The Market Timing Value of Outlook Price Forecasts

by

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Abstract

The purpose of this study was to conduct a comprehensive evaluation of the market timing value of outlook price forecasts. One-, two-, and three-quarter ahead hog and cattle price forecasts from the four outlook programs were examined. Results of Merton market timing tests indicate that the outlook programs generally produce valuable hog price forecasts. However, the strength of the market timing value tended to diminish as the forecast horizon increased. The performance of the outlook programs in forecasting cattle prices was not as impressive.

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Introduction

The formation of commodity price expectations is a critical problem faced by virtually all agricultural producers. In a recent survey (Smith), 80 percent of producers indicated that pricing and marketing decisions were either important or very important to the financial success of their operations.

An important purpose of outlook programs in the U.S. Department of Agriculture and State Land-Grant Colleges of Agriculture is to enable agricultural producers to develop more accurate expectations and forecasts of crop and livestock prices (Futrell, 1987). Considerable resources are devoted to these programs. For example, situation and outlook activities in the Economic Research Service of the USDA currently have a budget allocation in the range of $10 to 11 million (O'Brian).

Several studies have evaluated the accuracy of forecasts generated by these outlook programs (Baker and Paarlberg, 1952; Haidacher and Matthews, 1977; Helmers and Held, 1977; Marquardt, 1979; Just and Rausser, 1981; Moe, 1985; Aldinger, 1986). The results of these studies suggest that grain and livestock price forecasts generally are unbiased, but do not offer users any substantial improvement in accuracy over simple naive forecasts.

There are three notable concerns regarding the results of previous studies. First, and most importantly, none of the previous studies has directly tested for the market timing value of outlook program forecasts. Previous tests of accuracy have relied on statistical criteria such as mean squared error. The problem is that such tests may not account for market timing ability. That is, the crucial ability to consistently place users on the correct side of the market.

Second, previous studies generally are based on small samples that may be affected by idiosyncratic events, especially during the mid-1970s. Third, two of the studies (Haidacher and Matthews, Just and Rausser) are based on internal rather than published price forecasts. Presumably, users are most interested in the accuracy of published price forecasts.

The purpose of this study is to conduct a comprehensive evaluation of the market timing value of outlook price forecasts. Specifically, one-, two-, and three-quarter ahead hog and cattle price forecasts from the following four outlook programs are examined: University of Illinois, Iowa State University, University of Missouri, and U.S. Department of Agriculture. With the exception of University Illinois forecasts, sample periods begin in the mid-1970s and end in the late 1980s. Note that hog and cattle price forecasts are selected because: (1) they are quantitative and subject to little, if any, interpretation, and (2) relatively long samples of price forecasts are available for each of the programs and commodities.

Merton's Model of Market Timing Value

Merton's derivation of forecast value begins with a basic assumption that forecasts only have positive value if they cause rational investors to alter their expectations about the future. If there is no such alteration, all of the information contained within the forecast has already been assimilated into the market; thus, the forecast has no positive value. Merton's methodology for obtaining the value of this forecast is independent of investor's preferences, endowments, or prior assessments of an asset's return stream.

A brief description of Merton's forecast model follows. First, define a forecast variable Z_{t+1} such that $Z_{t+1} = 1$ if the forecast, made at t, for time period t+1 is that price will rise. Analogously, $Z_{t+1} = 0$ if price is forecast to stay constant or fall. Then, probabilities for Z_{t+1} conditional upon the realized change in price, M_{t+1}, are defined by:

$$p^1 = \text{Prob}\{ Z_{t+1} = 0 \mid M_{t+1} \leq 0 \} \quad (1a)$$

$$1 - p^1 = \text{Prob}\{ Z_{t+1} = 1 \mid M_{t+1} \leq 0 \} \quad (1b)$$

$$p^2 = \text{Prob}\{ Z_{t+1} = 1 \mid M_{t+1} > 0 \} \quad (1c)$$

$$1 - p^2 = \text{Prob}\{ Z_{t+1} = 0 \mid M_{t+1} > 0 \} \quad (1d)$$

Hence, p^1 is the conditional probability of a correct forecast given that $M_{t+1} \leq 0$, and p^2 is the conditional probability of a correct forecast given that $M_{t+1} > 0$. Merton assumes that p^1 and p^2 do not depend upon the magnitude of the realized change in price, M_{t+1}. Hence, the conditional probability of a correct forecast depends only on the realized direction of price change.

Under the previous assumptions, Merton proves that the sum of the conditional probabilities of a correct forecast, $p^1 + p^2$, is a sufficient statistic for evaluation of forecasting value. More specifically, Merton shows that the sum of conditional probabilities p^1 and p^2 must exceed one for a model to exhibit forecasting value. In addition, because the test statistic is $p^1 + p^2$, it is not necessary that the conditional probabilities remain constant across time, only that their sum be stationary. It is also not necessary that $p^1 = p^2$, allowing for the possibility that a model is better equipped to forecast upward market moves than downward market moves, or vice versa (Henriksson and Merton).

A simple example is helpful in illustrating Merton's market timing condition. Take the case of a model clearly without market timing ability: one that always forecasts price will rise. In this case, the conditional probability of correctly forecasting price will rise, p^2, will equal one. However, the conditional probability of forecasting price will be constant or fall, p^1, is equal to zero. Since $p^1 + p^2$ equals but does not exceed one, the model does not satisfy the necessary and sufficient condition for market timing ability.

Data

The forecast data for the study are the quarterly hog and cattle price forecasts issued by four well-known public outlook programs located at the University of Illinois, Iowa State University, University of Missouri, and the U.S. Department of Agriculture (USDA). The Illinois forecasts are drawn from issues of the *Illinois Outlook Update*. The Iowa State forecasts are compiled from issues of the *Iowa Farm Outlook*. The Missouri forecasts are drawn from issues of the *Missouri Agricultural Outlook Letter*. The USDA forecasts are drawn from issues of the *Livestock Situation and Outlook Report*.

A description of the forecast data is presented in Table 1. In all cases listed at least thirty observations are available. Some observations are missing for the two- and three-quarter ahead horizon, however, they are randomly distributed in the sample. Note that cattle price forecasts are unavailable for Illinois. Two-quarter ahead cattle price forecasts were not available for Iowa and Missouri. In addition, three-quarter

Econometric Procedures

Breen *et al.* show that Merton's test of market timing ability can be implemented in a regression framework. First, define a market direction variable $M_{t+i,j}$ such that:

$$M_{t+i,j} = 1 \text{ if } PA_{t+i,j} > PA_{t,j} \quad (2a)$$

$$M_{t+i,j} = 0 \text{ if } PA_{t+i,j} \leq PA_{t,j} \quad (2b)$$

where $PA_{t+i,j}$ is the actual price for quarter t+i (i=1,2,3) and commodity j (j=hogs, cattle), and $PA_{t,j}$ is the actual cash price for quarter t and commodity j. Next, define a forecast direction variable $Z_{t+i,j,k}$ such that:

$$Z_{t+i,j,k} = 1 \text{ if } PF_{t+i,j,k} > PA_{t,j} \quad (3a)$$

$$Z_{t+i,j,k} = 0 \text{ if } PF_{t+i,j,k} \leq PA_{t,j} \quad (3b)$$

where $PF_{t+i,j,k}$ is the forecast price for quarter t+i and commodity j by outlook program k (k=Illinois, Iowa, Missouri, USDA). Then, the following regression equation can be specified:

$$Z_{t+i,j,k} = \alpha_{i,j,k} + \beta_{i,j,k} M_{t+i,j} + \epsilon_{i,j,k} \quad (4)$$

where $\epsilon_{i,j,k}$ is a standard normal error term.

Breen *et al.* show that $\beta_{i,j,k} = p^1_{i,j,k} + p^2_{i,j,k} - 1$. As a result, if $\beta_{i,j,k}$ is significantly greater than zero, then the forecasts have met the necessary and sufficient condition for market timing value (Breen, *et al.*). That $\beta_{i,j,k} = p^1_{i,j,k} + p^2_{i,j,k} - 1$ can be seen by noting that:

$$E(Z_{t+i,j,k} \mid M_{t+i,j} = 0) = \alpha_{i,j,k} = Prob(Z_{t+i,j,k} = 1 \mid M_{t+i,j} = 0) = 1 - p^1_{i,j,k} \quad (5a)$$

and

$$E(Z_{t+i,j,k} \mid M_{t+i,j} = 1) = \alpha_{i,j,k} + \beta_{i,j,k} = Prob(Z_{t+i,j,k} = 0 \mid M_{t+i,j} = 1) = p^2_{i,j,k} \quad (5b)$$

Subtracting equation (5a) from (5b) produces the result.

A problem involved in estimating equation (4) via OLS is that serial correlation is introduced into the error term for equations corresponding to two- and three-quarter ahead forecasts. This is due to the overlapping nature of the forecasting horizons. Box and Jenkins (1976) demonstrate that such overlapping introduces a moving average process into the error term of the order i-1, where i is the forecast horizon. Newey and West (1987) have developed a covariance estimator that is consistent with respect to this type of serial correlation. This covariance estimator is used in the case of two- and three-quarter ahead forecasts.

Results

Merton market timing test results for one-quarter ahead forecasts are presented in Table 2. Noting again that $\beta_{i,j,k} = p^1_{i,j,k} + p^2_{i,j,k} - 1$, market timing is found if the slope coefficient is significantly greater than zero. The t-statistics for the slope coefficients of the Iowa, Missouri, and the USDA equations indicate significant market timing ability in forecasting one-quarter ahead hog prices. Only Illinois forecasts failed to exhibit market timing value. With a slope coefficient of 0.527, Missouri exhibits the highest degree of market timing value. More specifically, this shows that the sum of the conditional probabilities of a correct forecast (up or down) for Missouri equals 1.527.

The performance of the outlook programs in forecasting one-quarter ahead cattle prices was not as impressive. Only USDA forecasts exhibited significant market timing value. Even in this case, the size of the slope coefficient was substantially smaller than any of the three significant slope coefficients for hog price forecasts. The difference in results across cattle and hogs is particularly interesting in the case of Iowa and Missouri. The reason is that the one economist generated both cattle and hog price forecasts at these programs.

Finally, it should be noted that the intercept is significant in all of the estimated equations for one-quarter ahead hog and cattle price forecasts. As shown in equation (5a) the intercept is an estimate of the conditional probability of forecasting price will increase, given that price declines. Hence, all of the forecasts are biased towards forecasting price increases.

Results of Merton market timing tests for two-quarter ahead price forecasts are presented in Table 3. Again, three of the four outlook programs produce hog price forecasts with significant market timing value. However, at this horizon, Illinois hog forecasts have significant market timing value, but USDA forecasts do not. Just the opposite result was found at the one-quarter ahead horizon. Both Iowa and Missouri hog price forecasts continue to exhibit significant timing value. Iowa forecasts have the highest level of market timing value, as indicated by the sum of the conditional probabilities of a correct forecast (up or down) equalling 1.592.

At the two-quarter ahead horizon for cattle, only forecasts from the USDA are available. These forecasts exhibit significant market timing value, but in contrast to the one-quarter ahead result, have a level of market timing value comparable to the successful hog price forecasts. Finally, note that intercepts were significant in all of the two-quarter ahead estimated equations, indicating again an upward forecasting bias.

Three-quarter ahead market timing results (available only for hogs) are presented in Table 4. Two of the three programs, Illinois and Missouri, generate hog forecasts with market timing value. However, compared to the shorter forecast horizons, the strength of the value is lower as measured by the magnitude of the slope coefficient and the size of the t-statistics. As before, the intercept was significant in each of the estimated equations.

Seasonality Tests

One possible explanation of the market timing ability of these forecasts is that they are identifying the seasonal patterns found in hog and cattle prices. A more rigorous definition of market timing ability requires that these forecasts have market timing ability greater than that found by simply identifying seasonal trends in hog or cattle prices. To test for a more restrictive form of market timing ability, simple seasonal models of livestock prices are constructed using dummy intercept terms representing the first, second, and third quarters. A seasonal trend model is developed for the Omaha and Iowa-Southern Minnesota hog and cattle price series, and the 7-Market Average hog price series corresponding to the appropriate forecast series for each outlook program (Table 1).

The initial estimation period begins with the first quarter of 1972 and extends to the quarter prior to the start of the pertinent outlook forecast series. These seasonal trend equations are updated and re-estimated quarterly. The estimates are used to generate a forecast series comparable to each outlook series.

Using the Breen regression framework, Merton market timing tests are performed on the seasonal forecast resulting in estimates of described in equations (5a) and (5b). If the market timing ability of the outlook forecast series is limited to an ability to identify seasonal patterns in hog and cattle prices, then $\beta_{i,j,k} = \beta_{i,j,n}$, where k refers to the outlook program and n refers to the actual price series (n = Omaha, Iowa-Southern Minnesota, and 7-Market Average Prices).

Results of the restriction tests are presented in Table 5. It should be noted that in the case of the one-quarter ahead forecasts, the test statistic has a standard F-distribution. However, in the case of the two- and three-quarter ahead forecast comparisons, the test statistic has a chi-squared distribution. The difference is due to the use of the Newey-West covariance estimator to deal with the problem of serial correlation in overlapping forecast horizons.

The original Merton market timing tests indicate that the outlook programs of Iowa, Missouri, and USDA have significant market timing ability in forecasting one-quarter ahead hog prices. The additional tests indicates that the forecasts generated by these outlook programs represent a significant improvement over the market timing performance of forecasts based on simple seasonal trend models.

Again, the performance of the outlook programs in forecasting one-quarter ahead cattle prices is not as impressive. Originally, only the USDA forecasts exhibit market timing ability. However, the results of the restriction test indicates that the USDA forecasts are no better than those generated by a seasonal model. Therefore, under the more rigorous definition of market timing ability, no outlook forecasts of one-quarter ahead cattle prices have significant market timing ability.

For two-quarter ahead price forecasts, three of four programs produce forecasts that have significant market timing ability: Illinois, Iowa, and Missouri. Further testing indicates that only the Iowa program produces results that represent a significant improvement over forecasts derived from a simple seasonal trend model.

At the two-quarter ahead forecast horizon only the USDA produces forecasts of cattle prices. These forecasts exhibit significant Merton timing ability, unlike the two-quarter ahead USDA hog price forecast. Moreover, in contrast to both the two-quarter ahead hog price forecasts and the one-quarter ahead cattle price forecasts, these forecasts are also significantly better than comparable forecasts generated by a seasonal trend model.

Three-quarter ahead forecasts of hog prices are generated by outlook programs in Illinois, Iowa, and Missouri. The forecasts produced by Illinois and Missouri exhibit Merton market timing ability. However, further testing indicates that these forecasts are no better than forecasts developed using a simple seasonal model. Moreover, the seasonal forecasts are actually superior to the forecasts from the Iowa program.

Summary and Conclusions

The purpose of this study was to conduct a comprehensive evaluation of the market timing value of outlook price forecasts. Specifically, one-, two-, and three-quarter ahead hog and cattle price forecasts from the following four outlook programs were examined: University of Illinois, Iowa State University, University of Missouri, and U.S. Department of Agriculture. With the exception of University Illinois forecasts, sample periods began in the mid-1970s and ended in the late 1980s.

Results of Merton market timing tests indicated that the outlook programs generally produce valuable hog price forecasts. At both the one-and two quarter ahead horizons, hog price forecasts from three of the four programs exhibited market timing value. At the three-quarter ahead horizon, two of three programs generated hog price forecasts with significant market timing value. However, the strength of the market timing value tended to diminish as the forecast horizon increased.

The performance of the outlook programs in forecasting cattle prices was not as impressive. At the one-quarter ahead horizon, the forecasts of only one of three programs exhibited significant market timing value. Even in this case, the level of the market timing value was substantially smaller than that of any of the successful hog price forecasts.

It was also found that price forecasts were significantly biased upwards. This bias was consistent across outlook programs, commodities, and forecast horizons.

Of the fifteen forecast series examined, ten exhibited significant market timing ability. The definition of market timing was restricted to determine if this market timing ability was superior to that attributed to simply identifying seasonal trends in livestock prices. In six of the fifteen cases, forecasts produced by outlook programs were no better than forecasts generated by simple seasonal forecasting models. Further, the performance of the outlook programs relative to seasonal trend models tended to diminish as the forecast horizon increased.

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Table 1: Forecast Data

			No. of Observations		
Commodity/ Program	Forecast Series	Sample Period	One-Qtr. Ahead	Two-Qtr. Ahead	Three Qtr. Ahead
Hogs					
Illinois	Omaha	1979:3-1990:1	35	35	33
Iowa	Iowa & S Minn	1975:1-1988:4	55	54	41
Missouri	7 Mkt Avg	1974:2-1989:2	58	58	40
USDA	7 Mkt Avg	1974:1-1990:1	65	40	NA
Cattle					
Iowa	Iowa & S Minn	1975:1-1988:4	53	NA	NA
Missouri	Omaha	1974:2-1989:2	56	NA	NA
USDA	Omaha	1974:1-1990:1	64	41	NA

Note: NA indicates forecast data unavailable

Table 2: Merton Market Timing Test: One-Quarter Ahead Forecasts

	α	β	R^2
Hogs			
Illinois	0.400** (3.035)	0.126 (0.716)	.016
Iowa	0.250** (2.618)	0.395** (3.107)	.154
Missouri	0.160** (1.854)	0.527** (4.581)	.276
USDA	0.346* (3.736)	0.356** (2.949)	.125
Cattle			
Iowa	0.345** (3.742)	0.155 (1.158)	.025
Missouri	0.577** (5.992)	0.090 (0.682)	.008
USDA	0.613** (7.621)	0.200** (1.769)	.200

Note: The figures in parentheses are t-statistics. Two (one) stars indicates significance at the 5% (10%) level.

Table 3: Merton Market Timing Test: Two-Quarter Ahead Forecasts

	$\hat{\alpha}$	$\hat{\beta}$	R^2
Hogs			
Illinois	0.500** (3.299)	0.250* (1.346)	.066
Iowa	0.167** (2.502)	0.592** (5.801)	.347
Missouri	0.429** (5.539)	0.286** (2.688)	.083
USDA	0.350* (2.842)	0.176 (1.095)	.031
Cattle			
USDA	0.412** (3.293)	0.458** (3.383)	.233

Note: The figures in parentheses are t-statistics. Two (one) stars indicates significance at the 5% (10%) level.

Table 4: Merton Market Timing Test: Three-Quarter Ahead Forecasts

	α	β	R^2
Hogs			
Illinois	0.385** (2.704)	0.365** (2.261)	.133
Iowa	0.565** (4.849)	0.101 (0.907)	.011
Missouri	0.350** (3.193)	0.350** (2.200)	.123

Note: The figures in parentheses are t-statistics. Two (one) stars indicates significance at the 5% (10%) level.

Table 5: The Market Timing Value of Outlook Forecasts Relative to a Naive Seasonal Forecasting Model[a]

Commodity/ Program	One-Quarter Ahead	Two-Quarter Ahead[b]	Three-Quarter Ahead[b]
	F-statistic	X^2	X^2
Hogs			
Illinois	2.10	1.76	0.27
Iowa	21.69*	25.98*	4.31[c]
Missouri	21.10*	0.75	0.22
USDA	5.34*	0.11	NA
Cattle			
Iowa	0.07	NA	NA
Missouri	0.33	NA	NA
USDA	0.23	5.49*	NA

Note: One star indicates significance at the 5% level

[a] The null hypothesis of the restriction test is H_0: $\beta_{i,j,k} = \beta_{i,j,n}$.

[b] Because of the use of the Newey-West covariance estimator to solve the serial correlation, the test statistic has a X^2 distribution.

[c] Forecasts from the seasonal model are preferred to forecasts produced by the outlook program.