Inquiry: The University of Arkansas Undergraduate Research Journal

Volume 19

Article 5

Fall 2015

Information Content of USDA Rice Reports and Price Reactions of Rice Futures

Jessica L. Darby
University of Arkansas, Fayetteville

Information Content of USDA Rice Reports and Price Reactions of Rice Futures

By: Jessica L. Darby
Department of Economics

Faculty Mentor: Dr. Andrew M. McKenzie
Department of Agricultural Economics and Agricultural Business

Abstract

Rice is a predominant food staple in many regions of the world, and it is important to determine how efficiently the U.S. rice market helps to ensure world food security. This question can be answered by gauging the price discovery performance of the U.S. rice futures market and the economic usefulness of the U.S. government's supply and demand forecasts. So, to this end, we employ two event study approaches: (1) to examine variability in returns on report-release days as compared to returns on pre- and post-report days, and (2) to regress price reactions on changes in usage and production information. It is found that the USDA provides the rice futures markets with valuable information and rice futures respond to the information in an economically consistent manner.

Introduction

Rice is a predominant food staple in many regions of the world, and international rice markets play a vital role in ensuring the food security needs of developing countries. The U.S. rice industry has an important role to play in feeding the world's population. The U.S. is the 5th largest rice exporter, accounting for approximately ten percent of world trade, and compared to other crops, a large portion – approximately 45% – of rice produced in the U.S. is exported. So an important question to address is how efficient is the U.S. rice marketing system in meeting these world food needs? Specifically, how valuable is the U.S. rice futures market and supply and demand information published by the U.S. Department of Agriculture (USDA) to the U.S. rice marketing system? There is significant evidence that futures markets play a vital price discovery role in the U.S. grain marketing system for raw commodities such as corn and soybeans, and that the main source of economic trading information used to guide production and marketing decisions for the U.S. grain industry are government reports provided by the USDA. These reports comprise U.S. and World Agricultural Supply and Demand Estimates (WASDE), National Agricultural Statistics Service (NASS) Crop Production forecasts, and NASS Prospective Plantings and Acreage estimates. The actively traded corn and soybean futures markets have been found to adjust quickly to supply and demand information contained in these government reports and to provide important pricing signals to farmers and the grain industry (Adjemian, 2012; Garcia, Irwin, Leuthold, & Yang, 1997; Isengildina-Massa, Irwin, Good, & Gomez, 2008a; Isengildina-Massa, Irwin, Good & Gomez, 2008b; McKenzie, 2008; Sumner & Mueller, 1989).

However, no prior research has attempted to analyze the economic value of USDA rice forecasts and the price discovery role played by the U.S. rice futures market. The U.S. rice futures market is relatively thinly traded compared with other grain futures, which begs the question as to how efficiently this market is able to discover price by embodying relevant economic information. In addition, the U.S. rice market exhibits a number of production-based idiosyncrasies making it somewhat unique compared with other grains. So, for example, the potential economic value of USDA production forecasts may be less for rice compared with other grains because it is an irrigated crop with much lower production variability (McKenzie, 2012). With this in mind, the overarching aim of this study is to estimate the economic value of these reports in terms of their impact on U.S. rice futures prices and their ability to support the U.S. rice industry's production and marketing decision-making.

Methodology

USDA Methods and Procedures

In this section, we provide a brief description of the three types of USDA reports and the data contained in these reports that we examine in our empirical analysis. First, the NASS Crop Production reports project forthcoming harvest-time rice supply based upon forecasted acres, yield, and overall production. These reports are released monthly from August through November.

The second type of USDA report that we consider consists of the WASDE reports, which are released each month and which provide forecasts of beginning stocks, imports, production, domestic food, industrial, and seed use, residual use, exports, and ending stocks over each crop year. The U.S. rice harvest typically occurs over the September through October period while the crop year runs from August to July of the following year; as a result, WASDE reports contain both pre- and post-harvest information about rice markets. We focus attention on WASDE reports released in May through November. The May through July reports use statistically based model forecasts from historical and expected data while the August through November reports utilize the NASS Crop Production report information.

The third type of USDA report is the NASS March Prospective Plantings report, which estimates planted area based on a survey of producers (representative stratified sample) completed during the first two weeks of March.

It is important to note that WASDE and NASS Crop Production reports are released simultaneously during August through November and the crop supply numbers are identical in the two reports. Therefore, in our empirical analysis, we are in effect considering the impact of the Prospective Plantings report in March, the impact of WASDE reports alone in May through July, and the joint impact of WASDE and NASS Crop Production reports in August through November.

The releases of all monthly WASDE reports for rice from January 1990 to December 2014 were analyzed in this study. Within this time period, a total of 287 WASDE reports were released; October 2013 is the only month without a report release due to the government shutdown. The WASDE report is typically released between the 9th and 12th of the month, but the time of release varies across the sample period. From January 1985 to April 1994, monthly reports were released at 3:30 p.m. EST, following the close of the Chicago Board of Trade (CBOT) trading session. From May 1994 to December 2012, with the exception of December 1994, monthly reports were released at 8:30 a.m. EST, prior to the start of CBOT trading session. From January 2013 to current, monthly reports were released at 12:00 p.m. EST, during the CBOT trading session. Additionally, March Prospective Plantings reports, which are typically released between the 28th and 31st of March, were analyzed for the same time period and had the same change in release time.

For futures prices, Chicago Board of Trade opening and closing futures prices for current (at the time of release) year rough rice November contracts were collected for six trading days prior and five trading days following the release of the WASDE, NASS Crop Production, and Prospective Plantings reports. While previous studies have used the nearest-to-maturity contracts for each release to measure price reactions to information about current market year information, November contracts were used in this study to capture price reactions to forthcoming market year information. The November futures contract is the harvest-time new-crop contract in rice markets. As such, it is the first contract to cover the forthcoming market year and should be sensitive to market expectations about harvest production and beginning stock levels for the forthcoming market year. In addition, the November contract is highly liquid, both in terms of volume and open interest, as it is used to hedge future levels of expected production over the pre-harvest period.

Event Study Approach

A vast literature has explored if various USDA Crop Production reports contain new and unanticipated information. Typically, an event-study framework is utilized to test whether significant changes in market prices occur following the release of a report. Event studies are based on the premise that information is valuable to the market if prices react to the release of reports (Campbell, Lo, & MacKinlay, 1997). If reports contain only anticipated information at the time of release, then futures prices will not react and the report does not provide "news" to the market. The underlying assumption is that markets are not strong form efficient, only semi-strong form efficient, as futures prices would reflect both public and private information in a strong form efficient market (Fama, 1970). Thus, markets would already anticipate the information contained in the USDA reports. The concept of futures market efficiency and informational content of USDA reports are intrinsically linked in the event-study approach (McKenzie, 2008).

Sumner and Mueller (1989) examined the informational content of USDA reports and its impact on corn and soybean futures prices. The impact was measured by the absolute mean differences between futures price changes following the report release and futures price changes on non-report release days. Sumner and Mueller concluded that USDA reports provided news to the market, as the absolute mean price change following the release of the report was higher than that of non-report release days. Similarly, Isengildina-Massa et al. (2008a) examined the impact of WASDE reports using the change between the closing price immediately prior to the report release and the opening price immediately following the report release for corn and soybean futures contracts over the 1985-2006 time period. Known as the close-to-open return, this price change captures the impact of information made available between those two points. The results of the event study found that WASDE reports have a substantial impact on corn and soybean futures markets, as illustrated by a return variance on report releases almost three times that of pre- and post-report return variances. Thus, there is information provided in WASDE reports that is unanticipated in corn and soybean markets. Fortenbery and Sumner (1993) employed a similar methodology and compared close-to-close futures price and option premium returns on report release days to returns on non-report release days. The results of their analysis, however, found that the report releases from 1985-1989 did not result in larger average returns. "One cannot rule out that USDA reports still provide news, but that the news can no longer be measured by a simple price change variable" (Fortenbery & Sumner, 1993, p.172).

If traders' perceptions of supply and demand are altered by the release of a WASDE report, then this new information should be reflected in a change in futures prices (Fortenbery & Sumner, 1993). As such, November rough rice futures prices represent the market's expectation of rice prices at harvest time. Variability of futures price returns around report releases including market news should "spike" upon announcement and maintain normal pre-report variability levels for days following the announcement. The "spike" reflects a change in the market's expectation of prices due to the news included in the announcement.

Following Isengildina-Massa et al. (2008a), the time index for this event study is t = -6,…, -1, 0, +1, …, +5. In order to account for the change in release times over the course of this sample period, t = 0 indicates the trading session at the CBOT immediately following the release of a WASDE (or equivalently NASS Crop Production report), or Prospective Plantings report. For WASDE reports, the event index is i = 1, … , 287, where i = 1 represents the January 1990 release of the WASDE report and i = 287 represents the December 2014 release of the WASDE report. For Prospective Plantings reports, the event index is i = 1, …, 24, where i = 1 represents the March 1990 Prospective Plantings report and i = 24 represents the March 2014 Prospective Plantings report.

If WASDE, NASS Crop Production, or Prospective Plantings reports include news, the information should be reflected in futures price movements immediately following the release of the report. For this reason we analyze the change or return in future prices based upon the percentage difference between closing futures prices observed just prior to report release and opening futures prices observed immediately after report release. Closing prices represent the average prices traded at the end of a day's trading session while opening prices are representative of the first trades in a session. For the statistical tests in this study, variances of close-to-open returns were analyzed to investigate the reaction of rough rice futures prices. The close-to-open returns for a given WASDE (NASS Crop Production) or Prospective Plantings report release date were calculated as:

$$(1) \quad r_{t,i} = \ln(p^{o}_{t,i}/p^{c}_{t-1,i}) \times 100$$

$$t = -6, \ldots, 0, \ldots, +5,$$

where $p^{o}_{t,i}$ is the opening price of the current (at time of release) year November rough rice futures contract for session t and event i, $p^{c}_{t-1,i}$ is the closing price of the current (at time of release) year November rough rice futures contract for session t – 1 and event i, and ln is the natural logarithm. The natural logarithm is used to measure daily percentage returns, which allows us to estimate and compare price reactions across years when rice traded at vastly different price levels.

A one-tailed F-test was applied to close-to-open returns. The null hypothesis is that the return variability for the report release session is less than or equal to the variability of the pre-report and post-report sessions. The alternative hypothesis is that the return variability for the report release session is greater than the variability of the pre-report and post-report sessions. Pre- and post-report session returns were aggregated to obtain a single estimate of non-release day session variances across the different reporting months. This is referred to as pre/post session variance in subsequent results sections. All statistical tests were computed using Data Analysis Toolpak included in Excel software.

Private Forecasts and Regression Analysis

Regression analysis can also be utilized to determine if various USDA Crop Production reports contain new and unanticipated information. Typically, the regression model involves regressing futures price changes on a dummy variable for report release dates as well as other explanatory variables (Fortenbery & Sumner, 1993). The regression-based event study model is typically estimated using Ordinary Least Squares (OLS), or using Weighted Least Squares (WLS), in the presence of heteroskedasticity (Fortenbery & Sumner, 1993). The estimated regression coefficient measures the average price response to a change in the news provided in USDA reports. Fortenbery and Sumner (1993) regressed the futures price change against loan prices, U.S. share of the world markets, and availability of option markets.

In order to compute the magnitude of news included in USDA reports, an estimate of market expectations measured just prior to USDA report release dates is necessary to capture the anticipated versus unanticipated component of USDA reports. As noted earlier, and according to the Efficient Markets Hypothesis, futures markets should only react to new unanticipated information. Due to the growth of private firms providing information on agricultural markets, a number of studies (Egelkraut, Garcia, & Good, 2003; Garcia et al., 1997; Good & Irwin, 2006) have utilized private information to proxy the amount of anticipated information in the market. Theoretically, the price impact of USDA production forecasts should be determined by how well the market anticipates the forecasts (Good & Irwin, 2007). Good and Irwin (2006) found that, on average, USDA corn production forecasts were more accurate than private market forecasts for most of the 1970-2003 time period. However, production forecast errors for USDA and private firms were highly correlated, suggesting that the private market anticipates at least some of the information in USDA reports. Thus, unanticipated information is measured as the difference between private information and information contained in USDA reports.

Alternatively, Lehecka (2014) assumed that the crop-condition information in Crop Progress reports serves as a proxy for anticipated information, thus the unanticipated information component is reflected in a change in crop-condition information from one report to the next. The study examined the relationship between changes in information provided in USDA Crop Progress and immediate price reactions. A WLS procedure was utilized, and close-to-open returns on report release sessions were regressed against the difference in the percentages of the crop in excellent or good condition from week to week. The results of the study indicated that there are price impacts from unanticipated information, and that Crop Progress reports provide significant informational value to corn and soybean markets.

There is a distinct lack of rice forecasts and information supplied by private analytical firms. This is in stark contrast to the large amount of private forecasts and information provided to other grain markets. Thus, in our analysis, the production and usage information included in the previous (at the time of release) USDA reports are used as a proxy for anticipated information. So, similar to Lehecka (2014), the news or unanticipated information is measured as the difference in production and usage numbers from one USDA report to the next. This measure of "news" allows us to empirically test if there is a private information gap in rice markets between the releases of public USDA numbers. If rice futures prices react to changes in month to month changes in USDA numbers, this would indicate that (1) any interim private information does not fully replace or adjust market expectations based upon previous month USDA numbers; and that (2) any interim private information does not fully foreshadow the information contained in newly released USDA numbers.

A typical event study model can be written as an Ordinary Least Squares (OLS) regression:

$$(3)\ f_{+1} - f_{-1} = \tilde{a} + \tilde{b}\,(F_{ijt}^{USDA} - F_{ijt}^{Private}) + e_t$$

where $f_{+1} - f_{-1}$ represents the price change from the closing November futures price on the day prior to the report release to the opening November futures price on the first trading day after the report release. The term, $F_{ijt}^{USDA} - F_{ijt}^{Private}$ represents the "news" element of USDA reports, where F_{ijt}^{USDA} represents the USDA forecast of either usage or production i, observed in month j and year t, and $F_{ijt}^{Private}$ represents the private market consensus forecast of either usage or production i, observed in month j and year t. And e_t is a mean zero normally distributed error term.

In the traditional event study approach, the estimated regression coefficient $\tilde{b}$ measures the average price response to a one-percentage point change in the "news" element of USDA reports. Thus, it is assumed that futures prices only react to the element of USDA production forecasts that was not anticipated by the private sector.

For this study, the previous month USDA reports serve as a proxy for private production forecasts, as it is assumed that the private production forecasts contain no additional information compared to previous month USDA forecasts. In this case, equation (3) can be rewritten as:

$$f_{+1} - f_{-1} = \tilde{a} + \tilde{b} \; (F_{ijt}^{USDA} - F_{i,j-n,t}^{USDA}) + e_t \quad (4)$$

where the private forecast is replaced with the previous USDA forecast observed at time j-n. This would be the USDA forecast observed in the previous month and the term $F_{ijt}^{USDA} - F_{i,j-n,t}^{Private}$ would measure the monthly revision in USDA forecasts as in (Isengildina, Irwin, & Good, 2006).

$$f_{Nov} - f_{jt} = \tilde{a} + \tilde{b} \; (F_{iNovt}^{USDA} - F_{ijt}^{USDA}) + e_t \quad (5)$$

Equation (5) above was used to analyze USDA forecasts observed at time j compared to the USDA forecast observed in November, which has final numbers for production and usage. In this case, the term $F_{iNovt}^{USDA} - F_{ijt}^{Private}$ would measure the USDA forecast error for a specific month (at the time of the report) in comparison to final estimates published in November. In this case, F_{ijt}^{USDA} represents the USDA forecast of harvest area, yield or usage i, observed in month j and year t, and F_{iNovt}^{USDA} represents the corresponding final USDA estimate of harvest area, yield or usage i, observed in month j and year t.

Results

Event Window Returns

The impact of USDA reports on event returns is illustrated graphically in **Figure 1** for close-to-open return variances for March, May, June, July, August, September, October and November. With the exception of September, the overall pattern of return variances for each of the months is consistent with the prediction that the return variance "spikes" on release days. The most notable statistically significant release "spikes" occur in July and October. For July, close-to-open report return variance is approximately 2.2 times larger than the pre- and post-report return variances. For October, the close-to-open report session return variance is approximately 3.6 times greater than the pre- and post-report return variances.

Table 1 presents the close-to-open F-test statistics for pre- and post-report return variances as compared to report session return variance. With the exception of September, there was substantially higher variance on report sessions than on pre- and post-report sessions when observing close-to-open prices. If markets overreact to the USDA report releases, then the close-to-open returns could overstate the "news" component included in the report (Isengildina-Massa et al., 2008). However, close-to-open returns tend to best represent the instantaneous incorporation of new information into market prices, and other information events, observed over the course of the release date trading day.

One would expect to see large reactions to July and August information, as these represent the first release times of truly new production information. Subsequent USDA reports might contain less unanticipated supply information, hence less variability for September. October may be more variable as the market adjusts to final (i.e. "more certain") production numbers. Adverse weather events, such as too hot nighttime temperatures over summer months, which are known to adversely affect rice yields, are over by October, and the effects are now realized and reflected in October production numbers for the first time. For this reason, the futures returns during the September period may be particularly noisy across the whole event window.

These explanations for the F-test results should be qualified by the fact that reports contain projected usage information as well as projected supply

Figure 1. Pre-Report, Release, Post-Report Session Close-to-Open Return Variances[1]
(January 1990-December 2014)

[1]The following dates did not have available opening futures price data and were excluded from the event windows for the close-to-open return variance results: April 6, 2012; November 4, 2012; November 8, 2012; November 12, 2012; November 14, 2012; March 24, 2013; March 25, 2013; March 26, 2013; May 7, 2013; May 8, 2013; May 9, 2013; May 14, 2013; May 15, 2013, May 16, 2013; May 17, 2013; May 20, 2013; May 21, 2013; November 7, 2013; November 10, 2013; November 12, 2013; November 13, 2013; November 14, 2013.

information. Usage shocks can be revealed at any time during the year, so the spike in October numbers could have also been the result of large unanticipated change in usage numbers over the sample period. The regression analysis results in this study will be able to offer more discerning results as to the relative impacts of both supply (production) and demand (usage) shocks revealed in this report.

Regression Analysis – Price Reactions to Month to Month Pre-Harvest Information

Regression results for immediate futures price reactions to production and usage "news" announced in USDA reports across the pre-harvest period from June to November are reported in **Table 2**. With the exception of the July usage coefficient, all of the

Table 1: Rice Futures Close-to-Open Return Variance Test Results for WASDE Reports (January 1990-December 2014)

Month	Report Session Return Variance	Pre/Post Report Return Variance	F-Statistic
March	1.569	0.701	2.240***
May	1.826	0.929	1.963***
June	1.256	0.975	1.288
July	1.763	0.803	2.195***
Aug	1.618	0.777	2.083***
Sep	0.885	0.815	1.086
Oct	2.953	0.814	3.630***
Nov	1.412	1.252	1.128

*Indicates significance at the 10% level,
**Indicates significance at the 5% level,
*** Indicates significance at the 1% level

estimated coefficients in **Table 2** are statistically significant and of the expected sign. An increase in production, a supply side factor, should elicit a price decrease – as indicated by the negative coefficient. An increase in usage, a demand factor, should elicit price increase – as indicated by the positive coefficient. The results illustrate that futures price responses to supply and demand information across the pre-harvest period are consistent with a well-functioning and efficient market. Prices rise with respect to increased usage, or demand shocks, and fall with respect to increased production, or supply side shocks. Furthermore, as indicated by the R^2 in **Table 2**, changes in production and usage information account for a larger proportion of overall variation in futures prices movements later in the season. September and October have the highest R^2 as any changes in production and usage information account for more of the variation in futures prices movements as it gets closer to harvest. A battery of residual diagnostic tests, presented at the foot of **Table 2,** indicates that our model is well specified.

The average rice futures price over the time period of January 1990 to December 2014 was $9.78/cwt. The results in **Table 2** show that, on average, a 1 percent unanticipated increase in production from the July to August period would elicit, on average, a 0.49 percent decrease in futures prices, a decrease of 5 cents/cwt. Conversely, a 1 percent unanticipated increase in usage from the July to August period would result in, on average, a 0.57 percent increase in futures prices, an increase of 6 cents/cwt. On average, unanticipated changes in production elicit the largest futures price responses from the September to October period at -0.71 percent, a decrease of 7 cents/cwt. On average, unanticipated changes in usage elicit the largest futures price responses from the October to November period at 0.94 percent, an increase of 9 cents/cwt.

On a month-to-month basis, the change in production and usage numbers announced in USDA reports elicits an immediate futures price response; public "news" drives futures prices in rice markets. Irwin, Good, Gomez, & Isengildina (2002) found that futures prices only respond to news unanticipated by private forecasts, which are released prior to the official public USDA numbers. The results in **Table 2** suggest that private rice forecasts released between monthly USDA reports are not viewed by rice futures markets as complete information updates on previous USDA report numbers. The fact that rice futures prices react to these month to month changes in USDA numbers indicates that any interim private information does not fully foreshadow the information contained in newly released USDA reports.

Table 2: Futures Price Reactions to Production and Usage "News" Announced in USDA Reports across the Pre-harvest Period

Parameters	June	July	Aug	Sep	Oct	Nov
Constant	0.29	0.19	0.20	-0.44	-0.17	-0.46
	(0.26)	(0.46)	(0.28)	(0.17)	(0.25)	(0.28)
Production	-0.38*	-0.20*	-0.49***	-0.44***	-0.71***	-0.43*
	(0.19)	(0.11)	(0.17)	(0.09)	(0.14)	(0.26)
Usage	0.87**	0.21	0.57**	0.27**	0.54***	0.94***
	(0.33)	(0.19)	(0.26)	(0.11)	(0.18)	(0.27)
R^2	0.19	0.07	0.21	0.51	0.50	0.30
Q (1)	0.37	3.96	1.55	0.24	0.00	0.00
	(0.55)	(0.05)	(0.21)	(0.62)	(0.91)	(0.97)
Q(2)	0.55	4.17	2.56	0.42	2.43	1.71
	(0.76)	(0.12)	(0.28)	(0.81)	(0.30)	(0.43)
LM(1)	0.39	3.64	1.49	0.38	0.01	0.10
	(0.53)	(0.06)	(0.22)	(0.54)	(0.91)	(0.76)
B-P	1.69*	1.12	1.32	3.40	1.16	0.75
	(0.43)	(0.57)	(0.52)	(0.18)	(0.56)	(0.69)
F Test	3.79*	1.91	4.27**	13.64***	12.51***	5.94***
	(0.04)	(0.17)	(0.03)	(0.00)	(0.00)	(0.01)

*Indicates significance at the 10% level,
**Indicates significance at the 5% level,
*** Indicates significance at the 1% level
White standard errors are presented for regressions with heteroskedasticity

Regression Analyses

Price Reaction to Information Changes from Pre-Harvest Time Periods to Harvest Time

Regression results for futures price changes regressed on harvest area, yield, and usage forecast errors of USDA reports across the pre-harvest period from June to November are reported in **Table 3**. All of the estimated coefficients in **Table 3** are statistically significant and of the expected sign. An increase in harvest area and production, supply side factors, should elicit a price decrease – as indicated by the negative coefficient. An increase in usage, a demand factor, should elicit price increase – as indicated by the positive coefficient. Prices rise with respect to increased usage, or demand shocks, and fall with respect to increased harvest area and yield, or supply side shocks. Furthermore, as indicated by the R^2 in **Table 3**, changes in production and usage information account for a large proportion of overall variation in futures prices movements throughout the pre-harvest period. This is in contrast to the month-to-month results in **Table 2**, which indicated that the regression explains more as harvest approaches. Once again, residual diagnostics show that our model is well specified.

As mentioned previously, the average rice futures price over the time period of January 1990 to December 2014 was $9.78/cwt. The results in **Table 3** show that, on average, a 1 percent unanticipated increase in harvested area from the July to harvest period would elicit, on average, a 3.13 percent decrease in futures prices, a decrease of 31 cents/cwt. Additionally, a 1 percent unanticipated increase in yield from the July to harvest period would elicit, on average, a 3.33 percent decrease in futures prices, a decrease of 33 cents/cwt. Conversely, a 1 percent unanticipated increase in usage from the July to harvest period would result in, on average, a 2.63 percent increase in futures prices, an increase of 26 cents/cwt. On average, unanticipated changes in harvested area elicit the largest futures price responses from the September to harvest period at -3.17 percent, a decrease of 31 cents/cwt. On average, unanticipated changes in yield elicit the largest futures price responses from the June to harvest period at -3.34 percent, while unanticipated changes in usage elicit the largest futures price responses from the October to harvest period at 4.53 percent.

The price of U.S. rice is highly influenced by the export market, as almost half – about 45 percent - of domestic production is exported (Childs & Livezy, 2006). The extent to which, if any, domestic supply influences futures prices is an open question. The results in **Table 3** suggest that domestic supply factors (i.e., yield and harvested area) do influence futures prices across the pre-harvest period.

Table 3: Futures Price Changes Regressed on USDA Forecast Error of Harvest Area, Yield and Usage Measured at USDA Report Times across the Pre-harvest Period

Parameters	May	June	July	Aug	Sep	Oct
Constant	1.23	2.07	5.28	3.48	2.23	1.11
	(4.62)	(5.28)	(3.22)	(2.39)	(2.64)	(1.77)
Harvest	-2.68***	-2.45**	-3.13***	-2.84***	-3.17***	-2.01***
Area	(0.78)	(1.00)	(0.91)	(0.70)	(0.80)	(0.77)
Yield	-3.21***	-3.34**	-3.33***	-3.29***	-2.85***	-2.07***
	(1.23)	(1.41)	(0.88)	(0.66)	(0.71)	(0.75)
Usage	2.99***	2.95**	2.63**	2.86***	3.07**	4.53***
	(1.03)	(1.16)	(0.94)	(0.82)	(0.03)	(1.55)
R^2	0.42	0.31	0.44	0.58	0.43	0.33
Q (1)	0.00	0.00	0.16	0.00	0.12	0.00
	(0.91)	(0.79)	(0.69)	(0.79)	(0.72)	(0.91)
Q(2)	0.79	0.94	0.72	1.78	3.11	1.06
	(0.68)	(0.62)	(0.70)	(0.41)	(0.21)	(0.59)
LM(1)	0.33	0.41	0.23	0.10	0.15	0.05
	(0.56)	(0.52)	(0.63)	(0.75)	(0.70)	(0.83)
B-P	10.75**	9.35**	4.92	8.50**	5.41	10.93**
	(0.01)	(0.03)	(0.18)	(0.04)	(0.14)	(0.01)
F Test	6.70***	4.54**	7.17***	11.98***	7.04***	4.83**
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)

*Indicates significance at the 10% level
**Indicates significance at the 5% level
*** Indicates significance at the 1% level
White standard errors are presented for regressions with heteroskedasticity

Discussion and Conclusion

The purpose of this study was to determine whether USDA reports, specifically WASDE, NASS Crop Production, and March Prospective Plantings, reveal valuable "news" information to the U.S. rice industry. If reports contain only anticipated information at the time of release, then futures prices will not react and the report does not provide "news" to the market. Two event study approaches were utilized to: (1) examine variability in returns on report-release days as compared to returns on pre- and post-report days, and (2) regress price reactions on changes in usage and production information.

The most notable release "spikes" occur in July and October, as reflected in the close-to-open variances. The regression analysis indicates that the supply (harvest area and yield) shocks have the largest impact on July variances. This is consistent with the fact that July is the first release time of truly new production information, as the June Prospective Plantings data are incorporated in the July WASDE report. By October, the market has adjusted to final production numbers with more certainty, but demand shocks can be revealed at any time. Thus, the regression analysis indicates that the impact of demand (usage) shocks have the largest impact on October variances.

From a practical standpoint, our regression results show that the USDA provides the futures market with important information, which is vital to the price discovery process. The pre-harvest information and futures price reactions are correlated, thus futures prices are driven by new information as it is released. Private rice forecasts released between monthly USDA reports are not viewed by rice futures markets as complete information updates on previous USDA report numbers due to the fact that rice futures prices react to these month-to-month changes in USDA numbers. Any interim private information does not fully foreshadow the information contained in newly released USDA reports, thus suggesting that there is an information gap between USDA reports. The information gap is an opportunity that could be profitably exploited by private firms that could provide accurate and timely forecasts of monthly USDA numbers.

This is the first event study to measure futures price reactions to USDA reports in rice markets, and the findings are significantly different than that of event studies on corn and soybeans. Studies (Good & Irwin, 2006) in corn and soybeans find that futures prices only respond to news unanticipated by private forecasts. On a month-to-month basis, corn and soybeans futures prices do not react based solely on information provided in USDA reports. There is a large amount of private information that is incorporated in the reactions.

Due to the lack of private forecasts, rice futures prices tend to react to information provided in USDA reports more than corn and soybeans futures prices. While rice is sensitive to many of the same market factors as corn and soybeans, rice markets have a number of idiosyncrasies and are very different from other grain markets. All rice is irrigated, thus yields are much less variable. Production is sensitive to availability of water resources and some weather variability, but overall production risks are lower. Furthermore, rice markets have thinly traded futures markets. In fact, the Risk Management Agency is not providing 2015 Crop Year rice revenue protection coverage because there is not enough trading volume in November (harvest time) contracts.

Production and usage information is necessary to attract speculative interest in futures contracts and to aid in the price discovery process. Pricing signals from the futures markets are important for all participants in the supply chain – from farmers to exporters to retailers to consumers. Futures markets cannot discover price in an information vacuum – futures markets need to trade based on comprehensive and frequently published supply and demand information (McKenzie, 2012). If the production and usage information provided to the marketplace can be improved and the error in USDA's pre-harvest forecasts reduced, then movements in rice futures could be better predicted. Rice futures price realignments over the pre-harvest period indicate that more timely and accurate private forecast of production and usage could potentially be used to exploit trading strategies. Future research is needed to determine the extent of profitability of private forecasts in rice markets. Furthermore, future research could consider developing and testing trading strategies based upon advanced knowledge of information contained in USDA reports or upon private forecasts released prior to USDA reports.

References

Adjemian, M. K. (2012). Quantifying the WASDE announcement effect. *American Journal of Agricultural Economics*, *94*(1), 238-256.

Campbell, J. Y., Lo, A. W., & MacKinlay, A. C. (1997). *The econometrics of financial markets.* Princeton, NJ: Princeton University Press.

Childs, N., & Livezey, J. (2006). Rice backgrounder. *Outlook Report from the Economic Research Service*, RCS-2006-01, 1-44.

Egelkraut, T. M., Garcia, P., Irwin, S. H., & Good, D. L. (2003). An evaluation of crop forecast accuracy for corn and soybeans: USDA and private information services. *Journal of Agricultural and Applied Economics, 35*, 79-95.

Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *Journal of Finance, 25*, 383–417.

Fortenbery, T. R., & Sumner, D. A. (1993). The effects of USDA reports in futures and options markets. *Journal of Futures Markets, 13*, 157-173.

Garcia, P., Irwin, S. H., Leuthold, R. M., & Yang, L. (1997). The value of public information in commodity futures markets. *Journal of Economic Behavior and Organization, 32*, 559-570.

Good, D. L., & Irwin, S. H. (2006). *Understanding USDA corn and soybean production forecasts: An overview of methods, performance and market impacts.* AgMAS Project Research Report 2006-01, University of Illinois at Urbana-Champaign, Department of Agricultural and Consumer Economics, Urbana-Champaign, IL.

Irwin, S. H., Good, D. L., Gomez, J. K., & Isengildina, O. (2002, December). *The value of USDA outlook information: An investigation using event study analysis.* Final Research Report, Economic Research Service, US Department of Agriculture.

Isengildina, O., Irwin, S. H., & Good, D. L. (2006). The value of USDA situation and outlook information in hog and cattle markets. *Journal of Agricultural and Resource Economics*, *31*, 262-282.

Isengildina-Massa, O., Irwin, S. H., Good, D. L., & Gomez, J. K. (2008a). The impact of situation and outlook information in corn and soybean futures markets: Evidence from WASDE reports. *Journal of Agricultural and Applied Economics*, *40*, 89-103.

Isengildina-Massa, O., Irwin, S. H., Good, D. L., & Gomez, J. K. (2008b). The impact of WASDE reports on implied volatility in corn and soybean markets. *Agribusiness*, *24*, 473-490.

Lehcka, G. V. (2014). The value of USDA crop progress and condition information: Reactions of corn and soybean futures markets. *Journal of Agricultural and Resource Economics*, *39*(1), 88–105.

McKenzie, A. M. (2008). Pre-harvest price expectations for corn: The information content of USDA reports and new crop futures. *American Journal of Agricultural Economics*, *90*(2), 351-366.

McKenzie, A. M. (2012). *Prefeasibility study of an ASEAN rice futures market.* ADB Sustainable Development Working Paper Series, *19*, 1-49.

Sumner, D. A., & Mueller, R. A. E. (1989). Are harvest forecasts news? USDA announcements and futures market reactions. *American Journal of Agricultural Economics, 71*, 1-8.