ESO 2069

FEASIBILITY OF TRADING FUTURES FOR MILK AND MILK PRODUCTS

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July 6, 1993

OVERVIEW

Feasibility of trading futures contracts for fluid milk, butter, cheddar cheese, and nonfat dry milk is evaluated. All conditions needed for a futures market to be successful are not known, but at least two conditions must exist: (1) price variability and (2) a sufficiently large cash market value. Different aspects of these two conditions are examined in this study.

FINDINGS

- Compared with other agricultural commodities currently traded on futures markets, milk, butter, cheddar cheese and nonfat dry milk all have sufficient cash market value, although the value of the milk products is on the low end.

- Compared with other agricultural commodities traded on futures markets, only butter and nonfat dry milk appear to have sufficient price variability and thus to have the potential for successful futures contracts.

- If a cheddar cheese futures contract was successful, mozzarella, process, and Swiss cheeses probably can be successfully cross hedged in the contract. The reason is that the price variabilities of mozzarella, process, and Swiss cheese are greater than the price variabilities of the comparable price spreads of these three cheeses with cheddar cheese.

- Because milk, cheddar cheese and nonfat dry milk prices move together, milk processors are likely to use the proposed cheddar cheese and nonfat dry milk futures contracts only as part of a processing spread.

- Variability of the milk-to-cheese and, especially, the milk-to-butter/nonfat dry milk spread suggests that these two processing spreads could possibly be traded on a futures market. Milk and butter futures contracts would need to be developed.

RECOMMENDATIONS

- Of the cheddar cheese and nonfat dry milk futures contracts currently being traded, nonfat dry milk appears to have the most potential for success. Thus, educational efforts should focus on it.

- The potential for a futures contract on milk as well as for butter should be explored. These contracts would allow the milk-to-butter/nonfat dry milk and milk-to-cheddar cheese processing spreads to be traded.

OVERVIEW OF U.S. MILK PRODUCTION AND CONSUMPTION

PRODUCTION

In 1980, U.S. milk production totaled 128.4 billion pounds. By 1991, production totaled 148.5 billion pounds. The increase resulted from more milk per cow. In 1991, milk per cow averaged 14,867 pounds compared to 11,891 pounds per cow in 1980. Due to this increased productivity and the decline in number of farms with milk cows, average milk production per farm more than doubled from 382,400 pounds in 1980 to 819,100 pounds in 1991 (Figure 1.2).

CONSUMPTION

Per capita consumption of all dairy products, in milk equivalent pounds, increased from 544 pounds in 1980 to 601 pounds in 1987, then decreased to 565 pounds in 1991. Of particular note, per capita cheese consumption increased from 17.5 pounds in 1980 to 24.7 pounds in 1990.

PROCESSING SECTOR

According to the U.S. Census of Manufacturers, the number of plants which process milk into fluid milk and milk products declined from 3,731 in 1977 to 2,364 in 1987 (latest year data are available). Consequently, average milk processed per plant nearly doubled, from 33 million pounds in 1977 to 60 million pounds in 1987.

IMPLICATION FOR RISK EXPOSURE

- During the last decade, potential exposure to risk per milk farm and per milk processor has approximately doubled due to increased milk production per farm and milk processed per processor.

Fig. 1.1. U.S. MILK PRODUCTION PER FARM
1980-1991

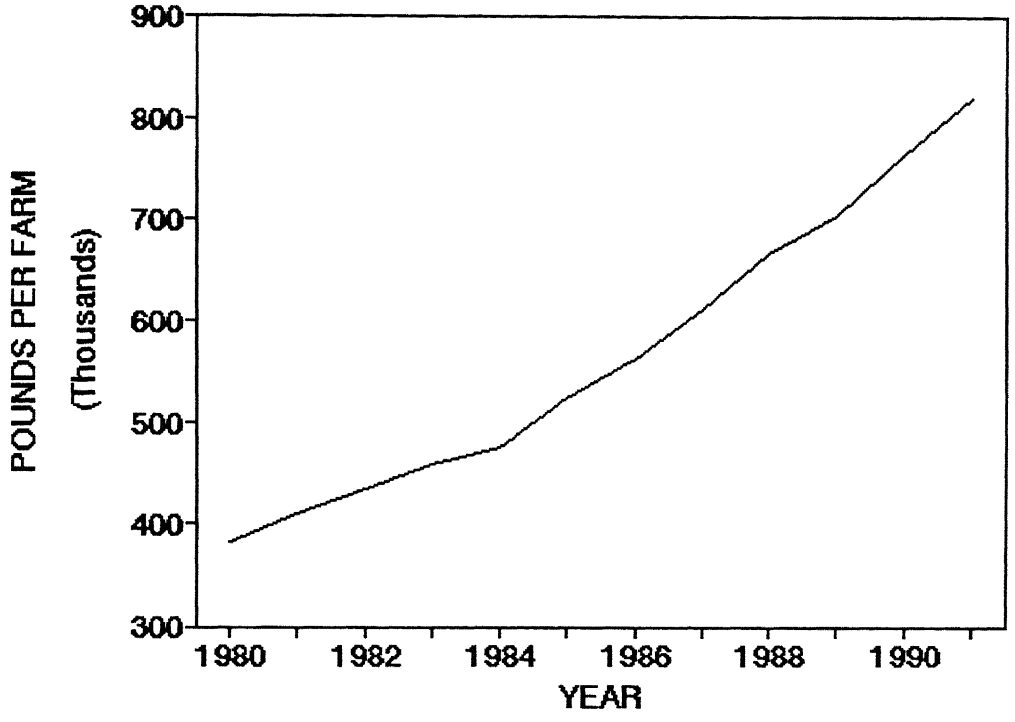
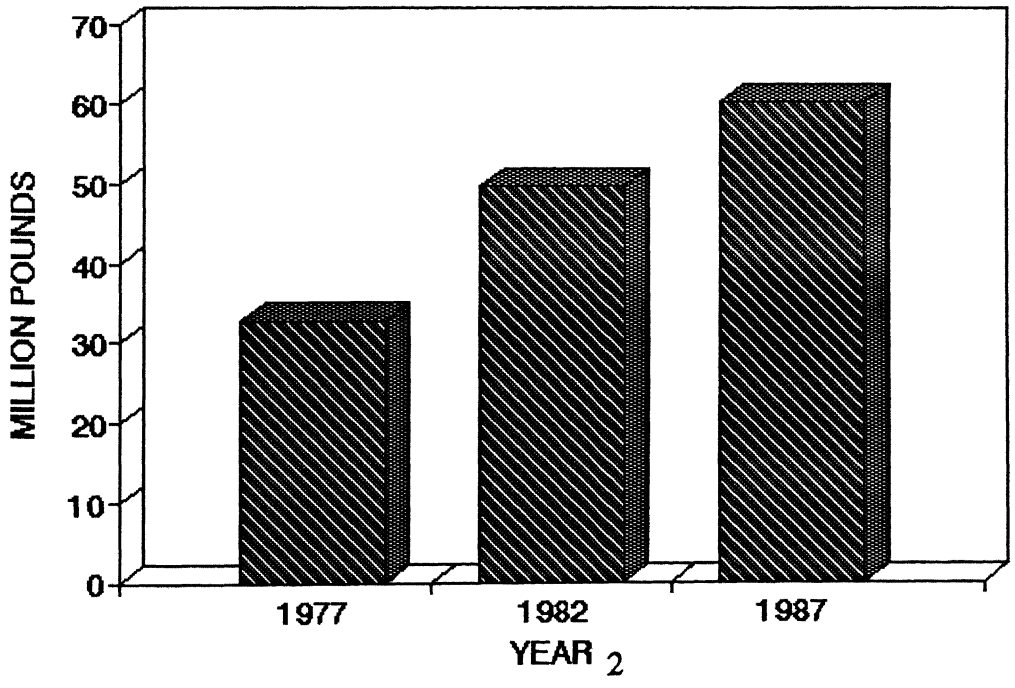


Fig. 1.2. MILK PRODUCTION PER PROCESSOR
1977, 1982, 1987



NECESSARY CONDITION: VALUE OF PRODUCTION

OVERVIEW

The U.S. cash market value of production for 10 primary agricultural commodities currently traded on futures markets is compared to the cash market value of milk, butter, cheddar cheese, and nonfat dry milk. The 10 commodities are beef cattle, corn, cotton, hogs, Florida Valencia oranges, oats, soybeans, soybean meal, soybean oil, and wheat. Value of production is calculated as the average annual value of production over a 12 year period from 1980 through 1991. All data are from U.S. Department of Agriculture publications.

VALUE OF PRODUCTION OF AGRICULTURAL COMMODITIES

Beef cattle had the highest average annual value of production between 1980 and 1991, $24.9 billion (Table 2.1). Florida Valencia oranges had the smallest average value, $456 million. Milk ranks second at $18.4 billion. Of the three milk products, cheddar cheese had the highest value of production at just under $3 billion annually. The annual value of butter and nonfat dry milk exceed only the annual value of oats and Florida Valencia oranges.

RELATIONSHIP WITH VOLUME OF FUTURES TRADING

For each of the 10 agricultural commodities traded on futures markets, the average annual number of futures contracts traded was calculated for the period 1980-1991. A statistical analysis was performed to determine how much of the variation in the average annual number of futures contracts traded could be explained by the average annual value of production. This analysis indicated that the average annual value of production explains 36% of the annual variation in the average annual number of futures contracts traded for the 10 commodities (Figure 2.1). If beef cattle is excluded from the analysis, 72% of the variation in the average annual number of futures contracts traded is explained by the average annual value of production.

IMPLICATIONS

- Milk and the three milk products probably have sufficient value of cash market production to be traded as futures contracts, although cheddar cheese, butter, and nonfat dry milk are at the low end.

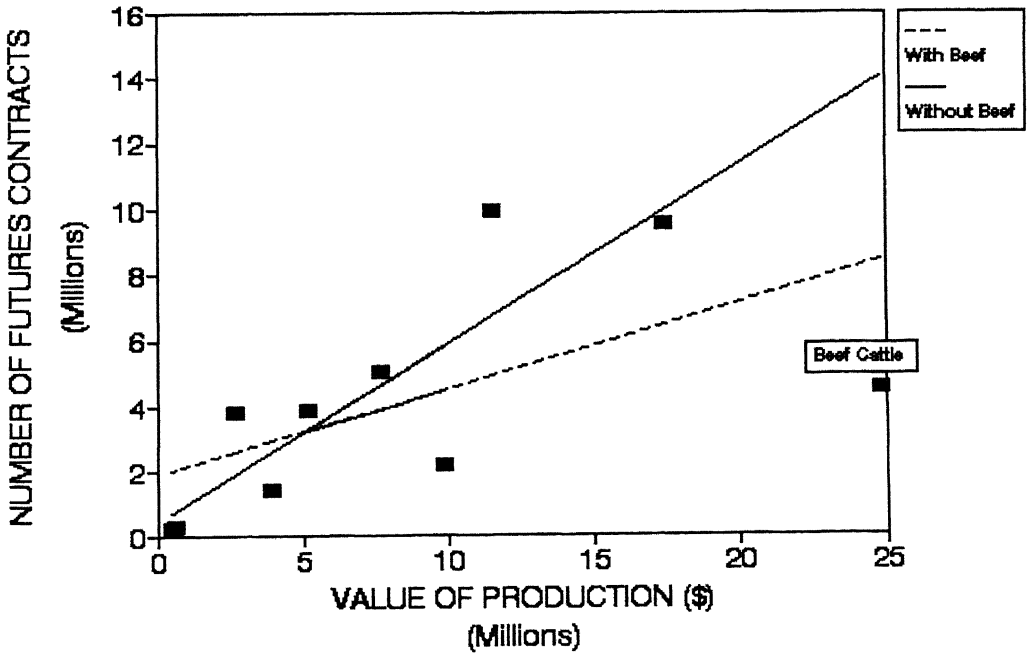
- Using the statistical analysis that excludes beef cattle, potential annual volume of futures contracts is estimated at 10 million for milk, 1.6 million for cheddar cheese, 0.9 million for butter, and 0.6 million for nonfat dry milk.

Table 2.1 Average Annual Value of Production and Number of Futures Contracts Traded for Milk, Milk Products, and Selected Agricultural Commodities Traded on Futures Markets, U.S., 1980-1991.

Commodity	Average Annual Value of Production	Average Annual Trading Volume
	(million $)	(contracts)
Beef Cattle	24,867	4,517,683
Raw Milk (All)	**18,385**	**N/A***
Corn	17,405	9,505,142
Soybeans	11,461	9,901,570
Hogs	9,801	2,174,192
Wheat (All)	7,663	5,063,389
Soybean Meal	5,145	3,843,607
Cotton	3,906	1,424,770
Cheddar Cheese	**2,899**	**N/A***
Soybean Oil	2,647	3,811,795
Butter	**1,649**	**N/A***
Nonfat Dry Milk	**1,039**	**N/A***
Oats	645	289,227
Florida Valencia Oranges	456	263,329

*N/A - not applicable SOURCE: Various U.S. Department of Agriculture publications

Fig. 2.1. VALUE OF PRODUCTION AND NUMBER OF CONTRACTS TRADED, 1980-1991



NECESSARY CONDITION: PRICE VARIABILITY

OVERVIEW: Since 1949, U.S. milk prices have been supported by a public policy which purchases cheese, butter, and nonfat dry milk when milk prices decline below a predetermined support price. This support price in effect establishes a price floor. Net removals of milk products by the U.S. Department of Agriculture, although variable, have trended downward since 1983. This downward trend reflects a reduction in the milk price support rate from $13.10 per hundredweight in 1980 to $10.10 per hundredweight in 1991.

PRICE VARIABILITY OF AGRICULTURAL COMMODITIES: Price variability is measured as the standard deviation of the price divided by the average price. Standard deviation is a measure of the difference or variation in price. The greater the difference, the greater standard deviation. Dividing standard deviation by the average allows prices for different units (such as bushels vs. pounds) and magnitudes (dollars vs. cents) to be directly compared. This ratio measures price variability in percentage terms, with a higher percent indicating greater price variability.

Reflecting the declining importance of government programs, price variability of the annual price of cheddar cheese and milk increased from 3% to 5% between 1980-1985 and 1986-1991 (Table 3.1). Nevertheless, this variability remains substantially below the annual price variability of the 10 U.S. agricultural commodities currently traded on futures markets. In contrast, price variability of butter and nonfat dry milk increased from 3% to 15% and from 4% to 13%, respectively. Their recent annual price variabilities now exceed or are comparable to the price variabilities of beef cattle, cotton, and hogs.

RELATIONSHIP WITH VOLUME OF FUTURES TRADING: For the 10 U.S. agricultural commodities currently traded on futures markets, no statistical relationship exists between annual percent price variability and average annual number of futures contracts traded (Figure 3.1). This finding holds even when the effects of the average annual value of production are taken into account. Despite the lack of a statistical relationship, each of the 10 commodities had a price variability that exceeded 10% over the 1980-1991 period. Furthermore, price variability during a subperiod dropped below 8% only for beef cattle during 1980-1985.

IMPLICATIONS

- A lower limit of 8-10% annual price variability appears to exist before futures trading becomes viable over a long period of time. Nonfat dry milk and butter surpassed this limit over the 1986-1991 period. However, milk and cheddar cheese remain substantially below it.

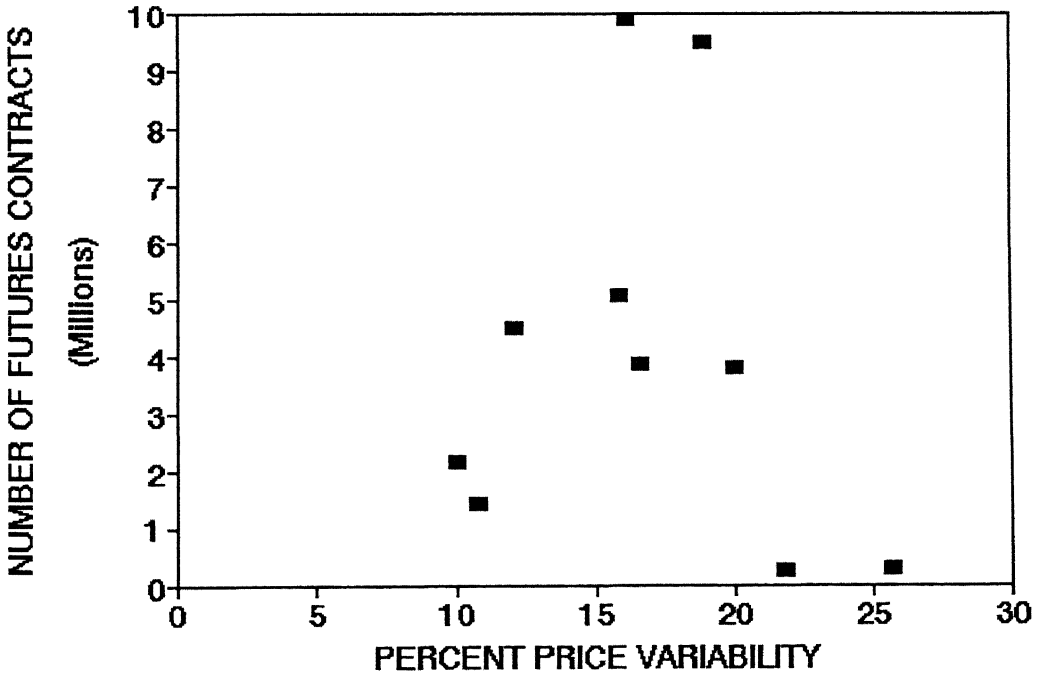
- From a price variability perspective, only nonfat dry milk and butter appear to have the potential for successful futures markets.

Table 3.1 Annual Price Variability of Milk, Milk Products, and Selected Agricultural Commodities Traded on Futures Markets, U.S., 1980-1991.

Commodity	Price Variability[a] by Period		
	1980-1991	1980-1985	1986-1991
	- - - - - - - - - - - - - - % - - - - - - - - - - - - - -		
Oats	25.67	13.88	35.95
Florida Valencia Oranges	21.82	19.92	19.07
Soybean Oil	20.07	23.07	13.28
Corn	18.91	14.22	17.61
Soybean Meal	16.62	17.97	15.99
Soybeans	16.15	17.52	14.75
Wheat (All)	15.90	8.67	19.45
Butter	**12.75**	**2.79**	**15.49**
Beef Cattle	12.08	5.18	12.36
Cotton	10.80	12.12	10.34
Hogs	10.03	10.41	9.70
Nonfat Dry Milk	**9.05**	**4.05**	**12.82**
Cheddar Cheese	**4.99**	**3.34**	**5.37**
Raw Milk (Manufacturing Grade)	**4.58**	**3.22**	**5.19**

a. Price variability equals standard deviation of annual price divided by average annual price.
SOURCE: Original Calculations and various U.S. Department of Agriculture publications

Fig. 3.1. PERCENT PRICE VARIABILITY AND NUMBER OF CONTRACTS TRADED, 1980-1991



ANALYSIS OF CHEESE PRICE SPREADS

OVERVIEW

The spreads between the price of cheddar cheese and the prices of three other cheeses were calculated to determine the viability of cross-hedging the other cheeses using a cheddar cheese futures contract. The specific prices used in this evaluation were Wisconsin wholesale monthly prices (in cents per pound) for cheddar 40 pound block, mozzarella 5-6 pound, process 5 pound loaf, and domestic Swiss cut grade A. These prices are listed in the U.S. Department of Agriculture's Dairy Market News and were collected from 1987 through 1992.

CALCULATIONS

The cheese price spreads were calculated as follows:

Spread	Calculated As:
Cheddar/Mozzarella	Cheddar price - Mozzarella price
Cheddar/Process	Cheddar price - Process price
Cheddar/Swiss	Cheddar price - Swiss price

Because all prices are measured in cents per pound, standard deviation by itself is used as the measure of variability in this analysis. The smaller the standard deviation, the smaller the variability of a price or spread.

RESULTS

The monthly prices of mozzarella, process, and Swiss cheeses had standard deviations of 11.6, 13.3, and 14.6 cents per pound, respectively (Table 4.1). In contrast, the cheddar/mozzarella, cheddar/process, and cheddar/Swiss cheese spreads had standard deviations of 3.3, 6.2, and 9.9 cents per pound, respectively (Table 4.1). Thus, variability of the price spread with cheddar cheese was lower than the variability of the price of the cheese itself. The reduction in variability was 72% for mozzarella cheese, 53% for process cheese, and 32% for Swiss cheese.

IMPLICATIONS

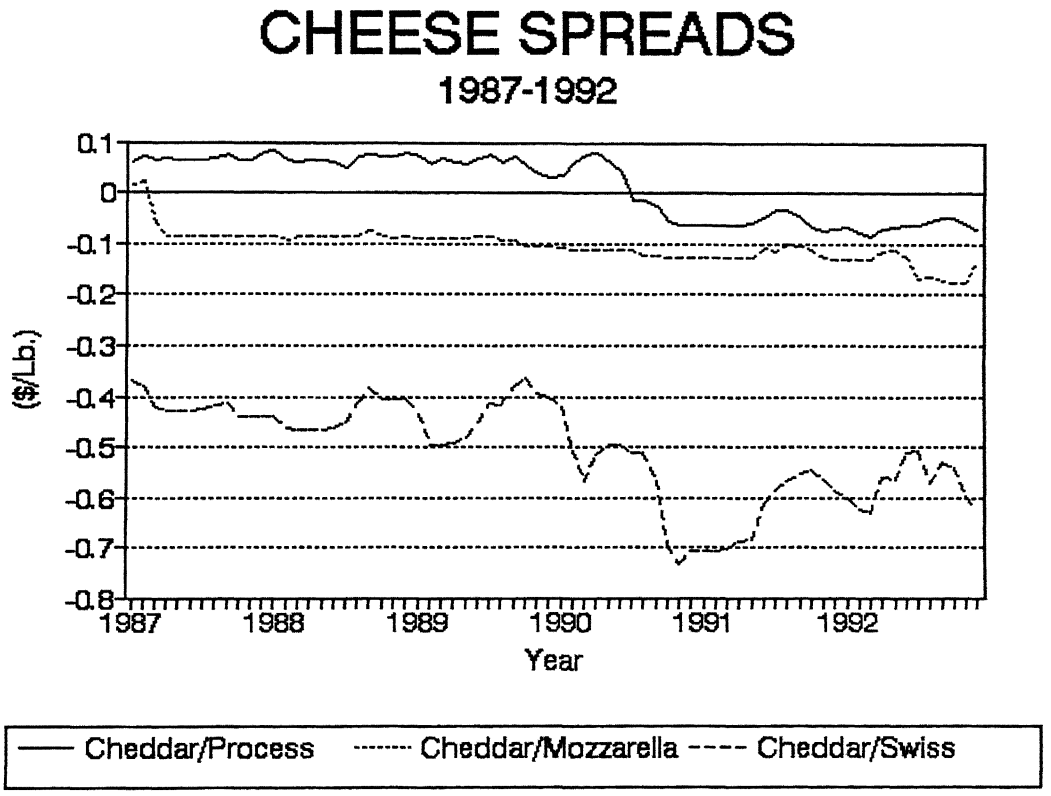
- The smaller standard deviations of the cheese spreads suggest that cross hedging mozzarella, process, and Swiss cheeses in a cheddar cheese futures contract may reduce the price variability faced by mozzarella, process, and Swiss cheese processors.

- The ability to successfully cross-hedge increases the potential trading volume of a cheddar cheese futures contract, as well as its usefulness to the cheese processing industry.

Table 4.1 Standard Deviation of Selected Monthly Cheese Prices and Spreads, U.S., 1987-1992.

Cheese/Spread	Standard Deviation of Price/Spread
	(¢/lb.)
Cheddar	9.7
Mozzarella	11.6
Process	13.3
Swiss	14.6
Cheddar/Mozzarella Price Spread	3.3
Cheddar/Process Price Spread	6.2
Cheddar/Swiss Price Spread	9.9

SOURCE: Original Calculations and U.S. Department of Agriculture's Dairy Market News



ANALYSIS OF MILK PROCESSING SPREADS

OVERVIEW-PRICE CORRELATIONS: Over the 1981-1992 period, the monthly price of cheddar cheese, nonfat dry milk, and butter had a correlation of 0.97, 0.71, and 0.28 with the monthly price of milk. A correlation of 1.0 would indicate perfect positive movement between two prices. Thus, the correlations between milk and cheddar cheese and milk and nonfat dry milk suggest that purchasing (selling) a cheese or nonfat dry milk contract would be equivalent to purchasing (selling) milk. A milk processor buys milk to sell cheese and nonfat dry milk. Thus, the high positive price correlations suggest processors are unlikely to trade the new cheddar cheese and nonfat dry milk futures contracts. This finding begs a question: Do the milk processing spreads have sufficient variability to be potentially traded on futures markets?

SPREAD CALCULATIONS: Gross return for processing 100 pounds of milk into 10.1 pounds of cheese was calculated as: [price of cheddar cheese (40-pound block, Wisconsin assembly point) in cents per pound times 10.1 pounds] minus [average U.S. price of milk used for manufacturing in cents per pound times 100 pounds]. Gross return for processing 100 pounds of milk into 8.13 pounds of nonfat dry milk and 4.48 pounds of butter was calculated as: [price of butter (Central States) in cents per pound times 4.48] plus [price of nonfat dry milk (Grade A, Chicago) in cents per pound times 8.13 pounds] minus [price of milk in cents per pound times 100 pounds]. These two spreads were calculated over the 1981-1992 period.

Three agricultural spreads traded on futures markets also were calculated: soybean processing (soybeans, soybean meal, soybean oil), hog feeding (corn, soybean meal, live hogs), and cattle feeding (corn, feeder cattle, live cattle). These three spreads were calculated using nearby futures prices on the first trading day of each month over the 1981-1991 period.

Price variability was calculated for each of the five spreads as: standard deviation of the spread divided by the average spread. Due to substantial seasonal variation in these spreads, the percent variability of the spreads was adjusted for seasonal fluctuations.

RESULTS: Price variability in the milk processing spreads increased substantially between 1981-1985 and 1986-1992 (Table 5.1). Variability of milk-to-cheese and milk-to-butter/nonfat dry milk spreads were 27% and 65%, respectively, during 1986-1992. Price variability of the spreads exceeds price variability of milk and the milk products. Variability of the soybean processing spread, the most commonly traded spread, exceeded 40% during both subperiods. Variability of the cattle and hog feeding spreads ranged from 25% to 35%.

IMPLICATIONS

- Because milk, cheddar cheese and nonfat dry milk prices tend to closely move together, milk processors are likely to use the cheddar cheese and nonfat dry milk futures contracts only as part of a processing spread.

- Variability of the milk-to-cheese and, especially, the milk-to-butter/nonfat dry milk spread suggests that these two spreads could possibly be traded on a futures market. Milk and butter futures contracts would need to be developed.

Table 5.1 Variability of Monthly Cattle Feeding, Hog Feeding, Milk Processing, and Soybean Processing Spreads, U.S., 1981-1991.

Spread	Spread Variability[a]		
	1980-1991	1981-1985	1986-1991
	- - - - - - - - - - % - - - - - - - - - -		
Cattle Feeding	31	34	25
Hog Feeding	34	35	29
Soybean Processing	69	41	61
Butter/Nonfat Dry Milk Processing[b]	41	8	65
Cheese Processing[b]	23	12	27

a. Price variability is defined as the standard deviation divided by the average spread.
b. These spreads are calculated for 1986-1992 and 1981-1992.

SOURCE: Original Calculations and U.S. Department of Agriculture, Dairy Situation and Outlook Report