The Potential of Dairy Futures Contracts as Risk Management Tools

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Abstract: We examine the young dairy futures market as a risk management tool. Using New York Board of Trade (NYBOT) data, we find that the BFP futures market is efficient and may potentially be a useful hedging tool. However, we also find that competition from Chicago Mercantile Exchange (CME) contracts has significant detrimental effects on the NYBOT dairy futures contracts. As a result NYBOT dairy futures contracts are likely to dry up.
The Potential of Dairy Futures Contracts as Farmer Risk Management Tools

Dairy futures contracts became a reality in the early 1990’s. There are currently contracts traded for butter, cheese, powder, and the Basic Formula Price (BFP). ¹ The volatility of milk and dairy product prices in recent years has lead many policy-makers and economists to conclude that futures markets are needed as a risk management tool for dairy farmers. We use data from 1997 and 1998 dairy futures contract trading on the New York Board of Trade (NYBOT) to examine the performance of the contract as a risk management tool.

A futures contract might fail as a risk management tool in any or all of three senses:

1. farmers do not use the contract as a hedging tool,
2. farmers attempt to use the contract as a hedging tool but the contract is not effective in off-setting risk, or
3. the futures contract in question is not an efficient price discovery tool.

The dairy futures contracts, as measured by volume, open interest, and participation, have not yet performed to the level of expectations or that of many other agricultural commodity futures contracts. There are many potential reasons for this lack of performance including: the flow nature of milk production, the perishability of raw milk, government intervention in milk marketing, trade barriers across regions and countries, cautiousness and learning curve of dairy farmers, and the relative immaturity of the contracts.

In dairy markets, the proprietary firms that would naturally take long positions in the market may not participate because they are bound by federal minimum prices. However, if the futures contract efficiently reflects and incorporates information from the cash market, this should not be a deterrent.

¹ The Basic Formula Price is derived from surveys of cheese plants nation-wide and the largest butter spot market in Chicago. It is basis of all milk prices in Federal Milk Marketing Order system.
Similarly, one school of thought has it that speculators avoid BFP futures because of their lack of understanding of dairy markets. However, if there were substantial profits to be made speculating in these futures, speculators would have incentive to quickly become experts in dairy markets. A more reasonable conclusion might be that there is not enough movement in BFP futures prices for short-term speculation to be profitable, and the low volume and open interest in the market does not provide the liquidity that speculators desire. Without speculators, hedgers have nobody with which to trade.

Finally, the relative immaturity of the dairy contracts might suggest that more time is needed for potential participants to come into the market. In their infancy, dairy futures have been characterized by low volume and open interest. This is beginning to change as these markets are maturing, and most of the trading is being consolidated in Chicago.

Black identified several characteristics of successful futures markets, and provided a methodology to examine whether these characteristics are present in a given contract specification. To be successful, the contract must be an efficient hedging instrument, it must possess sufficient liquidity, and the underlying cash market must be volatile and large. We examine the BFP futures contract and test whether the above characteristics are met.

**History of Dairy Futures**

Two commodity exchanges trade dairy futures contracts today: the New York Board of Trade and the Chicago Mercantile Exchange (CME). There are currently contracts traded for cheddar cheese, butter, non-fat dry milk, and the Basic Formula Price (BFP). The BFP is the logical risk management tool for dairy farmers and we base our analysis on this contract. The actual mechanics of the BFP are discussed in the next section.
All dairy futures contracts are young contracts. The NYBOT initiated trading in cheddar cheese and non-fat dry milk in 1993. The initial expectation was that the correlation between cheddar cheese prices and fluid milk prices would allow effective cross-hedging so that firms handling both fluid milk and manufactured products would use the cheese contract as a hedging tool (Fortenbery, Cropp, and Zapata). The lack of interest by fluid milk handlers and farmers in the cross-hedge led to the introduction of the BFP contract at both the NYBOT and CME. The relative size of the volume and open interest suggests that the markets are neither large nor liquid.

While these futures contracts might attract speculators and hedgers from manufactured dairy products firms and cooperatives, we concentrate on the farmer’s use of these markets as a risk management tool. In order to understand the farmer’s milk price risk management problem, the policy context and pricing procedures are reviewed briefly below.

**Basis and Farm-level Milk Price Risk Management**

As the BFP underlies virtually all milk prices in the United States, that contract is the natural one for use by farmers to manage milk price risk. However, the milk basis varies across individual farms and the basis risk might also vary. The basis is defined as the ‘mailbox’ milk price less the BFP futures price. Each farmer has a mailbox milk price that reflects the class prices and utilization in that order as well as the quality premiums, other cooperative and over-order premiums, and hauling charges. Formally, each farmer, , in order , has a mailbox milk price in month that can be expressed as

\[
(1) \quad p_{ijt}^m = (1 - w_j)(BFP_t) + w_j(BFP_{t-2} + d_j) + \epsilon_i,
\]

where \( w_j \) is the percentage of milk in Class I use in order \( j \), \( BFP \) is the national basic formula price, \( d_j \) is the fluid differential in order \( j \), and \( \epsilon_i \) represents hauling charges and premiums for
that farmer. This formula simplifies the milk market to two classes: fluid and manufactured. In practice, there is another class of soft-manufactured products that are also priced off the two-months previous BFP with a fixed differential.

Because no marketing order is 100 percent manufactured milk, using the BFP futures contract is to some extent a cross-hedge for all farmers. The basis risk has both intertemporal and spatial dimensions across the United States. For example, farmers in Wisconsin have a fluid utilization of only 15 percent with the balance in manufactured products. This puts the bulk of the weight on the current month BFP. In contrast, farmers in Florida have a fluid utilization of 85 percent, which puts the bulk of the mailbox price weight on the BFP two-months previous.

The basis for a California farmer is more complicated as California’s state marketing order does not use the BFP to price its milk. The BFP generally reflects the cheese price which is national in nature. Because dairy futures are a relatively new market, there is reason to consider whether these markets are performing well.

This paper is a preliminary look at dairy futures, the NYBOT BFP in particular. Specifically, we consider whether BFP futures at the NYBOT are useful as a hedging tool for dairy producers, whether this market is efficient, and whether this market is well positioned for success. These issues are related, because they determine whether BFP futures attract a sufficient volume of trading to be successful.

**Assessing Potential for BFP Futures Market Success**

Black (1986) and Chambers (1988) researched the determinants of success and failure in futures markets. Among the important characteristics they identified were the size of the underlying cash market, the usefulness of the futures market at a risk reduction tool, the price variation in the cash market, and the liquidity of the futures market.
A successful market must attract a sufficient volume of trading, and an inefficient market or a market with a high cost of hedging is unlikely to do so, because the volume of trading is largely determined by the contract’s appeal to hedgers (Working, 1953 and 1954). Hedging positions by producers are especially important in dairy futures because the policies that govern prices in the industry discourage participation by the processors of dairy products (Glenn).

Speculators are also important to make the market work. However, they are not the focus of this paper and we assume that a market with sufficient liquidity and price movement will be attractive to speculative money.

Several features of the BFP futures contract make empirical work difficult. First, BFP futures are a new market, so there is not a long time-series of data to work with. Second, there is no “cash” BFP market, since the actual BFP price is based on surveys by the USDA. This is even more problematic because the survey results are released only once a month. Any empirical technique that compares cash prices to futures prices will be further hampered by a low number of observations. Third, the BFP, and other dairy-related futures, trade on two different exchanges, the NYBOT and the CME. BFP futures have been trading for a longer time at the NYBOT, but it seems that most of the market volume has shifted to the CME in recent months. Unfortunately, data for the full history of the BFP futures at the CME are currently unavailable.

Many writers have viewed price discovery as an important function of futures markets, especially for those commodities without continuous inventories (e.g., Kofi). We can determine how well the BFP futures perform this function by viewing the futures price as forecasts of the BFP, and estimating the linear regression:

\[
BFP_t = \alpha + \beta * BFP_{t-1} + \epsilon \quad ,
\]
where $BFP_t$ is the actual BFP reported at time $t$, and $BFP^j_{t-j}$ is the $j$ month ahead futures price of the BFP futures contract maturing at time $t$.

The BFP futures contract should predict well in the near future, because the formula for calculating the BFP from readily available data is well known. As expected, the BFP futures market, with an $R^2$ of 0.967, performs adequately when forecasting one month ahead (see table 1). However, as the forecasts become more distant, forecasting performance falls off rapidly. The futures market is of essentially no value more than two months ahead.

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<th>Table 1. Regression of Spot BFP on Prior BFP futures</th>
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<td>Intercept</td>
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<td>1 month from expiration</td>
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<td>2 months from expiration</td>
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<td>3 months from expiration</td>
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<td>4 months from expiration</td>
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<tr>
<td>5 months from expiration</td>
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Note: Standard errors are in parentheses.

The forecasting performance of the BFP futures contract is significantly worse than the futures markets for Potatoes, Cocoa, Coffee, Wheat, Corn and Soybeans considered by Kofi. These results are not particularly surprising, considering that almost all of the activity in the BFP futures is in the two contracts closest to maturity.
Testing Efficiency in BFP Futures Markets

One criteria for efficiency in the BFP futures market is that the prices must follow a random walk, which means that returns from the futures market are not predictable based on past returns (if this were true, the futures market would be weak-form efficient). The random walk hypothesis for market efficiency requires that prices be integrated of order 1, or a unit root. An augmented Dickey-Fuller (ADF) tests the null hypothesis is that a unit root exists. Using daily data for the nearby futures, we could not reject the null hypothesis of a unit root in the futures prices. Taking the first difference of the futures prices results in a stationary series for which the unit root is rejected. These results suggest the BFP futures market is weak-form efficient.

Fortenbery and Zapata (1997) perform a different type of test for efficiency in the newly created NYBOT cheese futures market. They test whether the spot price and the futures price are stationary, using an ADF test, and find that both the cash and futures markets are characterized by unit roots. If this is true, then for the cheese market to be efficient requires that these two series be cointegrated, meaning there is a long term relationship between them that is stationary (for example, the basis). Fortenbery and Zapata find that the basis is not stationary, and the series are not cointegrated, suggesting that the cheese market is inefficient. Thraen (1999) extends the work of Fortenbery and Zapata using additional data that is now available, and finds that a cointegrating relationship between the spot and futures markets has become established. We performed this same analysis for BFP futures. Although an ADF test was already performed on the daily futures data above, the monthly data necessary to consider the relationship between the BFP spot and futures markets also required testing. For both monthly spots and futures, the null hypothesis of a unit root could not be rejected. Unlike the cheese market in its infancy, the BFP spot and futures price are cointegrated for the nearby futures.
BFP Futures as Risk Management Tools

Although the BFP futures market is efficient in a finance sense of having unpredictable returns, it not be useful as a risk management tool for dairy producers. Black found the usefulness of a contract for risk management was one of the important determinants of its success or failure. Black's method, following Ederington and Figlewski estimates the equation

\[(3) R_s = \alpha + \beta R_f + \epsilon,\]

where \(R_s\) is the return of from holding the asset in the spot market and \(R_f\) is the return from holding a futures position. A measure of the residual risk that remains in a portfolio of spot and futures positions is \((1-R^2)\), where \(R^2\) is from the regression in (3). This measure of residual risk gives us some idea of the value of using the BFP future as a risk management tool. By substituting a different futures market returns on the right hand side, we obtain the measure of residual risk remaining after performing a cross hedge. According to Black, for a new contract to be successful, the ability to perform a direct hedge is only useful if the residual risk is significantly lower than a currently available cross hedge. For the purposes of this test, we assume the BFP futures is a direct hedge of farmer's price risk. This assumption is a simplification that will be corrected in future work and is equivalent to assuming that all the milk sold within a marketing order is sold as Class I milk. The residual risk from a full hedge of the BFP spot with the BFP futures is 0.268. If the BFP futures were a perfect hedge (meaning the basis would be constant) the residual risk from this own hedge would be zero. In this case, remember that the residual risk from an actual hedge in this market would be higher, because returns to the dairy producer are merely a function of the BFP. Prior to the introduction of the BFP futures on the NYBOT, the dairy producer could cross hedge the risk of changes in the spot BFP by using cheese, butter, or non-fat dry milk (NFDM) futures, all at the NYBOT. The
residual risk from a cross hedge in the other dairy futures is in table 2. Neither the butter or the NFDM futures are particularly useful for hedging the price risk that comes from fluctuations in the spot BFP, but the cheese futures cross-hedge performs almost as well as the BFP own hedge. This is not surprising as cheese markets drove most changes in the BFP during the time period analyzed.

The relative residual risk measure in table 2 is the residual risk from the cross hedge divided by the residual risk from the own hedge. The relative residual risk is a measure of how much more risk is borne when a cross hedge is utilized rather than an own hedge. A relative residual risk coefficient equal to one means that there is no difference between a cross or an own hedge. A relative residual risk coefficient greater than one means that the own hedge is a better contract to manage risk. Black was concerned with whether newly innovated futures contracts would survive. In this sense the relative risk coefficient of 1.08 for cheese futures is problematic for the BFP futures, because there is little risk-reduction benefit to hedgers from the introduction of the new contract. A better interpretation in this context is that only one of the two contracts is useful for hedging spot BFP risk.

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<th>Cross Hedge Residual Risk</th>
<th>Relative Residual Risk</th>
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<tbody>
<tr>
<td>Butter</td>
<td>0.933</td>
<td>3.47</td>
</tr>
<tr>
<td>Cheese</td>
<td>0.289</td>
<td>1.08</td>
</tr>
<tr>
<td>NFDM</td>
<td>0.913</td>
<td>3.40</td>
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</table>

The fact that one of these markets was redundant, coupled with the introduction of cheese trading at the CME, signaled the end of the cheese futures in New York. If the CME data were available we suspect the same result would hold between NYBOT BFP and CME BFP futures. That is, there is only room for one exchange in this market. At this point, it looks as if the CME
BFP futures will replace the NYBOT BFP futures and all dairy futures will consolidate in Chicago. Additional market evidence that this is true is the price of permit to trade dairy contracts at the NYBOT is only $2,500, and no transaction has taken place in the last nine months.

Liquidity in a futures market is also important for a successful contract, because speculators and hedgers wish to be certain that positions can be taken or changed without a large price concession. From the hedger’s point of view, a futures contract that is illiquid is costly to use as a hedging tool. With that in mind, consider the liquidity of the NYBOT BFP futures contract. This market is very small, especially when compared to the huge value of the U.S. dairy industry. One commonly used criteria for success of a futures market is that the daily open interest exceeds 5,000 contracts, and the trading volume is greater than 1,000 contracts per day. These criteria are used by Carlton to determine the existence (rather than success) of a futures market, and the also the criteria used by the Wall Street Journal to determine whether to report prices in the market (Black).

By any reasonable definition of size, the BFP futures at the NYBOT have been a failure. Figure 1 displays the daily open interest over the life of the contract. The open interest is small; the average open interest is about 710 contracts, and the highest value was 1,445 contracts on July 21, 1997 (representing approximately 0.09% of 1997 U.S. milk production). The volume of trades is also quite small. Figure 2 shows a 30-day moving average of the volume of trades on the NYBOT BFP. This chart may be a little misleading, because the moving average dampens out days with extremely high volume, but the message is that volume of trading in this market is also low. The average number of transactions in this market is just over 30 per day, with a peak of 199 on July 15, 1999. Both of these measures, this market is not a liquid, well functioning
market. The costs of a thin market are usually seen in higher bid-ask spreads, and a hesitation by potential participants. Although the open interest appears to be relatively stable, the volume of trading is continuing to decline. Combined with the growing size of the BFP market in Chicago, these facts point out that the demise of the NYBOT BFP futures market is likely.

Figure 1. Open Interest in NYBOT BFP Futures
Conclusions

We examine the young dairy futures market as a risk management tool. Using New York Board of Trade (NYBOT) data, we find that the BFP futures market is efficient and may potentially be a useful hedging tool. However, we also find that competition from Chicago Mercantile Exchange (CME) contracts has significant detrimental effects on the NYBOT dairy futures contracts. As a result NYBOT contracts are likely to dry up.

Future work includes incorporating CME data and performing the same efficiency tests. Using CME data will also reflect the entire market since these contracts began trading in the last couple of years. Simulations to address the cost of hedging will also provide useful information to address the viability of dairy futures contracts as risk management tools.
References


Glenn, Marcia E. “Why dairy needs forward contracts.” Dairy Today (February 1999):48


