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Surprise and Dispersion: Informational Impact of USDA Announcements

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Abstract

We examine the role of information asymmetry on the changes in bid-ask spreads during the major United States Department of Agriculture (USDA) announcements. Our analyses, using corn, wheat and soybean futures, indicate that information asymmetry is significantly higher on the USDA announcement days compared to non-announcement days. We further observe that the increased information asymmetry prior to the news announcements is mainly driven by the divergence in private information possessed by market participants. However, once the USDA news are released, not only the dispersion in private information but also the news surprises contribute to increased information asymmetry and widening of bid-ask spreads.

JEL Classification: G1, C58, E44

Keywords: Agricultural Commodities, Bid-Ask Spreads, Spread Decomposition

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1. Introduction

It is generally accepted that public news announcements affect the cost of trading. In the context of agricultural commodities, several studies find an increase in the bid-ask spread (BAS) due to the United States Department of Agriculture (USDA) announcements (e.g., Wang et al., 2014; and Lehecka et al., 2014). These studies suggest that a widening in the BAS around the USDA announcements is mainly due to the increased volume and volatility on these days. In addition, active trading at the time of major news releases exacerbates price volatility and could present challenges for some producers seeking to manage their risk, hence resulting in a wider BAS (Garcia et al., 1997; Isengildina-Massa et al., 2008; McKenzie, 2008; Adjemian, 2012). An issue that has received little attention to date is the fact that the BAS has several components and that the arrival of news, such as the USDA announcements, can have a different impact on the components of spreads.

Market microstructure theory generally acknowledges two main components that make up the BAS. The first component reflects the difference in information held by traders and liquidity providers, and is commonly referred to as the information asymmetry component. When a subset of traders has superior information relative to the liquidity provider, the latter will increase the BAS to recover potential losses she incurs when trading against an informed counterparty (see e.g., Glosten and Milgrom, 1985; and Glosten, 1987). The second component reflects the costs that the liquidity provider incurs for providing liquidity, and includes order processing (fees, equipment, etc.) and inventory costs. Important news events, such as the USDA announcements, can indeed have a major impact on these components of the BAS, and understanding the impact that news events have on these different components can provide important insights on the behavior and dynamics of the BAS.

In this paper, we examine how different components of the BAS are affected by the USDA announcements. Our sample contains transaction-level data of agricultural commodities futures on corn, wheat and soybean from January 2013 to July 2016, a time period where the USDA announcements occur during trading hours. We consider the USDA announcements such as the World Agricultural Supply and Demand Estimates, Grain Stocks, Prospective Planting and Acreage reports. We then employ the well-established spread decomposition model of Madhavan et al. (1997), which separates the BAS into its two components, information asymmetry and liquidity provision costs. For our sample of agricultural commodities, we document that the BAS increases substantially, and that both components of the BAS are significantly affected by the USDA announcements. Interestingly, we observe that while the information asymmetry component of the spread increases, the liquidity provision component decreases (the information asymmetry component of the spread increases from 9.1% to 31.7%, 34.1% to 53.3%, and 35.6% to 51.4% for corn, wheat and soybean futures, respectively, in the 40-minute window surrounding the news release on non-announcement days versus announcement days).¹ This finding suggests that around the USDA announcement there is both an increase in liquidity-motivated trading which reduces the liquidity cost component, and in informed trading, which causes the information asymmetry component to increase. These findings shed light on previous studies on the BAS (e.g., Wang et al., 2014), which document that the BAS responds negatively to volume and positively to volatility. Our results suggest that, in this case, volume would proxy for liquidity-motivated trade, while volatility would proxy for the degree of information asymmetry in the market.

¹Since the percentage of the BAS due to liquidity provision costs is the remainder, the percentage decrease in the spread due to liquidity provision costs is the same as the percentage increase in the information asymmetry costs.

To further examine what drives the increase in information asymmetry around the USDA announcements, we focus on the resolution of uncertainty occurring at the time of the announcement (McNew and Espinosa, 1994). To capture the resolution of uncertainty, we focus on two metrics. First, we consider the surprise in the USDA announcement (measured by the difference between actual figures announced and those of market expectations). Second, we consider the degree of dispersion in analyst forecasts (measured by the interquartile range of different analyst forecasts one week prior to the USDA announcement). When we focus on the period prior to the USDA announcements, we observe that the dispersion in analyst forecasts is a strong determinant of the degree of information asymmetry. This implies that when there is a high level of disagreement among investors about the content of the upcoming USDA announcement, traders with access to private information will be more active. This finding is in line with McNichols and Trueman (1994) and Riordan et al. (2013) who argue that a high degree of uncertainty about a public announcement, before such an announcement is made, provides for an environment where the acquisition of private information is beneficial. After the USDA announcement, however, we observe that both analyst forecasts dispersion and news surprises are responsible for increased information asymmetry. This finding suggests that a big surprise or a large dispersion in beliefs creates an environment where some market participants can process information faster than others. Investors who can process this information faster and act accordingly, have a short-term informational advantage over others (Kim and Verrecchia, 1994).²

Our work contributes to the literature in several ways. First, to our knowledge, this is the first paper that applies a spread decomposition model to the BAS for agricultural commodity

² Kauffman (2013) suggests that small agricultural enterprises may not have the resources to process new information quickly enough to place trades in competition with large trading firms.

futures, and documents the significant changes that occur in these components around the time of the USDA announcements. Our results in this regard provide insights into the determinants of the BAS for agricultural commodities. Second, we explore what causes the increase in information asymmetry observed around the USDA announcement by linking it to two measures of the informational environment around the announcement: news surprise and analyst forecasts dispersion. We document that both metrics of the informational environment provide evidence about the degree of informed trading around the USDA announcement.

We structure the remainder of this paper as follows. Section 2 details the model we use to decompose the bid-ask spread into its two components. Section 3 describes the data, and particularly defines how we measure news surprises and analyst forecasts dispersion. Section 4 reports our empirical findings. Finally, Section 5 concludes.

2. Spread Decomposition Model

To decompose the spread into its two components (information asymmetry and liquidity provision costs), we employ the commonly used spread decomposition model of Madhavan et al. (1997) (MRR, hereafter). The information asymmetry component reflects the compensation a liquidity provider requires for trading against better informed counterparties, and thus reflects the degree of information privately obtained by market participants. The liquidity provision component aggregates inventory and order processing costs.³

³Inventory costs reflect the costs the liquidity provider faces for holding a position that deviates from her optimal position, whereas order processing costs reflect the direct costs a liquidity provider faces in making a market (i.e. fees, equipment, etc.). As inventory costs are less relevant in an electronic limit order book market (since there are no designated market makers in the agricultural futures markets such as the Chicago Mercantile Exchange), and we are predominantly interested in the asymmetric information component, we refrain from decomposing liquidity costs into its two parts.

The MRR model is based on the standard market microstructure assumption that changes in public beliefs about the value of an asset can originate from two sources. First, public beliefs can change due to the arrival of new public information. Public news may cause revisions in beliefs of market participants without any trade occurring. Second, changes in public beliefs can be due to privately informed trades, which become public knowledge through order flow. An informed buy (sell) order will be associated with an increase (decrease) in price, and thus the market can learn about the degree of informed trade by considering the price impact of these trades.

To formalize these two sources of information, let ϵ_t be the innovation in beliefs due to new public information and x_t be a trade indicator variable (+1 if a trade is buyer-initiated, -1 if a trade is seller-initiated, and 0 otherwise).⁴ The change in beliefs due to privately informed trades (order flow) is expressed as $\theta(x_t - E[x_t|x_{t-1}])$, where $(x_t - E[x_t|x_{t-1}])$ is the surprise in order flow and $\theta \geq 0$ measures the degree of information asymmetry. Higher values of θ indicate larger permanent price impacts of the surprise in order flow. Given these definitions, the post-trade expected value of an asset, μ_t , conditional on new public information and order flow innovations, can be expressed as

$$\mu_t = \mu_{t-1} + \theta(x_t - E[x_t|x_{t-1}]) + \epsilon_t. \quad (1)$$

Liquidity providers' quotes reflect this expected value, but also incorporate their compensation for providing liquidity. As such, the bid and ask prices quoted by liquidity providers reflect the

⁴Some trades end up being executed at the midpoint, commonly known as crossing trades. We estimate the probability of trades at the midpoint as $\lambda = 1 - |x_t|$.

expected value of the asset conditional on the arrival of a buy or sell order plus a compensation for their cost of doing business. Let $\phi \geq 0$ be the liquidity provider's compensation for inventory and order processing costs. The ask price will then be the price conditional on a buy order arriving, while the bid price is the price conditional on a sell order arriving, i.e.,

$$p_t^a = \mu_{t-1} + \theta(1 - E[x_t|x_{t-1}]) + \phi + \epsilon_t \quad (2)$$

$$p_t^b = \mu_{t-1} - \theta(1 + E[x_t|x_{t-1}]) - \phi + \epsilon_t.$$

The bid-ask spread, based on Equation (2), is a random variable with mean $p_t^a - p_t^b = 2(\theta + \phi)$, and thus reflects both information asymmetry costs (θ) and liquidity provision costs (ϕ).

Given that trades are executed at either bid or ask, the transaction price process is given as

$$p_t = \mu_{t-1} + \theta(x_t - E[x_t|x_{t-1}]) + \phi x_t + \epsilon_t. \quad (3)$$

To estimate Equation (3), we must complete this Equation by providing a specification for $E[x_t|x_{t-1}]$. As in MRR, we assume a general Markov process for the trade indicator variable, x_t . This implies that the conditional expectation of the trade indicator variable given the public information can be expressed as a first-order autoregressive process, $E[x_t|x_{t-1}] = \rho x_{t-1}$, where ρ is the autocorrelation in order flow. Substituting this into Equation (3) we can re-write Equation (3) in first differences as

$$p_t - p_{t-1} = (\phi + \theta)x_t - (\phi + \rho\theta)x_{t-1} + \epsilon_t. \quad (4)$$

Equation (4) expresses the transaction price change as a linear function of contemporaneous and past order flow.

We estimate the parameters in Equation (4) by Generalized Method of Moments (GMM). Specifically, let $u_t = p_t - p_{t-1} - (\phi + \theta)x_t + (\phi + \rho\theta)x_{t-1}$. Then, the following moment conditions can be employed to identify the parameters of interest $\beta = \{\theta, \phi, \lambda, \rho\}$ and a constant drift, α , i.e.,

$$E \begin{pmatrix} x_t x_{t-1} - x_t^2 \rho \\ |x_t| - (1 - \lambda) \\ u_t - \alpha \\ (u_t - \alpha)x_t \\ (u_t - \alpha)x_{t-1} \end{pmatrix} = 0.$$

The first equation is simply the definition of the autocorrelation in order flow, the second equation defines the crossing probability (trades at the midpoint), the third equation defines the drift term as the average pricing error, and the last two equations are the OLS normal equations.

3. Data

Our sample covers the period January 1, 2013 to July 31, 2016, and we focus on three major agricultural commodities: corn, wheat and soybean. The start of the sample is chosen to match the change in the USDA announcement time from 8:30am to 11:00am CST.⁵ We first describe the data related to the USDA announcements and then describe the transaction-level data on the agricultural futures.

⁵In January 2013, the release time of major USDA reports was changed to occur during the most active trading session at 11:00am CST, allowing markets the best chance to absorb news at a time of ordinarily high liquidity (Abbott, 2012). This change allows us to assess the impact of news since market participants can rapidly adjust their positions during this time.

3.1. USDA Announcements, News Surprises and Analyst Dispersion

We focus on the major USDA reports such as the World Agricultural Supply and Demand Estimates (WASDE), Grain Stocks Report (GSR), Prospective Planting Report (PPR), and Acreage Report (AR).⁶ The WASDE report provides monthly USDA forecasts of U.S. and global supply-use balances of major agricultural commodities. The GSR is issued quarterly in January, March, June and September (the January report is released together with January WASDE), and contains estimated agricultural stocks on a state and national level, as well as on- and off-farm storage. The PPR and AR are announced annually in March and June, respectively, (both reports are released together with the March and June GSRs, respectively) and contain the expected plantings as of March 1 and acreage by planted and/or harvested areas, respectively, for crops such as corn, wheat and soybean.

To measure news surprises and analyst forecasts dispersion, we collect data on analyst forecasts. In particular, we obtain analyst forecasts and actual end-inventories figures for the USDA reports from Bloomberg. Bloomberg conducts surveys among various analyst firms which cover the agricultural commodities in our sample. These surveys are conducted one week prior to the announcement of the USDA reports, covering as many as 32 analysts per survey and commodity. Appendix A lists all analysts that have participated in the Bloomberg survey over our sample period along with the number of responses they provide.⁷ The market expectation is then calculated as the median estimate across these surveys. We follow Andersen

⁶We do not consider the weekly Crop Progress Report because it is released at 4:00pm (CST) when the corn, wheat and soybean futures markets are closed.

⁷Isengilda et al. (2016) focus on two companies that provide private crop forecasts to capture the unanticipated news in the USDA announcement. We focus on analyst forecast, as we need a wider range of forecast in order to calculate a meaningful measure of forecast dispersion. In addition, the properties of the Bloomberg News have been investigated, for example, by Gay et al. (2009) and Chen et al. (2013), who find that, on average, Bloomberg forecasts are more consistent with the market consensus view for natural gas futures and E-mini S&P 500 futures, respectively.

et al. (2003) and compute the standardized news surprise by subtracting the market expectation from the actual end-inventories and dividing this by its in-sample standard deviation. Hence, the standardized news surprise associated with report type $i = \{WASDE, GSR, PPR, AR\}$ at announcement time t is

$$S_{i,t} = \frac{A_{i,t} - E_{i,t}}{\sigma_i}, \quad (5)$$

where $A_{i,t}$ and $E_{i,t}$ are the actual and expected value of report i , respectively, and σ_i is the standard deviation of $A_{i,t} - E_{i,t}$.

Apart from providing a consensus view, the surveys also allow us to compute a measure of dispersion in analyst expectations. To measure dispersion, we compute the interquartile range among the different forecasts at time t , $IQR_{i,t}$, and normalize this by the average inventories forecast, $\mu_{i,t}$, i.e.,

$$DISP_{i,t} = \frac{IQR_{i,t}}{\mu_{i,t}}. \quad (6)$$

Table 1 provides an overview of the USDA announcements, including the time of their releases, the frequency of the release, the number of observations, and summary statistics on the content of the announcements. In total, there are 902 trading days in our sample. Of these, 53 contain USDA announcements. For the majority of the announcements, surprises are non-zero, suggesting that there is unanticipated news in the USDA announcements. Table 1 also reports the analyst forecast dispersion. The average degree of dispersion varies across the different announcements, but appears to be highest for the WASDE (between 0.0459 and

0.1135) and lowest for the AR (between 0.0067 and 0.0084), reflecting a lower degree of consensus in end-inventories forecasts on the former.

INSERT TABLE 1 HERE

One issue that we may face with the USDA announcement data is the presence of seasonalities, i.e., the predictability of the USDA announcement may depend on the time of the season. To address this issue, we run regressions of the news surprises and analyst forecast dispersion on monthly dummies. We find evidence of seasonalities for both news surprises and forecast dispersion. For news surprises, the seasonalities are relatively weak, with F-tests for the joint significance of monthly dummies to capture the seasonal effect producing test statistics of 2.03 (p-value 0.05), 2.32 (p-value 0.03) and 3.15 (p-value 0.00) for corn, wheat and soybean, respectively. However, for the dispersion measure, we find a considerable seasonal pattern. F-statistics for the joint significance of monthly seasonal dummies are 8.16 (p-value 0.00), 9.30 (p-value 0.00), and 8.19 (p-value 0.00), for corn, wheat and soybean, respectively. For all three commodities, we observe that particularly in the months of May, July and August, dispersion tends to be high. High dispersion in May is due to the end of the planting season, which makes inventory levels more difficult to forecast (Lehecka, 2014). Dispersion is also high in July and August because crop yields during these times are sensitive to northern-hemisphere summer weather conditions (Tannura et al., 2008; Lehecka, 2014). In contrast, dispersion is decreasing from October to November during the harvesting season when analysts have a greater degree of certainty about their crop inventory forecasts. Finally, the lowest dispersion is during the months of December and January when the current crop season ends. We control for both seasonalities in news surprise and analyst dispersion in our regressions.

3.2. Futures Contracts Data

We focus on the three most actively traded agricultural commodities futures at the Chicago Mercantile Exchange (CME): corn, wheat and soybean. These futures are electronically traded on the Chicago Board of Trade's GLOBEX trading platform. Trading in these futures is divided into a daytime (8:30am to 1:20pm) and an evening session (7:00pm to 7:45am). We focus on the daytime session as the majority of trading (approximately 90%) occurs during this period (see Wang et al., 2014; Lehecka et al., 2014), and the USDA announcements take place during this period. Corn and wheat futures contracts have five maturities per year: March, May, July, September, and December, while soybean futures contracts have seven maturities: January, March, May, July, August, September and November. Each futures contract is for 5,000 bushels to be delivered on the second business day following the last trading day of the delivery month. On each trading day, about 10 to 20 maturities are traded with different levels of activity. We focus on the nearby contracts as they are the most liquid, which should allow for a more accurate assessment of market response to USDA announcements (Isengildina-Massa et al., 2008; Karali, 2012). Each contract is rolled over to the second-nearby contract when the volume of the second-nearby contract exceeds the volume of the front-end contract.

We obtain transaction-level data for prices, volume, bid-ask quotes and bid-ask depths from Thomson Reuters Tick History maintained by the Securities Industry Research Centre of Asia-Pacific. These data contain all activity observed at the top of the limit order book which includes transactions and revisions in bid and ask prices and depths, time-stamped to the nearest millisecond. We treat multiple trades that are executed at the exact same time as one trade, as these typically reflect a trade that is initiated by one market participant but executed against the limit orders of multiple market participants. In such cases, we use the value-weighted average price and aggregate the traded volume. We also clean our data from obvious outliers

using the filters proposed by Chordia et al. (2001): (i) Quoted Spread > \$5; (ii) Effective Spread/Quoted Spread > 4.0; (iii) Quoted Spread/Transaction Price > 40%; (iv) Price is higher (lower) than the daily mean plus (minus) 5 times the daily standard deviation.⁸

Table 2 presents summary statistics for the futures contracts in our sample. It reports the average contract price, quoted spread, effective spread, daily number of trades, daily trading volume, volume per trade and the bid and ask depths. As can be seen from this table, the average quoted and effective spreads are comparable for the different contracts. The average number of trades is highest for soybean futures at 9,979 trades per day. The average daily trading volume and volume per trade are highest for corn futures at 67,651 and 8.6 contracts, respectively. Finally, we note that the average quantity offered at the bid and ask prices are roughly equal for wheat and soybean, but higher for corn, suggesting greater liquidity for the corn contracts.

INSERT TABLE 2 HERE

4. Empirical Results

We present our empirical results by first comparing the BAS surrounding the USDA announcement time on days with announcements versus days without. Second, we decompose the BAS and assess how the different components of the BAS are affected by the USDA announcements. Third, we conduct regression analyses to study the effects of news surprises

⁸Quoted spread is defined as the difference between the ask and bid prices, while effective spread is defined as two times the absolute difference between the transaction price and the quote midpoint.

and analyst forecast dispersion on the information asymmetry components of the BAS. Finally, we provide some robustness tests.

4.1. Spreads and USDA Announcements

To assess whether the BAS reacts to the USDA announcements, we first plot the BAS during the daytime session on days with USDA announcements in Figure 1. Specifically, we show the average abnormal BAS, which is the average difference between the spread during announcement and non-announcement days, along with their 95% confidence intervals. We observe that the abnormal BAS is relatively constant throughout the trading day except for the period surrounding the USDA announcements. BAS widens shortly prior to the news release and peaks at 11:00am when the USDA reports are released. Following the announcement, the BAS declines gradually. Given the window surrounding the USDA announcements in which we observe the reaction in BAS, we focus our subsequent analysis on the period from 20 minutes before the announcement to 20 minutes after.

INSERT FIGURE 1 HERE.

In Table 3, we present averages for various variables on non-announcement and announcement days. We also report difference in means and medians between announcement and non-announcement days. Panel A reports the statistics for the 40-minute window surrounding the USDA announcement (20 minutes before and after). We find that quoted spreads increase significantly during this period by 0.027 cents, 0.042 cents and 0.058 cents for corn, wheat, and soybean futures, respectively. Similarly, average effective spreads increase during the same period. The number of trades and trading volume also increase significantly across all commodities. However, we observe no significant change in the average volume per trade,

indicating that trade size is not affected by the USDA announcements. The last two rows in Panel A show that bid and ask depths decrease during announcement periods. In the case of corn futures, the bid (ask) depth decreases by 100 (92) contracts. This observation suggests that market participants provide less volume at the best quotes during announcement periods.

Panels B and C report the statistics for the 20-minute period before and after the USDA announcement. We observe that while both quoted and effective spreads increase during the announcement period, but the increase is stronger after the news release. We also find an increase in both the number of trades and volume in both periods, which are stronger after the announcement. These observations indicate that trading and quoting activities are affected significantly in both periods.

INSERT TABLE 3 HERE

To decompose the bid-ask spread, we estimate the parameters in Equation (4) by GMM for each day over the 40-minute window surrounding the announcement time of 11:00am.⁹ Table 4 presents statistics for the average quoted spread, the effective spread and the implied spread, IS_t , computed as $IS_t = 2(\phi_t + \theta_t)$ during days with and without USDA announcements. The implied spread consists of information asymmetry and liquidity provision costs, which we report in cents, as well as in percentages.¹⁰ We also provide the difference in means and medians, along with their respective test statistics.¹¹

⁹We also consider information asymmetry and order processing components during the day before and after the announcement days with non-announcement days. On these days, we find no significant differences between the components from those pre/post-announcement days and the rest of the days, excluding announcement days.

¹⁰We only report the percentage spread due to information asymmetry, that is $\theta_t/(\phi_t + \theta_t)$, as the percentage of liquidity costs makes up the remainder of the spread.

¹¹We conduct a similar analysis for the four different USDA announcements, separately. In general, those findings are consistent with results reported in Table 4, and are available on request.

INSERT TABLE 4 HERE

Panel A of Table 4 presents the results for the period from 10:40am to 11:20am. The first two rows show the average quoted and effective spreads as the basis for comparison. Both spreads are significantly higher (at the 1% level) during days with announcements compared to days without. For instance, the average quoted spread for corn futures increases by 0.027 cents while the average effective spread increases by 0.020 cents. These results are consistent with those depicted in Figure 1. The third row reports the implied spread estimated using the MRR model. Similar to the quoted and effective spreads, implied spreads are significantly wider during announcement days. When we consider the two components of the spread, we observe that the increase in spread is largely due to an increase in the information asymmetry component (an increase of 0.050 cents in the case of corn futures). The liquidity provision component decreases by 0.036 cents during announcement days, which is expected as the increased trading activity around the announcement times leads to a lower per-trade cost of processing a transaction (Copeland and Stoll, 1990). In percentage terms, we observe that the information asymmetry component of the BAS increases from 9.1% to 31.7% for corn, 34.1% to 53.3% for wheat, and 35.6% to 51.4% for soybean futures. Overall, these results are in line with studies in financial markets (see, for example, Krinsky and Lee, 1995; Riordan et al., 2013), where information asymmetry increases surrounding important news announcements.

Panel B reports the results for the period before the news release (10:40am – 11:00am).¹² We observe that the quoted, effective and implied spreads increase significantly during this period.

¹²Release dates and times are published on the USDA website. Using the Bloomberg news platform as source of precise news release (considering the precise release time as the first time when the news is mentioned in Bloomberg), we observe that the 90% of news releases of our sample are during the first second after 11am. There are no news releases before 11:00am.

This increase is attributed to information asymmetry (the average information asymmetry component increases by 0.009 cents, 0.024 cents and 0.022 cents for corn, wheat and soybean futures, respectively). The liquidity provision component remains relatively unchanged in the period before the USDA announcement. These results suggest that there is an increase in trades based on private information in the period just before the announcement, and this private information is reflected in the BAS prior to the news announcement.

Panel C reports the results for the period after the news release (11:00am – 11:20am). We observe that the increase in BAS after the USDA news release is larger than in the period before the release. Again, this increase in BAS is mainly driven by the increase in the asymmetric information component of the BAS. However, we also observe a significant decrease in the liquidity costs in the period after the USDA announcement. In the case of corn futures, the information asymmetry component increases by 0.057 cents while the liquidity cost component decreases by 0.046 cents. This leads to an overall increase in the implied spread of 0.012 cents. The increase in information asymmetry after the USDA announcement can be attributed to divergent speeds at which market participants process new information (see e.g., Kim and Verrechia, 1994), where some market participants process this information faster than others. The decrease in liquidity provision costs can be attributed to the decline in order processing costs after the announcement, i.e. since trading volume is considerably higher after the announcement, the per-trade cost of a transaction declines, and this is reflected in the BAS.

4.2. Information Asymmetry and the Informational Environment

We have so far demonstrated that the increase in the BAS surrounding the USDA announcements is primarily driven by the increase in information asymmetry. In this section,

we consider the information content of news. Specifically, we assess the impact of two important aspects of news on information asymmetry: (i) the news surprise; and (ii) the dispersion in analyst forecasts.

We study the impact of news surprise and analyst forecast dispersion on information asymmetry using OLS regressions.¹³ In the first specification, we examine the impact of news surprises measured by the absolute value of the surprise, $|S_t|$.¹⁴ In the second specification, we separate the positive and negative news surprises. We do this by constructing a dummy variable, I_t^+ , which is equal to +1 if the surprise is positive and 0 otherwise, and another dummy variable, I_t^- , which is equal to -1 if the surprise is negative and 0 otherwise. Here, a positive (negative) surprise reflects an announcement which is more positive (negative) than expected by analysts. For the third specification, we examine the impact of analyst forecast dispersion, $DISP_t$, on information asymmetry. Finally, for the fourth and fifth specification, we include both the news surprise and analyst forecast dispersion variables in the same equation.¹⁵

We include several control variables in our regressions. First, we control for time effects similar to Frank and Garcia (2011) and Wang et al. (2014). Specifically, we control for seasonalities and day-of-the-week effects by including monthly and daily dummies. We also include roll-day dummies (5th to 9th day of the month prior to maturity) to capture any effects of the roll days of the futures contracts. Second, to control for market conditions, we include lagged

¹³Prior to estimating the regression model, we test for non-stationarity of the dependent variable using Augmented Dickey-Fuller tests. We find that the information asymmetry component, θ_t is stationary.

¹⁴Given that the quarterly GSR is released together with WASDE, PP or AR in some quarters, we use the surprises and analysts' dispersion of GSR on those days, as Wang et al. (2014) found that GSR reports have the biggest influence on the bid-ask spread.

¹⁵The correlation between the absolute news surprises and the forecast dispersion variables are 24% (p -value = 0.0462) for corn, 0% (p -value = 0.9840) for wheat, and 32% (p -value = 0.0099) for soybean.

information asymmetry, θ_{t-1} , and the roll returns (log front-end futures settlement price minus log second-nearby futures settlement price). We also include the lagged daily depth difference (average daily ask minus bid depth), the lagged (log) daily volume and lagged (log) daily realized volatility (at 1-minute frequency) volatility. These are all lagged by one day to avoid endogeneity issues as pointed out by Wang et al. (2014).

Table 5 reports the results for the period surrounding the news release (10:40am to 11:20am). In the first column, we observe that the coefficients for the absolute surprises, $|S_t|$, are positive and significant at the 1% level (0.029, 0.026, and 0.023 for corn, wheat and soybean futures, respectively), indicating that the bigger the surprise, the larger the information asymmetry component. In the second column, we observe that both positive and negative surprises increase the information asymmetry component at the 1% level.¹⁶ In the third column, we replace news surprises with the dispersion in analyst forecasts, $DISP_t$. We observe that the coefficients for the forecast dispersion variables are positive and highly significant for all three commodities, indicating that higher dispersion in analyst forecasts prior to the USDA announcement leads to increased information asymmetry surrounding the USDA announcements. In the fourth and fifth columns, we add back the news surprise. With the addition of the analyst dispersion variable, we note that the magnitudes of the news surprise coefficients decline substantially, and lose their statistical significance in the case of soybean futures. The analyst dispersion measure remains a highly significant determinant of information asymmetry.

INSERT TABLE 5 HERE

¹⁶We conduct Wald tests to assess whether the impacts of positive and negative surprises are significantly different. In all cases we do not reject the null hypothesis of symmetric impact of news surprises.

With regards to the control variables, we observe that the coefficient for the lagged information asymmetry is positive and significant, suggesting that there is persistence in information asymmetry across days. The roll-returns coefficient is positive and significant, in line with Wang et al. (2014). We also observe that lagged volume and lagged realized volatility are significant determinants of information asymmetry.

In Table 6, we split the period surrounding the USDA announcements into a pre-announcement period covering the 20 minutes prior to the USDA announcement (Panel A), and a post-announcement period covering the 20 minutes after the USDA announcement (Panel B).¹⁷ Turning first to the pre-announcement period, we find that the coefficients for the news surprise are positive and significant across all commodities. This observation, that the surprise in the news is related to the degree of information asymmetry prior to the release of that news, suggests that some market participants could be informed about the content of the announcement before its release. As for the differential impact of positive and negative surprises, we find no difference between them. When we introduce the analyst dispersion measure to the regressions in columns 3-5 for each commodity, we observe that the dispersion measure is highly significant, i.e. if there is high dispersion in forecasts about the upcoming USDA announcement, then the information asymmetry prior to the news announcement is higher. The most striking result of Panel A is that when we include both the news surprise and dispersion variables, the significance of the news surprise coefficients disappears almost completely (only the significant effect of news surprises on information asymmetry for corn remains). This finding suggests that it is not the surprise in the news announcement that drives the degree of information asymmetry prior to the announcement, but the degree of dispersion

¹⁷All control variables and seasonality dummies are included in these regressions, but not reported for the sake of brevity.

among analysts. This finding is in line with McNichols and Trueman (1994) who show that it is beneficial for market participants to engage in the acquisition of private information when there is a high level of disagreement in the market.

INSERT TABLE 6 HERE

Panel B of Table 6 reports the results for the information asymmetry component of the three commodities for the 20 minute period following the USDA announcement. The results suggest that both news surprise and forecast dispersion are important determinants of information asymmetry in the period after the USDA announcements. These findings suggest that a large news surprise, or a high dispersion lead to a temporary informational asymmetry, where some market participants are faster and better at interpreting the information than others (see Kim and Verrecchia, 1994). A large news surprise, in this case, can be seen as a large informational shock that takes time to be incorporated into prices; whereas a large dispersion can be interpreted about divergent views, which can lead to information asymmetry.

The results reported in Tables 5 and 6 are based on the full sample, including days with and without the USDA announcements. As a robustness test, we also conduct our analysis focusing only on days with news releases, i.e., the 53 USDA announcement days in our sample period. To save degrees of freedom in this analysis, we control for the seasonality effects in both surprises and analysts dispersion by first running regressions of $|S_t|$ and $DISP_{i,t}$ on monthly dummy variables. We collect the deseasonalized residuals from these regressions, which we refer to as the *deseasonalized absolute news surprises*, $|DS_t|$ and the *deseasonalized analyst*

forecast dispersion, $DDISP_{i,t}$. We then use $|DS_t|$ and $DDISP_{i,t}$ in the regressions similar to Tables 5 and 6.^{18, 19}

Table 7 reports the results for the announcement day regressions. We observe that the results are generally consistent with those reported in Tables 5 and 6. In particular, the coefficients for the analyst forecasts dispersion variable are positive and highly significant across all periods. This observation suggests that the increase in information asymmetry on announcement days is mainly driven by the dispersion in analyst forecasts. In contrast, the news surprises, which are significant on their own accord, lose significance when analyst dispersion is included.

INSERT TABLE 7 HERE.

5. Conclusion

In this paper, we assess the impact of USDA announcements on changes in the bid-ask spreads for the agricultural commodities futures contracts on corn, wheat and soybean. We employ the spread decomposition model of Madhavan et al. (1997) to separate spreads into information asymmetry and a liquidity provision components. When we compare these components during days with and without the USDA announcements, we find that information asymmetry is significantly higher during the USDA announcement days. More importantly, we find that the increase in information asymmetry prior to the news announcements is driven mainly by the

¹⁸Unlike the news surprise and dispersion variables, we do not observe seasonality effect in the information asymmetry component when we consider only those 53 USDA announcement days. Specifically, we run regressions of the information asymmetry component on the 53 USDA announcement days on monthly dummies and their F-tests for the joint significance of monthly dummies to capture the seasonal effect produce test statistics of 0.85 (p-value 0.59), 0.48 (p-value 0.91) and 0.32 (p-value 0.98) for corn, wheat and soybean, respectively. Hence, we only deseasonalize the news surprises and the analyst forecast dispersion.

¹⁹We also deseasonalize the news surprises (DS_t) using monthly dummies before discretizing them among positive and negative surprises.

divergence in private information possessed by market participants (proxied by the dispersion of analyst forecasts one week prior to the USDA announcement release). This finding leads us to suggest that market participants engage in private information acquisition when the uncertainty about the upcoming event is large (McNichols and Trueman, 1994). Once the news is released, we observe that both analyst forecast dispersion and news surprises (the difference between actuals and market expectations) contribute to increased information asymmetry and widening of the spreads. This finding is in line with Kim and Verrecchia (1994) who suggest that some traders have an informational advantage due to their speed of obtaining and processing information.

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Appendix A. Analyst Forecast in the Bloomberg's Survey

Panel A: Forecasts for Corn

	Corn					Corn			
	WASDE	GSR	PP	AR		WASDE	GSR	PP	AR
A/C Trading	37	8	4	2	GlobalEcon LLC	0	0	0	0
ABN Amro	3	2	1	0	Goldman, Sachs & Co.	0	0	0	1
ADM Investor Services	42	13	4	3	Grain Service	24	13	3	3
Advance Trading Inc	2	0	0	0	Hightower Report	9	4	3	2
Advanced Economic Solutions	2	2	1	1	Hueber Report	13	3	0	1
Advanced Market Concepts	39	15	4	4	INTL FCStone	41	13	3	4
AgResource	10	3	2	1	Jefferies Bache	27	10	3	2
AgriSource	34	2	3	0	Jefferies Llc	1	0	0	0
AgriVisor Services	34	15	4	4	Linn Group	33	12	4	4
Allendale Inc.	24	6	3	3	Love Consulting	42	15	4	4
Bennett Consulting	8	4	1	2	Macquarie Bank Ltd.	1	0	0	0
Brock Associates	1	0	0	1	Macquarie Group	20	8	2	2
Brugler Marketing	35	11	0	2	Mckeaney-Flavell	35	11	3	3
CHS Hedging Inc	21	8	2	2	Midco Commodities	6	0	0	0
CHS Hedging Llc	11	2	1	1	Morgan Stanley	1	1	0	1
Citi Futures Perspective	5	0	0	0	NewEdge	20	7	2	2
Citigroup	19	7	3	3	Northstar Commodity	41	13	4	4
Citigroup Global Markets Inc	0	1	0	1	Pira Energy Group	12	3	4	3
Commodity Information Systems	29	11	4	4	Price Futures Group	40	15	4	3
Corn & Soybean Advisor	0	0	0	0	Prime Agriculture Consulting	36	15	4	4
Country Hedging	3	1	0	0	R.J. O'Brien & Associates	41	14	4	4
Daniels Trading	1	1	0	1	Rabobank	5	0	2	1
DC Analysis Llc	6	2	1	1	Rabobank Nederland	0	0	1	0
Deutsche Bank Securities	4	1	0	1	Risk Management Commodities	13	1	1	0
Doane Agricultural Services	42	15	2	4	Roach AG	1	0	0	0
ED&F MAN Capital Markets Inc	36	13	3	4	Societe Generale	3	0	3	2
EFG Group	41	14	4	4	Stewart-Peterson Group	38	12	4	4
Farm Direction Llc	7	3	2	1	U.S. Commodities Inc.	36	12	4	3
Farm Futures	39	13	4	4	Vantage RM	36	12	3	4
FC Stone Inc	4	1	0	0	Walsh Trading	14	0	2	1
Fimat Futures	0	1	0	0	Water Street Solutions Inc	3	1	1	1
Fintec Group Inc	4	2	1	0	Western Milling	15	5	2	2
Futures International LLC	35	12	3	3	Zaner Group Llc	29	11	3	3
Global Commodity A&C	7	0	1	0					

Note: This table reports the analysts that provide forecasts for the various USDA announcements for corn. The table reports the name of the analyst firm as well as the number of forecasts that the analyst produced over the sample period.

Panel B: Forecasts for Wheat

	Wheat								
	WASDE	GSR	PP	AR		WASDE	GSR	PP	AR
A/C Trading	26	3	0	0	Grain Service	23	13	2	1
ABN Amro	3	2	1	0	Hightower Report	9	4	3	1
ADM Investor Services	42	13	4	2	Hueber Report	11	3	0	0
Advanced Economic Solutions	2	2	1	1	INTL FCStone	41	13	3	2
Advanced Market Concepts	41	15	4	2	Jefferies Bache	27	10	3	1
AgResource	5	3	2	0	Jefferies Llc	1	0	0	0
AgriSource	28	1	1	0	Linn Group	28	11	4	2
AgriVisor Services	35	15	4	2	Love Consulting	42	15	4	2
Allendale Inc.	25	6	3	1	Macquarie Bank Ltd.	0	1	0	0
Bennett Consulting	5	2	1	1	Macquarie Group	21	7	2	1
Brock Associates	1	0	0	1	Mckeaney-Flavell	32	11	3	2
Brugler Marketing	31	8	0	0	Midco Commodities	6	0	0	0
CHS Hedging Inc	21	8	2	1	NewEdge	20	7	2	1
CHS Hedging Llc	11	2	1	1	Northstar Commodity	41	12	4	2
Citi Futures Perspective	5	0	0	0	Pira Energy Group	5	1	3	1
Citigroup	17	6	3	1	Price Futures Group	39	13	4	1
Commodity Information Systems	18	3	4	1	Prime Agriculture Consulting	35	15	3	2
Country Hedging	3	1	0	0	R.J. O'Brien & Associates	41	13	4	2
Daniels Trading	1	1	0	1	Rabobank	0	0	2	0
DC Analysis Llc	6	2	1	1	Risk Management Commodities	2	1	0	0
Deutsche Bank Securities	1	0	0	0	Roach AG	1	0	0	0
Doane Agricultural Services	35	12	2	2	Societe Generale	3	0	3	0
ED&F MAN Capital Markets Inc	36	13	3	2	Stewart-Peterson Group	38	12	4	2
EFG Group	41	14	4	2	U.S. Commodities Inc.	10	4	2	0
Farm Direction Llc	7	2	2	0	Vantage RM	36	12	2	2
Farm Futures	38	14	4	2	Walsh Trading	14	0	1	0
FC Stone Inc	4	1	0	0	Water Street Solutions Inc	3	1	1	1
Fintec Group Inc	5	2	1	0	Western Milling	14	5	2	1
Futures International LLC	35	12	3	1	Zaner Group Llc	29	11	3	2
Global Commodity A&C	7	0	1	0					

Note: This table reports the analysts that provide forecasts for the various USDA announcements for wheat. The table reports the name of the analyst firm as well as the number of forecasts that the analyst produced over the sample period.

Panel C: Forecasts for Soybean

Soybean									
	WASDE	GSR	PP	AR		WASDE	GSR	PP	AR
A/C Trading	37	8	4	2	GlobalEqon LLC	0	1	0	0
ABN Amro	3	2	1	0	Goldman, Sachs & Co.	0	0	0	1
ADM Investor Services	42	13	4	3	Grain Service	24	12	3	3
Advance Trading Inc	1	0	0	1	Hightower Report	9	4	3	2
Advanced Economic Solutions	2	2	1	1	Hueber Report	13	3	0	1
Advanced Market Concepts	40	15	4	3	INTL FCStone	41	13	3	4
AgResource	8	3	2	1	Jefferies Bache	27	10	3	2
AgriSource	35	2	3	0	Jefferies Llc	1	0	0	0
AgriVisor Services	35	15	4	4	Linn Group	33	12	4	4
Allendale Inc.	24	6	3	3	Love Consulting	42	15	4	4
Bennett Consulting	8	4	1	2	Macquarie Bank Ltd.	2	0	0	0
Brock Associates	1	0	0	1	Macquarie Group	19	8	2	2
Brugler Marketing	35	11	0	2	Mckeaney-Flavell	35	11	3	3
CHS Hedging Inc	21	8	2	2	Midco Commodities	6	0	0	0
CHS Hedging Llc	11	2	1	1	Morgan Stanley	1	1	0	1
Citi Futures Perspective	5	0	0	0	NewEdge	20	7	2	2
Citigroup	19	7	3	3	Northstar Commodity	41	13	4	4
Citigroup Global Markets Inc	0	1	0	1	Pira Energy Group	12	3	4	3
Commodity Information Systems	28	10	4	4	Price Futures Group	40	15	4	3
Corn & Soybean Advisor	1	0	0	0	Prime Agriculture Consulting	36	15	4	4
Country Hedging	3	1	0	0	R.J. O'Brien & Associates	41	14	4	4
Daniels Trading	1	1	0	1	Rabobank	5	1	2	1
DC Analysis Llc	6	2	1	1	Rabobank Nederland	0	0	1	0
Deutsche Bank Securities	4	1	0	1	Risk Management Commodities	13	1	1	0
Doane Agricultural Services	42	14	2	4	Roach AG	1	0	0	0
ED&F MAN Capital Markets Inc	36	13	3	4	Societe Generale	3	0	3	2
EFG Group	41	14	4	4	Stewart-Peterson Group	38	12	4	4
Farm Direction Llc	7	3	2	1	U.S. Commodities Inc.	36	12	4	3
Farm Futures	39	14	4	4	Vantage RM	36	12	3	4
FC Stone Inc	4	1	0	0	Walsh Trading	14	0	2	1
Fintec Group Inc	4	2	1	0	Water Street Solutions Inc	3	1	1	1
Futures International LLC	35	12	3	3	Western Milling	15	5	2	2
Global Commodity A&C	7	0	1	0	Zaner Group Llc	29	11	3	3

Note: This table reports the analysts that provide forecasts for the various USDA announcements for soybean. The table reports the name of the analyst firm as well as the number of forecasts that the analyst produced over the sample period.

Table 1. US Department of Agriculture (USDA) Announcements

This table provides summary statistics for the USDA announcement releases for the period January 1, 2013 to July 31, 2016. It reports the time of the release (in Central Standard Time), the frequency of the release, and the total number of releases in the sample period. The table also reports statistics for the surveys, actuals, and surprises for each of the agricultural commodities, along with the standard deviation of the surprises and the average analyst forecast dispersion.

Agricultural Announcements	CST	Frequency	Obs	Survey (in millions)	Actual (in millions)	Surprises (in millions)	Non-zero surprises	Surprises std dev	$DISP_t$
World Agricultural Supply and Demand Estimate	11:00	Monthly							
- Corn			42	1,722.3	1,699.3	-22.98	40	96.22	0.0644
- Wheat			42	734.6	739.3	4.64	40	37.87	0.0459
- Soybean			42	325.8	327.7	1.95	37	26.78	0.1135
Grain Stocks Report	11:00	Quarterly							
- Corn			15	5,877.7	5,893.8	16.13	15	181.66	0.0245
- Wheat			15	1,339.9	1,338.1	-1.80	15	33.77	0.0289
- Soybean			15	1,140.3	1,131.2	-9.07	15	48.96	0.0516
Prospective Plantings Report	11:00	Annually							
- Corn			4	92.4	92.9	0.52	4	2.20	0.0094
- Wheat			4	54.8	54.3	-0.50	4	0.67	0.0117
- Soybean			4	82.2	81.4	-0.86	4	0.98	0.0140
Acreage Report	11:00	Annually							
- Corn			4	92.2	93.0	0.79	4	1.03	0.0071
- Wheat			2	52.9	55.0	2.11	2	1.55	0.0084
- Soybean			4	82.3	82.8	0.53	4	0.19	0.0067
Total Announcements Days (adjusted)			53						
Total Non-Announcement Days			849						
Total Sample Days			902						

Table 2. Summary Statistics

This table provides summary statistics for the agricultural futures contracts. The reported figures are based on activities observed during daytime trading (8:30am and 11:00am), averaged over the sample period from January 1, 2013 to July 31, 2016.

	Corn	Wheat	Soybean
Price per bushel (in cents)	513.8	620.1	1214.3
Quoted Spread (in cents)	0.253	0.261	0.262
Effective spread (in cents)	0.255	0.261	0.265
Trades per day	8,129	5,642	9,979
Volume per day	67,651	26,999	46,658
Volume per Trade	8.6	4.9	4.8
Bid Depth	173	28	28
Ask Depth	177	28	27

Table 3. Summary Statistics Surrounding News Announcements Period

This table provides summary statistics for the agricultural futures contracts during the period surrounding USDA report announcements. The reported figures are the average values over the sample period from January 1, 2013 to July 31, 2016. "NA" and "A" denote Non-Announcement and Announcement days, respectively. Panel A reports the summary statistics during the full 40-minute period surrounding the announcement (10:40am to 11:20am). Panel B reports the summary statistics for the 20-minute period prior to the announcement (10:40am to 11:00am). Panel C reports the summary statistics for the 20-minute period following the announcement (11:00am to 11:20am). Figures in parentheses are the t-statistics corrected using Newey-West correction. ***, ** and * denote statistical significance at 1%, 5% and 10% level, respectively.

	Corn Futures						Wheat Futures						Soybean Futures					
	NA	A	Mean Diff	T-stat	Median Diff	Wilcoxon	NA	A	Mean Diff	T-stat	Median Diff	Wilcoxon	NA	A	Mean Diff	T-stat	Median Diff	Wilcoxon
Panel A: Full Period (10:40 – 11:20)																		
Quoted Spread	0.252	0.279	0.027***	(18.51)	0.021***	(11.37)	0.259	0.301	0.042***	(13.08)	0.041***	(10.73)	0.260	0.318	0.058***	(19.80)	0.058***	(10.99)
Effective Spread	0.249	0.269	0.020***	(20.65)	0.015***	(11.39)	0.252	0.284	0.032***	(19.14)	0.025***	(11.57)	0.253	0.299	0.046***	(25.21)	0.039***	(11.67)
Trade	1,502	7,028	5,526***	(9.93)	5,608***	(10.13)	1,092	4,012	2,919***	(10.55)	3,006***	(10.95)	1,883	8,063	6,179***	(12.04)	6,321***	(12.50)
Volume	12,376	58,814	46,438***	(11.14)	47,436***	(11.47)	5,206	17,917	12,711***	(11.24)	13,303***	(12.12)	8,833	38,248	29,415***	(11.56)	30,282***	(12.05)
Volume per Trade	8.4	9.0	0.6	(1.34)	1.1**	(2.35)	4.8	4.6	-0.2	(-1.36)	0.0	(-0.04)	4.8	4.9	0.1	(1.03)	0.2**	(2.01)
Average Bid Depth	176	77	-100***	(-5.92)	-85***	(-5.82)	29	17	-12***	(-11.19)	-10***	(-9.51)	28	19	-9***	(-5.93)	-7***	(-5.35)
Average Ask Depth	178	86	-92***	(-4.53)	-77***	(-3.87)	29	16	-12***	(-12.16)	-11***	(-11.56)	27	17	-11***	(-4.85)	-9***	(-4.71)
Panel B: 20-minute before (10:40 – 11:00)																		
Quoted Spread	0.252	0.258	0.006***	(6.33)	0.004***	(8.01)	0.259	0.270	0.011***	(3.92)	0.008***	(5.89)	0.260	0.273	0.013***	(5.93)	0.014***	(7.46)
Effective Spread	0.249	0.253	0.002***	(6.00)	0.004***	(6.56)	0.252	0.259	0.008***	(5.78)	0.005***	(6.35)	0.253	0.263	0.011***	(8.69)	0.009***	(9.21)
Trade	667	1,018	352***	(8.40)	415***	(10.13)	488	575	86***	(3.23)	143***	(5.28)	827	1,135	308***	(4.16)	395***	(5.42)
Volume	5,431	7,915	2,484***	(7.12)	3,358***	(9.70)	2,345	2,635	290*	(1.91)	605***	(4.05)	3,888	5,030	1,142***	(3.72)	1,625***	(5.39)
Volume per Trade	8.2	8.1	0.0	(-0.09)	0.5	(1.57)	4.8	4.7	-0.1	(-0.67)	0.1	(0.42)	4.8	4.5	-0.2**	(-1.97)	-0.1	(-0.50)
Average Bid Depth	173	123	-50***	(-5.85)	-31***	(-5.30)	29	21	-7***	(-3.83)	-5***	(-2.63)	27	20	-8***	(-5.82)	-6***	(-4.76)
Average Ask Depth	173	130	-44***	(-4.41)	-26***	(-2.76)	28	21	-8***	(-5.45)	-6***	(-4.64)	27	21	-6***	(-4.57)	-4***	(-3.56)
Panel C: 20-min after (11:00 – 11:20)																		
Quoted Spread	0.252	0.283	0.031***	(19.79)	0.025***	(11.56)	0.307	0.259	0.048***	(14.15)	0.039***	(10.95)	0.326	0.260	0.066***	(21.09)	0.066***	(11.14)
Effective Spread	0.249	0.272	0.024***	(21.81)	0.017***	(11.51)	0.288	0.251	0.037***	(20.01)	0.028***	(11.65)	0.305	0.253	0.052***	(26.28)	0.049***	(11.70)
Trade	648	5,798	5,149***	(9.90)	5,213***	(10.00)	457	3,306	2,849***	(10.92)	2,891***	(11.15)	832	6702	5,870***	(12.82)	5,972***	(12.92)
Volume	5,400	49,237	43,837***	(11.19)	44,703***	(11.36)	2,169	14,705	12,536***	(11.94)	12,832***	(12.33)	3,882	32,263	28,380***	(12.42)	28,948***	(12.68)
Volume per Trade	8.3	9.3	0.9	(1.57)	1.5***	(2.71)	4.8	4.6	-0.1	(-1.00)	0.1	(1.02)	4.8	5.0	0.2*	(1.88)	0.4***	(2.88)
Average Bid Depth	180	62	-118***	(-5.65)	-98***	(-5.49)	29	15	-13***	(-9.55)	-11***	(-8.12)	28	18	-10***	(-4.84)	-8***	(-4.52)
Average Ask Depth	181	67	-114***	(-4.45)	-95***	(-4.12)	29	15	-14***	(-10.18)	-12***	(-9.75)	27	16	-12***	(-4.25)	-10***	(-3.99)

Table 4. Spread Decomposition during Announcements

This table reports the estimates from the MRR decomposition model. It includes the quoted, effective and implied spreads, and the various spread components during USDA report announcements (A), non-announcement days (NA), and their mean and median differences. Panel A reports the components during the full 40-minute period surrounding the announcement (10:40am to 11:20am). Panel B reports the components for the 20-minute period prior to the announcement (10:40am to 11:00am). Panel C reports the components for the 20-minute period following the announcement (11:00am to 11:20am). Figures in parentheses are the t-statistics corrected using Newey-West correction. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively.

	Corn Futures						Wheat Futures						Soybean Futures					
	NA	A	Mean Diff	T-stat	Median Diff	Wilcoxon	NA	A	Mean Diff	T-stat	Median Diff	Wilcoxon	NA	A	Mean Diff	T-stat	Median Diff	Wilcoxon
Panel A: Full Period (10:40 - 11:20)																		
Quoted spread	0.252	0.279	0.027***	(18.51)	0.021***	(11.37)	0.259	0.301	0.042***	(13.08)	0.041***	(10.73)	0.260	0.318	0.058***	(19.80)	0.058***	(10.99)
Effective Spread	0.249	0.269	0.020***	(20.65)	0.015***	(11.39)	0.252	0.284	0.032***	(19.14)	0.025***	(11.57)	0.253	0.299	0.046***	(25.21)	0.039***	(11.67)
Implied spread	0.189	0.203	0.014**	(2.51)	0.009**	(2.31)	0.161	0.215	0.054***	(7.86)	0.047***	(9.35)	0.171	0.247	0.076***	(12.95)	0.078***	(10.57)
-Information asymmetry, θ (in cents)	0.016	0.066	0.050***	(12.64)	0.026***	(11.48)	0.054	0.116	0.062***	(9.41)	0.068***	(10.54)	0.061	0.129	0.068***	(8.70)	0.069***	(10.46)
-Liquidity provision, ϕ (in cents)	0.173	0.137	-0.036***	(-3.65)	-0.021***	(-7.48)	0.107	0.099	-0.008	(-1.03)	-0.009*	(-1.86)	0.110	0.118	0.008	(1.11)	0.010**	(1.97)
-Information asymmetry, θ (in %)	9.1%	31.7%	22.6%***	(9.57)	24.9%***	(11.17)	34.1%	53.3%	19.2%***	(5.13)	20.4%***	(8.56)	35.6%	51.4%	15.8%***	(3.81)	16.1%***	(8.11)
Panel B: 20-minutes before (10:40 - 11:00)																		
Quoted spread	0.252	0.258	0.006***	(6.33)	0.004***	(8.01)	0.259	0.270	0.011***	(3.92)	0.008***	(5.89)	0.260	0.273	0.013***	(5.93)	0.014***	(7.46)
Effective Spread	0.249	0.253	0.002***	(6.00)	0.004***	(6.56)	0.252	0.259	0.008***	(5.78)	0.005***	(6.35)	0.253	0.263	0.011***	(8.69)	0.009***	(9.21)
Implied spread	0.187	0.197	0.009*	(1.81)	0.011**	(2.14)	0.161	0.179	0.018***	(2.61)	0.019***	(4.13)	0.170	0.191	0.021***	(3.69)	0.024***	(5.78)
-Information asymmetry, θ (in cents)	0.016	0.025	0.009**	(2.39)	0.009***	(3.79)	0.054	0.078	0.024***	(3.49)	0.029***	(4.51)	0.060	0.082	0.022***	(2.78)	0.020***	(4.90)
-Liquidity provision, ϕ (in cents)	0.171	0.172	0.000	(0.02)	-0.005	(-0.23)	0.107	0.101	-0.006	(-0.72)	-0.001	(-0.68)	0.110	0.109	-0.001	(-0.07)	0.003	(0.17)
-Information asymmetry, θ (in %)	9.3%	12.9%	3.5%	(1.64)	3.8%***	(3.08)	34.4%	42.8%	8.4%**	(2.02)	10.6%***	(3.13)	35.6%	42.6%	6.9%	(1.61)	4.9%***	(3.11)
Panel C: 20-minutes after (11:00 - 11:20)																		
Quoted spread	0.252	0.283	0.031***	(19.79)	0.025***	(11.56)	0.307	0.259	0.048***	(14.15)	0.039***	(10.95)	0.326	0.260	0.066***	(21.09)	0.066***	(11.14)
Effective Spread	0.249	0.272	0.024***	(21.81)	0.017***	(11.51)	0.288	0.251	0.037***	(20.01)	0.028***	(11.65)	0.305	0.253	0.052***	(26.28)	0.049***	(11.70)
Implied spread	0.191	0.203	0.012**	(1.99)	0.004	(1.53)	0.161	0.221	0.060***	(13.39)	0.053***	(9.14)	0.172	0.257	0.085***	(13.98)	0.086***	(10.63)
-Information asymmetry, θ (in cents)	0.015	0.074	0.057***	(14.09)	0.061***	(11.54)	0.054	0.122	0.069***	(9.76)	0.073***	(10.73)	0.061	0.137	0.076***	(9.27)	0.080***	(10.69)
-Liquidity provision, ϕ (in cents)	0.176	0.129	-0.046***	(-4.63)	-0.048***	(-8.21)	0.107	0.098	-0.009	(-1.14)	-0.009**	(-1.99)	0.110	0.119	0.009	(1.17)	0.009**	(2.05)
-Information asymmetry, θ (in %)	8.8%	35.9%	26.5%***	(10.96)	28.5%***	(11.33)	34.2%	55.0%	20.9%***	(5.35)	22.9%***	(8.55)	35.8%	52.8%	17.0%***	(3.95)	17.6%***	(8.29)

Table 5. The Impact of News Surprises and Analyst Forecast Dispersion on Information Asymmetry (Full Period)

This table reports the regression coefficients of news surprises and analyst forecast dispersion on the information asymmetry component of spread over the sample period from January 1, 2013 to July 31, 2016. $|S_t|$ denotes the absolute news surprises. $(I_t^+ * S_t)$ and $(I_t^- * S_t)$ denote positive and negative news surprises, respectively. $DISP_{i,t}$ denotes the dispersion variable of Equation (6). The control variables included are lagged information asymmetry component (θ_{t-1}), lagged market depths ($Depth_{t-1}$), roll returns ($Roll_Ret_t$), lagged (log) daily volume (Vol_{t-1}), lagged (log) daily realized volatility ($RVol_{t-1}$), roll days ($Roll_Day_t$) and dummies for seasonalities (month of the year and day of the week effects). Newey-West consistent t-statistics are presented in parentheses. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively.

	Corn Futures					Wheat Futures					Soybean Futures				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
<i>Constant</i>	0.053*** (4.93)	0.053*** (4.89)	0.056*** (5.22)	0.055*** (5.56)	0.055*** (5.52)	0.087*** (3.35)	0.086*** (3.31)	0.090*** (3.57)	0.092*** (3.70)	0.092*** (3.65)	0.127*** (4.42)	0.126*** (4.36)	0.135*** (4.56)	0.133*** (4.60)	0.130*** (4.53)
$ S_t $	0.029*** (10.22)			0.016*** (5.48)		0.026*** (7.81)			0.013*** (3.25)		0.023*** (4.03)			0.005 (0.80)	
$I_t^+ * S_t$		0.027*** (6.13)			0.013*** (3.46)		0.025*** (5.37)			0.012*** (2.74)		0.021*** (2.76)			0.001 (0.10)
$I_t^- * S_t$		0.031*** (8.62)			0.018*** (4.80)		0.028*** (6.13)			0.015*** (2.90)		0.026*** (3.72)			0.010 (1.47)
$DISP_t$			0.325*** (9.29)	0.217*** (5.89)	0.219*** (6.36)			0.539*** (6.56)	0.361*** (4.12)	0.360*** (4.14)			0.246*** (8.16)	0.214*** (7.38)	0.222*** (6.59)
θ_{t-1}	0.175*** (3.59)	0.179*** (3.66)	0.177*** (3.45)	0.187*** (3.86)	0.192*** (3.95)	0.278*** (6.02)	0.277*** (6.03)	0.263*** (5.67)	0.269*** (5.87)	0.269*** (5.88)	0.366*** (9.03)	0.367*** (8.87)	0.361*** (8.97)	0.364*** (9.17)	0.367*** (9.10)
$Depth_{t-1}$	0.000 (0.10)	0.000 (0.09)	0.000 (-0.33)	0.000 (-0.16)	0.000 (-0.17)	0.000 (0.25)	0.000 (0.20)	0.000 (0.83)	0.000 (0.68)	0.000 (0.63)	0.000 (1.41)	0.000 (1.39)	0.000 (0.94)	0.000 (0.97)	0.000 (0.92)
$Roll_Ret_t$	0.065*** (8.11)	0.065*** (8.12)	0.066*** (7.18)	0.064*** (7.46)	0.063*** (7.43)	0.198*** (3.38)	0.195*** (3.37)	0.192*** (3.69)	0.194*** (3.59)	0.191*** (3.55)	0.036 (1.08)	0.037 (1.10)	0.017 (0.57)	0.021 (0.71)	0.022 (0.74)
Vol_{t-1}	-0.003*** (-4.63)	-0.003*** (-4.65)	-0.003*** (-5.02)	-0.003*** (-5.27)	-0.003*** (-5.35)	-0.005*** (-3.19)	-0.005*** (-3.15)	-0.005*** (-3.29)	-0.005*** (-3.46)	-0.005*** (-3.42)	-0.007*** (-4.12)	-0.007*** (-4.11)	-0.007*** (-4.10)	-0.007*** (-4.13)	-0.007*** (-4.09)
$RVol_{t-1}$	0.002* (1.87)	0.002* (1.80)	0.002* (1.93)	0.002* (2.05)	0.002* (1.95)	0.003 (1.26)	0.003 (1.23)	0.004 (1.40)	0.004 (1.52)	0.004 (1.49)	0.006** (2.48)	0.006** (2.41)	0.007*** (2.84)	0.007*** (2.84)	0.007*** (2.75)
$Roll_Day_t$	0.001 (1.27)	0.001 (1.21)	0.000 (-0.08)	0.000 (-0.20)	0.000 (-0.32)	-0.001 (-0.35)	-0.001 (-0.39)	-0.001 (-0.54)	-0.001 (-0.84)	-0.002 (-0.87)	0.001 (1.06)	0.001 (1.02)	-0.002 (-1.63)	-0.002 (-1.45)	-0.002 (-1.55)
<i>Month of year dummies</i>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
<i>Day of week dummies</i>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
<i>Adj-R2</i>	0.52	0.52	0.55	0.60	0.61	0.30	0.30	0.32	0.34	0.34	0.33	0.33	0.40	0.40	0.41

Table 6. The Impact of News Surprises and Analyst Forecast Dispersion on Information Asymmetry (Before and After)

This table reports the regression coefficients of news surprises and analyst forecast dispersion on the information asymmetry component of spread over the sample period from January 1, 2013 to July 31, 2016. $|S_t|$ denotes the absolute news surprises. $(I_t^+ * S_t)$ and $(I_t^- * S_t)$ denote positive and negative news surprises, respectively. $DISP_{i,t}$ denotes the dispersion variable of Equation (6). The *Control* variables include the lagged information asymmetry component, the lagged market depths, the roll returns, the lagged (log) daily volume and the lagged (log) daily realized volatility. The *Time Effects* variables include the dummies for month, day-of-the-week and roll days. Newey-West corrected t-statistics are reported in parentheses. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively.

	Corn Futures					Wheat Futures					Soybean Futures				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Panel A: 20-minute before (10:40 - 11:00)															
<i>Constant</i>	0.05*** (4.79)	0.05*** (4.79)	0.05*** (4.97)	0.05*** (4.98)	0.05*** (4.98)	0.08*** (3.11)	0.08*** (3.05)	0.08*** (3.26)	0.08*** (3.29)	0.08*** (3.23)	0.07*** (2.98)	0.07*** (2.96)	0.08*** (3.09)	0.08*** (3.09)	0.08*** (3.06)
$ S_t $	0.01*** (4.96)			0.002** (2.20)		0.01*** (3.54)			0.00 (0.57)		0.01*** (3.54)			0.00 (0.28)	
$I_t^+ * S_t$		0.01*** (4.19)			0.00* (1.75)		0.01** (2.42)			0.00 (-0.21)		0.01*** (4.12)			0.00 (-0.57)
$I_t^- * S_t$		0.01*** (3.51)			0.00* (1.82)		0.01*** (2.84)			0.01 (1.06)		0.01** (2.00)			0.00 (0.70)
$DISP_t$			0.08*** (6.18)	0.06*** (4.21)	0.06*** (4.18)			0.21*** (4.42)	0.19*** (2.77)	0.19*** (2.79)			0.08*** (5.77)	0.08*** (3.72)	0.08*** (3.84)
<i>Control</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Time Effects</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adj-R2</i>	0.42	0.42	0.43	0.43	0.43	0.18	0.19	0.20	0.20	0.20	0.31	0.31	0.32	0.32	0.32
Panel B: 20-minute after (11:00 - 11:20)															
<i>Constant</i>	0.06*** (4.82)	0.06*** (4.79)	0.06*** (5.06)	0.06*** (5.41)	0.06*** (5.40)	0.13*** (3.99)	0.13*** (3.97)	0.13*** (4.10)	0.13*** (4.24)	0.13*** (4.21)	0.20*** (6.35)	0.20*** (6.32)	0.21*** (6.51)	0.21*** (6.54)	0.21*** (6.51)
$ S_t $	0.03*** (10.39)			0.02*** (5.46)		0.03*** (7.57)			0.01*** (3.25)		0.03*** (4.04)			0.01 (0.72)	
$I_t^+ * S_t$		0.03*** (6.11)			0.01*** (3.26)		0.03*** (5.17)			0.01*** (2.69)		0.02*** (2.71)			0.00 (0.06)
$I_t^- * S_t$		0.03*** (8.87)			0.02*** (4.87)		0.03*** (6.06)			0.02*** (2.88)		0.03*** (3.91)			0.01 (1.47)
$DISP_t$			0.37*** (9.12)	0.25*** (5.81)	0.25*** (6.24)			0.60*** (6.63)	0.40*** (4.27)	0.40*** (4.28)			0.27*** (8.10)	0.24*** (7.55)	0.25*** (6.67)
<i>Control</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Time Effects</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adj-R2</i>	0.47	0.47	0.51	0.56	0.56	0.26	0.25	0.28	0.30	0.30	0.29	0.29	0.37	0.37	0.37

Table 7. The Impact of News Surprises and Analyst Forecast Dispersion on Information Asymmetry (Announcement Days Sample)

This table reports the regression coefficients of news surprises and analyst forecast dispersion on the information asymmetry component of spread over the 53 announcement days. $|DS_t|$ denotes the deseasonalized absolute news surprises. $(I_t^+ * DS_t)$ and $(I_t^- * DS_t)$ denote deseasonalized positive and negative news surprises, respectively. $DDISP_t$ denotes the deseasonalized analyst forecast dispersion variable. White corrected t-statistics are presented in parentheses. ***, ** and * denote statistical significance at 1%, 5% and 10% levels, respectively.

	Corn Futures					Wheat Futures					Soybean Futures				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Panel A: Full Period (10:40 - 11:20)															
<i>Constant</i>	0.033*** (18.72)	0.029*** (10.68)	0.033*** (18.94)	0.033*** (19.45)	0.03*** (11.48)	0.058*** (24.42)	0.056*** (15.85)	0.058*** (24.88)	0.058*** (24.89)	0.056*** (16.08)	0.065*** (25.04)	0.064*** (18.88)	0.065*** (27.00)	0.065*** (27.01)	0.065*** (20.25)
$ DS_t $	0.013** (2.42)			0.009* (1.67)		0.001 (0.17)			0.001 (0.27)		0.003 (1.01)			-0.000 (-0.09)	
$I_t^+ * DS_t$		0.004 (0.90)			0.003 (0.72)		-0.001 (-0.23)			0.000 (0.03)		0.005 (0.96)			0.001 (0.15)
$I_t^- * DS_t$		0.012*** (2.70)			0.010** (2.25)		0.005 (1.35)			0.006 (1.41)		-0.002 (-0.90)			-0.002 (-0.68)
$DDISP_t$			0.197*** (3.15)	0.153** (2.39)	0.173*** (2.72)			0.212** (2.17)	0.214** (2.17)	0.213** (2.12)			0.170*** (3.20)	0.172*** (3.14)	0.164*** (2.70)
<i>Adj-R2</i>	0.09	0.06	0.11	0.14	0.13	-0.02	-0.01	0.02	0.00	0.01	-0.01	-0.01	0.13	0.12	0.10
Panel B: 20-minute before (10:40 - 11:00)															
<i>Constant</i>	0.013*** (10.49)	0.011*** (5.91)	0.013*** (10.74)	0.013*** (11.00)	0.012*** (6.41)	0.039*** (13.99)	0.042*** (9.07)	0.039*** (14.31)	0.039*** (14.42)	0.041*** (9.26)	0.041*** (19.21)	0.042*** (13.62)	0.041*** (19.92)	0.041*** (20.09)	0.043*** (14.59)
$ DS_t $	0.009** (2.33)			0.006* (1.66)		-0.005 (-1.42)			-0.005 (-1.22)		-0.001 (-0.47)			-0.003 (-1.30)	
$I_t^+ * DS_t$		0.003 (0.82)			0.002 (0.69)		-0.009* (-1.92)			-0.008* (-1.70)		-0.001 (-0.35)			-0.003 (-1.12)
$I_t^- * DS_t$		0.003 (1.15)			0.002 (0.59)		0.001 (0.18)			0.002 (0.29)		-0.002 (-0.63)			-0.002 (-0.49)
$DDISP_t$			0.145** (2.57)	0.116** (2.06)	0.140*** (2.54)			0.322** (2.34)	0.315** (2.26)	0.288** (2.16)			0.097*** (2.59)	0.112*** (2.77)	0.108*** (2.80)
<i>Adj-R2</i>	0.09	-0.02	0.13	0.15	0.10	0.00	0.03	0.04	0.04	0.06	-0.02	-0.03	0.05	0.05	0.03
Panel C: 20-minute after (11:00 - 11:20)															
<i>Constant</i>	0.036*** (19.24)	0.032*** (11.38)	0.036*** (19.45)	0.036*** (19.83)	0.033*** (12.02)	0.061*** (24.97)	0.059*** (16.94)	0.061*** (25.36)	0.061*** (25.37)	0.059*** (17.09)	0.069*** (25.70)	0.068*** (19.80)	0.069*** (27.72)	0.069*** (27.73)	0.069*** (21.22)
$ DS_t $	0.012** (2.05)			0.008 (1.36)		0.001 (0.23)			0.001 (0.31)		0.003 (0.84)			-0.001 (-0.19)	
$I_t^+ * DS_t$		0.004 (0.82)			0.002 (0.62)		0.000 (-0.03)			0.001 (0.22)		0.004 (0.89)			0.001 (0.12)
$I_t^- * DS_t$		0.013*** (2.72)			0.011** (2.28)		0.005 (1.29)			0.005 (1.34)		-0.003 (-1.05)			-0.002 (-0.85)
$DDISP_t$			0.189*** (3.00)	0.148** (2.23)	0.163*** (2.54)			0.200** (1.98)	0.201** (1.99)	0.204* (1.93)			0.175*** (2.98)	0.179*** (3.00)	0.168*** (2.53)
<i>Adj-R2</i>	0.06	0.06	0.08	0.10	0.11	-0.02	-0.02	0.01	-0.01	0.00	-0.01	-0.01	0.13	0.11	0.10

Figure 1. Abnormal Quoted Spreads

This figure plots the abnormal quoted spread (quoted spread during USDA report announcement less non-announcement days) for the agricultural futures contracts, along with the 95% confidence intervals. The plots are the average spreads across the sample period from January 1, 2013 to July 31, 2016.

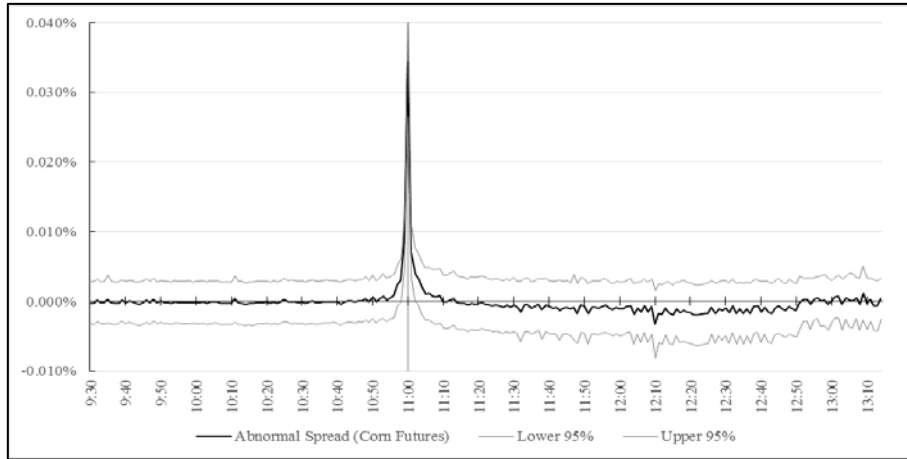


Figure 1.A: Corn Futures Abnormal Quoted Spread

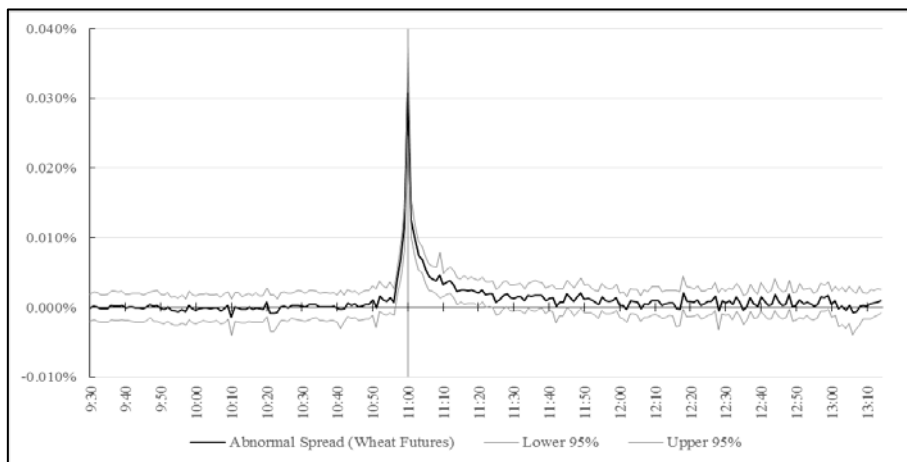


Figure 1.B: Wheat Futures Abnormal Quoted Spread

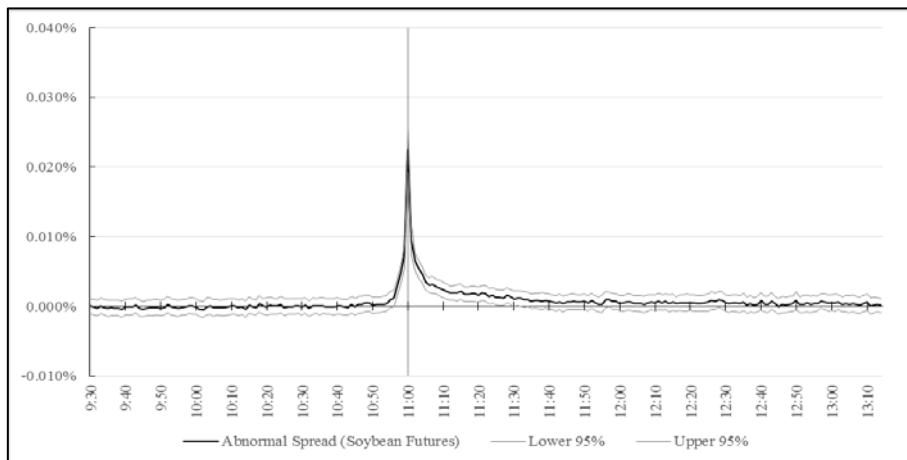


Figure 1.C: Soybean Futures Abnormal Quoted Spread