NCCC-134
APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

Impacts of Crop Conditions Reports on National and Local Wheat Markets

by

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Paper presented at the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management
St. Louis, Missouri, April 22-23, 2013

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The USDA releases crop condition reports that contain crop progress and growing conditions estimates for various crops including corn, soybeans, and winter wheat. Previous work has investigated national market impacts from various USDA reports. However, this work is new because it investigates crop conditions report releases for price impacts on winter wheat at both the local and national level. The primary tools for analysis are parametric tests and the non-parametric Savage scores test. The results suggest that crop conditions reports may be anticipated by the futures markets prior to release, with similar though non-significant impacts felt in local cash markets. These results contrast significantly with those found in similar studies for corn and soybeans.

Keywords: event study, futures markets, Savage scores, crop conditions, public information

Introduction

There have been several studies over the last 30 years or so examining the impact of public information on market prices. The general objectives have often focused on whether the release of public reports (USDA crop reports for example) provides new information to market participants. If so then it is argued that public investment in the reports has value. These are generally referred to as Event Studies. A short list of examples in agricultural commodity markets include Milonas; Sumner and Mueller; Colling and Irwin; Fortenbery and Sumner; Robenstein and Thurman; and Garcia, Irwin, and Yang. Each of these studies focused on some measure of national average price, but to our knowledge, none conducted an actual cost/benefit analysis related to publicly generated reports. If empirical results generally supported a price response to the release of public reports, than it was concluded that the reports provided some value to the market. Whether the price response (i.e., value of the news) justified the cost was generally not addressed empirically.

Missing from the literature to date are local measures of report impacts. The USDA crop production report, for example, details production prospects on individual production units, yet previous analyses of report impacts have focused on national average prices. Even when an impact is found, it is possible results understate the actual value of the information if there are differences in local impacts across regions. For example, if production prospects increase in one area relative to earlier expectations (a price negative result) but decrease in another (a price positive result), impacts may at least partially offset each other in the calculation of national average prices, and the actual “news” would be undervalued when looking at national average price reactions.

The objective of the work here is to investigate the impact of weekly USDA crop progress and condition reports on national price and wheat basis levels in the Pacific Northwest. This will provide local producers with a better understanding of the risks they may face prior to a report release, and help them determine whether basis protection makes sense going into a report.

Earlier work often focused on whether producers face “abnormal” price risk prior to a report release, and in some cases (Fortenbery and Sumner) has described futures or flat cash price strategies one might consider to mitigate that risk. However, if the price and basis risks are not symmetric, than producers may want to consider strategies that lock in a basis level even when flat prices are not attractive, or not lock in the basis level even when futures prices are attractive. This requires a more complete understanding of the local impacts of new information, and whether they may differ systematically from some measure of the national average impact. Similar to previous work focused on national price impacts, the research here evaluates whether price and/or basis changes on days when the crop condition reports are released differs significantly from price and/or basis changes on days with no release. Results will help market participants dis-entangle national from local risks associated with new, publically generated information.

Literature Review

There is a broad literature examining effects of news on national commodity prices that focus on both livestock and crop markets. Some analyses considered information reported through the popular press, while many have looked at the impacts of systematically released government reports.

In their paper *Health Risk and the Demand for Red Meat*, Robenstein and Thurman used a regression technique first pioneered by Fama et al. to investigate whether negative health news regarding the consumption of red meat affected live cattle, feeder cattle, pork belly, and live hog futures contracts. They examined whether there were changes in market returns to red meat futures positions following press reports focused on the relationship between red meat consumption and cholesterol. While they did not find any affects from negative health news, they did suggest that futures contracts and their pricing may not be the appropriate place to look for changes in consumer demand. The type of model that Robenstein et al. used is less attractive for examining the impact of frequent and systematically released news like USDA production reports. A market returns model requires first estimating the expected rate of return, in this case average price changes, over periods of time up to, but not including, the event of interest. Because crop conditions reports are released weekly, the estimation window before each event is too brief for valid estimation of the regression parameters, making it difficult to dis-entangle post-event effects from pre-event effects on a week to week basis (MacKinlay).

Sumner and Mueller investigated the effect of USDA harvest forecasts on corn and soybean futures prices using parametric test statistics and the non-parametric Savage scores test. Non-parametric tests are useful for analyzing futures prices because they do not require the assumption of a normal distribution. By nature, the distribution of prices is truncated at zero, which suggests the use of a non-parametric test to account for violations of normality might be more appropriate than a test based on a regression. Using both techniques, Sumner and Mueller found that following the release of USDA corn and soybean reports futures prices had higher mean price changes and larger variances compared to days when a report was not released.

Fortenbery and Sumner then investigated whether the impacts of harvest forecast announcements changed following the introduction of options for corn and soybeans futures contracts. They also implemented the Savage scores as well as the Kruskal-Wallis and Van der Waerden non-parametric tests. They included no parametric tests in their analysis. Results were consistent across the three tests, and Fortenbery and Sumner found diminished futures price effects from USDA report releases after the advent of options trading for the corn and soybean markets. They hypothesized that traders may take options positions to protect against futures price risk prior to the reports, and dampen some of the post report futures trading that drove earlier price effects.

Lehecka performed a market event study for corn and soybean futures markets analyzing the effect of USDA Crop Progress and Conditions reports. He was the first to study the impact of these reports. He used both parametric and non-parametric tests, including the Kruskal-Wallis, to determine if crop progress reports affect market prices. He found a significant impact on market price variance on report days, with price variances increasing following report releases. His study period ran from 1986 to 2012 and overlaps with the sample period presented in this study.

Objectives

The objective of this paper is to examine the effect of weekly USDA crop conditions reports on both national and local markets for winter wheat. As such, we extend Lehecka's work by investigating the extent to which local market impacts might vary from national impacts. Local market impacts have generally been ignored in earlier work.

Similar to earlier work, we employ both parametric and non-parametric tests. The parametric tests include F-tests for equivalence of variance and t-tests for equivalence of means. Since the data used in testing for report effects are calculated as absolute price changes, they follow a distribution close to that of an exponential distribution. This violates the assumption of normality implied by the parametric tests. To account for this, we also employ the Savage scores test, which is based on order statistics from an exponential distribution. In addition, the Kruskal-Wallis non-parametric statistic is included as a check for robustness.

The efficacy of the condition reports' ability to predict final per acre yields in the six largest winter wheat producing states is first estimated to determine if they should reasonably be expected to provide market information. Tests are then applied to futures and local cash market data to determine whether there are price effects associated with the release of the reports. It is theorized that if the crop conditions reports provide useful predictions of individual state final yields, we should observe local price responses that do not necessarily mirror those observed nationally. This hypothesis follows from the possibility that condition report effects in different markets could be "averaged out" in the national market and would not be reflective of the reports' values locally. If the reports do not contain useful information relative to final realized yields and the markets still react, or vice versa, it might indicate some inefficiency in short run market price formation.

Data

Data for the USDA weekly crop conditions reports was collected from April 1986 through June 2012. April through June reports were used to account for changes in conditions through the winter wheat growing season. Data were collected for the six largest winter wheat producing states[2]. The six states include Washington, Colorado, Kansas, Montana, Oklahoma, and Texas. Importantly, winter wheat crop conditions are not distinguishable between hard red, hard white, soft red, and soft white winter wheat. However, it is known that each of the six largest winter wheat growing states primarily grows hard red winter wheat, except for the state of Washington, which primarily grows soft white winter wheat.

Contracts for hard red winter wheat futures are traded on the Kansas City futures exchange. Soft white winter wheat is not traded in the futures market, but is generally priced based on the soft red winter wheat futures price traded at the Chicago Mercantile Exchange. Thus, both Chicago and Kansas futures market data are examined in order to capture effects on both futures used in the pricing of cash winter wheat. The futures prices come from the Commodity Research Bureau database.

In this analysis we consider one local cash market, Odessa, Washington. This is due to the difficulty of collecting a consistent time series of local cash market prices for other locations. Cash prices for Odessa come from CashGrainBids.com. While we have complete data for Odessa, CashGrainBids was not able to furnish complete data for most other Washington markets.

The final yearly yields of winter wheat production in bushels per acre were gathered from USDA NASS for all six states along with the national average yield of winter wheat over the time period 1986-2012.

Only the conditions reported for the growing/harvesting season from March[3] to July were used in estimation. Because the length of the growing and harvest seasons may vary by three to four weeks year to year and by state, we use the first thirteen weeks of the post emergence growing season beginning with the first report released in March/April. This results in a consistent number of reports used for each state's growing year. In addition, we remove price changes from weekends as the amount of information being brought to the market from Friday to Monday may bias the variance of the non-report trading days. This is in following with Lehecka 2013, among others.

We additionally separate the data into two periods. The first period is selected to include the earliest data collected for each market through the end of 2007. This period captures the market before the effects of the Great Recession and the general increase in commodity price levels, and corresponds to the gap observed in Fig. 1.

The second period begins with the start of 2008 and runs to the end of the data period. It captures each market from the start of the Great Recession forward and reflects higher average commodity prices compared to the earlier period. The intuition is that as more uncertainty is introduced in the economy, USDA reports may convey more information to the market and we should expect to see greater effects from reported crop information. This is consistent with

[2] Determined by percent total of US winter wheat production from 2003-2012.

[3] Data begin in April 1986, but some years the first of the 13 weekly reports is released in late March.

Lehecka 2013. The separation into two time periods may also serve to proxy for technological improvement in crop production over time.

Methodology

For parsimony in estimating yield values from crop conditions, we construct an index of weekly crop conditions:

$$CCIndex \ = \ (\%\ Acreage\ Excellent) * 1 + (\%\ Good) * .75 + (\%\ Fair) * .5 + \ (\%\ Poor) * .25 + (\%\ Very\ Poor) * 0$$

The index ranges from [0, 100]. An index value of 100 corresponds to 100 percent of the surveyed crop being reported in excellent condition, and a value of 0 indicates 100 percent of the crop is in very poor condition.

To examine national average price effects from changes in crop conditions, we examine futures price changes in Kansas City and Chicago following a report release. Only July futures contracts are considered. These contracts are the first new crop contracts, and should be most sensitive to changes in expected wheat production from the coming harvest.

To measure local price impacts from crop condition reports we analyze changes in basis levels following a report release. Basis is measured as cash minus the nearby futures price. Since our local market is represented by a white wheat producing area, the basis is white wheat cash price minus soft red wheat futures. If crop conditions reports provide local information relative to production potential that differs from national average yield expectations, then a change in basis should be expected: i.e., local prices should change relative to national prices to reflect the change in local crop conditions.

Results

<u>State Yield Predictions Using Crop Conditions</u>

The individual index of weekly winter wheat crop conditions for each of the six states considered is first used to examine the relationship between the final state yields each year from 1986-2008. This is done by regressing each week's index against that year's final yield per acre. Thus, there are 13 yield regressions for each state each year; one for each of the 13 weekly conditions. In addition, a national index of crop conditions is regressed against the national average winter wheat yield. Regressions are estimated using OLS and take the form:

$$Yield_t = \alpha + \beta_1 * CCIndex_{ti}$$

where $CCIndex$ is the crop conditions index, t denotes the year, and i denotes the week. The R^2 values and coefficients for the national average yield (US) and each state's conditions estimates regressed on final yield by week from 1986-2008 are reported in Tables 1a and 1b.

It is apparent that as the season advances the conditions reports do a better job of predicting the final yield of the crop. In Washington, for example, the thirteenth crop progress report predicts

58 percent of the final annual yield variation, while in week one it only predicts 15 percent. This is illustrated in Fig. 2. The change in the coefficients of the estimates in table 1b demonstrates that the crop condition index coefficient, "Beta 1", increases as the R^2 increases through the growing season.

Using these regressions, we forecast the final yields out-of-sample for 2009-2012 at each weekly horizon. We then compute the RMSE for each set of predictions using the realized final yield values for each state. These are reported in Table 2a by state and week, and graphically presented in Fig. 3. Once again, note that in general the prediction error goes down over the course of the growing season, although this may not be statistically significant. Texas alone does not appear to experience markedly improved forecasts over the course of the season.

These results provide a reasonable expectation that crop conditions reports provide information relative to final realized production. As such, we should expect efficient cash markets to respond to unexpected changes in local crop conditions if the changes represent new market information (i.e., they were not anticipated prior to a report's release).

National Yield Prediction

Aggregating the weekly crop conditions indices for the six winter wheat producing states considered, we create an index to predict the national average yield for U.S. winter wheat. This is based on the assumption that the six largest winter wheat producing states should be good predictors of the national production of winter wheat. The individual state indices are weighted by the percent of total U.S. production accounted for by the considered states. This results in:

$$Index_t = \sum_{s=1}^{6} (CCIndex_{sti} * \%NatProd_{s\,t-1})$$

where $\%NatProd_{i,t-1}$represents state s's percentage of the total national production of winter wheat from the previous year, $t-1$.

Tables 1a, 1b, and 2a contain the R-squared values of the U.S. winter wheat yield estimates based on this index, the coefficients from these estimates, and the RMSEs from out of sample predictions, respectively. Though the beta coefficient increases in statistical significance over the course of the growing season, it appears that the yield prediction forecasts also increase in error as we move through the growing season. This likely indicates that the aggregate index is mis-specified and does not capture all of the factors that determine final U.S. yield.

Production Estimates

Using the estimated yields for the states and nation, we can make a prediction of total winter wheat production based upon the number of acres planted in each state, and nationally. We consider two formulations to estimate production that are based on estimated yield and planted acres. The first is:

$$\hat{y}_{sti} = \left(\hat{\alpha}_{si} + \hat{\beta}_{si} * index_{sti} + \varepsilon_{sit}\right) * (planted\ acres)_{st} + \mu_{si}$$

where $\hat{y}_{sti}$ is the estimated final production for state s in year t based on week i's crop conditions index. $\hat{\alpha}_{si}$ and $\hat{\beta}_{si}$ are the yield estimate coefficients for state s in week i of the growing season, $index_{sti}$ is the crop conditions index of week i for state s in year t, and $(planted\ acres)_{st}$ is the number of acres planted in year t for state s.

In the second formulation we weight the number of acres planted by the ratio of acres harvested over acres planted from the previous year:

$$\hat{y}_{sti} = \left(\hat{\alpha}_{si} + \hat{\beta}_{si} * index_{sti} + \varepsilon_{sti}\right) * (planted\ acres)_{st} * (harvest\ ratio)_{st-1} + \mu_{si}$$

where $\hat{\beta}_{si}$ is the yield for state s in week i of the growing season, $index_{sti}$ is the crop conditions index of week i for state s in year t, $(planted\ acres)_t$ is the number of acres planted in year t, and $(harvest\ ratio)_{t-1}$ is the number of acres harvested divided by the number of acres planted for state s in the previous year, $t-1$. The RMSEs from out-of-sample production predictions for 2009-2012 are listed in tables 2b and 2c for the first and second specifications respectively. The final bold RMSE in tables 2b and 2c identifies the specification with the smallest forecast error for each state, highlighting the difference between the two specifications by state.

There is a distinct difference between the two specifications for the two most southern states, Oklahoma and Texas. These states tend to harvest a lower percentage of their planted acres year over year, and this appears to factor into the prediction noticeably. The yield and production predictions do not do a particularly good job in predicting total U.S. winter wheat production. The prediction errors generally decrease from week 1 to week 13 across both specifications, except for the case of total U.S. production predicted without the weighting of acres planted over acres harvested.

Noticeably, Washington and Montana have the lowest production prediction errors. Table 2d contains the root mean squared percentage error of the production predictions, using the specification for each state that yielded the lowest error, to aid in interpreting the significance of each RMSE. The week 13 estimates of total production are off by 7% for Washington, ranging up to 21% for the state of Colorado. Though we may not employ the most robust specification for predicting total state production of winter wheat, these calculations again suggest that crop condition reports are providing information that market prices should react to if the information is unanticipated.

National Price Responses

To determine the effects of report releases on national markets, we examine the July Chicago and Kansas winter wheat futures contracts. Since the crop conditions reports are released on Monday afternoons after the day session of the futures markets have closed, we calculate absolute price change as:

$$ABS(P_t - P_{t-1})$$

where P_t is the day session opening price and P_{t-1} is the market settlement price at the end of the previous day session. This assumes that the markets will adjust fully from the reports, released at 4 PM EST, between market close and open.

Price changes are then compared based on whether they occurred on days of a report release or on a non-report day, excluding weekends. We first test for equivalence of variance between the two groups for both Chicago and Kansas winter wheat futures. The associated F-statistics in Table 3a are highly significant, implying the null hypothesis of equal variances should be rejected for both time periods considered. In contrast to Lehecka, we actually find smaller price variances following a report release when compared to no report release.

Next, we test for equivalence of means, assuming unequal variances, and find that the means are unequal in both markets at the 5% level of significance, but only for the time period 2008-2012. As with variance, mean price changes are actually *smaller* following a report release. These results appear counterintuitive and inconsistent with previous commodity market event studies. However, results are robust whether the daily price changes are measured from market close to next day open, or when measured as market close to next day close (Table 3b).

Due to the daily price changes being measured in absolute terms, the data follow an exponential distribution. A more appropriate test for differences in these populations is the Savage scores test, which does not assume normality. The chi-square statistics from the Savage tests are reported in Tables 3a and 3b with their associated p-values, and reinforce that the two populations of price changes are indeed significantly different for the Kansas wheat market in the 2008-2012 period under both price measurement specifications, as well as for the Chicago market in the 2008-2012 period under the close-close price measurement. These results lead to three possibilities. First, perhaps the appropriate event window is mis-specified. However the window definitions are consistent with previous studies.

Second, perhaps rather than providing new market information, the conditions reports simply confirm what market participants already know. If traders and/or private sector analysts accurately predict the information contained in the condition reports, then prices will have already reacted to the new market information, suggesting the reports only confirm existing market information, thus no price effect is realized.

Third, perhaps there are changes in local markets, but with the broad geographic dispersion of U.S. wheat production, local market changes offset each other when looking at national production impacts. In 2012, for example, Southern wheat producing states experienced drought stress while many Pacific Northwest producers experienced excellent yields. If these offset each other, then futures prices may not react, but local prices in each individual markets do. This possibility is evaluated below.

<u>Local Market Event Study</u>

To evaluate local price impacts of crop condition reports, we employ local winter wheat price and basis data from June 1999 to Dec 2011 for Odessa, WA[4]. The absolute change in daily basis is recorded as:

$$ABS(Basis_t - Basis_{t-1})$$

for the Odessa market. Table 4 presents the results. The Savage scores test rejects the null hypothesis of zero difference between daily basis changes after a report release versus no report release beyond the 20% level of significance for the 2008-2011 period, but fails to rejects the null hypothesis for the 1999-2007 period. Though not statistically significant, the descriptive statistics again suggest that the price changes after a report release are smaller than those changes when there is no release. In tables 5a and 5b it is evident that the mean absolute monthly basis changes are larger in the 2008-2011 period than in the 1999-2007 period. The variance of the monthly basis changes is higher in the 2008-2011 period as well. This is similar to what we observed for the Chicago and Kansas futures markets, though again not statistically significant.

Based on the Odessa results, it appears local prices react in a similar way to national prices following the release of crop condition reports, although with less statistical significance. The lack of significance in the report effects for the Odessa market might be due to the fact that, in general, Washington's crop conditions have lower variance than those of the other five main winter wheat producing states, as evident from Table 5c. This suggests that the information contained in crop conditions reports for Washington might in general be less impactful, as the conditions change less year over year across every week than in states that represent much of the rest of the winter wheat market. To more fully investigate local impacts, cash prices for geographically disparate regions needs to be collected. This effort is currently underway.

Nonetheless, since the crop conditions reports do provide insight into final yields yet prices do not seem to react to their release it appears that market participants are accurately predicting the yield implications of the reports prior to their release dates. As a result, the reports do not appear to be providing new information, but simply confirming what market participants already know.

Conclusions

Crop Conditions reports are shown to provide valuable information in predicting crop yields for various individual winter wheat markets. However, pricing effects of these reports on both the Chicago and Kansas futures markets is minimal after accounting for the effects of weekends and a possible structural change in the market following the advent of the Great Recession. We find that crop condition report effects in the period marked by high levels of uncertainty in the economy, 2008-2012, are significant for the Kansas futures market under both close-open and close-close price change measurements using both parametric and non-parametric tests. Similarly, the parametric techniques suggest significance for the Chicago market under both price measurement methods for the 2008-2012 period, as well as effects according to the non-parametric statistics under the close-close measurement method in the same period. However, the statistics show there to be *less* variance on days when a report is released than on non-report release weekdays. This seems to indicate that the market is very good at anticipating the

[4] We are not able to get daily transaction prices prior to June 1999.

information contained in the reports, thus the reports are simply confirming previous expectations. It is also possible, however, that the event window is more complicated than measured here and we are not properly capturing the markets' adjustments to the report releases.

Similarly, for the local market of Odessa, Washington we observe higher levels of variance and mean absolute daily changes in basis levels in the period beginning with the Great Recession compared to the period before. We do not find, though, that either parametric or non-parametric techniques detect significant effects from report releases (they are present according to the Savage statistic at the 20% alpha level in the 2008-2011 period). The lack of significance in the Odessa market may be partially due to the fact that Washington has less variance in the crop conditions reported week by week over the growing season compared to the other major winter wheat growing states, but is consistent with the national market results.

Future work includes expanding the cash markets considered, and a market impact analysis examining whether the market reacts in the expected direction to crop condition reports, even if price changes are not different than on no-report days. In addition, it would be of interest to evaluate market impacts for individual states when the conditions reported in a particular state are bearish or bullish relative to those of the other major growing regions, or looking at price responses when changes in a condition index from one period to the next exceeds some threshold.

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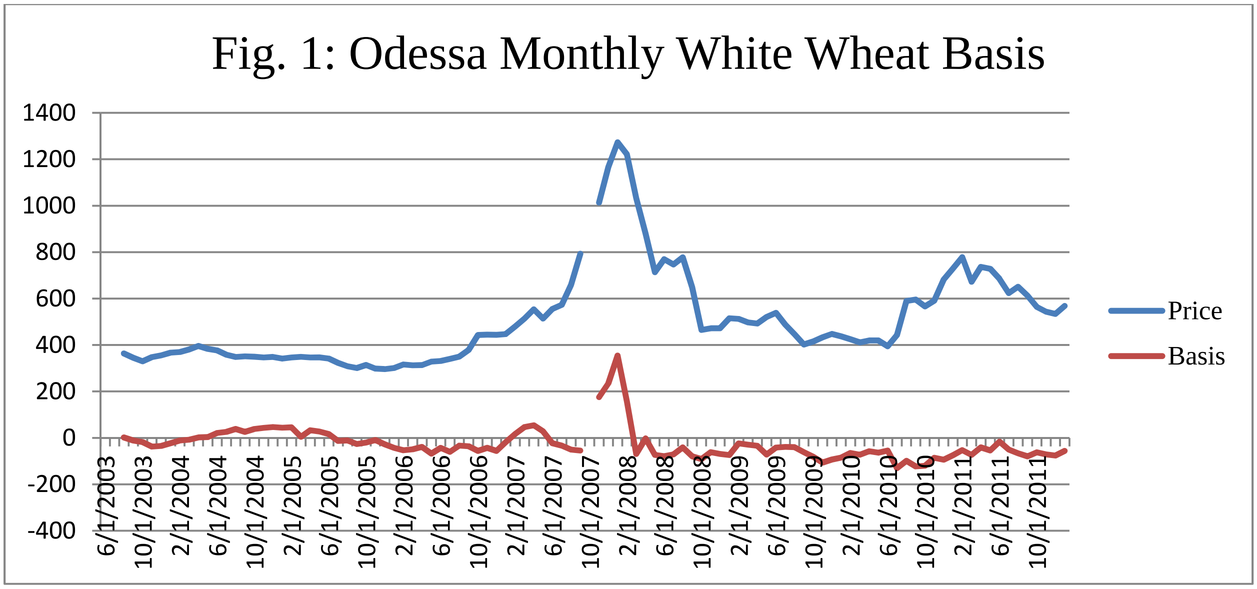
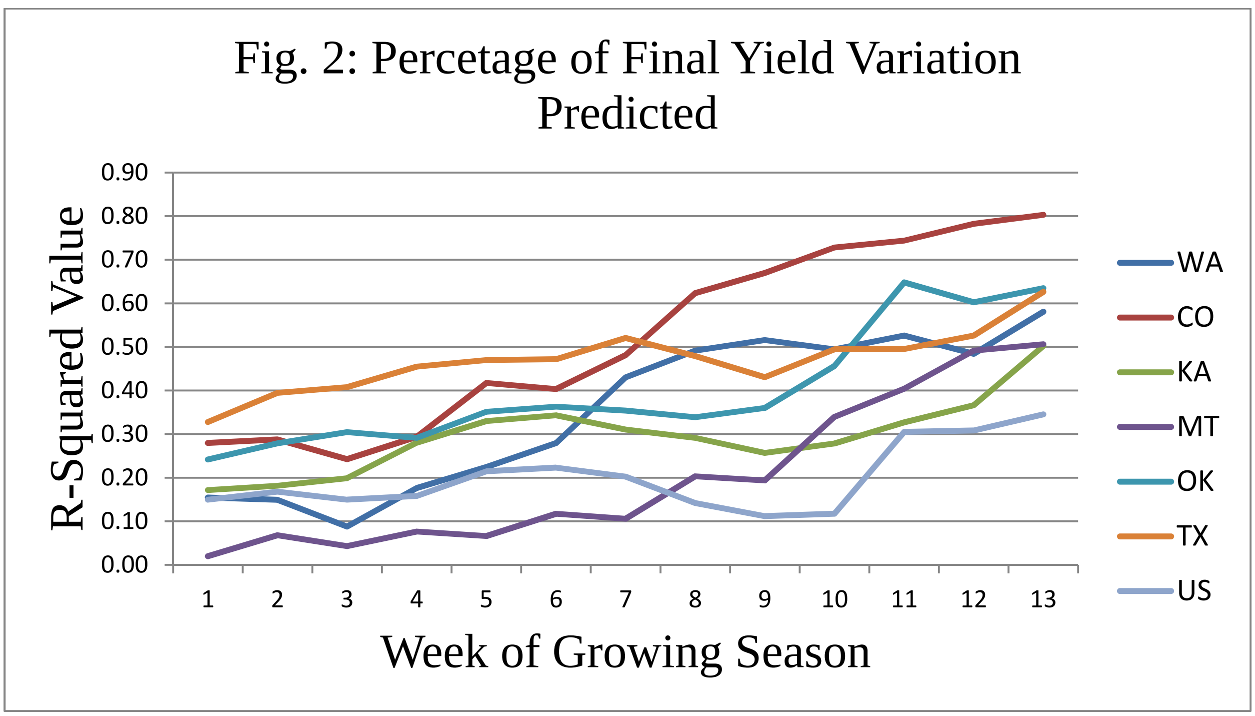


*Data for October of 2007 was unavailable.



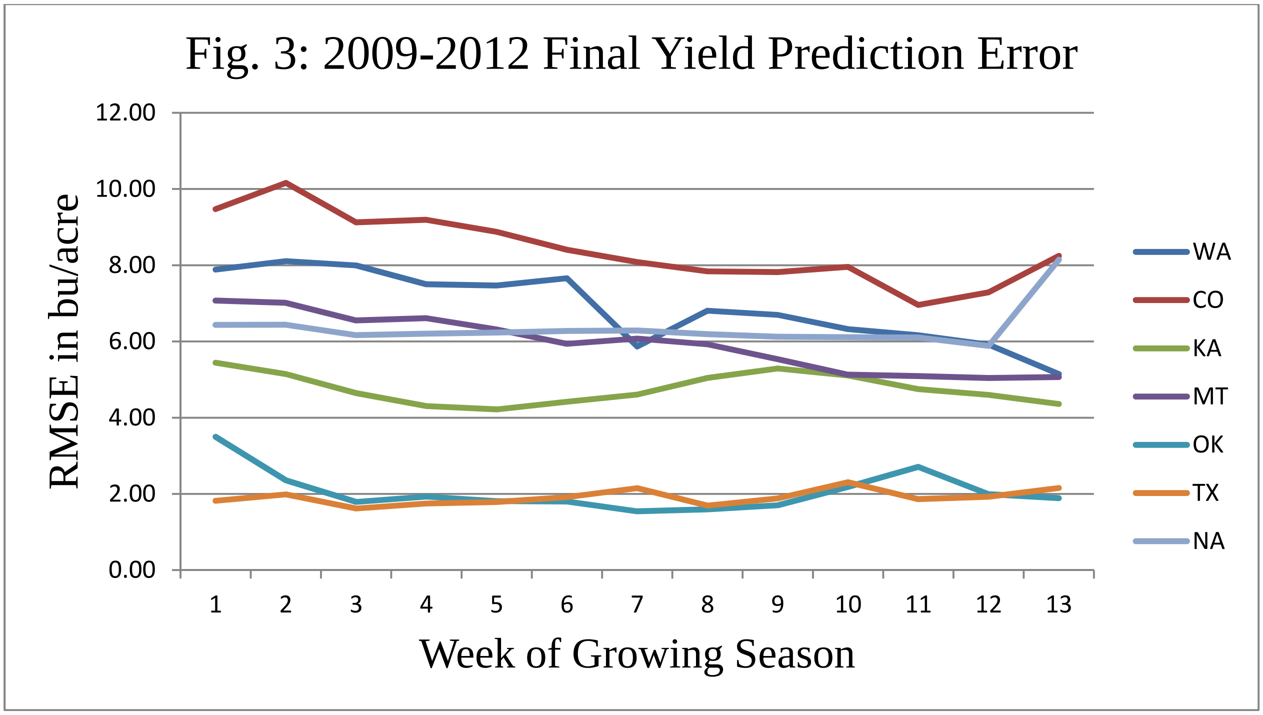


Fig. 3: 2009-2012 Final Yield Prediction Error
RMSE in bu/acre
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1
2
3
4
5
6
7
8
9
10
11
12
13
Week of Growing Season
WA
CO
KA
MT
OK
TX
NA

Table 1a: R-Squared Values from Yield Regressions

	Week												
	1	2	3	4	5	6	7	8	9	10	11	12	13
WA	0.15	0.15	0.09	0.18	0.22	0.28	0.43	0.49	0.52	0.49	0.53	0.48	0.58
CO	0.28	0.29	0.24	0.29	0.42	0.40	0.48	0.62	0.67	0.73	0.74	0.78	0.80
KS	0.17	0.18	0.20	0.28	0.33	0.34	0.31	0.29	0.26	0.28	0.33	0.37	0.50
MT	0.02	0.07	0.04	0.08	0.07	0.12	0.11	0.20	0.19	0.34	0.40	0.49	0.51
OK	0.24	0.28	0.30	0.29	0.35	0.36	0.35	0.34	0.36	0.46	0.65	0.60	0.63
TX	0.33	0.39	0.41	0.45	0.47	0.47	0.52	0.48	0.43	0.49	0.50	0.53	0.63
US	0.15	0.17	0.15	0.16	0.21	0.22	0.20	0.14	0.11	0.12	0.30	0.31	0.35

Table 1b: Yield Estimation Coefficients

	WA			CO		
Week	Beta 1	P-Value	Constant	Beta 1	P-Value	Constant
1	0.17	0.06	50.32	0.24	0.01	16.52
2	0.16	0.07	50.58	0.25	0.01	16.47
3	0.15	0.13	51.37	0.21	0.02	18.58
4	0.23	0.05	46.27	0.25	0.01	15.89
5	0.31	0.02	40.83	0.30	0.00	13.22
6	0.40	0.01	34.14	0.28	0.00	14.62
7	0.49	0.00	28.64	0.30	0.00	14.13
8	0.55	0.00	24.84	0.33	0.00	12.71
9	0.47	0.00	30.34	0.32	0.00	13.01
10	0.41	0.00	34.35	0.33	0.00	12.67
11	0.40	0.00	34.78	0.33	0.00	12.66
12	0.40	0.00	34.68	0.34	0.00	11.86
13	0.50	0.00	28.35	0.37	0.00	9.99

	MT			KS		
Week	Beta 1	P-Value	Constant	Beta 1	P-Value	Constant
1	0.09	0.52	29.97	0.18	0.05	25.21
2	0.16	0.23	25.68	0.19	0.04	25.11
3	0.13	0.34	27.67	0.20	0.03	25.15
4	0.15	0.20	26.65	0.23	0.01	23.22
5	0.14	0.24	27.16	0.24	0.00	23.01
6	0.18	0.11	25.01	0.23	0.00	23.68
7	0.16	0.13	26.29	0.22	0.01	24.58
8	0.22	0.03	22.55	0.22	0.01	24.41
9	0.19	0.04	24.56	0.20	0.01	25.65
10	0.24	0.00	21.85	0.21	0.01	25.05
11	0.25	0.00	20.40	0.25	0.01	23.40
12	0.28	0.00	18.40	0.27	0.00	22.10
13	0.31	0.00	16.07	0.34	0.00	18.33

Table 1b Cont.: Yield Estimation Coefficients

	TX			OK		
Week	Beta 1	P-Value	Constant	Beta 1	P-Value	Constant
1	0.17	0.00	20.77	0.19	0.02	18.67
2	0.19	0.00	19.77	0.21	0.01	17.29
3	0.19	0.00	19.92	0.23	0.01	16.79
4	0.20	0.00	19.76	0.20	0.01	18.01
5	0.21	0.00	19.52	0.21	0.00	18.10
6	0.20	0.00	19.65	0.23	0.00	17.28
7	0.22	0.00	18.74	0.25	0.00	16.28
8	0.21	0.00	19.23	0.26	0.00	15.61
9	0.20	0.00	19.81	0.27	0.00	15.33
10	0.21	0.00	19.56	0.32	0.00	12.19
11	0.21	0.00	19.37	0.35	0.00	10.54
12	0.22	0.00	18.75	0.33	0.00	11.92
13	0.24	0.00	17.74	0.33	0.00	11.57

	United States (US)		
Week	Beta 1	P-Value	Constant
1	0.25	0.08	32.70
2	0.25	0.06	32.50
3	0.24	0.08	33.24
4	0.24	0.07	33.01
5	0.28	0.03	32.02
6	0.29	0.03	31.88
7	0.28	0.04	32.20
8	0.24	0.08	33.48
9	0.22	0.13	34.18
10	0.23	0.12	33.84
11	0.33	0.01	31.13
12	0.31	0.01	31.80
13	0.31	0.00	32.26

*2008, no state reported growing conditions past 12 weeks

Table 2a: Yield Prediction RMSEs (bu/acre) by Week of Growing Season

	Week												
	1	2	3	4	5	6	7	8	9	10	11	12	13
WA	7.89	8.11	7.99	7.50	7.46	7.66	5.87	6.81	6.70	6.32	6.17	5.91	5.14
CO	9.47	10.16	9.13	9.19	8.88	8.41	8.08	7.84	7.82	7.96	6.96	7.29	8.25
KS	5.44	5.14	4.65	4.30	4.22	4.42	4.61	5.05	5.29	5.11	4.75	4.60	4.36
MT	7.07	7.01	6.55	6.61	6.32	5.94	6.07	5.93	5.54	5.13	5.09	5.04	5.06
OK	3.50	2.36	1.79	1.93	1.81	1.80	1.54	1.59	1.70	2.19	2.71	1.99	1.89
TX	1.82	1.99	1.62	1.75	1.79	1.92	2.15	1.69	1.88	2.31	1.86	1.93	2.15
US	6.43	6.44	6.16	6.20	6.23	6.27	6.29	6.19	6.12	6.11	6.10	5.88	8.15

Table 2b: Production Prediction RMSEs in bushels							
	State						
Week	WA	CO	KS	MT	OK	TX	US
1	12,044,488	15,903,149	34,170,773	11,550,762	54,345,510	80,055,679	94,235,724
2	12,436,460	17,514,012	31,269,442	11,445,714	49,864,917	76,541,251	87,667,707
3	12,010,813	15,148,913	26,400,370	10,513,069	47,683,328	77,504,409	96,782,916
4	11,293,101	15,063,836	21,712,514	10,760,708	47,228,762	76,968,556	94,585,667
5	11,327,426	14,067,806	20,230,229	10,254,799	47,373,781	76,348,317	91,927,591
6	11,439,051	13,323,828	21,450,541	9,906,124	47,483,145	75,635,005	90,581,584
7	8,248,625	12,637,058	23,174,711	9,933,915	45,662,547	74,922,367	93,577,249
8	9,927,407	11,836,271	27,346,288	9,507,432	44,928,287	77,228,987	95,857,209
9	9,593,223	11,949,670	30,902,681	8,761,001	45,678,478	76,728,567	100,400,000
10	9,023,298	12,055,113	28,975,965	8,535,006	42,289,937	75,913,510	101,100,000
11	8,757,043	10,179,274	25,560,553	7,536,040	44,299,226	76,363,634	98,826,701
12	8,560,852	11,104,592	24,139,146	7,897,951	43,233,878	78,249,876	109,000,000
13	**7,015,631**	**12,670,065**	**21,049,028**	**7,542,807**	41,414,761	75,639,631	**205,700,000**

*Terms in bold indicate the model specification (between Tables 2b and 2c) that minimizes prediction error.

Table 2c: Production Prediction RMSEs with Acres Planted/Acres Harvested Weighting

	State						
Week	WA	CO	KS	MT	OK	TX	US
1	14,093,078	21,639,952	53,586,829	14,374,220	35,778,260	42,791,328	267,500,000
2	14,491,578	22,892,492	50,596,210	14,232,051	31,237,605	41,372,759	265,000,000
3	14,018,119	20,758,270	45,937,894	13,345,901	27,903,007	40,532,685	256,800,000
4	13,450,428	20,439,684	42,342,814	13,396,111	28,733,086	40,113,127	257,100,000
5	13,382,661	19,300,563	41,692,095	12,871,909	27,518,374	39,512,532	256,200,000
6	13,675,701	18,426,802	42,885,351	12,031,389	27,064,601	39,222,208	257,300,000
7	10,534,400	17,412,127	45,102,411	12,398,505	26,050,324	38,486,878	258,900,000
8	12,277,653	16,742,001	49,694,419	12,100,052	24,839,251	38,564,014	256,300,000
9	11,988,659	17,266,512	52,358,866	11,231,147	25,291,916	39,732,154	255,400,000
10	11,329,552	17,347,041	50,329,617	10,328,002	21,583,553	39,750,471	255,000,000
11	10,867,199	15,990,645	47,361,011	10,498,406	19,212,028	39,244,914	253,200,000
12	10,514,439	16,821,906	46,288,838	10,189,373	20,980,734	39,213,614	248,200,000
13	9,280,324	18,465,094	43,410,396	10,932,312	**21,504,455**	**37,687,211**	347,600,000

*Terms in bold indicate the model specification (between Tables 2b and 2c) that minimizes prediction error.

Table 2d: Yield Prediction RMSPE by Week of Growing Season

	Week												
	1	2	3	4	5	6	7	8	9	10	11	12	13
WA	0.11	0.11	0.11	0.10	0.10	0.11	0.08	0.09	0.09	0.09	0.08	0.08	0.07
CO	0.23	0.25	0.22	0.23	0.22	0.21	0.20	0.19	0.19	0.20	0.17	0.18	0.21
KS	0.13	0.12	0.11	0.10	0.10	0.10	0.11	0.12	0.12	0.12	0.11	0.11	0.11
MT	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.12	0.11	0.11	0.11	0.11
OK	0.14	0.09	0.06	0.07	0.06	0.06	0.05	0.06	0.06	0.08	0.10	0.08	0.08
TX	0.06	0.06	0.05	0.06	0.06	0.07	0.08	0.06	0.06	0.08	0.07	0.07	0.08
US	0.14	0.14	0.13	0.13	0.13	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.17

Table 3a: Means, Variances, and Statistical Tests for Chicago and Kansas Close/Open Report Effects

		Chicago				Kansas			
		Pre-Crisis		2008-2012		Pre-Crisis		2008-2012	
		Report Day	Non Report Day	Report Day	Non Report Day	Report Day	Non Report Day	Report Day	Non Report Day
Obs		103	564	60	362	103	564	60	362
Mean	$	0.009	0.009	0.012	0.025	0.016	0.015	0.013	0.024
Variance	$	0.0001	0.0004	0.0002	0.0092	0.0003	0.0004	0.0003	0.0047
F-statistic for unequal variance:		2.984***		53.272***		1.469**		14.974***	
Parametric test statistic for report effects									
t - statistic		-0.45		2.464**		-0.76		2.551**	
Non-parametric test statistic for report effects									
Chi-square statistics									
Kruskal-Wallis		2.649	P=0.104	0.273	P=0.601	1.092	P=0.296	3.197*	P=0.074
Savage		1.854	P=0.173	1.350	P=0.245	1.362	P=0.243	3.090*	P=0.079

*, **, *** Indicate statistical significance at the 10%, 5%, and 1% levels respectively.

Table 3b: Means, Variances, and Statistical Tests for Chicago and Kansas Close/Close Report Effects									
		Chicago				Kansas			
		Pre-Crisis		2008-2012		Pre-Crisis		2008-2012	
		Report Day	Non Report Day	Report Day	Non Report Day	Report Day	Non Report Day	Report Day	Non Report Day
Obs		103	564	60	362	103	564	60	362
Mean	$	0.041	0.043	0.102	0.144	0.045	0.041	0.095	0.133
Variance	$	0.0016	0.0020	0.0081	0.0236	0.0020	0.0016	0.0061	0.0179
F-statistic for unequal variance:		1.286		2.904***		0.812		2.9309***	
Parametric test statistic for report effects									
t-statistic		0.04		3.001***		-0.79		3.138***	
Non-parametric test statistic for report effects									
Chi-square statistics									
Kruskal-Wallis		0.082	P=0.775	3.537*	P=0.060	0.048	P=0.826	3.504*	P=0.061
Savage		0.121	P=0.728	4.092**	P=0.043	0.675	P=0.411	4.300**	P=0.038

*, **, *** Indicate statistical significance at the 10%, 5%, and 1% levels respectively.

Table 4: Means, Variances, and Statistical Tests for Odessa Report Effects

		Pre-Crisis		2008-2011	
		Report Day	Non Report Day	Report Day	Non Report Day
Obs		39	275	47	278
Mean	$	0.045	0.056	0.092	0.115
Variance	$	0.0009	0.0067	0.0104	0.0155
F-statistic for unequal variance:		7.6240***		1.4936*	
Parametric test statistic for report effects					
t-statistic		1.6627*		1.3831	
Non-parametric test statistic for report effects					
Chi-square statistic					
Kruskal-Wallis		0.055	P=0.814	2.072	P=0.150
Savage		0.366	P=0.545	1.649	P=0.199

*, **, *** Indicate statistical significance at the 10%, 5%, and 1% levels respectively.

Table 5a: Statistics for Odessa Daily Price Change, by Month, 1999-2007

	March	April	May	June	July
Obs	70	57	57	70	60
Mean	0.07	0.05	0.04	0.06	0.06
(s.e.)	0.02	0.01	0.00	0.01	0.01
Variance	0.018	0.002	0.001	0.004	0.002

Table 5b: Statistics for Odessa Daily Price Change, by Month, 2008-2011

	March	April	May	June	July
Obs	70	65	59	70	61
Mean	0.14	0.13	0.09	0.11	0.09
(s.e.)	0.02	0.02	0.01	0.01	0.01
Variance	0.027	0.020	0.010	0.010	0.004

Table 5c: CC Index Variance by Week for 1986-2012

	State						
Week	WA	CO	KS	MT	OK	TX	US
1	173	147	189	85	198	204	35
2	176	156	190	92	206	213	36
3	147	169	201	92	217	210	37
4	115	148	208	123	254	222	37
5	79	150	228	119	276	214	38
6	59	156	251	132	254	220	37
7	64	165	257	151	225	210	35
8	55	175	235	151	209	208	34
9	79	187	249	191	198	215	32
10	100	196	234	215	190	225	30
11	116	193	207	218	208	219	37
12	105	185	197	212	216	206	41
13	83	171	187	183	214	222	48