illinois University-Carbondale. Dr. Altman's background is in agricultural and organizational economics, and rural and regional growth and development. Recently he has specialized in the organization and development of renewable energy industries from agriculture.

Dwight R. Sanders, Ph.D., is an Associate Professor in the Department of Agribusiness Economics at Southern Illinois University-Carbondale. Dr. Sanders teaches and conducts applied research in agricultural marketing with an emphasis on risk management techniques for agribusiness firms. His industry experience includes production agriculture, futures brokerage, as well as risk management positions with The Pillsbury Company and Darden Restaurants, Inc.

Jonathan Schneider, MSc, was a graduate student at Southern Illinois University-Carbondale. He is employed by Monsanto. He grew up on a dairy farm in Southwest Illinois.

Hedging milk price risk with the Class III fluid milk futures at the Chicago Mercantile Exchange (CME) is one specific way for individual producers to manage price risk. However, milk quality – and therefore prices – can vary dramatically across producers. Likewise, quality attributes can vary across geographic locations due to differing weather patterns and ration availability. So, it is important that individual producers carefully evaluate the hedging potential for their individual farm by using a history of their own "mailbox" milk prices. In this paper, we demonstrate how a representative Illinois dairy farm can use their farm-level data to develop a hedging and budgeting tool using the CME Class III milk futures. The empirical methods provide a template that other farm managers can utilize to evaluate the potential for hedging milk production for their specific dairy operation.

Fluid Milk Futures and Hedging

Class III fluid milk futures contracts began trading in at the CME in the year 2000 (prior to that, there were contracts on the Basic Formula Price or BFP). The fluid milk futures cash or financially settle to the USDA announced Class III milk price for the contract month. Futures contracts are listed for each calendar month and represent 200,000 pounds of milk. Prices are quoted in dollars per hundredweight (Milk Futures, Options, and Basis).

Class III milk is generally used in the manufacturing of hard cheeses and cream cheese. As such, the Class III milk futures are commonly used within the industry to price and hedge common cheeses, e.g., block cheddar cheese prices. Participation in the milk futures market by individual producers seems to be relatively limited, partially because dairy farmers often do not have a history or familiarity with hedging (Hanson & Pederson, 1998).

For a dairy producer, hedging is the process of using futures contracts to protect against falling prices for anticipated future production. Hedging involves establishing a price for expected milk production by selling futures contracts that are pricing distant months. The sold (short) futures contracts are offset by either purchasing back an identical futures contract prior to expiration or letting the futures contract automatically off-set (cash settle) to the USDA announced Class III milk price for the month (Thraen, 2002). In either case, it is crucial that the producer understand how his particular "mailbox" price relates to the USDA announced Class III price underlying the futures contracts. While there are a number of ways to approach this problem, here we focused on understanding the cash-futures relationship by using a simple regression model to estimate risk-minimizing hedge ratios and gauge hedging effectiveness (Sanders, Manfredo, & Greer, 2003).

Farm-Level Milk Pricing

A hedging program should help producers reduce risk and create a more steady cash flow. A predictable cash flow may allow financially levered dairy operations to reliably service their debt. To accomplish this through hedging, a dairy producer must know how the Class III futures prices move with the revenue components of his monthly mailbox price (Thraen, 2002). A key component is understanding this particular basis, where basis is defined as the difference between the cash price and the futures price (basis = cash price – futures price).

For milk, the basis represents the difference between the revenue components of the monthly mailbox price and the futures price (Thraen, 2002). Therefore, comparing the cash milk price (mailbox price) with the Class III futures contract price is not as straightforward as with other commodities, such as grains. Due to the Federal Order Marketing System, a daily spot or cash market for milk does not exist. Instead, milk producers are paid a monthly price based on a weighted average of three milk component prices, a return from a classified pricing system called the producer price differential, and other adjustment factors. The revenue per hundredweight received by a producer can be broken down as follows (Thraen, 2002):

Milk Check Revenue =
Pounds of Butterfat x Butterfat price + Pounds of Protein x Protein Price + Pounds of Other Solids x Other Solids Price + Producer Price Differential + Net Adjustment Factors

Milk check revenue is the net revenue received by the producer for the total volume of milk sold. The price per hundredweight is then simply calculated as the total net revenue divided by the volume sold in hundredweights. The Class III basis is then calculated by taking the computed mailbox price minus the Class III futures settlement price (Thraen, 2002).

In the next section, the computed farm-level milk price for a representative dairy in Illinois is used to illustrate how the Class III milk futures can be used to implement a hedging program, as well as provide input for the budgeting process.

Data and Methods

For this research, milk revenue and price information is gathered from a representative dairy producer in Washington County, Illinois. The dairy is a two hundred cow operation, milking twice per day, and feeding a ration of haylage, corn silage, brewer's grain, cracked corn, cottonseed, corn gluten, and minerals. The milk is sold to Prairie Farms, a Midwest dairy marketing cooperative. Each month, Prairie Farms distributes a summary of the farm's milk production, including total production, butterfat content, protein content, and component prices. From this summary, the monthly mailbox price is computed.

Monthly mailbox prices are available from December 2000 to November 2006, providing a sample of 72 monthly observations. The futures prices are the final settlement prices for the Class III futures for the corresponding month, where the final settlement price equals the average Class III milk price for that month as announced by the USDA. The data set subsequently consists of 72 monthly mailbox prices and the corresponding USDA Class III milk prices for the same month. The data are shown in Figure 1, where it is clear that the mailbox prices follow the major trends displayed by the futures prices. However, there are some deviations that may be caused by systematic variations in the producer's revenue component pricing. Next, we use a simple regression model to capture and explain these systematic basis components.

Following the methods proposed by Sanders, Manfredo, and Greer (2003), a hedging effectiveness regression is specified where the monthly mailbox price at time t is a function of the monthly Class III futures price plus monthly dummy variables to capture shifts in the revenue component of farm-level pricing.

$$(1)\quad \text{Farm Price}_t = \alpha + \beta * \text{Class III Futures Price}_t + \sum_{i=2}^{12} \delta_i \,\text{Month}_{i,t} + e_t.$$

In this regression, the slope coefficient, β, is the risk-minimizing hedge ratio. So, for each hundredweight of expected production, the producer should hedge using β hundredweights of futures contracts. For month i, the intercept shifting variable, δ_i, detects monthly shifts in price. In this specification, the intercept term for the regression, α , contains the premium or discount received in the base month of January, and each estimated coefficient, δ_i, represents the basis shift during the months of February through December (i = 2 to 12). For instance, higher butterfat content in the fall would generate a premium or positive coefficient for the autumn months. The goodness of fit measure, R^2, for the regression is associated with the potential effectiveness of the hedge. The R^2 can range from zero to one, where a higher R^2 is indicative of greater hedging effectiveness.

Regression equation (1) is estimated using ordinary least squares and the results are presented in Table 1. In Table 1, we can see that the risk minimizing hedge ratio, β, is equal to 0.85. The hedge ratio is the proportion of the production that should be hedged to minimize the overall price risk. So, the representative dairy should hedge 85 percent of its milk production to minimize price risk. Importantly, the estimated hedge ratio, 0.85, is statistically less than one, which would suggest that this particular farm would not want to employ the traditional unit-for-unit hedging strategy. The in-sample hedging effectiveness is equal to 0.91, as represented by the R^2. This means that 91 percent of the cash price fluctuations are explained by the futures price, which implies that a futures hedge can reduce price risk by 91 percent.

Importantly, the hedging regression also identifies the monthly premiums and discounts received by the producer. In this case, the base month is January, which receives a premium of $4.25 per hundredweight as shown by the intercept term (α), given the futures price. The other months are then measured relative to the January premium. As an example, in February the expected premium is $0.30 ($\delta_2$) less than January resulting in a total premium of $3.95 (4.25 - 0.30). Note however, the estimated δ_2 is not statistically different from zero; so, there is not a statistically different price in February versus January, all else being equal.

In contrast, the coefficients from April (δ_4) through August (δ_8) are statistically less than zero. The price premiums received by the farm decline significantly in the summer, with a low in

April of $2.87 (4.25 - 1.38). The seasonal pattern in these premiums is displayed in Figure 2. There are a number of reasons that the premiums may decline in the late spring and summer. Primarily, this time period is marked by hot and humid conditions in Southern Illinois that may increase bacterial cell counts in milk, reducing overall premiums. Additionally, the month of April marks the onset of the "spring flush" where milk volumes increase, reducing the relative butterfat content and associated premiums. It is highly likely that farms using alternative feeding regimes in other locations can have very different premium patterns, and farm managers would be well-advised to estimate a similar model for their own production operation.

It is important to note that actual implementation of equation (1) provides the producer not only with an expected hedged price but also a forecast price if they choose not to hedge. For example, actual Class III futures prices from January 1, 2007 are shown in Table 2 along with the expected price from using equation (1). On January 1, the June Class III futures were trading at $14.09. So, the producer can hedge their expected production by selling the June Class III futures contract at $14.09. In doing so, they are "locking-in" an expected price of $15.03 (4.25 + 0.85 * 14.09 - 1.20). The actual net hedged price will undoubtedly deviate from this calculation because it is unlikely that the estimated relationship will hold precisely when applied out-of-sample. Still, equation (1) provides the producer with the expected hedged price based on the historical relationship between the mailbox price and the futures price (see University of Wisconsin Web site for a dairy hedging tutorial).

For the producer who does not want to hedge, the hedging effectiveness regression still provides a useful link between observed futures prices and the expected mailbox price. That is, the producer can substitute a deferred futures price into the equation and calculate an expected price for a particular month. Given that the futures price is often considered the best available forecast for prices, this procedure provides the producer with a futures-based forecasting system. The forecasts are easily updated (by substituting in the most recent futures prices) and they may be useful for forming budgets and other business planning (Sanders, Apgar, & Manfredo, 2005). In this regard, equation (1) and the use of farm-level data are useful regardless of whether or not the hedge is actually placed. For instance, on January 1 the producer in this study can use the forecasts in Table 2 to make a monthly cash flow forecast which may help with financial management. Alternatively, the estimated parameters from equation (1) may allow the farm manager to see the months in which their milk prices decline relative to the futures prices. The seasonal basis weakness – captured in the monthly dummy variables – may identify quality issues that can be addressed by better management techniques.

Summary and Conclusion

In this paper, we evaluate the potential hedging effectiveness of Class III milk futures for a representative Illinois dairy. The results suggest that using a hedge ratio of 0.85 can reduce producer-level price risk by over 90 percent. Moreover, the estimated hedging regression provides considerable insight as to the seasonal variations in the producer's quality premiums and discounts (basis), which may allow more closely focused management efforts. Even without implementing a hedging program, the estimated regression model provides a tool for making futures-based price forecasts to aid in the budgeting and planning processes.

Importantly, the specific results in this paper are only valid for the representative producer chosen. The estimated hedging regression parameters will be different for each producer. The seasonal premiums (dummy variables) will be different across producers depending on their specific quality characteristics, herd breed, rations, and location. The methods presented in this research provide a roadmap that other dairies can follow to estimate hedging effectiveness and generate forecasts for budgeting and planning.

The research has a number of practical considerations and limitations. First, small sized dairies may not want use futures contracts. A monthly futures contract is 200,000 pounds and a dairy would need approximately 175 cows to produce this much milk per month. A small dairy operation would need to aggregate production across months to use a single futures contract. Also, the effort required to open a futures account and maintain a hedging program may not be a good use of a manager's resources for smaller dairy operations. Still, these producers may benefit from knowing their relationship with the futures market (equation [1]) to make forecasts for budgeting and to understand the seasonality and magnitude of their basis.

The research clearly demonstrates the variability of the premiums producers can receive based on milk quality. In this research the variation across months was as much as $1.38 per hundredweight or 11 percent of the average Class III price ($12.65). So, knowing the relationships discussed in this research may motivate the dairy to focus on their quality premiums. Indeed, a dairy manager may be able to increase average prices by understanding seasonal premiums and better managing the factors that impact them. Regardless of the approach taken, the results presented here suggest that producers who invest time in understanding their producer-level pricing vis-à-vis Class III fluid milk futures may be able to better manage output prices.

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Table 1. Hedging effectiveness regression

Coefficient	Estimated Value
Intercept, α	4.25 (8.45)*
Hedge Ratio, β	0.845 (23.98)
February, δ_2	-0.30 (-0.75)
March, δ_3	-0.39 (-0.99)
April, δ_4	-1.38 (-3.43)
May, δ_5	-1.21 (-3.00)
June, δ_6	-1.20 (-2.98)
July, δ_7	-1.26 (-3.13)
August, δ_8	-1.25 (-3.12)
September, δ_9	-0.53 (-1.32)
October, δ_{10}	-0.18 (-0.44)
November, δ_{11}	0.12 (0.30)
December, δ_{12}	0.19 (0.48)
R-squared	0.91

*T-statistic in parenthesis.

Table 2. 2007 expected prices, $/cwt., on January 1

Month	Class III Futures	Expected Price
Jan.	13.20	15.47
Feb.	13.32	15.28
Mar.	13.42	15.27
Apr.	13.71	14.53
May	13.93	14.88
June	14.09	15.03
July	14.45	15.28
Aug.	14.65	15.45
Sep.	14.78	16.28
Oct.	14.39	16.31
Nov.	14.21	16.45
Dec.	14.04	16.38
Average	14.02	15.55

Figure 1. Milk prices, December 2000 – November 2006

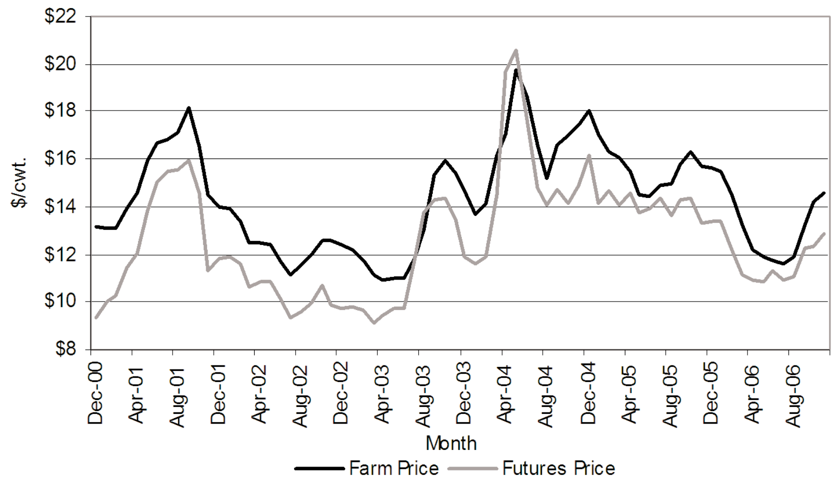

Figure 2. Monthly farm-level price premiums