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FORECASTING PERFORMANCE OF STORABLE AND NON-STORABLE COMMODITIES

Scott Daniel, Ted Schroeder, and Kevin Dhuyvetter*

This study examines the relationship between the futures price at the time of the production/placement decision and the price at the time of the harvest/marketing decision for the storable commodities corn, soybean, and wheat and non-storable commodities, fed cattle and hogs. Additionally, a model is employed to identify determinants of the error associated with the use of a springtime futures price as a forecast for the harvest period price of corn, soybeans, and wheat. Results indicate that the springtime futures price is a biased forecast for the harvest price of corn, soybeans, and wheat. However, the price forecast is an unbiased estimate for the price of cattle and hogs during the marketing period. The predictability of supply and demand estimates and the time period of the price forecast for the storable commodities are significantly related to the error associated with the forecast.

Introduction

Decoupling of payments from production instituted by *the Federal Agricultural Improvement and Reform Act of 1996* (i.e., Freedom to Farm), means agricultural producers must now manage more according to market-driven factors than in the past. The restructuring of the farm bill to eliminate price-sensitive deficiency payments and establish fixed payments to farmers for the principal commodity crops implies that agricultural producers can no longer rely on the high levels of support the government has provided in the past. Consequently, producers must look to other sources in establishing price and income risk management strategies. The futures market is one means by which producers manage price risks. Given the current structure of farm policy, more producers may now consider use of the futures market as an avenue for risk management.

At any point in time the futures market offers a forecast of future prices. If futures markets are efficient, the established futures price incorporates all available information. Therefore, producers seeking a price forecast upon which to base their management decisions will likely find the futures price as reliable as any other forecast. Producers consider futures prices when developing price expectations and making resource allocation decisions (Gardner; Chavas, Pope, and Kao; Eales et al.). If the futures price provides an inaccurate or biased forecast then decisions made based upon that forecast may result in less than optimal resource

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allocations. Therefore, forecast performance of the futures price is a significant factor in the effectiveness of agricultural futures markets.

Even if the futures market is efficient, this does not necessarily mean price forecasts based on futures are accurate (Tomek). Knowledge of the variables affecting the error from the price forecast may allow us to improve the accuracy of the forecast. However, if the errors from the futures price forecast are entirely random then it is not possible to systematically account for the errors.

Several studies have examined the relationship between corn and soybean futures prices at harvest and the prices of the contracts during the previous planting period (Tomek and Gray; Kenyon, Jones, and McGuirk; and Zulauf et al.). Examining the 1952-1968 period, Tomek and Gray concluded that the springtime futures price for a harvest period contract was an unbiased estimator of the harvest cash price for corn or soybeans. However, the same measure of forecast performance applied to potatoes, a commodity not easily stored across growing seasons, revealed that the springtime price of the harvest contract was neither unbiased nor consistently accurate as a forecast for the harvest price. Further, they concluded that markets for storable commodities tend to provide more reliable forecasts than those of non-storable commodities because the futures price serves as a source of price stability for the non-storable commodity rather than a measure of inventory allocation as is the case for storable commodities.

Kenyon, Jones, and McGuirk found similar results to those of Tomek and Gray with regard to the accuracy of the springtime price of harvest futures as a forecast for harvest time price between 1952 and 1968. However, Kenyon, Jones, and McGuirk also concluded that the forecasting accuracy of springtime futures has declined in more recent years, specifically 1974-1991. They attributed the decline in forecasting performance principally to errors in forecasting crop yield and the impacts of government loan rates. In addition, they noted that loan rates limit potential price movements and consequently, increase the price forecasting accuracy of the springtime price. This would imply that in our current situation of less government price influence, we might expect the forecasting ability of springtime futures to be less accurate than in the past.

Zulauf et al. concluded that model specification affected whether the springtime futures price was an unbiased estimator of the harvest price. When they used a price-level model similar to those of Tomek and Gray and Kenyon, Jones, and McGuirk, they determined that the springtime price was an unbiased estimator in the corn market for two different time periods, but biased in the soybean market over the 1973 to 1997 period. However, when a percent-change model was employed, results indicated that the springtime price was an unbiased estimator in both markets and over both time periods. Given the non-stationarity often present in futures prices, Zuluaf et al. favored the percent-change model over the price-level model as the better estimator of the relationship between springtime and harvest prices. Similar to Kenyon et al., results from Zulauf et al. indicate that the forecasting ability of new crop futures has diminished in more recent years. Thus, even if futures markets are efficient, there remains some discrepancy as to the predictive ability of springtime futures and hence their usefulness to producers in making production and marketing decisions.

Considering that there remains some discrepancy as to whether the springtime futures price is unbiased or accurate as a forecast and the extent to which it has changed over time, this paper seeks to further explore the area. First, this analysis uses the framework discussed by

Tomek and Gray to examine the storable commodities, corn, soybeans, and wheat and the predictive performance of the futures price at the time of the planting decision as an estimate of the harvest period price. Similarly, the predictive performance of the futures price at the approximate time of the placement/purchase decision for the selling period price in the cattle and hog markets is examined. Finally, the paper assesses factors in the grain markets determining the error resulting from the use of the harvest contract, springtime futures price as a forecast for the harvest period price.

Econometric Methods

The following relationship describes the model specified by Tomek and Gray and subsequently used by others to estimate the springtime futures price of the harvest period contract as a forecast for the harvest time price:

$$F_{t,h} = \alpha + \beta F_{t,p} + \varepsilon_t. \qquad (1)$$

$F_{t,h}$ is the price of futures in year t during the expiration month of the harvest or marketing period (h) and $F_{t,p}$ is the price of futures prior to the expiration month near the time of the production/placement decision (p). Previous analyses have used various estimates for the springtime and harvest prices, but they typically use a daily settlement price in the spring for $F_{t,p}$ and a daily settlement price during the expiration month for $F_{t,h}$. For December corn futures, Tomek and Gray used the settlement price on April 30th as the springtime price and the settlement price on the last day of the contract as the harvest time price. Kenyon, Jones, and McGuirk used prices on April 15th and December 15th while Zulauf et al. used settlement prices on May 1st and December 1st as the spring time and harvest time quotes. Zulauf et al. noted that results do not appear to be sensitive to dating assumptions and thus, the alternative dating choices do not affect the comparison of results across analyses. In this analysis, a weekly average for the settlement price is used rather than the settlement price on a specific date. The harvest quote is determined as the weekly average closing price in the week ending on or near the 15th of the expiration month and the springtime quote is the weekly average closing price 36 weeks prior to the expiration week. The settlement price in the 36th week approximately coincides with the planting time decision for the grains, the farrowing decision in hogs, and the growing/backgrounding decisions for cattle.

In equation 1, the null hypothesis is that $\alpha=0$ and $\beta=1$ and thus, the expected harvest price of futures is equal to the springtime price of the harvest futures. If alpha is significantly different from zero and/or beta is significantly different from one, then the springtime price forecast is a biased estimator of the harvest price. The null hypothesis is evaluated with the joint F-test for bias. The R^2 from equation 1 provides an estimate of the explanatory power of the springtime price quote for the harvest period quote and the greater the R^2 the closer the relationship between the two prices (Tomek and Gray).

The mean value of the error term (ε_t) in equation 1 is expected to be zero. However, for a specific period, it is likely that the error may be different from zero. If there are systematic variables that significantly influence the level of error associated with the use of the springtime price as a forecast for the harvest price then knowledge of these variables may reduce the error associated with the futures price forecast. The error associated with the price forecast may be assessed by multiple definitions. One method of defining futures price forecast error is the absolute percentage forecast error (APFE), defined as:

$$APFE_t = \left| (FP_{t,h} - FP_{t,p}) / FP_{t,h} \right| * 100. \qquad (2)$$

The APFE is evaluated each week for the 36 weeks prior to the specified expiration week and across 24 years (1975 to 1998).

With determination of the APFE, a set of variables closely linked to the production characteristics of the underlying commodity is used to generate an explanatory model for the APFE. The following model was specified to analyze the relationship:

$$APFE = f(\%\Delta\text{Stocks-to-Use}, \text{Week}, \text{Week}^2, FB96, FB90, FB85, FB81, FB77, FB73). \qquad (3)$$

Because the dependent variable is a difference variable, we also differenced the variable representative of the estimated supply and demand relationship. The %ΔStocks-to-Use incorporates the principal measures of supply and demand for the specified crop. The stocks-to-use ratio provides an estimate for the relationship between the market supply of a commodity and the level of demand in the market. Periods with a high stocks-to-use ratio are typically associated with lower prices and periods with a low stocks-to-use ratio are normally associated with higher prices. The percentage change in the stocks-to-use estimate is calculated as:

$$\%\Delta\text{Stocks-to-Use}_t = \left| (\text{St-to-U}_{t,h} - \text{St-to-U}_{t,p}) / \text{St-to-U}_{t,h} \right| * 100. \qquad (4)$$

The absolute percentage change in the stocks-to-use variable represents a change in the supply and demand estimates from one month to the next and provides a measure of the ability to forecast supply and demand. Therefore, we would expect that an inaccurate springtime forecast of the harvest period stocks-to-use ratio would increase the error associated with use of the springtime futures price as a forecast for prices in the harvest period.

The Week and Week^2 variables establish the time horizon for the forecast error. At the time of expiration, all information should be incorporated in the futures price and as a result, the forecast error is zero in the expiration week. However, as the time horizon moves away from the expiration week, less information is available to the futures market, resulting in greater errors in the price forecast. The time horizon is modeled as a non-linear relationship because as the price forecast is further removed from the expiration week the increase in the forecast error is marginal.

FB96, FB90, FB85, FB81, FB77, and FB73 are dummy variables to establish comparisons in the forecast errors under the various farm bills. Policies resulting from a change in the farm bill are implemented with the start of the new marketing year. However, information concerning the new farm bill is known in the springtime and producers will make decisions about the new crop based on the impending farm policy. As a result, dummy variables are assigned to each farm bill according to the calendar year in which crop production occurs. The dummy variable assumes a value of one for the farm bill that coincides with the date of the specific error observation and a value of zero otherwise (e.g. FB96=1 from 1996-1998 and zero for all other dates).

Data

Time series price data from 1975 to 1998 for corn, soybeans, wheat, cattle, and hogs are used to evaluate the forward pricing efficiency of the various futures contracts. Data on the weekly average closing price of the December contract for 36 weeks prior to the week ending on or near the 15th of December were collected from the *CRB-Bridge* database for the corn, live cattle, and lean hog futures contracts. Similarly, data on the November contract were collected for soybeans and the July contract for KC wheat futures. To evaluate the forecast performance of the springtime futures price, the weekly average closing price in week zero was used as the harvest price and the weekly average closing price in week 36 (roughly the first week of April in corn, cattle, and hogs; the first week of March in soybeans; and the first week of November in wheat) provided the estimate for the production period price. Estimates of ending stocks and total use for U.S. corn, soybeans, and wheat for the period 1975-1998 were taken from the *World Agricultural Supply and Demand Estimates* and used in the calculation of the stocks to use ratios.

Figures 1-5 illustrate the relationship between springtime futures price and the closing futures price during the 1975-1998 period for corn, soybeans, cattle, and hogs and wheat. Examination of the figures reveals that the forecast week tracks most closely with the expiration week for live cattle futures while the relationship between the forecast week and expiration looks similar among corn, soybeans, wheat, and hogs. Therefore, we might expect that the live cattle futures would outperform the other commodities when serving as a price forecast. Further, it appears that prices in the corn and hog markets tend to possess the greatest variability during the period. Summary statistics corresponding to the prices in figures1-5 are provided in Table 1. The mean, standard deviation, minimum, and maximum of the forecast price, expiration price, and the absolute percentage forecast error are listed for each commodity. The mean forecast price is higher in the spring than the price at harvest for all commodities except cattle. Therefore, it would likely benefit producers to implement hedging strategies prior to the harvest/marketing period. Observing the range of prices, the variation between the minimum and maximum prices is greater at harvest than during the forecast period for soybeans, wheat, cattle, and hogs but not for corn. Thus, prices tend to be lower and more variable during the harvest/marketing period relative to the forecast period. Hogs and corn have the greatest APFE during the period followed closely by soybeans and wheat. However, if we drop the large error that occurred in the hog market in 1998, the APFE for the hog price forecast is reduced considerably from 17.89% to 12.86%. Hence, the downward spiral of prices the hog market experienced during 1998 had a drastic effect on the ability of the futures market to predict the marketing period price.

Figure 6 illustrates the absolute percentage forecast error calculated for the 36th week prior to the expiration week for each commodity by year. The magnitude of errors tends to be relatively similar over the period for all commodities with the exception of the hog market in 1998. To illustrate the impact of the large price forecast error for hogs in 1998, Figure 7 plots the APFE excluding errors for each commodity in 1998. Consistent with the mean statistics in

Table 1, the errors are most variable in the hog, corn, and wheat markets while the least variable in the cattle market. This is likely due to horizon between the forecast and the expiration periods. The production cycle for hogs is much shorter than that of cattle so hog producers still have a significant impact on the supply of hogs at 36 weeks prior to expiration whereas the calf crop has been established long before this period. However, the decision to place cattle in the feedlot has not typically occurred at 36 weeks prior to expiration so there still is some uncertainty as to the supply of cattle and consequently the effect on the price. Similarly, a price forecast in the grain markets, 36 weeks prior to expiration occurs approximately at the time of the production/planting decision. Consequently, there is less information in the futures market concerning the available supply, resulting in greater variability in the price forecast. Hence, it appears that the closer to the forecast is to the production decision, the greater the potential for large errors.

Regression Results

The regression results from estimating equation (1) for corn, soybeans, wheat, cattle, and hogs for the period 1975-1998 are listed in Table 2. The null hypothesis of unbiased forecasts (i.e. $\alpha=0$ and $\beta=1$) produces mixed outcomes when tested against the results in Table 2. Results from the F-test of joint significance indicate that we should reject the null hypothesis in the corn, soybean, and wheat markets. Thus, the intercept (α) and the slope (β) are significantly different from zero and unity, respectively. Consequently, springtime prices of the harvest contracts for corn, soybeans, and wheat provide biased estimates of the harvest price during the 1975-1998 period. This would imply that if the model in (1) is the correct specification, then the springtime price is not a good forecast for the harvest period price and it might be possible to formulate a price forecast that is more reliable than the futures market. The joint F-test for the slope and the intercept was insignificant for the cattle and hog markets. Therefore, we would conclude that the price forecast 36 weeks prior to contract expiration provides an unbiased estimate of the price during the marketing period. However, results must be interpreted with caution. Results are often sensitive to large unexpected shocks, frequently referred to as an "outlier" problem. Such events occur very infrequently, but can have a significant effect on the magnitude of the slope coefficient as estimated by OLS. Consequently, tests that indicate forecasts are biased or inefficient may not be entirely accurate but merely that the market cannot anticipate these unexpected shocks. On the other hand, the hypothesis tests may be accurate and the markets biased as reflected above.

The R^2 values are similar for all commodities except for cattle, where it is significantly higher than the other commodities. The R^2's for corn, wheat, and cattle tested statistically different from zero at the 5% level. While insignificant at the 5% level, the R^2 for the hog equation is significant at the 10% level the R^2 for wheat is significant at the 12% level. The higher R^2 for cattle may be attributable to the time of the price forecast in relation to the length of production. A price forecast 36 weeks prior to expiration closely coincides with the time of the production decision for corn, soybeans, wheat, and hogs but the production decision made by the cow-calf producer occurs well beyond 36 weeks from the futures contract expiration. As a result, a price forecast in the cattle market 36 weeks prior to expiration presumably contains more information relating to supply and demand factors than forecasts in the other commodity markets.

Our results vary somewhat from those of comparable analyses over similar time periods. Kenyon, Jones, and McGuirk concluded that there was not a statistically significant relationship between the springtime forecast and the harvest price in either the corn or soybean market between 1974 and 1991 (i.e. the R^2's were insignificant). Using a price-level model, Zulauf et al. determined that the springtime price was a biased estimator in the soybean market between 1973 and 1997 but concluded that the springtime price forecast for harvest corn prices was unbiased. However, R^2's for both equations were insignificant at the 5% level and thus, there was not a statistically significant relationship between the springtime and harvest period prices.

The model discussed in (3) was estimated for corn, soybeans, and wheat and results are reported in Table 3. The relationship between absolute percentage change in the stocks-to-use ratio was statistically significant (at the 5% level) and as expected for the corn market but insignificant for soybeans and wheat. Hence, the ability to forecast supply and demand does not appear to have a considerable impact on the price-forecast errors in the soybean and wheat markets. It may be that the markets are realizing information prior to the USDA reports and consequently, information contained in the reports is of marginal value. Results indicate that a decrease in the ability to estimate the supply and demand for corn will decrease the performance of the price forecast, yielding larger errors. However, the effect of the stocks-to-use ratio is relatively small. For example, for corn, a one-percent increase in the ability to estimate the supply and demand results in a 0.3 percent reduction in the forecast error.

The variables employed to account for the relationship between the time horizon and the price forecast, Week and $Week^2$, were significant determinants for all three commodities. Figure 8 illustrates the relationship between the forecast error and the forecast horizon. The graph plots the weeks to contract expiration versus the absolute percentage error for all three crops. The impact of the time between the price forecast and the contract expiration is similar across the three crops considering the errors are contained within a small range even in the 36th week from expiration. In an efficient futures market, the market incorporates new information as it becomes available and adjusts commodity prices accordingly. Thus, new information is continually contributed to the market as time moves closer to the harvest period allowing the accuracy of the price forecast to improve and the magnitude of the forecast error to decline.

Given that the 1996 (Freedom to Farm) farm bill allows producers greater flexibility in their production and marketing decisions, we would expect price variability to increase and the forecast errors to be significantly greater due to the new policy. Results are consistent with this expectation in the corn and wheat markets. For corn, significantly greater errors in the price forecast coincided with the 1981, 1990, and 1996 farm bills relative to farm policy in 1973, with the greatest impact occurring in the years under the 1996 farm bill. For wheat, errors were statistically lower in years under the 1981, 1985, and 1990 farm programs but significantly higher under the 1996 farm bill. In soybeans, errors were statistically lower in years under the 1985, 1990, and 1996 farm bills. The reduced errors in recent years in the soybean market may be attributable to introduction of a marketing loan for soybeans in accordance with the 1985 farm bill that still remains effective. Kenyon, Jones, and McGuirk indicated that loan rates serve to limit price movements and increase price-forecasting accuracy with respect to springtime futures. Consequently, because there was no loan program associated with the soybean market prior to

1985, introduction of the marketing loan may have reduced forecast errors relative to farm policy in 1973. Conversely, movement in the corn and wheat markets from more restrictive non-recourse loans to marketing loans might imply that potential price movements have increased and thus we would expect a decrease in the price-forecasting accuracy of the springtime futures price.

Examining the R^2 for the regression estimations, the relatively low values for all three commodities indicate that the model does not yield a high degree of explanatory power for the price-forecast error. Hence, it may be that the specified model does not fully recognize all of the determinants for the forecast error. This may be due to the absence of one or more explanatory variables. Given that an error in a price forecast is an unexpected result, it is difficult to systematically predict either the level or the direction of an error.

Conclusions and Implications

This analysis evaluates the performance of weekly average closing futures price in the production/placement period as a price forecast for the forthcoming harvest/marketing period for corn, soybeans, wheat, hogs, and fed cattle. Regression equations are estimated using a forecasting model similar to those employed by Tomek and Gray; Kenyon et al.; and Zulauf et al. A second model is estimated to identify determinants of the errors associated with price forecasts formulated for corn, soybeans, and wheat. Results of the first model indicate that the springtime futures price may be a biased forecast of harvest prices in the corn, soybean, and wheat markets, but a futures price prior to the marketing period provides an unbiased estimate of the marketing period price for fed cattle and hogs. Further, the R^2 values associated with the empirical estimation were relatively low with the exception of the fed cattle market, indicating a weak relationship between the prices of the two time periods in the corn, soybeans, wheat, and hog markets. Estimation of the second model reveals that changes in the information contained in the stocks-to-use ratio effect the price-forecast error only in the corn market. The time at which the price forecast occurs is significantly related to the magnitude of the forecast error. Price forecast errors were significantly higher in years under the market-oriented 1996 farm bill for the corn and wheat markets while forecast errors have declined in the soybean market during the years under the three most recent farm bills.

The ability to use planting (placement/purchase) time futures prices, as a harvest (selling) period price forecast is a simple and important tool employed by agricultural producers. However, even in an efficient futures market, if futures prices do not provide a relatively accurate estimate of harvest prices or if the accuracy is changing over time, then this price forecast may be less reliable and greater risk management is necessary. Because production decisions are being made according to market conditions more today than at anytime in the past, it is important for producers to know if the signals they get from the futures market are more or less accurate than in the past. The recent changes in farm policy yield commodity markets that are more closely associated with supply and demand factors. This analysis indicates that the futures price alone may not provide a reliable price forecast in the corn, soybean, and wheat markets. Therefore, agricultural producers that use futures prices to guide their production and resource allocations should hedge these markets at the time these decisions are made.

References

Chavas, J., R. Pope, and R. Kao. "An Analysis of the Role of Futures Prices, Cash Prices, and Government Programs in Acreage Response." *Western Journal of Agricultural Economics*. 8 (July 1983): 27-33.

Eales, J.S., B.K. Engel, R.J. Hauser, and S.R. Thompson. "Grain Price Expectations of Illinois Farmers and Grain Merchandisers." *American Journal of Agricultural Economics*. 72 (August 1990): 701-708.

Gardner, B.L. "Futures Prices in Supply Analysis." *American Journal of Agricultural Economics*. 58 (February 1976): 81-84.

Kenyon, D., E. Jones, and A. McGuirk. "Forecasting Performance of Corn and Soybean Harvest Futures Contracts." *American Journal of Agricultural Economics*. 75 (1993): 399-407.

Tomek, W.G. "Commodity Futures Prices as Forecasts." *Review of Agricultural Economics*. 19 (1997): 23-44.

Tomek, W.G., and R.W. Gray. "Temporal Relationships Among Prices on Commodity Futures Markets: Their Allocative and Stabilizing Roles." *American Journal of Agricultural Economics*. 52 (1970): 372-380.

World Agricultural Outlook Board. "World Agricultural Supply and Demand Estimates." U.S. Department of Agriculture, World Agricultural Outlook Board, Washington, D.C. Various Issues.

Zulauf, C., S. Irwin, J. Ropp, and A. Sberna. "A Reappraisal of the Forecasting Performance of Corn and Soybean New Crop Futures." *Journal of Futures Markets*. Forthcoming 1999.

Figure 1. Weekly Avg Close of Dec Corn Futures the Second Week of December (Expiration) and 36 Weeks Prior (Forecast), 1975-1998

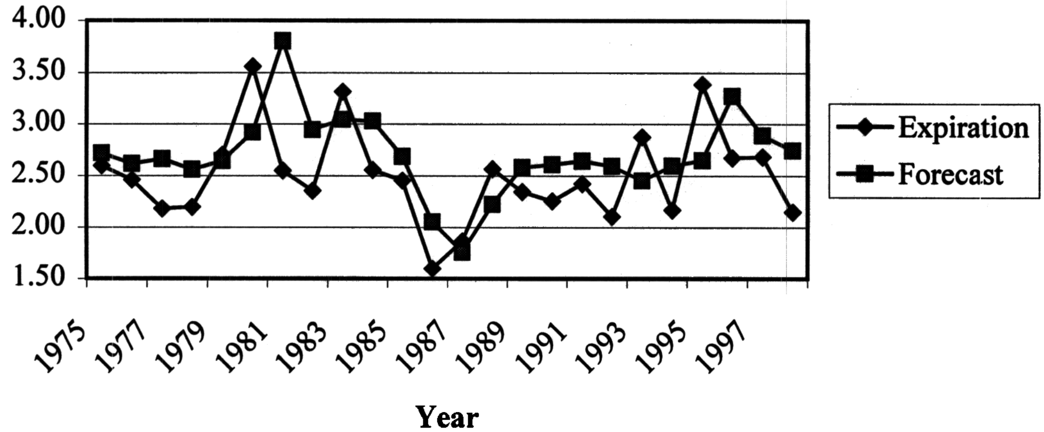

Figure 2. Weekly Avg Close of Nov Soybean Futures the Second Week of December (Expiration) and 36 Weeks Prior (Forecast), 1975-1998

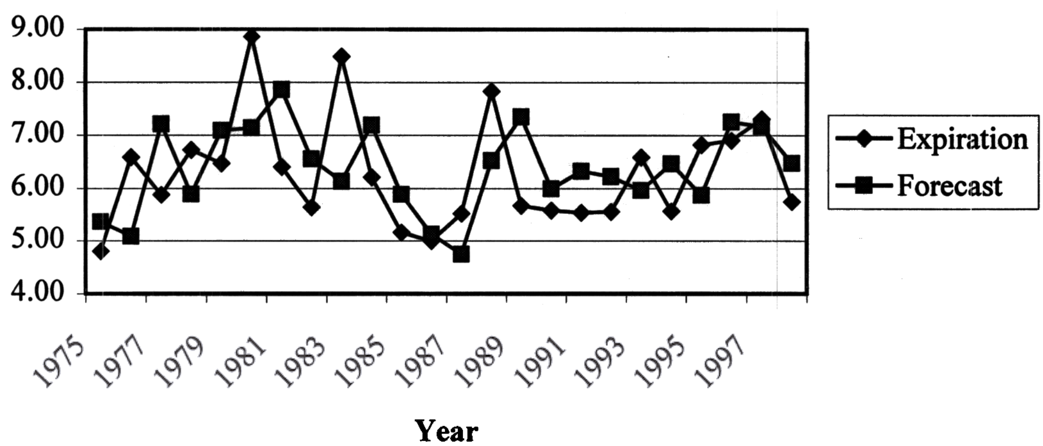

Figure 3. Weekly Avg Close of July Wheat Futures the Second Week of July (Expiration) and 36 Weeks Prior (Forecast), 1975-1998

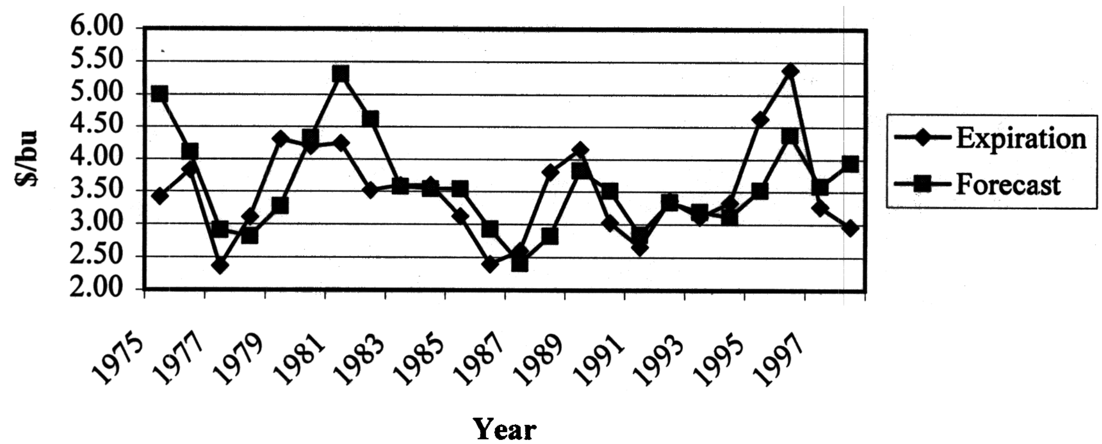

Figure 4. Weekly Avg Close of Dec live Cattle Futures the Second Week of December (Expiration) and 36 Weeks Prior (Forecast), 1975-1998

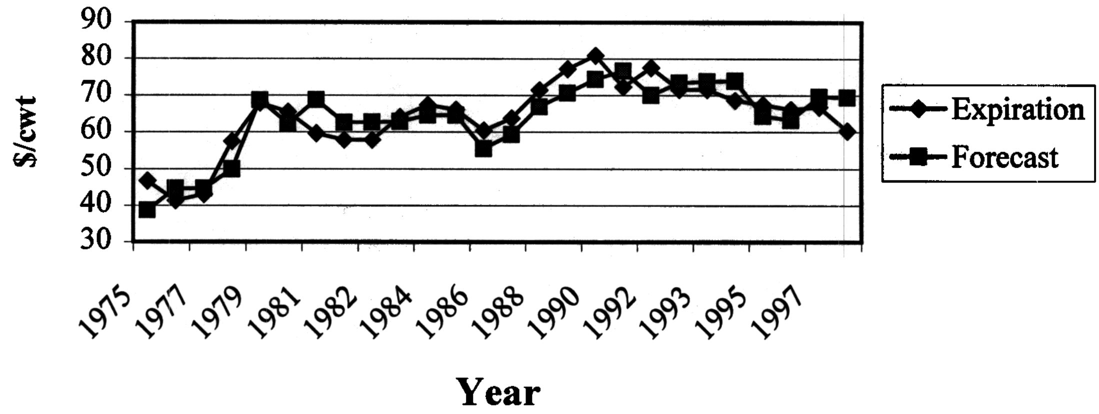

Figure 5. Weekly Avg Close of December Hog Futures the Second Week of December (Expiration) and 36 Weeks Prior (Forecast), 1975-1998

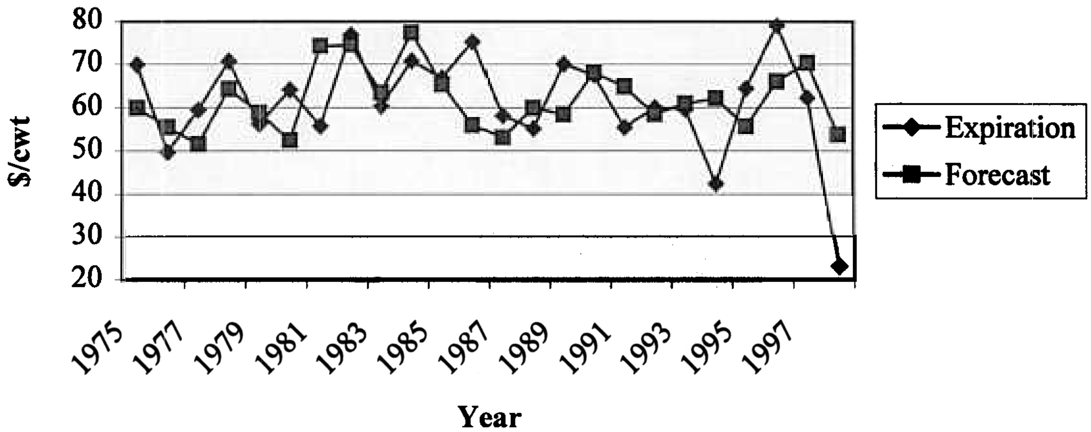

Table 1. Summary Statistics for Corn, Soybean, Wheat, Cattle, and Hog Prices, 1975-1998

Commodity	Statistic	Unit	Mean	Standard Deviation	Min	Max
Corn	Forecast Price	$/bu	2.69	0.40	1.76	3.81
	Expiration Price	$/bu	2.50	0.45	1.60	3.56
	APFE	Percent	16.68	10.31	2.26	49.36
Soybeans	Forecast Price	$/bu	6.37	0.81	4.75	7.86
	Expiration Price	$/bu	6.28	1.04	4.80	8.86
	APFE	Percent	14.62	7.07	1.92	29.60
Wheat	Forecast Price		3.60	0.73	2.41	5.31
	Expiration Price	$/bu	3.50	0.73	2.37	5.38
	APFE	Percent	15.24	12.03	0.54	46.11
Cattle	Forecast Price	$/cwt	63.68	9.87	38.68	76.65
	Expiration Price	$/cwt	64.23	9.74	41.34	80.83
	APFE	Percent	7.05	4.29	1.17	17.28
Hogs	Forecast Price	$/cwt	61.88	7.22	51.60	77.32
	Expiration Price	$/cwt	61.36	11.92	23.03	79.04
	APFE	Percent	17.89	26.79	0.95	133.56

Table 2. Estimated Relationships between the Harvest Futures Price and the Springtime Futures Price for Corn, Soybeans, Wheat, Cattle, and Hogs, 1975-1998

Commodity	α	β	R^2	F-test $\alpha= 0, \beta=1$
Corn	1.1148 (0.0746)[a]	0.5139 (0.0282)	0.2005	5.1118*
Soybeans	3.5669 (0.0435)	0.4265 (0.1022)	0.1094	2.5340*
Wheat	1.5631 (0.0272)	0.5377 (0.0068)	0.2887	3.6163*
Cattle	9.8599 (0.1423)	0.8538 (0.001)	0.7490	1.2092
Hogs	25.2641 (0.2308)	0.5834 (0.329)	0.1249	0.8248

N = 24
[a] P-values of the respective coefficient are listed in parentheses
* Indicates significance at the 5% alpha level

Table 3. Regression between Absolute Percentage Forecast Error and Stocks-to-Use, Forecast Horizon, and Farm Bills for Corn, Soybean, and Wheat Harvest-Time Contracts, 1975-1998

Crop	Variable	Parameter Estimate	Standard Error	P-Value
Corn	Intercept	-1.0870	1.0947	0.3210
	%ΔStocks-to-Use	0.1549	0.0406	0.0001
	Week	0.6335	0.0938	0.0001
	$Week^2$	-0.0065	0.0024	0.0085
	Farm Bill 77	-0.6233	1.0667	0.5591
	Farm Bill 81	5.6202	1.0724	0.0001
	Farm Bill 85	-0.0254	1.0391	0.9805
	Farm Bill 90	2.1769	1.0437	0.0373
	Farm Bill 96	2.9878	1.1216	0.0079
$R^2 = 0.3402$				
	Intercept	3.3324	0.8965	0.0002
	%ΔStocks-to-Use	0.0091	0.0183	0.6192
	Week	0.6077	0.0772	0.0001
	$Week^2$	-0.0064	0.0020	0.0014
	Farm Bill 77	-0.3638	0.8648	0.6741
	Farm Bill 81	1.1750	0.8690	0.1767
	Farm Bill 85	-3.5063	0.8412	0.0001
	Farm Bill 90	-3.6364	0.8233	0.0001
	Farm Bill 96	-3.5483	0.9429	0.0002
$R^2 = 0.3724$				N = 887
	Intercept	4.9783	1.0081	0.0001
	%ΔStocks-to-Use	-0.0153	0.0274	0.5732
	Week	0.6128	0.0949	0.0001
	$Week^2$	-0.0079	0.0025	0.0018
	Farm Bill 77	-0.7601	0.9841	0.4401
	Farm Bill 81	-5.4052	0.9833	0.0001
	Farm Bill 85	-4.2828	0.9172	0.0001
	Farm Bill 90	-4.7232	0.8777	0.0001
	Farm Bill 96	3.3388	1.0048	0.0009
$R^2 = 0.2456$				

Figure 6. Absolute Percentage Forecast Error for Corn, Soybeans, Wheat, Cattle, and Hogs, 1975-1998

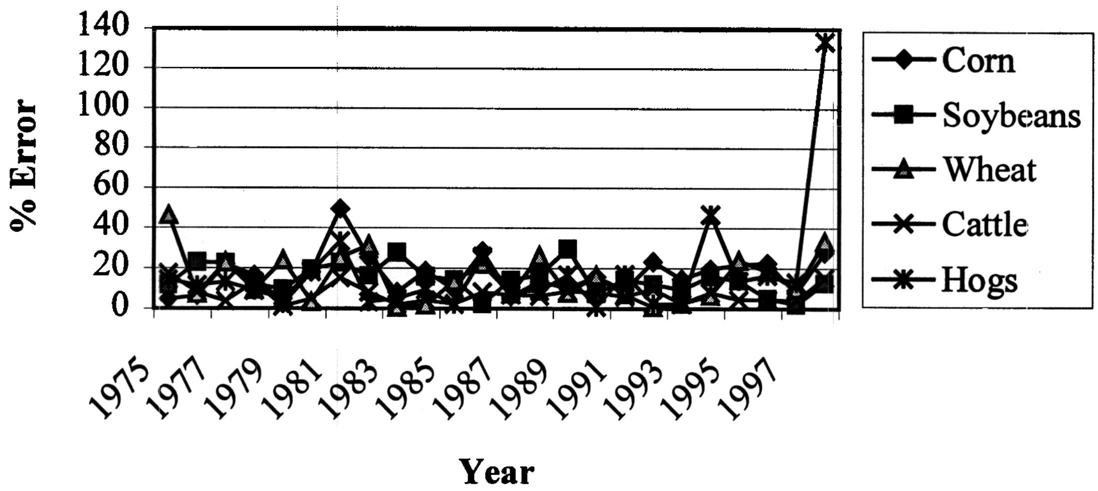

Figure 7. Absolute Percentage Forecast Error for Corn, Soybeans, Wheat, Cattle, and Hogs, 1975-1997

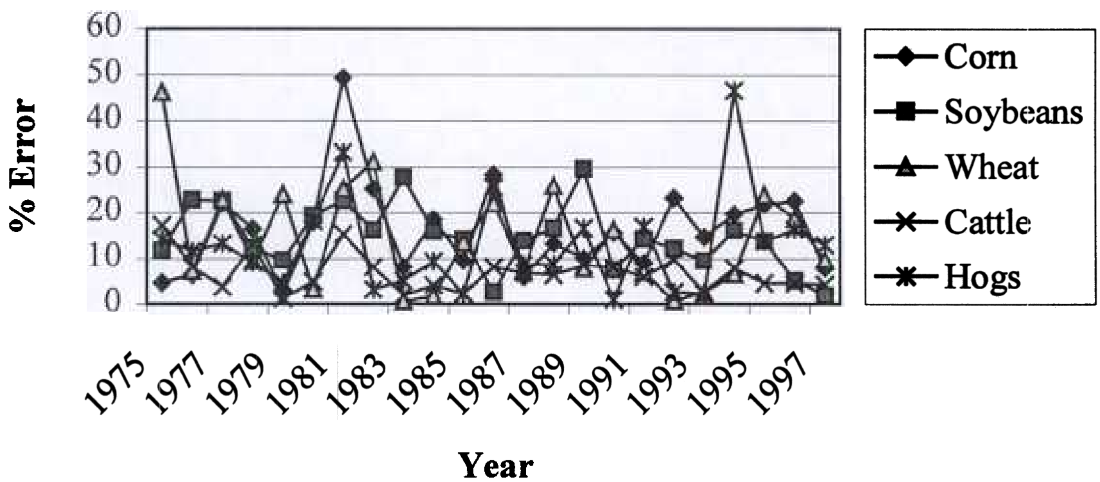

Figure 8. Predicted Percentage Forecast Error by Week to Contract Expiration for Dec Corn, Nov Soybeans, and July Wheat