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APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

On the Value of Outlook Economists' Price Forecasts

by

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I. Introduction

One of the major difficulties facing agricultural producers is unstable prices. Price instability can be attributed to the combination of a highly inelastic demand for food and a production technology which is subject to such vagaries of nature as weather, pests, and biological lags. Empirical estimates of the price elasticity of the demand for food items are generally less than unity and from 50 to 75 percent lower than those for non food items. Thus, changes in supply induced by stochastic variables such as weather will result in proportionately greater changes in market equilibrium price than on the quantity exchanged. This combination of factors results in a set of market prices which may vary substantially within a year and from year-to-year.

In agriculture, the problem of unstable prices is compounded by the fact that many production and marketing decisions are made without perfect knowledge of actual prices. These decisions are made on the basis of price expectations; therefore, price expectations are a central component in decision making regarding planting and harvesting, as well as decisions about forward contracting, storage, and transportation. An important ingredient in developing sound price expectations or forecasts is information. It is of considerable importance that these price expectations mirror all available information at a given point in time. To assist in the collection and dissemination of information and the formation of price forecasts a wide variety of both public and private sources are available.

Within the public arena, a major source of market and price information is the U.S. Department of Agriculture and state Land-Grant Colleges of Agriculture. The mission of these institutions is two-fold. The first function is to provide economic education to agricultural porducers and agribusinesses. In other words, this role entails assisting their clientele in formulating rational price expectations which do reflect all available information. In conjunction with this function, public institutions provide economic outlook information to agricultural producers and agribusiness firms.

They have been providing such information in one form or another since the 1920s. This includes analyses of domestic and world commodity markets, as well as domestic and international macroeconomic variables. But for many producers and agribusiness firms utilizing outlook information, the centerpiece of the program is the development of forecasts of crop and

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livestock prices. Price forecast information can be in terms of an actual level, a change in current levels, or a general prediction of the direction of change.

It is not obvious that forecasts issued by public outlook programs offer users an opportunity to realize substantial economic benefits. The theoretical basis for the skepticism is the efficient market hypothesis (Fama). In an efficient market all available information is fully reflected in current prices. Thus, users of forecasts issued by public outlook programs can realize substantial economic gains only if the forecasts are based on information not generally available to other market participants. Furthermore, even if such "valuable" forecasts are issued in an otherwise efficient market, other traders will quickly react to the publication of the forecasts. They will bid the information into market prices with sufficient speed to prevent other users from earning abnormal profits.

The previous discussion pointedly suggests that in assessing the usefulness of public outlook information it is crucial to determine if utilizing outlook information within a decision making framework offers users significant economic opportunities. Or conversely, if such information has already been assimilated into the market place resulting in little economic value associated with current outlook information. Hence, the purpose of this study is to test whether public outlook information services provide users with economically valuable information.

This study offers two major improvements over previous works (Just and Rausser; Marquardt). First, the time period over which the assessment will take place is longer. The largest forecast sample begins in November 1973 and ends in November 1988. The smallest forecast sample begins in April 1979 and ends in October 1988. Hence, results should be more credible and less subject to the structure of any small time period. In addition, the evaluation of the forecasts will utilize an economic criteria rather than a statistical criteria. In particular, this study will use the Cumby-Modest regression test to evaluate the ability of outlook forecasts to outperform the market.

II. Previous Studies

Despite the long history of public and private outlook services, only two studies have been devoted to assessing the economic value of such programs to producers and related agribusinesses. In studies by Marquardt and Just and Rausser, outlook forecasts from both public and private sources are compared to those available in futures markets. Just and Rausser examine the price forecasts generated by the U.S. Department of Agriculture and four major commercial firms: Chase Econometrics, Doanes Agricultural Service, Data Resources Inc. (DRI), and Wharton Econometric Forecasting Associates. These quarterly price forecasts are made for wheat, corn, cotton, soybeans, soybean oil, soybean meal, hogs, and live cattle. These forecasts are updated either monthly or bimonthly over the period July 1976-December 1977. Forecast horizons range from one to eight quarters in advance. Just and Rausser define the accuracy of these forecasts in terms of statistical measures of equality - root mean squared error and root mean squared percentage error of the forecasts of average quarterly cash market prices.

Just and Rausser found that the relative accuracy of outlook forecasts differed across both commodity group and forecast horizons. Some of the econometric forecasts seemed preferable for livestock commodities, while results for other commodities were mixed (Just and Rausser). Further, for active and fluctuating markets such as soybeans, the longer-term forecasts were more accurate than short-term forecasts. However, for more stable markets such as wheat and hogs, accuracy declined as the forecast horizon lengthened (Just and Rausser).

One of the major criticisms of this work has been the extremely small sample size which is used to measure accuracy. The lack of both a large cross sectional sample and an extensive time period casts some doubts upon the subsequent results. Further the use of statistical criteria for accuracy need not be consistent with and optimal for the subsequent use of the forecasts in a decision framework. This is only the case if the underlying economic problem is characterized by a symmetrical loss function. Therefore, unless the value of a firm falls by exactly the same amount when it loses a dollar as it rises when the firm gains a dollar, a commodity price forecasting model chosen under statistical criteria will not be optimal (Stockman).

Marquardt examined two livestock commodities, live cattle and hogs, and three grain commodities, wheat, corn, and soybeans. He reviewed the outlook letters issued by ten agencies both public and private over a four year period from January 1, 1970-December 31, 1973. Price forecasts were in terms of actual price levels, changes in price levels, or the general direction of a price change. Accuracy was measured again using statistical means, the mean deviation of forecast price changes from actual price changes or the standard deviation of forecasts from actual price changes. His findings indicated that across commodities, the information obtained in the outlook letters was less accurate than that found in the futures market for all commodities except wheat. The outlook letters did do a better job forecasting directional movements of the wheat market than did the futures markets (Marquardt).

Several of the same criticisms leveled at the Just and Rausser work apply here. First, while the number of observations was larger than found in Just and Rausser, the time period was still relatively short. Furthermore, the use of statistical criteria for accuracy again failed to provide any substantive evidence of the economic value of this outlook information within a decision framework.

III. The Value of Forecasts and Market Timing

Merton's theoretical 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. In other words, a rational investor has some initial expectation regarding the distribution of the future asset returns. This expectation, when combined with a simple forecast, should result in a new posterior probability distribution of the future returns of the asset. 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 builds upon this assumption to define a methodology for obtaining the value of this forecast which is independent of an investor's preferences, endowments, or prior assessments of an asset's return stream.

Cumby and Modest, adopting Merton's criteria of changing expectations due to forecast information, proposed a general regression test of market timing ability. They hypothesize a linear relationship between a forecast signal and a benchmark measure of economic returns. In the case of price forecasts for a commodity, Cumby and Modest suggest the use of a naive long positon in the appropriate futures market as the benchmark measure of returns. Based on this assumption, the model for testing market timing ability is:

$$(1) \quad R_t = \alpha + \beta X_{ti} + \epsilon_{ti}$$

where R_t equals the percentage rate of return to a naive long position for time period t, X_{ti} equals one for a buy signal and zero otherwise for time period t and model i, and ϵ_{ti} is a standard normal error term. Market timing ability is found under the Cumby-Modest test if β in (1) is significantly different from zero. In other words, market timing ability is found if the fractional increase in average holding period returns, conditional on a buy signal, is significantly different from zero.

If additional assumptions are made, the Cumby-Modest test provides evidence of market efficiency as (defined by Fama). In order for the rejection of the null hypothesis to imply that the markets are inefficient, risk premiums must be constant across time. Alternatively, if it can be assumed that all publicly available information is included in the model, then the test results also provide evidence of market inefficiences (Cumby and Modest).

IV. Data and Procedures

The forecast data for the study are the quarterly hog and cattle price forecasts issued by three well-known public outlook programs: University of Illinois, Missouri University, and the U.S. Department of Agriculture (USDA). The Illinois forecasts were drawn from issues of the Livestock Outlook. The Missouri forecasts were drawn from issues of the Livestock Outlook Letter. The USDA forecasts were drawn from issues of the Livestock Situation and Outlook Report. These sources are identified randomly by numbers, 1 through 3, in the remainder of the paper.

Forecasts for each program were available for horizons of one and two quarters ahead. The exact date of release of the forecast was available for the Missouri and USDA forecasts. Only the month of release was availble for Illinois forecasts. After conversations with an Outlook Specialist at the University of Illinois it was concluded that the 15th day of the indicated month was a reasonable approximation of the actual release date of Illinois price forecasts.

A description of the forecast data is presented in Table 1. Note that the sample of cattle price forecasts from outlook program 1 was considered too small to be included in the analysis. Otherwise, sample sizes were at least

30 observations, with the exception of two quarter ahead cattle forecasts for outlook program 2. Also note that forecasts were not neccesarily issued at regular time intervals over the indicated sample periods.

For each set outlook program forecasts, buy and sell signals were generated by a decision rule similar to that employed in previous economic evaluations of forecasting models (i.e., Wright, et. al.). Under the decision rule, buy and sell signals are generated in the following manner:

Buy Signal:

$$FLP_{ti} \geq LP_k$$

Sell Signal:

$$FLP_{ti} < LP_k$$

where FLP_{ti} is the forecasted cash livestock (hogs or cattle) price for time period t and model i and LP_k is the actual cash livestock price on the last trading day, k, of time period t-1.

Following the procedure used by Cumby and Modest in their study of exchange rate advisory services, the investment benchmark for the market timing tests is assumed to be a naive long position in the appropriate livestock futures market. Positions are initiated on the first trading day of the forecast period. It is assumed that long positions are initiated at the opening price in the nearest maturity contract that does expire in the forecast quarter.[1] All positions are offset at the closing futures price on the last day of the forecast quarter.

Because margin requirements can be satisfied by pledging U.S. Treasury Bills that continue to earn interest, the profits and losses from following the naive long positions may be calculated as the change in futures prices over the holding period. Hence, the percentage gross return for naive positions is:

$$(2) \quad R_t = [\ln(FLP_{n}) - \ln(FLP_{m})] * 100$$

where R_t is the percentage gross return realized over time period t, and FLP_n and FLP_m are the appropriate livestock futures prices on the first and last trading days of the time period, respectively.

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[1]The matching of forecast quarter and futures contract is as follows,

Forecast Quarter	Futures Contract	
	Hogs	Cattle
I	April	April
II	July	August
III	October	October
IV	February	February

Since the forecasts are predetermined, consistent estimates of the parameters of (1) can be obtained by ordinary least squares (OLS) [Cumby and Modest]. However, it is questionable whether the error term in the equation will have a constant variance due to the heteroskedasticity of futures price changes (i.e. Hall, Brorsen, and Irwin). Therefore, White's test statistic is computed to determine if significant heteroskedasticity exists.[2] If the White test indicates significant heteroskedasticity, estimates of (1) will be obtained using White's heteroskedastic-consistent covariance estimator.

V. Market Timing Test Results

Results of the market timing tests are presented in Tables 2 and 3. None of the error terms of the estimated equations exhibited significant serial correlation or heteroskedasticity as measured by the Durbin-Watson and White statistics, respectively. The possibility of structural change in the market timing equations was investigated via Chow tests. No evidence of structural change was found after splitting each sample into numerous combinations of two sub-samples. These results suggest that the underlying assumptions of OLS regression are not violated.

The null hypothesis of no market timing value is tested using a one-tailed t-test of the β coefficient in each of the estimated equations. None of the t-statistics are significant at conventional confidence levels (5% and 10%). Thus, the null hypothesis cannot be rejected for any of the programs, regardless of the commodities or time horizons. Hence, over substantial lengths of time, the three outlook programs have not generated hog or cattle price forecasts that afford users substantial economic value.

The Cumby-Modest test may also be interpreted as a test of market efficiency. Thus, the failure to reject the null hypothesis of no market timing ability implies the existence of a semi-strong form efficient market.

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[2]The White Statistic is,

$$nR^2 \sim X^2_{k(k+1)/2}$$

where n is the number of observations in the original sample and k is the number of independent variables in the OLS estimation equation.

R^2 is the (constant-adjusted) squared multiple correlation coefficient from the following regression:

$$\epsilon^2_i = \alpha_0 + \sum_{j=1}^{K} \sum_{k=1}^{K} \alpha_s X_{ij} X_{ik} \qquad (i=1,\ldots,n)$$

where ϵ_i is the error of the ith observation from the OLS estimation and X_{ij} and X_{ik} are the ith observation of the jth and kth independent variable, respectively.

The test results from this study are a particularly strong test of market efficiency because of the true _ex ante_ nature of the forecasts which are used. Because these forecasts actually are made on a particular day in time, they can only reflect information which is available on that date. This is in contrast to simulated forecast models which are built using _ex post_ information. Often, data used in these models are updated and in actuality may not have been available for the time the forecast is simulated. In contrast to earlier work (Leuthold and Hartmann; Leuthold _et. al._), these results indicate that the hog futures market is semi-strong form efficient. These results also offer evidence that the live cattle market is semi-strong form efficient confirming earlier findings (Garcia, et. al.).

VI. Summary

One of the major difficulties facing agricultural producers is unstable prices. Price instability can be attributed to the combination of a highly inelastic demand for food and a production technology which is subject to such vagaries of nature as weather, pests, and biological lags. In agriculture, the problem of unstable prices is compounded by the fact that many production and marketing decisions are made without perfect knowledge of actual prices. These decisions are made on the basis of price expectations; therefore, price expectations are a central component in decision making regarding planting and harvesting, as well as decisions about forward contracting, storage, and transportation.

A wide variety of both public and private programs exist to assist producers in forming price expectations. Within the public arena, a major source of market and price information is the U.S. Department of Agriculture and state Land-Grant Colleges of Agriculture. The mission of these institutions is two-fold. The first function is to provide economic education to agricultural porducers and agribusinesses. The second is the development of forecasts of crop and livestock prices.

It is not obvious that forecasts issued by public outlook programs offer users an opportunity to realize substantial economic benefits. The theoretical basis for this skepticism is the efficient market hypothesis (Fama). In an efficient market all available information is fully reflected in current prices. Thus, users of forecasts issued by public outlook programs can realize substantial economic gains only if the forecasts are based on information not generally available to other market participants. This pointedly suggests that in assessing the usefulness of public outlook information it is crucial to determine if utilizing outlook information within a decision making framework offers users significant economic opportunities. Hence, the purpose of this study is to test whether public outlook forecasts provide users with economically valuable information.

The forecast data for the study are the quarterly hog and cattle price forecasts issued by three well-known public outlook programs: University of Illinois, Missouri University, and the U.S. Department of Agriculture (USDA). The largest forecast sample begins in November 1973 and ends in November 1988. The smallest forecast sample begins in April 1979 and ends in October 1988. Forecasts for each program are available for horizons of one and two quarters ahead.

The Cumby-Modest regression test is used to evaluate the ability of outlook forecasts to outperform the market. The null hypothesis of no market timing value is not rejected for any of the forecasts of the two commodities, across either time horizon. Hence, over substantial lengths of time, the three outlook programs have not generated hog or cattle price forecasts that afford users substantial economic value.

The market timing results also imply that both the live hog and live cattle futures markets are semi-strong form efficient. This is in contrast to earlier work indicating that the hog futures market is semi-strong form inefficient (Leuthold and Hartmann; Leuthold <u>et. al.</u>). These results confirm earlier findings that the live cattle market is semi-strong form efficient (Garcia, et. al.).

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TABLE 1. Public Outlook Program Forecast Data

Outlook Program	Commodity	Forecast Horizon	Time Period	Number of Observations
1	Hogs	One Quarter	4/15/79 - 10/14/88	32
1	Hogs	Two Quarters	4/15/79 - 10/14/88	31
2	Hogs	One Quarter	3/27/74 - 10/10/88	56
2	Hogs	Two Quarters	3/27/74 - 7/18/88	39
2	Cattle	One Quarter	1/25/74 - 11/09/88	62
2	Cattle	Two Quarters	1/25/74 - 8/18/88	22
3	Hogs	One Quarter	11/27/73 - 11/03/88	85
3	Hogs	Two Quarters	11/27/73 - 8/16/88	43
3	Cattle	One Quarter	11/27/73 - 11/03/88	85
3	Cattle	Two Quarters	11/27/73 - 8/16/88	44

TABLE 2. Market Timing Tests of Hog Price Forecasts Issued by Public Outlook Programs

Outlook Program	Forecasting Horizon	α	β	R^2
1	One Quarter	1.76	0.77	0.0007
		(0.42)	(0.14)	
1	Two Quarters	-4.27	-14.73	0.0063
		(-0.15)	(-0.43)	
2	One Quarter	5.77	-4.83	0.0263
		(2.08)	(-1.21)	
2	Two Quarters	-2.42	2.53	0.0048
		(-0.51)	(0.42)	
3	One Quarter	0.84	0.36	0.0001
		(0.35)	(0.10)	
3	Two Quarters	1.40	5.35	0.0306
		(0.42)	(1.14)	

TABLE 3. Market Timing Tests of Cattle Price Forecasts Issued by Public Outlook Programs

Outlook Program	Forecasting Horizon	α	β	R^2
2	One Quarter	-16.60	14.63	0.0146
		(-1.36)	(0.94)	
2	Two Quarters	9.22	-12.78	0.1127
		(1.24)	(-1.59)	
3	One Quarter	3.32	-2.66	0.0125
		(1.59)	(-1.02)	
3	Two Quarters	7.42	-5.49	0.0557
		(2.45)	(-1.57)	