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Information Content in Deferred Futures Prices: Live Cattle and Hogs

Dwight R. Sanders, Philip Garcia, and Mark R. Manfredo

The informational content in live cattle and hog deferred futures prices is assessed using a direct test of incremental forecast ability for two- to twelve-month horizons. For 1976–2007, the results indicate that hog futures prices add incremental information at all horizons, but unique information in live cattle prices declines quickly beyond the eight-month horizon with no incremental information at the twelve-month horizon. The contrast in performance is likely attributable to differences in the quality of public information and the nature of the production process.

Key words: forecast evaluation, forecast information, futures markets

Introduction

Futures prices play a key role in production and consumption decisions in agriculture (Gardner, 1976; Hurt and Garcia, 1982), and are often touted as useful and low-cost price forecasts for agribusiness firms making economic decisions (Kastens, Jones, and Schroeder, 1998). Given the reliance on futures prices as forecasts, it is critical to understand their forecasting performance. Indeed, optimal and efficient forecasts can enhance social welfare by improving economic decisions (Stein, 1981; Kenyon, Jones, and McGuirk, 1993). Forecast users, depending on their information needs, are likely to desire futures price forecasts at varying horizons. For instance, agribusinesses making strategic production decisions are likely to need longer-term price forecasts commensurate with their decision-making horizon. In this light, it is especially important to understand the forecasting performance of deferred futures contracts.

A large collection of research exists on futures market efficiency and forecasting (Tomek, 1997; Garcia and Leuthold, 2004). A majority of the research focuses on semi-strong form efficiency by comparing futures forecast accuracy to that of an alternative forecasting model such as time-series and econometric models (Leuthold et al., 1989), commercial services (Just and Rausser, 1981), and forecasts produced by other market experts such as extension economists (Irwin, Gerlow, and Liu, 1994; Sanders and Manfredo, 2005).

Dwight R. Sanders is associate professor of agribusiness economics, Southern Illinois University, Carbondale; Philip Garcia is professor of agricultural and consumer economics, the University of Illinois, Urbana-Champaign; and Mark R. Manfredo is associate professor, the Morrison School of Agribusiness and Resource Management, Arizona State University. The authors thank the participants of the 2007 NCCC-134 Conference on Applied Price Analysis, Forecasting, and Market Risk Management for their helpful comments and suggestions.

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For agricultural commodities, the overall results of these studies are mixed depending on the markets examined and alternative forecasting methods (Garcia, Hudson, and Waller, 1988). Generally speaking, futures pricing efficiency has been rejected most often using ex post forecasts generated by the researchers' own models and in the livestock markets. In particular for livestock markets, Irwin, Gerlow, and Liu (1994) report there is evidence of forecast inefficiency, especially at longer forecast horizons, which is consistent with earlier findings by Leuthold and Hartmann (1979), and Leuthold et al. (1989). Sanders and Manfredo (2005) also document the potential for inefficiency in deferred fluid milk futures when testing forecast efficiency in an encompassing framework.

On balance, prior research suggests nearby futures provide largely efficient forecasts, but less conclusive evidence exists for the forecasting efficiency of deferred futures prices, especially in livestock markets. Interestingly, most of the livestock studies have focused on efficiency and have not considered directly the extent to which deferred contracts can provide information to firms about the subsequent movement of prices. If futures prices are only adding information for the first six months of listed contracts, then there may be little justification for using more deferred futures in decision making. By isolating horizons at which there appears to be little added information, it may indicate reasonable limits and expectations for futures-based forecast horizons. In addition, the results may provide insight into the relative scarcity of public information available to the marketplace for forming longer-term expectations.

In this research we assess the information content of deferred futures prices for two non-storable commodities—live cattle and hogs—using a direct test for incremental forecast ability proposed by Vuchelen and Gutierrez (2005). Specifically, at different forecast horizons we assess the following question type: If the April futures price is at $75 and the June futures are priced at $77, do the June futures provide any additional information relative to the April futures with regard to the subsequent price in June? or is the June price simply reflecting a random adjustment to the information contained in the April futures price? The results offer a unique perspective on the information provided by deferred futures prices for these non-storable commodities.

It is important to note that this research is not testing for futures market efficiency per se, since the futures forecasts are not compared directly to alternative forecasting models. Instead, the procedure merely uses the nearby futures prices as a reference point, and tests for any additional information contained in deferred futures prices at different horizons. In effect, the presented methods provide a unique way of analyzing futures market forecasts. Given futures-based forecasts are generally believed to be the best forecasts available (Tomek, 1997), we are able to identify directly how they perform at alternative horizons.

Here, we seek to determine the maximum horizon at which the marketplace is incorporating unique information into market prices. Agribusinesses that utilize futures prices as forecasts will better understand the effective horizon of their futures-based forecasts. If futures forecasts derived from deferred contracts are found to contain no unique information relative to forecasts derived from more nearby contracts, it may call into question the quality of public information often used by futures market participants [e.g., the U.S. Department of Agriculture's (USDA's) *Hogs and Pigs Report* and *Cattle on Feed* report, and other public information].

A Direct Test for Information

Traditionally, forecast efficiency has been tested with the following regression:

$$A_{t+1} = \alpha + \beta F_t^{t+1} + u_{t+1}, \tag{1}$$

where A_{t+1} is the realized value at time $t + 1$, F_t^{t+1} is the forecast for time $t + 1$ made at time t, and u_{t+1} is the error term. The conventional test of forecast rationality is performed using the joint null hypothesis of a zero intercept ($\alpha = 0$) and unitary slope coefficient ($\beta = 1$). Moreover, an efficient forecast is characterized by an i.i.d. error term with no serial correlation in u_{t+1}.

Holden and Peel (1990) have shown that the traditional joint null hypothesis is a sufficient, but not necessary, condition for rationality. Therefore, a rejection of the null hypothesis in (1) does not lead to clear alternative statements about forecast properties. Given this, Granger and Newbold (1986) advise researchers to focus strictly on the forecast error terms, and a number of studies have employed these methods (see Pons, 2000). While this approach is informative with respect to forecast quality, it says little about information content.

Vuchelen and Gutierrez (2005) develop a direct test for information content by writing forecasts as simply the sum of consecutive adjustments to the most recent observation. A one-period-ahead forecast can be decomposed into the following components:

$$F_t^{t+1} = A_t + (F_t^{t+1} - A_t), \tag{2}$$

and for the two-step-ahead forecast,

$$F_t^{t+2} = A_t + (F_t^{t+1} - A_t) + (F_t^{t+2} - F_t^{t+1}). \tag{3}$$

From (2), it is clear that the one-step-ahead forecast can be expressed as a simple adjustment to the current level. The one-step-ahead forecast, F_t^{t+1}, is equal to the current level, A_t, plus the expected change or adjustment from the current level, $F_t^{t+1} - A_t$. Likewise, in (3), the two-step-ahead forecast, F_t^{t+2}, is equal to the current level, A_t, plus the forecasted change from the current level ($F_t^{t+1} - A_t$) and the forecasted adjustment in the following period ($F_t^{t+2} - F_t^{t+1}$).

Vuchelen and Gutierrez (2005) develop a direct test by substituting the decomposition in (2) into (1) to obtain a one-step-ahead expression:

$$A_{t+1} = \theta + \kappa A_t + \lambda(F_t^{t+1} - A_t) + u_{t+1}. \tag{4}$$

In (4) we can see that A_{t+1} is equal to A_t (the previous period's value) plus $F_t^{t+1} - A_t$ (the forecasted change in value) plus a random error, u_{t+1}. This representation provides a wealth of information about the forecast's quality and information content. An unbiased and efficient forecast is characterized by $\theta = 0$ and $\lambda = \kappa = 1$, in which case (4) simplifies to (1). However, as shown by Vuchelen and Gutierrez, for a forecast to contain information only requires that $\lambda \neq 0$. In the sense that the framework allows for testing of both optimal properties and information content simultaneously, it provides a more revealing and comprehensive examination of forecast performance. The test for information content is perhaps more interesting in the case of multiple step-ahead forecasts.

Following Vuchelen and Gutierrez (2005), the test equation for two-step-ahead forecasts is developed by substituting equation (3) into (1):

$$A_{t+2} = \gamma + \delta A_t + \eta(F_t^{t+1} - A_t) + \varepsilon(F_t^{t+2} - F_t^{t+1}) + u_{t+2}. \tag{5a}$$

In (5a) an unbiased forecast is tested under the null that $\gamma = 0$, and $\delta = \eta = \varepsilon = 1$. Again under this null hypothesis, equation (5a) simplifies to the two-step-ahead version of (1). Note, however, equation (5a) tells us whether F_t^{t+2} provides information relative to A_t, the most recent observation, and F_t^{t+1}, the one-period-ahead forecast. If $\varepsilon = 0$, the two-step-ahead forecast does not provide any incremental information over the one-step-ahead forecast. This is more easily observed by again substituting (2) into (5a) and simplifying:

$$A_{t+2} = \gamma + \phi F_t^{t+1} + \mu(F_t^{t+2} - F_t^{t+1}) + u_{t+2}. \tag{5b}$$

In (5b) the null hypothesis that F_t^{t+2}, the two-step-ahead forecast, adds no incremental value to F_t^{t+1}, the one-step-ahead forecast, is tested under $\mu = 0$. Through repeated substitution, a direct test for k-step-ahead forecasts can be written:

$$A_{t+k} = \beta_1 + \beta_2 F_t^{t+k-1} + \beta_3(F_t^{t+k} - F_t^{t+k-1}) + u_{t+k}. \tag{5c}$$

In equation (5c) the null hypothesis that F_t^{t+k}, the k-step-ahead forecast, adds no incremental value to F_t^{t+k-1}, the $k-1$ step-ahead forecast, is tested under $\beta_3 = 0$. A more stringent rationality test requires that $\beta_3 = \beta_2 = 1$, $\beta_1 = 0$.

Equation (4) can be estimated using standard OLS procedures. However, versions of equation (5c) with $k > 1$ are characterized by overlapping forecast horizons which result in correlated forecast errors and subsequent biased and inconsistent standard errors. To remedy this problem, we follow Brown and Maital (1981) and employ the OLS coefficient estimates, but correct the variance-covariance matrix using methods proposed by Hansen (1982) and applied by Hansen and Hodrick (1980). With these methods, equation (5c) allows us to evaluate the informational content in deferred futures prices of live cattle and hogs.

Data

The direct test is applied to two traditional futures markets for non- or semi-storable commodities: live cattle and live (lean) hogs.[1] These markets are chosen because they represent the most actively traded non-storable commodities, and there is a rich literature on these markets available for comparison.[2] Moreover, there is a long history for both live cattle and hog futures contracts allowing the compilation of a relatively long time series. For both live cattle and hog futures, deferred futures contracts begin trading

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[1] Contract specifications on hog futures were altered from live hogs (physical delivery) to lean hogs (cash settlement) with the February 1997 contract. To avoid confusion, we simply refer to it as the hog futures market for both contract specifications.

[2] This research applies the method to traditional non-storable commodities (hogs and cattle). The application to storable commodities is less straightforward due to the explicit storage relationships between futures contracts within a crop year (Tomek, 1997). A possible extension to storable commodities could focus on new crop futures prices across multiple crop years.

approximately one year prior to expiration, allowing for the examination of forecasts with horizons up to twelve months ahead.[3]

Following the convention established by Tomek and Gray (1970) (see also Kenyon, Jones, and McGuirk, 1993; Zulauf et al., 1999), we assume that deferred futures prices are trying to forecast the delivery time futures price. For instance, at the end of September, the December futures quote is considered a two-month-ahead forecast for the December futures price that will exist on the first notice day for delivery (the last trading day of November). More explicitly, the futures price for the December contract at the end of September is defined as f_t^{t+2}, and the first notice day price for the December contract is a_{t+2}, or the actual realized price two months later.[4]

Consistent with this format, futures prices (end-of-day settlements) are collected on the last trading day of each month beginning twelve months prior to the first notice day. For example, the December futures contract's price at the end of November in the previous year represents a twelve-month-ahead forecast. The settlement price for the December futures contract on July 31 is the four-month-ahead forecast. Both live cattle futures and live hog futures have a contract cycle that includes the even months of February, April, June, August, October, and December. So, there are six realized or actual prices per year being forecast, which generates evenly spaced time-series observations at 60-day intervals or two-month steps. The data are collected for the February 1975 contract through the February 2007 contract, resulting in 193 observations.

Vuchelen and Gutierrez's (2005) original application examined growth rates in seasonal macroeconomic measures. Not surprisingly, the price level of livestock follows a seasonal pattern reflecting seasonality in production. For instance, pork production tends to be lowest in the early summer, resulting in seasonally high prices for hogs during that period. Following Vuchelen and Gutierrez, we focus on seasonal differences defined as the log-relative change in price from the same month of the previous year. For example, let a_t equal the actual price in month t, and f_t^{t+1} equal the one-step-ahead forecast for that price. Recalling there are six observations per year, the variables of interest are defined as $A_t = \ln(a_t/a_{t-6})$, the year-to-year percentage change in actual prices, and $F_t^{t+k} = \ln(f_t^{t+k}/a_{t+k-6})$, the forecasted percentage change in price from the previous year.[5] The conversion to year-to-year changes eliminates one year of data or six observations, reducing the final data set to 187 observations. Accounting for seasonality makes our testing more stringent as we identify whether deferred futures prices contain incremental information beyond that found in the seasonal production patterns.

Results

The independent and dependent variables used in the analysis were all found to be stationary using augmented Dickey-Fuller tests. Equation (5c) was estimated for both live

[3] There were several occasions when the twelve-month-forward futures contract had not yet been listed or traded at the end of a forecast month. In these cases the first traded price is used as the forecast. This occurred in 35 of the 193 cattle forecasts and seven of the 193 hog forecasts. Due to their infrequency and relative stability of our findings, it is unlikely that these observations have a material impact.

[4] Lower case variables, f and a, refer to price levels. Consistent with (5c), upper case variables, F and A, refer to log-relative price changes which are used in estimation procedures.

[5] The live hog futures ceased with the December 1996 contract. Starting in February 1997, the contract represents lean hog prices. The year-over-year actual and forecasted price changes in 1997 were calculated after multiplying the lean hog futures price by the standard yield factor of 0.74.

cattle and live hog futures forecasts at the two-, four-, six-, eight-, ten-, and twelve-month forecast horizons.[6] The coefficients are estimated using OLS with the standard errors adjusted for overlapping horizons incorporating Hansen's (1982) procedure. From equation (5c), we test two hypotheses. First, a rational and unbiased forecast is tested under the null hypothesis that $\beta_2 = \beta_3 = 1, \beta_1 = 0$. Then the primary focus of this research is examined with the test of $\beta_3 = 0$, the null hypothesis of no incremental information at the forecast horizon. When the null hypothesis is rejected, there is evidence of unique information contained in deferred futures price forecasts (k-step-ahead forecasts) relative to the more nearby forecast ($k - 1$ step-ahead forecast).

The live cattle estimation results for the full sample and at all forecast horizons are shown in panel A of table 1. At the two-month horizon the null hypothesis of a rational forecast is rejected at the 5% level. Examining the individual coefficient estimates, it is clear the rejection stems from a rejection that $\beta_3 = 1$ (5% level, two-tailed t-test). This finding suggests the two-month-ahead futures forecasts are not properly scaled [$\beta < 1$ in equation (1)]. Hence, the futures market may not be efficiently incorporating information into the forecast (Nordhaus, 1987). However, there is little doubt that the two-month-ahead forecast is providing unique information, as $\beta_3 = 0$ is rejected at conventional significance levels. Consequently, at the two-month horizon there is evidence showing the live cattle futures price forecast is inefficiently utilizing information, but at the same time providing unique information to the marketplace.

At the four-month horizon, a rational null hypothesis is again rejected. Yet, four-month-ahead live cattle futures prices are providing incremental information not found in the two-month-ahead forecast ($\beta_3 = 0$ rejected at the 5% level). For example, at the end of January, the June live cattle futures price (four months ahead) is providing unique information that cannot be obtained by simply using the April futures price (two months ahead). Importantly, because this method is using year-to-year actual and forecasted changes, we are controlling for seasonality, which strengthens the result. The additional information provided by the futures forecasts is beyond that found in seasonal price patterns.

Similar results are found at the six-, eight-, and ten-month horizons for live cattle (table 1). At each forecast horizon, forecast rationality is rejected, yet deferred prices provide unique information. However, as evidenced by the declining magnitude of the estimated β_3 coefficient, the ability of the deferred futures prices to provide unique information decays quickly beyond the eight-month horizon. At the eight-month horizon the β_3 is estimated at a statistically significant 0.7048, but at the ten-month horizon declines to a still statistically significant 0.5496. At the twelve-month horizon, β_3 is estimated at 0.2648, which is not statistically different from zero at the 5% level. This finding reveals that the twelve-month-ahead live cattle futures price is not providing any statistically significant information beyond that contained in the ten-month-ahead futures price. This result is consistent with findings reported by Irwin, Gerlow, and Liu (1994) who suggest that longer horizon livestock futures prices may not provide a great deal of forecasting ability.

[6] Since the time series are spaced at 60-day (two-month) intervals, a one-step-ahead forecast is a two-month-ahead horizon. The method is then applied to the two-, four-, six-, eight-, ten-, and twelve-month-ahead horizons, representing the spacing of delivery months.

Table 1. Information Test for Live Cattle[a]

PANEL A: 1976–2007 (*N* = 187)

	Horizon					
Coefficient	2-Month	4-Month	6-Month	8-Month	10-Month	12-Month
β_1	0.0061	0.0136	0.0182	0.0229	0.0258	0.0270
	(0.0050)	(0.0072)	(0.0095)	(0.0121)	(0.0141)	(0.0154)
β_2	0.9769	0.9517	0.8956	0.6810	0.6333	0.5410
	(0.0689)	(0.1034)	(0.1348)	(0.1572)	(0.1590)	(0.1917)
β_3	0.7682	0.7275	0.7335	0.7048	0.5496	0.2648
	(0.0884)	(0.0789)	(0.0905)	(0.0923)	(0.1254)	(0.1642)
$\beta_2 = \beta_3 = 1, \beta_1 = 0$	0.0111	0.0000	0.0001	0.0011	0.0004	0.0000
$\beta_3 = 0$	0.0000	0.0000	0.0000	0.0000	0.0000	0.1086

PANEL B: 1976–1991 (*N* = 96)

	Horizon					
Coefficient	2-Month	4-Month	6-Month	8-Month	10-Month	12-Month
β_1	0.0071	0.0167	0.0223	0.0305	0.0373	0.0404
	(0.0080)	(0.0142)	(0.0182)	(0.0227)	(0.0267)	(0.0292)
β_2	0.9745	0.9517	0.9245	0.7907	0.6935	0.5545
	(0.0743)	(0.1526)	(0.2016)	(0.2344)	(0.2536)	(0.3162)
β_3	0.6845	0.7093	0.7563	0.7479	0.5879	0.2289
	(0.1064)	(0.1203)	(0.1360)	(0.1421)	(0.2036)	(0.2843)
$\beta_2 = \beta_3 = 1, \beta_1 = 0$	0.0049	0.0082	0.0788	0.1087	0.0950	0.0179
$\beta_3 = 0$	0.0000	0.0000	0.0000	0.0000	0.0049	0.4228

PANEL C: 1992–2007 (*N* = 91)

	Horizon					
Coefficient	2-Month	4-Month	6-Month	8-Month	10-Month	12-Month
β_1	0.0048	0.0096	0.0114	0.0103	0.0119	0.0121
	(0.0059)	(0.0102)	(0.0136)	(0.0169)	(0.0191)	(0.0197)
β_2	0.9908	0.9408	0.8171	0.4157	0.5002	0.4612
	(0.0838)	(0.1799)	(0.2179)	(0.2613)	(0.2497)	(0.2864)
β_3	0.9559	0.7681	0.6828	0.6374	0.4393	0.3013
	(0.1223)	(0.1362)	(0.1665)	(0.1568)	(0.1975)	(0.2307)
$\beta_2 = \beta_3 = 1, \beta_1 = 0$	0.8309	0.1163	0.1767	0.0749	0.0532	0.0162
$\beta_3 = 0$	0.0000	0.0000	0.0001	0.0001	0.0144	0.1949

Notes: Values in parentheses are standard errors. Numbers in the last two rows of each panel are the *p*-values for the stated restrictions.

[a] The direct test for *k*-step-ahead forecasts is written as $A_{t+k} = \beta_1 + \beta_2 F_t^{t+k-1} + \beta_3(F_t^{t+k} - F_t^{t+k-1}) + u_{t+k}$ [refer to text equation (5c)].

Because of the long history of data examined, it is important to test the results for sensitivity through time. We split the data set into two subperiods, 1976–1991 (96 forecast observations, table 1, panel B) and 1992–2007 (91 forecast observations, table 1, panel C), and estimate the relationships again. The 1991 break point roughly splits the sample in half, and it coincides with the accelerated concentration in the red meat industry—especially in the retail supply chain—during the 1990s (see Barkema, Drabenstott, and Novack, 2001).

Focusing on the hypothesis tests, there does not appear to be a meaningful change in performance across the two periods. In both periods the incremental performance falls off notably at the ten-month horizon and the twelve-month horizon fails to add statistically significant information. The only notable improvement is that the rationality null hypothesis ($\beta_2 = \beta_3 = 1$, $\beta_1 = 0$) is not rejected at the two-month horizon in the 1992–2007 period. Otherwise, the rationality null hypothesis is rejected at or near the 10% level at each horizon in both periods. The live cattle results are relatively consistent across these two periods, providing additional confidence in the conclusions.

The results for the hog futures market are presented in table 2, panel A. These results are strikingly different from those obtained for live cattle (table 1, panel A). The two-month-ahead hog futures prices are rational ($\beta_2 = \beta_3 = 1$, $\beta_1 = 0$) and provide unique information ($\beta_3 \neq 0$). Indeed, for all horizons there is a failure to reject the null rationality hypothesis at the 5% level. Moreover, at every horizon, we reject the null hypothesis that $\beta_3 = 0$. Therefore, unique information is being provided. Unlike the live cattle results, the hog futures prices show very little decay in the estimated β_3 across horizons. Only at the twelve-month horizon is there some visual decay in information as the estimated β_3 falls below 0.90, but it still does not statistically differ from unity (5% level, two-tailed *t*-test). Also, at the twelve-month horizon rationality is not rejected at the 5% level, but is rejected at the 10% level with a *p*-value of 0.0685. The results paint the hog futures market as a rational assimilator of unique information at each forecast horizon.

Once again the sample is split after 1991 to create two subperiods: 1976–1991 (table 2, panel B) and 1992–2007 (table 2, panel C). There are some visual differences across the estimated coefficients. For instance, the estimated β_2 is consistently less than unity in the 1976–1991 period, while the estimated β_2 is uniformly greater than one in the 1992–2007 period. However, these disparities are within the realm of random fluctuations since the hypothesis tests are consistent across the two periods. For each period, rationality of the hog futures forecasts ($\beta_2 = \beta_3 = 1$, $\beta_1 = 0$) is not rejected at the 5% level, and the null of no unique information ($\beta_3 \neq 0$) is rejected at the 5% level. Again the similarity of results across time periods lends greater confidence to the full sample findings.

Collectively, the results portray a live cattle futures market that is not particularly rational, and the amount of unique information in prices falls quickly beyond the eight-month horizon. In stark contrast, in the hog futures market the null rationality hypothesis is not rejected at any horizon, and there is unique information provided out to the twelve-month horizon. The full sample results hold across time periods, when the data are split in 1991.

Table 2. Information Test for Live Hogs[a]

PANEL A: 1976–2007 (N = 187)

Coefficient	Horizon					
	2-Month	4-Month	6-Month	8-Month	10-Month	12-Month
β_1	0.0041	0.0133	0.0209	0.0266	0.0356	0.0394
	(0.0074)	(0.0110)	(0.0150)	(0.0184)	(0.0211)	(0.0220)
β_2	1.0020	0.9964	0.9857	0.9402	0.9655	0.9861
	(0.0389)	(0.0614)	(0.0985)	(0.1271)	(0.1380)	(0.1600)
β_3	0.9516	0.9308	0.9103	0.9410	0.9145	0.8501
	(0.0808)	(0.0689)	(0.0736)	(0.0883)	(0.1082)	(0.1183)
$\beta_2 = \beta_3 = 1, \beta_1 = 0$	0.7784	0.3909	0.1989	0.4020	0.2389	0.0685
$\beta_3 = 0$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PANEL B: 1976–1991 (N = 96)

Coefficient	Horizon					
	2-Month	4-Month	6-Month	8-Month	10-Month	12-Month
β_1	0.0097	0.0183	0.0216	0.0270	0.0381	0.0395
	(0.0106)	(0.2061)	(0.0268)	(0.0316)	(0.0353)	(0.0351)
β_2	0.9484	0.8330	0.7146	0.5742	0.6745	0.6629
	(0.0543)	(0.1125)	(0.1646)	(0.1912)	(0.2141)	(0.2585)
β_3	0.8392	0.8361	0.7761	0.8119	0.8223	0.7145
	(0.0979)	(0.1205)	(0.1165)	(0.1339)	(0.1877)	(0.2056)
$\beta_2 = \beta_3 = 1, \beta_1 = 0$	0.2495	0.2730	0.1509	0.0756	0.2082	0.1969
$\beta_3 = 0$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0008

PANEL C: 1992–2007 (N = 91)

Coefficient	Horizon					
	2-Month	4-Month	6-Month	8-Month	10-Month	12-Month
β_1	-0.0022	0.0080	0.0189	0.0266	0.0325	0.0370
	(0.0095)	(0.0161)	(0.0230)	(0.0282)	(0.0347)	(0.0406)
β_2	1.0593	1.1622	1.3013	1.4455	1.3701	1.3572
	(0.0463)	(0.0889)	(0.1506)	(0.2138)	(0.2427)	(0.2824)
β_3	1.0953	1.0401	1.0750	1.1273	1.0504	1.0054
	(0.0970)	(0.1029)	(0.1207)	(0.1512)	(0.1797)	(0.2156)
$\beta_2 = \beta_3 = 1, \beta_1 = 0$	0.5994	0.2667	0.1558	0.0996	0.2708	0.3090
$\beta_3 = 0$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: Values in parentheses are standard errors. Numbers in the last two rows of each panel are the p-values for the stated restrictions.

[a] The direct test for k-step-ahead forecasts is written as $A_{t+k} = \beta_1 + \beta_2 F_t^{t+k-1} + \beta_3(F_t^{t+k} - F_t^{t+k-1}) + u_{t+k}$ [refer to text equation (5c)].

Summary, Conclusions, and Discussion

The incremental forecast information contained in deferred futures prices is evaluated using Vuchelen and Gutierrez's (2005) direct test. The test is applied to live cattle and hog futures prices for even contract months from February 1975 through February 2007. Rationality is never rejected in the hog futures market at any horizon, and the hog futures prices provide unique information at each forecast horizon out to twelve months. In contrast, rationality is always rejected in the live cattle futures market at each forecast horizon, and unique information seems to decline quickly beyond the eight-month horizon with no incremental information provided at the twelve-month horizon. The results hold across the 1976–1991 and 1992–2007 subperiods.

To some degree the overall results are better than might have been expected based on prior research. Earlier work, which focused on market efficiency tests, largely identifies a decline in ability of these markets to incorporate information beyond the six-month horizon (see Irwin, Gerlow, and Liu, 1994). In this regard, the results which show unique information in both markets out to ten months shed a somewhat more favorable light on the performance of these markets. However, the tendency for deferred live cattle futures to reject rationality may underlie some of the inefficiency found in previous studies. Indeed, the poor performance of the live cattle futures market relative to the hog futures market is consistent with early work by Martin and Garcia (1981). Still, the discrepancy in results across the two markets is surprising and somewhat confounding.

The live cattle futures market fails the rationality test, and it shows a marked decline in information content beyond the eight-month horizon. In contrast, the hog futures market does not reject rationality, and it provides unique information in even the most deferred prices. The stark difference in performance may stem from the structure of the industries coupled with the public data provided by the USDA. For example, the primary supply data source provided by the USDA for the live cattle market is the monthly *Cattle on Feed* (*COF*) report. Since cattle are in feedlots for roughly six months, it can be argued that the market has very good information about supplies (and subsequent prices) for six months ahead. Beyond that window, a lack of timely information coupled with the relatively long beef production cycle may make forecasting particularly difficult. At a minimum, it may be more complicated for the market to assimilate unique information at alternative horizons beyond six to eight months.

In the hog market, the primary USDA supply data source is the quarterly *Hogs and Pigs Report* (*HPR*). The *HPR* contains current and intermediate inventory information, such as "market inventory," similar to the *COF* report, but also contains information vital to longer-term supplies, such as "breeding inventory," not found in the *COF*. Moreover, the *HPR* provides explicit forward-looking information in the form of "farrowing intentions." Consequently, the hog market may have a richer information set for making twelve-month forecasts than is available to the live cattle futures market. Further, the farrow-to-finish production cycle is shorter and more direct than the beef production cycle—which contains varying lengths of time for weaning, backgrounding, and feeding—perhaps allowing the hog futures market to better assimilate production information in more deferred futures prices.

It is important to note that the structure of both the cattle and hog marketing systems, as well as the futures markets, changed dramatically over the sample investigated.

Despite these changes, the results are remarkably similar across the two subperiods examined (1976–1991 and 1992–2007). Indeed, the consistency of the results across the two periods suggests that the market's ability to form price expectations at longer horizons may be more closely tied to relatively unvarying factors such as the type of public information available or the inherent production lags within the industry.

From a practitioner's perspective the hog results are encouraging. Agribusinesses that use hog futures prices to make forecasts can continue to utilize futures quotes out to the twelve-month horizon. Each contract month provides unique information and is a rational forecast. More care must be taken in using the live cattle futures price for forecasts. These forecasts are not rational and the information content drops quickly beyond the eight-month horizon. While these futures-implied forecasts are quite possibly better than most alternatives, they need to be effectively rescaled to reflect their reduced forecasting ability.

The Chicago Mercantile Exchange (CME) may find our information useful when considering when to list deferred contracts. Current CME rules essentially allow new livestock futures contracts to start trading (or be listed) shortly after the same contract month of the previous year expires. This results in futures contracts being listed out for roughly twelve months. Our findings suggest that a twelve-month horizon for trading deferred live cattle futures is more than adequate, since beyond the ten-month horizon no unique information is provided. However, in light of the performance of the hog futures market, the CME may want to consider listing contracts beyond twelve months with some confidence that the futures market will provide unique information in these deferred prices. Ultimately, these longer-term, futures-implied forecasts could assist the industry through improved decision making.

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