FORECASTING FARM LOAN RATES: SOME LOW-COST APPROACHES

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by

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Abstract: Futures is shown to be useful in a "cross-forecast" evaluation, i.e. a futures price is used to improve the prediction of an asset other than its underlying one. In particular, addition of U.S. T-bill futures in the information set of a model of farm nonreal estate loan rates improved out-of-sample forecasts. A model using the futures (basis) forecasting approach commonly used to predict prices in agricultural commodity markets was successful in predicting interest rates in agricultural loan markets. The results were robust when tested over three different periods.

Futures are often used to predict prices in agricultural commodity markets. Farming requires farmers to make business decisions based on their price expectations, such as sell forward, sell spot, store, or hedge in derivative markets.

Success in farming also requires well-informed decisions in agricultural credit markets. Farmers must decide whether to finance their operations with equity or some debt-equity combination, to speed up or delay a major investment, to finance an investment with one long-term vs. several shorter-term loans, to finance with a fixed or variable interest rate. Interest rate expectations play a role in all of these decisions.

The purpose of this paper is to see if interest rate futures can contribute to a better-informed forecast in agricultural credit markets.

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Forecasting Farm Prices with the Basis

By definition, the basis is the difference between a local spot price and the nearby futures price:

(1) BASIS = LOCAL SPOT PRICE - NEARBY FUTURES PRICE

While the above equation is used by some researchers and the Chicago Board of Trade (CBOT), others prefer: basis = nearby futures price - spot price. This paper will use the CBOT definition.

Given that spot prices are the local price for immediate delivery, there exists a different basis for each local market. The futures price used is that commodity's nearby futures price with respect to the timing of the local spot price (i.e. the futures contract for that commodity which will expire at least one month following the month in which the spot price was observed).

For example, if the local spot price wheat for August 10, 1997 is $1 per bushel and the settle futures price for October 1997 delivery is $1.15 per bushel, then the futures price for October is the one used to calculate the local basis (-$0.15 = $1.00-$1.15).

Farmers usually keep historical records of their bases during their respective marketing periods. They use their average basis for a particular date to make a forecast of the future basis, called the expected basis, for that later date in the marketing period. Methods vary as to how far back or what particular past bases are used to calculate the average basis for a particular week in the marketing horizon. For example, a forecast of the future basis made on March 1997 might be calculated as:

(2) E(BASIS) 1ST Wed. AUG 1997 = AVERAGE OF BASES 1ST WED AUG 1994-96

If the average of the past three year's (1994-1996) bases for the first week in August was -15 cents per bushel, then the farmer's expected basis for the first week of August 1997 is $1.03/bu.

It is important to note that many different methods have been used to calculate an average, and therefore expected, basis. These methods are usually offered without any justification, and no method has been shown to be consistently preferable.

The current day's settle futures price for the delivery month immediately following the relevant marketing month plus the expected basis is then used to give the farmer a predicted spot price for that particular week in his marketing horizon:

(3) E(SPOT PRICE) = NEARBY FUTURES PRICE + E(BASIS)

A farmer who wishes to predict the future spot price for his spot marketing period can use this simple formula to generate a series of forecasts for different days or more usually, a representative day for each week in his marketing horizon.

For example, if on May 1, 1997 the farmer wishes a forecast of the corn spot price in the 1st week in November 1997, he adds his average basis for the first week of November (= -$0.07 per bu., meaning that on average the corn spot price in the first week of November is 7 cents less or under the settlement price of the December futures price) to the May 1, 1997 corn settle futures price for December 1997 delivery (269 cents per bu., which is used as the May 1st prediction of what the December settle futures price will be in the first week of November):

(4) E(SPOT PRICE) = 269 cents per bu. + (-7 cents per bu.) = 262 cents per bu.

Hence, any production or marketing decisions made on May 1 relying on an expected spot price could use $2.62 per bu. as that expectation.

In this manner, the futures market can be used to generate a series of expected spot prices for each week of the marketing horizon (each differing according to the expected basis for that week) for the farmer's local market.

The fact that the mathematics is simple, that futures price information is both public and practically free, and that the method is well-understood from its long use in farm commodity price forecasting, makes it a relatively low-cost approach to consider adapting for use in farm credit markets.

This paper will evaluate this same simple approach to forecasting the cost of debt in agricultural credit markets by contrasting it to some other simple, commonly used, low-cost approaches.

Literature Review: Forecasting Prices and Interest Rates with Futures

The basis approach to forecasting prices has been extensively tested in agricultural commodity markets. Most research has shown the futures or basis approach to either outperform or perform at least as well as the forecast performance of econometric models and experts (Peck; Hauser et al; Irwin; Tomek).

T-bill interest rate futures have performed well in forecasts of U.S. T-bill spot rates when contrasted to the forecasts derived from forward rates and naive models (Howard; McDonald and Hein; Hafer and Hein; Kamara).

All the above-cited research on basis forecasting as well as other research on futures (non-basis) forecasting has evaluated the forecasting accuracy or efficiency of a futures contract in forecasting the future cash price of its underlying asset.

This paper will further the above research by testing whether futures might be used to improve the forecasts of a different but related asset; which I refer to as "cross-forecasting". Here, whether interest rates futures (U.S. T-bills) might be used to successfully cross-forecast interest rates on nonreal estate loans made in the agricultural sector.

Method

"Spot prices" will consist of quarterly average effective interest rates on nonreal estate farm loans ("all loans" category) made by commercial agricultural banks (agricultural banks are those that have a proportion of farm loans, both real estate plus nonreal estate, to total loan that is greater than the unweighted average of all commercial banks, usually around 16%) from 1977 through 1994. These effective interest rates on new farm nonreal estate loans are from a quarterly survey conducted by the Federal Reserve for the first full week of the second month of each quarter.

I use the T-bill futures market to derive an implied forward price for T-bills with a 90-day maturity (the futures contract calls for delivery of a 91-day T-bill although the futures price is for a 90-day T-bill). "Nearby Futures Price" consists of the expected yield calculated from the settle futures price for U.S. T-bill (International Monetary Market of the Chicago Mercantile Exchange) for delivery in the month following the month of the Fed's farm loan rate survey. This settle futures price and hence yield is based on the average settle futures price for the 5 days of the first full week of the second month of each quarter, concurrent with the Fed's farm loan rate survey.

For example, the average settle futures price for the first full week of the second quarter of 1994 (November 7-11, 1994) was 94.52, which is interpreted as a discount of 100-94.52 = 5.48. Then the price per $100 of par value is:

(5) $$100 - 5.48(90/360) = 98.63.$$

The yield on the purchase of a 90-day T-bill at 98.63 is:

(6) $$(100/98.63)^{365/90} - 1 = 0.0575 \text{ or } 5.75\%$$

This can be interpreted as the expected yield on a 90-day T-bill purchased on the futures contract's expiration day (Chance pp. 302-304).

The yield is subtracted from the farm loan interest rate for that quarter to give that quarter's basis. Carrying on from the previous example, the farm loan rate for the 4th quarter of 1994 was 8.3%, yielding a 1994 4th-quarter basis of:

(7) $$8.3\% - 5.75\% = 2.55\%$$

In this paper, two means of calculating the expected basis and therefore the expected loan rate will be used: 1) a moving average basis (MBAS) where the average for the 4 quarters previous to the forecasted quarter is used as the expected basis; and 2) a seasonal basis (SBAS) where last year's actual basis for the same quarter is used as the expected basis (e.g. use the basis observed in the 1st quarter of 1991 is the expected basis for the 1st quarter of 1992). These two methods are commonly used in the trade and in commodity price forecasting literature.

For example, assume it is the third week in November 1994. If the average of the four bases for the four quarters of 1994 is 2.85% and on the day the forecast is made the settle futures price for March 1995 T-bill gives a yield of 5.75%, then that day's forecast for the 1st quarter of 1995 nonreal estate loan rate, E(RATE) is:

$$\text{(NEARBY T-BILL FUTURES YIELD)} + \text{E(BASIS)} = \text{E(RATE)}$$

$$5.75\% + 2.85 = 8.6\%$$

Forecasts from the two basis models will be contrasted to forecasts issued by models relying solely on information contained in the forecasted series: 1) a naive model (next quarter's loan rate is same as this quarter's); and 2) a "trend is your friend" model (next quarter's loan rate is equal to this quarter's plus the change between this quarter and last quarter). In addition, forecasts will be issued by a composite model with its forecasts generated as an average of the forecasts issued by the first four models.

Quarterly data will cover the period from 1979 through 1994. One-quarter-ahead forecasts will be made, evaluated, and contrasted for all five models over three different periods (12 forecasts by each model for 1980-1982; 20 forecasts by each model for 1983-1987; and 20 forecasts by each of the five models for 1988-1992). These periods were chosen in order to test the robustness of the results over three different periods and to allow a comparison with the results of a similar study using U.S. T-bill futures to forecast U.S. T-bill spot rates by Hafer and Hein. Monetary policy was thought to be influenced by monetary aggregates behavior during 1980-1982 and by interest rate behavior during 1983-1987 period. A total of 52 forecasts will be generated out-of-sample by each models starting for the first quarter of 1978 to the fourth quarter of 1992. Forecasts will be evaluated on the basis of root mean squared error (RMSE), mean absolute percentage error (MAPE), and mean absolute error (MAE).

Results

Based on the overall ranking for all three periods, where each forecast technique (rmse, mape, mae) is assigned equal weight, consideration of interest rate futures improved predictions of farm loan rates. MBAS outperforms the NAIVE model in all three periods (Tables 1 - 3). This finding holds over very different periods of interest rate volatility.

The Ashley et al. test for significance was conducted on the rmse of all models, allowing a contrast (at the 5% l.o.s.) between the rmse of each model within the same period. The Ashley test showed the rmse of the MBAS model to be significantly lower in variance than the NAIVE model for 1980-1982; and no significant difference between the rmse of the two forecast models for 1983-1987 and 1988-1992.

The Composite model (COMP) ranked 2nd in the overall forecast competition, consistent with previous literature which usually finds a composite forecast model tends to rank highly when contrasted to the forecast performance of the models' used to create the composite forecast. In fact, COMP issued a significantly lower rmse (w.r.t. bias) in the second period than did MBAS; which was the only observation in which a model issued forecasts with significantly lower rmse than MBAS.

The results were similar, both with regard to the futures models' ability to forecast in contrast to a naive model and in the size of the forecast errors observed, to the ones observed by Hafer and Hein who used U.S.T-bill futures to forecast U.S. T-bill spot rate one-quarter ahead for the 1980-1982 and 1983-1987 periods.

Evaluation of each model's mean forecast errors (not shown), indicate the model's forecasts were biased downwards in the first period, i.e. the models generally under-predicted the loan rate by 23 basis points. In the second and third period's, the models generally over-predicted the loan rate; 11 basis points in the second period and about 10 basis points in the third period.

Attempting to improve performance by adjusting the models' forecasts in the second period for the bias observed in the first period would have probably resulted in a larger bias in the forecasts. This was probably due to the great difference in the interest rate processes in the 1980-1982 period versus the 1983-1987 period. However, the similarity of the bias between the second and third periods suggest use of this second period bias to recalibrate the forecast models in the third period could have reduced the bias.

Conclusions

This paper is distinguished from previous research in two ways:

(1) It tests a forecast approach commonly used to forecast prices in commodity markets to forecasting interest rates in agricultural loan markets; and

(2) A futures price is evaluated in its ability to forecast an asset other than the one underlying the futures contract; i.e. a "cross forecast".

Interest rate futures was successfully used in a "cross forecast". A simple forecast procedure, amenable to back-of-the-envelope calculation and commonly used to predict prices in agricultural commodity markets, was successful in improving the prediction of one-quarter ahead of nonreal estate loan rates in agricultural credit markets. Specifically, U.S. T-bill futures, using a basis forecast approach, issued superior forecasts to those issued by a naive model of farm nonreal estate loan rates.

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Table 1. Forecast Results 1980:1-1982:4

MODELS	RMSE	MAE	MAPE	Overall Rank
NAIVE	183 (3)	150 (3)	9.25 (3)	3
TREND	312 (5)	236 (5)	14.97 (5)	5
MBAS	117 (1)	88 (1)	5.34 (1)	1
SBAS	223 (4)	189 (4)	11.66 (4)	4
COMP	168 (2)	134 (2)	8.29 (2)	2

Ranks for each criteria are presented in ().
Overall rank is based on the lowest score when the ranks of rmse, mae, and mape are summed for each of the 5 models.
Results are based on 12 out-of-sample forecasts of quarterly interest rates on nonreal estate farm loans made by commercial banks from 1980:1 through 1982:4.
Root Mean Squared Error (rmse) and mean absolute error (mae) are all in basis points (where 1 basis point is 1/100 of 1 percent). Mean Absolute Percentage Error (MAPE) is in percentages.
Forecast error = actual - forecast

Table 2. **Forecast Results 1983:1-1987:4**

MODELS	RMSE	MAE	MAPE	Overall Rank
NAIVE	56 (2)	49 (3)	3.94 (3)	3
TREND	72 (4)	58 (4)	4.68 (4)	4
MBAS	62 (3)	47 (2)	3.77 (2)	2
SBAS	106 (5)	75 (5)	6.23 (5)	5
COMP	54 (1)	43 (1)	3.45 (1)	1

Ranks for each criteria are presented in ().
Overall rank is based on the lowest score when the ranks of rmse, mae, and mape are summed for each of the 5 models.
Results are based on 20 out-of-sample forecasts of quarterly interest rates on nonreal estate farm loans made by commercial banks from 1983:1 through 1987:4.
Root mean squared error (rmse) and mean absolute error (mae) are all in basis points (where 1 basis point is 1/100 of 1 percent). Mean absolute percentage error (mape) is in percent terms.
Forecast error = actual - forecast

Table 3. Forecast Results 1988:1-1992:4

MODELS	RMSE	MAE	MAPE	Overall Rank
NAIVE	59 (2)	49 (3)	4.90 (3)	3
TREND	86 (5)	70 (5)	6.83 (5)	5
MBAS	57 (1)	43 (1)	4.22 (1)	1
SBAS	77 (4)	62 (4)	6.03 (4)	4
COMP	59 (3)	47 (2)	4.72 (2)	2

Ranks for each criteria are presented in ().
Overall rank is based on the lowest score when the ranks of rmse, mae, and mape are summed for each of the 5 models.
Results are based on 20 out-of-sample forecasts of quarterly interest rates on nonreal estate farm loans made by commercial banks from 1988:1 through 1992:4.
Root mean squared error (rmse) and mean absolute error (mae) are all in basis points (where 1 basis point is 1/100 of 1 percent).
Mean absolute percentage error (mape) is in percentage terms.
Forecast error = actual - forecast