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by

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Paper presented at the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management
St. Louis, Missouri, April 18-19, 2016

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The Effect of Pit Closure on Futures Trading

Motivated by CME's decision to close down most of the futures pits in July of 2015, we analyze the changes in a number of important CME futures markets between 2012 and 2016. We find that although futures pit trading has been diminished to very low levels, it has not completely disappeared. While we do not have evidence of futures pit traders transitioning to the electronic market, we see that some futures pit traders are still active in options pit markets. When we explore the changes in daily trading patterns, we observe a shift in the timing of trading hours for a few select markets. In terms of execution costs, we do not observe any definitive effect of the pit closures on execution costs for most commodities in the electronic market. However, effective spreads for random length lumber futures appear to increase around the time of the announcement of the pit closures. A similar effect is observed for trading strategies in treasury futures during the roll periods.

Keywords: futures markets, pit trading, execution costs

1. Introduction

With the widespread use of electronic trading, futures volume in floor trading has been steadily declining. On July 6th 2015[1], floor trading ceased on almost all CME futures pits[2]. The change, originally announced on February 4th 2015, was met with resistance by some floor traders[3]. Those specializing on treasury futures have been insisting that the pit allows them to execute complicated trading strategies during the quarterly roll, such as calendar spreads with tails; a functionality which has not been readily available on Globex. Similar concerns have also been raised by soybean brokers[4], who argue that CME's trading platforms do not allow trading in soy crush spreads with non-standard ratios.

The floor traders' resistance raises concerns over the transition of floor order flow to the electronic market, and consequently questions whether CME's decision to close the futures pits had an effect on market quality. The execution difficulty of non-standard trading strategies, often cited by pit traders as a reason to keep the pits open, may have prevented the transition of floor order flow to the electronic market even after the pits closed, resulting in lower liquidity for such trades and the overall market. At the same time, orders for non-standard trading strategies may have also been alternatively diverted to the upstairs market as block orders; such order flow migration could have started long before CME's decision to close the futures pits and as early as in October 2012, when

[1] Polansek, T. (2015, July 6th). Closing bell rings on Chicago futures pits for final time. *Reuters.* Retrieved on October 12th 2015 from http://www.reuters.com/article/2015/07/07/us-cme-group-futures-closure-end-idUSKCN0PG2BX20150707

[2] Only the S&P 500 futures pit remains open. Source: CME Group. (2015, June 6). Market Notice, SER-7416, Retrieved from http://www.cmegroup.com/tools-information/lookups/advisories/ser/SER-7416.html#pageNumber=1

[3] Polanskek, T. (2015, June 24th). CME traders push regulator to delay futures pit closure by 90 days. Reuters. Retrieved on October 12th 2015 from http://www.reuters.com/article/2015/06/24/cme-group-futures-closure-cftc-idUSL1N0ZA2DS20150624

[4] Stebbins C. (2015, July 23rd). CME fields complaints on soy crush spread after futures pits close. Retrieved on October 26th 2015 from http://www.reuters.com/article/2015/07/23/cmegroup-markets-meeting-idUSL1N1031ZH20150723

minimum block thresholds were substantially reduced. However, despite concerns from former floor traders, it is also possible that the transition of floor trading to the electronic market has been relatively smooth, resulting in lower execution costs, increased liquidity and improved price discovery. Since we do not observe a substantial increase in block trading for the contracts we focus our analysis on, we explore whether the transition to electronic trading has been smooth by examining the effect of the pit closures on execution costs.

The objective of this study is to analyze the ongoing decline in floor trading (compared to electronic) during the three and a half years preceding the shutdown of futures pits, to examine whether floor order flow migrated to the electronic market following CME's decision to close futures pits and to reveal any potential effects of CME's decision to close futures pits on market operation and market quality. More specifically, our main analysis is centered on the following questions:

i. How did the ratios of futures pit volumes to overall volume change between 2012 and 2016 for the contracts analyzed? Were changes significantly different for outright vs. strategy trades?
ii. How have market liquidity measures changed for the contract analyzed? Were changes in liquidity measures different for outright vs. strategy trades?
iii. How has the daily timing of trading (what the literature calls "main trading hours") changed with the closure of pits?
iv. What has happened to pit traders after the closure of pits?

While we set out to measure the effect of CME's decision to close futures pits on all of the futures markets, we are selective in terms of which contracts we analyze due to limited computing power resources. We consider futures contracts in various commodity classes, such as metals (copper grade 1, gold, silver), grains (corn, wheat, soybeans, rough rice), livestock (feeder cattle, live cattle, lean hogs), dairy (milk grade 3), lumber (random length lumber) and treasuries (5-year T-Note Futures, 10-year T-Note Futures) [5,6]. However, we focus our analysis to select contracts with substantial floor trading before the February 4th announcement regarding the closure of the futures pits: livestock (feeder cattle, live cattle, and lean hogs), grains (corn), treasuries (5-year T-Note Futures, 10 year T Note Futures) and random length lumber.

Our main findings are as follows. We find that within the last four years, livestock contracts (feeder cattle, live cattle and lean hog futures) and to a lesser extent grains (corn futures) seem to experience a gradual decline in the ratio of futures pit volume to total trading volume for each contract respectively. While no contract experiences a growth in these futures pit ratios, markets such as Treasury futures have a very cyclical pattern, indicating significant pit trading around roll dates. We also show that these patterns hold when we focus solely on strategies as well. While futures pit volume declines significantly after the pit closures, it does not disappear completely. These futures trades represent legs of trading strategies consisting of futures and options, which are still allowed to be executed at the pit.

[5] The US treasury futures market presents an interesting case for evaluating the value of floor trading, both because of the significant size of the treasury futures market and the increased pit trading activity during roll periods. Moreover, block trades for US treasury intra-commodity calendar spreads are not permitted. Therefore, with the closure of the physical trading floor, there are no other alternative trading venues beyond the electronic market (Globex).

[6] We left one of the most iconic CME futures contracts, E-mini, out of our list because CME left the pits for trading contracts based on the S&P 500 index open.

To examine liquidity, we estimate daily average effective spreads for electronic trades, which we decompose into temporary and permanent impact. Descriptive statistics of these measures indicate that effective spreads rise around the time of the announcement of the pit closure and the actual closing of the pits. However, since we have not yet performed any econometric analysis, it is unclear of whether these results are significant and whether they should be attributed to the pit closure. A strong effect is detected in the random length lumber futures market, where effective spreads rise around the time of the announcement of the pit closure. Moreover, effective spreads for the 10-year Treasury futures strategies seem to increase around the rollover dates, following the shutdown of the futures pits.

We, also, explore whether there were any changes in the popular trading hours on the electronic platform, once the pits have closed. Our analysis is complimentary to studies such as Ozturk, et al. (2015), where they primary focus is on why the majority of electronic trades continue to occur during pit hours even though pit trading has long ceased to be a liquid and informative venue. In our analysis, we discover markets where trading hours have been shifting over the time period examined, but this is not true for all contracts analyzed. In particular, effective trading hours for livestock futures have been shortening over the years. While we cannot determine whether there is a direct effect of pit closures on this observed change, we speculate the narrowing of effective trading hours might be due to the decrease in the importance of pit trading over the years. We also observe that the change in trading hours is not as prevalent for all contracts.

Finally, we track traders that were classified as pit traders (locals) in the first half of 2014 and examine what happens to them after the pit closes. It is possible that some traders change their Traders IDs, making it difficult to track them over time. Nevertheless, we find that some former pit traders remain active after the change, and we provide some analysis on their trading. Pit traders that were and remain active in options pits continue to also engage in futures trading at the pits, even after the pits formally close[7]. Also, we have no evidence that pit traders move to the electronic market.

The rest of the paper is organized as follows. Section 2 gives a brief description of the literature. Section 3 describes the data used for the analysis and introduces the methodology used for estimating execution costs. Section 4 outlines the analysis and main findings. Section 5 concludes.

2. Literature Review

The value of the floor has been the subject of academic research since the introduction of the electronic order book. While early academic studies comparing floor trading to the electronic order book found floor trading to be associated with lower transaction costs (Venkataraman, 2001), Hendershott, et al. (2011) find that the rise of algorithmic trading has led to narrow spreads, and has enhanced the informativeness of quotes, resulting in improved liquidity. The literature suggests that liquidity in the electronic market is supplied by proprietary traders (Aitken, et al., 2007), who remain active participants even during stressful periods (Biais et al., 2015). Foucault, Moinas and

[7] We observe a small amount of futures pit activity even after the futures pits close down. We believe these trades are made in the options pit as *special strategy* trades with futures on one side and options on the other, mainly done for hedging purposes. These kinds of special strategy trades are still allowed and one leg of these trades gets recorded as a futures pit transaction.

Theissen (2007) attribute the lower quoted spreads to the anonymity of the electronic order book. They also present a model, showing that the anonymity of the order book can affect the information content of the order book both positively and negatively. Orlowski (2015), who studies the evolution of trading for the 10-year T-note futures from 1982-2011, finds that following the introduction of electronic trading in US treasury futures market in 2003, the trading volume and open interest increased substantially, whereas there was no discernable increase in price volatility. He also notes that pit volume spikes during the roll periods.

As our paper investigates the effects of the end of pit trading, it complements some of the existing literature that analyzes the introduction of electronic trading. Raman, Robe and Yadav (2016) investigate NYMEX's introduction of electronic trading and find that there is a sharp increase in trading by financial institutions after the introduction of electronic trading. As a result of this increase, they find that markets improve on many quality measures such as bid-ask spreads or (lower) intraday volatility but they also find that market depth shrinks. Another study analyzing the introduction of electronic trading is Jain (2005), where the announcement and implementation of electronic trading by the leading exchanges of 120 countries is analyzed. The study finds that automation of trading improves liquidity and informativeness of stock markets and lowers cost of equity for listed firms.

Another strand of literature that is related to our work is papers analyzing the co-existence of floor and electronic trading. Thiessen (2002), Pirrong (1996), and Wang (1999) are examples of such papers in the literature. Wang (1999) explores the Sydney Futures Exchange market and finds that in terms of setting the bid-ask spreads, screen-based traders are more sensitive to market volatility than floor-based traders. This is potentially due to the fact that floor traders are less concerned about adverse selection than screen-based traders. Pirrong (1996) compares liquidity supply mechanisms on automated futures trading systems and tradition open outcry systems, DTB and LIFFE respectively. They find the bid-ask spreads to be similar in these two venues but the automated system to be more liquid. Finally, Thiessen (2002) analyzes transaction costs from floor versus screen trading in the German stock market. They find the floor to be more competitive for less liquid stocks because they are not as severely affected by adverse selection. They also find that quoted spreads in electronic trading are more sensitive to changes in volatility than those on the floor.

In addition to the literature described above, there is also a related literature concerned with main trading hours and how they interact with pit trading hours. Ozturk et al. (2015) investigate why majority of trades still occur during pit trading hours, even after the pit ceased to be a liquid and informative venue. They analyze the 30-year treasury futures market using a data set spanning 10 years. They find that price informativeness and costs related to information asymmetry and price impact are significant explanatory factors for whether trading activity clusters around pit hours.

3. Data and Methodology

3.1 Data

Our dataset includes transaction data on futures during the time period extending from January 1st 2012 to December 31st 2015. The dataset, constructed using the proprietary TCR (Transaction

Capture Report) database of the U.S. Commodity Futures Trading Commission (CFTC), includes detailed transaction information, such as the price and quantity of every futures trade and the execution venue (electronic, pit and block trades)[8]. The dataset also specifies whether a particular trade was part of a trading strategy (spread), which is defined as a simultaneous position in multiple derivatives[9]. Moreover, for electronic trades we also know who initiated the trade (buy side vs. sell side). Finally, the dataset identifies counterparties to a transaction and provides information on market participants, such as the trader id of each trader, and the trading role of each customer account, as measured by the customer type indicator (CTI) code[10].

We focus on select number of contracts from various product groups, especially on those contracts with notable trading activity at the pit:

- Grains: corn
- Livestock: feeder cattle, live cattle, lean hogs
- Treasuries: 5 year notes, 10 year notes
- Other: random length lumber

3.2 Methodology: Execution Costs

We explore the potential impact of the pit closure on the liquidity of the electronic market, as measured by execution costs. Similar to the literature, we proxy execution costs for electronic trades using the effective half spread, estimated as:

$$\text{Effective half spread} = 100 * D_i * (\log(P_{t0}) - \log(P_{tbenchmark})),$$

where log represents the natural logarithm, P_{t0} is the transaction price of each trade, and P_t is the average price of outright trades occurring in the five minute interval preceding each trade. The variable D_i is a trade direction indicator where D_i= 1 trade for a buyer initiated trade and D_i = -1 for a seller initiated trade. The trade direction indicator is based on the aggressor indicator provided in the dataset.

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[8] Similar to our work, Roberts and Haynes (2015) also make use of this rich database and they analyze algorithmic vs. manual trading ratio across various CME markets.

[9] In this study we use the term "trading strategy" in lieu of the more common term "spread trade". This is to avoid any confusion between trading strategies (spreads) and effective spreads, which we use to measure execution costs.

[10] The Chicago Mercantile Exchange (CME) specifies the CTI codes as follows[10]:

"CTI 1: Electronic Trading, Open Outcry and Privately Negotiated – Applies to transactions initiated and executed by an individual member for his own account, for an account he controls, or for an account in which he has an ownership or financial interest. However, transactions initiated and executed by a member for the proprietary account of a member firm must be designated as CTI 2 transactions.

CTI 2: Electronic Trading, Open Outcry and Privately Negotiated – Applies to orders entered or trades executed for the proprietary accounts of a member firm.

CTI 3: Electronic Trading – Applies to orders entered by a member or a nonmember terminal operator for the account of another individual member or an account controlled by such other individual member. CTI 3: Open Outcry and Privately Negotiated – Applies to orders that a member executes on behalf of another individual member, or for an account such other member controls or in which such other member has an ownership or financial interest.

CTI 4: Electronic Trading Open Outcry and Privately Negotiated – Applies to all orders and transactions not included in CTI categories 1, 2 or 3. These typically are orders entered by or on behalf of nonmember entities."

Source: CME Group. (2014, April 2). Market Regulation Advisory Notice, Rule 536.D, Retrieved from www.cmegroup.com/rulebook/files/cme-group-ra1401-5.pdf

We are also interested in decomposing the effective half spread into a temporary and permanent components:

$$\text{Temporary spread} = 100 * D_i * (\log(P_{t0}) - \log(P_{t1})),$$

and

$$\text{Permanent spread} = 100 * D_i * (\log(P_{t1}) - \log(P_{tbenchamark})$$

Where P_{t1} is the average price of the electronic outright trades occurring between the fifth and tenth minute following each trade. The temporary spread represents compensation for search and negotiation costs, while the permanent spread represents the permanent price impact. Similar to the literature, we consider trades to be informed (liquidity driven) when the permanent spread constitutes a high (low) proportion of the effective half spread.

Our results include only those electronic trades occurring during the pit hours.

4. Analysis and Results

4.1 Pit Ratios and Trading Volume

We first analyze how the markets in question have changed over the years. Using transaction level data, we analyze the changes for three and one-half years leading up to the closure of pits and about half a year afterwards. Figure 1 presents data on trading volume for several products. For each product, the top panel presents a graph showing the ratio of pit trading volume to total trading volume, while the bottom panel shows total trading volume. Figure 1 portrays the livestock futures (feeder cattle futures, live cattle futures and lean hog futures), corn and random length lumber futures markets. We focus on livestock futures because these markets experienced a steady decline in pit trading for the years preceding the closure of the pits. We include the corn futures market because corn is the largest agriculture futures market and it is a good market for comparison purposes. We also include random length lumber because it exhibits substantial pit trading volume prior to the announcement of the futures pit closure.

The main observations from figure 1 are twofold. First, we observe that pit trading ratios for many futures contract decrease over time. In more detail, livestock futures markets have as high as 40 percent pit trading, but these high percentages are mainly observed in the first part of our sample. Corn futures pit trading appears to have declined to less than five percent prior to the announcement of the pit closure. However, random length futures pit trading remains high on certain dates prior to the pit closure. Second, while we observe that somewhere around July of 2015 the pit ratio suddenly drops to very low levels, due to CME closing the pits, these pit ratios do not go down to zero. This is because certain futures transactions are still allowed to be transacted on the pits by qualified members as long as they are part of a futures/options trading strategy[11]. A similar rule also applies for the post close session, available in select markets.[12] We should also note that there is a sharp dip in corn futures pit ratios around July 2012, much earlier than the announcement of the pit closure. This could be attributed to a shift in settlement price

[11] CME Group. (2015, June 6). Market Notice, SER-7416, Retrieved from http://www.cmegroup.com/tools-information/lookups/advisories/ser/SER-7416.html#pageNumber=1

[12] CME Group. (2015, June 8). Market Regulation Advisory Notice, Rule 550, Retrieved from https://www.cmegroup.com/rulebook/files/mran-ra1508-5.pdf

methodology in corn futures at that time, where the new methodology takes electronic as well as pit trades into account when determining settlement prices. This has drastically changed the importance of pit trades for settlement price determination[13].

In figure 2, we analyze the same markets as in figure 1, but this time we focus on just trades belonging to a trading strategy. While we do not find higher pit ratios in livestock markets and random length lumber futures when we compare strategy trades with the whole market, we notice that pit ratios for strategies in the corn futures market seem to be higher than the ratios observed for the whole market. This indicates that pits were used more for trading strategies than outrights in corn futures, while this was not necessarily the case in livestock futures or random length lumber. Next, we investigate how the pit ratios in the treasury futures markets have changed over time. Figure 3 shows the pit ratios and market trading volumes for the strategies in the 5 year and 10 year treasury futures markets, as well as the whole market in these products. The use of pits seems to be quite different for treasuries compared to livestock or corn futures. We see that pits are very useful for market participants during the roll dates[14]. While this is true for outrights as well as for strategies, the ratios are quite different. When we look at the whole market, we see pit trading approaching 13 percent of overall trading volumes during roll periods. This ratio approaches 80 percent when we only focus on strategies, which means pit trading has been much more important in treasury strategy trades. Another important finding is that pit ratios for strategies in treasury futures are high even at the tail end of our sample, which is not true for pit ratios for the whole market.

4.2 Liquidity Measures

In this section we analyze the liquidity calculated using the methodologies outlined in section 3.2. Due to the computing intensity required to calculate spreads using every transaction from four years of data for each market, we calculate liquidity measures only for 10 year treasury futures, livestock futures and for random length lumber futures markets.

Figure 4 presents the average execution costs in the electronic market for the 10 year treasury futures on selected dates between January 2012 and December 2015. We measure the average effective half spread, the temporary impact and the permanent price impact on specific rollover and non-rollover dates. For each rollover period we choose the rollover date with the highest proportion of total trading volume trading in the pit. Also, for every time period between two rollover periods, we choose the date with the lowest pit volume proportion and define it as a non-rollover date. The rationale behind this partition lies in that treasury pits become very active during rollover periods. Therefore, we should expect any changes in execution costs due to the change of the pit closure to be more pronounced during rollover dates. We also distinguish between outrights and trading strategies for similar reasons: pit traders have been arguing that there are certain trading strategies that are difficult to execute in the electronic market without being affected by leg risk. Accordingly, we would expect execution costs might rise once pit trading ceases. The top two graphs present execution costs on non-rollover dates for outrights and trading strategies respectively, while the bottom two graphs present execution costs on rollover dates for outrights

[13] See Onur and Reiffen (2015) for further details.
[14] Even though not discussed here, we observe a similar importance of pit trading during roll dates for random length lumber futures as well.

and trading strategies respectively. We do not observe a clear striking pattern for outrights and strategies on non–rollover dates. However, when trading strategies on rollover dates are considered (bottom right graph), effective half spread appears to be increasing, which is consistent with the argument presented earlier in this section. However, we should note, that we have very small number of observations, which limits the power of our results.

Figure 5 presents average daily execution costs for lean hogs and live cattle futures contracts. We calculate the average daily effective half spread, the temporary impact and the permanent price impact for outrights and trading strategies separately. While there appears to be an increase in both the effective half spread and the permanent price impact, it is not clear from the graphs whether these patterns are driven to a great extent by seasonality.

Figure 6 presents the average daily effective half spread and price impact for feeder cattle outrights. Similar to lean hogs and live cattle, there appears to be an increase in both the effective half spread and price impact. However, average daily execution costs do not increase monotonically. Instead there appears to be a surfige in execution costs at the beginning of 2015, which coincides with the announcement of the pit closure. This is followed by a subsequent decline and then another increase in execution costs around the time of the actual futures pits closures. Further tests are required to determine if these patterns are related to the shutdown of the futures pits.

We also present the average daily effective half spread and price impact for random length lumber in figure 7. Both effective half spread and price impact increase in the first quarter of 2015, which coincides with the announcement of the closure of the futures pits. Moreover, the level and volatility of execution costs appear to increase after the futures pits close. This is consistent with the observed decline in the total volume for random length lumber futures contract.

4.3 Trading Hours

With the closing of the pit trades, trading becomes less tethered to specific times of the day. Nevertheless, Ozturk et al. (2015) shows that that electronic trading tends to occur during pit trading hours, despite the decline in the share of trades that occur in the pits. Ozturk et al. (2015) suggest that the pits are an important venue for price discovery. In this paper, we examine the effect of a more dramatic decline in pit trading (the closure of the pits) on the timing of trading.

To that end, we calculate the aggregate trading volume at every hour of every day for four years for all of our fourteen sample contracts. Most of the contracts had very similar patterns of trading (in terms of time of trade) after the closure, as they did in the earlier period. Figures 8 and 9 focus on markets that experienced a shift in main trading hours. Each of the graphs in figures 8 and 9 represent the aggregate trading volume at every hour of every day spanning four years of trading for the corresponding futures market. In figure 8, panel A shows the trading hours for live cattle futures and panel B shows the trading hours for feeder cattle futures. Similarly, panel A in figure 9 shows the trading hours for lean hogs futures and panel B in the same figure shows the trading hours for corn futures. Trading hours in each figure starts at 6:00 in the morning and ends at 5:00 in the evening. All times are in Central Standard Time (CST) and they cover the whole trading hour starting with the indicated number. So, a 6:00am trading slot would cover all trading from 6:00 am until 6:59 am.

Our analysis reveals interesting results. Both panels in figure 8 and panel A in figure B show that for livestock futures markets there is a trend in transaction volume significantly increasing at 8:00am in the morning and declining at 12:00pm. While we do not present any statistical results testing this claim, the increase in trading seems to be especially drastic towards the end of our sample, possibly due to the closure of pits. The decline in pit trading at 12:00pm, except for feeder cattle futures, seems to be a much more gradual change, possibly driven by a reason other than pit closures.

In panel B of figure 9 we also present similar analysis for corn futures for comparison purposes. While we see gradual increase of transaction volume at 8:00am, and a gradual decline of transaction volume at 1:00pm, the shifts in trading volumes do not seem to be as drastic as those observed for livestock futures. While not shown here, the same pattern we observe in corn futures also exists for wheat and soybean futures markets. It is also worth noting that we failed to find any pattern of shift in trading volume at the beginning or end of trading hours for any of the other futures markets we analyzed.

4.4 What Happened to Pit Traders

We identify active locals at the futures pits and monitor their presence and activity after the futures pits shut down. Our objective is to document whether these traders move to the electronic market, become active at the remaining open options pits or cease their operations following the shutdown of the futures pits. Our dataset provides us with a trader id, which allows us to consolidate trades per trader. Pit traders are defined as locals, when they execute regular trades at the pit or the electronic market, using a CTI code equal to 1 for more than half of their volume during the last six months of 2014. We track their trading presence and behavior for the year before the futures pits closed and the six month period following the date that futures pits closed (July 7th 2015). For traders that remain active after the July 7th 2015, we present trading characteristics before and after the pit close. However, we do not find any transaction data linked to many traders identified as locals prior to the futures pits closing. For those "eliminated traders" we report their trading characteristics just for the year prior to July 7th 2015[15]. More specifically we measure what proportion of the locals' trading volume was in futures vs. options, what proportion of their volume constituted trading strategies and what proportion of their volume was in the specific commodity market and finally what proportion of their trading volume was executed in the electronic market. We also measure the average trading volume across traders in each commodity during the period examined. We focus on the pit locals for those commodities with substantial floor trading activity prior to the closing of the futures pits: the 10 year treasure futures, futures on livestock (live cattle, feeder cattle, lean hogs), corn futures and random length lumber.

Table 1 presents descriptive statistics on the 10-year-treasury futures contract. The first column includes descriptive statistics for eliminated locals, whereas the second and third columns present descriptive statistics on the remaining active locals before and after the futures pits close respectively. We have identified 72 locals in the pit, 62 of which disappear from our sample after the pit closes. Eliminated traders appear to trade on average more than locals remaining active

[15] We don't mean to indicate that these "eliminated traders" necessarily left the market. It is possible that they might have moved to a different firm and started trading in the electronic market under a new trader id. We cannot track such changes in our data.

after the pit closes. They also trade mostly futures (89% of their volume) and trading strategies (79.9% of their volume). However, only 34% of their volume involves 10 year futures: they trade other future contracts, such as lean hogs and live cattle. Eliminated pit locals do not appear to execute trades in the electronic market. Traders who remain active after the futures pits close appear to be options traders, potentially trading futures for hedging purposes, as the proportion of their futures trading volume in the last six months of 2014 was less than 17%. Their volume is a little lower[16] after the pits close, which can probably be attributed to their lower activity in futures. Similar to eliminated traders, they trade strategies (77% of their volume). Unlike eliminated traders, they focus more in the treasury market with 80% of their volume in 10 year treasury futures and options.

Table 2 presents similar descriptive statistics for livestock futures: lean hogs futures, live cattle futures and feeder cattle futures. Similar to the treasury market, surviving locals trade more options and less futures than eliminated locals. Also, after the futures pits close, active locals have less trading volume, which can probably be attributed to reduced futures trading. Moreover, active locals appear to trade many commodities, although they focus in livestock derivatives. About half of their trading volume constitutes trading strategies and this proportion increases after the futures pits close. Surprisingly, eliminated traders have a more significant presence in the electronic market, but this could be potentially explained by the more active electronic futures markets.

Table 3 presents the trading characteristics of locals in the corn market. Similar to other markets, three quarters of the locals disappear from the sample. Surviving locals trade primarily options and are active in other commodity markets. A substantial proportion of their volume constitutes trading strategies. Locals trading corn, both eliminated and surviving, are not active in the electronic market.

Table 4 describes the random length lumber market. The random length lumber market, although small, deserves special attention as none of the ten identified locals appears in our sample after the futures pits close. It is also a market with substantial pit volume prior to the shutdown of the futures contracts.

The overall conclusion about pit traders is that their skills do not appear to transfer readily to electronic trading on the same futures contracts. Most appear to exit futures trading entirely. The traders who do remain seem to already have had some experience in options trading. These traders became more active in options, and were able to execute some futures trades in the options pits.

5. Conclusion

On July 6th 2015[17], floor trading ceased on almost all of the CME futures pits. While pits have been losing their importance for the last few years, the decision to close the pits by the CME was not well received by everyone. There were many news articles filled with interviews of floor traders who were against this decision. As such, this paper analyzes the pit trading in the markets leading up to the closure and for some time afterwards as well. Due to the large number of markets

[16] We examine a period of one year before the futures pits close, but only six months afterwards.

[17] Polansek, T. (2015, July 6th). Closing bell rings on Chicago futures pits for final time. *Reuters.* Retrieved on October 12th 2015 from http://www.reuters.com/article/2015/07/07/us-cme-group-futures-closure-end-idUSKCN0PG2BX20150707

affected by this decision, we are unable to analyze all of the relevant CME markets because of resource constraints. Instead, we focus on select futures contracts from markets that had substantial floor trading before the February 4th announcement regarding the closure of the futures pits: grains (corn), livestock (feeder cattle, live cattle, lean hogs), lumber (random length lumber) and treasuries (5-year T-Note Futures, 10-year T-Note Futures) [18],[19]. We explore how the ratios of futures pit volume to total volume changed during the period of 2012-2016 for those contracts and examine whether these changes were different for outright and trading strategies. Moreover, we examine whether execution costs in the electronic market changed and whether pit trading hours changed after the futures pits closed. Finally, we track pit traders after the pits close to find out if their skills transfer to the electronic market.

While we observe drastic declines in pit trading ratios which could be attributed to the pit closure, we can still find some amount of futures pit trades even after the closure date. This is due to a CME exception allowing futures pit trades that are executed as part of a futures/options strategy. We also find that for certain futures markets, such as livestock futures, pit trades were more important than others. This is especially true when we focus just on strategy trades. For other markets, such as treasuries futures, we find that pits were mainly used during roll periods.

Despite the decline in pit trading ratios, we do not observe any definitive change in the liquidity measures we calculate for most contracts. This is true for outrights as well as strategy trades. However, we can discern a clear effect for random length lumber futures and for treasury futures belonging to a strategy during rollover periods. We find that effective half spread for treasury futures appears to be increasing but we also realize that we have a very small number of observations, which limits the power of our results. While we also present a few more cases where liquidity measures look like they might be reacting to the closure of the pits, we realize that further tests are required to determine if these patterns are related to the shutdown of the futures pits.

In terms of main trading hours, we observe significant increase at the 8:00am trading volume for livestock futures markets. The change is especially drastic towards the end of our sample, indicating that it is possible this shift is driven by pit closures. While we also observe a decline in trading volumes at the 12:00pm time slot, the decline seems to be much less drastic. This leads us to believe that the decline in trading volumes at the 12:00pm time slot is potentially driven by a different reason. We observe somewhat of a similar effect for wheat, corn and soybean futures markets, but do not observe any other trading hour change for any of the other markets analyzed.

In terms of futures pit traders (locals), we analyze which pit traders are still in the market as pit traders after the change and which ones are eliminated. We find that surviving locals trade more options and fewer futures than eliminated ones. Moreover, surviving locals appear to trade many commodities, with about half of their trading volume focused on strategies and this proportion increases after the futures pits close. We find these patterns for hold for livestock futures as well as for treasury futures.

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[18] The US treasury futures market presents an interesting case for evaluating the value of floor trading, both because of the significant size of the treasury futures market and the increased pit trading activity during roll periods. Moreover, block trades for US treasury intra-commodity calendar spreads are not permitted. Therefore, with the closure of the physical trading floor, there are no other alternative trading venues beyond the electronic market (Globex).

[19] We left one of the most iconic CME futures contracts, E-mini, out of our list because CME left the pits for trading contracts based on the S&P 500 index open.

Overall, we find that so far futures pit trading has been diminished to very low levels but it has not completely disappeared. We see some of the futures pit traders still “sticking around” in the pit markets and we also see some shift in main trading hours for a few select markets. In terms of execution costs, we do not find any significant influence of pit closures on price impact or effective spread in the electronic market.

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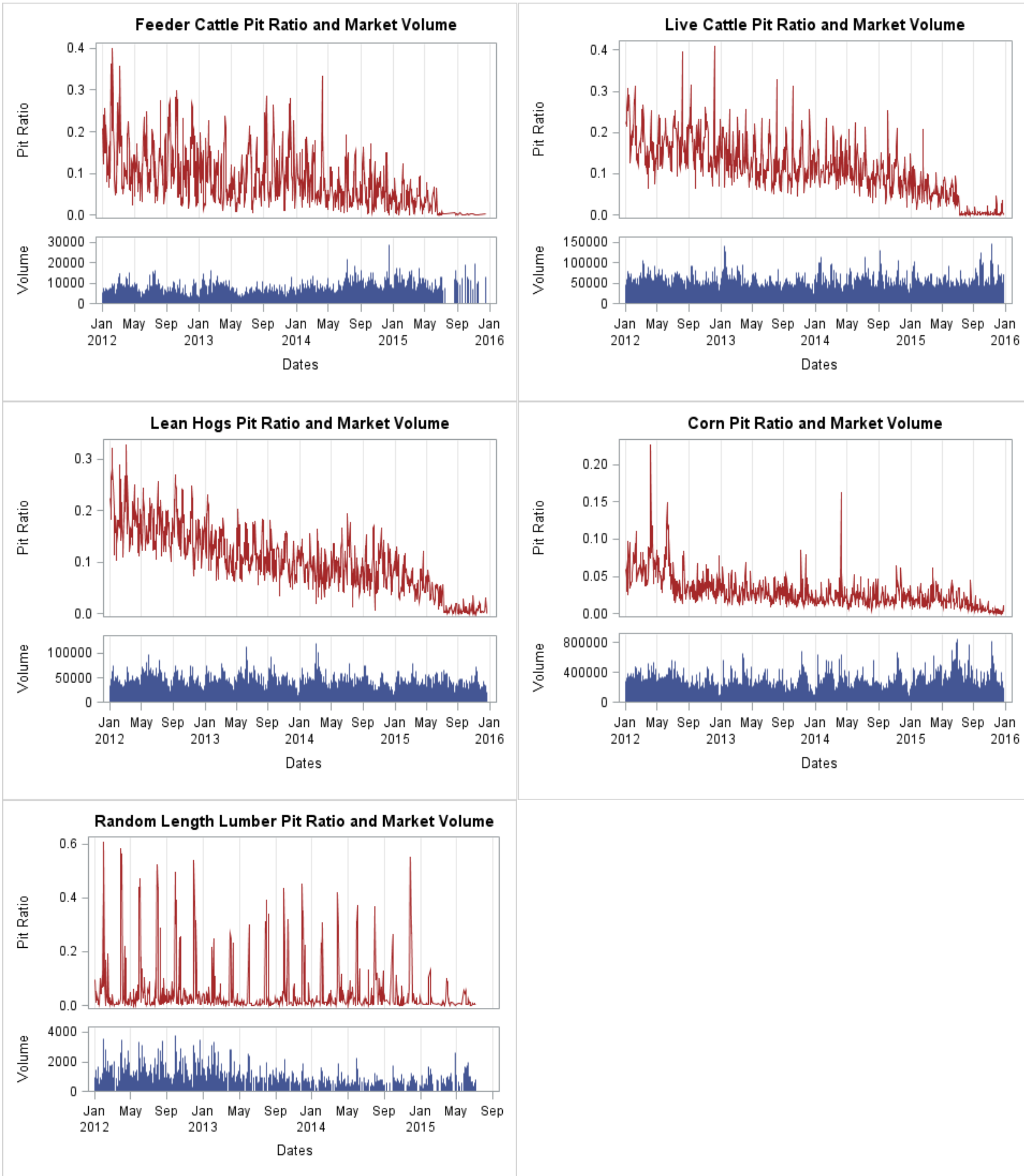


Figure 1. Trading Ratio of Pits and Total Trading Volume

Each of the five graphs above represents the trading ratio of pits in the top panel and total market trading volume in the bottom panel. Feeder cattle futures is shown in the top left graph, live cattle futures in the top right graph, lean hog futures in the middle left graph, corn futures in the middle right graph and random length lumber in the bottom left graph.

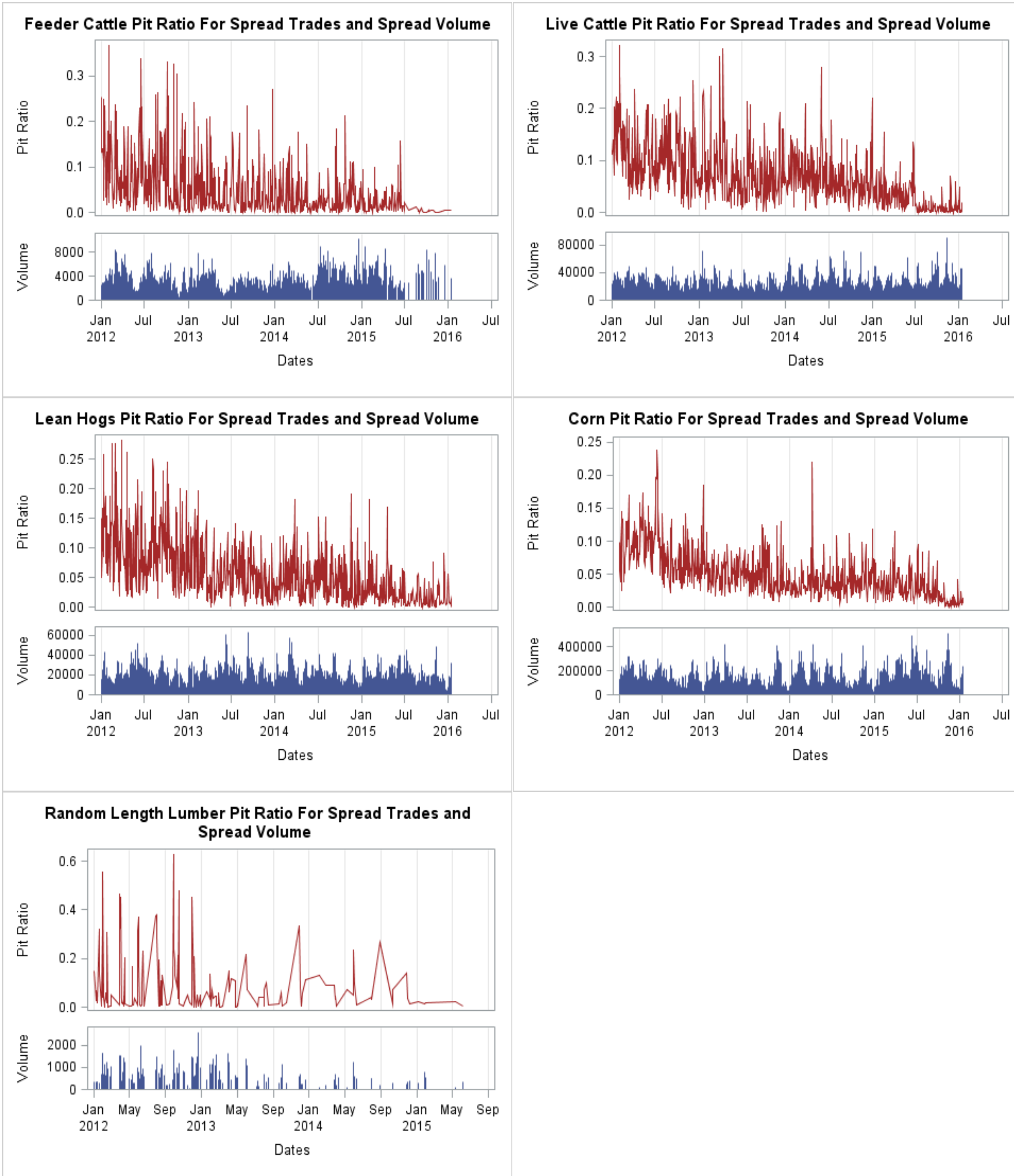


Figure 2. Strategy (spread) Trading Ratio of Pits and Total Trading Volume for Spreads

Each of the five graphs above represents the spread trading ratio of pits in the top panel and total market trading volume for spreads in the bottom panel. Feeder cattle futures is shown in the top left graph, live cattle futures in the top right graph, lean hog futures in the middle left graph, corn futures in the middle right graph and random length lumber in the bottom left graph.

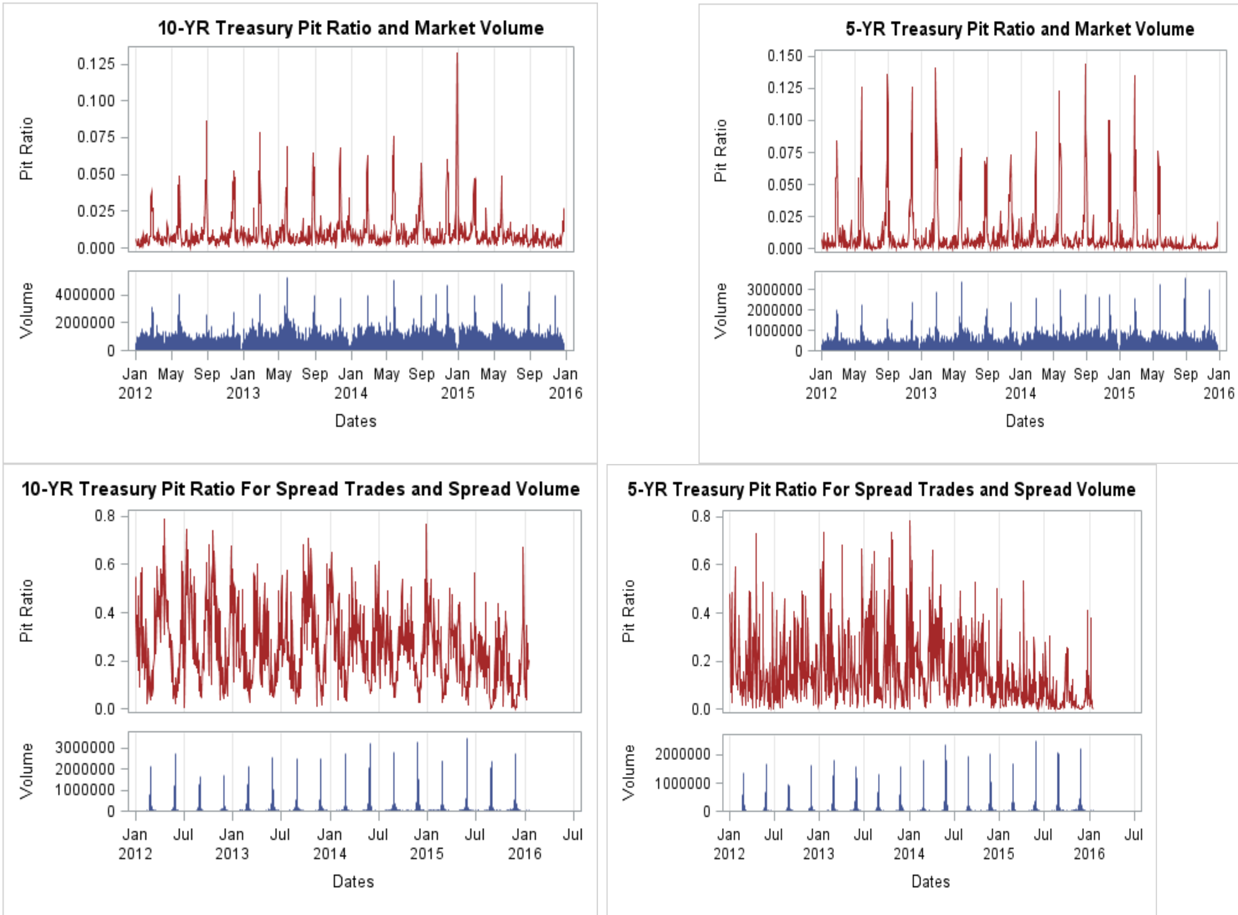


Figure 3. Treasuries Trading Ratio of Pits and Total Trading Volume for All Trades and Spreads

Each of the four graphs above represents the spread trading ratio of pits in the top panel and total market trading volume for spreads in the bottom panel. Two graphs on the top represent the pit ratios and trading for the whole market, whereas two graphs on the bottom represent the pit ratios and trading for spread trades only. All trades for 10 Year Treasury futures is shown in the first quadrant and spread trades for 10 Year Treasury futures is shown in the third quadrant. Similarly, all trades for 5 Year Treasury futures is shown in the second quadrant and spread trades for 5 Year Treasury futures is shown in the fourth quadrant.

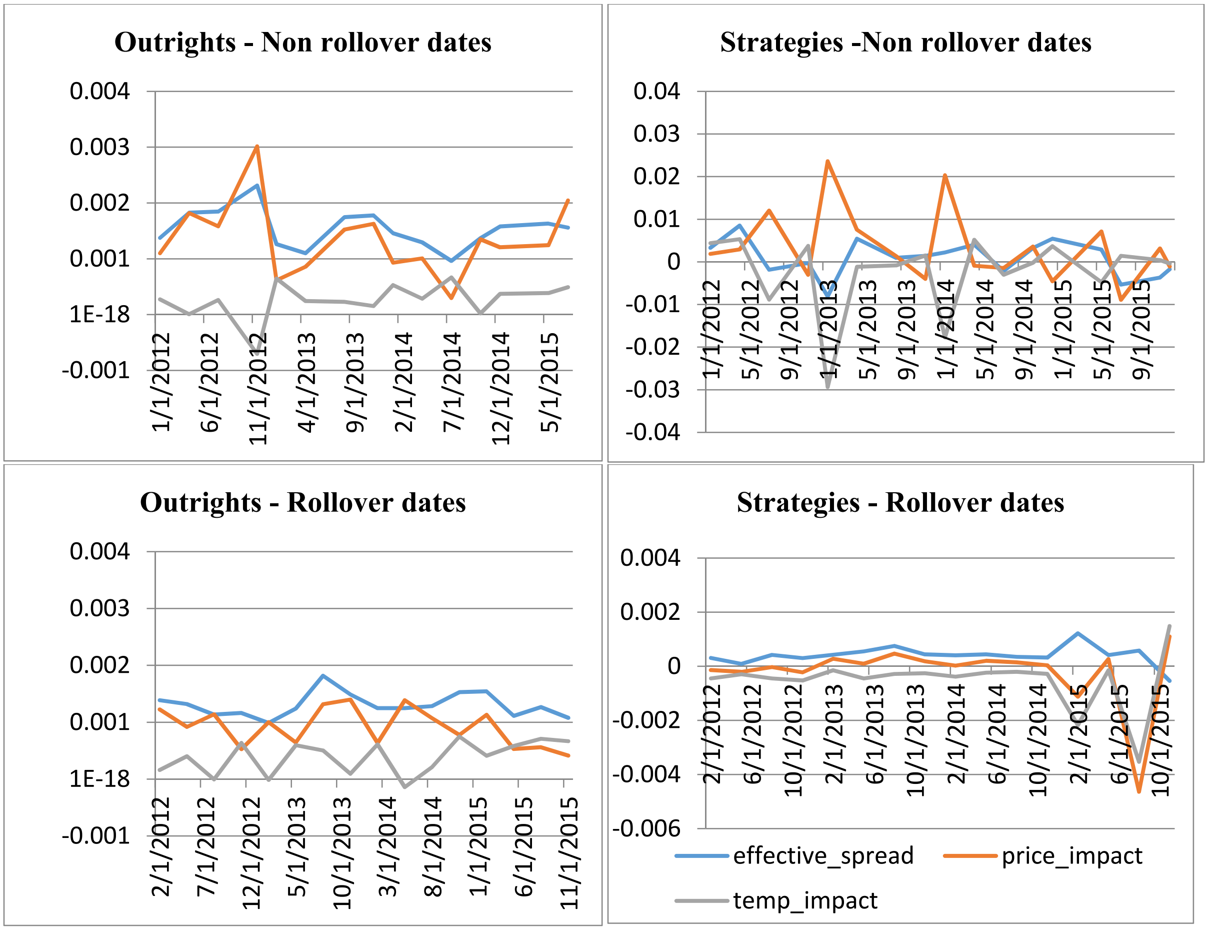


Figure 4. Execution costs for the 10 year treasury futures

Each of the four graphs above represents the execution costs (effective half spread, temporary impact, price impact) for 10 year treasury futures contracts. The two graphs on top represent outrights and strategies on non- rollover dates, whereas the two bottom graphs represent outrights and strategies on rollover dates.

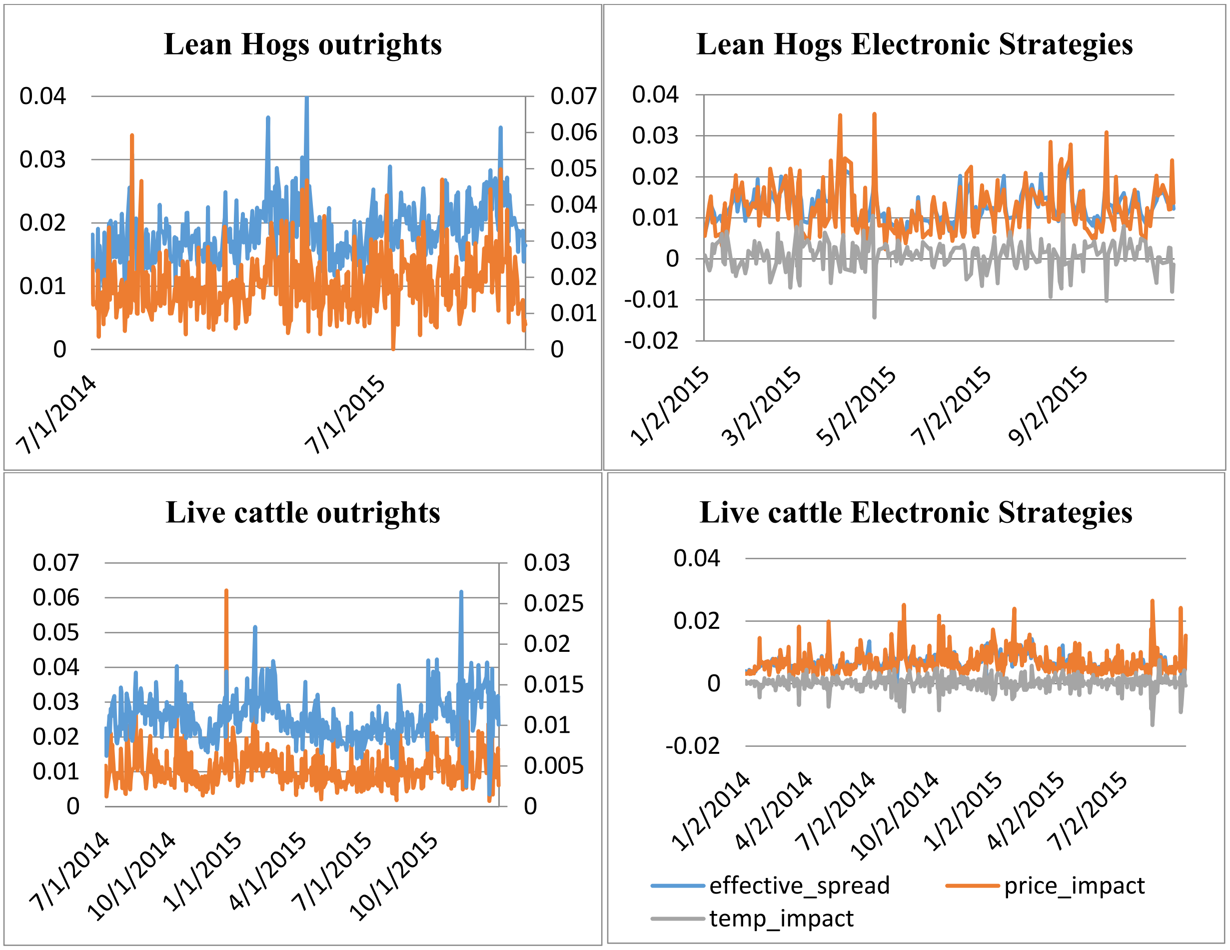


Figure 5. Execution costs for Lean Hogs and Live Cattle

Each of the four graphs above represents the execution costs (effective half spread, temporary impact, price impact) for live cattle and lean hogs futures contracts. The two graphs on top represent outrights and strategies for lean hogs futures, whereas the two bottom graphs represent outrights and strategies for live cattle futures.

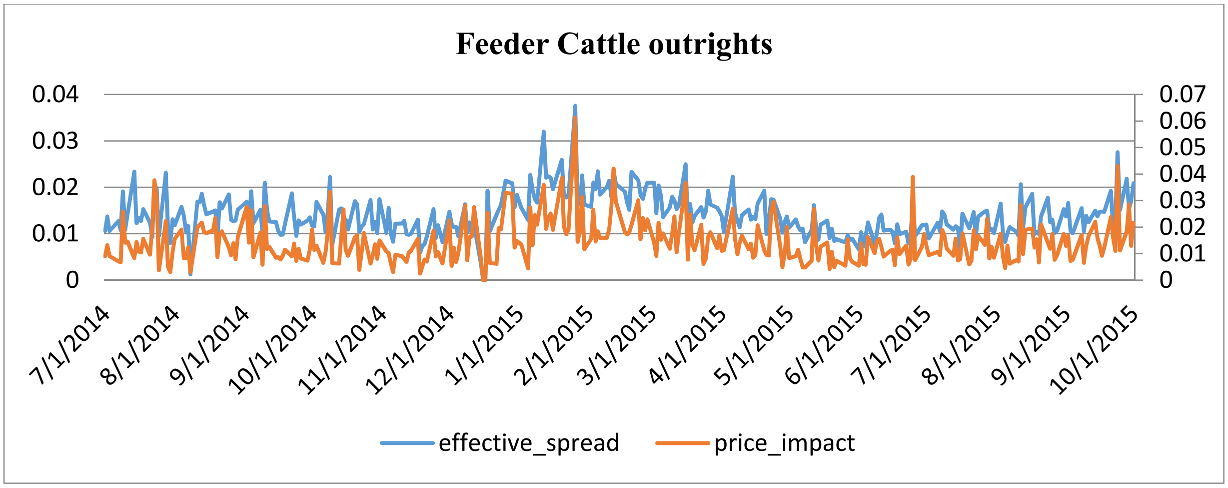


Figure 6. Execution costs for Feeder Cattle

The graph above represents the effective half spread and price impact for the feeder cattle futures contract.

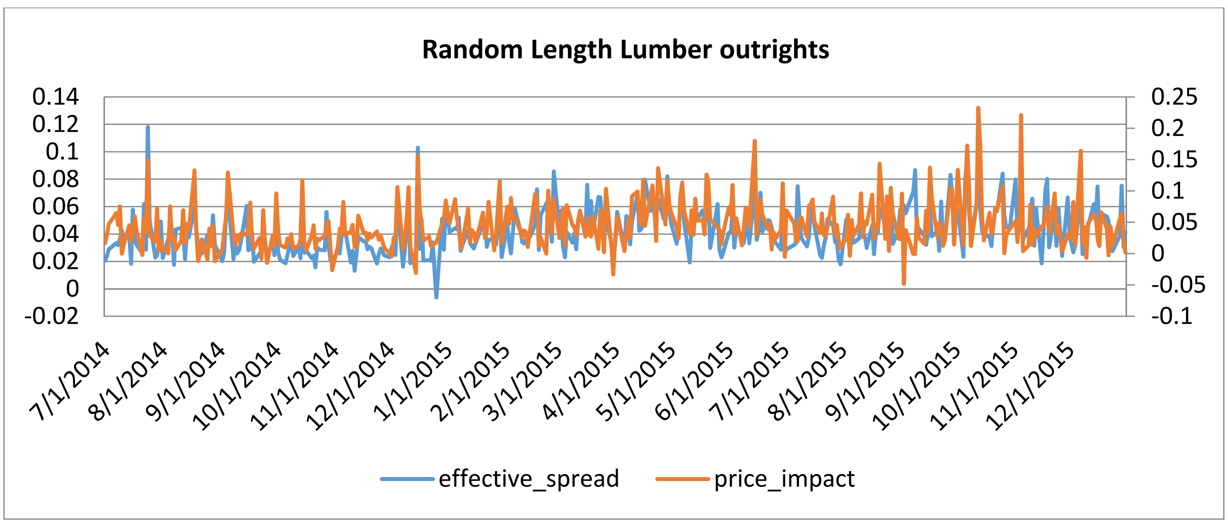
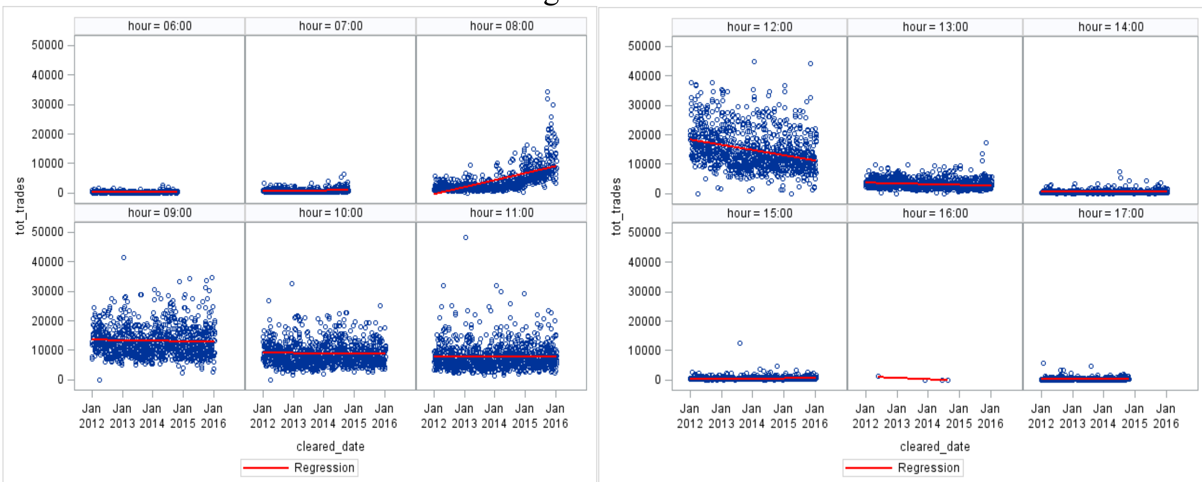


Figure 7. Execution costs for Feeder Cattle

The graph above represents the effective half spread and price impact for the random length lumber futures contract.

PANEL A: Trading Hours for Live Cattle Futures



PANEL B: Trading Hours for Feeder Cattle Futures

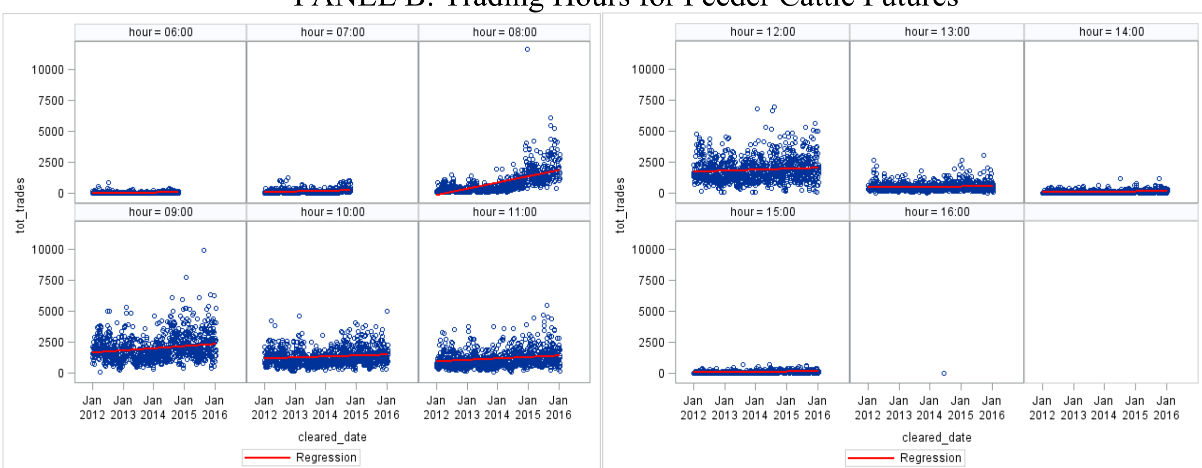
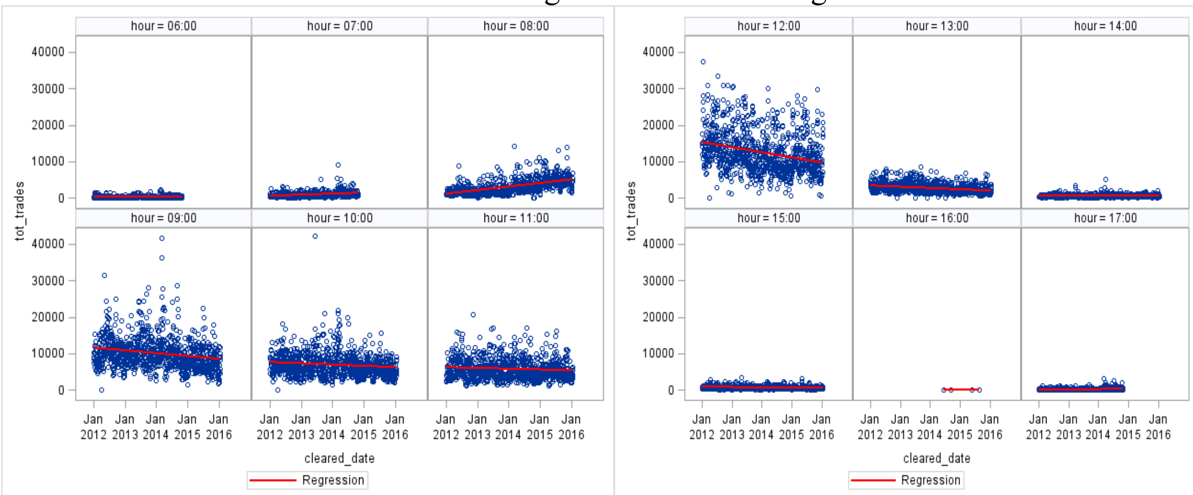


Figure 8. Trading Hours and Hourly Transaction Volume for Live Cattle and Feeder Cattle Futures

Each of the four graphs above represents the aggregate trading volume at every hour of every day spanning four years of trading for the corresponding futures market. Panel A shows the trading hours for live cattle futures and Panel B shows the trading hours for feeder cattle futures. Trading hours for each panel starts at 6:00 in the morning and ends at 5:00 in the evening. All times are in central standard time.

PANEL A: Trading Hours for Lean Hogs Futures



Panel B: Trading Hours for Corn Futures

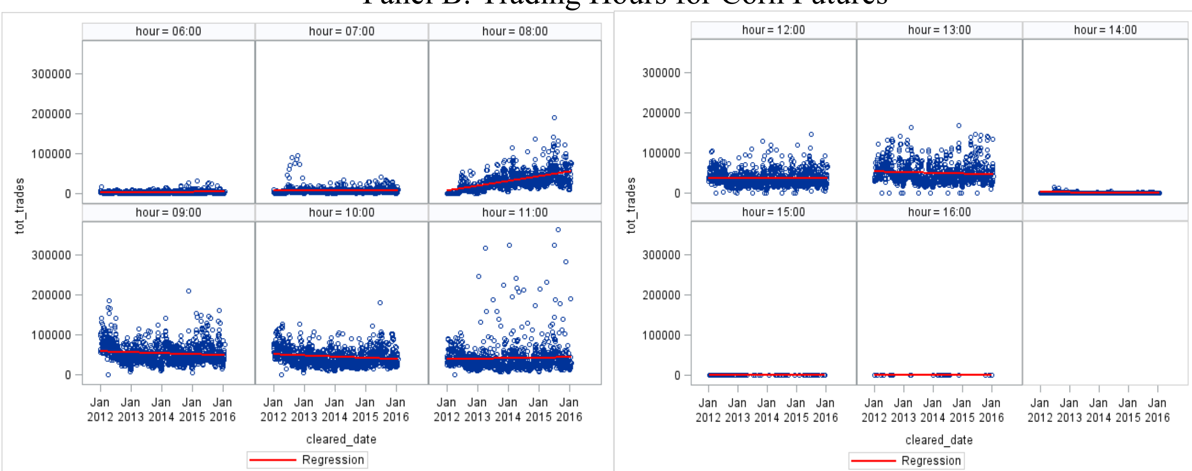


Figure 9. Trading Hours and Hourly Transaction Volume for Lean Hogs and Corn Futures

Each of the four graphs above represents the aggregate trading volume at every hour of every day spanning four years of trading for the corresponding futures market. Panel A shows the trading hours for live cattle futures and Panel B shows the trading hours for feeder cattle futures. Trading hours for each panel starts at 6:00 in the morning and ends at 5:00 in the evening. All times are in central standard time.

10-Year Treasury (21)			
	Eliminated Traders	Active traders before	Active Traders after
Average total volume	126524.5806	63821.8	28241.6
Proportion of futures volume	0.893345379	0.168674979	0.038267586
Proportion of strategy volume	0.79910739	0.902969763	0.765450767
Proportion of volume in (21)	0.340244303	0.789649784	0.798782564
Proportion of electronic trading	0	0	0
Other commodities traded	LN, 48, ES	17, TY5, TY2, UBE, US5, TY3	TY5, 17, Ty3, TY2
Total number of traders	62	10	
Total number of traders	72		

Table 1: What happened to traders in the treasury pit?

We track the locals' trading behavior in the treasury pit for the year before the futures pits closed and the six month period following the date that futures pits closed (July 7th 2015). We report the proportion of the locals' trading volume in futures vs. options, the proportion of their volume constituting trading strategies, the proportion of their volume in the specific commodity market, and the proportion of their trading volume executed in the electronic market. We track "eliminated" and surviving ("active") traders separately

LEAN HOGS (LN)			
	Eliminated Traders	**Active traders before**	**Active Traders after**
Average total volume	18980.61364	37518.26316	8671.947368
Proportion of futures volume	0.944145393	0.680818999	0.344224466
Proportion of strategy volume	0.428417742	0.472880178	0.529694759
Proportion of volume in LN	0.863061349	0.706714033	0.631510677
Proportion of electronic trading	0.500737832	0.138052744	0
Other commodities traded	38,17,SP,NQ,S	48,62, SP	48,SP,LN, 62, DA
Total number of traders	44	19	
Total number of traders	63		
LIVE CATTLE (48)			
	Eliminated Traders	**Active traders before**	**Active Traders after**
Average total volume	35548.52083	51156.36364	49666.6
Proportion of futures volume	0.950000221	0.604070039	0.227129765
Proportion of strategy volume	0.423801132	0.457456962	0.567160282
Proportion of volume in LN	0.709083374	0.610035447	0.468244753
Proportion of electronic trading	0.359692033	0.142778405	0
Other commodities traded	LN, 62, ES,ED,SP,S, NQ	LN, 62	48, 62
Total number of traders	48	11	
Total number of traders	59		
FEEDER CATTLE (62)			
	Eliminated Traders	**Active traders before**	**Active Traders after**
Proportion of futures volume	0.862671728	0.598210834	0.078249153
Proportion of strategy volume	0.364598379	0.582857595	0.723209518
Proportion of volume in LN	0.581768455	0.176418697	0.139724869
Proportion of electronic trading	0.281042914	0.11118993	0
Other commodities traded	LN, 48, NF, ES	LN, 48	LN, 48
Total number of traders	14	5	
Total number of traders	19		

Table 2: What happened to traders in the livestock pit?

We track the locals' trading behavior in the livestock pit for the year before the futures pits closed and the six month period following the date that futures pits closed (July 7th 2015). We report the proportion of the locals' trading volume in futures vs. options, the proportion of their volume constituting trading strategies, the proportion of their volume in the specific commodity market, and the proportion of their trading volume executed in the electronic market. We track "eliminated" and surviving ("active") traders separately.

CORN (C)			
	Eliminated Traders	Active traders before	Active Traders after
Average total volume	18025.20779	84265.4	31773.76
Proportion of futures volume	0.939203051	0.348250457	0.118443544
Proportion of strategy volume	0.66833205	0.641851343	0.596712313
Proportion of volume in (C)	0.66833205	0.470910562	0.479222057
Proportion of electronic trading	0	0	0
Other commodities traded	W, 7,S, YC, YK, YW, S, W, CDF	CDF, XCW, WZC, PYC, PY5, YW, WZC, PY1, S, Y, YK, PY3, 26, 3CC, 6, 7, 14, 8CC	CDF, XCW, WZC, C, PYC, PY5, WZC, XCW, 6, S, XCW, PY2, 14, SDF, 31, S
Total number of traders	77	25	
Total number of traders	102		

Table 3: What happened to corn pit traders?

We track the corn locals' trading behavior for the year before the futures pits closed and the six month period following the date that futures pits closed (July 7th 2015). We report the proportion of the locals' trading volume in futures vs. options, the proportion of their volume constituting trading strategies, the proportion of their volume in the specific commodity market, and the proportion of their trading volume executed in the electronic market. We track "eliminated" and surviving ("active") traders separately.

RANDOM LENGTH LUMBER (LB)			
	Eliminated Traders	**Active traders before**	**Active Traders after**
Average total volume	749.8	0	0
Proportion of futures volume	0.992832291	0	0
Proportion of strategy volume	0.327026918	0	0
Proportion of volume in LB	0.976681291	0	0
Proportion of electronic trading	0.439382524	0	0
Other commodities traded	LN, 48, ES	0	0
Total number of traders	10	0	
Total number of traders	10		

Table 4: What happened to the random length lumber traders?

We track the random length lumber locals' trading behavior for the year before the futures pits closed and the six month period following the date that futures pits closed (July 7th 2015). We report the proportion of the locals' trading volume in futures vs. options, the proportion of their volume constituting trading strategies, the proportion of their volume in the specific commodity market, and the proportion of their trading volume executed in the electronic market. We track "eliminated" and surviving ("active") traders separately.