Research Note:
Equity Market Volatility on August 24, 2015

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On Monday, August 24, 2015, the U.S. equity markets and equity-related futures markets experienced unusual price volatility, particularly during the period surrounding the 9:30 a.m. E.T.[2] start of regular trading hours for the equity markets.

- Prior to 9:30, the most actively traded equity product – the SPDR S&P 500 ETF Trust ("SPY") – declined to more than 5% below its closing price on the previous trading day (Friday, August 21, 2015). The most actively traded equity-related futures contract – the E-Mini S&P 500 ("E-Mini") – declined to its limit down price of 5% below the previous trading day's closing price and was paused for trading from 9:25 to 9:30.

- At 9:30, SPY opened for regular trading hours at 5.2% below its previous day's close and then further declined to a daily low of 7.8% by 9:35. By 9:40, SPY recovered past its opening price and eventually closed down 4.2%. SPY's decline from previous day close to August 24 open was the second largest in the last decade, while SPY's decline from previous day close to August 24 daily low was the 10th largest in the last decade.

- From 9:30 to 9:45, more than 20% of S&P 500 companies and more than 40% of NASDAQ-100 companies reached daily lows that were 10% or more below their previous day's closing price.

This Research Note assesses the operation of U.S. equity markets under the stressed conditions of August 24. In recent years, the SEC and self-regulatory organizations ("SROs") have implemented several regulatory initiatives to address transitory price volatility. Among other things, August 24 provides a useful opportunity to evaluate the practical operation of these initiatives.

This Research Note provides empirical data and other information to help assess trading on August 24, including several issues that have been debated among market participants and in

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[1] This Research Note was prepared by the Staff of the U.S. Securities and Exchange Commission. The Commission has expressed no view regarding the analysis, findings, or conclusions contained herein.

[2] Unless otherwise specified, times throughout this Research Note will be for a.m. E.T.

the media. These issues include the opening process at primary listing exchanges, the triggering of trading pauses under the National Market System Plan to Address Extraordinary Market Volatility (commonly known as the Limit Up-Limit Down, or "LULD", Plan), and the effects of market volatility on trading in exchange-traded products ("ETPs").[3]

Section I describes the data used in the paper and provides summary statistics about the data.

Section II provides an overview of trading on August 24 by examining two broad indices – the S&P 500 and NASDAQ-100 – and their related products.

Section III compares trading in a large dataset of corporate stocks and ETPs on August 24 with trading during previous control periods.

Section IV addresses the opening process at the primary listing exchanges.

Section V examines the operation of the LULD Plan and associated SRO rules and practices.

Finally, Section VI focuses on the widely varying nature of trading in ETPs on August 24, with a minority experiencing extreme volatility and a large number of LULD halts.

The following are some key data points in the paper:

Price Declines (Section III.A):

- Corporate stocks ("Corporates") with the largest capitalization were particularly affected on August 24.[4] Of the 41 Corporates in the Very Large capitalization bin (which alone represent nearly a third of Corporates market capitalization), more than half (21) declined by 10% or more on August 24. These included 5 of the largest 10. In comparison, only 30% of the more than 4,000 Corporates in the Large, Mid, and Small capitalization bins declined by 10% or more.

- The largest capitalization ETPs experienced declines that were similar to those of smaller ETPs. Of the 50 largest capitalization ETPs, 20 (40.0%) declined by 10% or more, while 36.5% of more than 1,300 other ETPs also declined by 10% of more.

[3] Unless otherwise specified, leveraged ETPs are excluded from the term "ETPs" in this paper. As noted in Section I below, leveraged ETPs are designed to trade differently in many respects than other ETPs. They therefore are excluded from most of the analyses in this paper to obtain more comparable statistics. The number of LULD halts and other summary statistics for leveraged ETPs are provided in Section VI below.

[4] Market capitalization bins for Corporates and ETPs are defined in Section I below.

- Regulation SHO short sale restrictions ("SSRs") were triggered on August 24 in more than 2,000 securities, which is the second largest number since SSRs were implemented in 2011. SSRs were triggered in 108 constituents representing more than 37% of the market capitalization of the S&P 500, and in 42 constituents representing more than 50% of the market capitalization of the NASDAQ-100. When SSRs are triggered, short sale orders in that security generally are subject to a price test that requires the orders to be executed at prices greater than the national best bid for the security.

Trading Metrics (Sections III.B and III.C):

- Trading metrics for control periods indicate that the opening 15 minutes of regular trading hours typically are the least liquid portion of the trading day, with wider spreads, less quoted depth, and higher volatility. These patterns were observed on August 24, but with much larger trading volume than normal.

- Trading volume in the minutes following the open was much higher than in control periods, particularly for Very Large Corporates (more than 400% higher) and for nearly all market capitalization bins of ETPs (ranging from more than 400% higher for Large ETPs to more than 800% higher for Small ETPs). The fact that prices also declined most substantially in the Very Large Corporates and in ETPs indicates that much of this volume surge after the opening was initiated by sell orders that were relatively insensitive to the previous day's prices.

- Quoted depth (inside through 19 cents away), which typically is at its daily lows in the opening minutes of a trading day, was much lower in the opening minutes on August 24 than in control periods, particularly for Very Large Corporates (more than 70% reduction) and for ETPs (more than 90% reduction). Consequently, the surge in selling in the minutes following the open on August 24 interacted with much lower than normal levels of displayed liquidity.

Opening Process and Market-Wide Circuit Breakers (Sections II and IV):

- NASDAQ and NYSE Arca open their listed equities electronically at 9:30. The NYSE incorporates a manual element in its opening process, particularly on volatile days. On August 24, many NYSE-listed stocks opened for trading later than 9:30 on the NYSE (though NYSE-listed stocks were traded at other exchanges and off-exchange venues before and after 9:30). By 9:35, for example, the NYSE had opened 38% of its listed S&P 500 companies representing 53% of such companies' market capitalization. By 9:45, these figures increased to 86% of NYSE-listed S&P 500 companies representing 91% of such companies' market capitalization.

- The S&P 500 Index ("SPX"), as calculated and disseminated by S&P Dow Jones Indices LLP ("S&P DJI"), declined on August 24 by only 5.2% from its previous day's close. Until approximately 9:42, SPX remained substantially higher than the prices of the SPY (7.8%

decline), E-Mini (7% decline), and the net asset value ("NAV") of SPY (8% decline, as calculated with reference to consolidated real-time trade prices). S&P DJI generally uses last sale prices from only the primary listing market to calculate its equity indexes. Until NYSE-listed constituents of the S&P 500 index were opened on the NYSE, the SPX disseminated by S&P DJI reflected NYSE closing prices from August 21. The use of these previous day closing prices to calculate SPX in the opening minutes of August 24 likely caused its decline to be less than S&P 500 related products that reflected real-time trade prices.

- The SPX is referenced in SRO rules to determine whether market-wide circuit breakers are triggered. Because the SPX did not decline by 7% (the first level trigger) on August 24, the market-wide circuit breakers, which would have implemented a 15-minute trading pause in all equities and related products, were not triggered on August 24.

- Six of the 41 Very Large Corporates reached daily lows of more than 20% below their previous closing price soon after the opening cross on their primary listing exchange. Much of the decline occurred in a very short period of continuous trading after the opening cross. The rapid price decline was accompanied by a volume surge after the opening cross that substantially exceeded the volume executed prior to and in the opening cross itself. An LULD pause was triggered in one of the six Corporates.

LULD Halts (Section V):

- Although most of the 1,278 LULD trading halts on August 24 occurred in ETPs, 80% of ETPs did not experience a single LULD halt. Overall, there were 1,058 LULD halts in 327 ETPs (many halts were repeats in the same ETP), and 220 LULD halts in 144 non-ETPs.

- Corporates were much less likely to experience an LULD halt. Only 8 constituents of the S&P 500 and 2 constituents of the NASDAQ-100 experienced LULD halts.

- A great majority (84%) of ETPs have small market capitalizations and, accordingly, most LULD pauses occurred in smaller ETPs. The rate of ETPs with LULD halts, however, was the same for both the largest and smaller ETPs. LULD trading pauses occurred in 20% of the 50 largest capitalization ETPs, and in 20% of the remaining 1,491 ETPs.

- More than 60% of LULD halts followed a price rise, and most of these (88%) occurred after 9:45 when the LULD percentage price bands are no longer doubled (as they are during the first 15 minutes of regular trading hours).

- NYSE Arca, which is the primary listing exchange for more than 85% of ETPs, applied price collars to reopening auctions after LULD halts on August 24. The reopening auctions on NYSE Arca generated prices that were substantially less dispersed than reopening auctions on other primary listing exchanges. The reopening auctions on NYSE Arca also left many unexecuted order imbalances. For reopening auctions with sell

imbalances, 94% of the total imbalances resulted from market orders. For reopening auctions with buy imbalances, 91% of the total imbalances resulted from orders with limit prices.

- Following LULD halts on August 24, 4,078 trades totaling $34.6 million in volume were executed at prices outside of the LULD bands that were disseminated after the halts. Reports of the trades generally were disseminated by the securities information processors ("SIPs") for the consolidated data feeds in a very short period (a few milliseconds) around the time that the SIP disseminated a trade resumption message and a message with new LULD price bands based on the reopening price of the primary listing exchange.

ETPs (Section VI):

- ETPs as a class experienced more substantial increases in volume and more severe volatility than Corporates on August 24, but individual ETPs varied widely in terms of their volatility. A majority of all ETPs (63.3%) declined by less than 10% -- a level that is consistent with broad market declines on August 24. A minority of ETPs (19.2%), however, declined by 20% or more (compared to only 4.7% of Corporates).

- Extreme volatility seemed to occur idiosyncratically among otherwise seemingly similar ETPs. SPY, for example, traded at a premium to its NAV until 9:37, while the next largest ETP – the iShares Core S&P 500 ("IVV") – traded at a substantial discount to the SPY, E-Mini, and SPY NAV until 9:43.

- The second most actively traded ETP on August 24 – the PowerShares QQQ Trust, Series 1 ("QQQ") – is designed to track the NASDAQ-100 index, which does not include any NYSE-listed constituents. All NASDAQ-100 constituents opened for regular trading hours on NASDAQ at 9:30. Similar to IVV, however, QQQ traded at a substantial discount to its NAV until 9:37.

- ETPs focused on U.S. equities ("US Equity ETPs") were much more affected on August 24 than other types of ETPs, but most (58%) did not experience a single LULD halt. For the 499 US Equity ETPs, 41.9% experienced an LULD halt and their mean percentage range for the day (reflecting the difference between their highs and lows) was 19.2%.

- Even within the category of US Equity ETPs, however, there was a wide variation in trading on August 24. Of the 114 US Equity ETPs with Large or Mid market capitalizations,[5] the most volatile 24 ETPs experienced an average of 8.2 LULD halts per ETP and had a mean percentage price range of 42.8%, while the least volatile 31 ETPs did not experience a single LULD halt and had a mean percentage price range of 7.2%.

[5] Market capitalization bins are defined in Section I below. As noted in Section VI below, Large and Mid US Equity ETPs represent 77% of the total market capitalization of US Equity ETPs.

- Section VI below explores trading metrics that are associated with these widely varying levels of volatility among seemingly similar ETPs. A pre-August 24 metric with a particularly strong association with volatility is secondary market turnover rate – the ratio of average daily volume in the secondary market for an ETP to its shares outstanding. Large and Mid market capitalization US Equity ETPs with comparatively low secondary market turnover rates in a control period were much more likely to experience severe volatility and multiple LULD halts on August 24 than ETPs with comparatively high secondary market turnover rates.

The foregoing data points are based on publicly available information. They, along with all of the empirical analyses and information provided in this Research Note, are not intended to reach or suggest any legal conclusions or factual findings regarding the causes of the volatility on August 24 or potential steps to address volatility. Rather, publication of this paper should be regarded as a preliminary step to help inform a public assessment of the operation of U.S. equity markets under stressed conditions. In this regard, SEC staff continue to examine a broad spectrum of issues related to trading on August 24. These include, among other things:

- factors that may have been associated with volatility in ETPs and other securities, including the nature of selling pressure, sources of liquidity provision, and, for ETPs, create and redeem activity;

- the effect of Regulation SHO SSRs;

- the opening process on primary listing exchanges, including the nature of trading prior to and immediately after the opening auction on the primary listing exchange;

- the reopening process following LULD halts, including the nature of participants in the reopening auctions on primary listing exchanges and the rules and practices employed by exchanges in connection with reopenings;

- the operation of the LULD Plan, particularly as it applies in the period following the opening of regular trading hours and to reopenings following LULD halts; and

- the operation of market-wide circuit breakers, particularly as they apply in the period following the opening of regular trading hours.

I. Data and Summary Statistics

Except as otherwise noted, the data used for the analyses in this paper was accessed through the SEC's Market Information and Data Analytics System ("MIDAS") and is sourced from the consolidated data feeds disseminated by the SIPs and the direct data feeds disseminated by the exchanges.

Our dataset comprises all tickers with trades reported by the SIPs for the consolidated market data plans on August 24, 2015. For most analyses, we exclude tickers that both are not included in the database of the Center for Research in Securities Prices ("CRSP") and are not included in the database of ETPs accessed through the Bloomberg Professional Service.

We further categorize included tickers based on whether they are reported in CRSP as corporate stocks (CRSP share codes 11 and 12) ("Corporates"), reported in CRSP as ETPs (CRSP share codes 73 and 74) or in Bloomberg Professional Service as ETPs. For most analyses, we exclude ETPs that are leveraged ("Leveraged ETPs"). In many respects, the Leveraged ETPs are designed to trade differently than other ETPs. They are excluded to obtain more comparable statistics.

All included tickers other than Corporates and ETPs are categorized as "Other Tickers." These include a variety of types of products, such as American Depositary Receipts and Real Estate Investment Trusts.

Corporates and ETPs are further categorized into four bins based on their market capitalization on August 24: Very Large >=$100 billion, Large >=$10 billion, Mid >=$1 billion, and Small <$1 billion.

While a variety of analyses are provided in the Sections that follow, Table I-1 below provides a few summary statistics for the various ticker categories and market capitalization bins on August 24:

Table I-1: Summary Statistics

			Market Cap			Dollar Volume		
Ticker Category	Market Cap Bin	Count	Total (Billion)	Percent of Ticker Category	Mean (Million)	Total (Million)	Percent of Ticker Category	Mean (Thousand)
Corporate	Very Large	41	$7,299	31.8	$178,029	$98,909	28.7	$2,412,421
	Large	383	$10,542	46.0	$27,526	$159,838	46.4	$417,332
	Mid	1,324	$4,389	19.2	$3,315	$78,269	22.7	$59,116
	Small	2,569	$690	3.0	$268	$7,807	2.3	$3,039
ETP	Very Large	1	$161	8.3	$160,962	$97,346	40.6	$97,346,220
	Large	49	$972	50.4	$19,843	$79,258	33.1	$1,617,512
	Mid	196	$597	30.9	$3,044	$51,057	21.3	$260,496
	Small	1,295	$199	10.3	$154	$11,922	5.0	$9,206
Other	N/A	1,334	$2,500	N/A	$1,874	$33,737	N/A	$25,290
Leveraged ETPs	N/A	213	$32	N/A	$151	$15,750	N/A	$73,943
Excluded	N/A	1,413	N/A	N/A	N/A	$2,263	N/A	$1,602

Table I-1: Summary statistics for ticker categories and market capitalization bins. Market Cap and Dollar Volume are calculated for August 24.

Market capitalization and trading volume for both Corporates and ETPs are highly tiered. The 424 largest Corporates (Very Large and Large) represent 77.8% of Corporates market capitalization and 75.1% of Corporates dollar volume on August 24. Similarly, the 246 largest ETPs (Very Large, Large, and Mid) represent 89.6% of ETP market capitalization and 95.0% of ETP dollar volume on August 24.

Two additional characteristics of ETPs warrant noting.

First, the Very Large ETP bin includes only one ticker, which is SPY. In many respects, SPY is quite different from all other ETPs. First, its market capitalization on August 24 was more than twice as large as the next largest ETP – IVV (and IVV was only 14% larger than the third largest ETP). Second, its $97.3 billion dollar volume on August 24 dwarfed all other tickers, whether ETP or Corporate. It was more than six times larger than the next highest volume ETP (QQQ), and more than five times larger than the next highest volume Corporate (AAPL).

Second, a great majority of ETPs fall within the Small market capitalization bin. The 1,295 Small ETPs represent 84.0% of ETP tickers, but only 10.3% of ETP market capitalization and 5.0% of ETP dollar volume on August 24.

II. S&P 500 and NASDAQ-100 Indices and Market-Wide Circuit Breakers

To give an overview of trading on August 24, this section examines two broad market indices – the S&P 500 index and the NASDAQ-100 index – along with selected related equities and futures.

The constituents of the S&P 500 index represented 76% of Corporates market capitalization on August 24. A majority of its constituents (77%) have their primary listing on NYSE, with the remaining 23% listed on NASDAQ. The largest ETPs related to the S&P 500 are SPY and IVV, and the most active related futures contract is the E-Mini.

The constituents of the NASDAQ-100 index represented 27% of Corporates market capitalization on August 24. All of its constituents have their primary listing on NASDAQ. The NASDAQ-100 thereby provides a useful point of comparison for assessing the extent to which some features of trading on August 24 are or are not associated with characteristics of the NYSE versus NASDAQ as a primary listing exchange. The largest ETP related to the NASDAQ-100 is QQQ, and the most active related futures contract is the E-Mini NASDAQ-100 futures contract ("N100 Future").

A. Pre 9:30 Trading

Even prior to the opening of regular trading hours on the equity markets at 9:30, the most active ETPs and futures products reflected substantial declines in the broad market indices. For the period from 9:00 to 10:00, Figure II-1 below provides relative returns from August 21 closing prices for SPY and E-Mini (top panel) and for QQQ and N100 Future (bottom panel).[6]

[6] The charts in Figure II-1 reflect prices at the end of 10-second increments to provide more precise comparisons of prices across the different products. Prices that occurred within the increments will not be reflected in the charts. Consequently, the charts may not reflect daily lows for a product if the low price occurred within a 10-second increment.

Figure II-1: Select ETPs and Futures – Relative Returns from 9:00 to 10:00

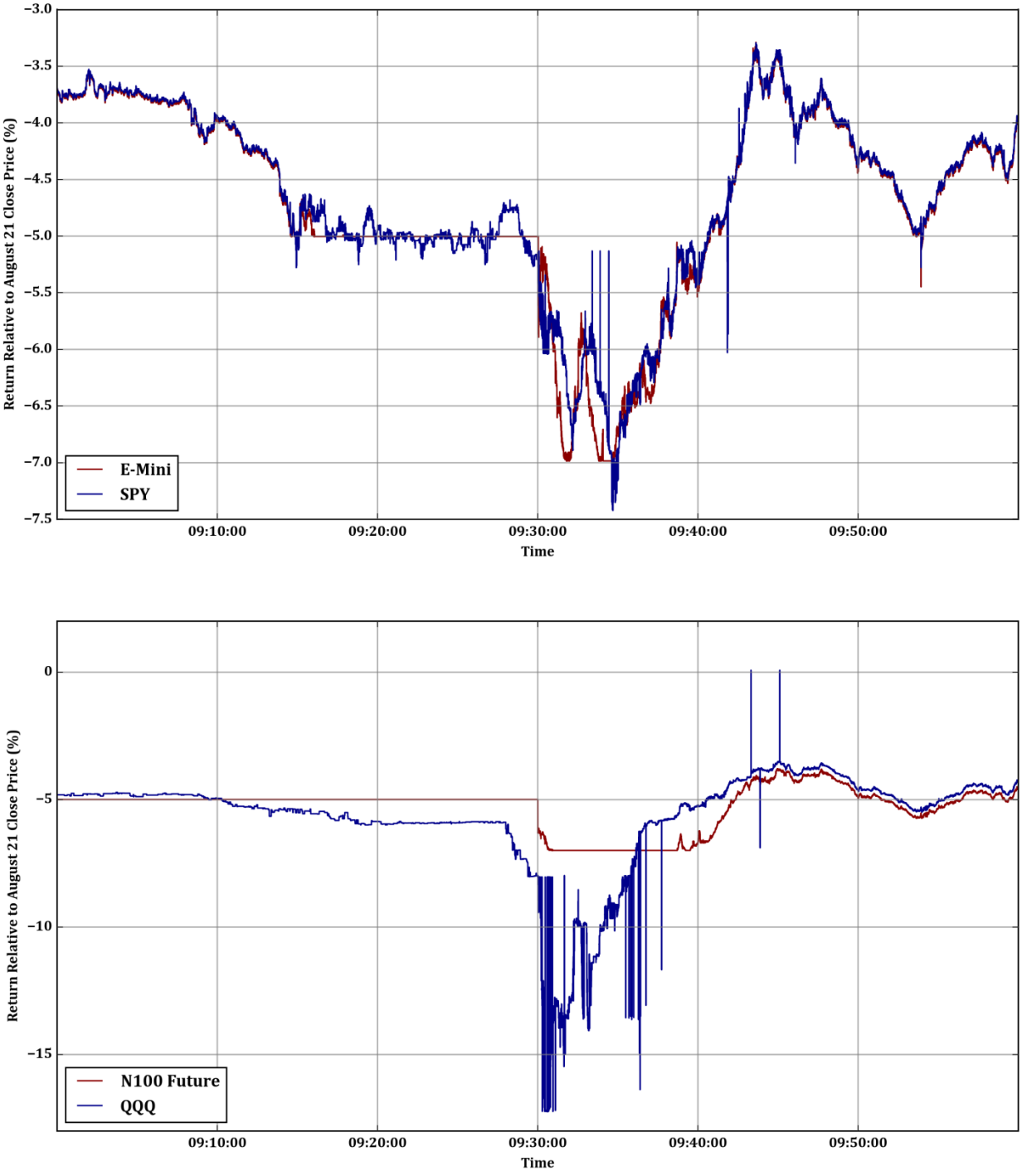

Figure II-1: Return relative to August 21 close for the E-mini and SPY (top panel) and the N100 Future and QQQ (bottom panel) from 9:00 to 10:00.

By 9:00, SPY and E-Mini had declined nearly 4% from their previous day close, and QQQ and N100 Future had declined by 5%. Indeed, N100 Future had reached its pre-9:30 limit down level of 5% (reflected in the horizontal line on its chart).

From 9:00 a.m. to 9:30 a.m., prices continued to decline. By 9:30, SPY was down more than 5%. At approximately 9:15, E-Mini reached its pre-9:30 limit down level of 5% (reflected in the horizontal line on its chart). QQQ declined further to more than 8% by 9:30.

At 9:25, both E-Mini and N100 Future paused for trading until the 9:30 opening of regular trading hours in the equity markets. Both products trade on the Chicago Mercantile Exchange ("CME"), and its rules prescribed a pause at 9:25 because the prices of the products had reached their pre-9:30 limit down levels for a sustained period of time. E-Mini and N100 Future reopened for trading at 9:30 with wider limit down levels of 7%.

B. Start of Regular Trading Hours

At the 9:30 start of regular trading hours for the equity markets, the primary listing exchanges conduct opening auctions in their listed tickers (and sometimes others). The primary listing exchange is NYSE Arca for SPY and NASDAQ for QQQ, both of which conduct a fully automated opening auction in their listed products.

Figure II-1 above indicates that SPY opened consistent with its pre-9:30 decline of more than 5%. The SPY then further declined to more than 7% by 9:35, before recovering above its opening price by 9:40. Consistent with SPY, E-Mini opened at a more than 5% decline and then further declined to its wider limit down level of 7%, before recovering largely in line with SPY.

QQQ and N100 Future traded quite differently – both from each other and when compared to the S&P 500 products. QQQ opened consistent with its pre-9:30 price level, but rapidly declined to its daily low of approximately 17% at 9:31. QQQ then recovered in choppy trading, exceeding its open price at approximately 9:36. N100 Future, as with E-Mini, reopened on CME at 9:30 with a lower limit down level of 7%. It immediately hit the 7% limit down level and remained there until approximately 9:38. when it began to recover. By 9:45, it was trading largely in line with QQQ.

C. Tracking of Indices and Related Products

To help further assess the extent to which the broad-market indices and related products tracked each other during regular trading hours, Figure II-2 below charts prices throughout the trading day of SPX (as calculated and disseminated by S&P DJI), SPY, IVV, E-Mini, and SPY NAV (as we computed based on consolidated last sale prices). Figure II-3 below provides the same

chart in relative returns[7] for the NASDAQ-100 index ("NDX"), QQQ, N100 Future, and QQQ NAV (as we computed based on consolidated last sale prices).

Figure II-2: Ten Second Prices for SPX, SPY, IVV, E-Mini, and SPY NAV

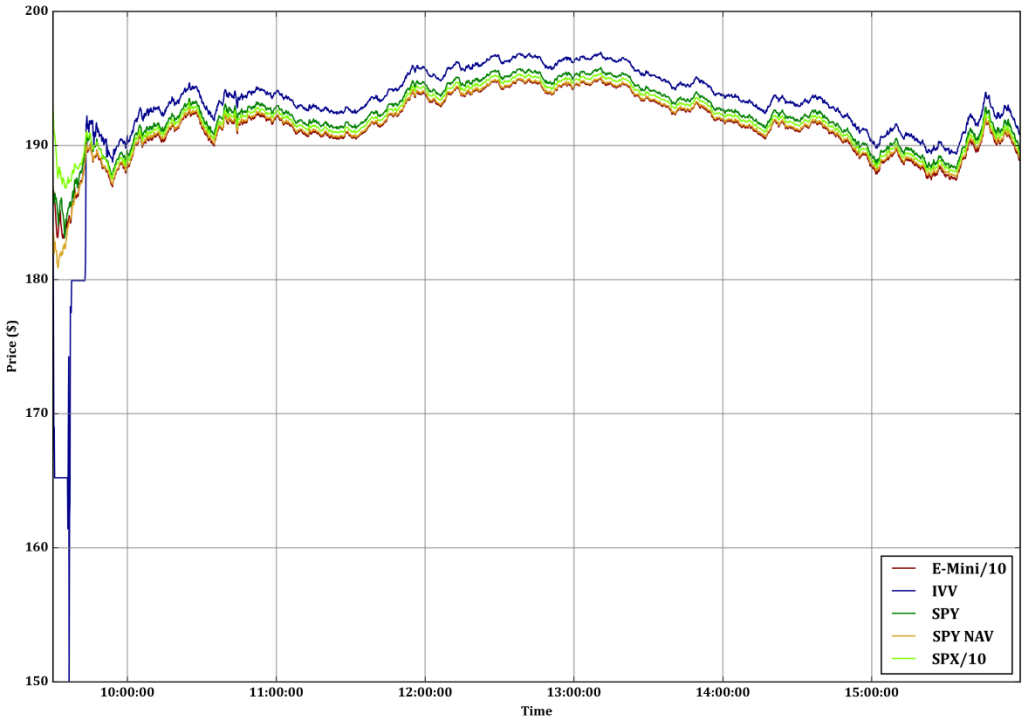

Figure II-2: End-of-period (last trade) prices on August 24 for SPX, SPY, E-Mini, IVV, and computed SPY NAV.

[7] Figure II-3 provides returns from August 21 close, rather than prices, to adjust for the different pricing convention of QQQ relative to NDX.

Figure II-3: Ten Second Relative Returns for NDX, QQQ, N100 Future, and QQQ NAV

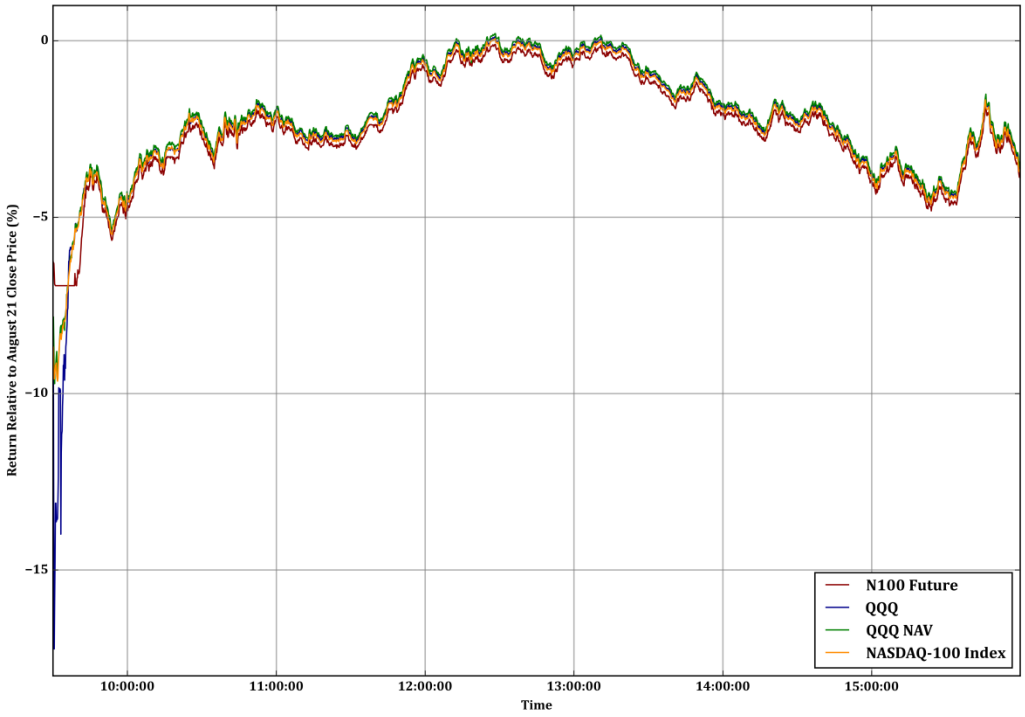

Figure II-3: Return relative to August 21 close for NDX, QQQ, N100 Future, and computed NAV for QQQ.

Both Figure II-2 and Figure II-3 indicate that prices of the broad-market indices and their related products tracked each other closely throughout nearly all of the trading day, with the notable exception of the first 15 minutes of trading.

To better illustrate how prices diverged during the opening minutes of trading, Figures II-4 and II-5 below provide the same charts as above, except limited to the period from 9:30 to 10:00 and with prices in 100 millisecond intervals.

Figure II-4: 100 Millisecond Prices for SPX, SPY, IVV, E-Mini, and SPY NAV
9:30 to 10:00

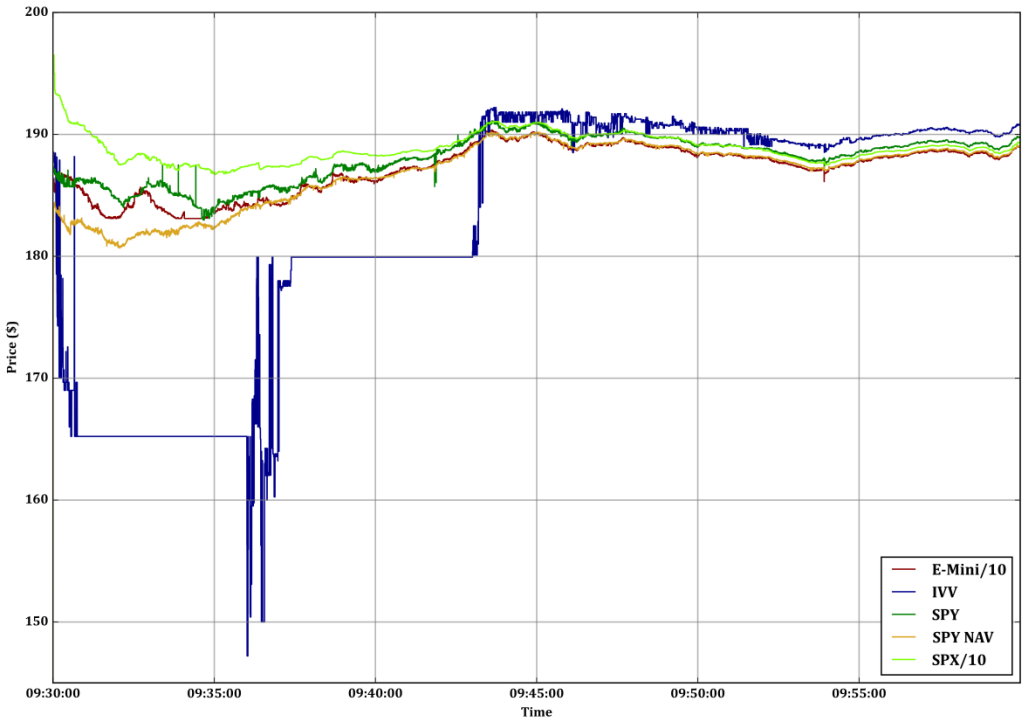

Figure II-4: End-of-period (last trade) prices for 9:30 to 10:00 on August 24 for SPX, SPY, IVV, E-Mini, and computed SPY NAV.

Figure II-5: 100 Millisecond Relative Returns for NDX, QQQ, N100 Future, and QQQ NAV 9:30 to 10:00

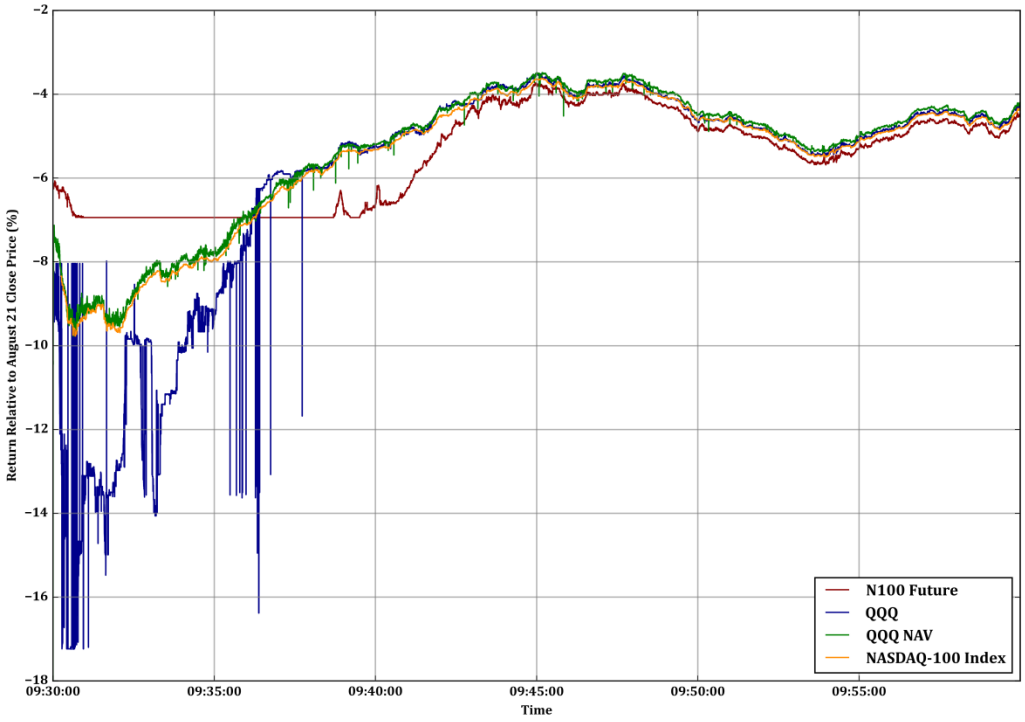

Figure II-5: Return relative to August 21 close for NDX, QQQ, N100 Future, and computed QQQ NAV.

For the SPX and related products, Figure II-4 indicates that SPY, E-Mini, and SPY NAV varied somewhat during the initial minutes of regular trading hours, but began tracking relatively closely at 9:38. Both SPY and E-Mini traded at a premium to SPY NAV during this period. In contrast, SPX and IVV varied more substantially and for longer periods from SPY, E-Mini, and SPY NAV.

SPX opened higher than all other related prices and remained higher until it largely began to track SPY, E-Mini, and SPY NAV at 9:43. This variation between SPX and related products likely is attributable to the S&P DJI methodology for calculating SPX. S&P DJI generally relies on trades executed by only the primary listing market to calculate SPX. As discussed further in Section IV below, many NYSE-listed stocks did not open immediately at 9:30 on the NYSE (though they were immediately open for trading at other exchanges and off-exchange venues). On the morning of August 24, the SPX calculation would have continued to reflect August 21 closing prices for NYSE-listed stocks that were not yet opened on NYSE. Based on this methodology, SPX reached its daily low of a little more than 5% at 9:35 and then recovered. At around 9:42, SPX began to track closely with SPY, E-Mini, and SPY NAV.

In contrast to SPX, IVV declined much farther than SPY, E-Mini, and SPY NAV immediately after 9:30. IVV reached a daily low of a more than 20% below its previous day's close, thereby trading at a large discount to SPY, E-Mini, and SPY NAV. At approximately 9:43, IVV fully recovered and began to closely track the other S&P 500 prices throughout the day. The issue of severe ETP volatility relative to broad-market indices is addressed in Section VI below.

Turning to NDX and related products, Figure II-5 above indicates that NDX and QQQ NAV tracked each other closely soon after the open. They opened at an approximately 8% decline, declined further to nearly 10% at 9:32, and then recovered above their opening prices by 9:35.

In contrast, N100 Future almost immediately hit its limit down level of 7% after 9:30 and remained there until 9:38 before beginning to recover. By 9:42, N100 Future began to track the other NASDAQ-100 prices closely throughout the trading day.

Finally, QQQ declined much more substantially immediately after the open than did NDX and QQQ NAV. It reached a daily low of more than 17% down at 9:31, thereby trading at a large discount to NDX and QQQ NAV. After trading choppily for several minutes, QQQ began to closely track NDX and QQQ NAV at 9:37. The issue of severe ETP volatility relative to broad-market indices is addressed in Section VI below.

D. Market-Wide Circuit Breakers

The fact that SPX did not decline as far as its related products on August 24 had a significant effect on market-wide circuit breakers established by SRO rules, which are outlined in Table II-1 below.[8]

Table II-1: Market-Wide Circuit Breakers

Circuit Breaker Level	SPX Decline	Through 3:25 p.m.	After 3:25 p.m.
One	7%	15-minute halt	No halt
Two	13%	15-minute halt	No halt
Three	20%	Close for day	Close for day

The first level of market-wide circuit breakers is triggered when SPX, as calculated and disseminated by S&P DJI, declines by 7% during regular trading hours from its previous day's close. At this point, trading is paused for 15 minutes in all equities and equities related futures and options. Unlike the prices for SPX-related products, however, SPX itself did not decline by 7% or more in the opening minutes of regular trading hours. Consequently, market-wide circuit breakers were not triggered on August 24.

[8] The market-wide circuit breakers are described in SEC Press Release No. 2012-107, "SEC Approves Proposals to Address Extraordinary Volatility in Individual Stocks and Broader Stock Market" (June 1, 2012) (available at http://www.sec.gov/News/PressRelease/Detail/PressRelease/1365171482422).

III. Trading in Corporates and ETPs

To broaden the analysis of trading on August 24, this Section III provides data on a variety of trading and market quality metrics for the more than 4,000 Corporates and more than 1,500 ETPs that traded that day. We first provide data on percentage declines and Regulation SHO short sale restrictions (which generally are triggered by a 10% decline from previous day's close). Next are charts comparing total share volume[9] and national best bid and offer ("NBBO") sizes on August 24 with a control day -- the preceding Monday, August 17. Finally, we provide charts comparing dollar volume, quoted spreads, and quoted depth on August 24 with a longer control period – the three-week period from August 3 to August 21, 2015.

A. Percentage Declines

Figure III-1 below provides histograms that set forth percentage declines (August 21 close to August 24 low) for Corporates, and Figure III-2 below provides histograms that set forth percentage declines for ETPs. Both Corporates and ETPs are binned by market capitalization. Following the histograms, Tables III-1 and III-2 below set forth counts of the data underlying the histograms. The data sources for the histograms and tables are the consolidated data feeds disseminated by the SIPs.

The histograms and tables indicate that Very Large Corporates experienced a larger percentage of severe declines on August 24 than other sizes of Corporates, with a proportionally higher number of tickers experiencing declines of 10% or more. For example, 51.2% of the 41 Very Large Corporates reached lows of 10% or more, while only 29.6% of the more than 4,000 Corporates in the Large, Mid, and Small bins reached lows of 10% or more.

As a class, ETPs experienced larger percentage declines than Corporates, with a proportionally higher number of tickers experiencing declines of 10% or more (36.6% of all ETPs compared to 29.8% of all Corporates). As just noted, however, Very Large Corporates experienced a rate of 10% or more declines (51%) that was greater than ETPs as a class (36.6%).

Moreover, individual ETPs varied widely in terms of their volatility. While 19.2% of all ETPs declined by 20% or more, 63.4% of all ETPs experienced declines of less than 10% -- a level that is consistent with broad market declines on August 24. The wide variation in volatility among ETPs is addressed further in Section VI below.

[9] The volume figures in this Section III do not include volume in opening, reopening, and closing crosses. Openings and reopenings are addressed in Section IV and V, respectively.

Figure III-1: Percentage Declines (Corporates)

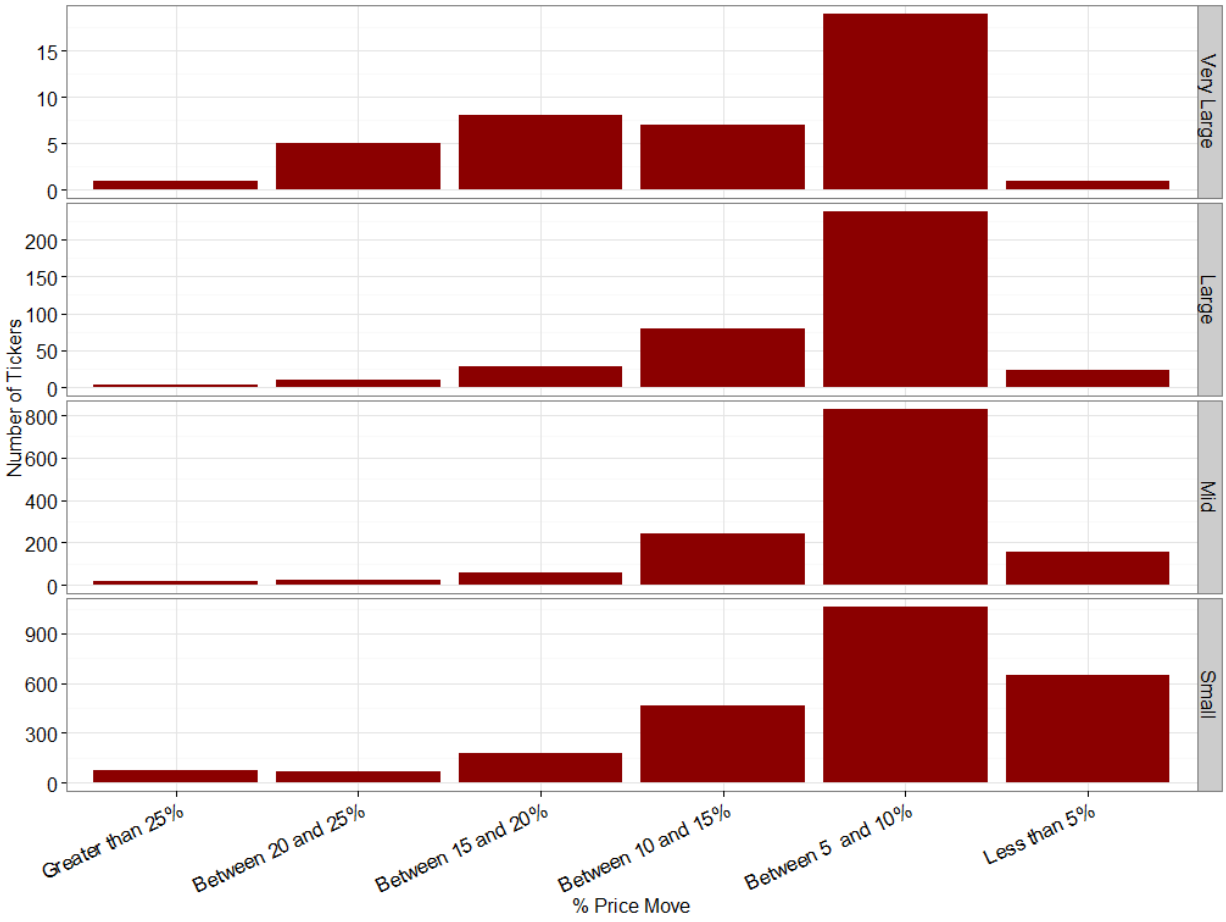

Figure III-1: Histograms of downward price moves[10] for Corporates split by market capitalization buckets on August 24. 5% increment bins are chosen.[11]

[10] We calculate price moves from last traded price on August 21, 2015 to lowest traded price on August 24, 2015.

[11] Intervals are closed only at the smaller number. For example, a 10% move would fall into the 10-15% bucket, not in the 5-10% bucket.

Figure III-2: Percentage Declines (ETPs)

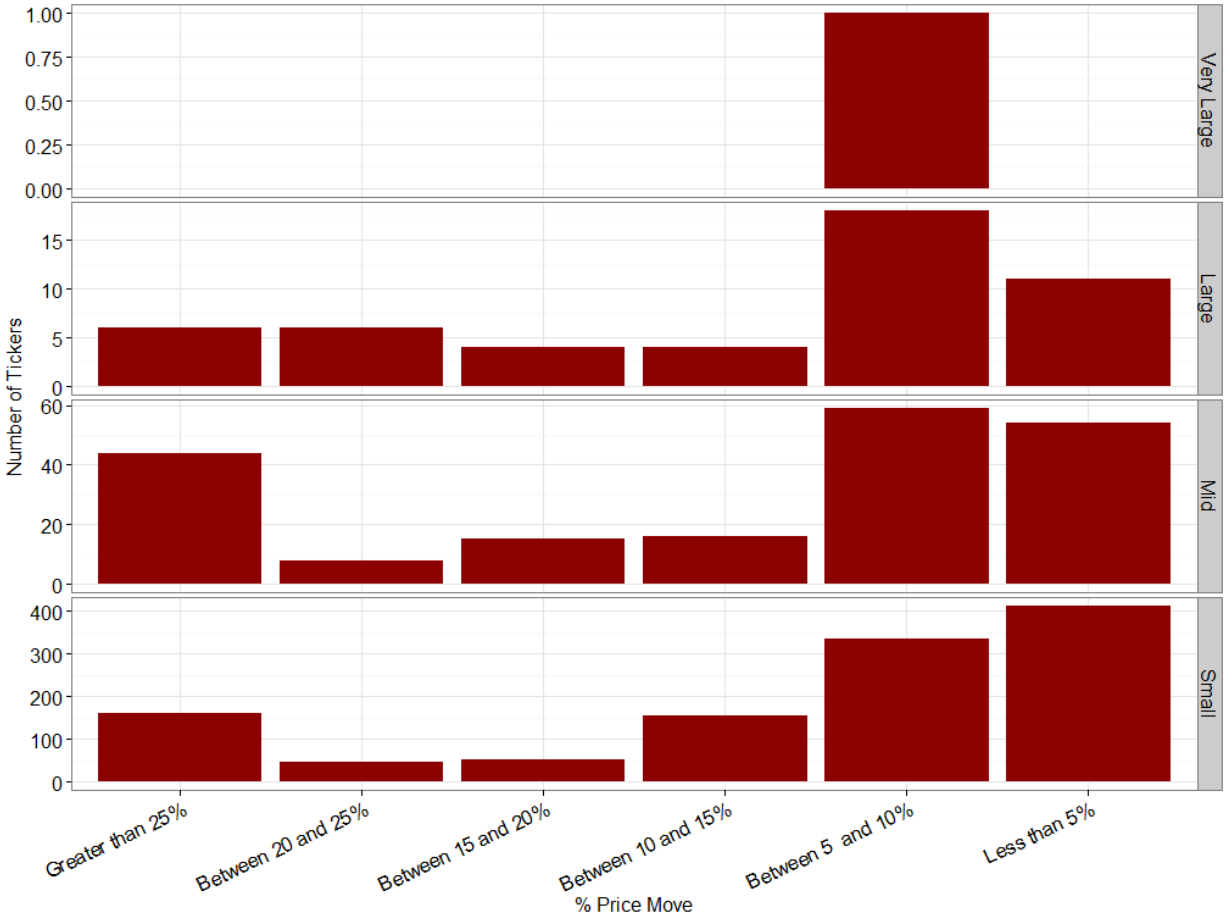

Figure III-2: Histograms of downward price moves for ETPs split by market capitalization buckets on August 24. 5% increment bins are chosen.

Table III-1: Percentage Declines (Corporates)

Market Capitalization	Price Move	Counts
Very Large	Greater than 25%	1
Very Large	Between 20 and 25%	5
Very Large	Between 15 and 20%	8
Very Large	Between 10 and 15%	7
Very Large	Between 5 and 10%	19
Very Large	Less than 5%	1
Total		**41**
Large	Greater than 25%	3
Large	Between 20 and 25%	10
Large	Between 15 and 20%	29
Large	Between 10 and 15%	79
Large	Between 5 and 10%	238
Large	Less than 5%	24
Total		**383**
Mid	Greater than 25%	16
Mid	Between 20 and 25%	22
Mid	Between 15 and 20%	59
Mid	Between 10 and 15%	243
Mid	Between 5 and 10%	829
Mid	Less than 5%	154
Total		**1,323**[12]
Small	Greater than 25%	73
Small	Between 20 and 25%	70
Small	Between 15 and 20%	175
Small	Between 10 and 15%	466
Small	Between 5 and 10%	1061
Small	Less than 5%	652
Total		**2,497**[13]
Total (ALL)		**4,244**

Table III-1: Counts of downward price moves for Corporates split by market capitalization buckets on August 24. 5% increment bins are chosen.

[12] One Mid Corporate did not trade on both days.

[13] 72 Small Corporates did not trade on both days.

Table III-2: Percentage Declines (ETPs)

Market Capitalization	Price Move	Counts
Very Large	Between 5 and 10%	1
Total		**1**
Large	Greater than 25%	6
Large	Between 20 and 25%	6
Large	Between 15 and 20%	4
Large	Between 10 and 15%	4
Large	Between 5 and 10%	18
Large	Less than 5%	11
Total		**49**
Mid	Greater than 25%	44
Mid	Between 20 and 25%	8
Mid	Between 15 and 20%	15
Mid	Between 10 and 15%	16
Mid	Between 5 and 10%	59
Mid	Less than 5%	54
Total		**196**
Small	Greater than 25%	160
Small	Between 20 and 25%	46
Small	Between 15 and 20%	52
Small	Between 10 and 15%	154
Small	Between 5 and 10%	336
Small	Less than 5%	412
Total		**1,160**[14]
Total (ALL)		**1,406**

Table III-2: Counts of downward price moves for ETPs split by market capitalization buckets on August 24. 5% increment bins are chosen. SPY is the only Very Large ETF in this analysis.

[14] 135 Small ETPs did not trade on both days.

B. Regulation SHO Short Sale Restrictions

Under Rule 201 of Regulation SHO, short-sale restrictions ("SSRs") generally are triggered when a ticker's price declines 10% below the previous day's close. At that point, short sale orders (other than those that are exempt) generally cannot be executed at prices that are equal to or lower than the national best bid. When triggered, the SSRs continue for the rest of that trading day ("new triggers") and carryover to all of the next trading day ("carryovers"). In addition, for a security primarily listed on the NYSE, NYSE rules provide that new triggers cannot occur on a trading day until the NYSE has opened trading in that security.

1. Total Number of SSRs

SSRs were implemented in February 2011. Since then, the largest number of new triggers was 2,318 on August 8, 2011.[15] On August 24, new SSR triggers totaled 2,069. The great majority, however, occurred by 9:45.

Table III-3 below sets forth the number of new triggers and carryovers from 9:30 to 10:00 on August 24.

[15] Data used in this Section III.B for calculating the number of Regulation SHO SSRs was obtained from NASDAQ and NYSE for securities primarily listed on NASDAQ, NYSE, NYSE Arca, and NYSE MKT.

Table III-3: SSR Triggers on August 24

	Corporates		ETPs		Other		Total
Time	8/24 New Triggers	8/21 Carryovers	8/24 New Triggers	8/21 Carryovers	8/24 New Triggers	8/21 Carryovers	
9:31:00	276	166	347	23	57	67	936
9:32:00	369	166	402	23	73	67	1,100
9:33:00	443	166	423	23	93	67	1,215
9:34:00	510	166	447	23	119	67	1,332
9:35:00	587	166	465	23	138	67	1,446
9:36:00	642	166	482	23	155	67	1,535
9:37:00	674	166	493	23	171	67	1,594
9:38:00	699	166	504	23	187	67	1,646
9:39:00	731	166	509	23	198	67	1,694
9:40:00	747	166	513	23	206	67	1,722
9:41:00	775	166	516	23	225	67	1,772
9:42:00	790	166	522	23	247	67	1,815
9:43:00	806	166	527	23	266	67	1,855
9:44:00	823	166	528	23	275	67	1,882
9:45:00	829	166	530	23	288	67	1,903
9:46:00	838	166	534	23	299	67	1,927
9:47:00	849	166	535	23	310	67	1,950
9:48:00	857	166	536	23	319	67	1,968
9:49:00	863	166	537	23	324	67	1,980
9:50:00	870	166	537	23	334	67	1,997
9:51:00	876	166	539	23	339	67	2,010
9:52:00	879	166	539	23	344	67	2,018
9:53:00	888	166	540	23	349	67	2,033
9:54:00	900	166	541	23	352	67	2,049
9:55:00	906	166	541	23	360	67	2,063
9:56:00	915	166	542	23	363	67	2,076
9:57:00	919	166	542	23	366	67	2,083
9:58:00	924	166	542	23	367	67	2,089
9:59:00	929	166	542	23	368	67	2,095
10:00:00	934	166	545	23	369	67	2,104

Table III-3: Cumulative number of SSR triggers on August 24 2015 from 9:30 to 10:00 split by security type and carryovers from the previous day (excluding securities primarily listed on BATS).

2. SSRs in S&P 500 and NASDAQ-100 Constituents

Under Regulation SHO, SSRs are designed, among other things, to prevent short selling from driving down further the price of a security that has already experienced a significant intra-day price decline, and to facilitate the ability of long sellers to sell first upon such a decline.[16] In this respect, some have suggested that SSRs could affect the ability of traders to engage in arbitrage between an ETP and its underlying constituents.[17] This effect could occur if an ETP's price declined faster than the price of a basket of its underlying constituents. In this situation, arbitrage typically would be conducted by buying the relatively underpriced ETP and selling the relatively overpriced basket of underlying constituents. For traders that were short the underling constituents, their ability to conduct this type of arbitrage could be affected by SSRs. If so, SSRs potentially could help reduce selling pressure in the underlying Corporates of an index that had experienced a large intraday decline, but also could reduce buying in an ETP based on the index.

To help assess the extent of a potential effect on arbitrage in products related to the S&P 500 and NASDAQ-100 indices, Figures III-3 through III-6 below set forth the number and market capitalization of constituents of the two indices that were subject to SSRs on August 24. SSRs were triggered in 108 constituents representing more than 37% of the market capitalization of the S&P 500, and in 42 constituents representing more than 50% of the market capitalization of the NASDAQ-100.

[16] Securities Exchange Act Release No. 61595, "Amendments to Regulation SHO," 75 FR 11232, 11234 (March 10, 2010).

[17] *See, e.g.,* Nick Baker, "Speed Traders Offer ETF Fix to Prevent Repeat of August Rout" (September 25, 2015) (available at http://www.bloomberg.com/news/articles/2015-09-25/speed-traders-propose-etf-fix-to-prevent-repeat-of-aug-24-rout).

Figure III-3: S&P 500 Constituents with SSRs (Counts)

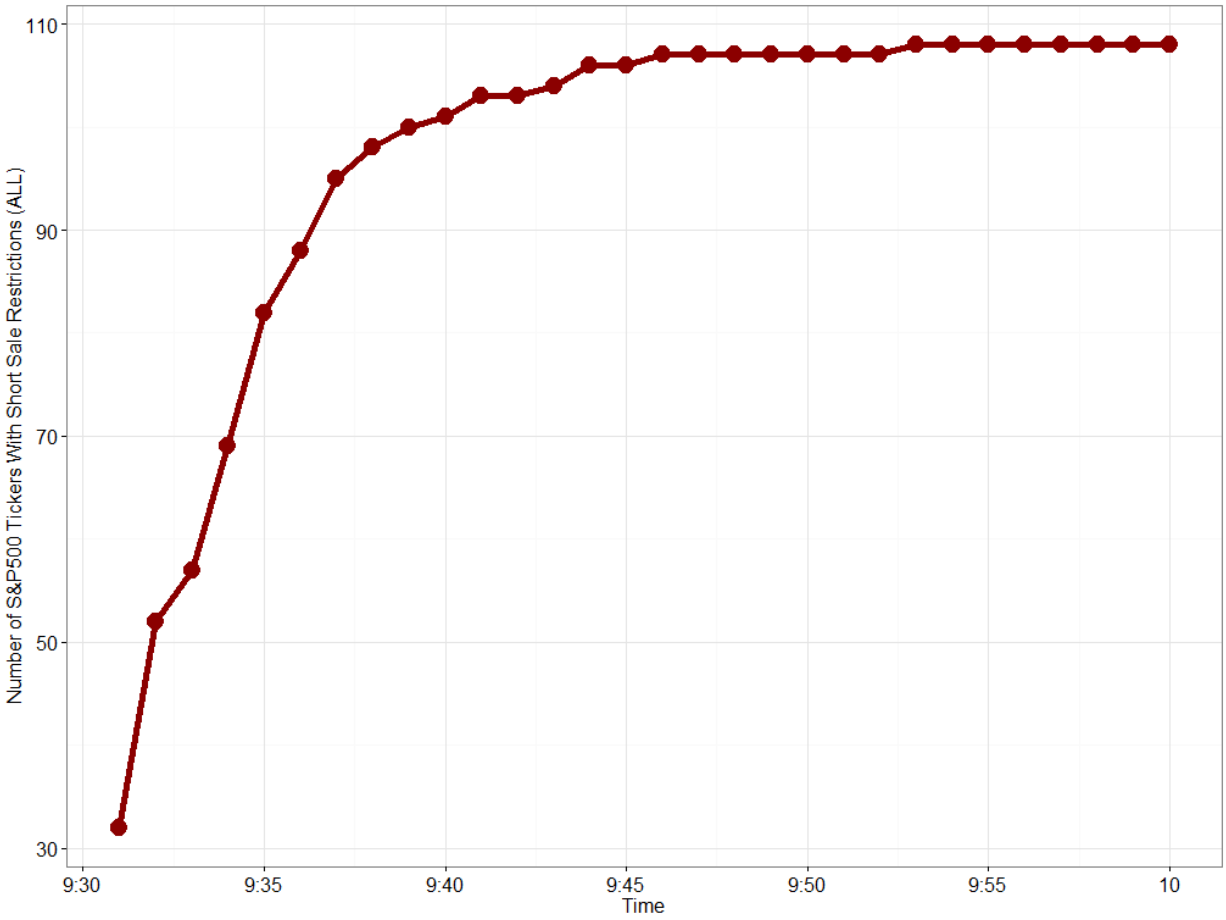

Figure III-3: Number of S&P 500 constituents with SSRs on August 24 between 9:30 and 10:00. All tickers but one were new triggers.

Figure III-4: S&P 500 Constituents with SSRs (Market Cap)

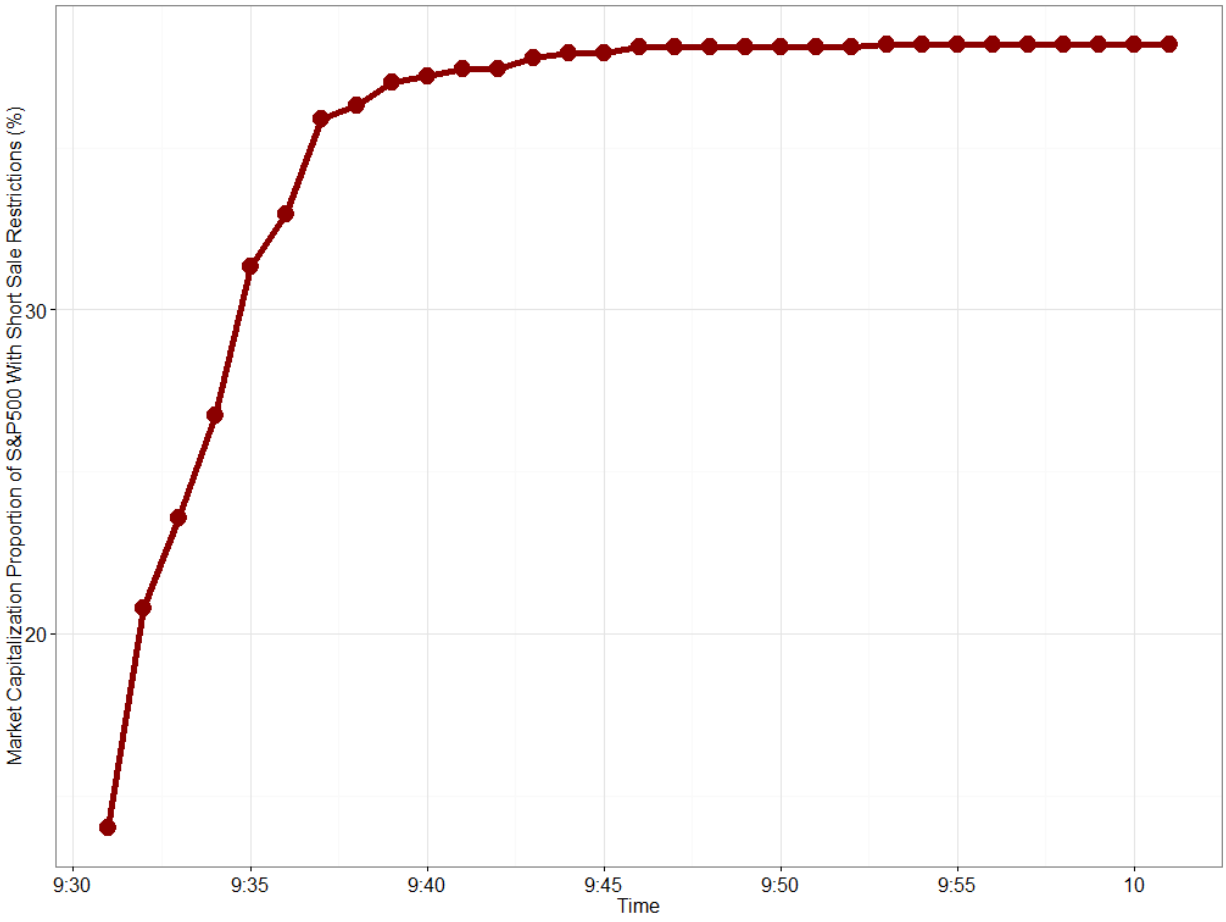

Figure III-4: Cumulative market capitalization proportion of S&P 500 constituents with SSRs on August 24 between 9:30 and 10:00.

Figure III-5: NASDAQ-100 Constituents with SSRs (Counts)

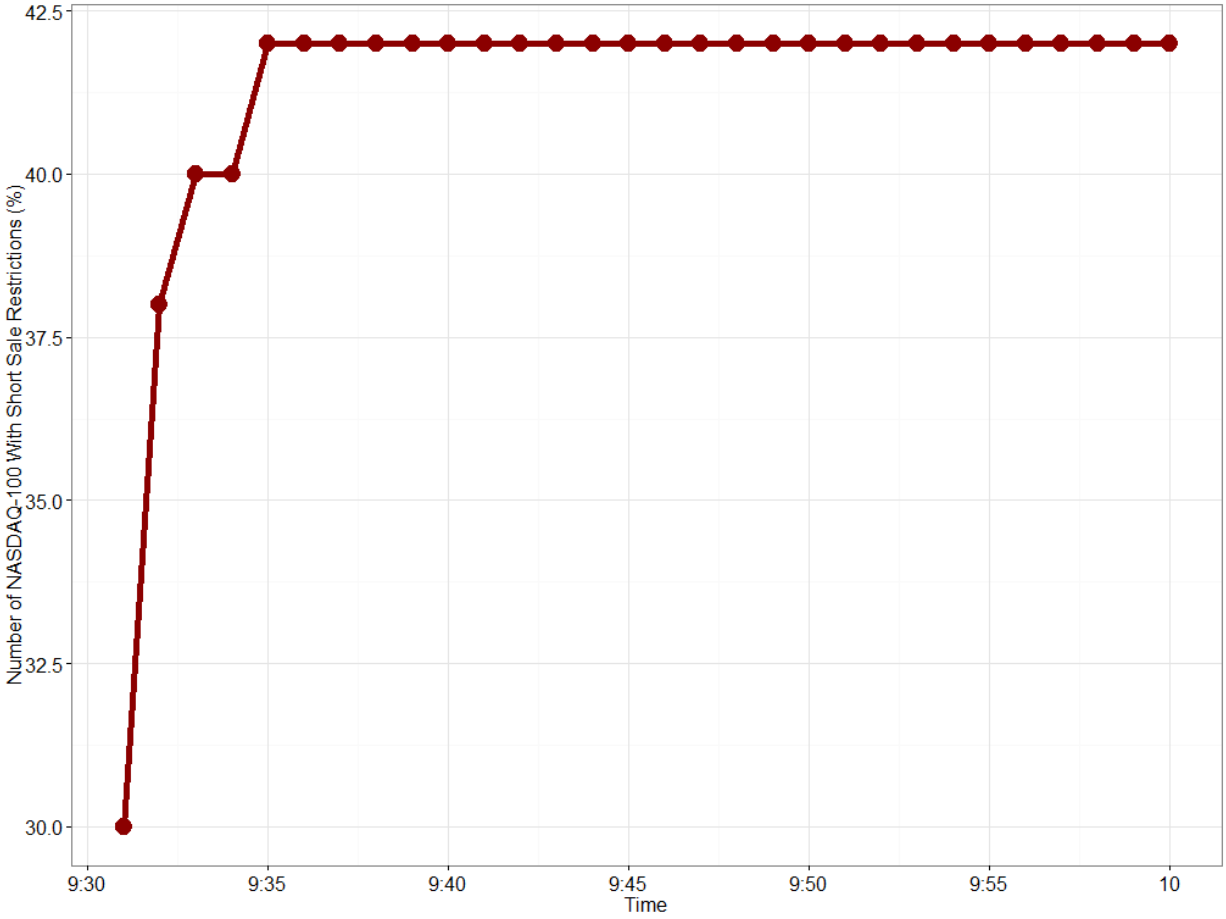

Figure III-5: Number of NASDAQ-100 constituents with SSRs on August 24 between 9:30 and 10:00. All tickers except two were new triggers.

Figure III-6: NASDAQ-100 Constituents with SSRs (Market Cap)

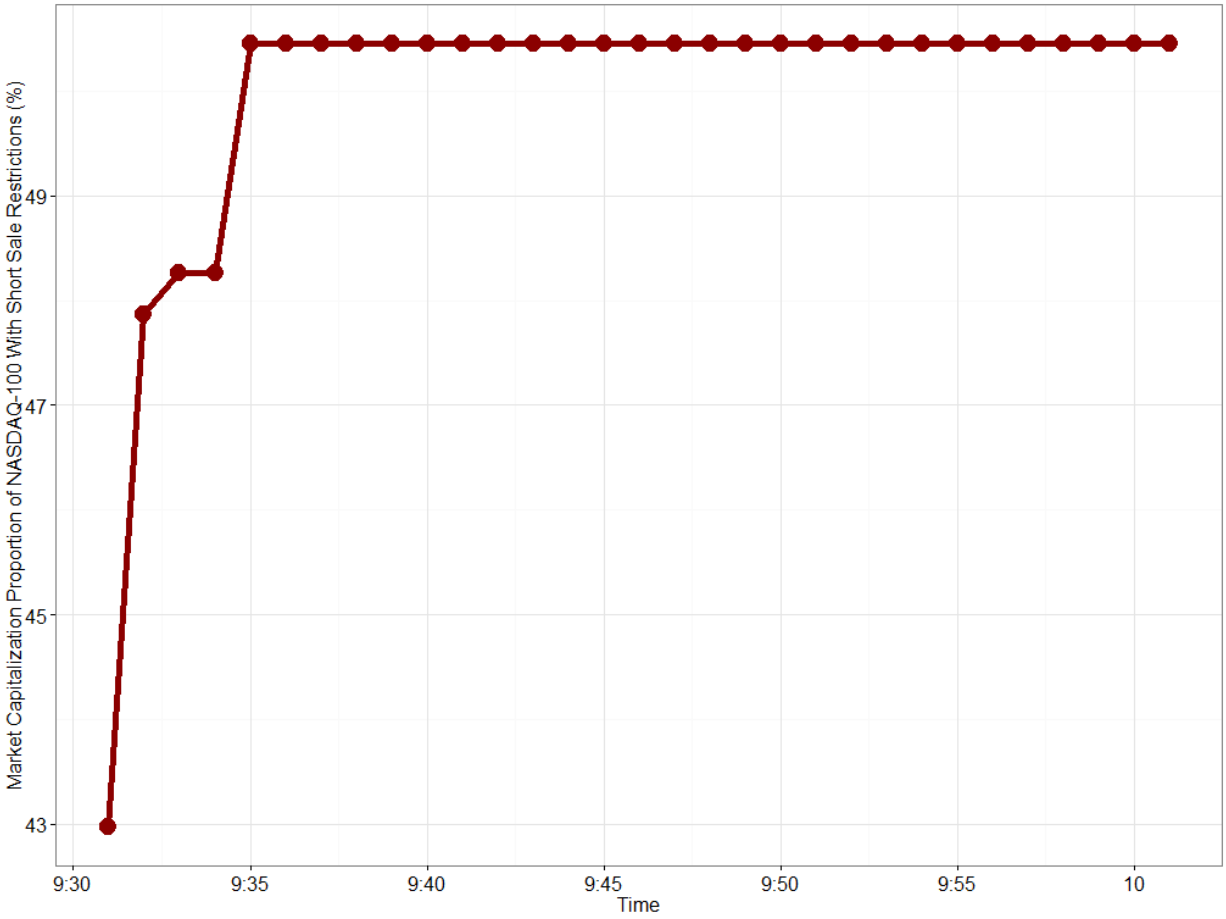

Figure III-6: Cumulative market capitalization proportion of NASDAQ-100 constituents with SSRs on August 24 between 9:30 and 10:00.

C. Share Volume and NBBO Sizes

Figures III-7 through III-18 below provide average (mean) share volume[18] and average (mean) NBBO size comparisons of trading on August 24 with a control day of the preceding Monday, August 17, 2015. Corporates and ETPs are treated separately, and each is binned by market capitalization. For each metric, a chart with full day data is provided, followed by the same chart focused on the first thirty minutes of trading. The data sources for the charts are the consolidated data feeds disseminated by the SIPs.

On August 24, average share volume was substantially larger in the opening minutes than the control day for all sizes of Corporates and ETPs, and remained higher through the trading day. Volume in the opening minutes was particularly higher than the control day for Very Large Corporates and for Large, Mid, and Small ETPs.

For both Corporates and ETPs on the control day, average NBBO bid and ask sizes generally are smallest in the opening minutes and improve through the trading day. On August 24, this intraday pattern continued, though with generally smaller sizes.

[18] The volume figures in this Section III do not include volume in opening, reopening, and closing crosses. Openings and reopenings are addressed in Section IV and V, respectively.

Figure III-7: Average Traded Share Volume (Corporates)

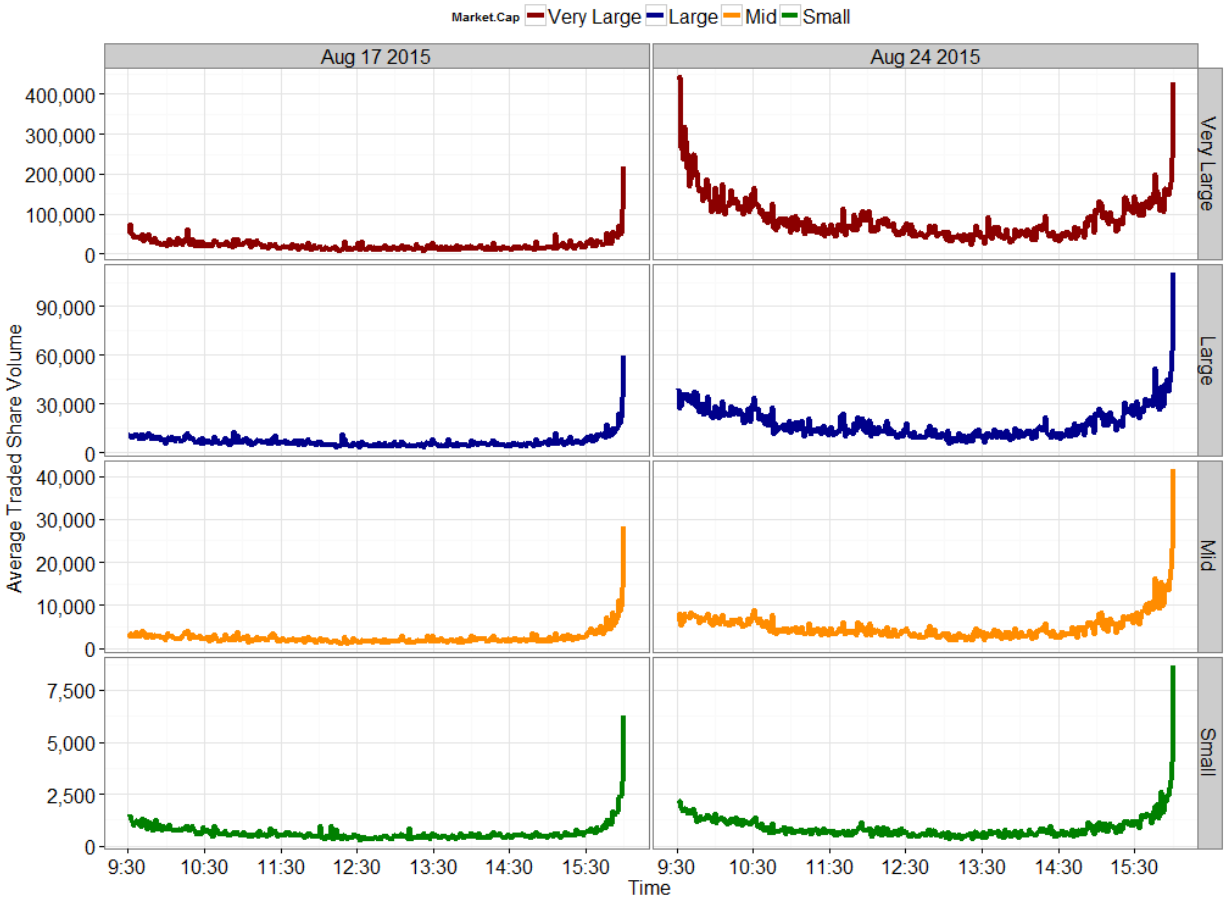

Figure III-7: Average traded share volume for Corporates by market capitalization for each minute on August 24 compared to August 17.

Figure III-8: Average Traded Share Volume (Corporates) – 9:30 to 10:00

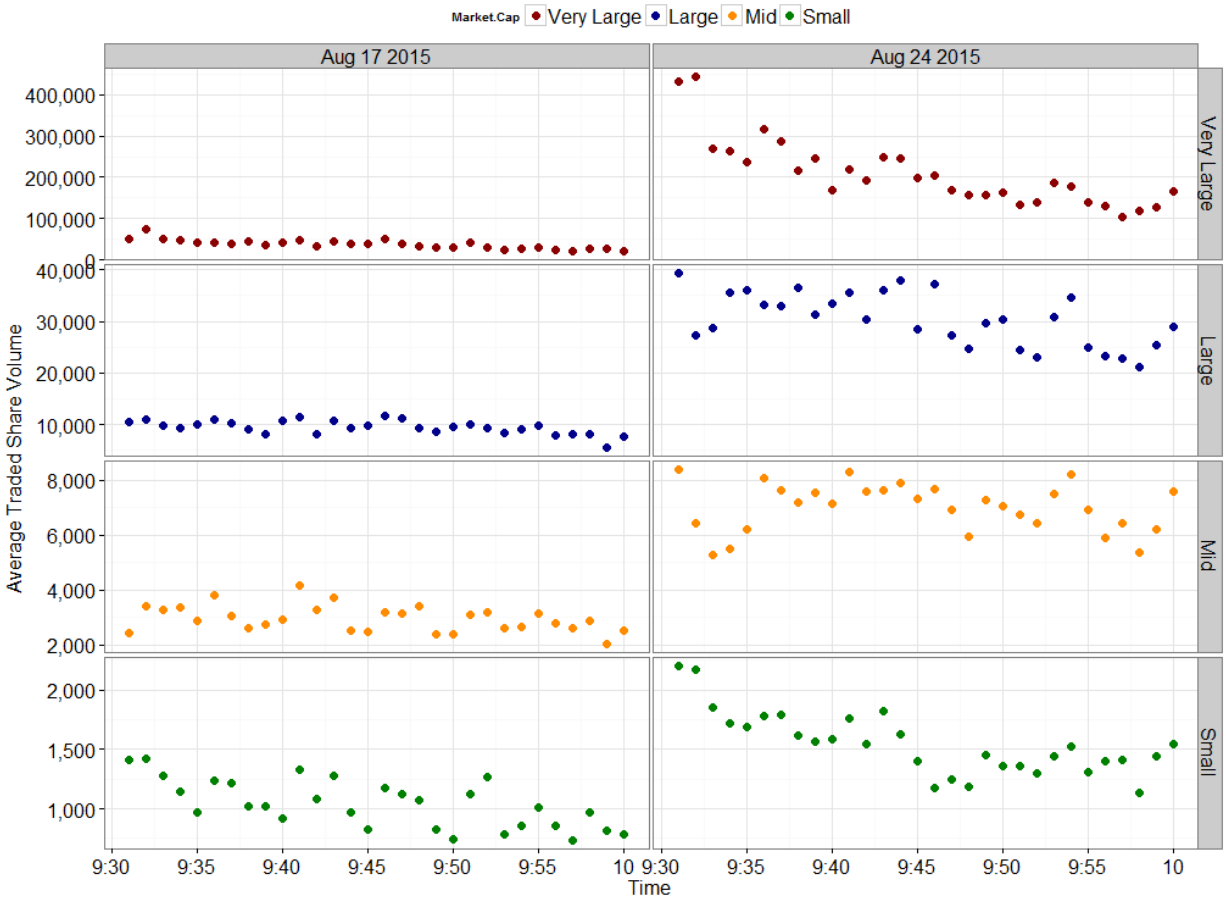

Figure III-8: Average traded share volume for Corporates by market capitalization for each minute from 9:30 to 10:00 on August 24 compared to August 17. [19]

[19] The volume in the interval from 9:30 to 9:31 (the first minute of trading in normal trading hours) is shown at 9:31 in this chart.

Figure III-9: Average Traded Share Volume (ETPs)

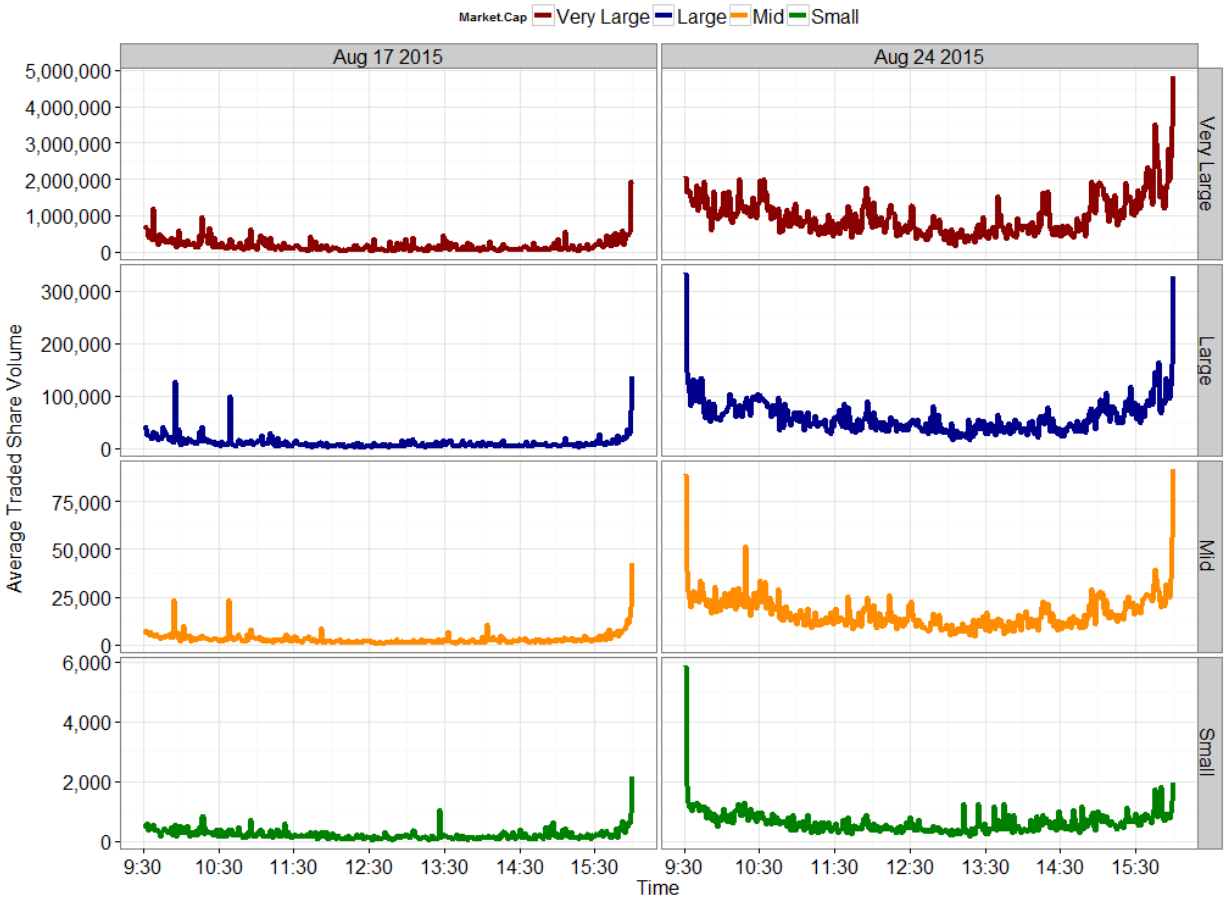

Figure III-9: Average traded share volume for ETPs by market capitalization for each minute on August 24 compared to August 17.

Figure III-10: Average Traded Share Volume (ETPs) – 9:30 to 10:00

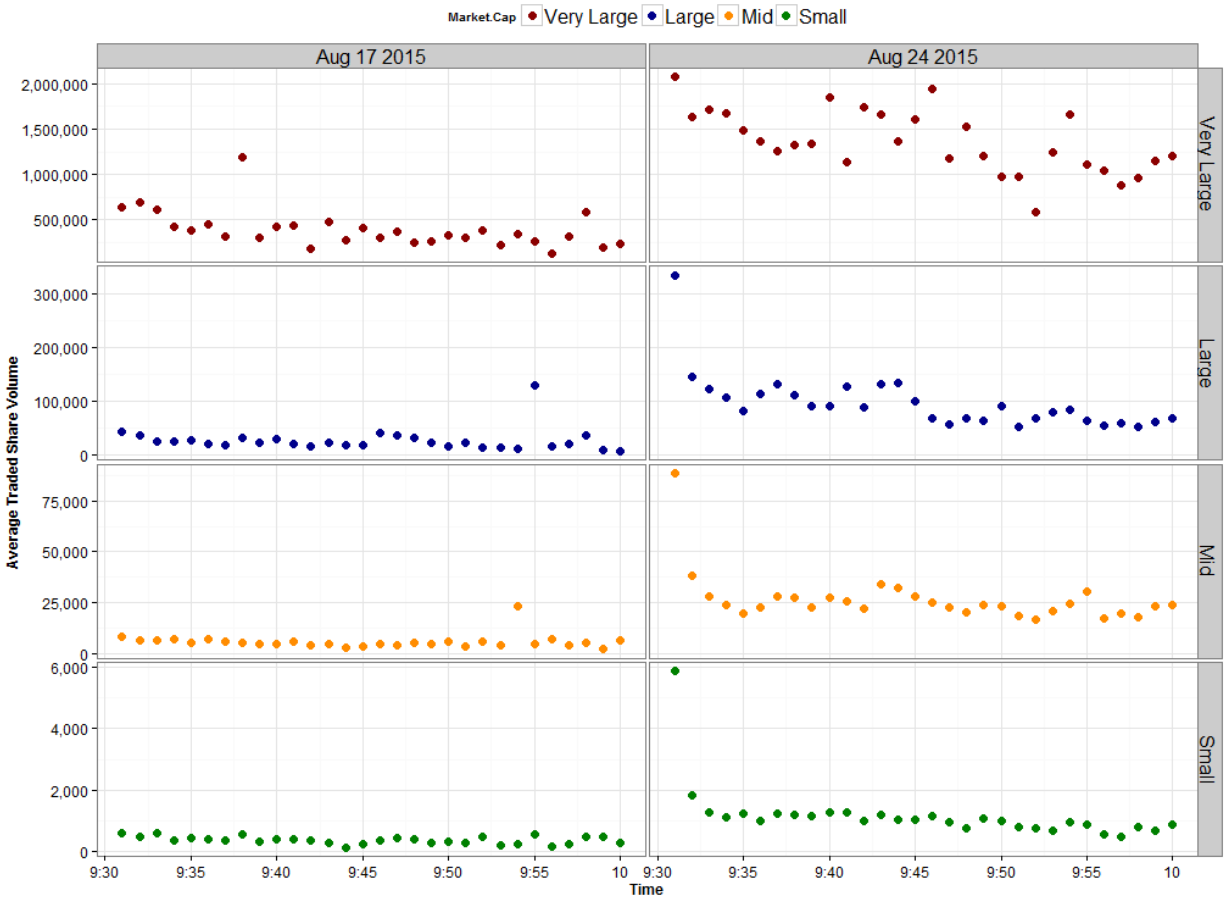

Figure III-10: Average traded share volume for ETPs by market capitalization for each minute between 9:30 and 10:00 on August 24 compared to August 17.

Figure III-11: Average National Best Bid Size (Corporates)

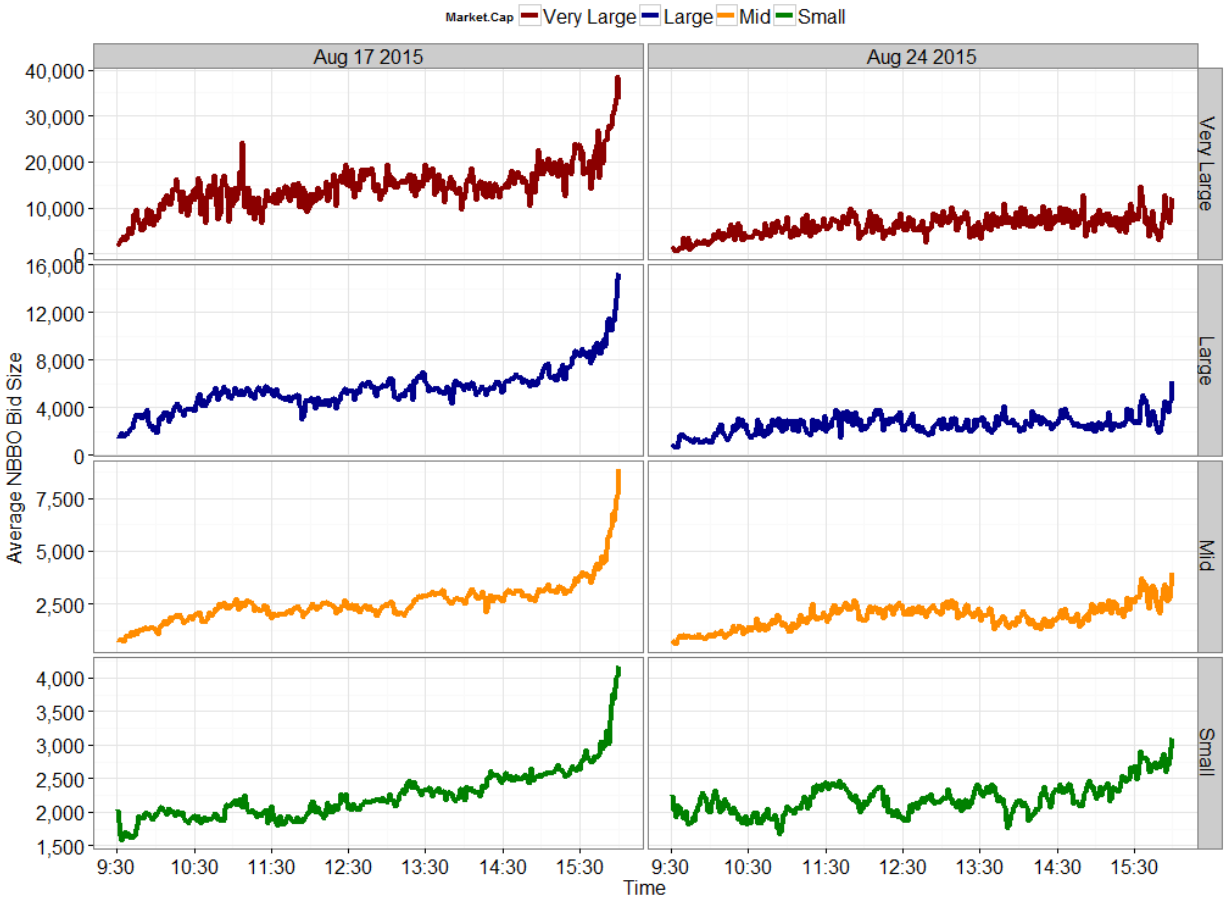

Figure III-11: Average national best bid size for Corporates by market capitalization for each minute on August 24 compared to August 17.

Figure III-12: Average National Best Bid Size (Corporates) – 9:30 to 10:00

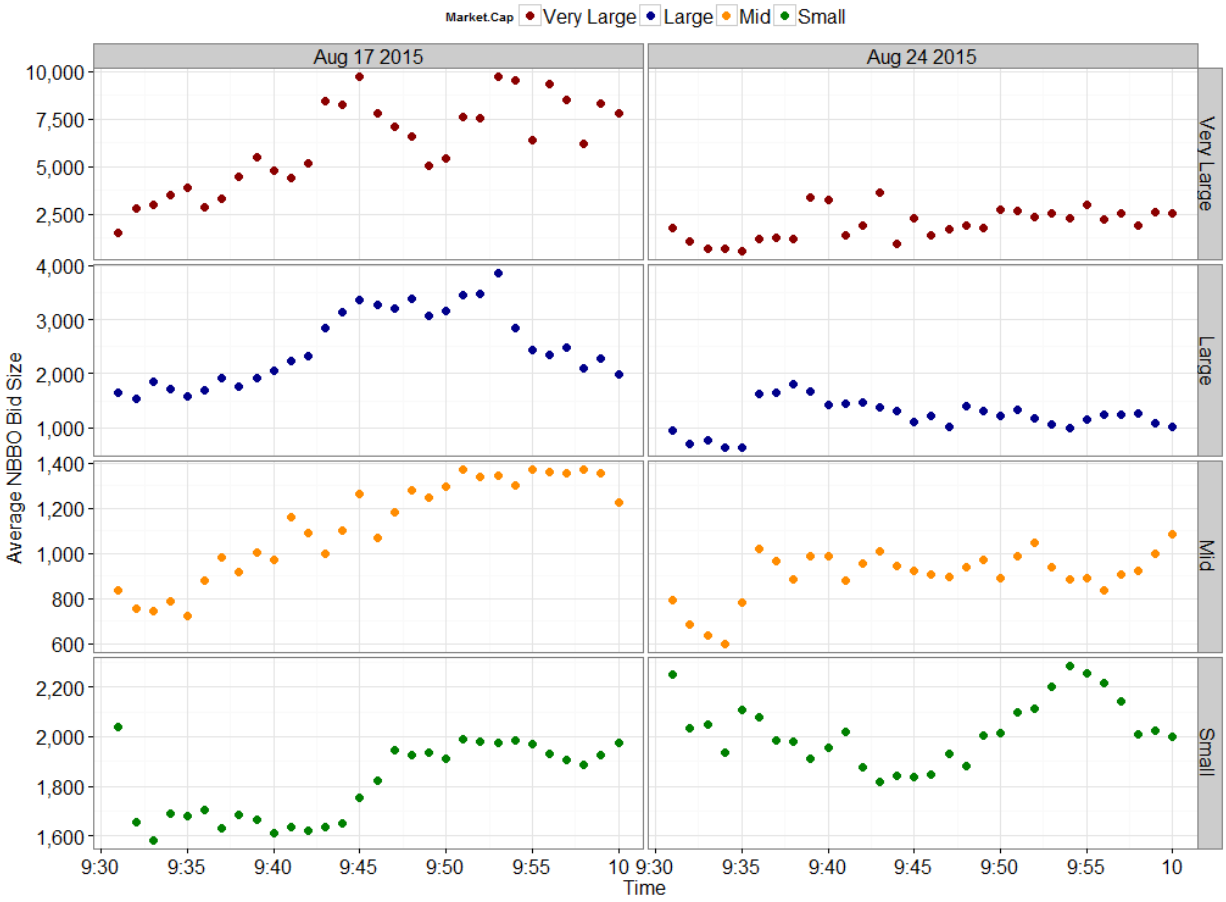

Figure III-12: Average national best bid size for Corporates by market capitalization for each minute between 9:30 and 10:00 on August 24 compared to August 17.

Figure III-13: Average National Best Ask Size (Corporates)

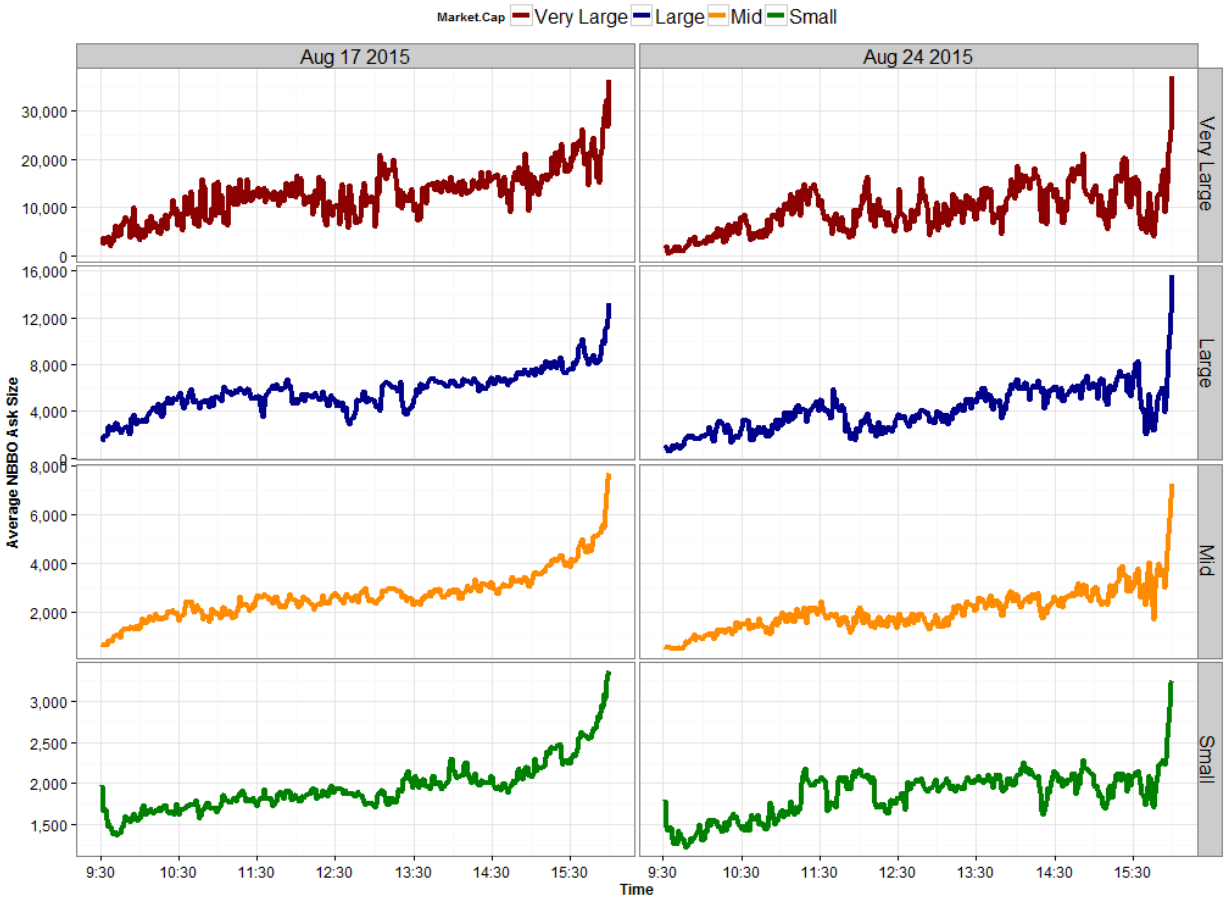

Figure III-13: Average national best ask size for Corporates by market capitalization for each minute on August 24 compared to August 17.

Figure III-14: Average National Best Ask Size (Corporates) – 9:30 to 10:00

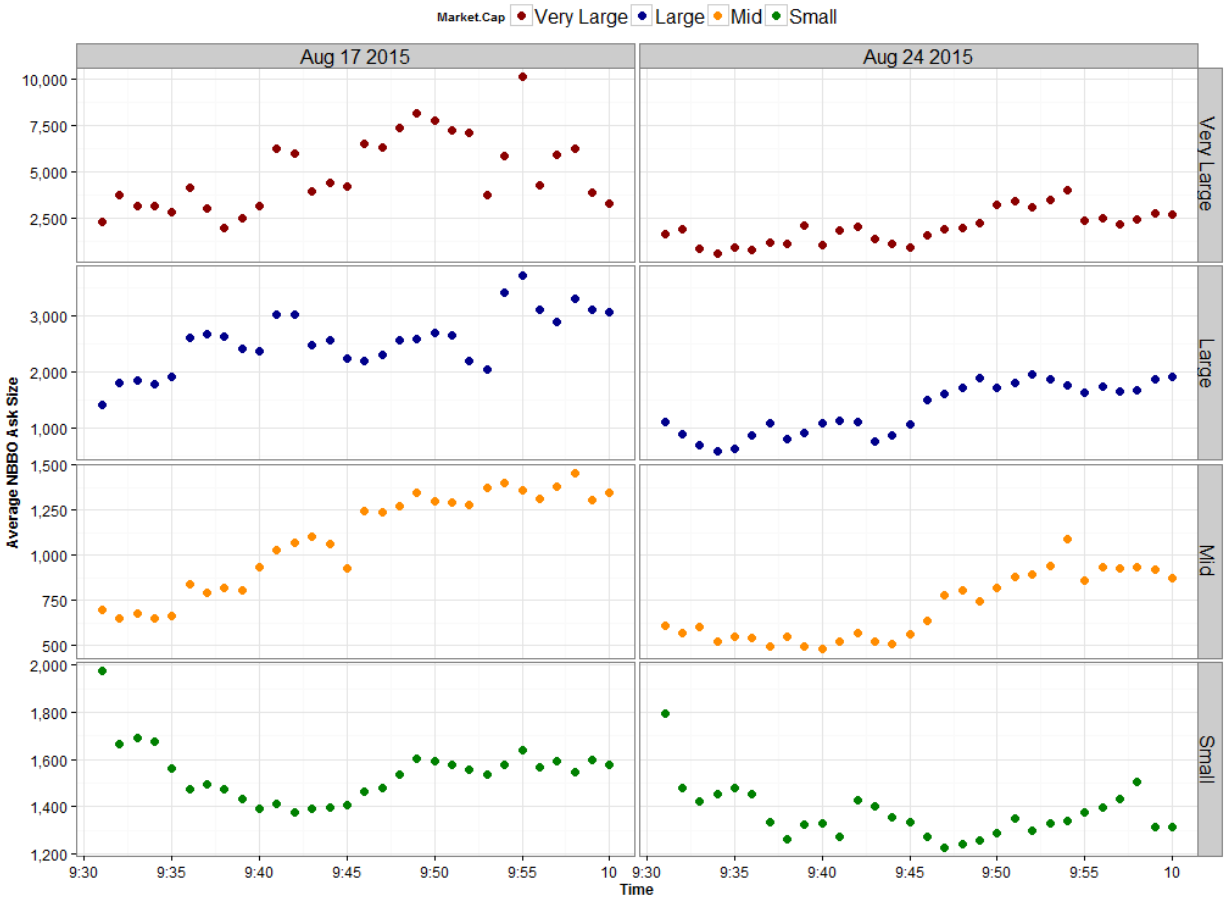

Figure III-14: Average national best ask size for Corporates by market capitalization for each minute between 9:30 and 10:00 on August 24 compared to August 17.

Figure III-15: Average National Best Bid Size (ETPs)

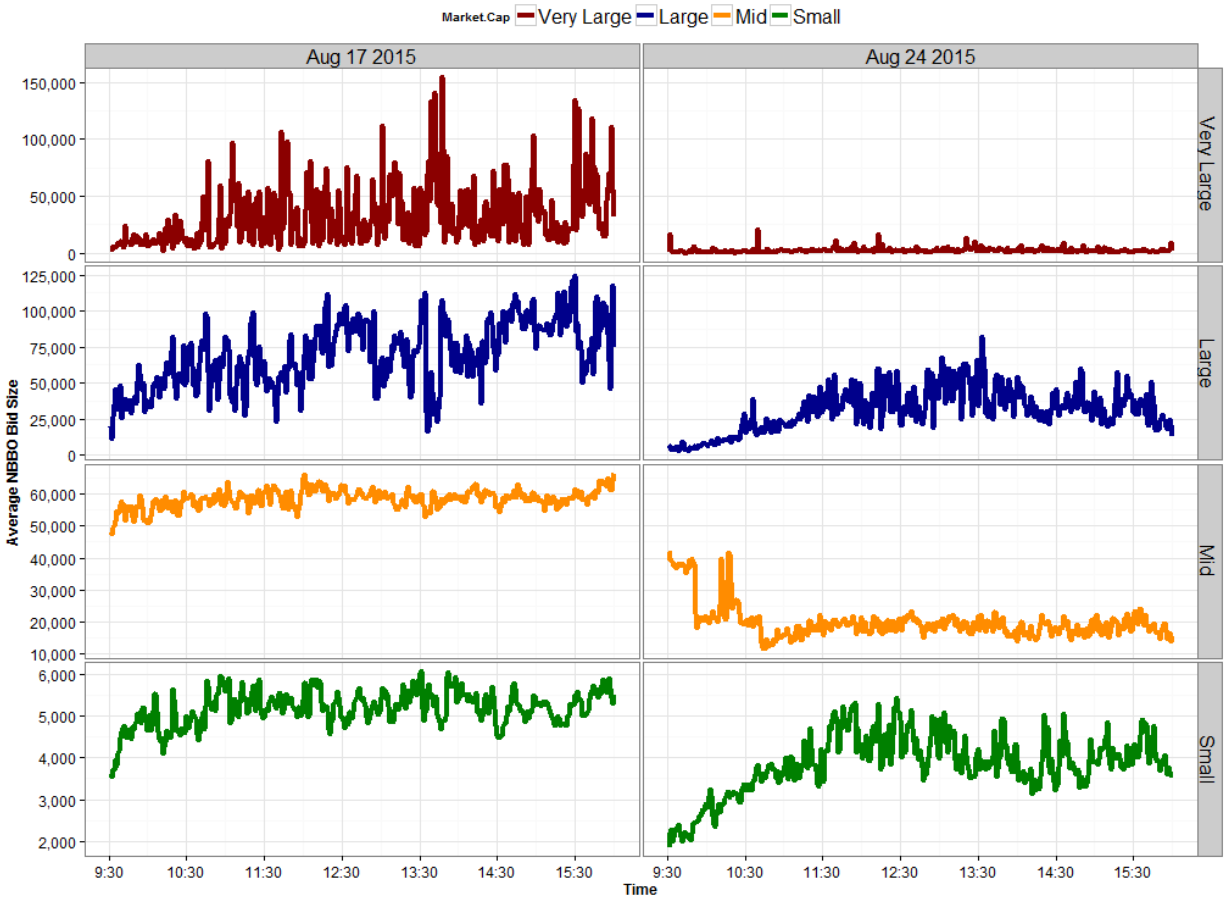

Figure III-15: Average national best bid size for ETPs by market capitalization for each minute on August 24 compared to August 17.

Figure III-16: Average National Best Bid Size (ETPs) – 9:30 to 10:00

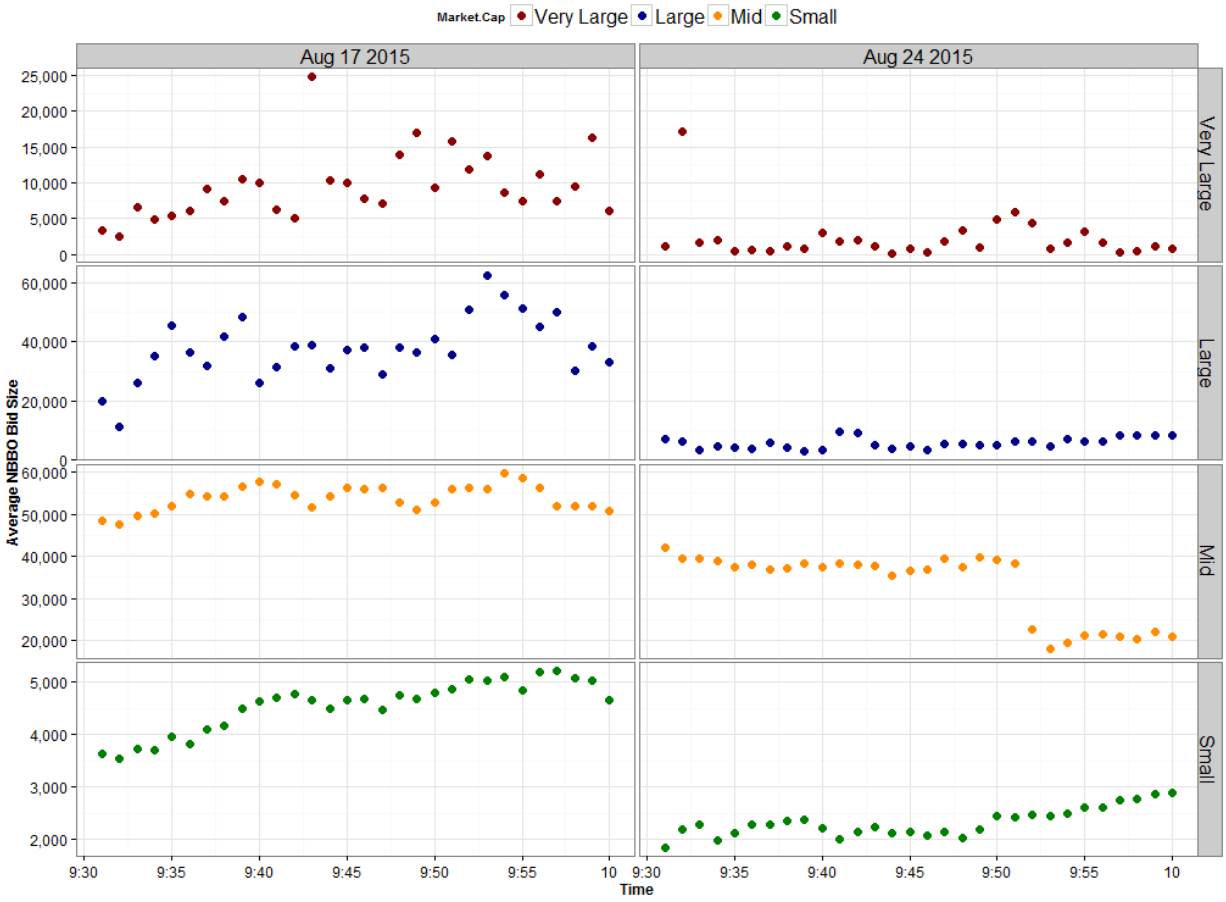

Figure III-16: Average national best bid size for ETPs by market capitalization for each minute between 9:30 and 10:00 on August 24 compared to August 17.

Figure III-17: Average National Best Ask Size (ETPs)

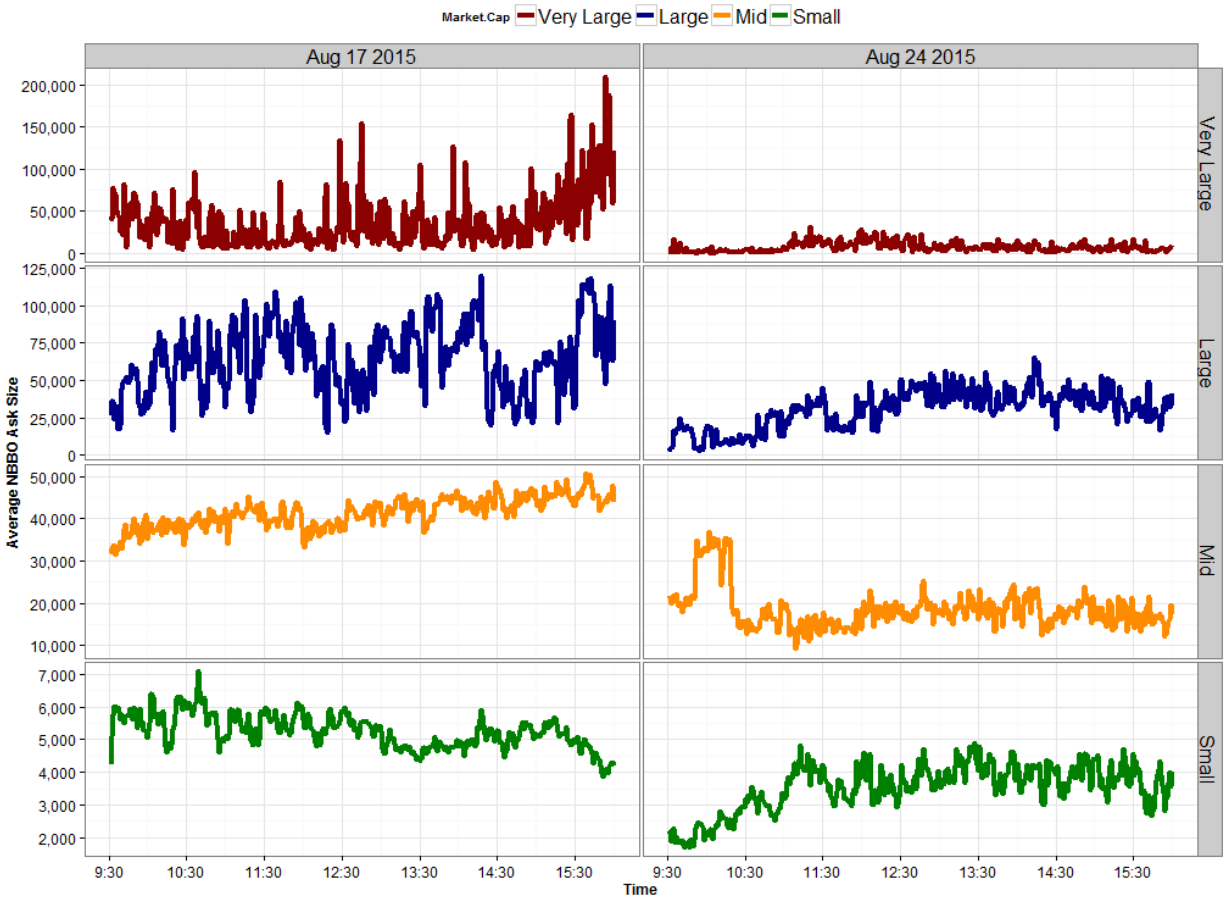

Figure III-17: Average national best ask size for ETPs by market capitalization for each minute on August 24 compared to August 17.

Figure III-18: Average National Best Ask Size (ETPs) – 9:30 to 10:00

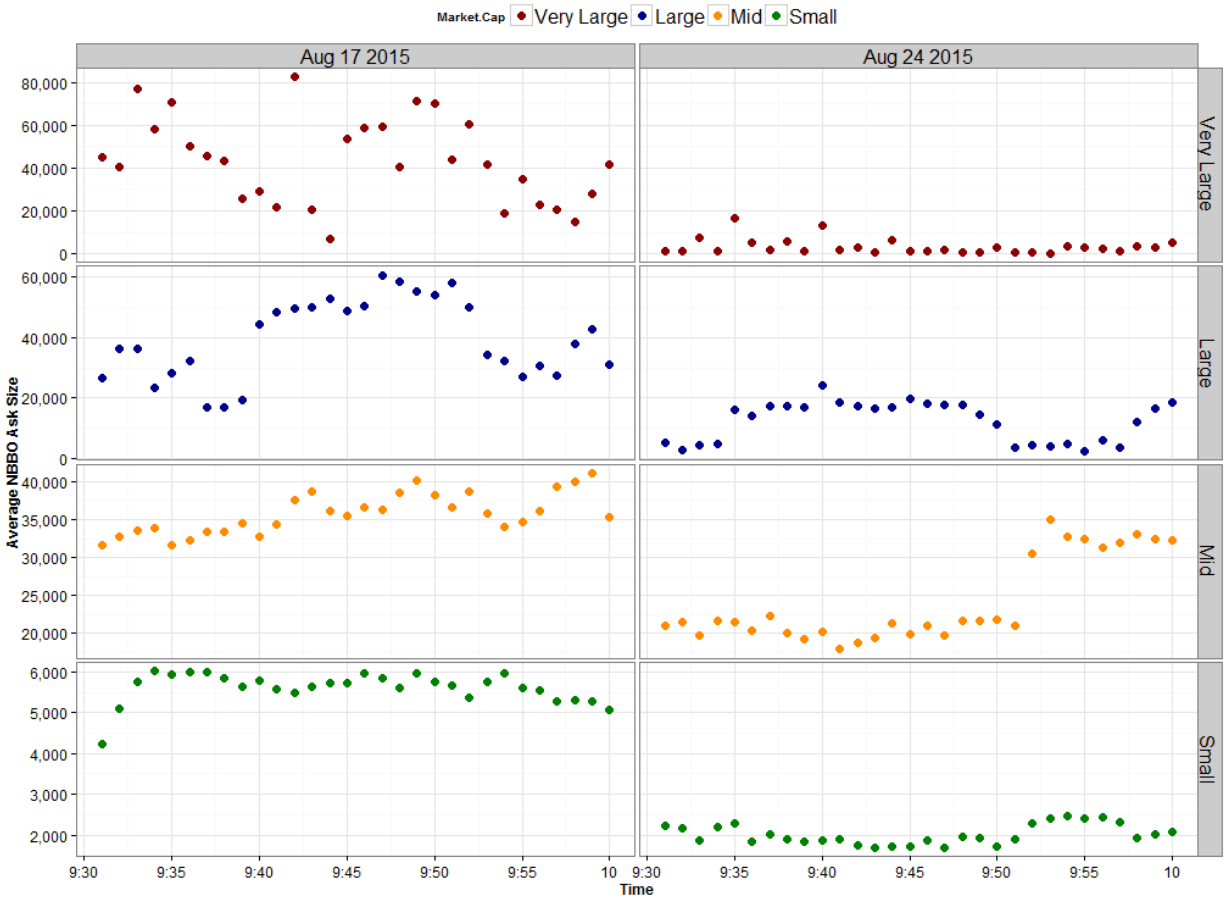

Figure III-18: Average national best ask size for ETPs by market capitalization for each minute between 9:30 and 10:00 on August 24 compared to August 17.

D. Dollar Volume, Quoted Spreads, Quoted Depth, and Range Ratio

Figures III-19 through III-32 below provide mean dollar volume,[20] median quoted spread, median quoted depth, and mean range ratio comparisons of trading on August 24 with a three-week control period of August 3 to August 21, 2015. Corporates and ETPs are treated separately, and each is binned by market capitalization. For each metric except quoted spread, a chart with full day data is provided, followed by the same chart focused on the first sixty minutes of regular hours trading.

As with the average share volume charts provided in Section III.C above, mean dollar volume on August 24 was substantially larger in the opening minutes than the control period for all sizes of Corporates and ETPs, and remained higher through the trading day. The ratio of August 24 to control period dollar volume in the opening minutes was particularly high for Very Large Corporates and for Large, Mid, and Small ETPs.

For both Corporates and ETPs, median quoted spreads were much wider in the opening minutes than other times of day during the control period. On August 24, quoted spreads were even wider than during the control period for all sizes of both Corporates and ETPs. Quoted spreads for Large, Mid, and Small ETPs were particularly affected, with August 24 spreads reaching levels that were at least 7 times wider than during the control period.

For both Corporates and ETPs, median quoted depth (inside through 19 cents away) during the control period is smallest in the opening minutes, improves through the trading day, and reaches its highest levels at the close. On August 24, quoted depth was substantially smaller in the opening minutes than during the control period for all sizes of Corporates. Quoted depth for all sizes of ETPs declined by more than 90%.

After the opening minutes, median quoted depth for Corporates improved throughout the day and generally reached levels consistent with the control period. In contrast, quoted depth for ETPs improved somewhat through the trading day, but did not reach levels consistent with the control period.

Mean range ratios for the control period (price range during each minute as a percentage of price range for the day) indicate that volatility for both Corporates and ETPs was much higher in the opening 15 minutes than other times of the trading day. On August 24, this pattern continued. The opening 15 minutes were by far the most volatile period of the day.

In sum, trading metrics for the control period indicate that the opening 15 minutes typically are the least liquid portion of the trading day, with wider spreads, less quoted depth, and higher volatility. These intraday patterns were observed on August 24, but with much larger trading volume.

[20] The volume figures in this Section III do not include volume in opening, reopening, and closing crosses. Openings and reopenings are addressed in Section IV and V, respectively.

Figure III-19: Mean Dollar Volume ($ Thousands) for Corporates

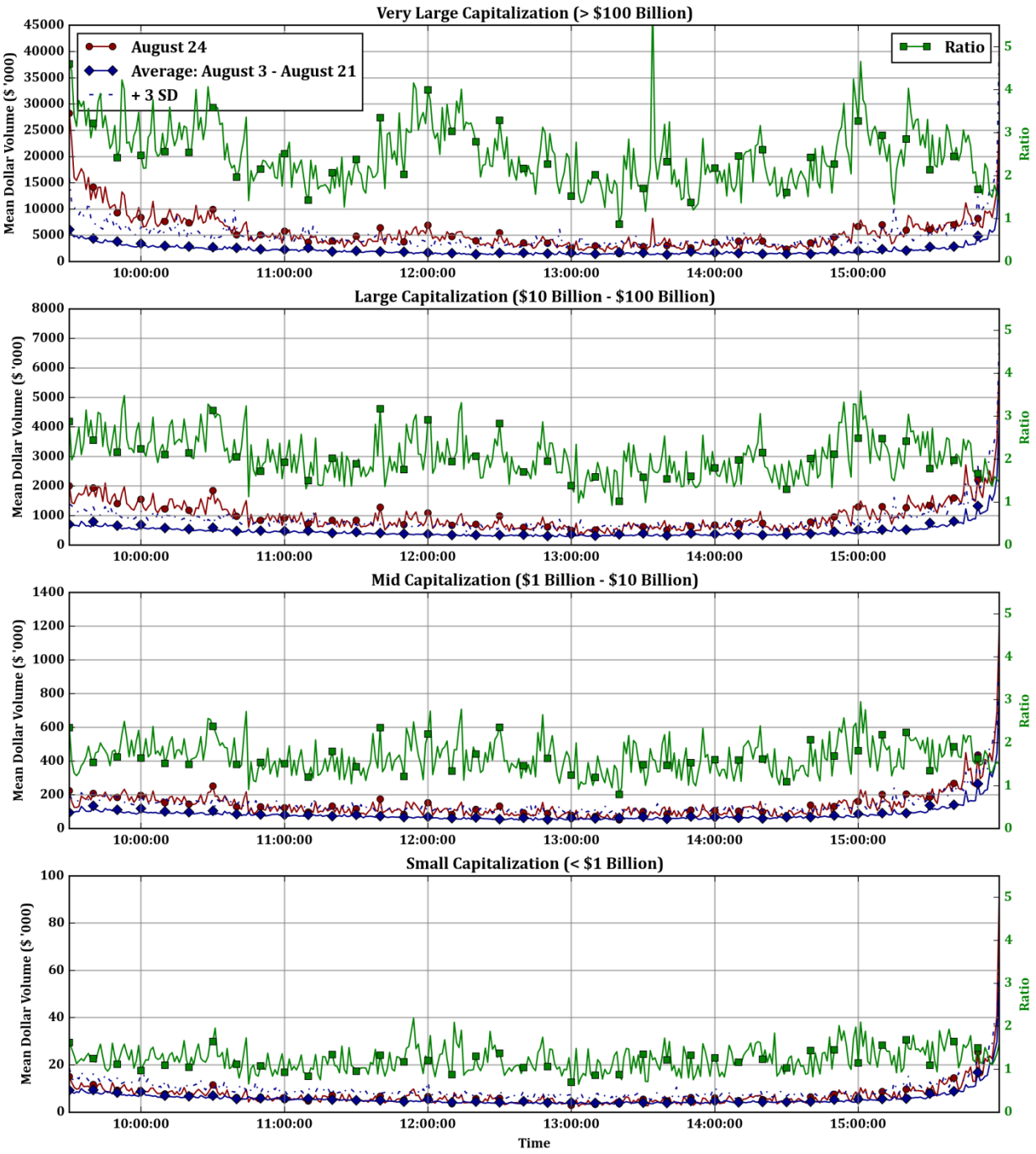

Figure III-19: Mean dollar volume (in $ Thousands) for Corporates on August 24 (red line), the average of August 3 to August 21 ('base period' - blue line), the base period average plus 3 standard deviations (blue dashed line) and the ratio of the August 24 dollar volume to the average base period dollar volume (green line).

Figure III-20: Mean Dollar Volume ($ Thousands) for Corporates – 9:30 to 10:30

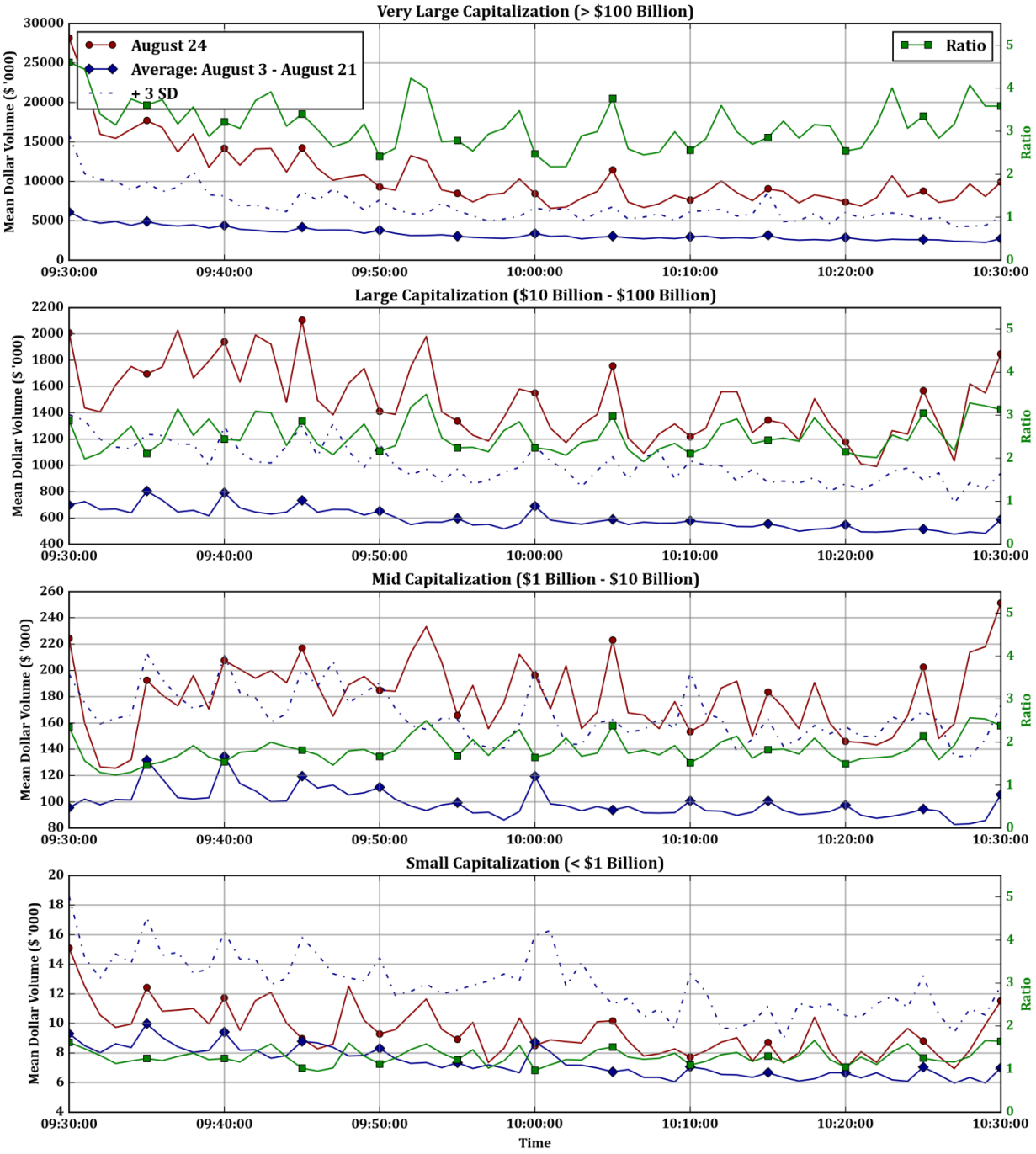

Figure III-20: Mean dollar volume (in $ Thousands) for Corporates on August 24 (red line), the average of August 3 to August 21 ('base period' - blue line), the base period average plus 3 standard deviations (blue dashed line) and the ratio of the August 24 dollar volume to the average base period dollar volume (green line).

Figure III-21: Mean Dollar Volume ($ Thousands) for ETPs

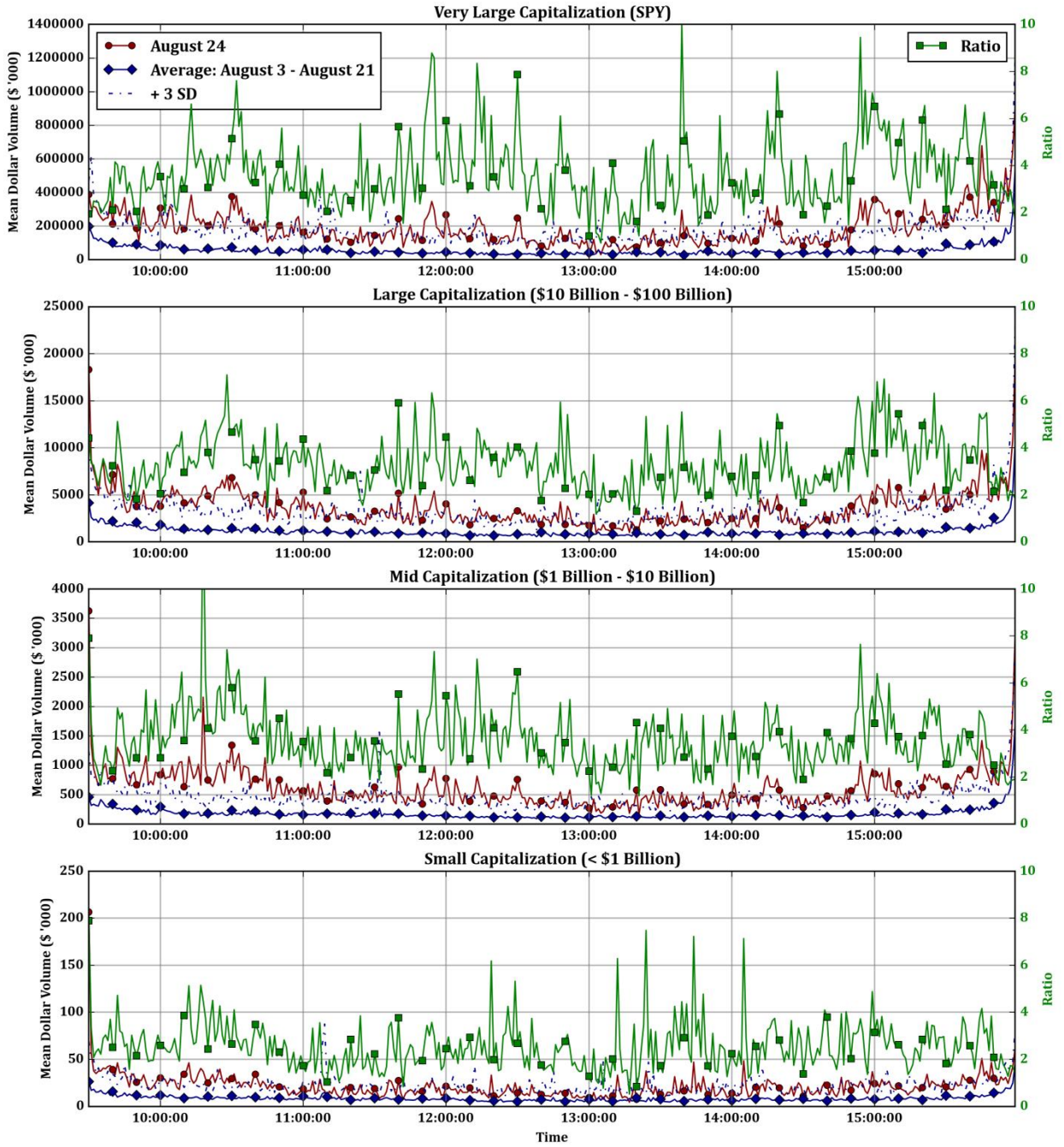

Figure III-21: Mean dollar volume (in $ Thousands) for ETPs on August 24 (red line), the average of August 3 to August 21 ('base period' - blue line), the base period average plus 3 standard deviations (blue dashed line) and the ratio of the August 24 dollar volume to the average base period dollar volume (green line). SPY is the only ETP with market capitalization greater than $100 Billion.

Figure III-22: Mean Dollar Volume ($ Thousands) for ETPs – 9:30 to 10:30

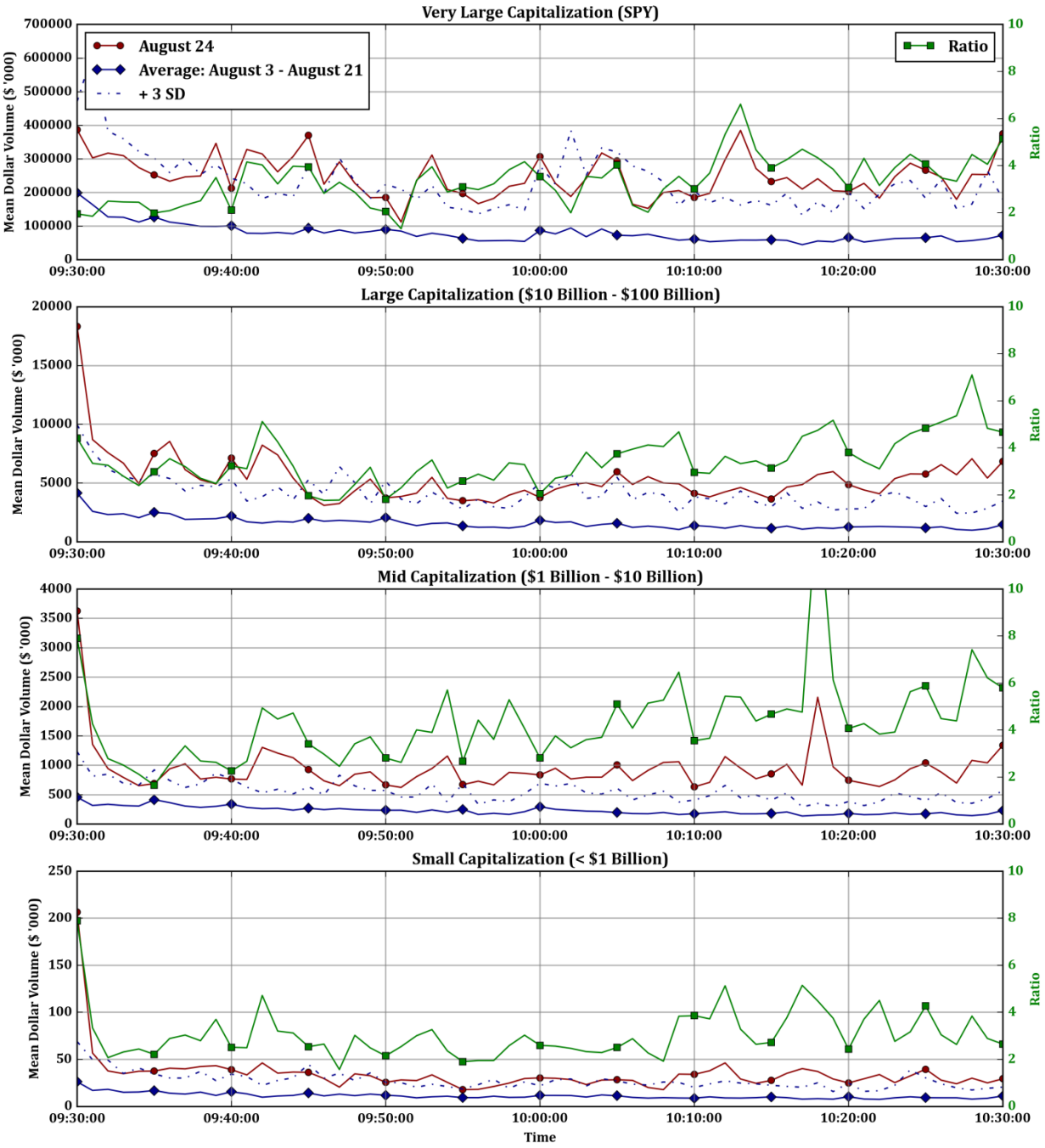

Figure III-22: Mean dollar volume (in $ Thousands) for ETPs on August 24 (red line), the average of August 3 to August 21 ('base period' - blue line), the base period average plus 3 standard deviations (blue dashed line) and the ratio of the August 24 dollar volume to the average base period dollar volume (green line). SPY is the only ETP with market capitalization greater than $100 Billion.

Figure III-23: Median Relative Quoted Spread (%) for Corporates

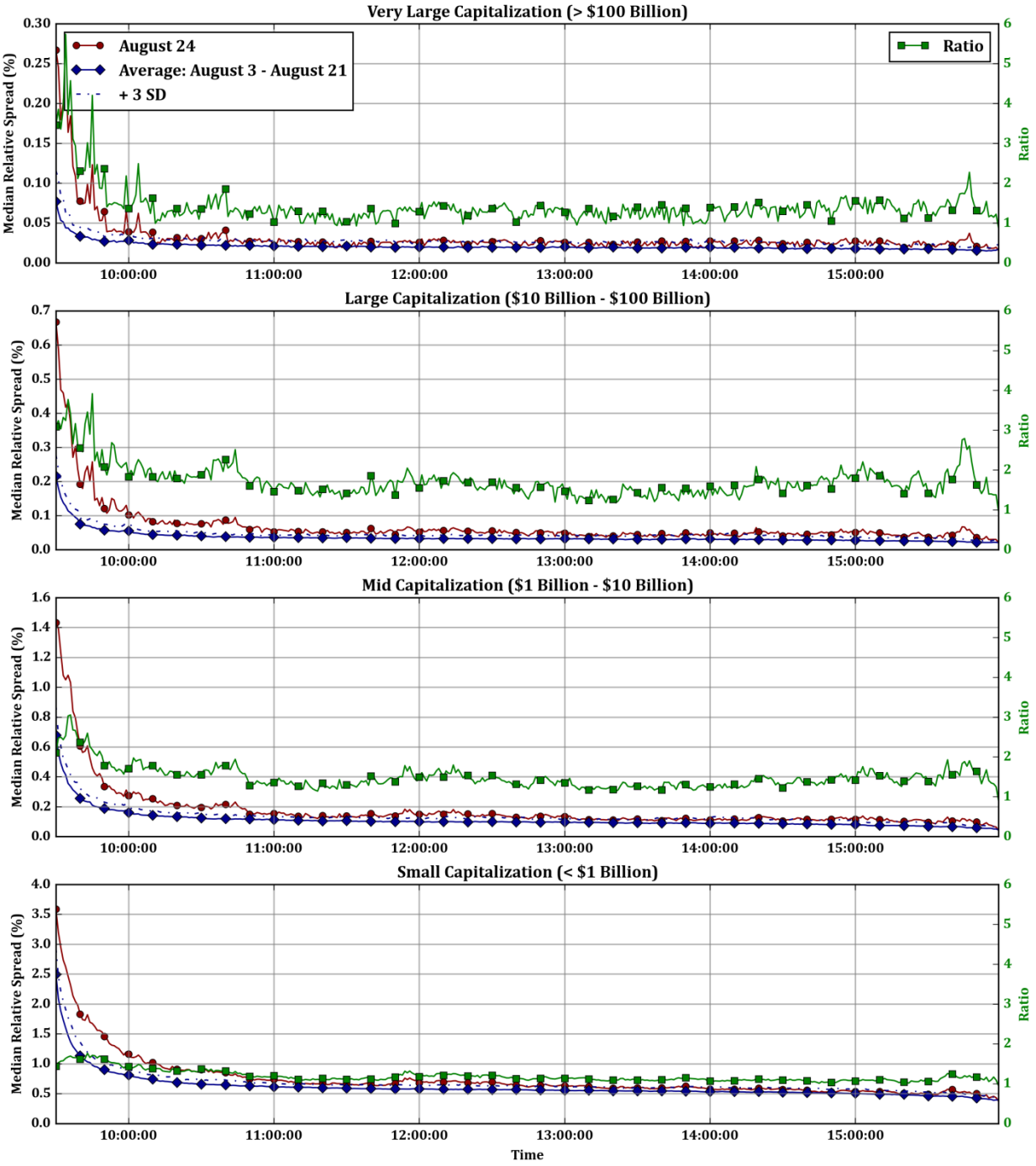

Figure III-23: Median relative quoted spreads (in percent) for Corporates on August 24 (red line), the average of August 3 to August 21 ('base period' - blue line), the base period average plus 3 standard deviations (blue dashed line) and the ratio of the August 24 spread to the average base period spread (green line).

Figure III-24: Median Relative Quoted Spread (%) for ETPs

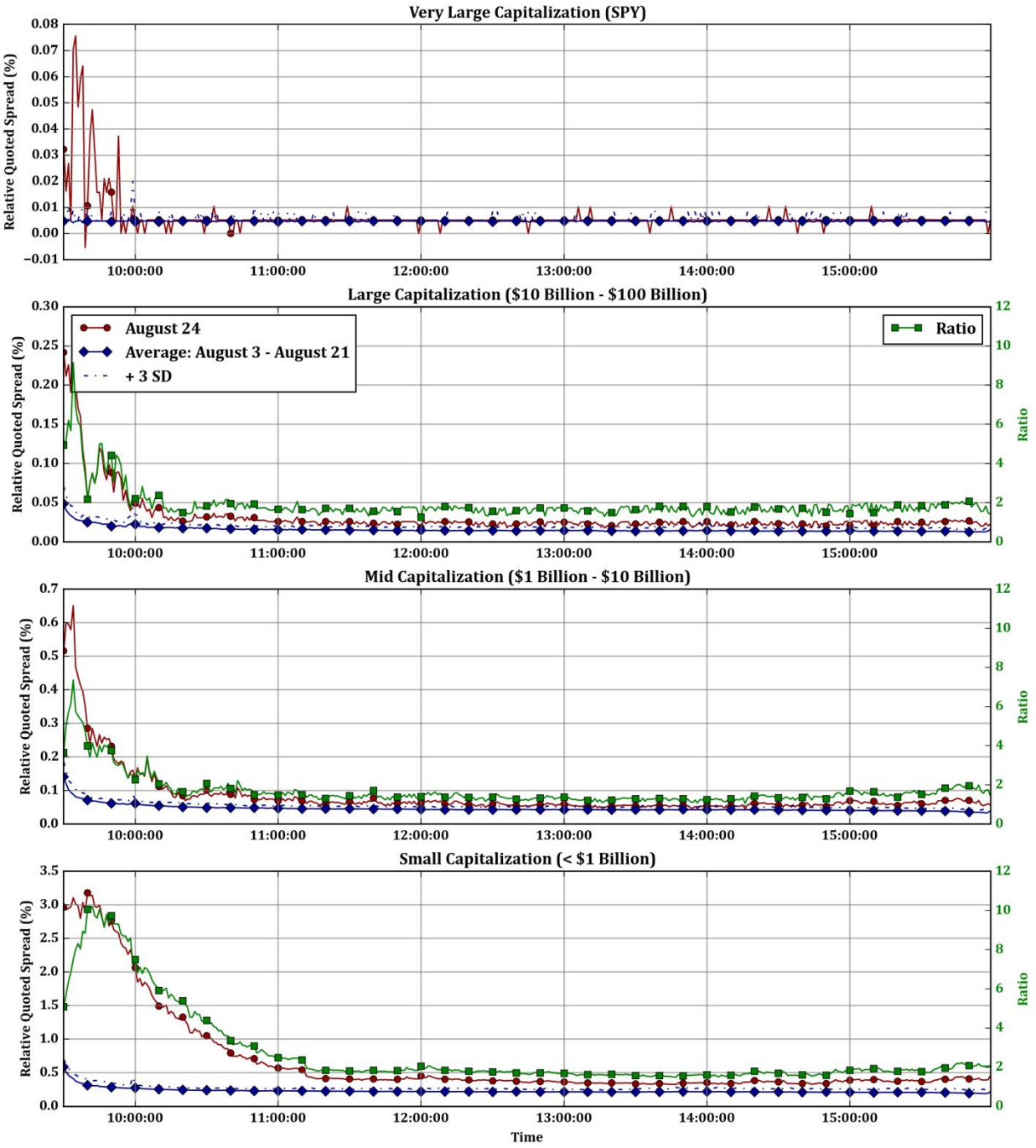

Figure III-24: Median relative quoted spreads (in percent) for ETPs on August 24 (red line), the average of August 3 to August 21 ('base period' - blue line), the base period average plus 3 standard deviations (blue dashed line) and the ratio of the August 24 spread to the average base period spread (green line). SPY is the only ETP with market capitalization greater than $100 Billion.

Figure III-25: Median Depth (Shares) for Corporates

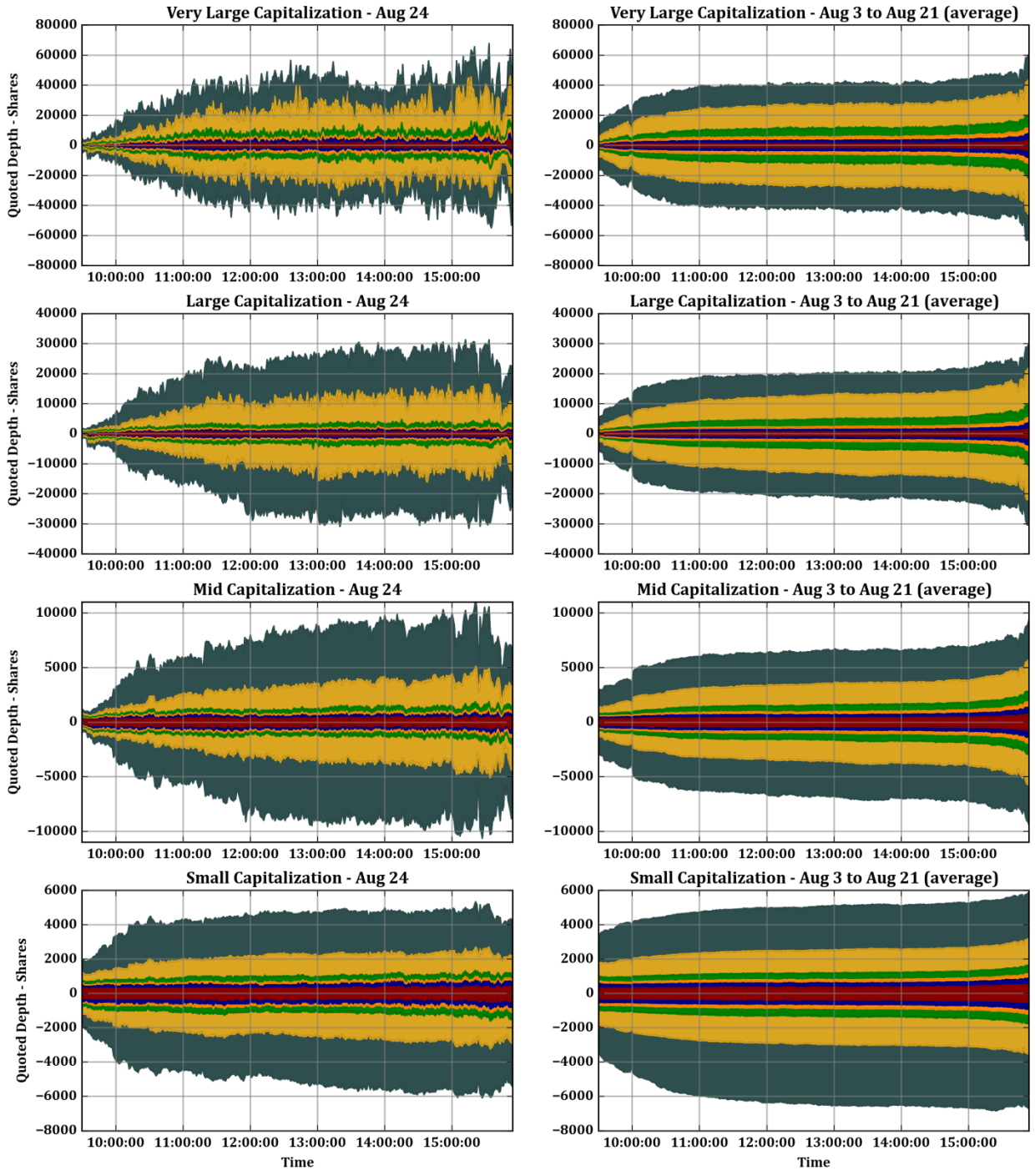

Figure III-25: Median cumulative quoted depth (in shares) for Corporates at the inside (red), 1 cent away (blue), 2 cents away (orange), 4 cents away (green), 9 cents away (yellow) and 19 cents away (slate). The y-axis scale is determined by the average of the base period (August 3 – August 21).

Figure III-26: Median Depth (Shares) for Corporates – 9:30 to 10:30

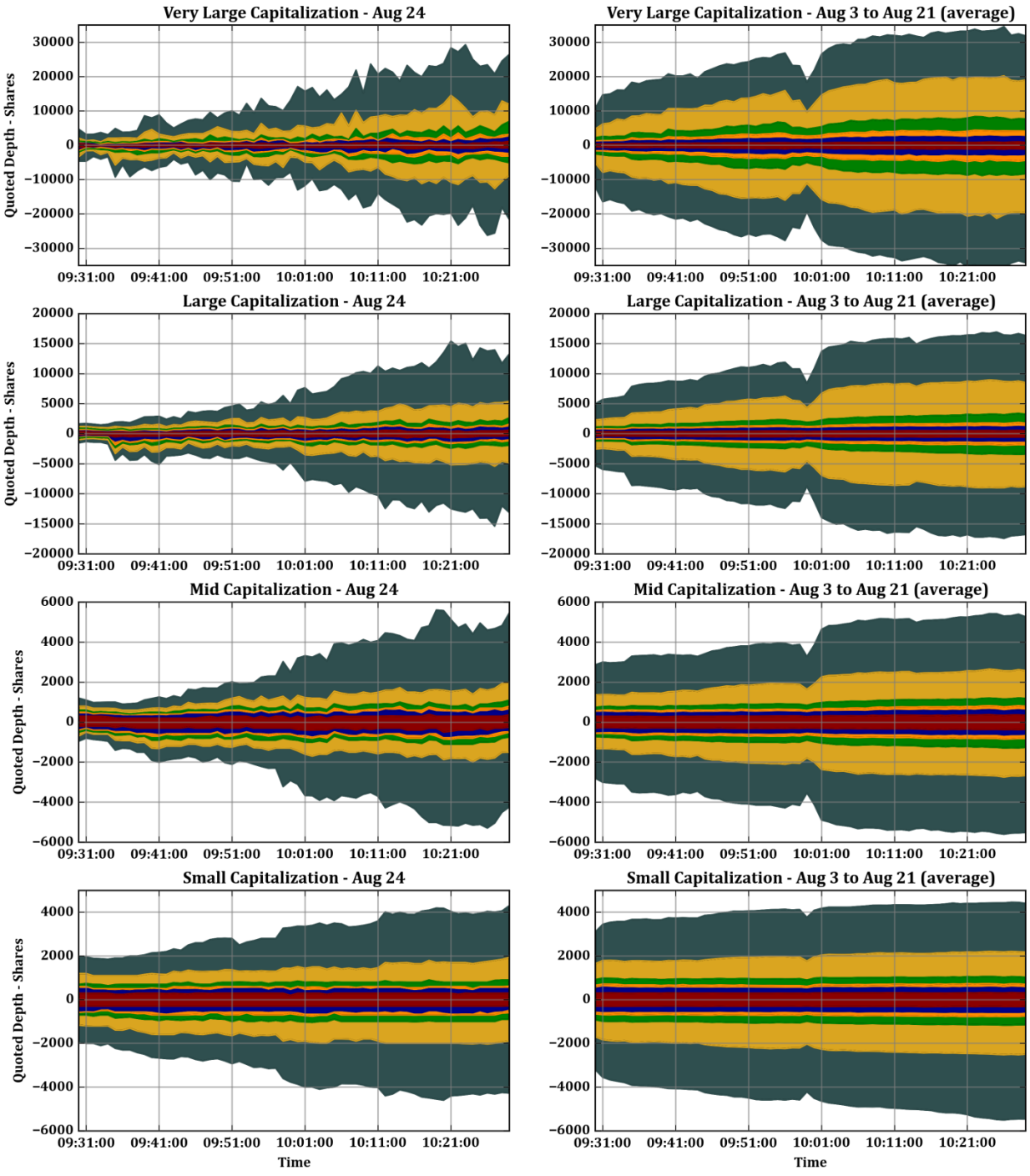

Figure III-26: Median cumulative quoted depth (in shares) for Corporates at the inside (red), 1 cent away (blue), 2 cents away (orange), 4 cents away (green), 9 cents away (yellow) and 19 cents away (slate). The y-axis scale is determined by the depth on Aug 24.

Figure 27: Median Depth (Shares) for ETPs

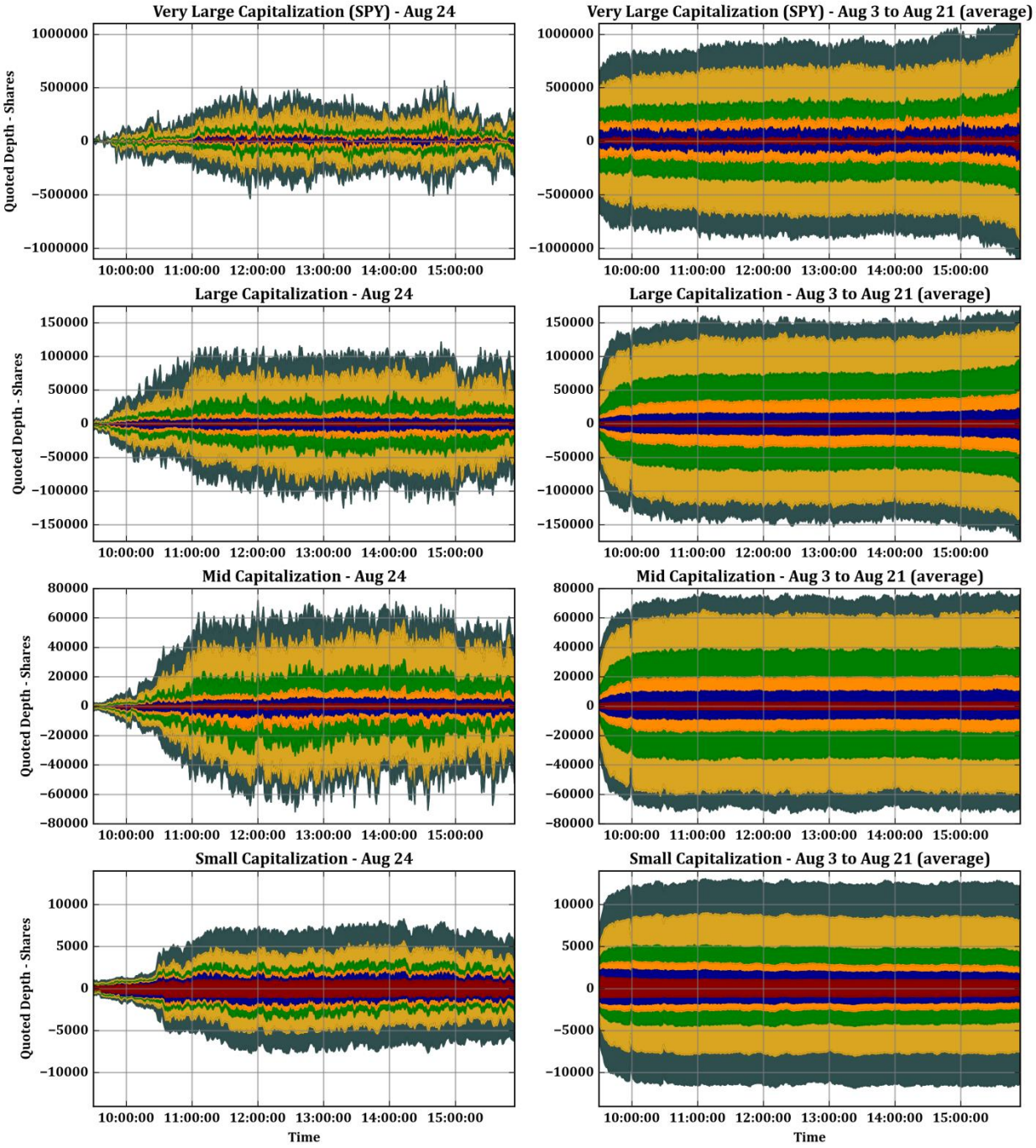

Figure III-27: Median cumulative quoted depth (in shares) for ETPs at the inside (red), 1 cent away (blue), 2 cents away (orange), 4 cents away (green), 9 cents away (yellow) and 19 cents away (slate). The y-axis scale is determined by the average of the base period (August 3 – August 21). SPY is the only ETP with market capitalization greater than $100 Billion.

Figure III-28: Median Depth (Shares) for ETPs – 9:30 to 10:30

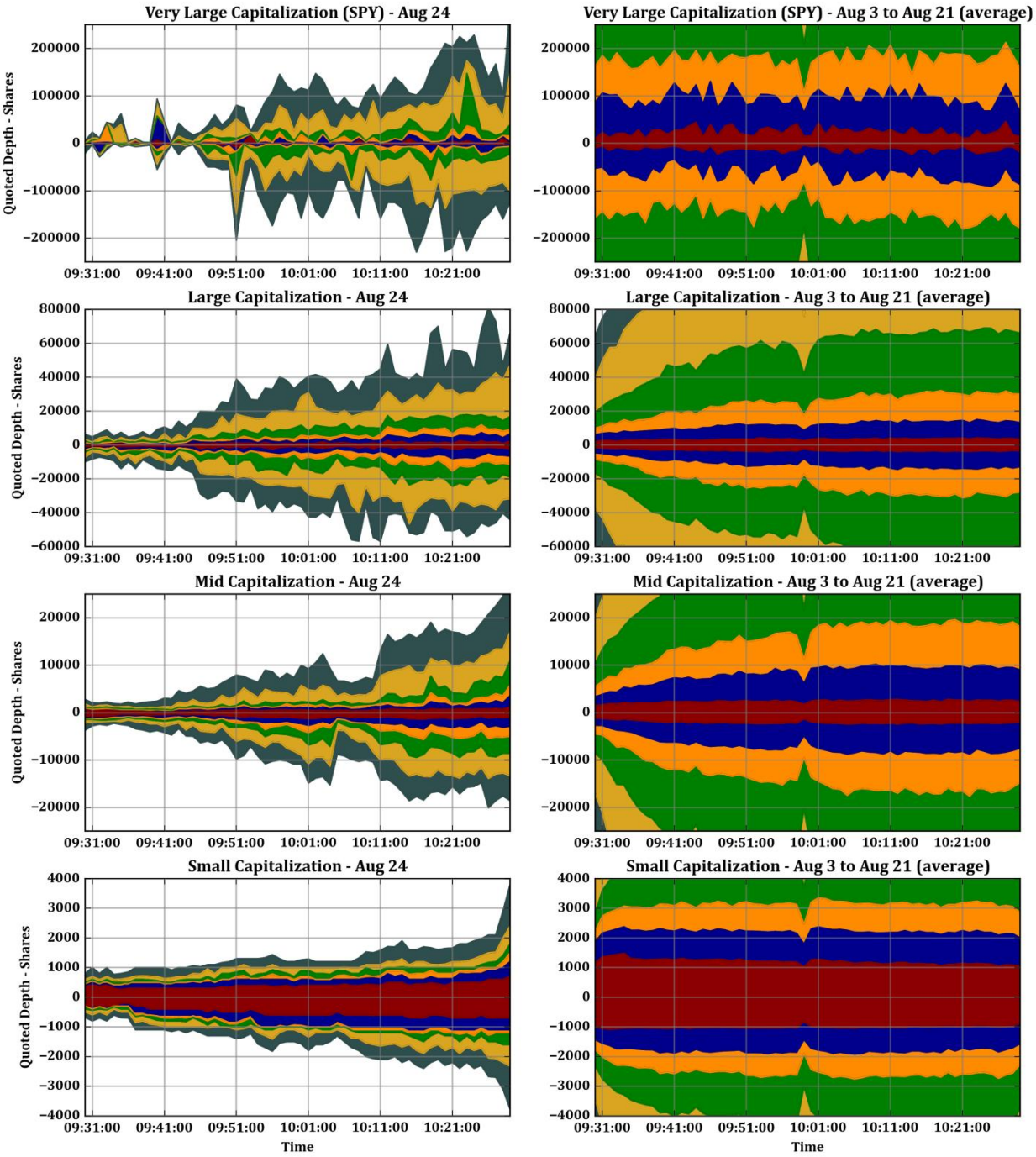

Figure III-28: Median cumulative quoted depth (in shares) for ETPs at the inside (red), 1 cent away (blue), 2 cents away (orange), 4 cents away (green), 9 cents away (yellow) and 19 cents away (slate). The y-axis scale is determined by the depth on August 24. SPY is the only ETP with market capitalization greater than $100 Billion.

Figure III-29: Mean Range Ratio (%) for Corporates

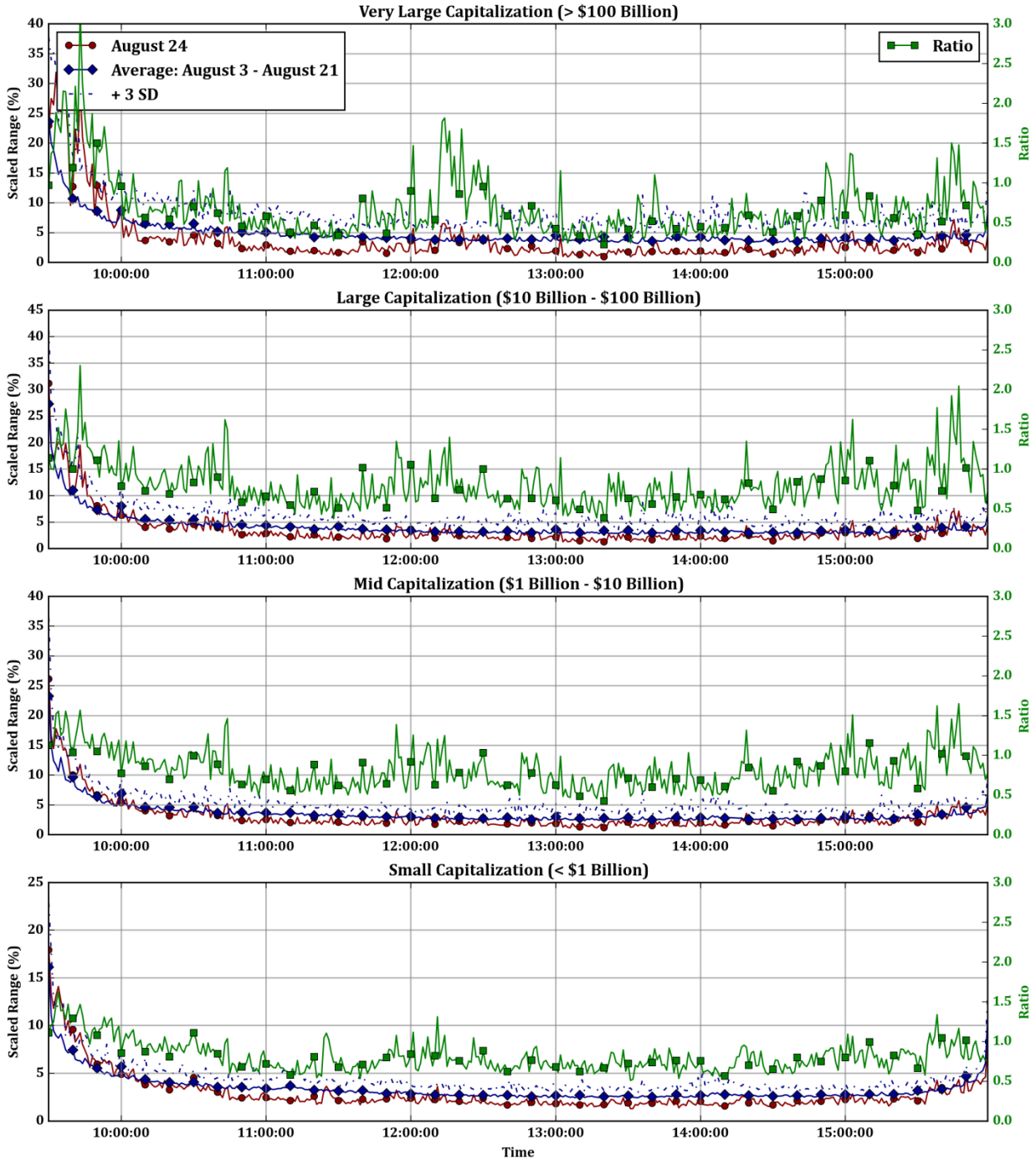

Figure III-29: Mean range ratio (in percent) for Corporates on August 24 (red line), the average of August 3 to August 21 ('base period' - blue line), the base period average plus 3 standard deviations (blue dashed line) and the ratio of the August 24 range ratio to the average base period range ratio (green line). Mean range ratio is calculated by dividing one-minute ranges (high minus low) by daily range (high minus low).

Figure III-30: Mean Range Ratio (%) for Corporates – 9:30 to 10:30

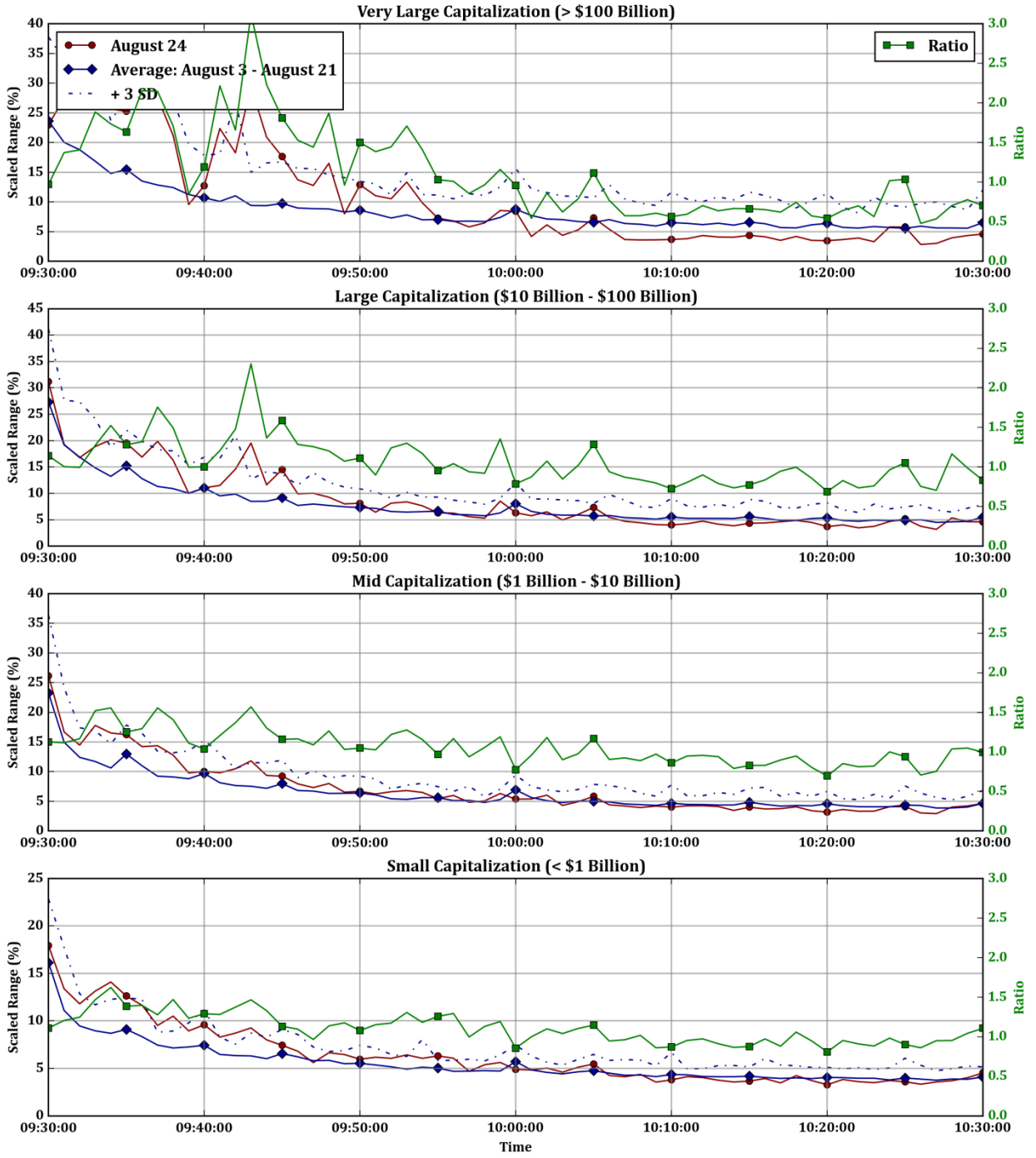

Figure III-30: Mean range ratio (in percent) for Corporates on August 24 (red line), the average of August 3 to August 21 ('base period' - blue line), the base period average plus 3 standard deviations (blue dashed line) and the ratio of the August 24 range ratio to the average base period range ratio (green line). Mean range ratio is calculated by dividing one-minute ranges (high minus low) by daily range (high minus low).

Figure III-31: Mean Range Ratio (%) for ETPs

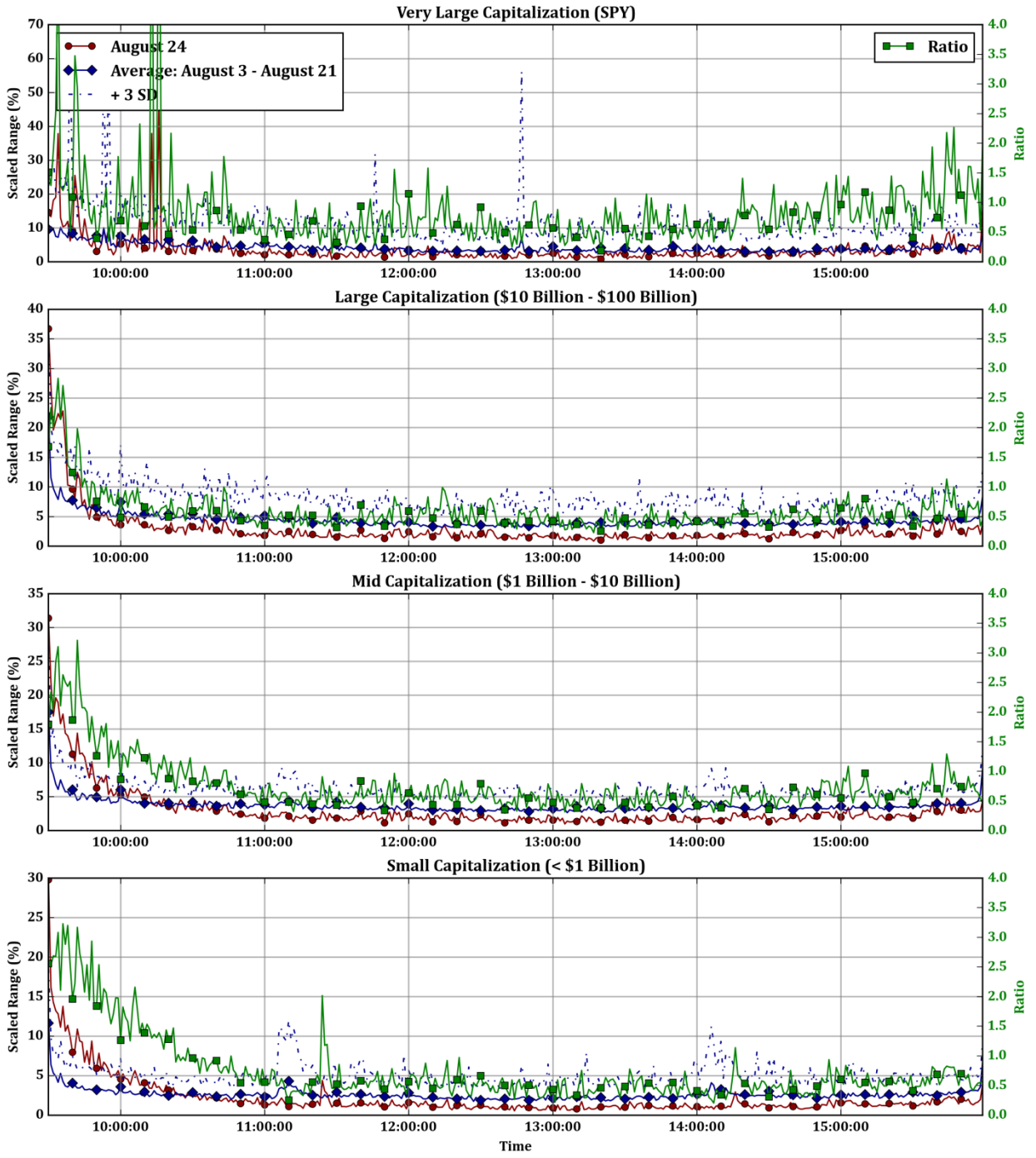

Figure III-31: Mean range ratio (in percent) for ETPs on August 24 (red line), the average of August 3 to August 21 ('base period' - blue line), the base period average plus 3 standard deviations (blue dashed line) and the ratio of the August 24 range ratio to the average base period range ratio (green line). SPY is the only ETP with market capitalization greater than $100 Billion. Mean range ratio is calculated by dividing one-minute ranges (high minus low) by daily range (high minus low).

Figure III-32: Mean Range Ratio (%) for ETPs – 9:30 to 10:30

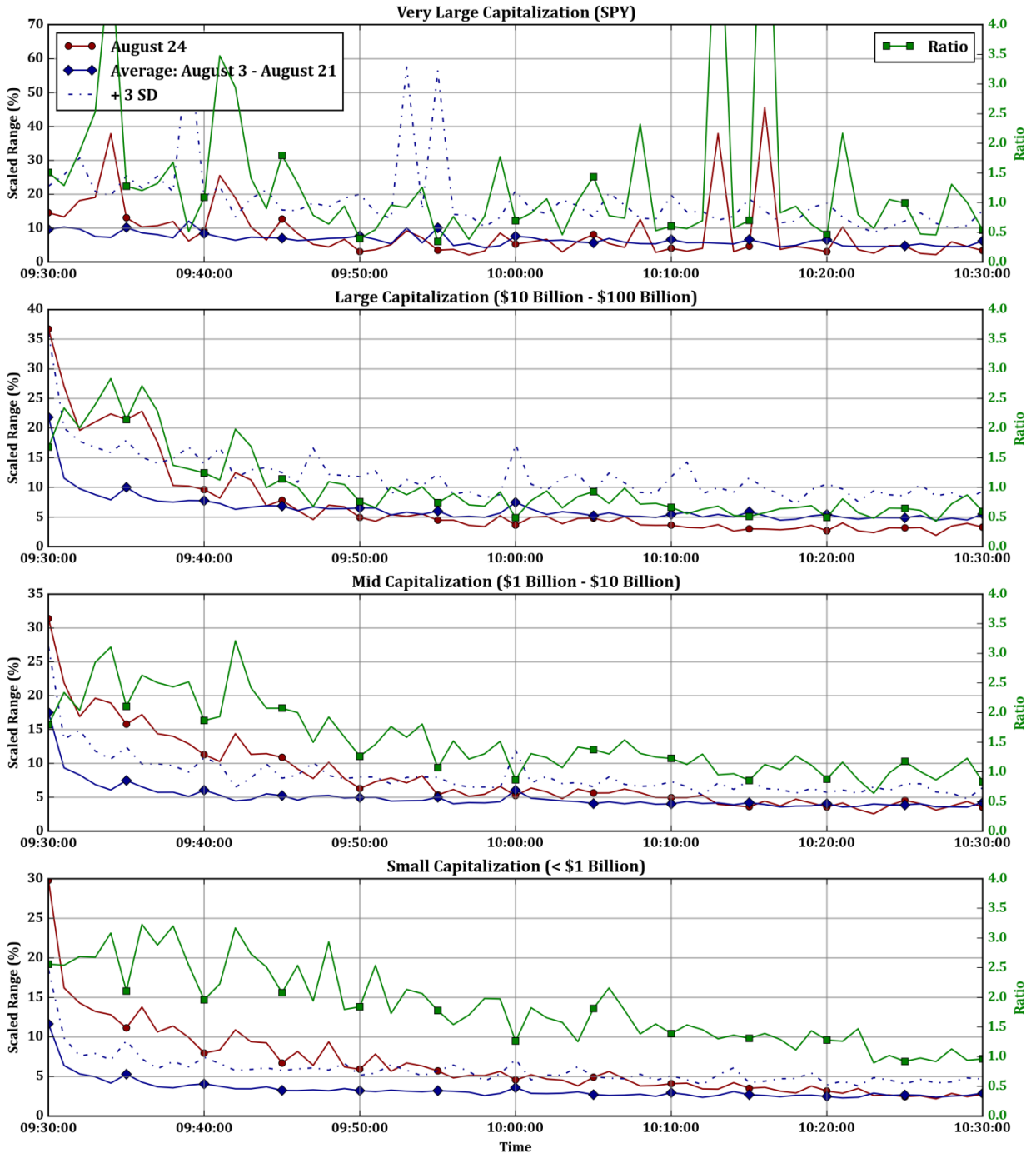

Figure III-32: Mean range ratio (in percent) for ETPs on August 24 (red line), the average of August 3 to August 21 ('base period' - blue line), the base period average plus 3 standard deviations (blue dashed line) and the ratio of the August 24 range ratio to the average base period range ratio (green line). SPY is the only ETP with market capitalization greater than $100 Billion. Mean range ratio is calculated by dividing one-minute ranges (high minus low) by daily range (high minus low).

IV. Openings on Primary Listing Exchanges

The opening process on the primary listing exchanges is important in a variety of respects. A large volume of orders typically participate and are executed in the opening cross on the primary listing exchange. As discussed in Section II above, S&P DJI generally uses prices from only the primary listing exchange for calculating index values, including the S&P 500 index that provides the reference for triggering market-wide circuit breakers. Finally, as discussed in Section V below, the price of the opening cross on the primary listing exchange (if it occurs before 9:35) is used as a reference price for calculation of the first LULD price bands of a trading day.

The primary listing exchanges have different processes for opening securities for trading in regular trading hours. The basic cross functions have similarities, but significant differences can exist among the primary listing exchanges with respect to timing, dissemination of information, and price controls.

A. BATS, NASDAQ, and NYSE Arca Opening Process

The opening processes for BATS,[21] NASDAQ[22] and NYSE Arca[23] are fully automated. They occur at 9:30 and, with some distinctions, are priced to maximize the volume that can be executed in the cross. Prior to the cross, they all periodically disseminate messages with imbalances and indicative prices through their direct data feeds. These messages provide direct data feed recipients with information on the likely price and size of a cross, given the current state of buy and sell interest.

As set forth in Table IV-1 below, the exchanges differ in the securities subject to the opening cross and the price controls for the cross.

[21] BATS Rule 11.23 governs its opening process.

[22] NASDAQ Rule 4752 governs its opening process.

[23] NYSE Arca Equities Rule 7.35 governs its opening process.

Table IV-1: BATS, NASDAQ, and NYSE Arca Openings

	BATS	NASDAQ	NYSE Arca
Symbols Subject to Opening Cross	BATS listed only	All exchange listed securities traded on NASDAQ	NYSE Arca listed and all exchange listed ETFs and ETNs
Price Controls	3% from a collared midpoint of the NBBO for midpoints over $50; 5% for $25.01 – $50; 10% for <$25	10% of the NASDAQ BBO midpoint is added to the best offer and subtracted from the best bid	1% from last trade prices for prices over $50; 2% for $25.01 – $50; 5% for < $25[24]

B. NYSE Opening Process[25]

Although other markets trade NYSE-listed symbols prior to the completion of NYSE's opening process, NYSE does not begin trading until the Designated Market Maker (DMM) opens a symbol for trading. The DMM may open a stock manually or electronically, on a trade or a quote, at 9:30 or thereafter, and the opening should be, according to NYSE Rule 123D, "fair and orderly, reflecting a professional assessment of market conditions at the time, and appropriate consideration of the balance of supply and demand as reflected by orders represented in the market."

Before the open on August 24, NYSE published information about order imbalances and indicative prices through its direct data feeds until the earlier of 9:35 or the opening.[26] If there is a significant price change in a symbol from the prior close, the DMM is required to obtain the approval of a floor official and manually disseminate a price range indication through the SIP. In the event of an extreme market volatility condition that is likely to have a floor-wide impact on the ability of DMMs to arrange for a fair and orderly opening, NYSE can invoke Rule 48 and suspend the DMMs' obligation to seek certain approvals from floor officials and to publish

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[24] On September 8, 2015, NYSE Arca revised the collar percentages applicable to the Market Order Auction to 10%, 5% and 3%. https://www.nyse.com/publicdocs/nyse/markets/nyse-arca/NYSE_Arca_Trader_Update_Auction_Collars_Sept_2015.pdf.

[25] NYSE Rules 15 and 123D govern its opening process. NYSE MKT follows the same process as NYSE for its opening.

[26] On October 26, 2015, NYSE extended the period for publishing imbalance information until the symbol is opened. NYSE Trader Update, "NYSE and NYSE MKT: Changes to Imbalance Publication" (October 22, 2015) (available at https://www.nyse.com/trader-update/history).

certain indication messages in the SIP data feeds. Rule 48 does not affect the information about order imbalances and indicative prices that NYSE provides through its direct data feeds.

C. Timing of NYSE Openings

On August 24, NYSE invoked Rule 48 to reflect volatile conditions in the pre-opening. NYSE opened trading in many of its symbols later than 9:35 (though NYSE-listed symbols traded on other exchanges and off-exchange venues at 9:30). Tables IV-2 below sets forth the timing, by market capitalization and number of securities, for NYSE openings in NYSE-listed constituents of the S&P 500 index.

Table IV-2: NYSE-Listed S&P 500 Openings

Time	Total S&P 500 Market Cap ($ Thousands)	Percent Of NYSE Open	Number Of Securities	Average Market Cap Per Security ($ Thousands)
9:30-9:34	7,001,441,765	53%	148	47,307,039
9:35-9:39	3,528,332,217	27%	109	32,370,020
9:40-9:44	1,395,070,112	11%	74	18,852,299
9:45-9:49	666,186,762	5%	19	35,062,461
9:50-9:54	485,477,256	4%	20	24,273,863
9:55-9:59	198,079,424	1%	15	13,205,295

Table IV-2: The timing, by market cap and number of securities, of NYSE opening crosses on August 24 in S&P 500 constituents. Percent of NYSE open is percentage of total market capitalization for NYSE-listed constituents of the S&P 500 index.

For NYSE-listed constituents of the S&P 500, NYSE had opened 38% of its listed S&P 500 companies representing 53% of such companies' market capitalization by 9:35. By 9:45, these figures increased to 86% of NYSE-listed S&P 500 companies representing 91% of such companies' market capitalization.

D. Opening Volume and Prices

Table IV-3 below provides data on opening cross volume on the primary listing exchange for August 24 in relation to opening cross volume on the primary listing exchange for August 17, along with data on opening cross prices on the primary listing exchange on August 24 in relation to closing cross prices on the primary listing exchange on August 21.

Table IV-3: Opening Volume Increases and Percent Price Changes

Corporates	Opening Volume Increase	8/21 Close To 8/24 Open Price Change	Total Securities
Very Large	6.9	-6.79%	41
Large	3.9	-6.06%	383
Mid	4.8	-5.41%	1,315
Small	25.5	-4.64%	2,326
ETPs	Opening Volume Increase	8/21 Close To 8/24 Open Price Change	Total Securities
Very Large	7.4	-5.23%	1
Large	7.6	-4.14%	49
Mid	7.0	-3.11%	196
Small	34.4	-2.73%	970

Table IV-3: Opening cross volume increases on the primary listing exchange on August 24 relative to August 17 and percentage price changes from August 21 close to August 24 open. The percentage volume change is based on the mean percentage change of the group. Securities that did not have any volume in the primary listing exchange's opening cross on August 17 or August 24 were not included in the analysis.

Table IV-3 indicates that opening cross volumes were substantially higher on August 24 than on August 17 for all categories of Corporates and ETPs. The volume increases for ETPs were greater for all market capitalization bins than the volume increases for Corporates. In contrast, the percentage price declines for ETPs from August 21 close to August 24 open were smaller for all market capitalization bins than the percentage price declines for Corporates.

Table IV-4 below provides another view into August 24 opening prices in relation to closing prices on August 21. Data is set forth by number of securities and is categorized by primary listing exchange and by percentage price changes from August 21 close to August 24 open.

Table IV-4: Opening Price Changes by Exchange

Corporates			
Close To Open Change			
	NYSE MKT	NASDAQ	NYSE
>0%	30	116	23
<=0%,>-1%	39	188	43
<=-1%,>-2%	24	188	52
<=-2%,>-5%	67	1,066	613
<=-5%,>-7%	38	510	488
<=-7%,>-10%	25	259	258
<=-10%,>-15%	17	115	87
<=-15%,>-20%	7	24	17
<=-20%	6	10	4
Total	253	2,476	1,585
ETPs			
Close To Open Change			
	NYSE Arca	NASDAQ	BATS
>0%	225	21	14
<=0%,>-1%	269	17	6
<=-1%,>-2%	221	7	2
<=-2%,>-5%	367	50	9
<=-5%,>-7%	142	34	
<=-7%,>-10%	62	23	1
<=-10%,>-15%	21	11	1
<=-15%,>-20%	4	2	
<=-20%	5	2	
Total	1,316	167	33

Table IV-4: August 24 opening prices in relation to closing prices on August 21. The data is for the number of securities and is categorized by primary listing exchange and by percentage changes from the August 21st close to the August 24th open. Three Corporates and 23 ETPs without an opening trade message are not included.

Table IV-4 indicates that Corporate opening prices generally reflected greater declines than did ETP opening prices. 43% of Corporates open with price declines of 5% or more, and 20% of ETPs open with price declines of 5% or more.

E. Percentage Changes for S&P 500 Stocks

Table IV-5 below provides pricing information for S&P 500 constituents with primary listings on NASDAQ and NYSE, broken out by the time period in which the opening occurred. For openings on both exchanges and at different times, nearly all categories opened with substantial average declines, but recovered somewhat by the end of the trading day.

Table IV-5: S&P 500 Constituent Open And Close Change By Exchange and Time

Before 9:31	Exchange	Count	8/21 Close To 8/24 Close	8/21 Close To 8/24 Open
Very Large	NASDAQ	11	-4.0%	-7.3%
	NYSE	10	-3.9%	-5.5%
Large	NASDAQ	68	-3.6%	-6.0%
	NYSE	14	-4.3%	-6.6%
Mid	NASDAQ	38	-3.7%	-5.3%
	NYSE	4	-4.0%	-4.6%
9:31 - 9:34				
Very Large	NYSE	9	-4.0%	-8.8%
Large	NYSE	88	-4.0%	-5.9%
Mid	NYSE	23	-3.4%	-4.3%
9:35 - 9:39				
Very Large	NYSE	8	-3.8%	-6.6%
Large	NYSE	66	-4.3%	-6.0%
Mid	NYSE	35	-4.2%	-6.0%
9:40 - 9:45				
Large	NYSE	54	-3.9%	-5.3%
Mid	NYSE	20	-4.6%	-4.2%
9:45 and after				
Very Large	NYSE	2	-2.9%	-4.5%
Large	NYSE	35	-4.1%	-5.1%
Mid	NYSE	17	-4.1%	-4.4%

Table IV-5: Pricing information for S&P 500 constituents that are primarily listed on NASDAQ and NYSE, broken out by the time period in which the opening occurred.

F. Pricing after Openings

Table IV-6 below sets forth absolute volume-weighted average price ("VWAP") changes following the opening cross in Corporates with primary listings on NYSE and NASDAQ, when the opening cross on the primary listing exchange occurred prior to 9:35. Table IV-7 below sets forth absolute VWAP changes following the opening cross in Corporates with primary listings on NYSE, when the opening cross on the primary listing exchange occurred after 9:35. The time periods for the two tables are chosen to reflect that, as discussed in Section II above, broad market prices had turned upward by approximately 9:35.

Table IV-6: VWAP from Open by Exchange – Pre-9:35 Open

	1 Minute VWAP	2 Minute VWAP	5 Minute VWAP	
NYSE	Absolute Deviation From Open	Absolute Deviation From Open	Absolute Deviation From Open	Total Securities
Very Large	3.35%	3.70%	3.21%	19
Large	1.41%	1.47%	1.46%	110
Mid	1.01%	1.22%	1.55%	198
Small	1.26%	1.56%	1.97%	182
Total	*1.27%*	*1.48%*	*1.74%*	*509*
NASDAQ				
Very Large	1.28%	1.51%	1.24%	11
Large	1.15%	1.59%	1.89%	87
Mid	0.96%	1.20%	1.50%	542
Small	1.48%	1.72%	2.20%	1,449
Total	*1.30%*	*1.57%*	*2.00%*	*2,089*

Table IV-6: Absolute volume-weighted average price changes following the opening in Corporates with primary listings on NYSE and NASDAQ, when open occurred prior to 9:35. Securities that did not have a trade within 5 minutes of the open were not included in the analysis. Securities that did not have an opening trade message were not included in the analysis.

Table IV-7: VWAP from Open by Exchange – Post-9:35 Open

	1 Minute VWAP	2 Minute VWAP	5 Minute VWAP	
NYSE	Absolute Deviation From Open	Absolute Deviation From Open	Absolute Deviation From Open	Total Securities
Very Large	1.42%	1.19%	0.88%	11
Large	0.89%	0.98%	1.20%	182
Mid	0.83%	0.88%	1.06%	566
Small	1.28%	1.37%	1.53%	279
Total	*0.96%*	*1.03%*	*1.21%*	*1,038*

Table IV-7: Absolute volume-weighted average price changes following the opening in Corporates with primary listings on NYSE, when open occurred after 9:35. Securities that did not have a trade within 5 minutes of the open were not included in the analysis. Securities that did not have an opening trade message were not included in the analysis.

For the five minutes (5 Minute VWAP) following opening crosses that occurred prior to 9:35, NYSE-listed Corporates in the Very Large and Mid market capitalization bins displayed larger deviations from the opening cross prices than did NASDAQ-listed Corporates, while NASDAQ-listed Corporates in the Large and Small market capitalization bins displayed larger deviations from opening cross prices than NYSE-listed Corporates. For NYSE openings after 9:35, NYSE-listed Corporates displayed smaller deviations from opening cross prices than did both NYSE-listed and NASDAQ-listed Corporates with opening crosses that occurred prior to 9:35.

G. Largest Corporate Decliners

As noted in Section III.A above, Very Large Corporates experienced a larger percentage of severe declines (August 21 close to August 24 low) than other sizes of Corporates. Of the 41 Very Large Corporates, six (15%) declined by 20% or more, and 21 (51%) declined by 10% or more. Of the 383 Large Corporates, in contrast, only 13 (3%) declined by 20% or more, and 121 (32%) declined by 10% or more. Moreover, Section III.B indicates that the great majority of declines exceeding 10% or more (and thereby triggering Regulation SHO SSRs) occurred within 15 minutes from the start of regular trading hours at 9:30.

To provide a more granular view into the dynamics of trading before, in, and after the opening cross on August 24, Table IV-8 below sets forth data for the six Very Large Corporates with percentage declines on August 24 that exceeded 20%.

Table IV-8: Very Large Corporates with Largest Daily Declines

Symbol	8/21 Close to 8/24 Low	8/21 Close to 8/24 Close	8/21 Close to 8/24 Opening Cross	Opening Cross Time	Time from Opening Cross to Low	Decline from Opening Cross to 8/24 Low	Volume: 9:30 to Opening Cross	Volume: Opening Cross	Volume: Opening Cross to Low	LULD Halts
MDT	-25.2%	-4.5%	-10.5%	9:33:11	0:00:39	-16.5%	73,916	228,737	366,834	0
JPM	-21.3%	-5.3%	-9.2%	9:31:53	0:01:05	-13.3%	100,444	756,889	1,238,465	0
GE	-21.2%	-2.9%	-8.3%	9:30:58	0:00:42	-14.1%	282,553	2,395,570	3,830,816	0
HD	-20.7%	-3.1%	-6.1%	9:30:29	0:01:10	-15.5%	27,250	293,826	667,251	0
PEP	-20.5%	-4.6%	-5.7%	9:31:09	0:01:42	-15.7%	20,042	202,755	601,010	0
CVS	-20.4%	-2.0%	-11.5%	9:31:21	0:05:40	-10.0%	18,652	333,938	755,960	2

Table IV-8: Price, time, and volume information for the six Very Large Corporates with largest daily declines on August 24. Time from Opening Cross to Low measures the period from the time of the opening cross on the primary listing exchange to the time of the consolidated daily low price. Volume: 9:30 to Opening Cross is consolidated share volume from 9:30 to the opening cross on the primary listing exchange. Volume: Opening Cross is share volume on the primary listing exchange. Volume: Opening Cross to Low is consolidated share volume from the time of the opening cross on the primary listing exchange to the time of the consolidated daily low price.

The six symbols in Table IV-8 display a similar pattern. Each reached a daily low of more than 20% soon after the opening cross, and the price decline was substantially reversed by the end of the day. Their opening cross prices, in contrast, were closer to their end-of-day prices. With the exception of CVS (discussed below), much of the day's decline occurred in a short period after the NYSE opening cross.[27] MDT declined by 16.5% in 39 seconds; JPM declined by 13.3% in 65 seconds; GE declined by 14.1% in 42 seconds; HD declined by 15.5% in 70 seconds; and PEP declined by 15.7% in 102 seconds. These rapid price declines were accompanied by volume surges after the opening crosses that substantially exceeded the volumes executed prior to and in the opening crosses themselves.

While each of the six symbols in Table IV-8 declined by at least 10% below its opening price in less than two minutes after the NYSE opening cross,[28] CVS differs from the other five symbols in that its price changes triggered LULD halts. The first LULD halt in CVS was triggered 35 seconds after the NYSE opening cross. When trading resumed five minutes later, CVS hit its daily low within one second following the NYSE reopening cross. The daily low was only one cent below

[27] Each of the six Very Large Corporates in Table IV-8 is primarily listed on NYSE. Of the total 41 Very Large Corporates, 30 are primarily listed on NYSE.

[28] As noted in Section V below, the reference price for determining LULD price bands for the first 30 seconds following a primary market opening cross that occurs prior to 9:35 is the opening price itself. After 30 seconds, however, the reference price can be updated to reflect the arithmetic mean price of eligible trades over the previous 30 seconds.

the low price prior to the LULD halt. The price of CVS then quickly recovered upward and a second LULD halt was triggered 31 seconds after the first reopening cross.

V. Operation of LULD Plan and Related SRO Rules and Practices

The SEC first approved the LULD Plan on a pilot basis in 2012,[29] and it has continued to operate on a pilot basis since then. As the most volatile trading day since the Plan's approval, August 24 enables an assessment of the operation of the Plan, and related SRO rules and practices, under stressed market conditions. This Section V is intended to provide background information and empirical analysis that will help inform such an assessment and includes the following subsections:

A. Background on LULD and its application to August 24;
B. Categories of LULD halts;
C. Durations of LULD halts;
D. Intervals between LULD halts;
E. LULD limit states;
F. LULD bands disseminated before NYSE opening auctions;
G. Reopening auctions;
H. NYSE Arca reopening price collars;
I. NYSE Arca imbalance messages before reopening auctions;
J. Trades outside of LULD bands.

A. Background on LULD and Its Application to August 24

The impetus for the LULD Plan can be traced to the "Flash Crash" in the U.S. equity market on May 6, 2010. After the Flash Crash, trades were broken in 326 securities with irrational price moves of 60% or greater. Of those, 237 were in ETPs and 89 were in other securities.

The LULD Plan was adopted to prevent trades in individual NMS securities from occurring outside specified price bands and provide trading pauses to accommodate more fundamental price moves (as opposed to erroneous trades or momentary gaps in liquidity). Certain elements of the Plan are summarized below to facilitate an understanding of the following analysis.

The LULD bands are calculated and disseminated by the SIPs in the consolidated market data feeds. The bands generally are based on a reference price that equals the arithmetic mean price of trades over the preceding five-minute period. Each new reference price remains in effect for at least 30 seconds, and a new reference price does not become effective unless it is one percent or more from the last reference price.

The bands are calculated during regular trading hours and are set at 5%, 10% or 20% from the reference price, depending on predefined tiers of securities and their previous closing prices. Securities with a previous closing price of less than $0.75 have a band of the lesser of $0.15 or 75%, and leveraged ETPs have the applicable band percentage multiplied by their leverage ratio. From 9:30 to 9:45 and from 3:35 to 4:00, the band percentages are doubled.

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[29] Securities Exchange Act Release No. 67091, 77 FR 33498 (June 6, 2012).

When the national best bid or offer reaches the band price on the contra side (that is, the national best bid reaches the upper band price or the national best offer reaches the lower band price), the security enters a Limit State. A Limit State will end if the national best bid (offer) moves below (above) the upper (lower) band. If the market does not exit the Limit State within 15 seconds, then the primary listing exchange declares a trading pause of at least 5 minutes that applies to all equity exchanges and off-exchange trading venues.

The initial reference price of the day and the first reference price following a trading pause are the first trade or, if there is no trade, the mid-point of the first bid and offer on the primary listing exchange. During the period less than five minutes after the opening, the reference price is the arithmetic mean price of trades following the opening. If the primary listing exchange does not open within 5 minutes after the start of regular trading hours at 9:30, the first reference price is the arithmetic mean price of trades by other markets during the preceding 5 minutes. The bands are not in effect until the earlier of the opening of the primary listing exchange or 9:35. If the primary listing exchange does not open within 10 minutes after a trading pause, the first reference price following the pause will be equal to the last reference price before the trading pause, and the bands will be tripled for the next 30 seconds.

Following a trading pause, the primary listing market for the symbol reopens in a similar manner to its opening for regular trading hours, but with some important differences. NASDAQ does not restrict the reopening auction price, but delays a reopening auction until all market orders can be matched. BATS also delays a reopening auction for unmatched market orders, and it applies a collar to the price of the auction. NYSE Arca also applies a collar to the price of its reopening auctions. NYSE's reopening process is not subject to certain floor official approvals for price moves, but the reopening may be delayed in the event of a significant imbalance.

B. Categories of LULD Halts

On August 24, 1,278 LULD halts were triggered in 471 securities.[30] The halts were concentrated in ETPs (83%), and less than 2% of the components of the S&P 500 and NASDAQ 100 indices triggered halts. One quarter (25%) of the impacted securities triggered halts in the first minute of regular hours trading, and most of the halts (87%) triggered in the first 45 minutes. More than half (55%) of the impacted securities triggered more than one halt, and over one quarter (26%) of the impacted securities were halted 4 or more times.

[30] Unless otherwise stated, the analysis of the LULD halts is based on all securities subject to LULD. Tables based on securities described in Section I of this Research Note are explicitly identified herein as "Covered Securities." Data are sourced from the consolidated data feeds disseminated by the SIPs, direct data feeds disseminated by the exchanges, and www.nasdaqtrader.com.

Just over 60% of all LULD halts were limit up halts, and most (88%) of the limit up halts triggered after the LULD bands tightened at 9:45. Of the securities with just one halt, 62% were limit up halts. Most (85%) of the multi-halt securities triggered both limit down halts and limit up halts, and 81.5% of all the halted symbols triggered at least one limit up halt.

A great majority (84%) of ETPs have small market capitalizations and, accordingly, most LULD pauses occurred in smaller ETPs. The rate of ETPs with LULD halts, however, was the same for both the largest and smaller ETPs. LULD trading pauses occurred in 20% of the 50 largest capitalization ETPs, and in 20% of the remaining 1491 ETPs.

The following tables provide more details:

Table V-1: LULD Halts

Halt Time	Listing Exchange					Direction		Product		Total
	BATS	NASDAQ	NYSE	NYSE Arca	NYSE MKT	Down	Up	ETP	Non ETP	
9:30	2	14	1	100		111	6	108	9	117
9:31 - 9:34		14	12	69		91	4	74	21	95
9:35- 9:44		16	13	199		142	86	202	26	228
9:45		14	18	39		17	54	44	27	71
9:46 - 9:59		46	17	289	4	72	284	306	50	356
10:00 - 10:14	1	29	7	205		23	219	216	26	242
10:15 - 10:29		17	5	57		14	65	62	17	79
10:30 - 10:44		7	1	17		9	16	18	7	25
10:45 - 10:59		8	3	11		10	12	11	11	22
11:00 - 11:59		15	1	8		10	14	10	14	24
12:00 - 12:59		4		3		2	5	4	3	7
1:00 - 1:59		4				1	3	1	3	4
2:00 - 2:59		4		2		2	4	2	4	6
3:00 - 4:00		2				1	1		2	2
Total Halts	3	194	78	999	4	505	773	1,058	220	1,278
Securities Halted	2	103	61	302	3	306	384	327	144	471
Securities Halted Up & Down	1	32	7	178	1	-	-	192	27	219

Table V-1: LULD halts by time, listing exchange, direction, product type, and security count.

Table V-2: LULD Halts Per Security

Halts Per Security	Securities by Listing Exchange					Total
	BATS	NASDAQ	NYSE	NYSE Arca	NYSE MKT	
1	1	65	45	101	2	214
2	1	16	15	50	1	83
3		9	1	42		52
4		7		30		37
5		5		20		25
6				17		17
7				14		14
8				15		15
9				2		2
10				8		8
11				2		2
12				1		1
17		1				1
Total	2	103	61	302	3	471

Table V-2: Count of LULD halts per security, separated by listing exchange.

Table V-3: LULD Halts in S&P 500 and NASDAQ-100 Securities

Halt Time	*CELG*				*KHC*				*NQ (2)*	
	CELG	CVS	F	HCA	KHC	UNH	XL	ZTS		S&P (8)
9:30:23	1								1	1
9:30:43					1				1	1
9:30:54						1				1
9:31:56		1								1
9:35:15				1						1
9:35:40							1			1
9:37:32		1								1
9:38:25			1							1
9:43:47							1			1
9:46:00				1						1
9:46:17								1		1
Total	1	2	1	2	1	1	2	1	2	11

Table V-3: Time and count of LULD halts in S&P 500 and NASDAQ-100 securities.

Table V-4: LULD Halts in Covered Securities

Market Cap Bin	Corporates			ETPs			Other		
	Halts	Securities Halted	Halts / Security	Halts	Securities Halted	Halts / Security	Halts	Securities Halted	Halts / Security
Very Large	3	2	1.5						
Large	10	7	1.4	37	10	3.7			
Mid	26	20	1.3	323	56	5.8	9	7	1.3
Small	117	65	1.8	683	249	2.7	28	23	1.2
Total	156	94	1.7	1,043	315	3.3	37	30	1.2

Percent of Covered Securities with LULD Halts

Market Cap Bin	Corporates			ETPs			Other		
	Total Securities	Securities Halted	Percent Halted	Total Securities	Securities Halted	Percent Halted	Total Securities	Securities Halted	Percent Halted
Very Large	41	2	5%	1		0%	1		0%
Large	383	7	2%	49	10	20%	49		0%
Mid	1,324	20	2%	196	56	29%	331	7	2%
Small	2,569	65	3%	1,295	249	19%	953	23	2%
Total	4,317	94	2%	1,541	315	20%	1,334	30	2%

Table V-4: LULD halts in covered securities, as described in Section I of this Research Note, separated by market capitalization bin and product.

C. Duration of LULD Halts

On August 24, almost all (95%) of the LULD halts lasted less than 6 minutes. However, more than half (51%) of NYSE's 78 halts lasted more than 6 minutes, 9% of NYSE's halts lasted more than 10 minutes, and NYSE's longest halt lasted over 18 minutes. NASDAQ also had some longer halts: 9% of its 194 halts lasted more than 6 minutes, over 6% lasted more than 10 minutes, and NASDAQ's longest halt lasted 43 minutes. BATS only had three halts, but one lasted for 28 minutes. All of NYSE Arca's halts lasted for 6 minutes or less.

Potential reasons for longer halts include: NYSE's reopening auctions are conducted manually by the DMM; NASDAQ and BATS electronically delay reopening auctions until market order imbalances are resolved; and NASDAQ will also delay reopening auctions if the last available imbalance reference price, when compared to any of the three preceding reference prices, differ by more than the greater of 5% or 50 cents.

If a primary listing market extends a halt beyond 10 minutes, the LULD bands are set by the SIP at triple-wide based on the prior reference price and the other markets are permitted to resume trading. In practice, most markets do not resume trading until the primary market reopens and issues a trade resumption message. On August 24, 11 of the 19 securities with halts over 10 minutes triggered another LULD halt shortly after reopening.

Table V-5: LULD Halt Duration

Duration in Minutes	Listing Exchange					Total
	BATS	NASDAQ	NYSE	NYSE Arca	NYSE MKT	
5	2	177	38	992	3	1,212
6		3	18	7		28
7		1	6		1	8
8		1	7			8
9		1	2			3
10 - 14			3			3
15 - 43	1	11	4			16
Total	3	194	78	999	4	1,278
Average Duration	12:40	6:05	6:59	5:34	5:54	5:45

Table V-5: Duration of LULD halts calculated as time between halt and trade resumption on the listing exchange.

D. Intervals between LULD Halts

On August 24, 257 securities triggered more than one halt, and those multi-halt securities accounted for 1,064 of the 1,278 halts. The average interval between the resumption of trading from one halt to the beginning of the next halt in the same security was just over 4 minutes (4:14) for the 807 intervals in the 257 securities. Over one quarter (26%) of those intervals lasted 15 seconds – the minimum possible interval due to the 15-second Limit State provided by the LULD Plan. Close to half (45%) of the halt intervals lasted less than 30 seconds, and more than half (58%) lasted less than 1 minute.

Table V-6: Trading Interval Between Halts in Multi-Halt Securities

Intervals (mm:ss)	Listing Exchange					Total
	BATS	NASDAQ	NYSE	NYSE Arca	NYSE MKT	
= 0:15		11		198	1	210
0:16 - 0:29		20	5	130		155
0:30 - 0:59		12	5	91		108
1:00 - 1:59	1	6		70		77
2:00 - 4:59		10	3	104		117
5:00 - 29:59		23	3	94		120
>= 30:00		9	1	10		20
Total	1	91	17	697	1	807
Average Interval	1:27	13:28	5:20	3:01	0:15	4:14

Table V-6: The interval measures the trading time in between two halts in the same security (LULD halt time minus prior trade resumption time).

E. LULD Limit States

As noted above, a security enters a Limit State if the national best bid equals the upper LULD price band or the national best offer equals the lower LULD price band. If the Limit State persists for 15 seconds, then the security is halted.

On August 24, 642 securities entered 5,551 Limit States. Most (73%) of the 642 securities that entered at least one limit state eventually halted, but most (77%) of the 5,551 limit states did not trigger a halt. Almost 30% of all limit states were concentrated in 6 securities.

Table V-7: LULD Limit States

Count	Bid Up	Offer Down	Total	Halts	Exits
Limit States	2,594	2,957	5,551	1,278	4,273
Securities w/ Limit States	445	501	642	471	171

Security	Securities with High Limit State Counts				
	Bid Up	Offer Down	Total	Halts	Exits
MLPG	340	1	341	2	339
MLPW	110		110	1	109
TSQ		718	718	1	717
CXRX	255		255	0	255
FOXA	103		103	0	103
LTRPB		94	94	17	77
Total	808	813	1,621	21	1,600

Table V-7: Count of LULD Limit States by direction, security count and resulting halts and exits without halts. This Table also shows the concentration of Limit States in six securities.

F. LULD Bands Disseminated before NYSE Opening Auctions

If the primary listing exchange does not open by 9:35, the SIP sets the LULD bands based on the arithmetic mean price of trades by other markets during the preceding 5 minutes. On August 24, NYSE opened many of its listed securities later than 9:35. Table IV-2 above, for example, indicates NYSE opened 62% of its listed S&P 500 companies after 9:35. These securities were able to trade on away markets without LULD bands until 9:35.

Of NYSE-listed securities that had opening crosses on August 24, there were 67 halts in 53 symbols. More than half of these NYSE-listed securities (31 of 53) opened after 9:35, and, consequently, their initial LULD bands were established based on trades from non-primary markets. Eight of those securities (BAP, GDP, HCA, HUSI-F, PAG, SCL, TTC, XL) triggered halts before NYSE's opening auction and 3 of those securities (HCA, HUSI-F, XL) halted again within 45 seconds of NYSE's auction. An additional 5 securities (CXP, EPE, GDP-D, GNK, MYJ) with non-primary LULD bands halted within 17 seconds of NYSE's post-9:35 opening and 1 (GEL) halted within 46 seconds.

G. Reopening Auctions

Almost one-third (31%) of LULD halts resulted in a reopening without an auction trade. This includes 19 halts that reopened for trading after 10 minutes because the primary listing market had not yet reopened. Close to two-thirds (64%) of LULD halts reopened with auction trades of less than 1000 shares or without a trade.

Table V-8: Shares Traded in Re-Opening Halt Auctions

Shares Traded	Auctions by Listing Exchange					Total
	BATS	NASDAQ	NYSE	NYSE Arca	NYSE MKT	
0	2	70	32	286	1	391
1 - 99		2		65		67
100 - 999		40	13	301	2	356
1,000 - 4,999		41	8	213		262
5,000 - 9,999		15	8	51	1	75
10,000 - 99,999	1	21	14	72		108
100,000 - 655,000		5	3	11		19
Total	3	194	78	999	4	1,278

Table V-8: Shares traded in auctions following LULD halts by listing exchange. The 391 auctions with 0 shares traded include 19 halts that reopened for trading after 10 minutes because the listing market had not yet conducted an auction.

H. NYSE Arca Reopening Price Collars

Under the LULD Plan, pricing bands are not applied to reopening auctions. In approving the LULD Plan, the SEC noted that "the Plan is also designed to accommodate more fundamental price moves, albeit in a manner that lessens the velocity of such moves. In this regard, the Commission notes that the Plan provides that the price bands shall not apply to single-priced reopenings, which allows for the stock to enter a trading pause and reopen at a price that is potentially significantly above or below its previous price. The Commission finds that this mechanism is reasonably designed to allow for more fundamental price moves to occur."[31]

NYSE Arca applied price collars to its reopening auctions after LULD halts on August 24, similar to its price collars for opening auctions noted in Section IV above. The collars were tiered based on the price of the last trade prior to the auction. The collars were 1% for last trade prices over $50, 2% for last trade prices from $25.01 to $50.00, and 5% for last trade prices $25.00 and under. BATS also applied price collars to its three reopening auctions, which were the same percentages as for openings noted in Section IV above (3% from a collared midpoint of the NBBO for midpoints over $50.00; 5% for midpoints from $25.01 to $50.00; and 10% for midpoints of $25.00 or under). NASDAQ did not apply price collars to its reopening auctions.

Price collars on reopening auctions after LULD halts potentially limit the extent to which prices can adjust to changing conditions without triggering additional LULD halts. One effect of price collars on an auction is that market orders and limit orders with limit prices better than the auction price may not be executed in the auction. After the collared auction ends, the unexecuted market orders and limit orders can seek immediate execution at the primary listing exchange or at other exchanges.

[31] Securities Exchange Act Release No. 67091, 77 FR 33498, 33509 (June 6, 2012).

To help assess the effect of the NYSE Arca price collars on reopenings after LULD halts, Table V-9 below compares the best offer (best bid) at the time of a limit down (up) halt with the price executed in the auction at the resumption of trading after the halts. Reopening auctions on NYSE Arca generated prices that were substantially less dispersed than reopening auctions on other exchanges. In total, 13% of NYSE Arca reopening auctions in ETPs generated prices that were 5% or more away from the relevant quote prior to the halt. In contrast, 54% of NASDAQ reopening auctions in ETPs generated prices that were 5% or more away from the relevant quote prior to the halt. For non-ETPs, 42% of all NASDAQ and NYSE reopening auctions generated prices that were 5% or more away from the relevant quote prior to the halt.

Table V-9: Reopening Auction Prices Following LULD Halts

Auction Price Move	ETPs				Non-ETPs			
	DOWN Halts		UP Halts		DOWN Halts		UP Halts	
	NASDAQ	NYSE Arca	NASDAQ	NYSE Arca	NASDAQ	NYSE	NASDAQ	NYSE
<=-30%	1			2	2			
>-30%,<=-20%	1			3				
>-20%,<=-10%	2	5	1	12	5			
>-10%,<=-5%	1	3	6	22	1	1	1	2
>-5%,<=-2%	3	37	1	50	1	2	3	1
>-2%,<=-1%		46		18	2	1		3
>-1%,<=1%	5	111	3	178	4	2	2	9
>1%,<=2%		30	2	79	1		1	4
>2%,<=5%	3	27	6	40	2	1	4	6
>5%,<=10%	2	23	5	11	2	1	5	1
>10%,<=20%		4	5	6	2	1	5	3
>20%,<=30%			2			1	1	
>30%			1	1			2	
Total	18	286	32	422	22	10	24	29

Table V-9: Comparison of reopening auction prices in covered securities to the best bid (offer) at the time of the limit up (down) halt. The numbers exclude 357 reopening auctions that did not result in a trade and 36 reopening auctions for inverse ETPs, securities with prices under $3, and securities listed on BATS and NYSE MKT.

I. NYSE Arca Imbalance Messages before Reopening Auctions

Through its direct data feeds, NYSE Arca disseminates imbalance messages before auctions that provide the indicative match price (the price at which the maximum volume of shares are executable), the matched volume at the indicative match price, the total imbalance of any remaining orders executable at the indicative match price, and the portion of the total imbalance that is comprised of market orders. Updates to NYSE Arca's imbalance messages are event driven, and NYSE Arca is the only exchange that specifically identifies market order imbalance volume.

NYSE Arca disseminated imbalance messages prior to 900 of the 999 reopening auctions. The remaining 99 reopening auctions did not result in any trades. In 80 of the 900 reopening auctions with imbalance messages, the shares traded in the auctions differed from the matched shares in the imbalance messages. The remaining 820 imbalance messages provided a matched share volume and indicative price that equaled the volume and price of the resulting auction, and as such are a reasonably reliable indicator of the orders that were executable in the auction.

A very large portion of those 820 messages (93% or 762) identified an imbalance volume, and more than half (62% or 509) identified a market order imbalance volume. More than a quarter (26% or 133 of the 509) of the auctions that were preceded by messages with market order imbalances did not result in a trade in the auction. In those instances, there were no contra-side orders in the auction that were within NYSE Arca's price collars, although there may have been contra-side orders executable outside of the collars.

Table V-10 below compares the volume of market order imbalances to the volume executed in the resulting auction. Twenty messages identified market order imbalances exceeding 100,000 shares and the average market order imbalance in those messages was over 175,000 shares. The average volume executed in the resulting auctions, however, was just over 15,000 shares. The large disparity between the size of the market order imbalance and the volume in the auction continued in each of the Table V-10 imbalance bins, except for the bins below 5,000 shares. As noted above, after the auction, the orders in the imbalance may seek immediate execution in continuous trading.

Table V-10 also shows that market order imbalances represented 94% of total sell imbalances. For buy imbalances, market order imbalances represented only 9% of the total imbalances. This distinction is also shown in the count of imbalance messages without a market order imbalance: 91% of the sell imbalance messages included market order imbalances while 52% of the buy imbalances included market orders. In sum, market orders were a significant source of the sell pressure in NYSE Arca's reopening auctions, but a much less significant source of buy pressure.

Table V-10: NYSE Arca Imbalance Messages Before an LULD Halt Reopening

Market Order Imbalance Bins		Market Order Imbalance			Total Imbalance		Auction		
		Count	Sum	Average	Sum	Average	Sum	Average	w/o Trades
Sell	> 100,000	20	3,544,311	177,216	3,664,163	183,208	303,875	15,194	
	50,001 - 100,000	31	2,202,558	71,050	2,384,964	76,934	123,518	3,984	1
	10,001 - 50,000	64	1,614,917	25,233	1,757,436	27,460	369,785	5,778	8
	5,001 - 10,000	28	205,693	7,346	240,518	8,590	39,640	1,416	2
	1,001 - 5,000	70	182,171	2,602	214,497	3,064	404,194	5,774	18
	1 - 1,000	52	19,293	371	22,346	430	18,790	361	23
	Subtotal (avg)	265	7,768,943	29,317	8,283,924	31,260	1,259,802	4,754	52
Buy	> 100,000	-							
	50,001 - 100,000	-							
	10,001 - 50,000	19	326,634	17,191	1,956,619	102,980	31,213	1,643	1
	5,001 - 10,000	11	78,585	7,144	927,170	84,288	17,410	1,583	
	1,001 - 5,000	63	141,730	2,250	2,442,479	38,770	61,308	973	9
	1 - 1,000	151	48,159	319	1,369,832	9,072	37,831	251	71
	Subtotal (avg)	244	595,108	2,439	6,696,100	27,443	147,762	606	81
Total (avg)		509	8,364,051	16,432	14,980,024	29,430	1,407,564	2,765	133
No Market Imbalance		311	0	0	5,389,075	17,328	1,702,060	5,473	54

Table V-10: A description of the last NYSE Arca imbalance messages before an LULD halt reopening in which the matched shares and the indicative price equal the shares and price of the resulting auction.

J. Trades Outside of LULD Bands

The SIPs reported over 4,000 trades totaling more than 835,000 shares and $34 million that occurred at prices outside of the LULD bands following LULD halts. Reports of most of the trades were disseminated by the SIPs in a short period (less than 2 seconds) from the time that the SIPs disseminated a trade resumption message and a message with new LULD price bands based on the reopening price of the primary listing exchange.

More than 97% of the trades occurred in NYSE-Arca listed ETPs, and over 38% of the trades were executed on Direct Edge. Almost one quarter (24%) of the trades were executed by the primary listing exchange.

Some of these trades set the daily low or high for certain securities and were the reference price for NYSE Arca's auction collars.

Table V-11: Trades Outside of LULD Bands Following LULD Halts

Value of Trades Outside the LULD Bands						
Executing Market	Listing Exchange					Total
	BATS	NASDAQ	NYSE	NYSE Arca	NYSE MKT	
BATS		$8,830	$11,351	$2,709,728		$2,729,909
BYX			$13,328	$430,759	$32	$444,119
EDGA			$3,194	$842,733		$845,927
EDGX		$37,109	$7,073	$15,876,461	$1,330	$15,921,974
NASDAQ		$4,890	$93,065	$3,275,192		$3,373,147
NASDAQ BX			$8,462	$14,543		$23,005
NASDAQ PSX			$2,609	$16,495		$19,104
NYSE			$291,260			$291,260
NYSE Arca		$22,494	$3,410	$9,575,261		$9,601,164
NYSE MKT						$0
Off-Exchange		$12,485	$22,908	$1,353,324		$1,388,716
Total	$0	$85,808	$456,659	$34,094,497	$1,362	$34,638,326

Count of Trades Outside the LULD Bands						
Executing Market	Listing Exchange					Total
	BATS	NASDAQ	NYSE	NYSE Arca	NYSE MKT	
BATS		1	5	328		334
BYX			4	89	1	94
EDGA			2	139		141
EDGX		6	5	1,551	1	1,563
NASDAQ		2	30	702		734
NASDAQ BX			1	6		7
NASDAQ PSX			2	7		9
NYSE			29			29
NYSE Arca		4	1	933		938
NYSE MKT						0
Off-Exchange		5	14	210		229
Total	0	18	93	3,965	2	4,078

Table V-11: Trades reported by the SIPs in covered securities at prices outside of the LULD bands and within 2 seconds following the band dissemination. Excluded from these numbers are trades reported as crosses, out of sequence trades, and special trades.

VI. Trading in ETPs

As addressed in several preceding sections, ETPs as a class were particularly affected on August 24. Section III indicates that ETPs experienced a larger number of extreme price declines than Corporates. For example, 19.2% (288) of ETPs experienced price declines of 20% or greater, while only 4.7% (280) of Corporates experienced such declines. Trading volume surged and displayed liquidity dropped, particularly at the open, in Large, Mid, and Small ETPs. Moreover, Section V indicates that 83% of LULD halts on August 24 were in ETPs, even though they represent less than 20% of the securities subject to the LULD Plan that were traded that day.

It bears emphasis, however, that there was a wide variation among ETPs in their volatility and number of LULD halts. The preceding sections also indicate, for example:

- Most ETPs (859, 63.3% of total ETPs) experienced price declines of less than 10% -- a level that is generally consistent with the broad-market price declines on August 24 and therefore suggestive that they traded with little, if any, discount to the indices they were designed to track.

- Most ETPs (1,226, 80% of total ETPs) did not experience even a single LULD halt on August 24, but the 315 ETPs that did experience an LULD halt averaged 3.3 halts per ETP.

- SPY, the largest ETP that tracks the S&P 500 index, traded in line with or at a premium to SPY NAV, while IVV, the second largest ETP that tracks the S&P 500 index, traded at a substantial discount to SPY, SPY NAV, and E-Mini in the opening minutes of August 24.

- Many NYSE-listed Corporates did not open on NYSE at 9:30 and their delayed opens potentially could have affected trading in ETPs designed to track indexes that include NYSE Corporates (such as the S&P 500). Nevertheless, all NASDAQ-100 constituents are listed on NASDAQ and opened on NASDAQ at 9:30, and still the highly active QQQ traded at a substantial discount to QQQ NAV in the opening minutes of August 24.

This Section VI is intended to provide data on ETP trading that helps illuminate two questions – why were a minority of ETPs more affected than Corporates on August 24 in terms of their volatility and number of LULD halts, and yet why did the majority of ETPs trade in a manner consistent with the broad market price declines in Corporates and not experience any LULD halts?

To begin, Table VI-1 below provides summary trading data on Corporates and ETPs for a control period from July 27 to August 21, 2015.

Table VI-1: Control Period Volume, Range and Turnover

Data from 7/27 - 8/21

Corporates

	Number Of Securities	Mean Daily Trading Volume	Mean Percentage Range	Median Percentage Range	ADV Turnover Rate
Very Large	41	14,725,707	1.7%	1.6%	0.5%
Large	383	3,921,719	2.1%	1.9%	0.8%
Mid	1,324	1,373,911	3.1%	2.7%	1.1%
Small	2,564	311,841	5.5%	4.5%	0.8%
Total	*4,312*				

ETPs

	Number Of Securities	Mean Daily Trading Volume	Mean Percentage Range	Median Percentage Range	ADV Turnover Rate
Very Large	1	124,336,940	1.1%	1.1%	14.6%
Large	49	7,541,604	0.9%	1.0%	2.3%
Mid	196	2,472,408	1.1%	1.0%	3.0%
Small	1,260	91,297	0.9%	0.8%	1.5%
Total	*1,506*				

Table VI-1: Summary trading data on Corporates and ETPs for a control period from July 27 to August 21, 2015. Range is defined as ((daily high - daily low)/daily close). ADV Turnover Rate is calculated by taking a security's average daily volume ("ADV") from July 27 to August 21 and then dividing that number by the security's shares outstanding from August 21. The mean of this ratio is then determined for each grouping. Securities that did not trade on all days from July 27 to August 21 were excluded from the analysis.

Table VI-1 shows that the great majority of ETPs (84%) fall within the Small market capitalization bin. These ETPs generally are much less actively traded than other ETPs, with mean daily trading volume of 91,297 shares compared to 2,472,408 shares for next larger bin of Mid ETPs.

During the control period, ETPs were less volatile than Corporates. While Very Large Corporates was the least volatile bin of Corporates with a 1.7% mean percentage range, all bins of ETPs had a range of 1.1% or less. In addition, the ADV Turnover Rate (the volume of trading in the secondary market in relation to the outstanding shares for a security) for all ETPs was higher than for any category of Corporate.

For comparison to the control period, Table VI-2 below provides the same metrics for trading on August 24.

Table VI-2: August 24th Volume, Range and Turnover

Data from 8/24

Corporates

	Number Of Securities	Mean Daily Trading Volume	Mean Percentage Range	Median Percentage Range	Volume Increase	8/24 Turnover Rate
Very Large	41	38,542,936	12.3%	10.5%	2.7	1.3%
Large	383	7,731,344	9.1%	7.6%	2.2	1.6%
Mid	1,324	2,125,447	8.5%	7.3%	1.7	1.7%
Small	2,564	376,483	9.7%	7.8%	1.6	0.9%
Total	*4,312*					

ETPs

	Number Of Securities	Mean Daily Trading Volume	Mean Percentage Range	Median Percentage Range	Volume Increase	8/24 Turnover Rate
Very Large	1	509,882,000	8.0%	8.0%	4.1	60.0%
Large	49	26,278,391	11.7%	8.1%	3.8	8.1%
Mid	196	7,438,085	14.1%	7.2%	3.9	9.3%
Small	1,260	294,821	10.2%	5.7%	4.5	5.1%
Total	*1,506*					

Table VI-2: Summary trading data on Corporates and ETPs on August 24. Securities that did not trade on all days from July 27 to August 21 were excluded from the analysis. Range is defined as ((daily high - daily low)/daily close). Volume Increase is calculated by taking the volume per security on August 24 divided by that security's ADV from July 27 - August 21. This value is then averaged over the entire bin. 8/24 Turnover Rate is calculated by taking a security's ADV from August 24 and then dividing that number by the security's shares outstanding from August 21. The mean of this ratio is then determined for each grouping.

Table VI-2 indicates how substantially trading on August 24 changed from the control period. In particular, the mean percentage ranges across all bins of both Corporates and ETPs increased substantially. With the exception of SPY in the Very Large ETP bin, however, each ETP bin for mean percentage range changed from being less volatile than the corresponding Corporates bin in the control period to being more volatile on August 24. Moreover, when comparing the mean to median percentage ranges for August 24 trading, the mean percentage ranges for each category of ETP (excluding SPY) were substantially higher than the median percentage range, indicating substantial variability within the same ETP market capitalization bin. In contrast, the differences between mean and median percentage ranges were less for all Corporates bins than any ETP bin (excepting SPY). Finally, the volume increases from the control period to August 24 were more substantial for all ETP bins than for any Corporates bin.

Among ETPs, the level of market capitalization and trading volume does not appear to be substantially associated with their degree of volatility on August 24. Large and Mid ETPs, with

higher market capitalizations and trading volumes than Small ETPs, nevertheless experienced a wider range of volatility on August 24 than did Small ETPs.

To further assess the variation of trading among ETPs, Table VI-3 below provides a variety of trading metrics that are categorized by geographic focus and asset class. In addition, Table VI-4 provides some information on trading activity specifically for Leveraged ETPs, which are generally excluded from the other analyses in this Research Note. As noted in Section V above, Leveraged ETPs have their LULD price band percentages multiplied by their leverage ratio. For example, the LULD price band percentage in the period from 9:30 to 9:45 on August 24 for a Tier 1 Leveraged ETP with a triple leverage ratio would have been 30%, rather than the 10% price band percentage applicable to a Tier 1 non-leveraged ETP.

Table VI-3: ETP Characteristics Breakdown

ETPs								
Geographic Focus	Number Of Securities	Total Halts	Unique Security Experiencing A Halt	Percent Of Securities Experiencing A Halt	Mean Percentage Range	Median Percentage Range	Volume Increase	ADV Turnover Rate
Global	719	152	75	10.4%	7.0%	5.0%	4.0	1.6%
US Only	787	887	236	30.0%	14.1%	8.4%	4.7	1.9%

ETPs								
Asset Class Focus	Number Of Securities	Total Halts	Unique Security Experiencing A Halt	Percent Of Securities Experiencing A Halt	Mean Percentage Range	Median Percentage Range	Volume Increase	ADV Turnover Rate
Alternative	27	2	2	7.4%	4.6%	1.6%	1.9	1.1%
Commodity	111	4	4	3.6%	2.7%	2.1%	2.1	1.5%
Equity	1,015	949	267	26.3%	13.6%	8.5%	4.5	1.7%
Fixed Income	276	26	18	6.5%	2.7%	1.1%	4.3	1.2%
Mixed Allocation	31	38	12	38.7%	15.1%	7.7%	3.3	0.6%
Specialty	46	20	8	17.4%	15.4%	2.8%	9.0	8.0%

US Only ETPs								
Asset Class Focus	Number Of Securities	Total Halts	Unique Security Experiencing A Halt	Percent Of Securities Experiencing A Halt	Mean Percentage Range	Median Percentage Range	Volume Increase	ADV Turnover Rate
Alternative	11	1	1	9.1%	6.7%	4.2%	1.9	1.4%
Commodity	28	0	0	0.0%	3.4%	3.1%	2.5	2.6%
Equity	499	825	209	41.9%	19.2%	14.3%	5.0	1.7%
Fixed Income	215	24	16	7.4%	2.7%	0.9%	3.6	1.2%
Mixed Allocation	11	22	5	45.5%	19.6%	24.5%	3.4	0.6%
Specialty	23	15	5	21.7%	23.7%	11.4%	12.2	14.2%

Table VI-3: Trading metrics for ETPs categorized by geographic focus and asset class. The geographic focus and asset class focus were obtained from Bloomberg Professional Service. Securities that did not trade on all days from July 27 to August 21 were excluded from the analysis. Range is defined as ((daily high - daily low)/daily close). Volume Increase is calculated by taking the volume per security on August 24th divided by that security's ADV from July 27 to August 21. This value is then averaged over the entire bin. ADV Turnover Rate is calculated by taking a security's average daily volume ("ADV") from July 27 to August 21 and then dividing that number by the security's shares outstanding from August 21. The mean of this ratio is then determined for each grouping.

Table VI-4: Leveraged ETP Characteristics Breakdown

US Only Leveraged ETPs						
Asset Class Focus	Number Of Securities	Total Halts	Unique Security Experiencing A Halt	Mean Percentage Range	Volume Increase	ADV Turnover Rate
Commodity	8	0	0	7%	1.3	40%
Equity	108	9	7	20%	6.2	12%
Fixed Income	16	2	1	9%	4.1	3%
Specialty	3	0	0	39%	10.5	61%

Global Leveraged ETPs						
Asset Class Focus	Number Of Securities	Total Halts	Unique Security Experiencing A Halt	Mean Percentage Range	Volume Increase	ADV Turnover Rate
Commodity	19	1	1	8%	2.5	4%
Equity	46	0	0	15%	7.0	7%
Fixed Income	3	0	0	2%	3.4	5%
Specialty	7	0	0	4%	6.6	2%

Table VI-4: Trading metrics for Leveraged ETPs categorized by geographic focus and asset class. The geographic focus and asset class focus were obtained from Bloomberg Professional Service. Securities that did not trade on all days from July 27 to August 21 were excluded from the analysis. Range is defined as ((daily high - daily low)/daily close). Volume Increase is calculated by taking the volume per security on August 24th divided by that security's ADV from July 27 to August 21. This value is then averaged over the entire bin. ADV Turnover Rate is calculated by taking a security's average daily volume ("ADV") from July 27 to August 21 and then dividing that number by the security's shares outstanding from August 21. The mean of this ratio is then determined for each grouping.

For ETPs and Leveraged ETPs, volatility levels and number of LULD halts were higher in U.S. ETPs relative to Global ETPs.

To further refine the analysis, Table VI-5 below provides trading metrics for ETPs focused on U.S. Equities ("US Equity ETPs") and for Corporates. The table adds a metric that focuses on volume increases during time intervals immediately following the 9:30 start of regular trading hours for the U.S. equity markets – the ratio of ADV during these time intervals in the control period to volume during the corresponding intervals on August 24.

Table VI-5: Comparison of US Equity ETPs and Corporates

US Equity ETPs				Volume Increase								
Bin	Mean Percentage Range	Median Percentage Range	Number of Securities	9:30-9:31	9:31-9:35	9:35-9:45	9:45-10:00	10:00-10:15	Total Halts	Unique Security Experiencing A Halt	Percent Of Bucket Experiencing a Halt	ADV Turnover Rate
Very Large	8.0%	8.0%	1	3.5	3.6	3.0	4.1	6.1	0	0	0.0%	14.6%
Large	17.4%	16.2%	28	6.6	4.4	5.5	4.4	6.2	36	9	32.1%	2.8%
Mid	23.6%	19.6%	86	6.9	0.8	0.8	1.5	1.5	286	45	52.3%	2.7%
Small	18.4%	12.3%	384	27.4	6.3	7.3	3.7	5.0	503	155	40.4%	1.3%
Total			*499*						*825*	*209*		

Corporates				Volume Increase								
Bin	Mean Percentage Range	Median Percentage Range	Number of Securities	9:30-9:31	9:31-9:35	9:35-9:45	9:45-10:00	10:00-10:15	Total Halts	Unique Security Experiencing A Halt	Percent Of Bucket Experiencing a Halt	ADV Turnover Rate
Very Large	12.3%	10.5%	41	9.0	6.2	6.2	5.2	4.6	3	2	4.9%	0.5%
Large	9.1%	7.6%	383	4.0	3.5	3.9	3.3	3.1	10	7	1.8%	0.8%
Mid	8.5%	7.3%	1,324	3.4	2.3	2.8	2.5	2.4	26	20	1.5%	1.1%
Small	9.7%	7.8%	2,564	1.9	1.9	1.8	1.6	1.5	117	65	2.5%	0.8%
Total			*4,312*						*156*	*94*		

Table VI-5: Trading metrics for US Equity ETPs and Corporates. Range is defined as ((daily high - daily low)/daily close). Volume Increase is calculated by summing all volume for the respective bin and time interval for August 24 and dividing it by all volume for the respective bin and time interval from August 17. Securities that did not trade on August 17 were excluded from the analysis. ADV Turnover Rate is calculated by taking a security's ADV from July 27th to August 21 and then dividing that number by the security's shares outstanding from August 21. The mean of this ratio is then determined for each grouping.

Table VI-5 indicates that US Equity ETPs were much more likely to experience an LULD halt and had much wider percentage ranges than were Corporates. With the exception of SPY (the sole Very Large ETP), these ETPs generally experienced greater volume increases (as a ratio of August 17 to August 24 volume) during the opening minutes of August 24 than did Corporates, indicating that more selling pressure likely was brought to bear on the US Equity ETPs relative to Corporates. This was particularly true for Small US Equity ETPs, which experienced a volume increase in the first minute of trading on August 24 that was 27.4 times larger than during the control period.

Among the different market capitalization bins of US Equity ETPs, Table VI-5 indicates that Mid US Equity ETPs were more likely than Small US Equity ETPs to experience higher volatility and an LULD halt. Even Large US Equity ETPs experienced nearly as high a mean percentage range of volatility (17.4%) and LULD halts (32.1%) as Small US Equity ETPs (18.4% and 40.4%, respectively).

In addition, 290 of the US Equity ETPs (58.1%) did not experience even a single LULD halt on August 24, while the remaining 209 US Equity ETPs experienced 825 LULD halts. To further analyze characteristics that might help explain variations within this category of ETP, Table IV-6 below categorizes US Equity ETPs by the extent of their percentage range on August 24. To

eliminate the effect of normally very inactive Small ETPs and of the single Very Large ETP (SPY), Table VI-6 focuses on the 114 US Equity ETPs that fall within the Large and Mid bins of market capitalization. These Large and Mid ETPs represent 77% of the market capitalization of US Equity ETPs.[32]

Table VI-6: Large and Mid US Equity ETPs Grouped By Range

Price Range Grouping	Number of Securities	Mean Range	Number Of Halts	Unique Security Experiencing A Halt	Halts Per Security	Volume Increase	Depth Of Book Percent At 9:30:10	Mean Imbalance Relative To Opening Volume	Median Imbalance Relative To Opening Volume	ADV Turnover Rate
>=35%	24	42.8%	196	24	8.2	6.6	7.9%	338.4%	88.2%	0.6%
>=20,<35%	31	27.3%	123	28	4.4	5.4	14.4%	316.5%	42.4%	1.0%
>=10,<20%	28	15.1%	3	2	1.5	3.7	22.0%	203.8%	31.5%	3.8%
<10%	31	7.2%	0	0	0.0	3.8	24.1%	122.3%	20.8%	5.3%

Table VI-6: Large and Mid US Equity ETPs categorized by the extent of their percentage range on August 24. Range is defined as ((daily high - daily low)/daily close). Volume Increase is calculated by taking the volume per security on August 24 divided by that security's ADV from July 27 to August 21. This value is then averaged over the entire bin. Securities that did not trade on all days from July 27 to August 21 were excluded from the analysis. Depth of Book Percent At 9:30:10 is calculated by taking the cumulative volume 19 cents from the national best bid for all securities in the bin. This amount is then divided by a similar amount from August 17. The Mean and Median Imbalance Relative to Opening Volume columns are calculated by taking the imbalance amount from the last imbalance message prior to the security's open and dividing it by the opening volume. The mean/median of these ratios are calculated across bins. ADV Turnover Rate is calculated by taking a security's ADV from July 27 to August 21 and then dividing that number by the security's shares outstanding from August 21. The mean of this ratio is then determined for each grouping.

Nearly all of the LULD halts for these ETPs occurred in the groups with ranges of 20% or more. On August 24, the two most volatile groups had higher volume increase ratios compared to the two less volatile groups, as well as lower depth of book percentages (a comparison of depth of book at 9:30:10 on August 24 compared to the control period). The two most volatile groups also experienced more significant imbalances in their opening auctions.

Volume increases, depth-of-book percentages, and imbalances are "after-the-fact" metrics based on August 24 trading. ADV Turnover Rate, in contrast, is based solely on control period trading volume in the secondary market. It measures average daily trading volume during the control period in relation to the number of outstanding shares of a security. As noted in Table VI-1, for example, SPY, the sole Very Large ETP, has a high ADV Turnover Rate of 14.6%, while the mean ADV Turnover Rate for Large ETPs is 2.3%.

[32] SPY alone represents 15% of the market capitalization of US Equity ETPs. The 384 Small US Equity ETPs represent 8% of market capitulation of US Equity ETPs.

Table VI-6 indicates that ADV Turnover Rate is associated with the likelihood a Large and Mid US Equity ETP was going to experience severe volatility and multiple LULD halts on August 24. The US Equity ETPs in the two least volatile groups exhibited ADV Turnover Rates (3.8% and 5.3%) that are at least three times higher than the rates for the most volatile groups (0.6% and 1.0%). The ADV Turnover Rates for the two most volatile groups also are very low when compared to the average turnover rates for all Large and Mid ETPs set forth in Table VI-1 above (2.3% for Large and 3.0% for Mid).

To further assess the association between secondary market turnover rates and volatility, Table VI-7 below categorizes Large and Mid US ETPs by their ADV Turnover Rates.

Table VI-7: Large and Mid US Equity ETPs Grouped By ADV Turnover Rate

Turnover Grouping	Number Of Securities	ADV Turnover Rate	Mean Range	Number Of Halts	Unique Security Experiencing A Halt	Halts Per Security	Volume Increase
Lowest Turnover	28	0.39%	27.3%	122	21	5.8	6.45
	29	0.61%	24.0%	92	15	6.1	5.30
	29	1.05%	24.4%	102	16	6.4	3.94
Highest Turnover	28	9.12%	12.5%	6	2	3.0	3.48

Table VI-7: Large and Mid US Equity ETPs categorized by ADV Turnover Rate. ADV Turnover Rate is calculated by taking a security's ADV from July 27th to August 21st and then dividing that number by the security's shares outstanding from August 21st. The mean of this ratio is then determined for each grouping. Range is defined as ((daily high - daily low)/daily close). Volume Increase is calculated by taking the volume per security on August 24th divided by that security's ADV from July 27 to August 21. This value is then averaged over the entire bin. Securities that did not trade on all days from July 27 to August 21 are excluded.

Table VI-7 indicates that the three bins with the lowest secondary market turnover rates during the control period (0.39%, 0.61%, and 1.05%, respectively) experienced price ranges on August 24 that were much higher than the bin with the highest secondary market turnover rate during the control period (9.12%). The three low turnover rate bins also include nearly all of the LULD halts in Large and Mid US Equity ETPs.