Should Macro-Economic Information Be Released During Trading Breaks in Futures Markets?

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Abstract

This study examines the impact of releasing macro-economic information during trading breaks *vis-à-vis* continuous trading in futures markets. In 2012 and 2013, the Chicago Mercantile Exchange (CME) changed the trading hours of its grain and oilseed derivatives contracts while in 2013 the US Department of Agriculture changed the time it released its *World Agricultural Supply and Demand Estimates (WASDE)* report – which previous research demonstrates moves the prices of grain and oilseed futures. These changes provide a natural experiment for assessing the impact of releasing price sensitive information during a break in trading as opposed to continuous trading. We examine price volatility, bid-ask spreads and market depth of trading following WASDE report releases for soybean and corn futures contracts traded on CME. Consistent with previous research, we find that information released both during a trading break or during continuous trading results in an increase in price volatility and bid-ask spreads, and a fall in market depth. We also find that price volatility and bid-ask spreads are abnormally elevated and market depth abnormally low for a longer period of time during continuous trading following WASDE report releases. In contrast to findings for equity markets, we conclude that releasing macroeconomic information during a trading break in future markets has a beneficial effect on market quality.

Keywords: Trading halts, volatility, bid-ask spreads, depth and market quality.

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1. Introduction

There is considerable diversity in the typical release time of macroeconomic information by different macroeconomic information bureaus around the world. In many markets macroeconomic information is released during normal trading – such as in Australia and South Africa where the Australian Bureau of Statistics and Statistics South Africa, respectively, releases most macroeconomic information during typical futures markets trading hours.[1] In contrast in other markets, macroeconomic information is released during trading breaks – such as the World Agricultural Supply and Demand Estimates *Report* (*WASDE*) released by the US Department of Agriculture prior to 2012, and key economic indicators (Inflation, Unemployment, GDP growth) released by the Hong Kong Census and Statistics Department. [2] In this paper, we examine whether it is better for the quality of markets to release such information during normal trading as opposed to trading breaks.[3]

To our knowledge, no one has examined the time at which information should be released. However, a related set of literature examines whether trading halts should be instituted at the time that information is released. Advocates of trading halts argue that they provide an opportunity for information to be disseminated which reduces uncertainty, thereby reducing price volatility and improving liquidity (IOSCO, 2002). In contrast, others argue that they deprive the market of the ability of 'learning through trading' thereby increasing uncertainty,

[1] The Australian Bureau of Statistics typically publishes macroeconomic information at 11:30 am AET when all futures contracts listed on the Australian Securities Exchange are trading continuously. Similarly, Statistics South Africa publishes the latest macroeconomic data at 11:30 am SAST when the South African Futures Exchange is open for trading. An additional futures market where macroeconomic information is released during continuous trading is the Zhengzhou Commodity Exchange in China where the National Bureau of Statistics of China releases most macroeconomic information at 10 am CST (China Standard Time) while the market is trading continuously.
[2] Prior to 21 May 2012, the US Department of Agriculture would publish macroeconomic information at 7:30 am CT when grain and oilseed futures contracts were closed for trading. Similarly, the Hong Kong Census and Statistics Department publishes the latest macroeconomic data at 4:30 pm HKT shortly after the afternoon session of the Hong Kong Futures Exchange is closed for trading. An additional futures markets where macroeconomic information is released during the trading break is the Tokyo Commodity Exchange where the Japan Statistics Bureau releases most macroeconomic information between 8.30 am and 8.50 am JST, minutes before the exchange opens for trading at 9 am JST.
[3] Whether a piece of macroeconomic news is released during a securities trading break is the result of a joint decision by an information bureau who choses what time of day to release information and an exchange which chooses what time to close its markets.

exacerbating price volatility and reducing liquidity (see Lee et.al., 1994). These contradictory predictions do not provide an unambiguous basis for determining whether information should be released before trading breaks or during continuous trading.

A considerable volume of evidence has been accumulated which supports the hypothesis that instituting trading halts around information releases *impairs* market quality. While early literature simply examined market behaviour around trading halts irrespective of the quantity of information released, Lee, Ready and Seguin (1994) developed a method for examining the impact of trading halts which compares market behaviour around an experimental sample of information-motivated trading halts with market behaviour around a control sample of "price-matched pseudo-halts" – that is a period of time during continuous trading which is identical to the trading halt and which is matched on the basis of the absolute value of the price movement during the trading halt. This approach controls for the effects of the price movement that typically accompanies information released during a trading halt and isolates the effect of the trading halt *per se*. Using a sample of 852 trading halts in 1988 for stocks listed on the NYSE they find that trading halts exacerbate price volatility for more than 4 hours following the reopening of the market. Christie, Corwin and Harris (2002) apply the price-matched pseudohalt method to examine a sample of 156 Delayed Openings and 265 intraday halts instituted between September 1997 and December 1998 for stocks listed on NASDAQ. They also confirm that trading halts exacerbate price volatility for more than 2 hours following the reopening of the market. They extend analysis to bid-ask spreads but find no evidence that trading halts cause a statistically significant change in bid-ask spreads in trading following a trading halt.[4] Frino, Lecce and Segara (2011) use the price-matched pseudo halt method to examine market behaviour around 1,592 trading halts instituted between 1 January 2005 and 26 September 2006 for stocks trading on the ASX. They also document that trading halts increase price volatility and bid-ask spreads for more than 1 hour following the reopening of the market, while depth is abnormally low for more than two hours. In summary, the literature concludes that instituting trading halts around an information release impairs price volatility and liquidity and therefore the quality of markets.

[4] The focus of Christie, Corwin and Harris (2002) however is to determine whether the re-opening method has an impact on price volatility and liquidity.

The results of research on information-motivated trading halts drawn from stock markets - which finds that releasing information during trading halts may impair market quality - may not be generalizable to macroeconomic information and futures markets for at least two reasons. First, the release time of macroeconomic information is typically scheduled many months ahead of time and is well known and easy to discover by all market participants, unlike company-specific information which occurs more randomly through time. This implies that security market participants are more likely to be able to prepare themselves for the release of the macroeconomic information and access, process and assess its impact on security prices rapidly after that macroeconomic information is released. In turn, information dissemination is more rapid and therefore information is more likely to be equalised across market participants by the time the market re-opens following a trading break. This implies that releasing macroeconomic information during a trading break is expected to have a dampening effect on price volatility and bid ask spreads. Second, macroeconomic information influences a large number of traded securities, including OTC, off-market and overseas traded securities, unlike information released by companies which is more likely to be stock specific and influence only the security it relates too. Hence, even though a specific futures contract may be closed for trading, thereby preventing 'learning-through-trading' from occurring in that futures contract, price discovery may occur in other related markets that are open for trading. This information is then disseminated to market participants broadly, which implies that price uncertainty may dissipate by the time the future market reopens and therefore unlike stock markets releasing information during trading halts may reduce price volatility and improve liquidity. For these reasons, it is unlikely that the results of research examining the release of stock specific information during trading halts in equities markets is generalizable to macroeconomic information and futures markets. In this paper, we test the impact of releasing macroeconomic during trading breaks in futures markets.

On 1 January 2013, the USDA changed the time that it published its WASDE reports from 7:30 am CT to 11 am CT (Central Time).[5] Previous research has demonstrated that the information content of the WASDE report is relevant to pricing soybean and corn futures contracts (Isengildina-Massa et.al., 2008; Adjemian, 2011; Lehecka et.al., 2014) – the two most heavily traded agricultural contracts on the CME (see Appendix). In turn, the CME changed its trading

[5] Although WASDE reports are always published on the second week of the month. The calendar day and day-of-week when the report is released varies for each month.

hours for its futures contracts in May 2012 and April 2013. The effects of these changes were to move the announcement of WASDE from during a trading break to during continuous trading. This provides a unique natural experiment for testing the impact of releasing macroeconomic information on related futures contracts during trading breaks. Specifically, we examine the impact of the release of WASDE reports by the USDA on the market quality (namely price volatility, bid-ask spreads and market depth) of soybean and corn futures contracts.

The remainder of this paper is organized as follows: Section 2 describes the data and method, section 3 sets out the empirical results, while section 4 presents the robustness test and section 5 provides the conclusion and suggestions for future research.

2. Data and Method

The data used in this study was obtained from the Thomson Reuters Tick History Data Base (TRTH) maintained by the Securities Industries Research Centre of Asia-Pacific (SIRCA) which contains trade and quote data for futures contracts traded on USA exchanges.[6] We use data for both corn and soybean contracts from 1st July 2009 to 31st December 2015.[7] The trade data describes the contract (code), date and time of each trade, along with the price and volume transacted. The data quote records document the prices and volumes of prevailing bid and ask quotes for the best level of order book. For each 10-minute interval, the last trade price, interval high and low prices, the average volume traded and the average best bid and ask prices, along with the average depth at the best prevailing bid and ask prices are sampled.

Consistent with prior studies for futures contracts, this study examines the nearest to expiry contracts which tend to be the most liquid. Studies analyzing agricultural futures have also observed that announcement effects are most pronounced in the most liquid contracts (Adjemian, 2012). To obtain the nearest and most liquid contracts, this study adopts the method

[6] The analysis of soybean and corn futures contracts produces qualitatively similar results, therefore, we only report the results for soybean futures.

[7] There is total of 35 WASDE releases in the period from January 2013 to December 2015 where WASDE announcements were published at 11:00 am CT during continuous trading. For symmetry, we go back through time before May 2012 to sample 35 WASDE announcements as well, during this period, WASDE reports are released when the market is close for trading. This produces a sample period of 1 July 2009 to 31 December 2015.

of Webb and Smith (1994), sampling the closest to expiry contract until the contract volume for the first deferred contact is higher than the nearest to delivery.

This research seeks to examine the impact of trading halts on price volatility and market liquidity. Using the changes to trading hours of soybean and corn futures contracts traded on CME and changes in the release time of the WASDE reports published by the USDA (see Appendix), we divide the period 1 July 2009 to 31 December 2015 into two sub-periods. The period from 1 July 2009 to 18 May 2012 is classified as the "Trading Break" sample where WASDE reports were released at 7:30 am CT during a trading break from 7:15 am CT to 9:30 am CT.[8] The second period from 1 January 2013 to 31 December 2015 is categorized as the "Continuous Trading" sample where WASDE announcements were published at 11:00 am CT during continuous trading.[9]

During the study's sample period from 1st July 2009 to 31st December 2015, a total of 70 WASDE reports were released. For the sub-periods, "Trading Break" contains 35 reports and "Continuous Trading" 35 reports.[10] This study adopts WASDE report days as the treatment sample to examine announcement effects, and non-WASDE days as a control.

2.1. Volatility

The measure of price volatility calculated and reported in this paper is the price range for each interval *t* calculated as follows:

[8] The WASDE report in May 2012 occurs during continuous trading hour therefore it is not included in the "Trading Break" sample.

[9] The period from 21 May 2012 to 31 December 2012, which contains 7 WASDE releases, is omitted from our study as the number of observations is too small to draw any reliable conclusions. During this period, WASDE reports are released at 7:30 am CT while the market is continuously trading. The figure below presents CME morning trading breaks and WASDE report time for the sample period.

Date	CME Morning Trading Break (Soybean and Corn Futures)	WASDE Release	Released During Break?
Aug '06 to May '12	7:15 am to 3:30 am	7:30 am	✓
May '12 to Dec '12	--	7:30 am	✘
Jan '13 to April '13	--	11:00 am	✘
April '13 onwards	7:45 am to 8:30 am	11:00 am	✘

[10] Lehecka, Wang and Garcia (2014) examine market reaction to the release of major USDA reports (i.e. WASDE, Crop Production, Grain Stocks, Prospective Planting, and Acreage reports). This study utilize only the WASDE report as it is released monthly and is well-documented to contain the most significant information for corn and soybean. To prevent bias, all other reporting days for the reports listed above have been removed from the study's sample.

$$R_{d,t} = \max_i\left(P_{d,t}^i\right) - \min_i\left(P_{d,t}^i\right) \quad (1)$$

where $\max_i\left(P_{d,t}^i\right)$ is the maximum price *i* in interval *t* of the day *d*, and $\min_i\left(P_{d,t}^i\right)$ is the minimum price *i* in interval *t* of the day *d*. This study implements price range as the main volatility indicator since it provides more accurate estimates and lower mean-squared error than other typical measures (Martens and Dijk, 2007).

2.2. Bid Ask Spreads

In addition to the impact of trading halts on price volatility associated with WASDE report releases, market liquidity may also be affected. One measure of market liquidity is the bid-ask spread which is a proxy for information asymmetry and also a component of trading costs (see Frino, Jones, Lepone and Wong, 2014). Higher spreads around WASDE releases suggest that there are higher levels of information asymmetry surrounding the announcements and higher transaction costs. To measure bid-ask spreads, this study adopts a measure similar to McInish and Wood (1992) as follows:

$$BAS_{d,t} = \frac{\sum_{i=1}^{n}\left(Ask_{d,t}^i - Bid_{d,t}^i\right)}{N_{d,t}} \quad (2)$$

where $Ask_{d,t}^i$ is the best ask price *i* in interval *t* of the day *d*, and $Bid_{d,t}^i$ is the best bid price *i* in interval *t* of the day *d*. $N_{d,t}$ is the total number of best quotes in interval *t* of the day *d*.

2.3. Market Depth

Market depth is another commonly used measure for liquidity (see Lee, Mucklow and Ready, 1993). High levels of quoted depth at the best prevailing bid and ask prices indicate high levels of liquidity and lower market impact costs for large trades. Decreases in market depth around WASDE releases would suggest that market makers and participants are less willingly to make markets because of the adverse selection problem created by information released. This study calculates average depth per 10-minute interval using all available quotes at the best price levels as follows:

$$Market\ Depth_{d,t} = \frac{\sum_i^n [(Bid\ Price_{d,t}^i\ x\ Bid\ Size_{d,t}^i) + (Ask\ Price_{d,t}^i\ x\ Ask\ Size_{d,t}^i)]}{N_{d,t}} \quad (3)$$

where $Bid\ Price_{d,t}^i$ and $Ask\ Price_{d,t}^i$ are best prevailing best bid and ask quotations at price i in interval t of the day d and $Bid\ Size_{d,t}^i$ and $Ask\ Size_{d,t}^i$ are the best prevailing bid and ask sizes at price i in interval t of the day d.

2.4. Magnitude of Price Movements Across Sub-Periods

It may be possible that the level of unexpected information or value of information in WASDE reports is systematically different over the 2 sub-periods - which could bias results. To test for this, we compare the average of absolute returns for each sub-period around the time the report is released. Specifically, for the "Trading Break" period, we calculate the return using the last traded price 20 minutes prior to WASDE announcements (this is the last price 5 minutes before the close of the night session during the Trading Break period) and the last traded price 240 minutes after the report is released (This is the price 120 minutes after the market opens for trading, which provides enough time for the information content of the WASDE report to be incorporated into the price). Similarly, for the "Continuous Trading" period, we calculate the return using the last traded price 20 minutes prior to WASDE announcements and the last traded price 120 minutes after the report is released (this is the last price 15 minutes before the closing time of the day session for the Continuous period). To illustrate, during the "Trading Break" period on WASDE days, returns are calculated using prices sampled at 7:10 am and at 11:30 am. Similarly, for the "Continuous Trading" period, the price is sampled at 10:40 am and at 1 pm.

Table 1 (Part A) compares the magnitude of price movements on WASDE days across the 2 sub-periods. While there are some differences in the average of absolute returns across sub-periods, the t statistic testing average returns between the Trading Break and Continuous Trading period is not statistically significant.[11] This implies that the average price movement on WASDE days is not systematically different across the two sub-periods and therefore the magnitude of the information released across sub-periods cannot explain any observed results.

[11] Table 1 (Part A) shows that the difference in the average of absolute returns on WASDE days between the Trading Break and Continuous Trading period is 0.31% and insignificant.

2.5. Time-of-day and day-of-week price matched sample

In this paper we adopt a sampling procedure similar to the Lee et.al (1994) price-matched pseudo-halts procedure. Specifically, we match each WASDE day in a sub-period with the non-WASDE day with the closest return on the same day of the week and time of the day within the sub-period. The purpose of this procedure is to control for time-of-day and day-of-week patterns in our volatility and liquidity variables, as well as the magnitude of the price movement associated with the WASDE release. To ensure a close match, any matched returns that differ by more than 1% are eliminated from the final sample.[12] The final sample consists of 66 WASDE reports: 34 reports for the "Trading Break" period and 32 reports for the "Continuous Trading" period. Table 1 (Part B) demonstrates that there is no significant difference in the average of absolute returns for the WASDE and non-WASDE day samples within each sub-period.[13]

<INSERT TABLE 1 HERE>

3. Results

3.1. Price Volatility

Table 2 presents the average price range (price volatility) for each 10-minute interval around the release time of WASDE reports on both WASDE and non-WASDE days for the two sub-periods. [14] During the "Trading Break" period, WASDE reports are released at 7:30 am and the day session opens at 9:30 am, hence there is a 2-hour trading break prior to the commencement of trading. The difference in price volatility across WASDE and non-WASDE intervals is statistically significant for up to 20 minutes following the release of the WASDE reports.

During the "Continuous Trading" period, WASDE reports are released at 11:00 am and the announcements occur during continuous trading. The results reported in Table 2 imply that price volatility for WASDE days are significantly greater than non-WASDE days for up to 60

[12] After implementing the matching mechanism, 1 (one) and 3 (three) reports from the "Trading Break" and "Continuous Trading" periods are eliminated, respectively.

[13] For each sub-period, the WASDE days and non-WASDE sample are categorized as our "Experimental" and "Matched Control" sample, respectively.

[14] Tables 2 to 5 present volatility and liquidity measures for 18 10-minute intervals of trading around the release of the reports. For Panel-A (Trading Break Period), the 7:10 am interval corresponds to a 5-minute interval (instead of 10 minutes) prior the closing of the market at 7:15 am. Similarly, for Panel-B (Continuous Trading Period), the 1:10 pm interval corresponds to a 5-minute interval (instead of 10 minutes) prior the closing of the market at 1:15 pm.

minutes at the 0.05 level or better when results are released during continuous trading. The adjustment time during this period is greater than that reported for the "Trading Break" sub-period and suggests that releasing WASDE reports during continuous trading increases the trading time it takes for price volatility to return to equilibrium.

<INSERT TABLE 2 HERE>

3.2. Bid-Ask Spreads

Table 3 presents the results for bid-ask spreads on WASDE and non-WASDE days for the two sub-periods. For the "Trading Break" period when WASDE reports are released during a trading break, bid-ask spreads for the WASDE sample are significantly greater than the non-WASDE sample only for the first 10 minutes following the resumption of trading after the release.[15] In contrast, during the "Continuous Trading" period when WASDE reports are released during continuous trading, bid-ask spreads are significantly higher for the WASDE sample for up to 7 10-minute intervals immediately following the release of the report. When compared to the results for the "Trading Break" sub-period, these results confirm that releasing WASDE reports during continuous trading increases the trading time it takes for bid-ask spreads to return to equilibrium following the information release.

<INSERT TABLE 3 HERE>

3.3. Market Depth

Table 4 presents intraday market depth on WASDE and non-WASDE days for the two sub-periods. During the "Trading Break" period, the difference in depth between WASDE release days and non-WASDE days is not significant for any of the time intervals immediately after the market resumes trading. In sharp contrast, during the "Continuous Trading" period, there is evidence that market depth is lower on WASDE days for at least 40 minutes of trading immediately following the release of the report. Again, this confirms the notion that releasing WASDE reports during continuous trading exacerbates market depth and increases the trading time it takes for market depth to return to equilibrium following the information release.

<INSERT TABLE 4 HERE>

[15] The difference in bid-ask spreads between the two samples is significant at the 10% level.

4. Robustness Tests

Two additional measures of volatility, *price volatility and frequency of price changes*, are estimated as a robustness test.[16] Results for the aforementioned two metrics suggest that with a trading halt for market participants to process the information from the reports, excess volatility on WASDE days persists for 20 minutes following the release of the WASDE reports.[17] On the contrary, once the trading halt is removed during the "Continuous Trading" period, high volatility on WASDE days persists for approximately 70 minutes. We conclude that releasing the WASDE report during the trading halt significantly reduces market volatility since it provides enough time to investors to analyze the information contained in the reports.

Although it has been demonstrated that the information content of the WASDE report has not changed significantly over the sample period,[18] we additionally control for any small difference in the size of the information released across the two sub-periods. To control for this, each WASDE day in the "Trading Break" period is matched with the closest in return WASDE day in the "Continuous Trading" sample, any matched returns that exceed a 1% difference between the two periods are eliminated.[19] The final sample consists of 60 WASDE reports: 30 reports for the "Trading Break" period and 30 reports for the "Continuous Trading" period. Each of these WASDE days is matched to a non-WASDE day observation as it was previously done for each sub-period.[20] This matching procedure controls for any significant change in the size of information content across and within sample periods.

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[16] *Price volatility* is the standard deviation of futures prices during each ten-minute interval calculated as follows:

$$S_{d,t} = \sqrt{\frac{\sum_{i=1}^{n}\left(P_{d,t}^{i} - \overline{P}_{d,t}\right)^{2}}{N_{d,t} - 1}} \tag{4}$$

where $P_{d,t}^{i}$ is the price i in interval t of the day d, $\overline{P}_{d,t}$ is the mean price in interval t of the day d and $N_{d,t}$ the number of price changes in interval t of day d. The *frequency of price changes* in an interval, is obtained by counting the number of price changes in each interval t on day d.

[17] During the "Trading Break" period, WASDE reports are released at 7:30 am and the day session opens at 9:30 am, hence there is a 2-hour trading break prior to the commencement of trading.

[18] Table 1 (Part A) shows that the information content has not changed significantly over the study's sample period by comparing the average return on WASDE days for the two sub-samples.

[19] After implementing the matching mechanism across periods, 5 (five) WASDE day observations were eliminated from each sub-period, and the difference in mean absolute returns between these two samples is approximately zero (0.1%) and insignificant.

[20] We match each WASDE day in a sub-period with the non-WASDE day with the closest return on the same day of the week and time of the day within the sub-period.

Table 5 presents intraday price range, bid-ask spread and depth for the two sub-periods after tightly controlling for any small difference in the size of the information content of the WASDE reports.[21] The results confirm that, with a trading break for market participants to process the information from the reports, excess volatility on WASDE days persists for just 20 minutes after the release of the report, and there is no significant impact on bid-ask spread and depth. On the contrary, if the report is released during continuous trading, high volatility and bid-ask spread on WASDE days persist for 60 and 70 minutes, respectively. Moreover, depth is lower on WASDE days for at least 40 minutes after the release of the report. These results confirm our previous findings that releasing substantial information during trading halts reduces market volatility and improves liquidity in the market.

<INSERT TABLE 5 HERE>

All the findings are replicated for soybeans on 1-minute intervals and corn contracts using 1 and 10-minute intervals, but the results are not included since there is not significant difference with the results here presented for soybeans. In summary, our central finding that trading halts reduce market volatility and improve liquidity in the market for soybean, is robust to our sample control method and size of the intervals for soybean and corn contracts.

5. Conclusion and Suggestions for Future Research

The move by CME to extend trading hours creates a natural experiment where scheduled price sensitive reports by the USDA shifts from being announced during off market hours to a release during continuous trading. Results in this research provide evidence that the removal of the trading halt exacerbates volatility. Further analysis on market quality using bid-ask spreads and depth indicates that information asymmetry increase around WASDE announcements and liquidity has decline significantly without a trading halt. Findings from this study suggest that trading halts are beneficial in reducing price volatility and improving market liquidity.

[21] Table 5 presents the difference in means between the WASDE and non-WASDE samples for the volatility and liquidity measures, along with t-statistics.

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Table 1: Comparison of Magnitude of Information Content Across and Within Sample Periods

Table 1 reports the sample absolute mean returns in percentage on WASDE days (Experimental Sample) and non-WASDE days (Matched Control Sample) for the 2 sample periods. Table 1 is divided into two part – (Part A) presents the difference in mean returns between the Trading Break and Continuous Trading periods, (Part B) reports the difference in mean returns between the experimental and matched control samples within each of the two periods.

	Experimental Sample			**Matched Control Sample**			Part B:	
	Mean (%)	S.D (%)	N. Obs	Mean (%)	S.D (%)	N. Obs	*Mean Difference (%)*	*T-Value*
Trading Break	1.171	0.935	34	1.110	0.856	34	0.06	0.28
Continuous Trading	0.857	0.616	32	0.784	0.533	32	0.07	0.51
Part A:								
Mean Difference (%)	0.31			0.33				
T-Value	1.60			1.83*				

* represents statistical significance at the 10% level

Table 2: Intraday Price Range for Soybeans Contracts

Table 2 reports intraday average Price Range for the Trading Break period where WASDE reports are released at 7:30 am, and the Continuous Trading period where WASDE reports are released at 11:00 am. Price range is measured using the difference between the highest and lowest price for soybeans during each ten-minute interval. Differences between WASDE days (Experimental Sample) and non-WASDE days (Matched Control Sample), along with the t-statistics are provided. Due to the small size of the two sample periods, the Wilcoxon–Mann–Whitney statistics are also reported for additional robustness.

Panel A: "Trading Break" Period

Time	Experimental Sample	Matched Control Sample	Difference	T-statistics	WMW
6:30	1.176	1.053	0.12	0.652	712.0*
6:40	1.331	1.346	-0.01	-0.083	581.5
6:50	1.625	1.544	0.08	0.423	655.0
7:00	2.191	1.566	0.63	2.898***	797.0***
7:10	1.743	1.368	0.38	2.012**	730.5*
9:30	13.088	8.118	4.97	4.361***	905.0***
9:40	7.728	5.625	2.10	2.537**	822.5***
9:50	5.375	5.074	0.30	0.530	627.0
10:00	4.728	4.309	0.42	0.790	678.0
10:10	4.331	4.176	0.15	0.300	642.5
10:20	3.926	3.574	0.35	0.841	708.5
10:30	3.816	3.441	0.38	0.871	728.0*
10:40	3.346	3.478	-0.13	-0.404	559.5
10:50	3.566	2.897	0.67	1.838*	694.0
11:00	2.875	3.390	-0.51	-1.415	479.0
11:10	3.051	3.169	-0.12	-0.269	617.0
11:20	2.971	2.978	-0.01	-0.020	574.5
11:30	3.118	3.110	0.01	0.018	604.0

Number of observations in the Trading Break sample: 34

Panel B: "Continuous Trading" Period

Time	Experimental Sample	Matched Control Sample	Difference	T-statistics	WMW
10:20	2.477	2.453	0.02	0.076	532.0
10:30	2.453	2.789	-0.34	-1.095	460.0
10:40	2.531	2.664	-0.13	-0.391	519.5
10:50	3.539	3.063	0.48	0.926	682.0**
11:00	18.141	3.078	15.06	12.809***	1016.0***
11:10	7.680	3.125	4.55	6.907***	934.0***
11:20	5.766	3.039	2.73	4.447***	824.0***
11:30	4.828	2.531	2.30	5.916***	871.0***
11:40	4.188	2.438	1.75	3.684***	794.5***
11:50	4.094	2.180	1.91	5.693***	862.0***
12:00	3.383	2.672	0.71	1.852*	665.0**
12:10	3.188	2.781	0.41	1.082	617.5
12:20	3.328	2.586	0.74	1.994*	649.5*
12:30	3.016	2.453	0.56	1.683*	611.0
12:40	2.797	2.680	0.12	0.326	546.5
12:50	3.039	2.586	0.45	1.378	607.5
13:00	3.422	2.992	0.43	1.237	627.0
13:10	3.492	3.836	-0.34	-0.881	475.5

Number of observations in the Continuous Trading sample: 32

***, **, * represents statistical significance at the 1%, 5% and 10% level

Table 3: Intraday Bid-Ask Spreads for Soybeans Contracts

Table 3 reports intraday average quoted bid-ask spreads (cents) for the Trading Break period where WASDE reports are released at 7:30 am, and the Continuous Trading period where WASDE reports are released at 11:00 am. Bid-ask Spread is calculated for each ten-minute interval using the difference between the best prevailing quotes in the market for soybeans. Differences between WASDE (Experimental Sample) and non-WASDE days (Matched Control Sample), along with the t-statistics are provided. Due to the small size of the two sample periods, the Wilcoxon–Mann–Whitney statistics are also reported for additional robustness.

Panel A: "Trading Break" Period

Time	Experimental Sample	Matched Control Sample	Difference	T-statistics	WMW
6:30	48.248	44.505	3.74	1.231	662.0
6:40	45.304	45.876	-0.57	-0.199	597.0
6:50	47.941	46.665	1.28	0.417	623.0
7:00	48.790	46.712	2.08	0.733	634.0
7:10	47.981	46.809	1.17	0.416	629.0
9:30	37.691	35.849	1.84	1.696*	732.0*
9:40	34.184	34.098	0.09	0.093	612.0
9:50	34.068	33.673	0.39	0.517	615.0
10:00	33.272	33.360	-0.09	-0.118	570.0
10:10	32.999	33.187	-0.19	-0.244	551.0
10:20	32.843	33.490	-0.65	-0.780	533.0
10:30	32.995	33.498	-0.50	-0.646	595.0
10:40	32.729	33.269	-0.54	-0.738	551.0
10:50	32.849	33.697	-0.85	-1.079	508.0
11:00	32.695	33.565	-0.87	-1.125	508.0
11:10	32.483	33.484	-1.00	-1.193	531.0
11:20	33.200	33.536	-0.34	-0.385	546.0
11:30	33.314	34.491	-1.18	-1.345	520.0

Number of observations in the Trading Break sample: 34

Panel B: "Continuous Trading" Period

Time	Experimental Sample	Matched Control Sample	Difference	T-statistics	WMW
10:20	29.310	29.439	-0.13	-0.348	493.0
10:30	29.407	29.831	-0.42	-1.161	431.0
10:40	29.396	29.640	-0.24	-0.553	507.0
10:50	32.556	29.848	2.71	3.752***	770.0***
11:00	41.805	29.859	11.95	8.438***	989.0***
11:10	32.942	30.235	2.71	4.022***	825.0***
11:20	32.414	29.658	2.76	4.526***	826.0***
11:30	31.220	29.758	1.46	2.879***	714.0***
11:40	30.712	29.607	1.11	2.265**	660.0**
11:50	30.780	29.558	1.22	2.691***	679.0**
12:00	30.495	29.468	1.03	2.334**	669.0**
12:10	30.281	29.613	0.67	1.430	610.0
12:20	30.352	29.596	0.76	1.625	636.0*
12:30	30.246	29.593	0.65	1.705*	642.0*
12:40	29.752	29.765	-0.01	-0.027	544.0
12:50	30.479	30.067	0.41	0.835	575.0
13:00	30.386	30.351	0.04	0.070	530.0
13:10	30.093	30.192	-0.10	-0.184	523.0

Number of observations in the Continuous Trading sample: 32

***, **, * represents statistical significance at the 1%, 5% and 10% level

Table 4: Intraday Depth for Soybeans Contracts

Table 4 reports intraday average depth for the Trading Break period where WASDE reports are released at 7:30 am, and the Continuous Trading period where WASDE reports are released at 11:00 am. Depth is measured using all available quotes at the best level for soybeans during each ten-minute interval. Differences between WASDE (Experimental Sample) and non-WASDE days (Matched Control Sample), along with the t-statistics are provided. Due to the small size of the two sample periods, the Wilcoxon–Mann–Whitney statistics are also reported for additional robustness.

Panel A: "Trading Break" Period

Time	Experimental Sample	Matched Control Sample	Difference	T-statistics	WMW
6:30	16017.932	17522.192	-1504.3	-0.836	528.0
6:40	18690.141	19684.357	-994.2	-0.475	621.0
6:50	17624.617	26826.561	-9201.9	-1.839*	527.0
7:00	20375.255	21102.250	-727.0	-0.252	513.0
7:10	19889.743	21540.101	-1650.4	-0.571	502.0
9:30	38843.626	40388.908	-1545.3	-0.524	515.0
9:40	46605.383	46655.821	-50.4	-0.013	541.0
9:50	41284.301	44832.246	-3547.9	-0.987	522.0
10:00	46574.599	45493.402	1081.2	0.256	611.0
10:10	45913.511	46286.852	-373.3	-0.088	592.0
10:20	48303.423	45152.217	3151.2	0.733	651.0
10:30	47912.286	47665.587	246.7	0.047	618.0
10:40	44200.282	49971.216	-5770.9	-1.142	524.0
10:50	46310.918	47483.273	-1172.4	-0.245	581.0
11:00	49452.476	50853.465	-1401.0	-0.267	584.0
11:10	48600.717	46017.796	2582.9	0.511	647.0
11:20	46331.918	43978.372	2353.5	0.564	634.0
11:30	47336.749	44293.568	3043.2	0.686	653.0

Number of observations in the Trading Break sample: 34

Panel B: "Continuous Trading" Period

Time	Experimental Sample	Matched Control Sample	Difference	T-statistics	WMW
10:20	47488.002	53418.682	-5930.7	-1.123	497.0
10:30	48135.920	53566.421	-5430.5	-0.960	506.0
10:40	46985.896	56349.893	-9364.0	-1.331	411.0
10:50	36496.752	53628.564	-17131.8	-3.121***	269.0***
11:00	28694.588	51278.494	-22583.9	-5.546***	129.0***
11:10	35247.131	50607.346	-15360.2	-3.696***	275.0***
11:20	36426.784	47365.904	-10939.1	-3.429***	295.0***
11:30	40218.281	48718.035	-8499.8	-2.025**	364.0**
11:40	42290.150	51582.873	-9292.7	-1.686*	371.0*
11:50	45591.193	52030.434	-6439.2	-1.176	355.0**
12:00	42635.923	50027.660	-7391.7	-1.915*	377.0*
12:10	44729.636	51152.385	-6422.7	-1.491	419.0
12:20	43495.933	53011.097	-9515.2	-2.069**	354.0**
12:30	44727.569	49302.210	-4574.6	-1.296	438.0
12:40	46706.891	49522.606	-2815.7	-0.738	476.0
12:50	47169.314	52803.204	-5633.9	-1.268	428.0
13:00	47758.908	52762.301	-5003.4	-1.155	426.0
13:10	70570.527	71120.570	-550.0	-0.077	478.0

Number of observations in the Continuous Trading sample: 32

***, **, * represents statistical significance at the 1%, 5% and 10% level

Table 5: Volatility and Liquidity Measures for Soybeans Contracts

Table 5 reports the difference in Price Range, Bid-Ask Spread and Depth between WASDE (Experimental Sample) and non-WASDE days (Matched Control Sample) for the Trading Break and Continuous Trading periods. For each 10-minute interval, Price range is measured using the difference between the highest and lowest price, Bid-ask Spread is calculated using the difference between the best prevailing quotes, and Depth is measured using all available quotes at the best level in the market for soybeans.

Panel A: "Trading Break" Period

	Price Range		Bid-Ask Spread		Depth	
Time	Difference	T-statistics	Difference	T-statistics	Difference	T-statistics
6:30	0.08	0.533	3.67	1.315	-1365.9	-0.717
6:40	0.02	0.092	1.89	0.795	-1242.3	-0.539
6:50	-0.11	-0.618	1.32	0.403	-10805.7	-1.938*
7:00	0.68	2.913***	3.11	1.016	-1075.4	-0.348
7:10	0.28	1.408	-0.07	-0.023	-1138.8	-0.356
9:30	4.01	3.665***	0.72	0.698	-2717.2	-0.871
9:40	2.62	3.856***	-0.59	-0.604	-2391.4	-0.621
9:50	0.62	1.008	-0.13	-0.160	-4707.5	-1.258
10:00	0.63	1.230	-0.52	-0.671	-563.9	-0.124
10:10	0.06	0.107	-0.72	-0.890	-2504.7	-0.565
10:20	0.42	0.922	-1.20	-1.385	1246.2	0.276
10:30	0.40	0.863	-0.80	-0.966	-1486.4	-0.264
10:40	-0.11	-0.307	-0.93	-1.168	-7138.5	-1.293
10:50	0.83	2.172**	-1.44	-1.734*	-2563.1	-0.499
11:00	-0.21	-0.579	-1.20	-1.417	-3698.0	-0.664
11:10	0.21	0.492	-1.28	-1.389	-53.5	-0.010
11:20	0.30	0.859	-0.30	-0.333	-180.7	-0.041
11:30	0.48	1.350	-1.08	-1.210	-94.5	-0.020

Panel B: "Continuous Trading" Period

	Price Range		Bid-Ask Spread		Depth	
Time	Difference	T-statistics	Difference	T-statistics	Difference	T-statistics
10:20	0.13	0.397	-0.18	-0.469	-7088.9	-1.560
10:30	-0.28	-0.871	-0.43	-1.123	-5310.0	-0.982
10:40	-0.18	-0.516	-0.33	-0.727	-9086.3	-1.565
10:50	0.46	0.846	2.79	3.696***	-17312.3	-3.097***
11:00	15.13	12.811***	11.48	8.874***	-21261.3	-6.103***
11:10	4.65	6.759***	2.66	3.759***	-15139.5	-3.653***
11:20	2.93	4.784***	2.77	4.332***	-10171.8	-3.296***
11:30	2.33	5.786***	1.36	2.551**	-7973.3	-1.872*
11:40	1.85	3.693***	1.07	2.122**	-8502.6	-1.527
11:50	1.93	5.751***	1.19	2.475**	-6596.2	-1.155
12:00	0.76	1.964*	0.97	2.074**	-8436.9	-2.15**
12:10	0.50	1.289	0.71	1.461	-4877.4	-1.200
12:20	0.80	2.073**	0.78	1.643	-9063.1	-1.936*
12:30	0.68	2.018**	0.53	1.352	-4632.9	-1.332
12:40	0.10	0.287	-0.17	-0.360	-3199.9	-0.830
12:50	0.45	1.313	0.26	0.520	-5647.5	-1.286
13:00	0.47	1.299	-0.07	-0.139	-5753.6	-1.291
13:10	-0.23	-0.623	-0.14	-0.260	-2003.1	-0.300

Number of observations in each of the two sample periods: 30

***, **, * represents statistical significance at the 1%, 5% and 10% level

Appendix. Institutional Detail

The Chicago Mercantile Exchange (CME) offers futures contracts on approximately 1,263 different contracts. Of these contracts, 49 relates to agricultural produces.[22] Based on the CME Group leading product reports, corn and soybean are consistently ranked as the most actively traded contracts.[23] For example, in 2015 (Quarter 4), the average notional daily volume for corn and soybeans was 5.5 and 10 billion USD respectively. This is not surprising as corn and soybeans represent 81% of the total US grain production (Isengilda-Massa et.al, 2015).[24] It is also noteworthy that WASDE reports are observed to have the most significant impact on corn and soybean futures contracts (Adjemian, 2012).

Over the past decade, there have been substantial structural changes in corn and soybeans trading that are driven by technology, changes on market participation, and demand. Prior to 2003, just about 1% of monthly trading was conducted electronically and non-producer shared around 25% of the total volume traded at the exchange. By 2009, electronically trading account for 95% of total daily volume and non-producer participation increased to around 40% of total volume traded at the exchange (Kaufman, 2013). Crop prices and trading volumes have also increased significantly in the last 10 years, not merely at CME but in prominent overseas markets too. Commodities prices and volumes have been driven by higher demand from emerging countries such as China and India, and new policies promoting the use of biofuels (Wright 2011, 2012). As an example, crop prices at the CME doubled between 2005 and 2007, and volumes at the Dalian Commodity Exchange increased three folds from 2005 to 2006 (Kaufman, 2013).

Trading at the exchange has also changed in the past years. Between 2009 and May 2012, corn and soybeans traded in two sessions which spans 17 hours daily. Day session during this period opens at 9:30 am CT and closes at 1:15 pm CT, and night session starts from 6 pm CT and cease at 7:15 am CT next day. The WASDE report by USDA was released at 7:30 am CT during the trading break where the market is closed. This creates a pseudo trading halt that allows all market participants time to access and analyze the information content of the reports.

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[22] CME Group product offerings list as of 31 December 2015.

[23] The 7 most actively traded contracts by notional dollar turnover are: Soybeans, Corn, Wheat, Soybean Oil, Soybean Meal, Live Cattle and Lean Hog. As a product line, agricultural products contribute to a 15% of the total clearing and transaction fees revenue. This contribution is the fourth largest after Interest Rate (31%), Energy (23%), and Equity (19%) products (CME group 10-K annual report, 2015).

[24] Soybean and corn futures contracts trade on different expiry dates of the year. Soybeans contracts trade on the 15th of January, March, May, July, August, September and November, and Corn futures contracts trade on the 15th of March, May, July, September and December. These contracts coincide with harvest period and the minimum tick is ¼ of one cent per bushel (or $12.50 per contract). Settlement is based on the delivery of the underlying commodities.

In May 2012, CME extended trading hours to 21 consecutive hours from 5 pm CT to 2 pm CT the next day. This creates an overlap between the unchanged WASDE report release times at 7:30 am CT and continuous trading, thereby effectively removing the pseudo trading halt that was previously in place. This now requires market participants to process the information real time and impound new content into prices promptly.

In January 2013, after considerable debate, USDA changed the WASDE released time from 7:30 am CT to 11:00 am CT (a period of higher liquidity). The justification for the shift was to release the report at a time where liquidity was highest (Kaufman, 2013).[25] On the 8th April 2013, based on market surveys and the need to reduce operating costs, CME again revised its trading hours back to day and night sessions (Kaufman, 2013). Now, a pause in electronic trading is observed from 7:45 am CT to 8:30 am CT. Both pit and electronic platforms now close at 1:15 pm CT with electronic markets reopening at 7 pm CT. While the agricultural futures market no longer trades on an extended basis, WASDE reports are still released at 11:00 am CT during trading hours.[26]

[25] Prior to this, in June 2012, the CME has already announced that open outcry hours would begin at 7:20 a.m. CT on days of a WASDE release in an attempt to increase liquidity. Pit trading opened at its usual time (9:30 a.m. CT) on all other days. During the period from 1 January 2013 to 8 April 2013, trading spans for 21 continuous hours in which WASDE report is released at 11 am CT.

[26] As of 31 December 2015.