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Empirical tests of the rationality of USDA crop forecasts

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1. INTRODUCTION

The U.S. Department of Agriculture (USDA) has released statistical reports on various crops for many years. Market agents and the public make their plans on current and future consumption and agriculture business decisions, based on the information from the government. Thus, the government's report about future acreage planted and harvest size potentially play an important role in the agricultural market.

Most studies concerning these reports have assumed that USDA forecasts contain full information. In this case, the market can do no better than to accept the USDA forecast as the best available information. But does the government's announcement really reflect all available market information? Could these reports mislead the market agent and the public? This thesis examines whether all available information has been used in an optimal manner in USDA forecasts. I will empirically test whether or not the government's forecast is rational in the case of announcements of planted acreage and harvest size.

The crop forecasts selected include corn, barley, oats, soybeans, and spring wheat over the period 1950 to 1986. The thesis begins with a history of forecasts in agriculture. I then review the literature and theoretical models to provide the background for this study. A discussion of materials and methods will also be developed in the third chapter. Thereafter, the results of estimation will be studied in the following chapters. I present my conclusions in the final chapter.

1.1 The History of Forecast in Agriculture

Since this thesis discusses the rational forecast of government reports, it is useful to first understand the history of forecasts of agricultural commodity production in the U.S. The U.S. Department of Agriculture (USDA) has a long history of releasing statistical reports about various crops at different points in the crop year. This information is important to the public. The estimates of production for most major field crops originated in 1866. Planted acreage estimates were initiated in 1919.

The forecasts of field crop are made during the growing season but the estimates are made after harvest. State and National estimates then are published in the monthly crop production report for planted acreage, harvest acreage, yield, and production. As a result of small acreage, the barley and rye estimates were dropped in some states from 1974 to 1979. Some of the crop reports including white corn and popcorn were cut short because of budget constraints in 1982. The July forecasts of yield and production of spring wheat, durum wheat, and corn were also discountinued at the same time.

The USDA uses probability, nonprobability surveys and area frame sampling for their monthly forecasts. The first forecasts for yield and production of winter wheat are made in July. The first oats and barley estimates are released in July. The first forecasts for spring wheat and soybeans are in August.

2. BACKGROUND

2.1 Theoretical Model

The essential idea of the Muth (1961) concept of rational expectation is that agents make use of all available relevant information in making forecasts of economic variables. This implies that agents derive their expectations of the future value of a variable from the true economic model that generates the variable. It follows that agents' subjective probability distribution about future outcomes will be the same as the actual probability distribution, conditional on the information available to them.

There are three issues which we address in examining whether a given forecast is rational.

1. The mean of the one-period ahead forecast error.
2. The variance of the error.
3. The relationship between forecasting errors over different time horizons.

To discuss these issues, we assume

$$y_t = \bar{y} + \sum_{i=0}^{\infty} a_i \epsilon_t - i$$

where y_t is the actual value of y at time t, $\bar{y}$ is the mean of the series; a_i are the constant parameters, and ϵ is a normally-distributed error with a zero mean, constant variance δ_ϵ^2, and zero covariance. Let E_{t-1} be the expectation operator conditional on information available at time t-1. Then

$$\begin{aligned} E_{t-1}y_t &= \bar{y} + a_1\epsilon_{t-1} + a_2\epsilon_{t-2} + \cdots \\ y_t &= \bar{y} + a_0\epsilon_t + a_1\epsilon_{t-1} + a_2\epsilon_{t-2} + \cdots \\ y_t - E_{t-1}y_t &= a_0\epsilon_t \end{aligned} \tag{2.1}$$

Because $E(\epsilon_t) = 0$, equation (2.1) indicates that the mean forecast error is 0. That is, $E_{t-1}y_t$ is an unbiased predictor of y_t. Therefore the rational forecast should be unbiased.

A rational forecast should also be efficient, which means the variance of the prediction error $a_0^2\delta_\epsilon^2$ is smaller than that of any other possible predictor. This follows from the assumption that ϵ_t is random, $E[\epsilon_t] = 0$, and uncorrelated with any previous event, $E[\epsilon_t, \epsilon_{t-i}] = 0$ for $i \neq 0$. Assume $y^* = E_{t-1}y_t$ and $y_t - E_{t-1}y_t = a_0\epsilon_t$ from (2.1). Let the mean squared error [MSE]= $E[y_t - y^*]^2$ be the loss function. We can rewrite the MSE as

$$\begin{aligned} & E[y_t - E(y_t) + E(y_t) - y^*]^2 \\ = \; & E\{[y_t - E(y_t)]^2 + [E(y_t) - y^*]^2 \\ & +2[y_t - E(y_t)][E(y_t) - y^*]\} \\ = \; & Var(y_t) + [E(y_t - y^*)]^2 \end{aligned} \tag{2.2}$$

Therefore MSE= $Var(y_t)$+bias (which is $[E(y_t) - y^*]^2$). The $E(y_t - y^*) = E(y_t) - E_{t-1}y_t = a_0E(\epsilon_t) = 0$ from (1-1).

$$\begin{aligned} Var(y_t) &= E[y_t - E(y_t)]^2 \\ &= E[y_t - y_t^*]^2 \end{aligned}$$

$$
\begin{aligned}
&= E[y_t - E_{t-1}y_t]^2 \\
&= a0^2 E[\epsilon_t^2] \\
&= a_0^2 \delta_\epsilon^2
\end{aligned}
\tag{2.3}
$$

The MSE will be minimized if the forecast is unbiased and efficiently incorporates all available information.

We now proceed to the third issue - the relationship between forecasting error over different time horizons. The values of y_t are defined as

$$
\begin{aligned}
y_t &= \bar{y} + a_0\epsilon_t + a_1\epsilon_{t-1} + \cdots \\
y_{t-1} &= \bar{y} + a_0\epsilon_{t-1} + a_1\epsilon_{t-2} + a_2\epsilon_{t-3} + \cdots \\
y_{t+1} &= \bar{y} + a_0\epsilon_{t+1} + a_1\epsilon_t + a_2\epsilon_{t-1} + \cdots
\end{aligned}
\tag{2.4}
$$

The two period ahead error for y_{t+1} when the information is set at date t-1 will be $y_{t+1} - E_{t-1}y_{t+1} = a_0\epsilon_{t+1} + a_1\epsilon_t$. Similarly, $y_t - E_{t-2}y_t = a_0\epsilon_t + a_1\epsilon_{t-1}$ which equals the two period ahead forecast error for y_t. The unconditional correlation between these two successive errors is given by $E(a_0\epsilon_{t+1} + a_1\epsilon_t)(a_0\epsilon_t + a_1\epsilon_{t-1}) = a_1 a_0 \delta_\epsilon^2$. The covariance terms are equal to zero and the related expected correlation for one-period ahead forecasts is given by $E(a_0\epsilon_{t+1})(a_0\epsilon_t) = 0$, because $E(\epsilon_t\epsilon_{t+j}) = 0$ for $j \neq 0$ by assumption. These results indicate that the forecast errors will be correlated until the forecast horizon is only 1 period. In the other words, the forecast errors will not be correlated with any information known at the time the forecast is made.

Given these properties of a rational forecast, the question becomes how to empirically test the rationality of any given forecast values. Let y_t^* be a forecast value of y_t as above, $E(\mu_t) = 0$ and $E(\mu_t, \mu_{t-i}) = 0$, $i \neq 0$. Consider a regression of the form

$$y_t = a_0 + a_1 y_t^* + \mu_t \tag{2.5}$$

where $\mu_t \sim IID(0, \delta_\mu^2)$. Then $E(y_t - a_0 - a_1 y_t^*) = E(\mu_t) = 0$. The requirement that $E(\epsilon_t) = 0$ in equation(2.1) is consistent with $a_0 = 0$, $a_1 = 1$ in (2.5). Given $a_0 = 0$, $a_1 = 1$ implies y_t^* is unbiased. This insures that $E(y_t) = y_t^*$ since $E(y_t = a_0 - a_1 y_t^*) = 0$. Tests of efficiency determine if information exists which can lower the error-variance μ_t. Therefore, we test whether the forecast error $y_t - y_t^*$ is uncorrelated with other variables in the information set I_{t-1}. Since y_{t-1} is definitely in the information set I_{t-1} , the following equation may be estimated:

$$y_t - y_t^* = b_0 + b_1 y_{t-1} + \mu_t$$

The hypothesis $b_0 = 0$, $b_1 = 0$ tests whether the rational forecast y_t^* is efficient.

Efficiency is one of the properties of the rational forecast as previously described. Efficiency requires that the variance of the prediction error is the smallest. We also could test if the y^* is a rational forecast by testing whether $Var(y_t) \geq Var(y_t^*)$. If $y_t = y_t^* + \epsilon_t$ and ϵ_t is uncorrelated with y_t^* as defined before, then $Var(y_t) = Var(y_t^*) + Var(\epsilon_t)$; hence $Var(y_t) \geq Var(y_t^*)$. In the following discussion, we will emphasize tests of $a_0 = 0$, and $a_1 = 1$ for rational forecast.

In general, market agents attempting least squares estimates of (2) with incomplete current information will derive biased estimates of a_0 and a_1. However, the least squares estimates of a_0 and a_1 will be unbiased since E(μ_t, $E(y_t)$) = 0 and least squares estimates have the property of unbiaseness. This situation is the same as that of overlapping information in the usually assumed case of full current information.

2.2 Literature Review

Keane and Runkle discuss how to test rational forecasts in 1989. They argued that better data and statistical methods must be used. They argue that what is required is survey data of forecasts and data on actual final values of the forecast variables. The best way to ensure that survey data on forecasts reflects the true expectations of market forecasters is to use only the forecasts of people with an economic incentive to report expectations accurately. Secondly, they argued that only available information should be included in specifications of the information sets. This means that only unrevised data can be used to reflect what the forecasters knew at the time they made their predictions. They test the price rationality by estimating

$$P_{t-1} = \alpha_0 + \alpha_1 \, {}_tP^f_{i,t+1} + \alpha_2 X_{i,t} + \mu_{i,t+1}$$

where ${}_tP^f_{i,t+1}$ is the one-period-ahead forecast of the price level made by forecaster i in period t and where $X_{i,t}$ is any other variable known to forecaster i at time t. They test the hypothesis that the price forecasts are rational by determining whether the data support the restrictions that $\alpha_1 = 1$ and $\alpha_0 = \alpha_2 = 0$.

Feenberg, Gentry, Gilroy and Rosen studied whether state revenue forecasts are formed rationally in 1989. They tested whether the coefficient on expectations of revenue equals one and the intercept equals to zero to analyzing budget data in regressions of actual revenue on forecasted revenue. Their findings from New Jersey, Massachusetts and Maryland indicated that revenue forecasts fail to incorporate all the available relevant information and that improvement in the forecasts was generally not statistically significant although it did improve over time.

In 1989, Summer and Rolf investigate the informational content of the harvest forecasts of the USDA by examining price movements in the relevant futures markets on days coinciding with the release of corn and soybean harvest forecast. They used various tests, finding that USDA harvest forecast announcements affect market price movements. The results show the intermediate releases - in August, September, and October - appear to have the strongest impact on daily changes of futures market closing prices for both corn and soybeans.

In 1988, Orazem and Falk explored the implications for announcement-effect studies when market agents do not respond directly to the government's estimates, but respond instead to the market's updated forecasts of true economic variables, conditional on the forecasts and other market information not contained in the announcement. Their findings were that the Fed's weekly money series were not rational forecast and the market has better information than accept the Fed's preliminary forecast at face value.

As yet, no systematic study of the rationality of USDA crop forecasts has been conducted. This thesis will attempt to shed light on the rationality of these forecasts, using methods similar to those above.

3. MATERIALS AND METHODS

3.1 Model Overview

Most of the data on U.S. Department of Agriculture crop forecasts which I use are for the years 1950 to 1986. The commodities analyzed include barley, corn, oats, soybeans, and spring wheat. The analysis focusses on the forecast values of planted acreage and final production. The analysis will use previous USDA crop forecasts and the change in commodity prices since the previous forecasts as measures of market information prior to a given forecast. The empirical models examine the rationality of government forecasts by determining whether the forecasts use available government and market information and whether they are unbiased forecasts of the true harvest size or planted acreage. The tests also indicate the extent to which government forecasts improve the market's information on acreage and output.

The planted acreage models will be discussed first. We estimate the following three equations:

$$PF_t = \alpha_{1,0} + \alpha_{1,1} AP_t^* + \alpha_{1,2} I_{t-1} + \alpha_{1,3} \triangle P_{t-1} + \mu_{1,t} \quad (3.1)$$

$$PF_t = \alpha_{2,0} + \alpha_{2,1} I_{t-1} + \alpha_{2,2} \triangle P_{t-1} + \mu_{2,t} \quad (3.2)$$

$$AP_t^* = \alpha_{3,0} + \alpha_{3,1} I_{t-1} + \alpha_{3,2} \triangle P_{t-1} + \mu_{3,t} \quad (3.3)$$

Where PF_t is the acres planted final figure corresponding to the preliminary forecast at time t; AP_t^* is the prediction of acres planted at time t; I_{t-1} represents the most recent relevant information released by the USDA on the crop, in this case the last available report on acres planted in the previous year, and $\triangle P_{t-1}$ is the change in the cash price from the release date of I_{t-1} to just before the release of AP_t^*. $\mu_{i,t}$ is an error term.

Because the survey method changed over time, it is interesting to inspect the impact of improvements in government forecasts on the structure of USDA forecast errors. Because the switch to area frame sampling occurred in the early '60s, I test for structural change in the coefficients after 1963. Comparisons are also made between the two periods (before and after 1963) to see if these changes affected the market's forecasts related to the crop. The models for these different scenarioes are as follows:

$$\begin{aligned} PF_t &= \beta_{1,0} + \beta_{1,1} AP_t^* + \beta_{1,2} AP63_t^* + \beta_{1,3} I_{t-1} + \beta_{1,4} I63_{t-1} + \\ &\quad \beta_{1,5} \triangle P_{t-1} + \beta_{1,6} \triangle P63_{t-1} + \epsilon_{1,t} \qquad (3.4) \\ PF_t &= \beta_{2,0} + \beta_{2,1} I_{t-1} + \beta_{2,2} \triangle P_{t-1} + \beta_{2,3} I63_{t-1} + \\ &\quad \beta_{2,4} \triangle P63_{t-1} + \epsilon_{2,t} \qquad (3.5) \\ AP_t^* &= \beta_{3,0} + \beta_{3,1} I_{t-1} + \beta_{3,2} \triangle P_{t-1} + \beta_{3,3} I63_{t-1} + \epsilon_{3,t} \qquad (3.6) \end{aligned}$$

$AP63^*$, I63, $\triangle P63$ are the values of AP, I, $\triangle P$ after 1963.

The announcements were released twice from 1972 to 1980 and only once for other years. The models will be estimated using both the first and the second announcements and using the first announcements for all samples separately. Tests of efficiency and unbiasedness will be conducted.

Similar tests were performed for the crop production forecasts. The production models were specified as follows:

$$QF_t = a_{1,0} + a_{1,1}AP_{t-1} + a_{1,2}Q_t^* + a_{1,3}\triangle P_{t-1} + \lambda_{1,t} \quad (3.7)$$

$$QF_T = a_{2,0} + a_{2,1}AP_{t-1} + a_{2,2}\triangle P_{t-1} + \lambda_{2,t} \quad (3.8)$$

$$Q_t^* = a_{3,0} + a_{3,1}AP_{t-1} + a_{3,2}\triangle P_{t-1} + \lambda_{3,t} \quad (3.9)$$

$$QF_t = a_{4,0} + a_{4,1}AP_{t-1} + a_{4,2}Q_t^* + a_{4,3}\triangle P_{t-1} + a_{4,4}AP63_{t-1} + a_{4,5}Q63_t^* + Q_{4,6}\triangle P63_{t-1} + \lambda_{4,t} \quad (3.10)$$

$$QF_t = a_{5,0} + a_{5,1}AP_{t-1} + a_{5,2}\triangle P_{t-1} + a_{5,3}AP63_{t-1} + a_{5,4}\triangle P63_{t-1} + \lambda_{5,t} \quad (3.11)$$

$$AP_t^* = a_{6,0} + a_{6,1}AP_{t-1} + a_{6,2}\triangle P_{t-1} + a_{6,3}AP63_{t-1} + a_{6,4}\triangle P63_{t-1} + \lambda_{6,t} \quad (3.12)$$

There are 3 or 4 reports for every crop in each year. For the first production forecast, the planted acreage forecast represents the most recent relevant USDA information on the crop. I therefore use AP_{t-1} as the measure of available government information prior to the release of the first production forecast. Q_{t-1} was used in place of AP_{t-1} after the first report of production. Since Q_{t-1} would be known after the first report, the models should incorporate Q_{t-1} starting from the second production report in each crop year. This insures proper measurement of the most recent relevant market information. I use the same models for all subsequent reports.

The models of (3.1) and (3.8) will test whether the announcement is a rational forecast by making appropriate the parameter restrictions. The null hypothesis for (3.1) is equivalent to the restrictions that $\alpha_{1,0} = \alpha_{1,2} = \alpha_{1,3} = 0$ and that $\alpha_{1,1} = 1$. Unbiasdeness and market efficiency which imply a rational forecast. If the null hypothesis is not rejected at standard significant levels, we fail to reject. There are three tests that will be conducted for (3.1) and (3.7); those tests are T1: $\alpha_0 = 0$, $\alpha_2 = 0$, $\alpha_3 = 0$, T2: $\alpha_1 = 1$ and T3: $\alpha_0 = 0$, $\alpha_1 = 1$, $\alpha_2 = 0$, $\alpha_3 = 0$. T1 tests the efficiency of government's forecast while T2 tests the unbiasedness; T3 is used as a joint test of the rationality of government's forecast. It would also be useful to discuss the notion of R^2 which is the proportion of the total variation in the dependent variable explained by the regression of the dependent variable on the independent variables. R^2 can be defined as $1 - \frac{ESS}{TSS} = \frac{RSS}{TSS}$ (where TSS is total sum of squares, ESS is the residual sum of squares, and RSS is the regression sum of squares). R^2 is used as a goodness-of-fit statistic. It can also be used to compare the state of information on eventual harvest size at the same time across crops, and at different points in the crop year for the same crop. The change in R^2 is from (3.2) to (3.1) or (3.8) to (3.7) used as a measure of the value of the government's forecasts; it measures the change in the market's information from before to after the announcement. If the R^2 after the announcement is significantly greater than the R^2 before the release of the announcement, it reveals that the government's reports do improve the market's information by reducing the error variance. The individual test of each parameter in every regression model will also be studied by t-test.

4. BARLEY

4.1 Acreage Planted

The estimated coefficients for the barley announcements are shown in Table 4.1 to Table 4.2 for acreage planted and Table 4.3 to Table 4.8 for production. The first six columns report equations that combine both first and second announcements. (4.4) to (4.6) report the results which allow for potential structural change after 1963. The estimated parameters from equations which only incorporate the first announcement are reported in the table in columns (4.7) to (4.12).

Test 2 indicates that the coefficient on AP_t^* in (4.1) is significantly different from 1 at the 0.10 level. The coefficient indicates that the preliminary barley acreage planted forecast is biased downward. The joint test of efficiency (i.e., the null hypothesis that $\alpha_0 = \alpha_2 = \alpha_3 = 0$) is reported as test 1. The null hypothesis is not rejected at the 5% significance level. The implication is that there is no relevant information available at the time of the forecast that is not incorporated into the government forecast. In addition, the joint test for unbiasedness and efficiency is the null hypothesis: $\alpha_2 = \alpha_0 = \alpha_3 = 0$, $\alpha_1 = 1$. The marginal significance level for this test is 0.17, indicating that rationality is not rejected at the 10% significificiance level.

The change in market information from the government announcement is measured by the change in R^2 from (4.2) to (4.1). The R^2 rises from 0.71 to 0.95, meaning that the market's error variance in forecasting PF_t falls from 0.28 to 0.04. Thus, the government substantially improves market information relative to its pre-announcement information. The market's error variance is reduced by 83 percent.

The market information set can explain 80 percent of the variation in preliminary barley acreage planted forecast. The interpretation is that the market can predict over four-fifths of the variation in the government's preliminary announcement before the announcement takes place, but only 71 percent of the true acres planted. However, the market does not know the government's information set exactly.

When we examine the individual t-test for each coefficient, it seems interesting that the standard errors for previous government reports are low relative to the coefficient both before and after the release of the preliminary forecast. The null hypothesis that $\alpha_2 = 0$ is rejected at the 0.01 significance level in (4.2) and (4.1). This means that the previous government forecast should not be ignored before and after the release of preliminary government forecast when forecasting barley acreage planted. This finding implies that the government could costlessly improve its acres planted forecast of barley by incorporating information on its final acreage planted figure for the previous year.

In the second scenario, we incorporate potential structural change in the coefficients after 1963. The results are shown in table 4.1 colums (4.4) to (4.6). Chow tests were conducted for the unconstrained model (4.14) and restricted model (4.1). Because the value of this F-statistic is not significant at the 0.05 level, we fail to reject the null hypothesis that the added parameters (α_4, α_5, α_6) are jointly 0. This implies that there was no structural change in the error structure of the government's forecast of acreage planted to barley.

The F-test comparing (4.5) with (4.2) tests whether structural change occured in the pre-announcement forecasts of true planted acreage. The test statistic comparing (4.5) and (4.2) is 4.8, and 5.6 for (4.3) and (4.6). Therefore, we reject the null hypothesis of no structural change at the 5% significance level. This implies that the market changed its forecasting procedures for both preliminary and final acres planted. In both cases, the change appears due to the the market agents' use of the past government information. The t-statistic indicates significant difference in the coefficient on the previous years acreage planted. There is also weak evidence that the response to market price gets smaller in the post 1963 period. These findings imply that the market revised its forecast methods after 1963 but the government did not. Because early announcements are likely to be more important than later announcements, I repeat these tests, focussing on the first announcement of each year (there were two announcements in the eight years between 1972 and 1980). The joint hypothesis of efficiency is rejected at the 0.1 level. The coefficient on the preliminary forecast is significantly above one, consistent with the earlier finding that barley acres planted forecasts are biased downward. However the joint test of bias and efficiency marginally fails to reject the null hypothesis at the 0.1 level. The rest of the test results for the sample of first announcements are almost identical to those which combined first and second announcements. It is interesting to note that the market's pre-announcement information on PF_t and AP_t^* is less certain compared to the regressions including both first and second announcements (as noted by the lower R^2 for the first announcement). Related to this is the larger increase in R^2 as a result of the government's announcement, signifying that first forecasts of barley acreage planted are more valuable to market agents than are subsequent forecasts.

4.2 Barley Production

The forecasts of barley production were released in July, August, September, and October. Therefore, we estimate the equation of the same form as (3.8) to (3.12) for each of these four months. Q_{t-1} will replace AP_{t-1} from August on since the previous production forecast is known after July.

The null hypotheses T1 $\sim$ T3 are all rejected at the 1% significance level for (4.16).These tests indicate that the government forecasts are inefficient and biased. Since the coefficient on Q^* is less than 1, first barley production forecasts tend to be biased upward. Those findings indicate that there should be other available information and resources that government could take into account to improve the production forecasts for barley. The R^2 for (4.16) is 0.90 which is much greater than the market's ability to forecast true barley production before the announcement. The proportion of the variance explainable by market information rises from 0.053 before the July production announcement to 0.92 after the announcement. The increases in R^2 indicates a reduction of the market's error variance of 92 percent, meaning that the government substantially improves market information relative to its preannouncement information.

Next, we compare equations allowing for structural change after 1963. Therefore, F-tests are used to test the significance of those added variables when structural change happened after 1963 by comparing (4.16) with (4.19), (4.17) with (4.20), and (4.18) with (4.21). The value of the F-tests are 0.14, 0.059, and 0.05 respectively. The null hypotheses that the added variables are equal to zero are not rejected at the 5% significance level, so it appears that structural changes in the forecasts do not occur.

Turning to the second report in August, the null hypotheses of T1 and T2 are both rejected at the 1% significance level for equation (4.22), meaning that the second report for the government forecast of barley production in August is unbiased and inefficient. Furthermore, the joint test of unbiasedness and efficiency also rejects the null hypothesis. The R^2 on the market's preannouncement forecast of QF_t (column 4.26) indicates no new market information since the previous government release. However, the second barley announcement raised the R^2 from 0.94 before the announcement to 0.98 after the announcement. Thus, the second barley announcement lowers the remaining uncertainty about the harvest size by 0.67 percent. Tests of structural change after 1963 have F-statistics of 1.72 for the comparison of (4.22) with (4.25), 0.007 for the comparison of (4.13) with (4.26), and 0.54 for the comparison of (4.24) with (4.27). All the above null hypotheses of added variables being equal to zero are not rejected at the 5% significance level. These results are the same as the results for July. 1963 do not happen.

In September, the three null hypotheses T1 to T3 for the third report are all rejected at the 5% significance level, meaning that the production forecasts of barley in September are inefficient and biased downward.Because the coefficient on Q_t^* in (4.31) is greater than one, the third barley forecast is biased. Again, we find that structural change does not occur after 1963.

Table 4.1: Acreage Planted to Barley (Combination of both Announcements)

	W/O structural change			W/structural change		
	PF_t (4.1)	PF_t (4.2)	AP^*_t (4.3)	FP_t (4.4)	PF_t (4.5)	AP^*_t (4.6)
Constant (α_0)	-30.86	1,499.07	1,339.04	-93.13	4,269.19	3,780.47
	(414.32)	(987.25)	(791.33)	(687.68)	(1,298.59)	(1017.60)
AP^*_t (α_1)	1.14	-	-	1.12	-	-
	(0.078)	-	-	(0.10)	-	-
I_{t-1} (α_2)	-0.152	0.86	0.89	-0.12	0.7015	0.75
	(0.077)	(0.084)	(0.067)	(0.095)	(0.94)	(0.07)
$\triangle P^*_{t-1}$ (α_3)	-0.59	-5.17	-4.004	6.61	134.48	112.37
	(6.15)	(15.11)	(12.11)	(37.5)	(72.29)	(62.14)
$AP63^*_t$ ($\alpha_{4)}$)	-	-	-	0.095	-	
	-	-	-	(0.17)	-	-
$I63_{t-1}$ (α_5)	-	-	-	-0.092	-0.125	-0.111
	-	-	-	(0.17)	(0.045)	(0.04)
$\triangle P63_{t-1}$ (α_6)	-	-	-	-6.91	-139.80	-116.29
	-	-	-	(39.95)	(80.12)	(67.79)
R^2	0.95	0.71	0.80	0.95	0.76	0.85
T1	F(3,42)	-	-	-	-	-
	=1.41	-	-	-	-	-
T2	F(1,42)	-	-	-	-	-
	=3.40	-	-	-	-	-
T3	F(4,42)	-	-	-	-	-
	=1.69	-	-	-	-	-

Table 4.2: Acreage Planted to Barley (1st announcement)

	W/O structural change			W/structural change		
	PF_t (4.7)	PF_t (4.8)	AP_t^* (4.9)	PF_t (4.10)	PF_t (4.11)	AP_t^* (4.12)
Constant (α_0)	58.91 (510.58)	2,193.67 (1,215.84)	1,866.12 (977.25)	-81.05 (835.71)	5,099.99 (1,504.25)	4,440.37 (1,177.47)
AP_t^* (α_1)	1.14 (510.58)	- -	- -	1.12 (0.11)	- -	- -
I_{t-1} (α_2)	-0.16 (0.08)	0.81 (0.10)	0.85 (0.08)	-0.12 (0.102)	0.64 (0.11)	0.70 (0.085)
$\triangle P_{t-1}$ (α_3)	-1.26 (12.92)	5.97 (32.36)	6.32 (26.0)	6.84 (40.94)	148.28 (85.56)	123.33 (66.97)
$AP63_t^*$ (α_4)	- -	- -	- -	0.13 (0.196)	- -	- -
$I63_{t-1}$ (α_5)	- -	- -	- -	-0.123 (0.193)	-0.13 (0.05)	-0.12 (0.034)
$\triangle P63_{t-1}$ (α_6)	- -	- -	- -	-8.37 (42.16)	-141.68 (93.32)	-115.26 (69.53)
R^2	0.95	0.68	0.78	0.95	0.75	0.84
T1	F(3, 33) = 1.28	- -	- -	- -	- -	- -
T2	F(1, 33) = 2.86	- -	- -	- -	- -	- -
T3	F(4, 33) = 1.30	- -	- -	- -	- -	- -

Table 4.3: The First Barley Production Forecasts

	W/O Structural Change		
	QF_t (4.16)	QF_t (4.17)	Q_t (4.18)
Constant (a_0)	48,257.06 (25,667.74)	372,254.24 (68,374.78)	376,180.94 (76,160.77)
Q_t^* (a_1)	0.86 (0.044)	- -	- -
AP_{t-1} (a_2)	1.697 (1.625)	3.01 (5.67)	1.53 (6.31)
$\triangle P_{t-1}$ (a_3)	320.07 (213.55)	-859.75 (715.06)	-1,369.85 (796.48)
Q_{t-1} (a_4)	-	-	-
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.92	0.053	0.085
T1	F(3,33) =6.85	- -	- -
T2	F(1,33) =9.89	- -	- -
T3	F(4,33) =5.91	- -	- -

Table 4.4: The First Barley Production Forecasts

	With Structural Change		
	QF_t (4.19)	QF_t (4.20)	Q_t (4.21)
Constant (a_0)	81,145.27 (34,031.21)	144,751.3 (87,307.67)	110,305.4 (99,112.56)
Q_t^* (a_1)	1.28 (0.26)	- -	- -
AP_{t-1} (a_2)	-10.21 (7.49)	16.68 (5.84)	17.17 (6.63)
$\triangle P_{t-1}$ (a_3)	1,990.81 (829.44)	1,276.83 (2,159.97)	-39.06 (2,452.02)
Q_{t-1} (a_4)	-	-	-
$Q63_t^*$ (a_5)	-0.48 (0.27)	- -	- -
$AP63_{t-1}$ (a_6)	11.62 (6.57)	10.32 (3.33)	12.23 (3.78)
$\triangle P63_{t-1}$ (a_7)	-1,876.15 (893.62)	-2,047.38 (2,296.70)	-1,128.2 (2,607.23)
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.94	0.42	0.42

Table 4.5: The Second Barley Production Forecasts

	W/O Structural Change		
	QF_t (4.22)	QF_t (4.23)	Q_t (4.24)
Constant (a_0)	35,095.5 (10,559.6)	73,103.9 (15,608.8)	34,373.9 (11,379.0)
Q_t^* (a_1)	1.106 (0.14)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-510.26 (127.23)	-689.74 (208.34)	-162.32 (151.88)
Q_{t-1} (a_4)	-0.177 (0.13)	0.85 (0.038)	0.93 (0.028)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.98	0.94	0.97
T1	F(3,33) =5.34	- -	- -
T2	F(1,33) =8.15	- -	- -
T3	F(4,33) =5.103	- -	- -

Table 4.6: The Second Barley Production Forecasts

	With Structural Change		
	QF_t (4.25)	QF_t (4.26)	Q_t (4.27)
Constant (a_0)	21,029.4 (11,672.4)	70,817.7 (17,751.5)	39,835.2 (12,763.6)
Q_t^* (a_1)	0.85 (0.26)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-9.65 (492.34)	-478.42 (874.63)	-416.75 (628.88)
Q_{t-1} (a_4)	0.13 (0.266)	0.86 (0.052)	0.90 (0.037)
$Q63_t^*$ (a_5)	0.414 (0.304)	- -	- -
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-498.03 (506.38)	-222.53 (902.72)	263.90 (649.07)
$Q63_{t-1}$ (a_8)	-0.44 (0.31)	-0.006 (0.022)	0.015 (0.016)
R^2	0.98	0.94	0.97

Table 4.7: The Third Barley Production Forecasts

	W/O Structural Change		
	QF_t (4.28)	QF_t (4.29)	Q_t (4.30)
Constant (a_0)	17,499.9 (9,076.5)	35,926.5 (13,778.8)	12,153.9 (7,117.8)
Q^*_t (a_1)	1.52 (0.212)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	273.12 (160.88)	79.69 (251.13)	-127.58 (129.73)
Q_{t-1} (a_4)	-0.56 (0.21)	0.93 (0.03)	0.98 (0.02)
$Q63^*_t$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.98	0.96	0.99
T1	F(3,32) =5.22	- -	- -
T2	F(1,32) =5.88	- -	- -
T3	F(4,32) =4.61	- -	- -

Table 4.8: The Third Barley Production

	With Structural Change		
	QF_t (4.31)	QF_t (4.32)	Q_t (4.33)
Constant (a_0)	3,560.6	26,173.5	11,968.9
	(9,332,1)	(15,119.3)	(8,098.4)
Q_t^* (a_1)	1.055	-	-
	(0.32)	-	-
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	19.97	-131.27	-168.14
	(515.14)	(888.73)	(498.58)
Q_{t-1} (a_4)	-0.04	0.97	0.98
	(0.32)	(0.043)	(0.023)
$Q63_t^*$ (a_5)	0.73	-	-
	(0.41)	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	399.69	326.99	45.53
	(540.91)	(930.83)	(498.58)
$Q63_{t-1}$ (a_8)	-0.77	-0.026	-0.0005
	(0.41)	(0.017)	(0.009)
R^2	0.99	0.97	0.99

5. CORN

5.1 Acreage Planted

The estimated coefficients for the corn announcements are reported in Tables 5.1 to 5.4 for acreage planted, and Table 5.5 to Table 5.16 for production. The rows and columns are displayed in the same order as for previous forecasts.

The government's forecast of corn acreage planted is efficient and unbiased. All the F-tests, T1, T2 and T3 which are shown on Table 5.1 failed to reject the null hypothesis. The implication is that the government's forecast gives the market a fully informational rational forecast. The R^2 changes from 0.54 to 0.81 following the government announcement.

The error variance was reduced by 0.27 (59 percent) which implies that the market significantly improves its information with the release of the preliminary acreage planted announcement. The tests of structural change in government forecasts reveal that the government forecasts of corn acreage planted did change after 1963. The F-tests for α_4, α_5, and α_6 jointly equal to zero had values of 2.63, 1.21 and 0.065. Therefore, the F-test comparing (5.1) to (5.4) rejects null hypothesis at the 0.1 significance level, implying that the coefficients of $AP63_t^*$, $I63_{t-1}$, and $\triangle P63_{t-1}$ are not jointly equal to zero. The government revised its forecast by incorporating new information into its corn forecasts. The evidence indicates that the change was due to the incorporation of market price movements into the forecast of corn acreage planted. The other F-tests failed to reject the null at the 5% significance level which means the market did not revise its pre-announcement forecast as the government changed its forecast methodology after 1963. It is interesting to find that the previous acreage planted information and the price movements leading to government's announcement are both very important to the market's forecast ability. The individual t-tests of the coefficients reject the null hypothesis at the 0.01 significance level. The estimated results for the sample containing only the first announcements are shown in Tables 5.3 and 5.4. The above results are still obtained. The F-tests for efficient and unbiased forecasts T1, T2, and T3 failed to reject the null hypothesis at the 0.05 level. The change in R^2 for these regressions is identical to the earlier results. Equations allowing structural change are almost the same as the above mentioned equations for both first and second announcements. F statistics were computed comparing (5.7) with (5.10), (5.8) with (5.11), and (5.9) with (5.12). The F-statistics for those three pairs are 1.20, 0.50, 0.12 separately. All null hypotheses are not rejected at the 5% significance level which implies both the government and market did not revise their forecast methodologies for first announcements. The earlier strong finding of change in the government's forecast methodology was apparently due to the discontinued second forecasts in the 1973-1980 period.

5.2 Production

The estimated results for corn production forecasts are displayed in Tables 5.5 to 5.16. The columns and the variables correspond to the presentation used for barley production forecasts. The announcements for corn production are released in

August, September, October, and November. The first announcement before 1971 and between 1975 and 1982 was released in July. For the first production report, our measure of past crop information is AP_{t-1}. There is no Q_{t-1} before the first report of production, and so the acres planted report is the most recent information on the size of the corn crop for the first production forecast. The samples are based on first reports, second reports and so on, rather than by month. The fifth sample covers years which had five reports. They includes the years before 1971 and the year between 1975 and 1982. This method enables us to hold fixed the type of relevant information available leading up to the announcement. Thus, all first announcement have an acreage planted forecast as the measure of past information. All second forecasts have the previous production forecast as the relevant information base.

For first announcements, the F-tests T1, T2 and T3 all fail to reject the null hypothesis at standard significance levels. There is weak evidence of inefficiency in that the change in market prices is significant at the 0.1 level. Nevertheless, the first production forecast appears to be clearly unbiased and at least weakly efficient. The R^2 rises from 0.067 to 0.94 from before to after the production announcement, which means the market improves its information substantially as a result of the government forecast. The market's error variance reduces by 94 percent after the release of the report. F-tests examine whether the structural change occurred in government and market forecast methods after 1963. The F-statistic values are 0.46, 53.9, and 6.66 for above comparison. The null hypothesis of no change in government forecast methodology is not rejected. However, The market is found to have revised its forecast because the null hypotheses for (5.17) and (5.20), and (5.18) and (5.21) are rejected. An examination of the individual t-tests indicates that the coefficient on $AP63_{t-1}$ is significant for (5.20) and (5.21). This implies that the market changed how it used the previous acreage planted figure in making its pre-announcement forecast of corn production after 1963.

Refer to T1, T2 and T3 for the second announcement. The null hypotheses of efficiency and unbiasedness are all rejected at the 5% significance level. These imply that the government's forecast is inefficient and biased. The government could improve its forecast of corn production at this stage by using available information to release a more rational forecast to the public. The individual t-test for Q_t^* indicates a failure to reject the null hypothesis that the second announcement adds nothing to predictions of final harvest size. However, the coefficient on the previous announcement is highly significant and the coefficient on the first announcement is not significantly different from one. The implication is that the market ignores the second production forecast. This presumption is supported by examining the change in R^2 following the release of the second production figure. The R^2 of the equations explaining corp production changes from 0.9412 to 0.9416 as a result of the government's second corn production forecast. In essence, the second forecast adds virtually no information to the market. In addition, there is no evidence of structural change after 1963.

Next I examine the results for the third announcement. The F- tests in T1 and T2 that are shown on Table 5.7 failed to reject the null hypothesis which means the government's forecast is unbiased and efficient. The joint test for rationality in T3 is rejected at the 5% significance level, although the reason for the rejection is unclear. All t-statistics are consistent with the finding of rationality.

The market tends to improve its information as a result of the third forecast. The

R^2 increases from 0.8077 (5.29) to 0.9915 (5.28). The low R^2 for the preannouncement market forecast is attributable to the poor second forecast. We reestimated the regressions for the third announcement by adding the production information from the first announcement (which appeared to dominate the information from the second announcement). The results are reported in table 5.7. We found all the R^2 are greater than the R^2 in those earlier results. Use of the first forecast and the associated price change raises the preannouncement R^2 to 0.9420 (5.35) in Table 5.7; The error variance is reduced by 96 percent as a result of the release of the third report. The F-tests for structural change after 1963 fail to reject the null hypotheses, implying that the government and the market did not change their forecast methodology.

I next report the estimates for the fourth announcement. The estimated results are shown on Table 5.15 and 5.16. Tests T1 and T2 support the hypothesis that the government forecast is efficient and unbiased at the 5% significance levels. As before, however, the joint test of efficiency and unbiasedness, T3, is rejected at standard significance level. The t-statistic on $\triangle P$ indicates that the government's forecast fails to take into account information from market price movements. Nevertheless, there is some slight value to the government's fourth forecast of the corn crop since the R^2 rises from 0.9918 before the announcement to 0.9947 after the announcement. F-statistics for the tests of structural change are 0.67, 0.13, and 2.3. All tests failed to reject the null hypotheses: $a_6 = a_7 = a_8 = 0$.

Finally, I examine the rationality of fifth forecasts. All F-tests support rationality at the 5% significance levels. The fifth report still has some marginal value. The R^2 rises from 0.9912 to 0.9936 as a result of the fifth forecast. The F-test for structural change after 1963 comparing (5.46) with (5.49), (5.47) with (5.50), and (5.48) with

(5.51) had the values of 1.36, 0.28 and 2.27. Therefore, we can not reject the null hypothesis of $a_5 = a_7 = a_8 = 0$ at the 5% significance level for those regression. No evidence of the structural change exists for the fifth forecast. All in all, the government's forecasts of corn production seem generally reliable from the first report to the last report except for the second report.

Table 5.1: Acreage Planted to Corn (Combination of both Announcements)

	W/O structural change		
	PF_t (5.1)	PF_t (5.2)	AP_t^* (5.3)
Constant (α_0)	-541.2	25,062.9	23,633.7
	(6,202.9)	(8,121.8)	(5,760.9)
AP_t^* (α_1)	1.08	-	-
	(0.14)	-	-
I_{t-1} (α_2)	-0.09	0.68	0.71
	(0.12)	(0.11)	(0.075)
$\triangle P_{t-1}$ (α_3)	-18.34	-121.9	-95.55
	(26.03)	(34.55)	(24.51)
$AP63_t^*$ (α_4)	-	-	-
$I63_{t-1}$ (α_5)	-	-	-
$\triangle P63_{t-1}$ (α_6)	-	-	-
R^2	0.81	0.54	0.70
T1	F(3,42)	-	-
	=0.70	-	-
T2	F(1,42)	-	-
	=0.36	-	-
T3	F(4,42)	-	-
	=1.26	-	-

Table 5.2: Acreage Planted to Corn (Combination of both Announcements)

	W/structural change		
	PF_t (5.4)	PF_t (5.5)	AP_t^* (5.6)
Constant (α_0)	-5,606.3	20,833.4	24,101.7
	(6,164.6)	(8,568.5)	(6,244.3)
AP_t^* (α_1)	0.92	-	-
	(0.27)	-	-
I_{t-1} (α_2)	0.11	0.71	0.70
	(0.27)	(0.11)	(0.08)
$\triangle P_{t-1}^*$ (α_3)	-64.54	-103.3	-51.37
	(117.28)	(185.9)	(135.45)
$AP63_t^*$ (α_4)	0.21	-	
	(0.29)	-	-
$I63_{t-1}$ (α_5)	-0.17	0.04	-0.002
	(0.3)	(0.023)	(0.02)
$\triangle P63_{t-1}$ (α_6)	39.82	-30.76	-44.88
	(120.4)	(188.91)	(137.67)
R^2	0.84	0.56	0.70

Table 5.3: Acreage Planted to Corn (1st announcement)

	W/O structural change		
	PF_t (5.7)	PF_t (5.8)	AP_t^* (5.9)
Constant (α_0)	1,904.4 (7,032.6)	30,417.9 (8,743.9)	26,568.6 (6,256.8)
AP_t^* (α_1)	1.07 (7,032.6)	- -	- -
I_{t-1} (α_2)	-0.11 (0.13)	0.60 (0.11)	0.67 (0.082)
$\triangle P_{t-1}$ (α_3)	-23.4 (29.4)	-138.6 (37.13)	-107.34 (26.6)
$AP63_t^*$ (α_4)	-	-	-
$I63_{t-1}$ (α_5)	-	-	-
$\triangle P63_{t-1}$ (α_6)	-	-	-
R^2	0.81	0.54	0.70
T1	F(3, 33) = 0.95	- -	- -
T2	F(1, 33) = 0.22	- -	- -
T3	F(4, 33) = 2.07	- -	- -

Table 5.4: Acreage Planted of Corn (1st announcement)

	W/structural change		
	PF_t (5.10)	PF_t (5.11)	AP_t^* (5.12)
Constant (α_0)	-2,984.3 (7,486.4)	26,936.9 (9,698.3)	27,341.3 (7,024.93)
AP_t^* (α_1)	0.9 (7,486.4)	- -	- -
I_{t-1} (α_2)	0.11 (0.29)	0.63 (0.12)	0.66 (0.088)
$\triangle P_{t-1}$ (α_3)	-61.7 (127.3)	-90.7 (195.3)	-44.6 (141.8)
$AP63_t^*$ (α_4)	0.23 (0.32)	- -	- -
$I63_{t-1}$ (α_5)	-0.21 (0.32)	-0.03 (0.03)	-0.003 (0.02)
$\triangle P63_{t-1}$ (α_6)	37.02 (131.6)	-57.4 (199.3)	-64.07 (144.4)
R^2	0.83	0.56	0.71

Table 5.5: The First Corn Production Forecasts

	W/O Structural Change		
	QF_t (5.16)	QF_t (5.17)	Q_t (5.18)
Constant (a_0)	-22,115.4 (851,790.79)	960,571.3 (3,367,746.94)	959,402.2 (3,184,519)
Q_t^* (a_1)	1.024 (0.05)	- -	- -
AP_{t-1} (a_2)	0.13 (0.13)	53.8 (43.5)	52.4 (41.13)
$\triangle P_{t-1}$ (a_3)	-3,599.4 (2,095.9)	-6,231.5 (8,284.4)	-2,569.8 (7,833.7)
Q_{t-1} (a_4)	-	-	-
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.94	0.067	0.053
T1	F(3,33) =1.05	- -	- -
T2	F(1,33) =0.28	- -	- -
T3	F(4,33) =1.11	- -	- -

Table 5.6: The First Corn Production Forecasts

	With Structural Change		
	QF_t (5.19)	QF_t (5.20)	Q_t (5.21)
Constant (a_0)	-540,363.5 (1,195,992.09)	-6,234,559.7 (1,802,353.4)	-5,932,943.5 (1,568,109)
Q^*_t (a_1)	1.16 (0.39)	- -	- -
AP_{t-1} (a_2)	-0.9 (20.3)	117.6 (22.3)	114.6 (19.4)
$\triangle P_{t-1}$ (a_3)	13,301.7 (16,232.9)	27,518.2 (30,763.1)	14,389.8 (26,764.9)
Q_{t-1} (a_4)	-	-	-
$Q63^*_t$ (a_5)	-0.19 (0.41)	- -	- -
$AP63_{t-1}$ (a_6)	12.4 (20.02)	45.63 (5.07)	42.8 (4.4)
$\triangle P63_{t-1}$ (a_7)	-17,284.5 (16,364.9)	-34,228.5 (30,956.4)	-17,183.0 (26,933.1)
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.94	0.79	0.82

Table 5.7: The Second Corn Production Forecasts

	W/O Structural Change		
	QF_t (5.22)	QF_t (5.23)	Q_t (5.24)
Constant (a_0)	-27,308.9 (238,516.04)	-19,399.7 (235,162.8)	194,500.0 (468,646.4)
Q_t^* (a_1)	0.04 (0.09)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-7,182.3 (5,155.7)	-7,727.08 (4,964.04)	-13,396.4 (9,892.6)
Q_{t-1} (a_4)	0.97 (0.01)	1.0 (0.05)	0.96 (0.09)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.9416	0.9412	0.7946
T1	F(3,33) =39.6	- -	- -
T2	F(1,33) =121.4	- -	- -
T3	F(4,33) =30.8	- -	- -

Table 5.8: The Second Corn Production Forecasts

	With Structural Change		
	QF_t (5.25)	QF_t (5.26)	Q_t (5.27)
Constant (a_0)	-116,089	-107,459.6	646,246.9
	(371,830.0)	(3666,615.98)	(724,938.3)
Q_t^* (a_1)	1.09	-	-
	(0.81)	-	-
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	13,004.3	-1,350.9	-11,107.2
	(18,026.7)	(25,867.6)	(51,149.98)
Q_{t-1} (a_4)	-0.03	0.04	0.80
	(0.81)	(0.11)	(0.22)
$Q63_t^*$ (a_5)	-1.06	-	-
	(0.82)	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-20,720.12	-6,769.5	-1,763.7
	(28,563.9)	(26,407.6)	(-1,763.7)
$Q63_{t-1}$ (a_8)	1.014	-0.023	0.1
	(0.81)	(0.11)	(0.12)
R^2	0.95	0.94	0.80

Table 5.9: The Third Corn Production Forecasts

	W/O Structural Change		
	QF_t (5.28)	QF_t (5.29)	Q_t (5.30)
Constant (a_0)	-42,064.7	-11,094.0	1,0135,598.1
	(90,831.5)	(383,033.8)	(358,638.8)
Q_t^* (a_1)	1.04	-	-
	(0.04)	-	-
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-2,081.8	-31,057.7	-27,750.6
	(2,556.1)	(10,846.4)	(10,155.6)
Q_{t-1} (a_4)	-0.02	0.77	0.76
	(0.03)	(0.07)	(0.07)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.9915	0.8077	0.8192
T1	F(3, 33)	-	-
	=0.67	-	-
T2	F(1, 33)	-	-
	=1.28	-	-
T3	F(4, 33)	-	-
	=3.59	-	-

Table 5.10: The Third Corn Production Forecast

	With Structural Change		
	QF_t (5.31)	QF_t (5.32)	Q_t (5.33)
Constant (a_0)	-11,1093.9 (145,515.2)	1,767,786.4 (570,862.4)	1,705,294.04 (534,934.5)
Q_t^* (a_1)	0.92 (0.33)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-16,639.7 (12,449.1)	-40,152.1 (53,516.5)	-23,892.8 (50,148.4)
Q_{t-1} (a_4)	0.09 (0.33)	0.48 (0.2)	0.50 (0.17)
$Q63_t^*$ (a_5)	0.13 (0.33)	- -	- -
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	14,981.6 (12,655.7)	6,790.8 (54,483.5)	-23,892.8 (51,054.5)
$Q63_{t-1}$ (a_8)	-0.11 (0.33)	0.19 (0.11)	0.16 (0.104)
R^2	0.9918	0.8246	0.8347

Table 5.11: The Third Corn Production Forecasts

	W/O Structural Change		
	QF_t (5.34)	QF_t (5.35)	Q_t (5.36)
Constant (a_0)	-21,540.8 (92,786.5)	8,206.13 (242.798.7)	26,616.6 (201,287.3)
Q_t^* (a_1)	1.1 (0.08)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-2,061.3 (2,552.4)	-9,640.5 (6,527.1)	-6,781.7 (5,411.2)
Q_{t-1} (a_4)	-0.01 (0.03)	0.1 (0.09)	0.1 (0.07)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
Q_{t-2} (a_9)	-0.09 (0.08)	0.9 (0.1)	0.89 (0.09)
$Q63_{t-2}$ (a_{10})	-	-	-
R^2	0.9918	0.9420	0.9572
T1: F(3,33)	0.78	-	-
T2: F(1,33)	2.15	-	-
T3: F(4,33)	3.10	-	-

Table 5.12: The Third Corn Production Forecasts

	With Structural Change		
	QF_t (5.37)	QF_t (5.38)	Q_t (5.39)
Constant (a_0)	31,806.1	-516.9	-29,167.9
	(154,650.8)	(398,986.7)	(331,176.6)
Q_t^* (a_1)	0.89	-	-
	(0.35)	-	-
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-18,259.1	-30,941.9	-14,280.9
	(13,580.5)	(32,601.7)	(27,060.8)
Q_{t-1} (a_4)	0.03	0.7	0.7
	(0.4)	(0.8)	(0.7)
$Q63_t^*$ (a_5)	0.24	-	-
	(0.36)	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	6,450.2	22,936.1	8,801.7
	(13,821.9)	(33,239.9)	(27,590.6)
$Q63_{t-1}$ (a_8)	-0.04	-0.61	-0.66
	(0.40)	(0.80)	(0.67)
Q_{t-2} (a_9)	0.08	0.31	0.26
	(0.32)	(0.79)	(0.66)
$Q63_{t-2}$ (a_{10})	-0.18	0.62	0.65
	(0.33)	(0.79)	(0.65)
R^2	0.9923	0.9448	0.9592

Table 5.13: The Fourth Corn Production Forecasts

	W/O Structural Change		
	QF_t (5.40)	QF_t (5.41)	Q_t (5.42)
Constant (a_0)	-95,246.9 (79,896.4)	-145,672.7 (96,610.7)	-41,492.4 (47,097.9)
Q_t^* (a_1)	1.22 (0.29)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-4,931.9 (2,774.9)	-5,413.1 (3,390.7)	-41,492.4 (1,652.9)
Q_{t-1} (a_4)	-0.19 (0.3)	1.04 (0.02)	1.01 (0.009)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.9947	0.9918	0.99
T1	F(3,33) =1.33	- -	- -
T2	F(1,33) =0.56	- -	- -
T3	F(4,33) =3.96	- -	- -

Table 5.14: The Fourth Corn Production Forecasts

	With Structural Change		
	QF_t (5.43)	QF_t (5.44)	Q_t (5.45)
Constant (a_0)	17,793.4 (119,335.8)	-166,390.2 (137,944.5)	-136,155.1 (63,070.5)
Q_t^* (a_1)	1.59 (0.82)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-2,686.6 (5,834.9)	-2,537.9 (7,151.7)	-70.3 (3,269.9)
Q_{t-1} (a_4)	-0.6 (0.83)	1.06 (0.04)	1.05 (0.02)
$Q63_t^*$ (a_5)	-0.26 (0.87)	- -	- -
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-2,646.0 (6,477.7)	-3,687.9 (7,942.4)	-574.9 (3,631.4)
$Q63_{t-1}$ (a_8)	0.29 (0.88)	-0.01 (0.02)	-0.02 (0.011)
R^2	0.99	0.99	0.99

Table 5.15: The Fifth Corn Production Forecasts

	W/O Structural Change		
	QF_t (5.46)	QF_t (5.47)	Q_t (5.48)
Constant (a_0)	-75,144.5 (81,570.9)	-112,845.4 (92,890.9)	-32,936.6 (42,705.5)
Q_t^* (a_1)	1.14 (0.38)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	969.2 (2,774.9)	-2,335.7 (3,390.7)	-2,887.23 (1,652.9)
Q_{t-1} (a_4)	-0.19 (0.3)	1.04 (0.02)	1.01 (0.009)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.9936	0.9912	0.99
T1	F(3,24) =0.37	- -	- -
T2	F(1,24) =0.15	- -	- -
T3	F(4,24) =1.21	- -	- -

Table 5.16: The Fifth Corn Production Forecasts

	With Structural Change		
	QF_t (5.49)	QF_t (5.50)	Q_t (5.51)
Constant (a_0)	134,958.4 (132,547.7)	-45,255.3 (146,160.8)	-123,044.1 (62,140.2)
Q_t^* (a_1)	1.39 (0.94)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-1,177.3 (5,834.9)	-8,062.8 (7,151.7)	2,167.3 (3,269.9)
Q_{t-1} (a_4)	-0.6 (0.83)	1.06 (0.04)	1.05 (0.02)
$Q63_t^*$ (a_5)	-0.26 (0.87)	- -	- -
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-2,646.0 (6,477.7)	-3,687.9 (7,942.4)	-574.9 (3,631.4)
$Q63_{t-1}$ (a_8)	-0.04 (1.05)	0.013 (0.02)	-0.02 (0.02)
R^2	0.99	0.99	0.99

6. OATS

6.1 Acreage Planted

The estimated results of oat acreage planted are shown in table 6.1 to 6.4 for acreage planted. Results for production forecasts are reported in table 6.5 to 6.10 for production. The same conceptual dependent and independent variables were used as for previous crops and the existence of structural change after 1963 is also explored.

Conflicting evidence is obtained regarding the rationality of the acres planted forecasts. I find that the government's forecasts are efficient and unbiased, based on Tests T1 and T2 using the sample combing first and second announcement. These tests fail to reject the independent null hypotheses of efficiency and unbiasedness at the 5% significance level. In fact, the marginal significance levels for these tests are larger than 0.7. Yet, the joint test of unbiasedness and efficiency, T3, is rejected at the 5% significance level. It is difficult to reconcile these conflicting fingings, but the weight of the evidence suggests that these forecasts are rational. The R^2 changes from 0.85 to 0.986 following the announcement. This implies that the market improves its information relative to its preannouncement level. The market's error variance is reduced 91 percent as a result of the acreage planted forecast. The previous acreage planted reports are the main source of information to the market before the announcement. In fact, price movements are not informative in forecasting acreage planted, but the market can still predict 85 percent of planted acreage based primarily on past government information. The tests of structural change after 1963 had F-tests of 1.18, 3.14, and 2.5. Therefore, we fail to reject the null hypothesis in (6.4). No evidence exists supporting structural change in the governments forecast. However, the null hypothesis of no change in the market's forecast structure is rejected which means that the market revised its forecast over time. The primary change is a reduction in the use of market prices to forecast acreage planted in the period after 1963.

Similar results are obtained from regressions using only the first announcements. Tests T1 and T2 fail to reject the null hypotheses of efficiency and unbiasedness respectively, but T3 rejects the joint hypothesis of efficiency and unbiasedness at the 5% significance level. These findings are the same as the results using the sample which combines both first and second announcements. These confirm the mixed findings on forecast rationality obtained earlier. The R^2 is increased from 0.835 to 0.986 following the first oats acreage planted announcement. The market's error variance is reduced 92 percent after the release of the government's announcement.

The market still regards the previous government information, I_{t-1}, as the primary source of information in forecasting future acreage planted. The individual t-test for I_{t-1} are significant at the 5% significance level in (6.8) and (6.9). The market can predict 84 percent of the variance in final acres planted before the first government release. The F-tests used to test for structural change after 1963 show the government did not revise its forecast after 1963 but the market did change its forecasts. These results are qualitatively similar to those obtained using first and second acres planted forecasts.

6.2 Production

The forecasts of oats production are usually released in July, August, September. The F-tests corresponding to T1, T2, and T3 all show that the government's first oats production forecasts are efficient and unbiased. The null hypotheses of rationality could not be rejected at standard significance levels. The implication is that the government has access to all relevant market information and used the information efficiently in making unbiased forecasts.

The R^2 increases from 0.91 (6.17) to 0.96 (6.16), meaning that the market's error variance is reduced by 56.5%. While the market improves its information from the release of the government's report, the extent of the improvement is less than for the other crops, because the market already has such good information on the harvest size. The market's preannouncement R^2 (0.91) is higher than that of all other crop except soybeans (0.97). No evidence was found of structural change after 1963. The values of F-statistics for the null hypothesis of no structural change were 1.06, 0.15 and 0.27. These fail to reject the null hypothesis of no change at the 5% significance level. Thus, the government and the market did not revise their forecast methodology after 1963.

For the estimates concentratings on the second announcement tests, T1 and T2 fail to reject the null hypotheses of efficiency and unbiasedness. However, T3 rejects the joint hypothesis of efficiency and unbiasedness at the 5% significance level. The pattern of results is similar to that obtained for acres planted forecast. An examination of the individual coefficients indicates no individually significant sources of information that could improve the government forecast. Still, the second forecast might be improved by incorporating market price and past production forecast information since both have coefficients that are higher than their standard errors. There is marginal evidence that the second forecast is biased downward as well. Thus, the overall forecast violates rationality. The R^2 still rises from 0.96 (before the forecast) to 0.987 (after the forecast), indicating the error variance is reduced by 75%. The market improves its information as a result of the second forecast, but by less than the reduction from the first production forecast.

The tests of structural change in forecast method have associated F-values of 0.15, 3.56, and 5.13. The first test fails to reject the null hypothesis of no change, implying that the government did not alter the structure of its forecast after 1963. The other tests reject the null hypothesis at the 5% significance level. Thus, the market did revise its forecasts of the preliminary and final production figures after 1963, mainly by raising the weight on the first government production figure and lowering the weight on market price changes.

The results of F-tests for the government's third oats production forecast are the same as for the previous forecast. The joint test T3 rejects the null hypothesis of rationality at the 5% significance level although the tests T1 and T2 fail to reject their respective null hypotheses at the 5% significance level. The R^2 also rises from 0.985 (6.29) to 0.99 (6.30) implying a very small improvement in market information after the release of the government's third report. The error variance has been reduced by 33 percent. No support for structural change in government and market forecasts was evident. F-values are 1.05, 0.31, and 0.74 respectively. All tests fail to reject the null hypothesis of no change.

Table 6.1: Acreage Planted to Oats (Combination of both Announcements)

	W/O structural change		
	PF_t (6.1)	PF_t (6.2)	AP_t^* (6.3)
Constant (α_0)	186.07 (489.9)	4,527.9 (1,414.3)	4,363.2 (1,352.6)
AP_t^* (α_1)	0.995 (0.05)	- -	- -
I_{t-1} (α_2)	-0.03 (0.042)	0.76 (0.05)	0.80 (0.05)
$\triangle P_{t-1}$ (α_3)	3.83 (32.85)	72.42 (105.11)	68.92 (100.52)
$AP63_t^*$ (α_4)	-	-	-
$I63_{t-1}$ (α_5)	-	-	-
$\triangle P63_{t-1}$ (α_6)	-	-	-
R^2	0.986	0.85	0.87
T1	F(3,42) =0.29	- -	- -
T2	F(1,42) =0.0098	- -	- -
T3	F(4,42) =5.67	- -	- -

Table 6.2: Acreage Planted to Oats (Combination of both Announcements)

	W/structural change		
	PF_t (6.4)	PF_t (6.5)	AP_t^* (6.6)
Constant (α_0)	729.7	9,710.9	9,061.5
	(983.96)	(2,628.5)	(2,550.8)
AP_t^* (α_1)	0.97	-	-
	(0.053)	-	-
I_{t-1} (α_2)	-0.022	0.66	0.71
	(0.04)	(0.06)	(0.71)
$\triangle P_{t-1}$ (α_3)	-99.28	-88.0	9.17
	(83.35)	(257.18)	(249.59)
$AP63_t^*$ (α_4)	0.19	-	
	(0.20)	-	-
$I63_{t-1}$ (α_5)	-0.20	-0.20	-0.18
	(0.04)	(0.087)	(0.084)
$\triangle P63_{t-1}$ (α_6)	106.27	182.05	63.97
	(91.81)	(279.85)	(271.58)
R^2	0.987	0.87	0.89

Table 6.3: Acreage Planted to Oats (1st announcement)

	W/O structural change		
	PF_t (6.7)	PF_t (6.8)	AP_t^* (6.9)
Constant (α_0)	417.13 (593.27)	5318.69 (1,777.57)	4,908.8 (1,701.15)
AP_t^* (α_1)	593.27 (0.054)	- -	- -
I_{t-1} (α_2)	-0.042 (0.05)	0.74 (0.057)	0.79 (0.054)
$\triangle P_{t-1}$ (α_3)	-32.4 (43.6)	87.3 (144.24)	119.8 (138.04)
$AP63_t^*$ (α_4)	-	-	-
$I63_{t-1}$ (α_5)	-	-	-
$\triangle P63_{t-1}$ (α_6)	-	-	-
R^2	0.986	0.835	0.86
T1	F(3, 33) = 0.65	- -	- -
T2	F(1, 33) = 0.0008	- -	- -
T3	F(4, 33) = 4.38	- -	- -

Table 6.4: Acreage Planted to Oats (1st announcement)

	W/structural change		
	PF_t (6.10)	PF_t (6.11)	AP_t^* (6.12)
Constant (α_0)	746.3 (1,087.98)	10,814.2 (3,102.31)	9,913.55 (3,008.65)
AP_t^* (α_1)	0.97 (0.055)	- -	- -
I_{t-1} (α_2)	0.044 (0.044)	0.64 (0.072)	0.69 (0.069)
$\triangle P_{t-1}$ (α_3)	-99.12 (85.38)	-74.7 (284.82)	19.5 (276.22)
$AP63_t^*$ (α_4)	0.58 (0.2642)	- -	- -
$I63_{t-1}$ (α_5)	-0.58 (0.26)	-0.2 (0.099)	-0.19 (0.096)
$\triangle P63_{t-1}$ (α_6)	-13.97 (107.49)	195.12 (327.29)	116.16 (317.41)
R^2	0.988	0.86	0.88

Table 6.5: The First Oats Production Forecast

	W/O Structural Change		
	QF_t (6.16)	QF_t (6.17)	Q_t (6.18)
Constant (a_0)	50,411.7 (38,076.7)	193,809 (41,520.62)	170,022.34 (170,022.34)
Q_t^* (a_1)	0.84 (0.15)	- -	- -
AP_{t-1} (a_2)	2.76 (4.04)	25.46 (1.45)	26.91 (1.25)
$\triangle P_{t-1}$ (a_3)	-423.31 (702.77)	-1,744.01 (952.96)	-1,565.92 (821.70)
Q_{t-1} (a_4)	-	-	-
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.96	0.91	0.94
T1	F(3,30) =0.96	- -	- -
T2	F(1,30) =1.16	- -	- -
T3	F(4,30) =1.22	- -	- -

Table 6.6: The First Oats Production Forecasts

	With Structural Change		
	QF_t (6.19)	QF_t (6.20)	Q_t (6.21)
Constant (a_0)	31,340.67 (56,341.62)	100,396.21 (100,396.21)	67,526.47 (56,460.24)
Q_t^* (a_1)	1.05 (0.24)	- -	- -
AP_{t-1} (a_2)	-2.82 (7.25)	27.33 (2.02)	28.76 (1.47)
$\triangle P_{t-1}$ (a_3)	6,626.99 (4,195.37)	-4,357.85 (4,757.16)	-10,516.31 (3,465.46)
Q_{t-1} (a_4)	-	-	-
$Q63_t^*$ (a_5)	-0.094 (0.35)	- -	- -
$AP63_{t-1}$ (a_6)	2.48 (2.48)	3.37 (2.20)	4.09 (1.60)
$\triangle P63_{t-1}$ (a_7)	-7,154.41 (4,272.17)	2,750.95 (4,871.66)	9,376.69 (3,548.88)
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.96	0.92	0.96

Table 6.7: The Second Oats Production Forecasts

	W/O Structural Change		
	QF_t (6.22)	QF_t (6.23)	Q_t (6.24)
Constant (a_0)	20,878.18 (19,628.33)	19,564.65 (33,787.65)	-1,132.38 (23,903.15)
Q_t^* (a_1)	1.16 (0.15)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-484.77 (463.62)	-1,402.1 (772.42)	-790.82 (546.45)
Q_{t-1} (a_4)	-0.21 (0.15)	0.95 (0.035)	1.008 (0.025)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.987	0.96	0.98
T1	F(3,30) =2.04	- -	- -
T2	F(1,30) =1.18	- -	- -
T3	F(4,30) =6.44	- -	- -

Table 6.8: The Second Oat Production Forecasts

	With Structural Change		
	QF_t (6.25)	QF_t (6.26)	Q_t (6.27)
Constant (a_0)	35,355.57	18,041.05	-15,225.20
	(32,472.73)	(49,225.98)	(33,401.33)
Q_t^* (a_1)	1.15	-	-
	(0.25)	-	-
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-1,395.19	-15,589.78	-12,385.99
	(4,677.51)	(5,390.18)	(3,657.4)
Q_{t-1} (a_4)	-0.21	0.93	0.99
	(0.25)	(0.042)	(0.028)
$Q63_t^*$ (a_5)	-0.01	-	-
	(0.36)	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	974.05	14,406.09	11,715.05
	(4,687.8)	(5,410.5)	(3,671.17)
$Q63_{t-1}$ (a_8)	-0.001	0.03	0.04
	(0.36)	(0.04)	(0.024)
R^2	0.987	0.968	0.99

Table 6.9: The Third Oat Production Forecasts

	W/O Structural Change		
	QF_t (6.28)	QF_t (6.29)	Q_t (6.30)
Constant (a_0)	20,359.20 (15,311.35)	15,555.16 (20,484.9)	-4,174.59 (12,083.58)
Q_t^* (a_1)	1.15 (0.22)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	1,140.77 (15,311.35)	233.09 (20,484.9)	-788.75 (12,083.58)
Q_{t-1} (a_4)	-0.205 (0.23)	0.95 (0.021)	1.007 (0.012)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.99	0.985	0.995
T1	F(3,31) =1.90	- -	- -
T2	F(1,31) =0.45	- -	- -
T3	F(4,31) =9.68	- -	- -

Table 6.10: The Third Oat Production Forecasts

	With Structural Change		
	QF_t (6.31)	QF_t (6.32)	Q_t (6.33)
Constant (a_0)	9,104.13 (22,494.54)	20,763.16 (30,740.02)	9,901.98 (17,880.89)
Q_t^* (a_1)	1.54 (0.33)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	1,140.77 (22,494.54)	233.09 (30,740.02)	-788.75 (1900.18)
Q_{t-1} (a_4)	-0.58 (0.33)	0.96 (0.03)	1.0 (0.02)
$Q63_t^*$ (a_5)	-0.71 (0.45)	- -	- -
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	586.5 (2,573.36)	2,494.82 (3,448.39)	934.85 (2,005.87)
$Q63_{t-1}$ (a_8)	0.72 (0.46)	-0.011 (0.023)	-0.02 (0.013)
R^2	0.99	0.985	0.995

7. SOYBEAN

7.1 Acreage Planted

The estimated coefficients and test results for the soybean announcements are shown in Table 7.1 to Table 7.4 for acreage planted, and Table 7.5 to Table 7.12 for production. The order of the columns is the same as for the previous crop. I first discuss the results from the acreage planted forecasts in Table 7.1. The results for T1, T2, and T3 are all shown to reject the null hypotheses at the 5% significance level which means the government forecasts are inefficient and biased. The coefficient on the preliminary acreage planted forecast is significantly greater than one, indicating that the USDA consistently predicts under soybean planted acreage. The rejection of rationality implies that there must be information available at the time of the forecast that is not incorporated into the government forecast. The change in market information from the government announcement is measured by the change in R^2 from (7.2) to (7.1). The R^2 rises from 0.96 to 0.987, which means that the market's error variance in forecasting PF_t falls from 0.04 to 0.013. The government substantially improves market information relative to its preannouncement information. The market's error variance is reduced by 68.5%. The market's ability to forecast soybean acres planted is greater than for barley. Before the government announcement, the market can explain 96 percent of the variation in soybean acreage planted but only

71 percent of the variation in barley acreage. Similarly, the market information set can explain 99%of the variation in the preliminary soybean acreage planted forecast but could only explain 95% of the preliminary barley acreage planted forecast. The market's information on soybeans may dominate that on barley because the government allows relatively free movements of soybean prices compared to barley prices. Therefore the soybean market may be a better at aggregating information than prices in the barley market.

Similar to the earlier findings for barley, t-tests indicate that previous government information adds significant information to the prediction of acreage planted in soybeans both before and after the release of the preliminary forecast. The government could costlessly improve its acres planted forecast of soybeans by incorporating information on its final acreage planted figure for the previous year.

Next, I discuss the comparison of the coefficients before and after 1963 to check for potential structural change in the market and government forecasts. The results are shown in table 7.1 from (7.4) to (7.6). The F-tests examine whether α_4, α_5, and α_6 are jointly equal to zero. The values of the F-statistics for these 3 tests are 0.39, 1.27 and 1.53. All fail to reject the irrespective null hypotheses at the 5% significance level. This implies that there was no structural change in the error structure of the government's forecast of acres planted to soybeans, and the market did not revise its forecast method before and after 1963.

The report focussing on the first announcement is examined next. The evidence implies that the government forecast of soybean acreage planted is biased downward. The significant coefficient on the previous year's acres planted implies that the government forecast is also inefficient, but the joint test of rationality, T3, marginally fails to reject the null hypothesis (marginal significance level=0.1286). The change in R^2 here is almost identical to the results using the combined first and second announcements. The F-tests for the potential structure after 1963 are also held and the values of the F-statistics for those comparisons are 0.34, 1.27, and 1.77 for (7.7) with (7.10), (7.8) with (7.11), and (7.9) with (7.12); All of the above F values are not significant and we fail to reject the null hypotheses that $\alpha_4 = \alpha_5 = \alpha_6 = 0$ at the 5% significance level. It implies that the government and the market did not revise their forecast method and available information when they forecast the soybean acreage planted. This result is similar to the earlier tests using first and second announcements.

7.2 Production

The reports of soybean production were released in August, September, October, and November. The same estimation method is used for soybeans in that Q_{t-1} replaces AP_{t-1} from September since the previous production forecast is known after the release of report in August. The measure of past information for soybeans is AP_{t-1} in August. For the August forecast, the null hypothesis of no bias is not rejected but T1 and T3 do reject the null at the 0.1 significance level. However, T3 is not rejected at the 5% significance level. These results indicate that the government forecasts are inefficient but unbiased. The Government could costlessly improve the forecast method by incorporating available market information.

The tests for structural change after 1963 reveal no changes in forecast method. Each coefficient on the variables interacted with the dummy variable representing the post-1963 period was not significantly different from zero in the individual t-tests.

The F-statistic for the hypothesis that a_5, a_6 and a_7 are equal to zero is 0.27 which fails to reject the null hypothesis.

The market views AP_{t-1} and $\triangle P_{t-1}$ as important information before the release of government report. The individual t-test that a_2 and a_3 separately equal zero both reject the null hypothesis. In fact, the market can forecast 97 percent of the final harvest size without the government's information. However, government soybean forecasts still have value. The R^2 rises from 0.97 (7.17) to 0.988 (7.16) which implies that the market's error variance is reduced by 60 percent. We find the market did not revise its forecast method when allowing for potential structural change after 1963. The F-statistic values are 0.3, 0.37 and 0.5 for (7.16) with (7.19), (7.17) with (7.20), and (7.18) with (7.21). Therefore, we fail to reject the null hypothesis of $\alpha_5 = \alpha_6 = \alpha_7 = 0$.

The second soybean production report is released in September. All the F-tests for (7.22) fail to reject the null hypotheses which implies that this forecast is efficient and unbiased. The R^2 changes from0.985 (before the forecast) to 0.99 (after the forecast) is virtually the same as that following the August soybean production forecast, so the market information had little improvement after the release of the second announcement. The t-tests indicate that Q_{t-1} is important information to the market before the release of government announcement. The change in market price is not useful information. The tests of structural change are then held for the null hypothesis: $a_5 = a_7 = a_8 = 0$ separately for (7.22) with (7.25), (7.23) with (7.26), and (7.24) with (7.27). The F-statistics are 0.18, 0.06, and 0.06. Thus, we fail to reject all the above null hypotheses. Again, the government and the market did not change their forecast methodology after 1963.

Next, the third announcement in October is examined and the results are shown in table 7.6 and 7.7. T1, T2, and T3 fail to reject the null hypotheses of efficiency and unbiasedness. The R^2 values for those regressions from (7.28) to (7.33) are very high; it rises from 0.9918 (7.29) to 0.9935 (7.28) implying that the market did improve its forecast by reducing the error variance by 21 percent. The values of F-statistic for testing the potential structural change are 0.71, 0.79, and 0.16 for comparing (7.28) with (7.31), (7.29) with (7.32), and (7.30) with (7.33). The results show the null hypothesis are not rejected at the 0.1 significance level; it reveals that structural change did not occur.

It seems to be interesting that the T1, T2 in the fourth announcement reject the null hypotheses of efficiency and bias at the 5% significance level. T3 does not reject the joint hypotheses of rationality at the 5% significance level, but does reject at the 10% significance level. Therefore, there might be some other available information that the government ignored. The R^2 also increase to 0.9965 (7.34) from 0.9932 (7.35). This indicates that the market improved its forecast after the release of the government report. The values of F-statistic are 0.57, 0.90, and 0.79 for comparing (7.34) with (7.37), (7.35) with (7.38), (7.36) with (7.39). These indicate no structural change in forecast methodology for the fourth production announcement.

Table 7.1: Acreage Planted to Soybean (Combination of both Announcements)

	W/O structural change		
	PF_t (7.1)	PF_t (7.2)	AP_t^* (7.3)
Constant (α_0)	-252.25 (875.7)	2,499.7 (1,343.95)	1,843.5 (720.29)
AP_t^* (α_1)	1.49 (0.17)	- -	- -
I_{t-1} (α_2)	-0.49 (0.17)	0.96 (0.028)	0.98 (0.02)
$\triangle P_{t-1}$ (α_3)	8.47 (6.70)	24.02 (10.63)	10.42 (5.70)
$AP63_t^*$ (α_4)	-	-	-
$I63_{t-1}$ (α_5)	-	-	-
$\triangle P63_{t-1}$ (α_6)	-	-	-
R^2	0.987	0.96	0.99
T1	F(3,42) =4.53	- -	- -
T2	F(1,42) =8.14	- -	- -
T3	F(4,42) =3.67	- -	- -

Table 7.2: Acreage Planted to Soybean (Combination of both Announcements)

	W/structural change		
	PF_t (7.4)	PF_t (7.5)	AP_t^* (7.6)
Constant (α_0)	17.29	5,367.97	3,540.36
	(1,568.34)	(2,278.11)	(1,213.68)
AP_t^* (α_1)	0.95	-	-
	(0.55)	-	-
I_{t-1} (α_2)	0.05	0.78	0.87
	(0.57)	(0.12)	(0.06)
$\triangle P_{t-1}$ (α_3)	22.77	22.97	7.87
	(26.91)	(39.07)	(20.82)
$AP63_t^*$ (α_4)	0.59	-	.
	(0.58)	-	-
$I63_{t-1}$ (α_5)	-0.59	0.13	0.05
	(0.57)	(0.086)	(0.05)
$\triangle P63_{t-1}$ (α_6)	-15.1	0.27	2.24
	(27.89)	(40.4)	(21.5)
R^2	0.988	0.97	0.96

Table 7.3: Acreage Planted to Soybean (1st announcement)

	W/O structural change		
	PF_t (7.7)	PF_t (7.8)	AP_t^* (7.9)
Constant (α_0)	-475.9 (1,095.3)	2,912.3 (1,590.07)	2,241.4 (828.9)
AP_t^* (α_1)	1.51 (0.21)	- -	- -
I_{t-1} (α_2)	-0.51 (0.2)	0.96 (0.03)	0.97 (0.018)
$\triangle P_{t-1}$ (α_3)	13.19 (19.68)	4.67 (31.44)	-5.63 (16.39)
$AP63_t^*$ (α_4)	-	-	-
$I63_{t-1}$ (α_5)	-	-	-
$\triangle P63_{t-1}$ (α_6)	-	-	-
R^2	0.986	0.96	0.99
T1	F(3, 33) = 2.44	- -	- -
T2	F(1, 33) = 6.19	- -	- -
T3	F(4, 33) = 1.93	- -	- -

Table 7.4: Acreage Planted to Soybean (1st announcement)

	W/structural change		
	PF_t (7.10)	PF_t (7.11)	AP_t^* (7.12)
Constant (α_0)	-267.80	5,704.87	3,857.14
	(1,846.26)	(2,493.56)	(1,281.7)
AP_t^* (α_1)	0.95	-	-
	(0.60)	-	-
I_{t-1} (α_2)	0.05 0.86	0.77	
	(0.62)	(0.07)	(0.13)
$\triangle P_{t-1}$ (α_3)	23.67	6.72	21.75
	(29.44)	(21.12)	(41.08)
$AP63_t^*$ (α_4)	0.62	-	-
	(0.64)	-	-
$I63_{t-1}$ (α_5)	0.054	0.09	0.14
	(0.67)	(0.047)	(0.092)
$\triangle P63_{t-1}$ (α_6)	-6.34	-23.48	-30.70
	(·42.34)	(32.06)	(62.37)
R^2	0.986	0.899	0.97

Table 7.5: The First Soybean Production Forecasts

	W/O Structural Change		
	QF_t (7.16)	QF_t (7.17)	Q_t (7.18)
Constant (a_0)	-8,276.59	-244,741.34	-26,3786
	(44,067.7)	(44,605.85)	(38,580.02)
Q_t^* (a_1)	0.896	-	-
	(0.13)	-	-
AP_{t-1} (a_2)	2.999	32.55	32.97
	(4.24)	(0.98)	(0.85)
$\triangle P_{t-1}$ (a_3)	-364.28	-688.93	-362.17
	(121.87)	(176.02)	(152.24)
Q_{t-1} (a_4)	-	-	-
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.988	0.97	0.97
T1	F(3,33)	-	-
	=3.27	-	-
T2	F(1,33)	-	-
	=0.66	-	-
T3	F(4,33)	-	-
	=2.51	-	-

Table 7.6: The First Soybean Production Forecasts

	With Structural Change		
	QF_t (7.19)	QF_t (7.20)	Q_t (7.21)
Constant (a_0)	7,743.68 (70,393.48)	-267,349.98 (80,896.40)	-314,941.98 (69,678.7)
Q_t^* (a_1)	0.73 (0.43)	- -	- -
AP_{t-1} (a_2)	5.86 (11.23)	34.3 (3.97)	36.12 (3.42)
$\triangle P_{t-1}$ (a_3)	152.45 (642.03)	-16.59 (960.36)	-119.68 (827.19)
Q_{t-1} (a_4)	-	-	-
$Q63_t^*$ (a_5)	0.17 (0.41)	- -	- -
$AP63_{t-1}$ (a_6)	-3.302 (9.78)	-1.41 (2.74)	-2.29 (2.36)
$\triangle P63_{t-1}$ (a_7)	-533.17 (653.28)	-692.73 (978.41)	-243.64 (842.74)
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.988	0.97	0.98

Table 7.7: The Second Soybean Production Forecasts

	W/O Structural Change		
	QF_t (7.22)	QF_t (7.23)	Q_t (7.24)
Constant (a_0)	13,587.01 (20,795.18)	18,010.66 (26,155.05)	5,394.17 (19,860.61)
Q_t^* (a_1)	0.82 (0.18)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	76.6 (149.98)	-192.71 (173.67)	131.87 (131.87)
Q_{t-1} (a_4)	0.17 (0.18)	0.98 (0.021)	0.99 (0.016)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.99	0.985	0.99
T1	F(3,33) =0.75	- -	- -
T2	F(1,33) =1.006	- -	- -
T3	F(4,33) =0.62	- -	- -

Table 7.8: The Second Soybean Production Forecasts

	With Structural Change		
	QF_t (7.25)	QF_t (7.26)	Q_t (7.27)
Constant (a_0)	28,510.62 (34,650.58)	26,506.72 (43,067.93)	-3,452.82 (32,703.31)
Q_t^* (a_1)	1.11 (0.84)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	388.66 (1,504.94)	164.88 (1,860.49)	-191.51 (1,412.75)
Q_{t-1} (a_4)	-0.17 (0.85)	0.96 (0.109)	1.02 (0.083)
$Q63_t^*$ (a_5)	-0.302 (0.859)	- -	- -
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-315.16 (1,514.60)	-359.72 (1,870.49)	-139.51 (1,420.34)
$Q63_{t-1}$ (a_8)	0.34 (0.87)	0.015 (0.088)	-0.023 (0.067)
R^2	0.99	0.985	0.99

Table 7.9: The Third Soybean Production Forecasts

	W/O Structural Change		
	QF_t (7.28)	QF_t (7.29)	Q_t (7.30)
Constant (a_0)	15,223.43 (17,565.34)	14,520.97 (19,456.16)	-627.14 (7,941.69)
Q_t^* (a_1)	1.12 (0.38)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-410.91 (17,565.34)	-674.87 (282.89)	-235.66 (115.47)
Q_{t-1} (a_4)	-0.14 (0.38)	0.98 (0.016)	0.997 (0.006)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.9935	0.9918	0.9987
T1	F(3,33) =1.27	- -	- -
T2	F(1,33) =0.10	- -	- -
T3	F(4,33) =0.98	- -	- -

Table 7.10: The Third Soybean Production Forecasts

	With Structural Change		
	QF_t (7.31)	QF_t (7.32)	Q_t (7.33)
Constant (a_0)	48,395.09 (29,010.56)	44,595.32 (31,870.06)	-3,339.96 (13,258.72)
Q_t^* (a_1)	1.12 (1.26)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	45.05 (818.19)	-56.67 (893.96)	-90.55 (371.91)
Q_{t-1} (a_4)	-0.32 (1.27)	0.91 (0.072)	1.008 (0.03)
$Q63_t^*$ (a_5)	0.023 (1.32)	- -	- -
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-538.52 (877.63)	-721.86 (953.96)	115.47 (396.87)
$Q63_{t-1}$ (a_8)	0.043 (1.33)	0.05 (0.056)	-0.0099 (0.023)
R^2	0.9940	0.9922	0.9987

Table 7.11: The Fourth Soybean Production Forecasts

	W/O Structural Change		
	QF_t (7.34)	QF_t (7.35)	Q_t (7.36)
Constant (a_0)	13,276.39 (13,039.85)	10,921.12 (17,995.01)	-1,282.88 (6,867.17)
Q_t^* (a_1)	1.84 (1.84)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	108.24 (320.34)	498.81 (431.84)	212.74 (164.80)
Q_{t-1} (a_4)	-0.85 (0.33)	0.99 (0.014)	1.003 (0.005)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.9965	0.9932	0.9936
T1	F(3,33) =2.92	- -	- -
T2	F(1,33) =6.60	- -	- -
T3	F(4,33) =2.46	- -	- -

Table 7.12: The Fourth Soybean Production Forecasts

	With Structural Change		
	QF_t (7.37)	QF_t (7.38)	Q_t (7.39)
Constant (a_0)	26,878.78 (23,087.90)	42,500.89 (29,698.83)	9,621.066 (11,373.003)
Q_t^* (a_1)	1.18 (1.95)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-23.71 (883.26)	-232.13 (1,172.92)	-127.09 (449.16)
Q_{t-1} (a_4)	-0.23 (1.93)	0.91 (0.064)	0.98 (0.025)
$Q63_t^*$ (a_5)	0.63 (1.97)	- -	- -
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	168.90 (967.17)	876.02 (1,273.57)	403.93 (487.71)
$Q63_{t-1}$ (a_8)	-0.6 (1.96)	0.054 (0.051)	0.016 (0.016)
R^2	0.9966	0.9990	0.9991

8. SPRING WHEAT

8.1 Acreage Planted

The estimated results for spring wheat are shown in Table 8.1 to 8.4 for acreage planted, and Table 8.5 to 8.12 for production. Looking first at results based on the combination of both first and second announcements, I find that the government's forecast are efficient but biased at 5% significant level. The coefficient on AP_t^* is greater than one, signifying that the preliminary acreage planted forecast is biased downward. The tests of efficiency and the overall tests of rationality, T1 and T3, just fail to reject the null hypotheses at 5% significant level. However, the t-statistic on past acreage planted indicates that there is other available which could be used to improve the efficiency of the government announcement. T2 rejects the null hypothesis, implying that the government forecast is biased.

The R^2 rises from 0.78 to 0.94 from before to after the government's planted acreage announcement. This implies that the market's error variance is reduced by 73 percent as a result of the government's report being released. The most important source of market information on acreage planted before the governments announcement is the most recently released previous information on acreage planted to spring wheat in the previous year. The tests for structural change after 1963 have F-statistics of 0.11, 4.8, and 5.9. It indicates that the market changed its forecast methodology after 1963 while the government did not.

I next report the regressions that incorporate only first announcements. The results are shown from (8.7) to (8.12). Test T2 rejects the null hypothesis of efficiency at the 10% significance level while T1 and T3 do not reject the null hypothesis of unbiasedness and the joint hypothesis of rationality. Thus, there is only weak evidence that the government's forecast is inefficient. The market's error variance falls as a result of the acres planted announcement. the R^2 increases from 0.7752 to 0.9385, implying the error variance is reduced by 73 percent. The market substantially improved its information after the release of the government's first report of spring wheat acreage planted. The tests of structural change after 1963 had F-statistics of 0.17, 4.4, and 5.5. These results are the same as previous results combining first and second announcements. They also indicate that the market revised its forecast methodology after 1963 but the government did not.

8.2 Production

The USDA has changed the timing of the production forecasts for spring wheat over the years. Before 1961, the government released its spring wheat production forecasts in June, July, August, September, and October. Between 1961 and 1982, the government released its announcements in July, August, September, and October. Since 1982, the government released its reports only in August, September, and October. We classified reports by the order of the release of the announcement in each time period reflect the relative timing of the report in each crop year. I categorize reports by the order of announcement, e.g., first announcements, second announcements, third announcements, and so on.

The F-tests for efficiency and unbiasedness generally fail to reject the null hypothesis of rationality for all announcements. The exception is the government's third forecast. For the third announcements, test T2 rejects unbiasedness at 5% significance level. Third announcements appear to be biased downward. The third announcement also appears to ignore relevant movements in market prices. No other forecast fails the tests of efficiency or unbiasedness. These findings imply that the government's forecasts are largely efficient and unbiased in the case of spring wheat production. Following the release of government spring wheat forecasts, the R^2 rises gradually, but steadily, from 0.92 for the first forecast to 0.996 for the fourth forecast. This means that the error variance is reduced because the government incorporated more accurate and available information over the crop year. The most important forecast is the first announcement. The market's R^2 rises from 0.39 to 0.92, a reduction in error variance of 87 percent. The R^2 also increases from 0.91 to 0.96 for the second announcement, and from 0.96 to 0.99 for the third. Past government information is relatively more important in shaping market expectations than are market price movements. AP_{t-1} is important in shaping the market's forecast of the first announcement and Q_{t-1} has a significant influence on the market's forecasts of all subsequent announcements.

Tests of structural change after 1963 had F-statistics of 0.68, 37,0 and 50.2 for first announcements. These tests imply that the market revised its forecasts after 1963 but the government did not. For the second announcements, no evidence of structural change was founded (the F-values are 0.35, 1.34 and 1.67). For the third forecasts, the related F-values are 3.56, 3.9 and 1.69. for these forecasts, there is evidence that both government and market forecasts of final spring wheat production changed. The null hypothesis of no change was rejected at the 5% significance level. In the case of the government forecast, the bias before 1963 was eliminated after 1963. Thus, the USDA forecast became more rational over time. Structural change appears to be placing a greater weight on past government's information and a lower weight on market price movements in the post-1963 period. For the fourth announcements, the F-values are 4.8, 5.56, and 8.4. All of the above test statistics are large enough to reject the null hypotheses of no structural change at the 5% significance level. The government and the market did revise their forecast at this stage. There are no fifth forecasts in the period after 1963, so we do not need to analyze structural change in that case.

Table 8.1: Acreage Planted to Spring Wheat (Combination of both Announcements)

	W/O structural change		
	PF_t (8.1)	PF_t (8.2)	AP_t^* (8.3)
Constant (α_0)	-51.89 (670.80)	2,267.03 (1,162.24)	2,678.2 (1,537.13)
AP_t^* (α_1)	1.204 (0.084)	- -	- -
I_{t-1} (α_2)	-0.19 (0.081)	0.85 (0.068)	0.83 (0.090)
$\triangle P_{t-1}$ (α_3)	-6.7 (12.81)	-35.05 (22.54)	-48.91 (29.80)
$AP63_t^*$ (α_4)	-	-	-
$I63_{t-1}$ (α_5)	-	-	-
$\triangle P63_{t-1}$ (α_6)	-	-	-
R^2	0.94	0.78	0.67
T1	F(3,42) =2.36	- -	- -
T2	F(1,42) =5.86	- -	- -
T3	F(4,42) =2.36	- -	- -

Table 8.2: Acreage Planted to Spring Wheat (Combination of both Announcements)

	W/structural change		
	PF_t (8.4)	PF_t (8.5)	AP_t^* (8.6)
Constant (α_0)	-52.56	2,621.26	2,206.83
	(690.51)	(1,519.55)	(1,143.48)
AP_t^* (α_1)	1.17	-	-
	(0.14)	-	-
I_{t-1} (α_2)	-0.17	0.78	0.82
	(0.13)	(0.094)	(0.071)
$\triangle P_{t-1}$ (α_3)	-65.96	115.56	154.77
	(90.75)	(202.95)	(152.72)
$AP63_t^*$ (α_4)	0.05	-	
	(0.18)	-	-
$I63_{t-1}$ (α_5)	-0.03	0.07	0.04
	(0.17)	(0.07)	(0.04)
$\triangle P63_{t-1}$ (α_6)	63.09	-158.98	-187.86
	(91.78)	(205.27)	(154.47)
R^2	0.94	0.69	0.80

Table 8.3: Acreage Planted to Spring Wheat (1st announcement)

	W/O structural change		
	PF_t (8.7)	PF_t (8.8)	AP_t^* (8.9)
Constant (α_0)	-8.51 (758.18)	2,526.65 (1,283.27)	3,014.86 (1,690.78)
AP_t^* (α_1)	1.20 (0.0959)	- -	- -
I_{t-1} (α_2)	-0.19 (0.091)	0.83 (0.077)	0.81 (0.101)
$\triangle P_{t-1}$ (α_3)	-4.59 7.56)	-19.08 (13.10)	-27.42 (17.26)
$AP63_t^*$ (α_4)	-	-	-
$I63_{t-1}$ (α_5)	-	-	-
$\triangle P63_{t-1}$ (α_6)	-	-	-
R^2	0.9385	0.7752	0.6488
T1	F(3, 33) = 2.10	- -	- -
T2	F(1, 33) = 4.19	- -	- -
T3	F(4, 33) = 1.62	- -	- -

Table 8.4: Acreage Planted to Spring Wheat (1st Announcement)

	W/structural change		
	PF_t (8.10)	PF_t (8.11)	AP_t^* (8.12)
Constant (α_0)	-60.66	2,999.96	2,513.06
	(808.75)	(1,681.59)	(1,275.50)
AP_t^* (α_1)	1.14	-	-
	(0.15)	-	-
I_{t-1} (α_2)	-0.13	0.77	0.80
	(0.15)	(0.11)	(0.081)
$\triangle P_{t-1}$ (α_3)	-3.92	-10.24	-5.996
	(9.3)	(20.48)	(15.53)
$AP63_t^*$ (α_4)	0.1.20	-	-
	(0.096)	-	-
$I63_{t-1}$ (α_5)	-0.088	0.032	0.022
	(0.15)	(0.054)	(0.04)
$\triangle P63_{t-1}$ (α_6)	-1.066	-60.68	-47.33
	(21.87)	(45.15)	(34.25)
R^2	0.9392	0.6734	0.7917

Table 8.5: The First Spring Wheat Production Forecasts

	W/O Structural Change		
	QF_t (8.16)	QF_t (8.17)	Q_t (8.18)
Constant (a_0)	47,102.23 (30,435.54)	12,874.40 (82,914.48)	-33,949.77 (76,707.91)
Q_t^* (a_1)	1.008 (0.068)	- -	- -
AP_{t-1} (a_2)	-3.008 (2.51)	22.33 (5.03)	25.13 (4.66)
$\triangle P_{t-1}$ (a_3)	193.16 (214.00)	-801.87 (555.33)	-986.95 (513.76)
Q_{t-1} (a_4)	-	-	-
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.9210	0.39	0.49
T1	F(3,33) =1.06	- -	- -
T2	F(1,33) =0.014	- -	- -
T3	F(4,33) =0.81	- -	- -

Table 8.6: The First Spring Wheat Production Forecasts

	With Structural Change		
	QF_t (8.19)	QF_t (8.20)	Q_t (8.21)
Constant (a_0)	40,083.68 (30,435.54)	23,231.66 (47,740.25)	-16,407.61 (39,685.61)
Q_t^* (a_1)	0.896 (0.337)	- -	- -
AP_{t-1} (a_2)	-1.18 (4.85)	13.69 (3.05)	16.45 (2.54)
$\triangle P_{t-1}$ (a_3)	2,302.98 (2,064.47)	718.76 (2,861.99)	-1,796.45 (2,379.12)
Q_{t-1} (a_4)	-	-	-
$Q63_t^*$ (a_5)	0.039 (0.392)	- -	- -
$AP63_{t-1}$ (a_6)	0.69 (7.30)	12.25 (1.42)	11.72 (1.18)
$\triangle P63_{t-1}$ (a_7)	-2,186.74 (2,093.13)	-1,293.88 (2,881.69)	1,057.41 (2,395.5)
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.926	0.8181	0.8776

Table 8.7: The Second Spring Wheat Production Forecasts

	W/O Structural Change		
	QF_t (8.22)	QF_t (8.23)	Q_t (8.24)
Constant (a_0)	-18,480.40 (13,151.6)	21,798.56 (19,527.41)	3,445.31 (14,840.95)
Q_t^* (a_1)	0.96 (0.16)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-12.51 (166.6)	-101.5 (240.05)	-92.4 (182.4)
Q_{t-1} (a_4)	-0.005 (0.115)	0.94 (0.05)	0.99 (0.04)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.96	0.91	0.95
T1	F(3,33) =0.64	- -	- -
T2	F(1,33) =0.006	- -	- -
T3	F(4,33) =0.5	- -	- -

Table 8.8: The Second Spring Wheat Production Forecasts

	With Structural Change		
	QF_t (8.25)	QF_t (8.26)	Q_t (8.27)
Constant (a_0)	27,176.99 (19,244.55)	49,887.15 (26,139.60)	23,697.2 (19,675.80)
Q_t^* (a_1)	0.77 (0.35)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	353.7 (1,731.4)	-1,233.52 (2,317.7)	-2,014.4 (1,669.3)
Q_{t-1} (a_4)	0.13 (0.34)	0.78 (0.11)	0.86 (0.09)
$Q63_t^*$ (a_5)	0.22 (0.40)	- -	- -
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-374.85 (1,739.6)	1,136.57 (2,230.5)	1,938.4 (1,678.9)
$Q63_{t-1}$ (a_8)	-0.18 (0.39)	0.12 (0.72)	0.09 (0.05)
R^2	0.96	0.92	0.96

Table 8.9: The Third Spring Wheat Production Forecasts

	W/O Structural Change		
	QF_t (8.28)	QF_t (8.29)	Q_t (8.30)
Constant (a_0)	5,710.5 (6,448.66)	14,145.25 (13,409.72)	6,723.31 (9,434.98)
Q_t^* (a_1)	1.25 (0.118)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-97.40 (176.72)	-471.3 (362.88)	-298.0 (255.30)
Q_{t-1} (a_4)	-0.27 (0.12)	0.97 (0.035)	0.99 (0.024)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.99	0.96	0.98
T1	F(3,32) =2.49	- -	- -
T2	F(1,32) =4.64	- -	- -
T3	F(4,32) =1.90	- -	- -

Table 8.10: The Third Spring Wheat Production Forecasts

	With Structural Change		
	QF_t (8.31)	QF_t (8.32)	Q_t (8.33)
Constant (a_0)	5,266.33 (8,128.17)	22,639.69 (16,833.3)	11,575.97 (12,592.2)
Q_t^* (a_1)	1.52 (0.20)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	-472.98 (405.2)	-2,67.5 (731.8)	-1,113.14 (547.4)
Q_{t-1} (a_4)	-0.55 (0.19)	0.87 (0.07)	0.93 (0.055)
$Q63_t^*$ (a_5)	-0.52 (0.24)	- -	- -
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	501.00 (445.7)	2,027.2 (841.87)	965.0 (629.8)
$Q63_{t-1}$ (a_8)	0.54 (0.23)	0.09 (0.05)	0.04 (0.04)
R^2	0.99	0.97	0.98

Table 8.11: The Fourth Spring Wheat Production Forecasts

	W/O Structural Change		
	QF_t (8.34)	QF_t (8.35)	Q_t (8.36)
Constant (a_0)	-3,384.6 (4,468.8)	7,235.41 (7,746.96)	8,775.81 (5,377.96)
Q_t^* (a_1)	1.21 (0.148)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	102.1 (94.09)	-35.83 (167.69)	-113.99 (116.4)
Q_{t-1} (a_4)	-0.2 (0.14)	0.98 (0.02)	0.98 (0.015)
$Q63_t^*$ (a_5)	-	-	-
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-	-	-
$Q63_{t-1}$ (a_8)	-	-	-
R^2	0.996	0.987	0.99
T1	F(3,28) =0.92	- -	- -
T2	F(1,28) =2.03	- -	- -
T3	F(4,28) =1.07	- -	- -

Table 8.12: The Fourth Spring Wheat Production Forecasts

	With Structural Change		
	QF_t (8.37)	QF_t (8.38)	Q_t (8.39)
Constant (a_0)	-1,172.8 (5,205.66)	8,898.30 (9,265.5)	9,793.3 (6,005.6)
Q_t^* (a_1)	1.51 (0.18)	- -	- -
AP_{t-1} (a_2)	-	-	-
$\triangle P_{t-1}$ (a_3)	479.99 (400.5)	-1,795.,15 (548.3)	-1,513.7 (355.37)
Q_{t-1} (a_4)	-0.51 (0.182)	0.994 (0.04)	0.99 (0.03)
$Q63_t^*$ (a_5)	-1.30 (0.35)	- -	- -
$AP63_{t-1}$ (a_6)	-	-	-
$\triangle P63_{t-1}$ (a_7)	-373.41 (407.79)	1,891.91 (568.7)	1,505.62 (368.6)
$Q63_{t-1}$ (a_8)	1.31 (0.35)	-0.014 (0.024)	-0.012 (0.015)
R^2	0.9975	0.999	0.996

9. CONCLUSION

It was observed that some USDA forecasts for these crops are irrational, because they are biased, inefficient or both biased and inefficient. The findings of all tests are summarized in table 9.1. The numbers represent the number of tests which failed to reject the null hypotheses. Referring to the acreage planted forecasts, forecasts for barley and corn were found to be efficient and unbiased. It is clear, therefore, that both those crop reports are rational forecasts. The forecasts of spring wheat are efficient but had evidence of bias. However, the joint test failed to reject rationality. The most controversial result is that the oats forecasts appeared to be inefficient and biased based on the individual tests, but the joint test failed to reject rationality. Soybean acreage planted forecasts appeared to suffer from both inefficiency and bias.

On the other hand, the evidence showed that the barley production forecasts were totally irrational. All null hypotheses were rejected at standard confidence levels. The soybean production forecasts seem rational because only the first announcement was inefficient. Later announcements appeared to be both efficient and unbiased. The joint test for spring wheat production forecasts also indicated the forecasts for spring wheat were rational although some of the individual tests were rejected. Half the corn and two of three oat production forecasts failed the joint test of rationality, but most passed the individual tests sof efficiency and of unbiasedness.

Little evidence was found of structural change after the 1963 switch to area frame sampling. The tests indicated that the government's forecast methodology did not change significantly after 1963. Only for corn production was there evidence that the forecast methodology was revised by the government.

Table 9.2: Summary of Test Results on USDA Forecast Rationality

Crop	Forecast	Null Hypothesis[a]			
		Efficiency	Unbiasedness	Rationality	No Structural Change
BARLEY	Planted	$\frac{2}{2}$	$\frac{2}{2}$	$\frac{2}{2}$	$\frac{0}{2}$
	Production	$\frac{0}{3}$	$\frac{0}{3}$	$\frac{0}{3}$	$\frac{0}{3}$
CORN	Planted	$\frac{2}{2}$	$\frac{2}{2}$	$\frac{2}{2}$	$\frac{0}{2}$
	Production	$\frac{5}{6}$	$\frac{5}{6}$	$\frac{3}{6}$	$\frac{6}{6}$
OATS	Planted	$\frac{2}{2}$	$\frac{2}{2}$	$\frac{0}{2}$	$\frac{0}{2}$
	Production	$\frac{3}{3}$	$\frac{3}{3}$	$\frac{1}{3}$	$\frac{0}{3}$
SOYBEANS	Planted	$\frac{0}{2}$	$\frac{0}{2}$	$\frac{1}{2}$	$\frac{0}{2}$
	Production	$\frac{2}{4}$	$\frac{3}{4}$	$\frac{4}{4}$	$\frac{0}{4}$
SPRING	Planted	$\frac{2}{2}$	$\frac{0}{2}$	$\frac{2}{2}$	$\frac{0}{2}$
WHEAT	Production	$\frac{3}{4}$	$\frac{2}{4}$	$\frac{4}{4}$	$\frac{2}{4}$

[a] The numerator indicates the number of tests which failed to reject the null hypothesis and the denominator indicates the number of test conducted.

10. BIBLIOGRAPHY

Fair, Ray C. and Shiller Robert J. "The Informational Content of Ex Ante Forecasts." *The Review of Economics and Statistics*, LXXI (May 1989), 325–331.

Feenberg, Daniel R., Gentry, William, and Gilroy, David and Rosen Harvey S. "Testing the Rationality of State Revenue Forecasts." *The Review of Economics and Statistics*, LXXI (MAY 1989), 300–308.

Holden, K., Peel, D. A. and Thompson J. L. "Expectations: Theory and Evidence." *New York: Macmillan Publishing Company*, 1st Ed., 1985.

Keane, Michael P. and Runkle, David E. "Are Economic Forecasts Rational?" *Quarterly Review of Federal Reserve Bank of Minneapolis*, 13, No. 2 (Spring 1989), 26–33.

Lovell, Michael C. "Tests of the Rational Expectations Hypothesis." *American Economic Review*, 76 (Mar. 1986), 110–124.

Maddala, G. S. "Introduction to Econometrics." *New York: Macmillan Publishing Company*, 1988.

Minford, Patrick and Peel, David, "Rational Expectations and the New Macroeconomics." *Oxford: Martin Robertson & Company Ltd.*, 1983.

Muth, John F. "Rational expectations and the Theory of Price Movements." *Rational Expectations and Econometric Practice*, 1 (1981): 3–22.

Orazem, Peter and Falk, Barry, "Measuring Market Responses to Error-Ridden Government Announcements." *Quarterly Review of Economics and Business*, 29, No. 2 (Summer 1988): 41–54.

Pindyck, Robert S. and Rubinfeld, Daniel L. "Econometric Models and Economic Forecasts." *New York: McGraw-Hill Book Company*, 1981.

Sargent., Thomas J. and Wallace, Neil. "Rational Expectations and the Theory of Economic Policy." *Journal of Monetary Economics*, 2 (April 1976): 169–83.

Summer, Daniel A. and Mueller Rolf A. E. "Are Harvest Forecasts News? USDA announcements and futures Market Reactions." *American Journal Agricultural Economic* 71 (Feb. 1989): 1–8.

United States Department of Agriculture, "Scope and Methods of the Statistical Reporting Service." USDA No. 1308 (Sept 1983).

Zarnowitz, Victor, "Rational Expectations and Macroeconomic Forecasts." *Journal of Business and Economic Statistics*, 3, No. 4 (Oct. 1985): 293–311.

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