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The Reaction of Corn Futures Markets to US and Brazilian Crop Reports

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Keywords: corn futures market | crop reports | price reaction

ABSTRACT

The purpose of this study is to examine the impact of US (WASDE) and Brazilian (CONAB) crop reports on corn futures prices and trading volumes in both the US and Brazilian markets. Employing an intraday announcement analysis, we investigate how return volatilities and trading volumes respond to the release of these reports. Specifically, we compare prices and volume behavior on report days with the 5 days preceding and following the announcements. Using both parametric and nonparametric tests, our results indicate that WASDE report announcements significantly influence returns and trading volumes in both markets. In contrast, the effects of CONAB reports are less pronounced than those associated with WASDE releases.

JEL Classification: Q11, G14

1 | Introduction

Government agencies in key agricultural-producing countries, such as the US Department of Agriculture (USDA) and the Brazilian Food Supply Company (CONAB), provide historical data on major grain and oilseed commodities, including projections for harvested areas, yields, production, imports, exports, domestic consumption, and ending stocks. Monthly reports from these agencies introduce new market information, influencing marketing strategies and financial decisions across the industry.

Several studies have already investigated the reaction of different reports on grain markets. Most of them explored the price response to USDA reports using an event study methodology. Overall, results have indicated the existence of market price response to the release of USDA reports, suggesting that these reports have informational value (Colling et al. 1996; Isengildina-Massa et al. 2008, 2020; Lehecka 2014; Lehecka et al. 2014; Mattos and Silveira 2016; Joseph and Garcia 2018; Karali et al. 2019, 2020; Adjemian and Irwin 2020; Huang et al. 2021; Cao and Robe 2022; McKenzie and Ke 2022; Massa et al. 2024; Lee and Park 2024).

Focusing on the corn market, Brazil and the United States are among the top three producers and exporters. Brazilian corn production expanded sixfold between 1980 and 2023, reaching around 5.19 billion bushels in 2022–2023.[1] During this period, Brazil's total corn planted area rose from 30 million to 55 million acres, while yield increased from 28 to around 94 bushels/

acre. Brazil's corn exports more than doubled between 2012/2013 and 2022/2023, and as a result, Brazil became the world's largest corn exporter in 2023. Considering the relevant share of Brazilian corn exports, information on the country's crop progress has become increasingly relevant to market participants for decision-making purposes.

Mattos and Silveira (2016) analyzed the impact of US and Brazilian crop reports on corn and soybean futures prices. For the United States, their findings indicate that World Agricultural Supply and Demand Estimates (WASDE) crop reports have a consistent and significant impact on price volatility in corn and soybean futures markets. Brazilian crop reports also influence price volatility, but their effects are weaker and less pronounced than the US reports. While the study provides relevant information regarding the impact of crop reports from different countries on the corn market, further investigation is necessary to account for new market developments in recent years and expand the scope of analysis. In recent years, in addition to the strong growth in Brazilian production, significant discrepancies between USDA and CONAB crop estimates have emerged, driven by methodological differences, volatile weather conditions, and changes in Brazil's corn production dynamics. Between 2010 and 2020, the average difference between the USDA and CONAB forecasts for Brazil's corn production was approximately 15 million bushels. However, this gap has widened substantially, reaching an average difference of about 106 million bushels in the 2020–2024 period (CONAB 2023; USDA Foreign Agricultural Service 2023)—Appendix 1. Furthermore, the discussion can be further refined by using intraday data, which allows for a more comprehensive analysis of both price and trading volume reactions. This approach can be applied not only to the Chicago Mercantile Exchange (CME) Group but also to the Brazilian exchange (B3), offering a broader perspective on market dynamics.

The purpose of this study is to analyze the impact of crop reports released by the USDA and CONAB on prices and trading volume in the CME Group and B3 corn futures markets. We adopt an event study method to investigate the announcement effect of both reports. The data set consists of crop reports and high-frequency corn futures prices and volumes from the CME Group and B3 between 2018 and 2024. We explore how prices and trading volume react immediately after the announcement of the reports. In addition, since USDA and CONAB reports were released on different days in 48 out of 73 months of our sample, we compare the reaction of prices and volumes to the announcement of each agency.

This analysis provides an opportunity to explore the recent period, characterized by significant divergence between USDA and CONAB projections. By using intraday data, the study offers a more detailed and accurate examination of price reactions to these crop reports, while also incorporating an analysis of trading volumes to provide a comprehensive understanding of market dynamics. Additionally, the inclusion of both CME Group and B3 corn futures markets enables a comparative analysis of how these two major markets respond to the release of crop reports from both agencies in different countries. As a result, our findings offer novel insights into how information from USDA and CONAB crop reports influences price and trading behavior, with implications for marketing and risk management strategies adopted by market participants. Moreover, the results may also be useful to evaluate the importance of public data to commodity markets, particularly considering budget reductions within federal governments and the growing role of the private sector in market data collection.

2 | Reports and Data

The data set used in this study consists of USDA and CONAB crop reports, along with prices and trading volume from the CME Group and B3 corn futures markets. For USDA reports, we used the WASDE monthly releases, which are prepared by the World Agricultural Outlook Board. The WASDE reports provide crop production forecasts and supply and demand projections for the United States and globally. CONAB monthly reports are limited to the Brazilian market and include production and supply and demand projections for major grains and oilseeds. Our analysis included all reports published between April 2018 and April 2024, totaling 72 WASDE and 73 CONAB reports—Appendix 2.

The announcements of the reports coincided in 25 months. CONAB released its report before the USDA in 30 months, when the average time lag between the release of the reports was 2.4 days (median 1.5 days). Conversely, in 16 months, the USDA released its report before CONAB—the average time lag between announcements was 3.4 days (median 2.0 days)—Table 1. Additionally, there was 1 month when only the WASDE report was released and another month when only CONAB released its report.

Considering the period of the study (2018–2024), WASDE reports are released at 11:00 a.m. central standard time (CST), while CONAB typically publishes its reports at 9:00 a.m. Brasília time (BRT). Consequently, CONAB's announcements occur between 5:00 a.m. and 7:00 a.m. CST, depending on daylight saving time in Brazil and the United States. The CME Group's trading hours for corn futures contracts are from Sunday to Friday, between 7:00 p.m. and 7:45 a.m. CST, and Monday to Friday, between 8:30 a.m. and 1:20 p.m. CST, as shown in Figure 1. In Brazil, B3 trading occurs between 9:00 a.m. and

TABLE 1 | The time lag between WASDE and CONAB report releases.

	CONAB before WASDE	WASDE before CONAB
Average (days)	2.4	3.4
Median (days)	1.5	2.0
Maximum (days)	1.0	20.0
Minimum (days)	11.0	1.0
SD (days)	2.2	4.6
Observations (months)	30	16

Abbreviations: CONAB, Brazilian Food Supply Company; WASDE, World Agricultural Supply and Demand Estimates.

4:30 p.m. BRT from Monday to Friday, with after-hours sessions between 5:05 p.m. and 6:00 p.m. BRT. Due to the time difference, WASDE reports are typically released between 1:00 p.m. and 3:00 p.m. BRT, depending on daylight saving time, as illustrated in Figure 2.

For the analysis of price and volume data, we used 1-min intraday futures prices and trading volumes, focusing on the nearest-to-maturity corn futures contracts traded on both the CME Group and B3 markets from April 2018 to April 2024. We selected nearby contracts due to their typically higher trading volumes and liquidity, as observed in previous studies (Karali 2012; Isengildina-Massa et al. 2008; Lehecka et al. 2014).

Corn returns were calculated using the last price per minute as in Equation (1), where $P_{m,d}$ and $P_{m,d-1}$ are the last prices of consecutive 1-min intervals ($m = 1, ..., 1440$) on a trading day $d = 1, ..., D$. In addition, we used standard deviation and average absolute deviation (AAD) as measures of volatility.

$$R_{m,d} = \ln(P_{m,d}/P_{m-1,d}) \times 100. \quad (1)$$

3 | Research Methods

The empirical analysis of this study was based on the theory of efficient markets. Given that futures prices reflect the conditional expectation of spot prices at the contract's maturity date, any influence from crop reports on market participants' perceptions of supply and demand conditions for a specific commodity should result in increased variability in futures returns upon the release of these reports. According to semistrong market efficiency, futures prices react instantaneously to such announcements (Isengildina-Massa et al. 2008; Lehecka et al. 2014).

We used an intraday announcement effect analysis to evaluate price and volume reactions to the release of reports in the corn futures markets, following Lehecka et al. (2014) and Joseph and Garcia (2018). We compared minute-to-minute returns and trading volumes from electronic trading platforms when reports were released with those from the same time of the day on pre- and post announcement days. Three steps were followed.

First, we collected volume data and calculated returns for intervals starting 15 min before the report release and ending 60 min after the event,[2] resulting in 75-min periods. For the CME Group futures market, we used the following method: (i) for WASDE reports, released at 11:00 a.m. CST (Figure 1), the first and last data points were set at 10:46 a.m. CST and 12:00 p.m. CST, respectively; (ii) for CONAB reports, similar data points were set at 6:46 a.m. CST and 8:00 a.m. CST, since the announcement occurs at 7:00 a.m. CST.[3] For the B3 futures market, considering that the WASDE reports are released at 1:00 p.m. BRT, data were collected from 12:46 p.m. to 2:00 p.m. BRT.[4] For CONAB reports, which are typically released at 9:00 a.m. BRT, coinciding with the start of the B3 trading session, the analysis focused on data between 9:00 a.m. and 10:00 a.m. BRT.

Second, for each report release, we obtained intraday returns and volumes per minute for five trading days before and five trading days after the release date, following the same 75-min window as on report days—except for the B3 market and CONAB announcements, where analysis is limited to a 60-min window due to the overlap between CONAB's release and the start of B3's trading session. This procedure is in line with previous studies, such as Joseph and Garcia (2018), Lehecka et al. (2014), and Isengildina-Massa et al. (2008). For every minute ($m = 1, ..., 75$), we then compared the returns and volumes for 72 WASDE days (73 CONAB days) with those from 360 (365 for CONAB) prereport days and 360 (365 for CONAB) postreport days.

At last, we used parametric and nonparametric tests to investigate the difference in return volatility and volume for report and nonreport days. For returns, to test the equality of variances and absolute returns, we used the two-tailed F test and Kruskal–Wallis χ^2 test. For volume, to test if volumes are equal on report days and pre-/postreport days, we used t and Wilcoxon tests.

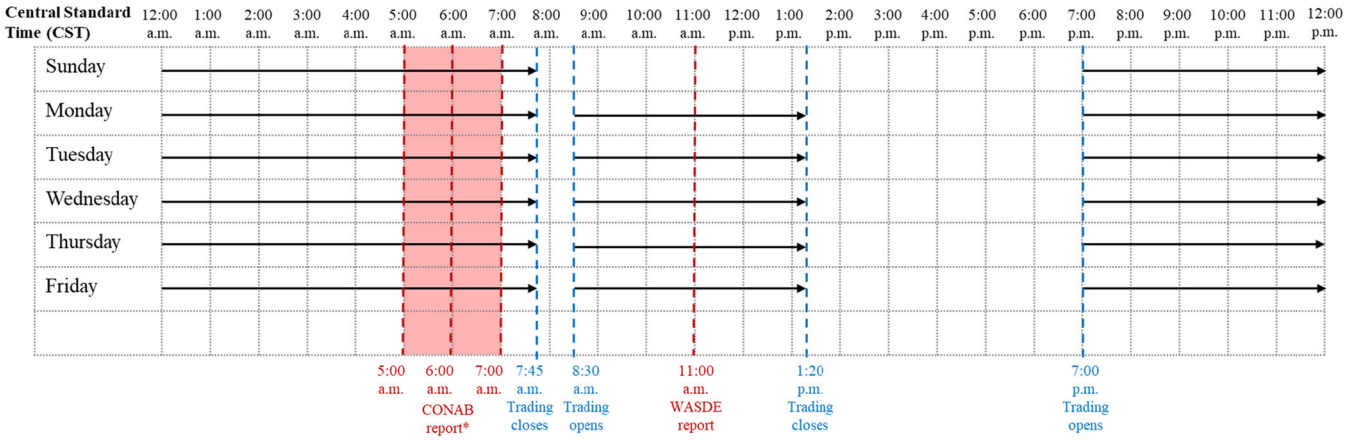

FIGURE 1 | Trading hours (CST) for corn futures contracts in the CME Group and WASDE and CONAB report release time between April 2018 and April 2024. *Note:* The release time of CONAB reports varies between 5 a.m. and 7:00 a.m. because of the daylight savings time in Brazil and the United States. CME, Chicago Mercantile Exchange; CST, central standard time; CONAB, Brazilian Food Supply Company; WASDE, World Agricultural Supply and Demand Estimates.

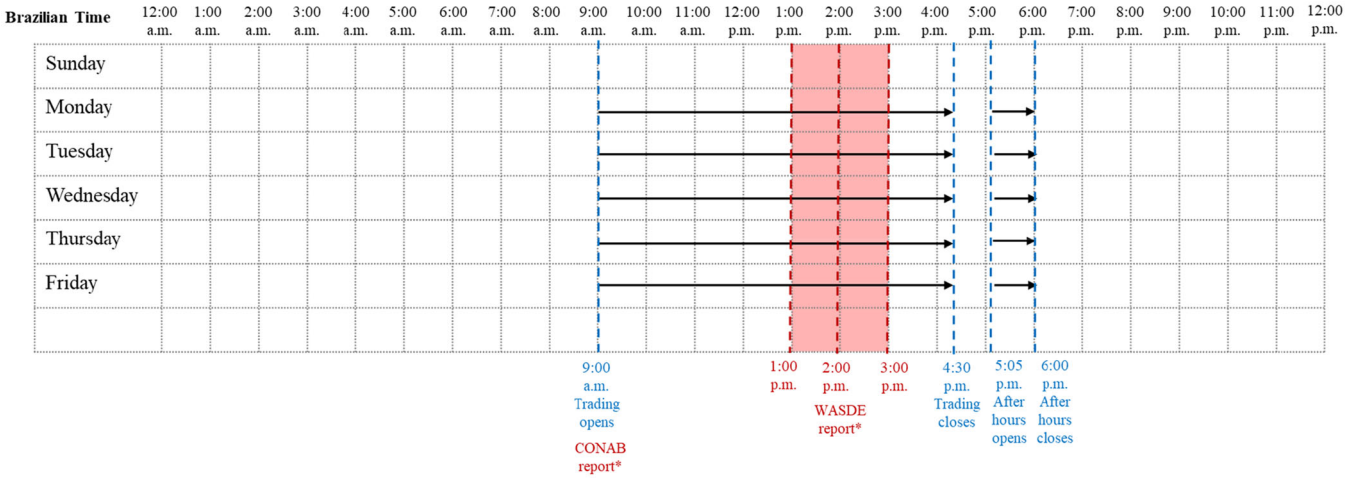

FIGURE 2 | Trading hours (BRT) for corn futures contracts in the B3 and WASDE and CONAB report release time between April 2018 and April 2024. *Note:* The release time of WASDE reports varies between 1 p.m. and 3:00 p.m. because of the daylight savings time in Brazil and the United States. B3, Brazilian exchange; BRT, Brasília time; CONAB, Brazilian Food Supply Company; WASDE, World Agricultural Supply and Demand Estimates.

TABLE 2 | Descriptive statistics of intraday returns and volumes (per minute) for the nearest-to-maturity CME Group and B3 corn futures contracts (April 2018–April 2024).

	CME group		B3	
	Return (%)	Volume (number of contracts)	Return (%)	Volume (number of contracts)
Mean	0.00	117.01*	0.00	17.07*
Median	0.00	22.00	0.00	6.00
Minimum	−17.75	1.00	−9.86	1.00
Maximum	6.19	26,214.00	6.69	9137.00
SD	0.07	312.68	0.11	47.19
Skewness	−28.88	12.37	−0.74	43.95
Kurtosis	7230.10	378.56	454.42	5533.40
Jarque–Bera statistics	25.78×10^{11}*	70.96×10^{8}*	32.23×10^{8}*	47.81×10^{10}*
Observations (n)	1,183,413	1,183,413	374,639	374,639

Abbreviations: B3, Brazilian exchange; CME, Chicago Mercantile Exchange.
*Significant at the 1% level.

4 | Results

Table 2 shows descriptive statistics for returns and volumes. We calculated minute-to-minute returns using Equation (1) between April 2018 and April 2024. In the CME Group (B3) market, returns (R_t) ranged from −17.75% to 6.19% (−9.86% to 6.69%), and had a standard deviation of 0.07% (0.11%), while the mean was not statistically distinguishable from zero. Although the calculated means indicate no consistent upward or downward trends, the negative skewness suggests that during the period under analysis, there were significant price declines relative to increases, particularly in the CME Group market. Furthermore, the high value of kurtosis provides additional evidence for this conclusion, indicating a significant occurrence of extreme events, that is, large returns in both positive and negative directions.

For the CME Group (B3) trading volume, 1-min mean and standard deviation were 117.01 (17.07) and 312.68 (47.19) contracts, respectively. As expected, the CME corn futures market exhibited significantly greater liquidity than the B3 market, particularly given the difference in contract sizes—5000 bushels for the CME Group and the equivalent of 1062.93 bushels for B3. The high skewness observed in both markets suggests that while trading volumes remain relatively low on most days, occasional spikes in volume occur. Likewise, the high kurtosis values reinforce this finding, indicating a frequent occurrence of extreme events. This pattern suggests that trading volume tends to increase sharply during specific periods, leading to a significant number of days with exceptionally high activity. Finally, the results of the Jarque–Bera tests confirm the nonnormality of all series.

Table 3 shows the comparison between the mean, median, and standard deviation of returns and trading volume on report and nonreport days. Overall, mean returns were not statistically distinguishable from zero. In both markets (CME Group and

TABLE 3 | Descriptive statistics of intraday returns and trading volumes (April 2018–April 2024), considering the report and nonreport days.

	CME				B3			
	WASDE report days	**WASDE nonreport days**	**CONAB report days**	**CONAB nonreport days**	**WASDE report days**	**WASDE nonreport days**	**CONAB report days**	**CONAB nonreport days**
Return								
Mean (%)	0.00	0.00	0.00	0.00	−0.00	0.00	0.00	0.00
Median (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SD (%)	0.08	0.07	0.07	0.07	0.12	0.11	0.11	0.11
Observations	55,448	1,127,965	56,473	1,126,940	17,418	357,221	18,409	356,230
Comparison between report days and nonreport days[a]								
Mean hypothesis test—*t* statistics	−0.00		1.1821		−1.5885		0.0109	
Median hypothesis test—*W* statistics	312.43×10^8		318.48×10^8		30.93×10^8		32.87×10^8	
Variance hypothesis test—*F* statistics	1.39	*	1.17	*	1.12	*	1.10	*
Comparison between WASDE and CONAB report days and no reports or only one report day[a]								
Mean hypothesis test—*t* statistics	−0.72				−1.17			
Median hypothesis test—*W* statistics	15.63×10^8				15.91×10^7			
Variance hypothesis test—*F* statistics	1.58	*			1.23	*		
Volume								
Mean	159.58	114.91	132.86	116.21	19.26	16.97	17.36	17.06
Median	23.00	22.00	23.00	22.00	6.00	6.00	6.00	6.00
SD	485.22	301.51	372.83	309.34	53.62	46.85	38.95	47.57
Comparison between report days and nonreport days[a]								
Mean hypothesis test—*t* statistics	21.47	*	10.43	*	5.55	*	1.01	
Median hypothesis test—*W* statistics	322.62×10^8	*	321.68×10^8	*	324.48×10^7	*	333.03×10^7	*
Variance hypothesis test—*F* statistics	2.59	*	1.45	*	1.31	*	1.49	*

(Continues)

TABLE 3 | (Continued)

	CME				B3			
	WASDE report days	WASDE nonreport days	CONAB report days	CONAB nonreport days	WASDE report days	WASDE nonreport days	CONAB report days	CONAB nonreport days
Comparison between WASDE and CONAB report days and no reports or only one report day[a]								
Mean hypothesis test—t statistics	10.32	*			3.82	*		
Median hypothesis test—W statistics	15.97×10^8	*			16.45×10^7	*		
Variance hypothesis test—F statistics	1.69	*			1.89	*		

Abbreviations: B3, Brazilian exchange; CME, Chicago Mercantile Exchange; CONAB, Brazilian Food Supply Company; WASDE, World Agricultural Supply and Demand Estimates.
[a]We used t and Wilcoxon tests to test the null hypothesis of equality of returns and volumes in report and nonreport days, and F tests to test the null hypothesis of equality of return variances in both periods.
*Significant at the 1% level.

B3), return volatility on WASDE report days was higher than on WASDE nonreport days, while return volatility on CONAB report days was lower than on CONAB nonreport days. These differences were statistically significant at 1%.

For trading volume at CME Group and B3, both the mean and standard deviation were significantly higher on report days compared with nonreport days, with statistical significance at the 1% level. The only exception was the difference in mean trading volumes between CONAB report and nonreport days at B3, which was not statistically significant.

Furthermore, we found that return volatility and trading volume were statistically higher on days when both WASDE and CONAB reports were released compared with days with either no reports or only one report.

Excluding the days when both WASDE and CONAB reports were released, we compared returns and volumes between days when only WASDE reports were released, days when only CONAB reports were released, and days without any report (neither WASDE nor CONAB). For CME Group and B3 markets, our findings indicate that all returns were not statistically distinguishable from zero at the 1% level in any case. Focusing on the CME Group market, return volatility was higher on WASDE-only report days in all comparisons: nonreport days, CONAB-only report days, and WASDE + CONAB report days (Table 4). Different results were found for CONAB. Return volatility for CONAB-only days was lower in all comparisons: nonreport days, WASDE-only report days, and WASDE + CONAB report days (Table 4).

Three significant results were identified for the B3 market. First, return volatility was higher on days when both WASDE and CONAB reports were released, compared with WASDE-only, CONAB-only, or nonreport days. Second, return volatility on WASDE-only report days was greater than on CONAB-only report days. Third, return volatilities on WASDE-only and CONAB-only report days were lower than on nonreport days. All results were statistically significant at the 1% level.

Furthermore, in both the CME Group and B3 markets, mean volume and volume variability on WASDE-only report days were generally higher across all comparisons, except for one case in the CME Group market, where days with both WASDE and CONAB reports showed higher values (Table 4). In the CME Group market, mean volume and volume variability on CONAB-only report days were lower than those observed on WASDE-only and WASDE + CONAB report days, with volume variability also being lower compared with nonreport days. The mean volume on CONAB-only report days was not statistically different from that on nonreport days. In contrast, in the B3 market, the mean volume on CONAB-only report days was higher than on both nonreport days and WASDE + CONAB report days, with all results statistically significant at the 1% level.

We used parametric and nonparametric tests to evaluate the impact of the WASDE and CONAB report announcements on return volatility and volume during 1-min periods starting 15 min before the announcements ($t - 15$), at the time of the

TABLE 4 | Additional descriptive statistics and tests, considering the report and nonreport days.

	Comparison 1		Comparison 2		Comparison 3		Comparison 4		Comparison 5		Comparison 6	
	WASDE-only report days (A)	Nonreport days (B)	CONAB-only report days (A)	Nonreport days (B)	WASDE-only report days (A)	WASDE-CONAB report days (B)	CONAB-only report days (A)	WASDE-CONAB report days (B)	WASDE-CONAB report days (A)	Nonreport days (B)	WASDE-only report days (A)	CONAB-only report days (B)
CME												
Return—CME Group												
Mean (%)	−0.00	0.00	0.00	0.00	−0.00	0.00	0.00	0.00	0.00	0.00	−0.00	0.00
Median (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SD (%)	0.09	0.07	0.06	0.07	0.09	0.08	0.06	0.08	0.08	0.07	0.09	0.06
Observations	36,792	1,090,148	37,817	1,090,148	36,792	18,656	37,817	18,656	18,656	1,090,148	36,792	37,817
Comparison: A and B												
Mean hypothesis test—*t* statistics	−0.80		0.41		−1.50		−0.92		1.26		−0.91	
Median hypothesis test—*W* statistics	2.00×10^{10}		2.06×10^{10}		3.42×10^{8}		3.52×10^{8}		1.02×10^{10}		6.39×10^{8}	
Variance hypothesis test—*F* statistics	1.46*		1.42*		1.21*		1.72*		1.21*		2.08*	
Volume—CME Group												
Mean	154.40*	114.92*	114.64*	114.92*	154.40*	169.80*	114.64*	169.80*	169.80*	114.92*	154.40*	114.64*
Median	22.00	22.00	21.00	22.00	22.00	26.00	21.00	26.00	26.00	22.00	22.00	21.00
SD	473.78	302.15	282.54	302.15	473.78	506.87	282.54	506.87	506.87	302.15	473.79	282.54
Comparison: A and B												
Mean hypothesis test—*t* statistics	15.87*		−0.19		−3.46*		−13.84*		14.74*		13.88*	
Median hypothesis test—*W* statistics	2.05×10^{10}*		2.04×10^{10}**		3.35×10^{8}*		3.34×10^{8}*		1.06×10^{10}*		7.16×10^{8}*	

(Continues)

TABLE 4 | (Continued)

	Comparison 1		Comparison 2		Comparison 3		Comparison 4		Comparison 5		Comparison 6	
	WASDE-only report days (A)	**Nonreport days (B)**	**CONAB-only report days (A)**	**Nonreport days (B)**	**WASDE-only report days (A)**	**WASDE-CONAB report days (B)**	**CONAB-only report days (A)**	**WASDE-CONAB report days (B)**	**WASDE-CONAB report days (A)**	**Nonreport days (B)**	**WASDE-only report days (A)**	**CONAB-only report days (B)**
Variance hypothesis test—*F* statistics	2.46*		1.14*		1.14*		3.21*		2.81*		2.81*	
B3												
Return—B3												
Mean (%)	−0.00**	0.00	0.00	0.00	−0.00	0.00	0.00	0.00	0.00	0.00	−0.00	0.00
Median (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SD (%)	0.11	0.11	0.09	0.11	0.11	0.14	0.09	0.14	0.14	0.11	0.11	0.09
Observations	12,169	344,061	13,160	344,061	12,169	5249	13,160	5249	5249	344,061	12,169	13,160
Comparison: A and B												
Mean hypothesis test—*t* statistics	−2.14		−0.13		−0.97		−0.06		0.02		−1.62	
Median hypothesis test—*W* statistics	2.07×10^9**		2.27×10^9		3.15×10^7		3.44×10^7		9.07×10^8		7.92×10^7	
Variance hypothesis test—*F* statistics	1.12*		1.62*		1.81*		2.61*		1.61*		1.44*	
Volume—B3												
Mean	21.20*	16.91*	18.40*	16.91*	21.20*	14.77*	18.40	14.77*	14.77*	16.91*	21.20*	18.40*
Median	7.00	6.00	6.00	6.00	7.00	5.00	6.00	5.0	5.00	6.0	7.00	6.00
SD	60.66	47.04	41.56	47.04	60.66	31.32	41.56	31.32	31.32	47.03	60.66	41.56
Comparison: A and B												
Mean hypothesis test—*t* statistics	7.72*		4.00*		9.20*		6.43*		−4.87*		4.26*	

(Continues)

TABLE 4 | (Continued)

	Comparison 1		Comparison 2		Comparison 3		Comparison 4		Comparison 5		Comparison 6	
	WASDE-only report days (A)	Nonreport days (B)	CONAB-only report days (A)	Nonreport days (B)	WASDE-only report days (A)	WASDE-CONAB report days (B)	CONAB-only report days (A)	WASDE-CONAB report days (B)	WASDE-CONAB report days (A)	Nonreport days (B)	WASDE-only report days (A)	CONAB-only report days (B)
Median hypothesis test—W statistics	2.25×10^{9}*		2.35×10^{9}*		3.51×10^{7}*		3.71×10^{7}*		8.71×10^{8}*		8.32×10^{7}*	
Variance hypothesis test—F statistics	1.66*		1.28*		3.75*		1.76*		2.26*		2.13*	

Abbreviations: B3, Brazilian exchange; CME, Chicago Mercantile Exchange; CONAB, Brazilian Food Supply Company; WASDE, World Agricultural Supply and Demand Estimates.
*Significant at the 1% level
**significant at the 5% level
***significant at the 10% level.

announcements ($t = 0$), and over the next 60 min following the announcements ($t + 60$).

Tables 5 and 6 show the test results for return volatility (return standard deviation) on WASDE and CONAB announcements, respectively. We used the two-tailed F tests to evaluate if returns variability for report days and nonreport days were equal. Our results show that CME Group (B3) return volatilities on WASDE announcement days were significantly greater than those from days without WASDE releases in 71 out of 76 (in 67 out of 76) intervals, indicating that WASDE reports provided relevant information to the CME Group and B3 corn markets—Table 5. Volatility in the CME Group (B3) was significantly greater on WASDE days in 10 out of 15 (in 12 out 15) intervals before the announcement time and in all intervals (in 55 out of 61) after and at the time of the announcement.

For CONAB, the standard deviation of CME Group returns on report days was significantly higher than those on days without CONAB announcements in 40 out of 75 intervals (including the time of the event)—Table 6. However, we found differences when comparing volatilities during 1-min intervals before and after the report release. Volatility on CONAB report days was significantly greater than on days without CONAB reports only in 2 out of 15 intervals before the report release and in 38 out of 61 intervals after the report release (including the time of the event). The difference in volatility between CONAB days and days without CONAB announcements was not statistically distinguishable from zero in four intervals (all of them after the report release). In the B3 market, similar analysis was done exclusively after CONAB announcements, as the report releases coincide with the opening of the Brazilian trading session at 9:00 a.m. BRT. Return volatility on CONAB report days was significantly higher than on non-CONAB report days in only 19 out of 61 intervals (31%), while in 42 intervals (69%), it was significantly lower.

These results were consistent with nonparametric Kruskal–Wallis tests applied on AAD. CME Group (B3) volatility on WASDE days (Table 7), measured by AAD, was significantly greater than on days without WASDE announcements in 4 out of 15 (in 5 out of 15) intervals before the report release, in the interval during the report release, and in 57 out of 60 (in 40 out of 60) intervals after the report release. Table 7 further indicates that no statistically significant difference in volatility was observed in 11 out of 15 (10 out of 15) intervals before the report release and in 3 out of 60 (20 out of 60) intervals after the release in the CME Group (B3) market.

The analysis using the AAD as a measure of volatility (Table 8) indicates that the difference in return variability between CONAB report days and non-CONAB report days was not statistically significant in 66 out of 76 intervals (87%) in the CME Group market and in 57 out of 61 intervals (93%) in the B3 market. Volatility on CONAB report days was significantly higher in eight intervals in the CME market (10.5%) and two intervals in the B3 market (3.3%), while it was significantly lower in two intervals in both markets.

We also compared return volatility across WASDE-only days, CONAB-only days, and nonreport days (neither WASDE nor

TABLE 5 | Intraday announcement effect test for corn futures return volatility to the release of WASDE reports.

	CME group						B3					
Minute marker	Mean returns (WASDE report day)	Mean returns (WASDE nonreport day)	SD (WASDE report day)	SD (WASDE nonreport day)	*F* statistics (WASD-E)	*p* value	Mean returns (WASDE report day)	Mean returns (WASDE nonreport day)	SD (WASDE report day)	SD (WASDE nonreport day)	*F* statistics (WASDE)	*p* value
−15	0.00	0.00	0.06	0.07	1.19	0.00*	0.01	−0.01	0.06	0.08	1.62	0.00*
−10	0.00	0.00	0.07	0.09	1.39	0.00*	−0.02	−0.01	0.08	0.07	1.09	0.00*
−5	0.00	0.00	0.10	0.08	1.52	0.00*	0.01	0.01	0.08	0.06	1.56	0.00*
−4	−0.01	0.00	0.09	0.07	1.74	0.00*	0.00	0.00	0.08	0.07	1.20	0.00*
−3	0.01	0.00	0.07	0.06	1.31	0.00*	0.00	0.00	0.09	0.07	1.58	0.00*
−2	0.02	0.00	0.09	0.07	1.72	0.00*	−0.01	0.00	0.11	0.07	2.41	0.00*
−1	0.06	0.01	0.32	0.07	20.05	0.00*	−0.01	0.00	0.14	0.07	4.48	0.00*
0	−0.03	−0.01	1.27	0.07	322.54	0.00*	−0.14	0.00	0.56	0.09	41.21	0.00*
1	−0.08	0.00	0.43	0.07	39.96	0.00*	−0.01	0.00	0.32	0.07	21.56	0.00*
2	0.07	0.00	0.41	0.07	33.32	0.00*	−0.04	0.00	0.29	0.07	14.98	0.00*
3	0.09	0.00	0.33	0.07	20.98	0.00*	−0.02	−0.01	0.22	0.07	10.98	0.00*
4	0.02	0.00	0.34	0.07	23.92	0.00*	0.02	0.00	0.15	0.07	4.90	0.00*
5	0.01	0.00	0.28	0.07	16.85	0.00*	0.02	0.01	0.13	0.06	3.79	0.00*
10	0.01	0.00	0.24	0.07	11.57	0.00*	0.04	0.00	0.16	0.06	7.11	0.00*
15	−0.01	0.00	0.14	0.07	3.82	0.00*	−0.01	0.01	0.13	0.06	4.20	0.00*
20	0.02	0.00	0.14	0.07	3.62	0.00*	−0.01	0.00	0.12	0.09	1.58	0.00*
25	−0.02	−0.01	0.13	0.07	3.58	0.00*	0.00	0.00	0.07	0.07	1.02	0.08***
30	0.01	0.01	0.11	0.07	2.91	0.00*	−0.01	0.00	0.07	0.07	1.06	0.00*
31	−0.01	0.00	0.11	0.07	2.59	0.00*	−0.01	0.01	0.11	0.09	1.34	0.00*
35	0.01	0.00	0.10	0.06	2.60	0.00*	0.01	0.00	0.08	0.08	1.14	0.00*
40	−0.02	0.00	0.10	0.07	2.35	0.00*	0.01	−0.01	0.09	0.08	1.10	0.00*
45	−0.01	0.00	0.10	0.07	1.87	0.00*	−0.02	0.00	0.12	0.06	3.52	0.00*
50	0.00	0.00	0.09	0.06	2.02	0.00*	0.02	0.01	0.08	0.10	1.56	0.00*
55	0.00	0.00	0.08	0.06	1.92	0.00*	0.00	0.00	0.07	0.11	2.95	0.00*
60	0.00	0.01	0.09	0.06	2.14	0.00*	0.01	0.00	0.11	0.09	1.43	0.00*

Abbreviations: B3, Brazilian exchange; CME, Chicago Mercantile Exchange; WASDE, World Agricultural Supply and Demand Estimates.
*Significant at the 1% level
**Significant at the 5% level
***Significant at the 10% level.

TABLE 6 | Intraday announcement effect test for corn futures return volatility to the release of CONAB reports.

	CME group						B3					
Minute marker	Mean returns (CONAB report day)	Mean returns (CONAB nonreport day)	SD (CONAB report day)	SD (CONAB nonreport day)	*F* statistics (CONA-B)	*p* value	Mean returns (CONAB report day)	Mean returns (CONAB nonreport day)	SD (CONAB report day)	SD (CONAB nonreport day)	*F* statistics (CONAB)	*p* value
−15	0.00	0.00	0.04	0.05	1.46	0.00*						
−10	−0.01	0.00	0.05	0.05	1.10	0.00*						
−5	0.00	0.00	0.04	0.05	1.37	0.00*						
−4	0.00	0.00	0.05	0.05	1.13	0.00*						
−3	0.01	−0.01	0.05	0.06	1.35	0.00*						
−2	−0.01	0.00	0.04	0.05	1.13	0.00*						
−1	0.01	0.00	0.05	0.05	1.26	0.00*						
0	0.00	0.00	0.07	0.05	1.69	0.00*	0.13	0.01	0.54	0.69	1.65	0.00*
1	0.00	0.00	0.06	0.06	1.02	0.08***	−0.02	0.03	0.28	0.29	1.08	0.00*
2	0.00	0.00	0.05	0.05	1.29	0.00*	−0.03	0.02	0.21	0.25	1.45	0.00*
3	0.00	0.00	0.06	0.05	1.16	0.00*	0.01	0.02	0.16	0.23	2.06	0.00*
4	0.00	0.00	0.05	0.06	1.29	0.00*	−0.03	−0.01	0.17	0.19	1.35	0.00*
5	−0.01	0.00	0.06	0.06	1.19	0.00*	−0.02	0.00	0.14	0.15	1.20	0.00*
10	0.00	0.00	0.06	0.06	1.12	0.00*	0.04	0.01	0.11	0.14	1.49	0.00*
15	−0.02	0.00	0.08	0.06	1.90	0.00*	0.00	0.00	0.10	0.13	1.87	0.00*
20	0.00	0.00	0.05	0.05	1.08	0.00*	0.02	0.00	0.10	0.10	1.02	0.09***
25	−0.01	0.00	0.06	0.06	1.01	0.27	−0.02	0.00	0.12	0.10	1.30	0.00*
30	−0.01	−0.01	0.08	0.07	1.07	0.00*	0.03	0.00	0.09	0.10	1.12	0.00*
35	−0.01	0.00	0.07	0.06	1.26	0.00*	−0.02	−0.01	0.08	0.09	1.44	0.00*
40	−0.01	0.01	0.06	0.06	1.05	0.00*	−0.01	0.01	0.08	0.10	1.40	0.00*
45	−0.01	0.00	0.06	0.06	1.09	0.00*	0.00	0.00	0.09	0.09	1.06	0.00*
50	0.00	0.00	0.04	0.05	1.24	0.00*	0.02	0.00	0.06	0.10	2.69	0.00*
55	0.00	0.00	0.05	0.05	1.22	0.00*	−0.01	0.00	0.08	0.09	1.14	0.00*
60	−0.01	0.00	0.06	0.05	1.70	0.00*	0.04	0.01	0.15	0.17	1.25	0.00*

Abbreviations: B3, Brazilian exchange; CME, Chicago Mercantile Exchange; CONAB, Brazilian Food Supply Company.
*Significant at the 1% level
**Significant at the 5% level
***Significant at the 10% level.

TABLE 7 | Intraday announcement effect test for corn futures absolute returns to the release of WASDE reports.

	CME group				B3			
Minute marker	AAD (WASDE report day)	AAD (WASDE nonreport day)	χ^2 (WASDE)	*p* value	AAD (WASDE report day)	AAD (WASDE nonreport day)	χ^2 (WASDE)	*p* value
−15	0.05	0.05	2.10	0.15	0.03	0.05	0.57	0.45
−10	0.05	0.05	1.79	0.18	0.04	0.05	2.04	0.15
−5	0.07	0.05	6.86	0.01*	0.06	0.04	7.24	0.01*
−4	0.07	0.05	7.89	0.01*	0.05	0.04	1.39	0.24
−3	0.05	0.04	0.47	0.49	0.06	0.04	9.27	0.00*
−2	0.07	0.05	8.94	0.00*	0.07	0.05	0.66	0.42
−1	0.13	0.05	21.43	0.00*	0.09	0.04	13.03	0.00*
0	0.83	0.05	103.84	0.00*	0.30	0.06	53.64	0.00*
1	0.31	0.05	99.74	0.00*	0.19	0.04	36.76	0.00*
2	0.29	0.05	75.90	0.00*	0.18	0.05	41.81	0.00*
3	0.25	0.05	103.53	0.00*	0.14	0.04	18.53	0.00*
4	0.24	0.04	83.27	0.00*	0.11	0.04	26.80	0.00*
5	0.20	0.05	66.59	0.00*	0.09	0.04	12.96	0.00*
10	0.17	0.05	62.84	0.00*	0.12	0.04	28.48	0.00*
15	0.11	0.05	25.91	0.00*	0.09	0.04	10.12	0.00*
20	0.11	0.05	32.79	0.00*	0.08	0.06	4.75	0.03**
25	0.10	0.05	28.02	0.00*	0.05	0.04	3.25	0.07***
30	0.09	0.04	25.22	0.00*	0.05	0.04	1.67	0.20
35	0.07	0.04	11.00	0.00*	0.06	0.05	5.20	0.02**
40	0.07	0.04	6.05	0.01*	0.06	0.05	2.56	0.11
45	0.07	0.05	1.70	0.19	0.07	0.04	3.46	0.06***
50	0.06	0.04	5.02	0.03**	0.05	0.05	0.19	0.66
55	0.06	0.04	9.07	0.00*	0.04	0.05	0.26	0.61
60	0.06	0.04	1.98	0.16	0.06	0.06	0.11	0.74

Abbreviations: AAD, average absolute deviation; B3, Brazilian exchange; CME, Chicago Mercantile Exchange; WASDE, World Agricultural Supply and Demand Estimates.
*Significant at the 1% level
**Significant at the 5% level
***Significant at the 10% level.

CONAB) in both the CME and B3 markets, as detailed in Appendixes 3–6. Results are qualitatively similar to results in Tables 5–8 and corroborate previous evidence and studies (Lehecka et al. 2014; Massa et al. 2024; Lee and Park 2024), underscoring the USDA's significant role in price discovery and mitigating information asymmetry in agricultural markets. Moreover, our findings highlight the greater influence of WASDE reports on return volatility compared with CONAB reports, which is consistent with Mattos and Silveira (2016).

As shown in Figures 3 and 4, return volatility during the days of WASDE report release reached its peak at the time of the announcement (1.27% in CME Group and 0.56% in B3). In the CME Group (B3) market, volatility on WASDE report days was around 18 (6) times higher than the average volatility during nonannouncement days. Even though return volatilities during report days were statistically higher during most of the period range, they continued at much higher levels after the announcement of the WASDE report in both markets. For instance, the CME Group (B3) average volatility for the 15-min-window before the report was 0.09% (0.08%) versus 0.08% (0.07%) on nonreport days. The same volatility level was only observed again around 30 min after the announcement in both markets. Comparing WASDE-only report days and nonreport days, we found similar results. This suggests that prices may take almost half an hour to reflect all the information contained in the WASDE reports. These results are similar to those found by Lehecka et al. (2014) and Lee and Park (2024). Lehecka et al. (2014) found that "the return variance for the first minute of the day trading session is forty times as much on days when a report is released as on days without a report is released." Previous studies suggest that it takes 10 min for the market to fully reflect the new information contained in the WASDE reports. Our results support this overall result, but the announcements of the WASDE report seem to have a lower but longer impact on intraday return volatilities.

TABLE 8 | Intraday announcement effect test for corn futures absolute returns to the release of CONAB reports.

	CME group				B3			
Minute marker	AAD (CONAB report day)	AAD (CONAB nonreport day)	χ^2 (CONAB)	*p* value	AAD (CONAB report day)	AAD (CONAB nonreport day)	χ^2 (CONAB)	*p* value
−15	0.03	0.03	0.34	0.56				
−10	0.03	0.03	0.88	0.35				
−5	0.03	0.03	0.22	0.64				
−4	0.03	0.04	0.15	0.70				
−3	0.03	0.04	1.75	0.19				
−2	0.02	0.03	2.99	0.08***				
−1	0.03	0.03	0.04	0.84				
0	0.05	0.03	6.01	0.01**	0.41	0.46	0.15	0.70
1	0.04	0.04	0.00	0.95	0.20	0.20	0.08	0.78
2	0.03	0.03	0.00	0.96	0.15	0.18	1.55	0.21
3	0.04	0.04	1.29	0.26	0.12	0.15	0.07	0.79
4	0.04	0.04	0.20	0.65	0.11	0.12	0.23	0.64
5	0.04	0.04	0.32	0.57	0.10	0.10	0.00	1.00
10	0.04	0.04	0.16	0.68	0.09	0.09	0.15	0.70
15	0.05	0.04	1.20	0.27	0.07	0.08	0.27	0.60
20	0.03	0.04	0.07	0.79	0.07	0.07	0.39	0.53
25	0.04	0.04	0.10	0.75	0.08	0.07	0.46	0.50
30	0.05	0.05	0.03	0.87	0.07	0.07	0.85	0.36
35	0.05	0.04	2.52	0.11	0.05	0.06	0.18	0.67
40	0.04	0.04	0.48	0.49	0.05	0.06	0.16	0.69
45	0.05	0.03	4.01	0.05**	0.07	0.05	3.62	0.06***
50	0.03	0.03	0.03	0.85	0.05	0.06	0.07	0.79
55	0.03	0.03	0.13	0.71	0.05	0.06	0.46	0.50
60	0.05	0.03	3.46	0.06***	0.10	0.10	0.10	0.76

Abbreviations: AAD, average absolute deviation; B3, Brazilian exchange; CME, Chicago Mercantile Exchange; CONAB, Brazilian Food Supply Company.
*Significant at the 1% level
**Significant at the 5% level
***Significant at the 10% level.

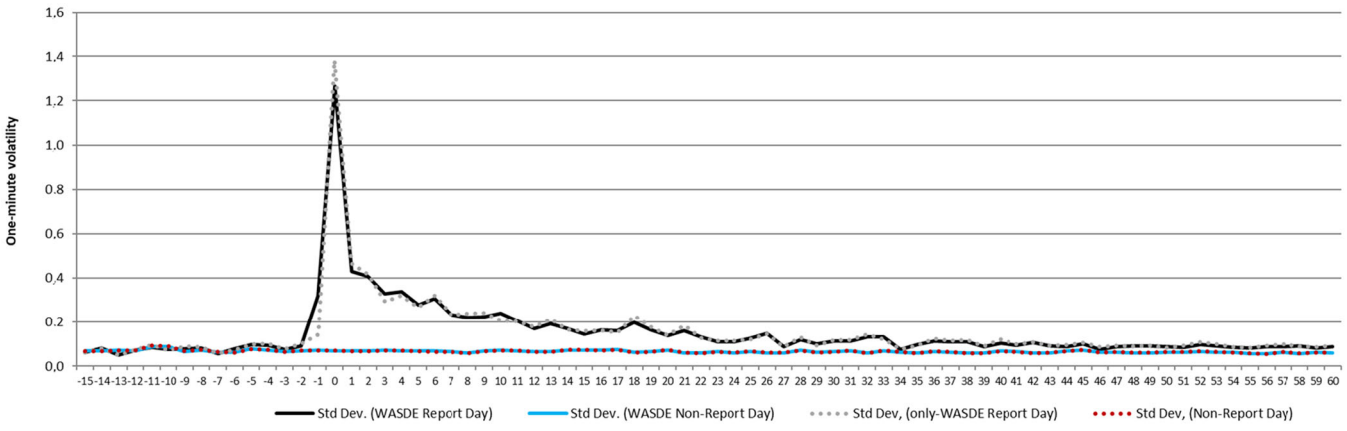

FIGURE 3 | CME Group intraday return volatility during WASDE report days and nonreport days. CME, Chicago Mercantile Exchange; WASDE, World Agricultural Supply and Demand Estimates.

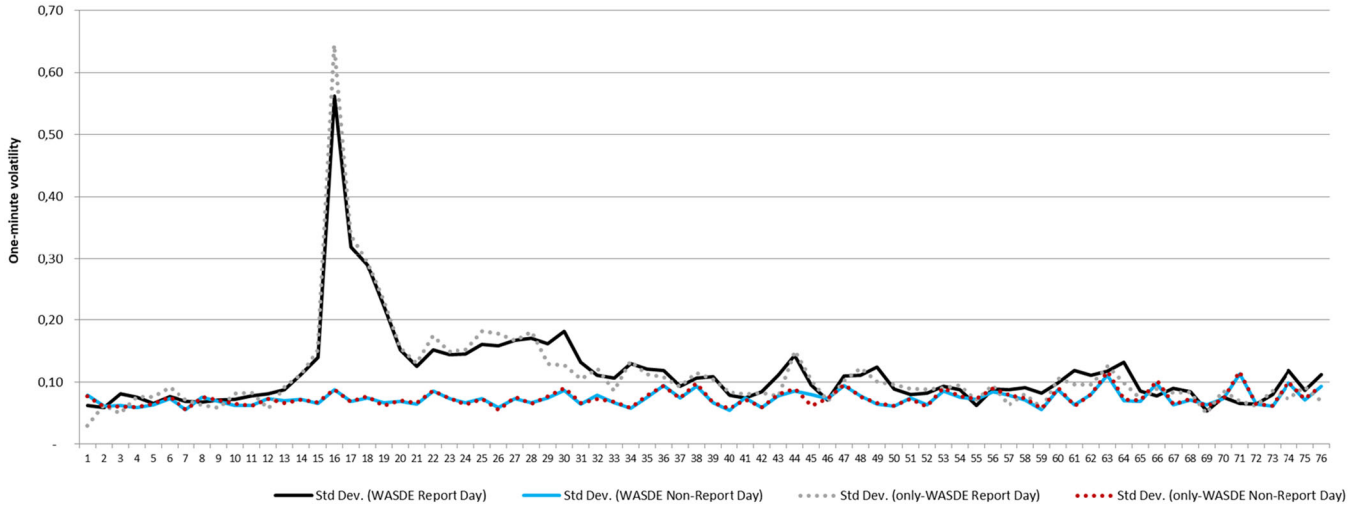

FIGURE 4 | B3 intraday return volatility during WASDE report days and nonreport days. B3, Brazilian exchange; WASDE, World Agricultural Supply and Demand Estimates.

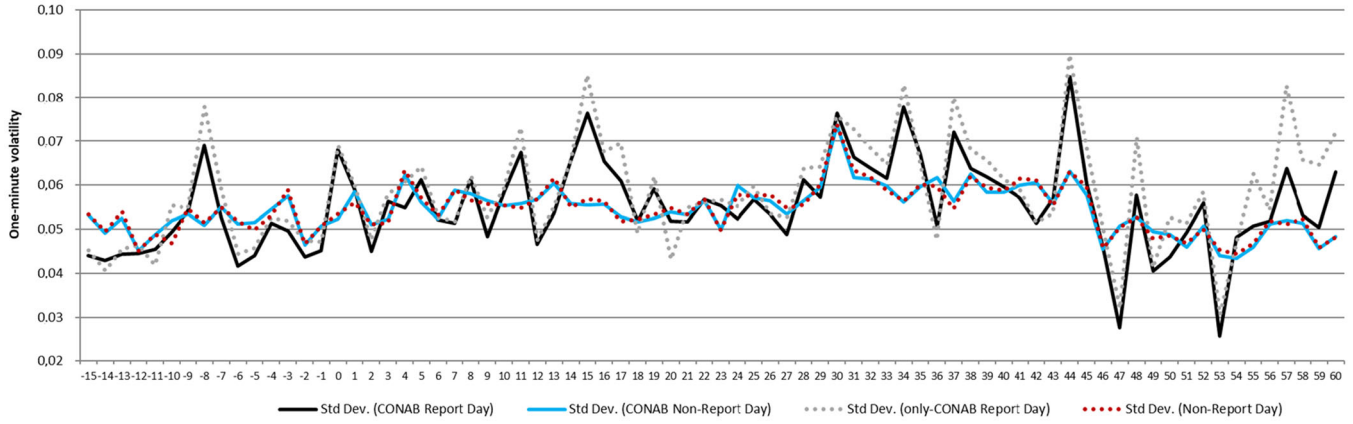

FIGURE 5 | CME Group intraday return volatility during Conab report days and nonreport days. CME, Chicago Mercantile Exchange; CONAB, Brazilian Food Supply Company.

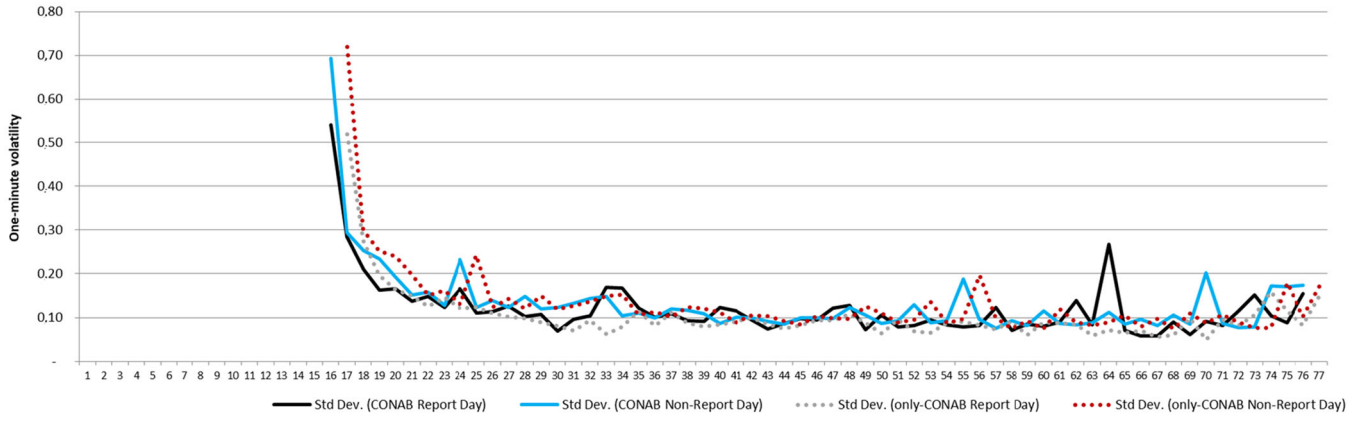

FIGURE 6 | B3 intraday return volatility during CONAB report days and nonreport days. B3, Brazilian exchange; CONAB, Brazilian Food Supply Company.

Moreover, almost all return volatilities during the days of the release of CONAB's reports were statistically different from those calculated on nonreport days—Figures 5 and 6. Unlike the result obtained for the WASDE report, CME Group return volatilities were lower on CONAB report days than on nonreport days in 87% of the period before the CONAB report was released, specifically from $t-15$ through $t-1$ (Figure 5). Return volatilities in the CME Group market were found to be

TABLE 9 | Intraday announcement effect test for corn futures volume to the release of WASDE reports.

	CME group						B3					
Minute marker	Mean volume (WASDE report day)[a]	Mean volume (WASDE nonreport day)[a]	*t* statistics (WASDE)	*p* value	*W* statistics (WASDE)	*p* value	Mean volume (WASDE report day)[a]	Mean volume (WASDE nonreport day)[a]	*t* statistics (WASDE)	*p* value	*W* statistics (WASDE)	*p* value
−15	356.15	198.87	2.67	0.01*	18,936.50	0.00*	8.51	11.19	−1.00	0.32	2944.00	0.12
−10	326.04	218.62	2.17	0.03**	17,855.50	0.00*	13.22	12.95	0.07	0.94	3044.50	0.72
−5	369.06	225.04	3.52	0.00*	20,488.50	0.00*	24.46	12.86	1.29	0.21	3083.00	0.09***
−4	339.30	208.06	4.57	0.00*	21,469.00	0.00*	10.00	13.91	−1.27	0.21	3671.50	0.86
−3	345.75	197.42	4.50	0.00*	20,871.50	0.00*	21.10	11.45	1.45	0.15	4595.00	0.03**
−2	369.58	189.47	5.21	0.00*	21,659.00	0.00*	21.78	15.70	0.89	0.38	4099.50	0.05***
−1	529.91	188.87	3.80	0.00*	23,010.50	0.00*	37.97	13.72	1.76	0.09***	4685.00	0.07***
0	6255.46	227.09	9.77	0.00*	27,481.00	0.00*	157.38	31.74	5.32	0.00*	9891.00	0.00*
1	3376.18	218.33	7.98	0.00*	27,454.00	0.00*	88.32	15.82	5.13	0.00*	8076.50	0.00*
2	2097.18	203.47	9.35	0.00*	27,042.50	0.00*	68.46	14.41	3.61	0.00*	8581.50	0.00*
3	1821.09	204.39	9.49	0.00*	26,092.00	0.00*	67.24	14.35	5.08	0.00*	8439.50	0.00*
4	1685.87	184.26	7.94	0.00*	26,623.50	0.00*	46.19	12.80	3.29	0.00*	7907.50	0.00*
5	1640.72	210.11	7.35	0.00*	25,916.00	0.00*	49.08	10.56	4.00	0.00*	7817.50	0.00*
10	1191.61	199.31	5.39	0.00*	25,340.00	0.00*	46.70	13.46	3.25	0.00*	6824.50	0.00*
15	856.70	185.62	7.71	0.00*	24,458.00	0.00*	27.55	11.47	2.46	0.02**	5452.50	0.00*
20	754.25	190.82	5.45	0.00*	22,644.50	0.00*	24.49	17.52	1.20	0.23	5159.50	0.13
25	497.13	191.80	5.57	0.00*	21,704.50	0.00*	28.79	11.56	1.44	0.16	4799.00	0.05***
30	582.22	209.33	4.09	0.00*	21,474.50	0.00*	27.25	12.71	2.26	0.03**	5797.00	0.00*
35	486.18	167.00	5.22	0.00*	20,941.00	0.00*	27.51	10.34	2.44	0.02**	4702.00	0.01*
40	402.25	170.08	3.37	0.00*	19,747.50	0.00*	19.90	15.32	0.98	0.33	4214.50	0.11
45	362.30	193.94	2.93	0.00*	19,049.50	0.00*	27.61	15.23	1.92	0.06***	4980.00	0.05**
50	319.45	186.82	2.64	0.01**	18,887.00	0.00*	13.31	12.50	0.28	0.78	4509.00	0.09***
55	247.36	167.42	2.02	0.05**	18,250.50	0.00*	13.22	14.94	−0.45	0.65	3977.00	0.52
60	291.31	173.53	2.89	0.01*	18,008.00	0.00*	32.74	33.23	−0.06	0.95	5056.50	0.22

Abbreviations: B3, Brazilian exchange; CME, Chicago Mercantile Exchange; WASDE, World Agricultural Supply and Demand Estimates.
[a]Volume expressed in billion contracts.
*Significant at the 1% level
**Significant at the 5% level
***Significant at the 10% level.

TABLE 10 | Intraday announcement effect test for corn futures volume to the release of CONAB reports.

	CME group						B3					
Minute marker	Mean volume (CONAB report day)[a]	Mean volume (CONAB nonreport day)[a]	*t* statistics (CONAB)	*p* value	*W* statistics (CONAB)	*p* value	Mean volume (CONAB report day)[a]	Mean volume (CONAB nonreport day)[a]	*t* statistics (CONAB)	*p* value	*W* statistics (CONAB)	*p* value
−15	30.62	36.56	−0.74	0.46	9882.00	0.22						
−10	39.84	42.07	−0.20	0.84	8149.50	0.20						
−5	27.46	36.05	−1.15	0.25	8703.50	0.76						
−4	39.96	47.32	−0.71	0.48	9296.50	0.86						
−3	24.33	39.93	−2.41	0.02**	7767.00	0.07***						
−2	38.95	34.30	0.41	0.68	9075.00	0.72						
−1	28.03	42.60	−1.97	0.05***	9119.50	0.23						
0	75.37	53.84	1.16	0.25	12,088.50	0.12	36.39	40.66	−0.72	0.47	7229.50	0.53
1	75.29	53.00	0.89	0.38	11,839.00	0.24	38.96	42.75	−0.53	0.60	6466.50	0.67
2	47.36	50.98	−0.33	0.74	10,340.50	0.67	33.48	35.31	−0.23	0.82	5875.00	0.08***
3	60.21	48.85	0.82	0.41	11,931.00	0.15	28.96	33.60	−0.84	0.40	6974.50	0.62
4	45.46	57.55	−0.98	0.33	10,968.50	0.73	27.23	26.86	0.08	0.94	7358.00	0.84
5	67.23	55.91	0.77	0.44	12,280.50	0.25	21.38	28.85	−2.08	0.04**	6856.00	0.82
10	58.37	48.59	0.69	0.49	10,636.00	0.79	18.80	19.44	−0.17	0.87	6043.00	0.96
15	45.86	47.29	−0.16	0.87	10,624.50	0.54	12.14	20.81	−3.16	0.00*	4793.50	0.13
20	56.37	60.08	−0.29	0.77	9933.50	0.91	17.00	20.16	−0.83	0.41	5482.50	0.79
25	54.56	54.14	0.03	0.97	10,478.50	0.96	15.26	20.05	−1.30	0.20	4606.00	0.48
30	72.07	80.22	−0.46	0.65	11,145.50	0.39	30.44	22.66	0.63	0.53	4158.00	0.30
35	67.05	65.10	0.15	0.88	11,936.00	0.46	17.32	16.40	0.21	0.83	3795.00	0.84
40	73.07	60.37	0.79	0.43	12,058.50	0.04**	19.36	18.25	0.19	0.85	4536.50	0.47
45	50.37	41.19	0.44	0.66	1244.50	0.96	15.00	15.72	−0.14	0.89	3507.00	0.67
50	50.95	45.38	0.45	0.66	1593.50	0.15	12.65	14.16	−0.42	0.68	3388.50	0.58
55	51.86	51.33	0.02	0.99	1176.50	0.34	16.19	13.54	0.58	0.57	4150.50	0.93
60	55.52	61.20	−0.37	0.71	1612.50	0.95	55.37	38.00	0.94	0.35	5089.00	0.63

Abbreviations: B3, Brazilian exchange; CME, Chicago Mercantile Exchange; CONAB, Brazilian Food Supply Company.
[a]Volume expressed in billion contracts.
*Significant at the 1% level
**Significant at the 5% level
***Significant at the 10% level.

30% higher at the time of the CONAB report release. A significant variability followed from $t+0$ through $t+60$, with 34% of calculated volatilities on report days being lower than those from nonreport days. One minute after the CONAB report was released, the average return volatility was only 1% higher than the average on nonreport days in the CME Group market. After 2 min of the announcement, average volatilities calculated on report days became 12% lower than on nonannouncement days. CME average volatility during CONAB report days reached its peak 44 min after the report release and then dropped approximately by half afterward. The lowest volatility during the report day occurred 53 min after the report was released.

In the B3 market, our results should be interpreted with caution, as the release of the CONAB report coincides with the opening of the trading session, which is also a time when volatility is already typically higher in futures markets. Return volatility reached its peak during the first minute of trade, a pattern observed on both the CONAB report and nonreport days. During the following minute, the standard deviation declined sharply by 47% on CONAB report days and by 57% on nonreport days. After approximately 10 min, volatility generally settled within a 0.08% to 0.12% range. Notably, in 70% of the period following the release of the CONAB report, return volatility in the B3 market was lower on report days compared with nonreport days.

Test results for volume are reported in Tables 9 and 10. In both markets (CME Group and B3), mean trade volumes were especially higher in the minutes following the release of the WASDE reports compared with mean volumes on days when no WASDE report was released, with the difference being statistically distinguishable from zero (Table 9 and Figures 7 and 8). Trading volume on report days was, on average, higher than on nonreport days throughout the entire 75-min analysis window. This effect was particularly pronounced in the CME Group market. In the B3 market, the difference was less evident before the WASDE announcement (between $t-15$ and $t-9$) and after 15 min of the announcement.

Appendix 7 presents the test results comparing trade volume between days when only WASDE reports were released and days without any reports. Overall, all results show that volume on WASDE days was significantly higher than on days without WASDE reports in both markets (CME Group and B3).

When analyzing the impact of the CONAB report on trading volume, we could not reject the null hypothesis of no difference in average volumes on the report and nonreport days for most periods (Table 10 and Figures 9 and 10). Similar findings were found when we compared trading volume between CONAB-only report days and nonreport days (Appendix 5). These results

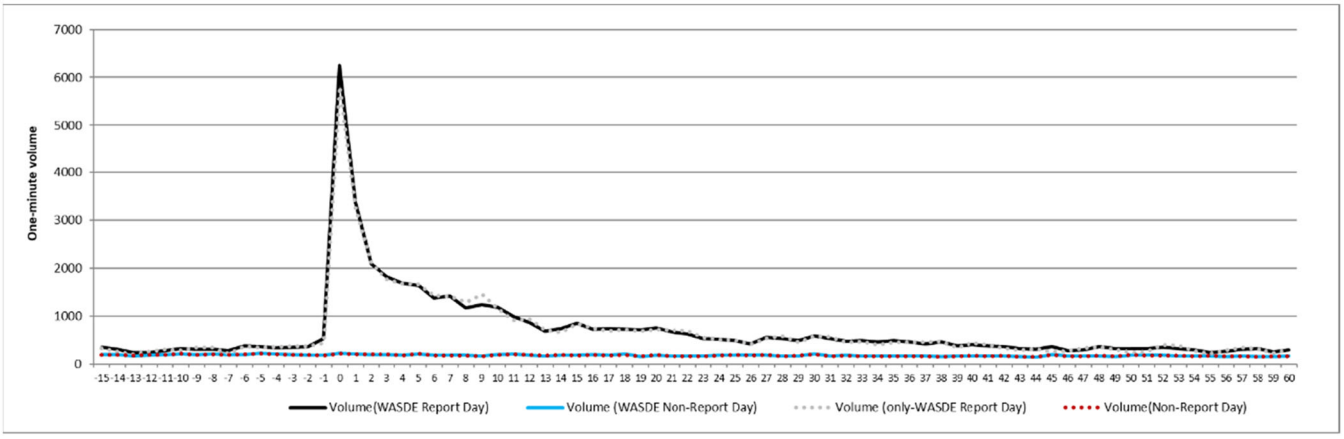

FIGURE 7 | CME Group mean volume during WASDE report days and nonreport days. CME, Chicago Mercantile Exchange; WASDE, World Agricultural Supply and Demand Estimates.

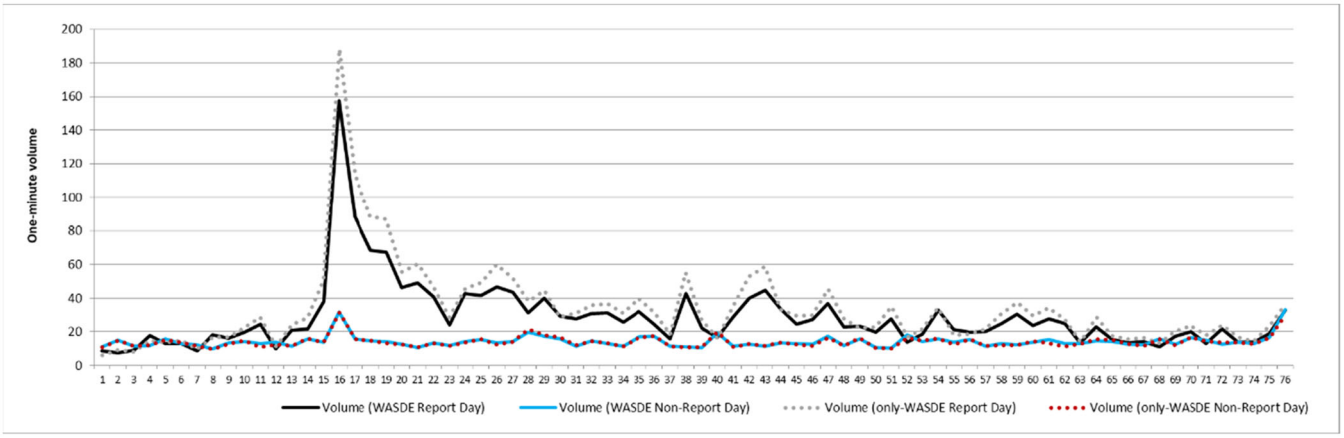

FIGURE 8 | B3 mean volume during WASDE report days and nonreport days. B3, Brazilian exchange; WASDE, World Agricultural Supply and Demand Estimates.

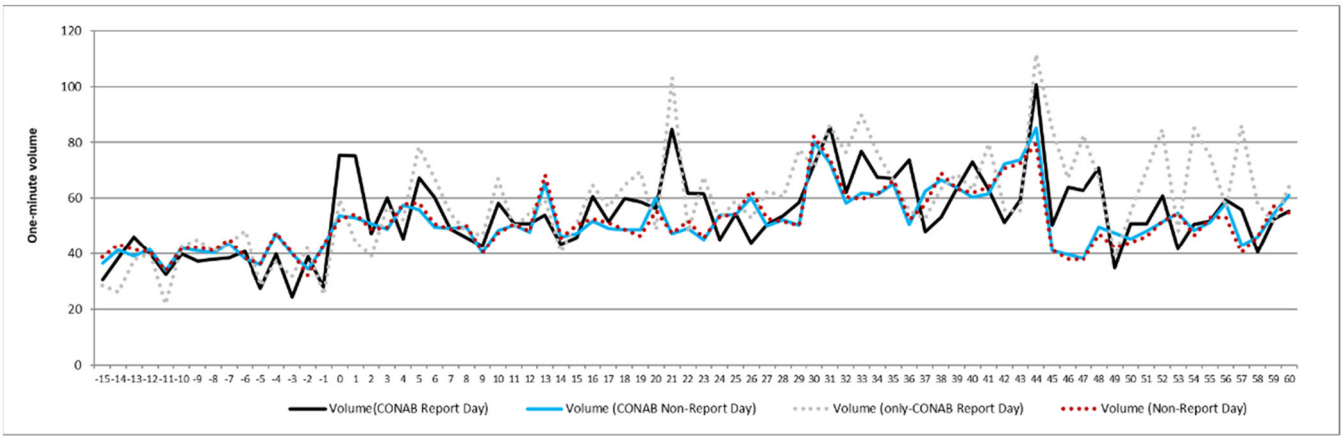

FIGURE 9 | CME Group mean volume during CONAB report days and nonreport days. CME, Chicago Mercantile Exchange; CONAB, Brazilian Food Supply Company.

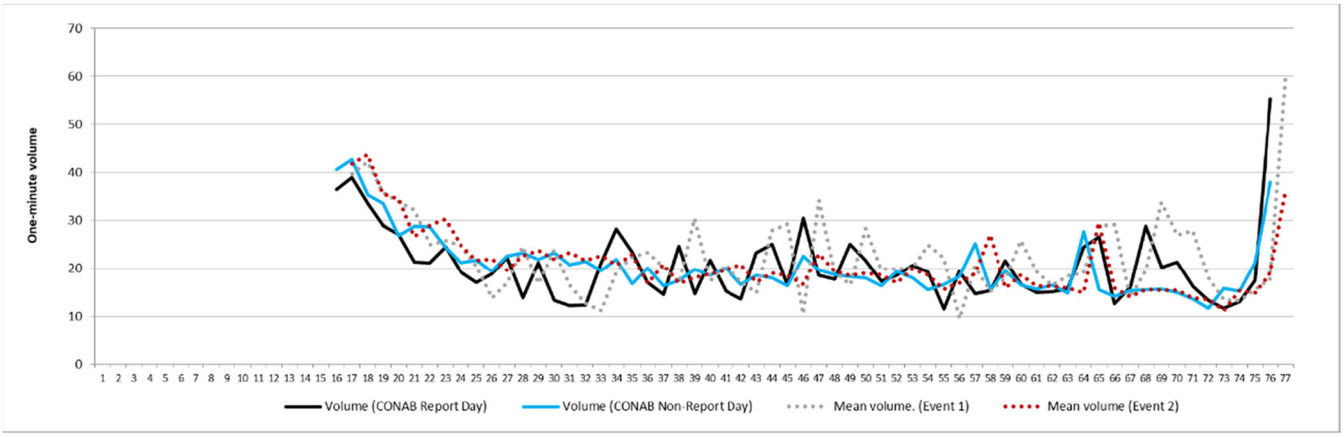

FIGURE 10 | B3 mean volume during CONAB report days and nonreport days. B3, Brazilian exchange; CONAB, Brazilian Food Supply Company.

suggest a minor reaction of market liquidity to the announcement of CONAB reports.

5 | Conclusions

This study investigates the impact of new public information using intraday futures prices and volumes in the CME Group and B3 corn futures market. Price and volume reactions to the release of the WASDE and CONAB crop reports were evaluated between April 2018 and April 2024. To the best of our knowledge, this is the first study that explores price and volume reactions to grain report announcements from different countries (the United statistics and Brazil) using intraday data.

Findings show the importance of WASDE and CONAB reports in providing new information to grain markets. During both report days, return volatilities were, in general, higher than the return variability observed in nonreport days. Trading volume was also higher when WASDE reports were released, but not nearly as much on CONAB report days. Moreover, during WASDE report days, return volatility and trading volume in both the CME and B3 markets were statistically higher than on days of CONAB reports.

Our findings were supported and confirmed by additional analysis. For every minute (from 15 min before through 60 min after the report release), price returns and volumes on report days (WASDE and CONAB) were compared with five nonreport days before and after the announcements. Parametric and nonparametric tests were used to investigate the difference in return volatility and trading volume for report and nonreport days. In general, results show a strong effect of the WASDE report release on intraday corn futures prices and volumes in both the CME and B3 markets. During days of CONAB reports, return volatility reactions were less frequent and generally of smaller magnitude compared with those in days of WASDE reports.

Our results are consistent with previous findings that WASDE reports have a significant impact on futures prices and trading volume in the corn market. On the other hand, CONAB reports do not seem to have nearly as much impact on corn futures prices and volume in the two exchanges. Despite the increasing importance of Brazilian corn production in the world market, futures market participants appear to still pay less attention to CONAB reports relative to WASDE reports. One possible explanation is that future market participants were satisfied with the information about Brazilian crops in the WASDE report during our sample period. Another hypothesis is that there can be different impacts of

CONAB reports during the year. Since in Brazil farmers are able to grow three corn crops in a marketing year, traders may pay more attention to CONAB reports that bring information about the largest of the three crops, which is harvested between June and August—the second corn crop (winter corn crop). We suggest that future research could investigate this topic and explore whether futures prices are impacted differently throughout the marketing year by CONAB and WASDE reports.

Author Contributions

All authors contributed equally to the conception, design, data collection, analysis, interpretation of results, and writing of the manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Endnotes

[1]The growth of Brazilian corn production is partly explained by its capacity to harvest three crops per year. The first corn ("summer crop") is harvested throughout the country from late January to April. The second crop ("winter crop") is mostly harvested in the central-west and southeast regions from June to August. The winter crop increased from 0.30 billion bushels in 2004–2005 to 4.03 billion bushels in 2022–2023 and represented about 77.6% of Brazilian total production (CONAB 2023). At last, the production of the third crop is more recent and smaller (less than 2% of the total crop in 2022–2023) and harvested mostly in northeastern Brazil between October and December.

[2]Previous studies found evidence that market participants in the corn futures market adjust their positions during this interval (Kauffman 2013; Joseph and Garcia 2018). Kauffman (2013) indicated that, in general, the impact on volatility is observed 30 to 60 min after the USDA announcement.

[3]When the release time is 5:00 a.m. or 6:00 a.m. because of daylight saving time, the intervals are 4:46–6:00 a.m. and 5:46–7:00 a.m., respectively.

[4]When the release time turned is 2:00 p.m. or 3:00 p.m. because of daylight saving time, the intervals are 1:46–3:00 p.m. and 2:46–4:00 p.m., respectively.

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Appendix 1

Brazilian Corn Production: USDA Versus CONAB (in Billion Bushels)

See Figure A1.

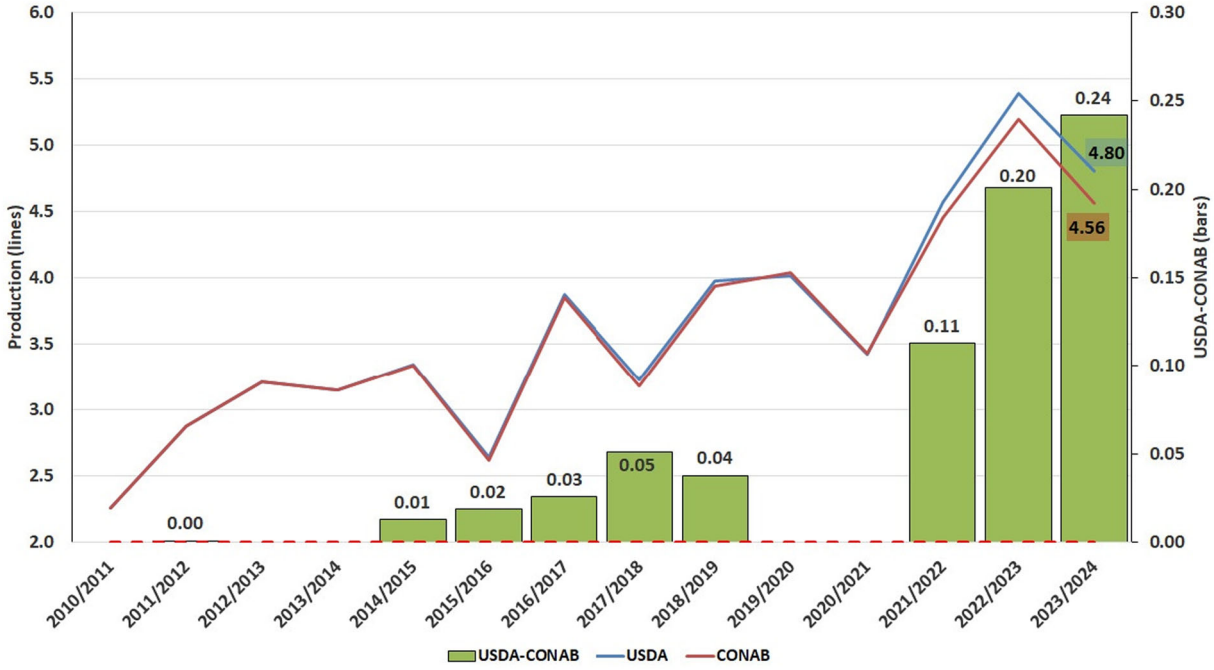

FIGURE A1 | The columns in green: USDA - CONAB. The blue line: USDA. The red line: CONAB. *Source:* USDA (2023) and CONAB (2023). CONAB, Brazilian Food Supply Company; USDA, US Department of Agriculture.

Appendix 2

Report Release Dates Between April 2018 and April 2024

Year	WASDE report release date	CONAB report release date
2018	January 12, February 8, March 8, April 10, May 10, June 12, July 12, August 10, September 12, October 11, November 8, and December 11.	April 11, May 10, June 12, July 10, August 9, September 11, October 11, November 9, and December 11.
2019	January 11, February 8, March 8, April 9, May 10, June 11, July 11, August 12, September 12, October 10, November 8, December 10.	January 10, February 12, March 12, April 11, May 9, June 11, July 11, August 8, September 10, October 10, November 13, December 10.
2020	January 10, February 11, March 10, April 9, May 12, June 11, July 10, August 12, September 11, October 9, November 10, December 10.	January 8, February 11, March 10, April 9, May 12, June 9, July 8, August 11, September 10, October 8, November 10, December 10.
2021	January 12, February 9, March 9, April 9, May 12, June 10, July 12, August 12, September 10, October 12, November 9, December 9.	January 13, February 11, March 11, April 8, May 12, June 10, July 8, August 10, September 9, December 9.
2022	January 12, February 9, March 9, April 8, May 12, June 10, July 12, August 12, September 12, October 12, November 9, December 9.	January 11, February 10, March 10, April 7, May 12, June 30, July 1st, July 7, August 11, September 8, October 6, November 9, December 8.
2023	January 12, February 8, March 9, April 11, May 12, June 9, July 12, August 11, September 12, October 12, November 9, December 8.	January 12, February 8, March 9, April 13, May 11, June 13, July 13, August 10, September 6, October 10, November 9, December 7.
2024	January 12, February 8, March 8, April 11.	January 10, February 8, March 12, April 11.

Abbreviations: CONAB, Brazilian Food Supply Company; WASDE, World Agricultural Supply and Demand Estimates.

Appendix 3

Intraday Announcement Effect Test for Corn Futures Return Volatility to the Release of Only WASDE Reports

	CME group						B3					
Minute marker	Mean returns (WASDE report day)	Mean returns (WASDE nonreport day)	SD (WASDE report day)	SD (WASDE nonreport day)	*F* statistics (WASDE)	*p* value	Mean returns (WASDE report day)	Mean returns (WASDE nonreport day)	SD (WASDE report day)	SD (WASDE nonreport day)	*F* statistics (WASDE)	*p* value
−15	0.01	0.00	0.06	0.07	1.27	0.00*	0.00	0.00	0.03	0.08	6.83	0.00*
−10	0.00	0.00	0.07	0.09	1.54	0.00*	−0.03	0.00	0.09	0.08	1.44	0.00*
−5	−0.01	0.01	0.10	0.08	1.56	0.00*	0.00	0.01	0.08	0.06	1.75	0.00*
−4	−0.01	0.00	0.10	0.07	2.04	0.00*	−0.01	0.00	0.06	0.07	1.64	0.00*
−3	0.01	0.00	0.08	0.07	1.40	0.00*	0.01	0.00	0.09	0.07	1.94	0.00*
−2	0.02	0.00	0.10	0.07	2.11	0.00*	−0.01	0.00	0.11	0.07	2.45	0.00*
−1	0.02	0.01	0.14	0.07	4.30	0.00*	−0.01	0.00	0.15	0.07	5.05	0.00*
0	−0.14	−0.01	13.81	0.07	374.95	0.00*	−0.18	0.00	0.64	0.09	53.20	0.00*
1	−0.12	0.00	0.47	0.07	47.16	0.00*	−0.04	0.00	0.34	0.07	24.29	0.00*
2	0.10	0.00	0.42	0.07	36.37	0.00*	−0.06	0.00	0.30	0.08	14.77	0.00*
3	0.08	0.00	0.29	0.07	17.27	0.00*	−0.03	−0.01	0.23	0.06	13.97	0.00*
4	0.03	0.00	0.32	0.07	21.34	0.00*	0.02	0.00	0.16	0.07	4.80	0.00*
5	0.05	0.00	0.27	0.07	14.94	0.00*	0.02	0.01	0.13	0.07	3.83	0.00*
10	0.03	0.00	0.21	0.07	8.87	0.00*	0.04	0.00	0.18	0.06	10.26	0.00*
15	−0.01	0.00	0.16	0.07	4.51	0.00*	0.00	0.01	0.10	0.07	2.48	0.00*
20	0.04	0.00	0.14	0.07	3.58	0.00*	0.02	0.00	0.11	0.09	1.33	0.00*
25	−0.03	−0.01	0.12	0.07	3.39	0.00*	0.00	0.00	0.08	0.07	1.27	0.00*
30	0.01	0.01	0.12	0.07	3.35	0.00*	0.00	0.00	0.07	0.07	1.15	0.00*
35	0.01	0.00	0.09	0.06	2.46	0.00*	0.01	0.00	0.09	0.07	1.50	0.00*
40	−0.02	0.00	0.12	0.07	3.18	0.00*	0.01	−0.01	0.09	0.09	1.14	0.00*
45	−0.02	0.00	0.11	0.07	2.08	0.00*	−0.03	0.01	0.10	0.06	2.36	0.00*
50	−0.01	0.00	0.08	0.06	1.64	0.00*	0.02	0.00	0.09	0.10	1.31	0.00*
55	0.01	0.00	0.08	0.06	2.04	0.00*	0.00	0.00	0.07	0.12	2.82	0.00*
60	0.00	0.00	0.09	0.06	2.39	0.00*	−0.01	0.00	0.07	0.09	1.86	0.00*

Abbreviations: B3, Brazilian exchange; CME, Chicago Mercantile Exchange; WASDE, World Agricultural Supply and Demand Estimates.
*Significant at the 1% level; **significant at the 5% level; ***significant at the 10% level.

Appendix 4

Intraday Announcement Effect Test for Corn Futures Return Volatility to the Release of Only CONAB Reports

	CME group						B3					
Minute marker	Mean returns (CONAB report day)	Mean returns (CONAB nonreport day)	SD (CONAB report day)	SD (CONAB nonreport day)	*F* statistics (CONAB)	*p* value	Mean returns (CONAB report day)	Mean returns (CONAB nonreport day)	SD (CONAB report day)	SD (CONAB nonreport day)	*F* statistics (CONAB)	*p* value
−15	0.00	0.00	0.05	0.05	1.39	0.00*						
−10	−0.01	0.00	0.06	0.05	1.40	0.00*						
−5	0.01	0.00	0.05	0.05	1.19	0.00*						
−4	0.01	0.00	0.05	0.05	1.02	0.09***						
−3	0.02	−0.01	0.05	0.06	1.28	0.00*						
−2	−0.02	0.00	0.05	0.05	1.04	0.00*						
−1	0.01	0.00	0.05	0.05	1.17	0.00*						
0	0.01	0.00	0.07	0.05	1.65	0.00*	0.11	0.02	0.52	0.72	1.93	0.00*
1	0.01	0.00	0.06	0.06	1.14	0.00*	0.02	0.04	0.28	0.30	1.19	0.00*
2	0.00	0.00	0.05	0.05	1.15	0.00*	−0.04	0.02	0.20	0.25	1.65	0.00*
3	0.00	0.00	0.06	0.05	1.27	0.00*	0.03	0.02	0.16	0.24	2.15	0.00*
4	0.00	0.00	0.06	0.06	1.10	0.00*	−0.01	−0.01	0.15	0.20	1.78	0.00*
5	0.00	0.00	0.06	0.06	1.27	0.00*	−0.01	0.00	0.12	0.15	1.45	0.00*
10	0.00	0.00	0.06	0.06	1.14	0.00*	0.01	0.01	0.10	0.14	1.93	0.00*
15	−0.01	0.00	0.09	0.06	2.25	0.00*	0.00	0.00	0.09	0.14	2.13	0.00*
20	0.01	0.00	0.04	0.05	1.61	0.00*	0.03	0.00	0.11	0.10	1.20	0.00*
25	−0.01	0.00	0.06	0.06	1.08	0.00*	−0.01	0.00	0.10	0.10	1.10	0.00*
30	−0.01	−0.01	0.08	0.07	1.05	0.00*	0.02	0.00	0.09	0.10	1.11	0.00*
35	−0.01	0.00	0.06	0.06	1.15	0.00*	−0.02	−0.01	0.07	0.09	1.93	0.00*
40	−0.01	0.01	0.06	0.06	1.09	0.00*	−0.03	0.00	0.07	0.10	1.93	0.00*
45	−0.02	0.00	0.07	0.06	1.33	0.00*	0.01	0.01	0.08	0.09	1.14	0.00*
50	0.00	0.00	0.05	0.05	1.17	0.00*	0.01	0.00	0.06	0.10	3.03	0.00*
55	−0.01	−0.01	0.06	0.05	1.78	0.00*	−0.01	0.00	0.08	0.09	1.19	0.00*
60	0.00	0.00	0.07	0.05	2.23	0.00*	0.02	0.01	0.15	0.17	1.32	0.00*

Abbreviations: B3, Brazilian exchange; CME, Chicago Mercantile Exchange; CONAB, Brazilian Food Supply Company.
*Significant at the 1% level; **significant at the 5% level; ***significant at the 10% level.

Appendix 5

Intraday Announcement Effect Test for Corn Futures Absolute Returns to the Release of Only WASDE Reports

	CME group				B3			
Minute marker	AAD (WASDE report day)	AAD (WASDE nonreport day)	χ^2 (WASDE)	*p* value	AAD (WASDE report day)	AAD (WASDE nonreport day)	χ^2 (WASDE)	*p* value
−15	0.05	0.05	1.66	0.20	0.02	0.04	2.04	0.15
−10	0.05	0.05	1.87	0.17	0.05	0.05	1.10	0.30
−5	0.07	0.05	3.52	0.06***	0.07	0.04	9.61	0.00
−4	0.08	0.05	10.09	0.00*	0.04	0.04	1.58	0.21
−3	0.05	0.05	1.03	0.31	0.07	0.04	13.32	0.00*
−2	0.08	0.05	11.14	0.00*	0.07	0.05	0.39	0.53
−1	0.11	0.05	20.60	0.00*	0.10	0.04	10.13	0.00*
0	0.86	0.05	67.75	0.00*	0.33	0.06	35.53	0.00*
1	0.32	0.05	67.20	0.00*	0.20	0.04	32.96	0.00*
2	0.30	0.05	60.49	0.00*	0.17	0.05	22.36	0.00*
3	0.22	0.05	62.05	0.00*	0.14	0.04	18.25	0.00*
4	0.24	0.04	77.38	0.00*	0.11	0.04	20.67	0.00*
5	0.19	0.05	44.73	0.00*	0.09	0.04	9.41	0.00*
10	0.16	0.05	48.19	0.00*	0.13	0.04	31.21	0.00*
15	0.12	0.05	26.86	0.00*	0.07	0.04	4.99	0.03**
20	0.10	0.04	22.00	0.00*	0.08	0.06	3.76	0.05***
25	0.09	0.05	15.10	0.00*	0.06	0.04	2.32	0.13
30	0.09	0.04	25.46	0.00*	0.05	0.04	1.88	0.17
35	0.06	0.04	3.96	0.05**	0.07	0.05	6.58	0.01**
40	0.08	0.04	15.19	0.00*	0.07	0.05	2.84	0.09***
45	0.07	0.05	1.99	0.16	0.06	0.04	2.39	0.12
50	0.06	0.05	1.56	0.21	0.06	0.05	0.54	0.46
55	0.06	0.04	8.52	0.00**	0.04	0.05	0.10	0.75
60	0.06	0.04	0.21	0.65	0.05	0.06	0.01	0.91

Abbreviations: AAD, average absolute deviation; B3, Brazilian exchange; CME, Chicago Mercantile Exchange; WASDE, World Agricultural Supply and Demand Estimates.
*Significant at the 1% level; **significant at the 5% level; ***significant at the 10% level.

Appendix 6

Intraday Announcement Effect Test for Corn Futures Absolute Returns to the Release of Only CONAB Reports

Minute marker	CME group				B3			
	AAD (CONAB report day)	AAD (CONAB nonreport day)	χ^2 (CONAB)	*p* value	AAD (CONAB report day)	AAD (CONAB nonreport day)	χ^2 (CONAB)	*p* value
−15	0.03	0.03	0.05	0.83				
−10	0.03	0.03	0.07	0.79				
−5	0.03	0.03	0.09	0.77				
−4	0.04	0.03	0.33	0.57				
−3	0.03	0.04	0.75	0.39				
−2	0.03	0.03	0.98	0.32				
−1	0.03	0.03	0.05	0.82				
0	0.05	0.03	5.11	0.02**	0.38	0.48	1.00	0.32
1	0.04	0.04	0.30	0.58	0.20	0.21	0.04	0.83
2	0.03	0.03	0.10	0.75	0.15	0.17	0.71	0.40
3	0.04	0.03	1.50	0.22	0.12	0.15	0.38	0.54
4	0.04	0.04	0.01	0.93	0.10	0.13	2.23	0.14
5	0.04	0.04	0.63	0.43	0.09	0.10	0.01	0.92
10	0.04	0.04	0.35	0.56	0.07	0.09	0.28	0.60
15	0.06	0.04	1.72	0.19	0.07	0.09	0.40	0.53
20	0.03	0.04	0.59	0.44	0.08	0.07	0.62	0.43
25	0.04	0.04	0.52	0.47	0.07	0.07	0.04	0.84
30	0.05	0.05	0.01	0.92	0.07	0.07	0.18	0.68
35	0.05	0.04	0.56	0.46	0.05	0.06	0.15	0.70
40	0.04	0.04	0.59	0.44	0.05	0.06	1.20	0.27
45	0.06	0.04	4.88	0.03**	0.06	0.05	2.38	0.12
50	0.04	0.03	1.17	0.28	0.04	0.06	0.08	0.78
55	0.04	0.03	0.05	0.82	0.05	0.06	1.35	0.24
60	0.05	0.03	3.39	0.07***	0.09	0.10	0.42	0.52

Abbreviations: AAD, average absolute deviation; B3, Brazilian exchange; CME, Chicago Mercantile Exchange; CONAB, Brazilian Food Supply Company.
*Significant at the 1% level; **significant at the 5% level; ***significant at the 10% level.

Appendix 7

Intraday Announcement Effect Test for Corn Futures Volume to the Release of Only WASDE Reports

	CME group						B3					
Minute marker	Mean volume (WASDE report day)[a]	Mean volume (WASDE nonreport day)[a]	*t* statistics (WASDE)	*p* value	*W* statistics (WASDE)	*p* value	Mean volume (WASDE report day)[a]	Mean volume (WASDE nonreport day)[a]	*t* statistics (WASDE)	*p* value	*W* statistics (WASDE)	*p* value
−15	333.25	195.21	1.82	0.08***	10,936.00	0.00*	6.04	10.78	−2.38	0.02**	1658.50	0.05**
−10	291.43	213.75	1.67	0.10	10,558.00	0.00*	14.81	13.76	0.24	0.81	1954.00	0.60
−5	343.82	226.07	2.64	0.01**	11,729.00	0.00*	28.78	10.71	1.71	0.10	2490.00	0.02**
−4	357.34	203.14	4.26	0.00*	12,797.00	0.00*	11.07	12.24	−0.36	0.72	2621.00	0.39
−3	373.82	197.10	3.92	0.00*	12,253.00	0.00*	24.14	11.52	1.44	0.16	3078.50	0.03**
−2	370.77	189.69	4.03	0.00*	12,624.50	0.00*	28.17	16.07	1.26	0.22	2692.50	0.01*
−1	439.25	185.23	4.37	0.00*	13,325.00	0.00*	50.50	13.62	1.88	0.07***	2975.00	0.04**
0	5808.98	220.94	7.52	0.00*	16,358.00	0.00*	188.16	31.39	4.93	0.00*	5979.50	0.00*
1	3231.55	212.72	6.18	0.00*	16,244.00	0.00*	113.18	15.58	5.18	0.00*	5280.00	0.00*
2	2103.07	199.68	7.25	0.00*	15,971.50	0.00*	88.54	14.84	3.46	0.00*	5593.50	0.00*
3	1775.00	200.69	7.16	0.00*	15,316.00	0.00*	86.97	13.04	5.30	0.00*	5353.50	0.00*
4	1674.45	182.49	6.12	0.00*	15,575.00	0.00*	55.76	12.62	3.13	0.00*	5211.00	0.00*
5	1672.05	216.81	6.29	0.00*	15,192.50	0.00*	60.28	10.72	3.74	0.00*	5052.00	0.00*
10	1172.57	192.17	4.69	0.00*	15,223.00	0.00*	59.90	12.49	3.52	0.00*	4591.50	0.00*
15	845.09	184.97	6.00	0.00*	14,350.00	0.00*	31.12	11.90	2.29	0.03**	3623.00	0.02**
20	727.64	190.01	4.39	0.00*	12,900.50	0.00*	31.63	17.73	1.77	0.09***	3264.50	0.07***
25	503.86	188.49	4.38	0.00*	12,745.50	0.00*	35.87	11.02	1.55	0.13	3381.50	0.01**
30	577.39	203.72	3.34	0.00*	12,790.00	0.00*	29.72	11.81	2.14	0.04**	3694.00	0.00*
35	457.89	165.50	4.63	0.00*	12,419.50	0.00*	35.04	10.08	2.51	0.02**	2987.50	0.00*
40	438.95	174.34	2.80	0.01**	11,818.50	0.00*	18.75	15.47	0.61	0.55	2626.00	0.20
45	266.39	194.02	1.44	0.15	10,725.00	0.00*	34.15	13.07	2.44	0.02**	3024.50	0.02**
50	254.52	189.13	1.56	0.12	10,163.00	0.01**	15.58	13.01	0.71	0.48	2848.50	0.02**
55	218.32	172.01	1.01	0.32	10,414.00	0.00*	17.88	14.45	0.67	0.51	2750.00	0.52
60	308.68	168.46	2.49	0.02**	10,350.50	0.01*	36.76	30.10	0.63	0.53	3434.00	0.18

Abbreviations: B3, Brazilian exchange; CME, Chicago Mercantile Exchange; WASDE, World Agricultural Supply and Demand Estimates.
[a]Volume expressed in billion contracts.
*Significant at the 1% level; **significant at the 5% level; ***significant at the 10% level.

Appendix 8

Intraday Announcement Effect Test for Corn Futures Volume to the Release of Only CONAB Reports

	CME group						B3					
Minute marker	Mean volume (CONAB report day)[a]	Mean volume (CONAB nonreport day)[a]	*t* statistics (CONAB)	*p* value	*W* statistics (CONAB)	*p* value	Mean volume (CONAB report day)[a]	Mean volume (CONAB nonreport day)[a]	*t* statistics (CONAB)	*p* value	*W* statistics (CONAB)	*p* value
−15	28.51	38.85	−1.29	0.20	6195.00	0.35						
−10	42.74	41.83	0.06	0.95	4856.50	0.31						
−5	28.53	36.48	−0.77	0.45	4699.50	0.55						
−4	37.08	47.54	−0.84	0.40	5279.00	0.72						
−3	31.67	40.56	−1.10	0.27	5358.50	0.84						
−2	42.38	32.04	0.71	0.48	5906.50	0.98						
−1	25.17	43.48	−2.34	0.02**	5677.00	0.30						
0	59.64	52.50	0.43	0.67	7204.00	0.22	39.74	41.82	−0.29	0.78	4775.00	0.98
1	44.00	54.30	−1.02	0.31	6894.00	0.28	42.20	43.74	−0.20	0.84	4508.00	0.59
2	39.36	48.84	−0.95	0.35	6170.00	0.91	35.77	35.61	0.02	0.99	4096.00	0.09***
3	56.69	49.57	0.48	0.63	7098.50	0.27	33.84	34.44	−0.09	0.93	4668.00	0.18
4	52.17	58.03	−0.37	0.72	6936.50	0.31	32.28	26.67	0.96	0.34	5480.00	0.42
5	78.47	58.41	0.98	0.33	7190.50	0.49	24.97	29.10	−0.96	0.34	4826.50	0.43
10	67.00	47.49	1.00	0.32	6567.50	0.65	16.94	19.65	−0.76	0.45	4002.50	0.86
15	51.13	50.45	0.06	0.95	6469.00	0.26	12.63	21.71	−2.76	0.01**	3111.50	0.14
20	48.83	55.63	−0.67	0.51	6361.50	0.58	20.35	20.92	−0.12	0.91	4101.50	0.50
25	59.15	54.41	0.27	0.79	6675.00	0.51	17.23	20.81	−0.82	0.42	3268.00	0.94
30	70.98	82.27	−0.53	0.60	7110.50	0.34	34.18	23.14	0.66	0.52	2611.00	0.27
35	66.19	66.57	−0.03	0.98	7231.50	0.54	19.96	16.93	0.58	0.57	2772.00	0.74
40	63.05	62.03	0.08	0.94	7772.50	0.05***	20.45	18.99	0.20	0.84	2995.50	0.99
45	85.10	41.54	1.24	0.24	742.50	0.16	16.48	16.36	0.02	0.98	2504.50	0.65
50	54.92	44.18	0.73	0.48	969.00	0.14	13.92	14.04	−0.03	0.98	2431.50	0.51
55	75.15	53.26	0.45	0.66	678.50	0.59	18.00	13.55	0.75	0.46	2773.00	0.51
60	64.47	54.91	0.50	0.62	1019.50	0.31	60.84	36.52	1.02	0.31	3496.00	0.63

Abbreviations: B3, Brazilian exchange; CME, Chicago Mercantile Exchange; CONAB, Brazilian Food Supply Company.
[a]Volume expressed in billion contracts.
*Significant at the 1% level; **significant at the 5% level; ***significant at the 10% level.