

# Price Discovery from Offer Price to Opening Price of Initial Public Offerings\*

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## Abstract

We examine the price discovery process during preopening of initial public offerings (IPOs). The average time spent in preopening has increased from 20 minutes in 2010 to 77.23 minutes in 2020. Each phase of preopening contributes to incremental price discovery for most IPOs, with almost all of the first day's price adjustment occurring during preopening. In contrast, for "cold" IPOs, half of the price adjustment takes place after the market opens. Canceled orders also play a role in price discovery. Underwriters make use of the discretion given to them after the Facebook IPO debacle in deciding when to release an IPO for trading.

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On Tuesday, January 25, 2023 the New York Stock Exchange had a glitch and the opening auction did not occur for many stocks resulting in wide price swings in stocks including Verizon, Nike and Wells Fargo. Not having an official opening price resulted in some stocks trading at unusually low or high prices. This affects companies and also investor confidence in the markets. In the case of initial public offerings (IPOs), there is considerable price uncertainty at the opening, which is reflected in order imbalance and volatility, therefore making a smooth preopening even more critical. The orderly opening of secondary market trading after an IPO is of keen interest to issuers, investors, exchanges, underwriters, and regulators.<sup>1</sup> However, studies examining the workings of the preopening process and price discovery for IPOs are limited.<sup>2</sup> As discussed by [Biais, Hillion, and Spatt \(1999\)](#), "one of the central issues in economics is how prices are formed, equilibrium is reached, and valuation is discovered." IPOs provide a unique opportunity to study the equilibrium price formation process without any intervening trade and inventory adjustments taking place. This setting allows us cleanly test the learning versus noise hypothesis of price discovery. Orders placed during preopening can be modified or canceled and there are no trade executions therefore they might be noisy and not contain any information. However, as per the learning hypothesis, the market imposes discipline and indicative prices should predict the value of the security.

Over the years, exchanges have made significant changes to the IPO preopening process in order to make price discovery more streamlined. These have included the introduction of an open auction in which all investors are able to enter orders and contribute to price discovery. The rationale is that a greater number of orders entered prior to commencement of trading, should result in a higher level of order

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<sup>1</sup><https://www.sec.gov/litigation/admin/2013/34-69655.pdf>

<sup>2</sup>See [Aggarwal and Conroy \(2000\)](#) and [Cao, Ghysels, and Hatheway \(2000\)](#) for U.S. and [Biais, Hillion, and Spatt \(1999\)](#) for France.

interaction at the open. Other changes, after the Facebook IPO problems, gave a larger discretionary role to underwriters in deciding when to commence trading depending on order imbalance and their other insights. If the IPO preopening process does not work smoothly, as was the case with Facebook, investors can suffer losses, while stock exchanges and underwriters can suffer both reputational and financial consequences. Due to design limitations in the preopening process, the preopening and the immediate secondary market trading in Facebook did not proceed as expected causing severe disruptions. This high-profile IPO debacle in 2012 brought renewed attention to the opening process.

Studies examining the workings of the preopening process and price discovery for IPOs are limited. As discussed by Biais, Hillion, and Spatt (1999), "one of the central issues in economics is how prices are formed, equilibrium is reached, and valuation is discovered." IPOs provide a unique opportunity to study the equilibrium price formation process without any intervening trade and inventory adjustments taking place. This setting allows us to cleanly test the learning versus noise hypothesis of price discovery. Orders placed during preopening can be modified or canceled and there are no trade executions therefore they might be noisy and not contain any information. However, as per the learning hypothesis, the market imposes discipline and indicative prices should predict the value of the security.

Ours is the only study to examine the preopening process and price discovery from the offer price to the first open price since the introduction of the auction IPO Cross system. The IPO Cross sets the Official Opening Price and was introduced to benefit both investors and issuers by appropriately reflecting supply and demand in the stock. The preopening process today is completely different and far more important for price discovery than what existed in earlier periods studied by [Aggarwal \(2000\)](#). Before the

introduction of the IPO Cross, only market makers could enter quotes during a short window with no auction to determine the opening price.

We specifically study the preopening process for Nasdaq IPOs. The New York Stock Exchange also has an opening auction, however, the order imbalance and indicative opening price data was not disseminated until recently, and therefore a comprehensive analysis cannot be conducted. The Nasdaq preopening process currently has several phases, including System Start-Up, during which orders can be entered; a required minimum Display Only Period (DOP), during which orders can be entered and information about quotes, indicative clearing price, and imbalance is disseminated; the Pre-Launch Period, which can extend the preopening and during which the lead underwriter coordinates with Nasdaq to determine the IPO Cross time and the start of trading; and, finally, the IPO Cross, in which an auction is conducted and the official open price determined. The current IPO preopening process also provides the unique opportunity to examine the role of executed and canceled orders by small and large investors.

We examine the preopening process for 824 Nasdaq IPOs during 2010 to 2020. It is well documented (see [Ellis, Michaely, and O'Hara \(2000\)](#); [Aggarwal, Prabhala, and Puri \(2002\)](#) [Aggarwal \(2000\)](#)) that the trading volume on the first day following an IPO is high. We find a significant proportion of this high volume on the first day is cleared in the IPO Cross based on orders placed during the preopening. The percentage of the day's volume executed in the opening cross is much higher at 15.3% than the approximately 1% for non-IPO stocks, indicating the importance of price discovery during preopening for IPOs.<sup>3</sup> This volume represents 8.3% of shares offered. The extent of price discovery in the IPO preopening process is much higher than in the open call for non-IPOs. The average time spent in preopening has increased from

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<sup>3</sup><https://www.tradersmagazine.com/am/buyers-and-sellers-meeting-earlier-in-the-nyse-opening-auction/>



20 minutes in 2010 to 77.23 minutes in 2020. In contrast, preopening for non-IPO stocks lasts for two minutes, specifically from 9:28 a.m. to 9:30 a.m.<sup>4</sup> IPOs that take a longer time in preopening have higher offer-to-open returns. However, the length of the preopening period is not related to secondary market open-to-close returns on day 1. We find that canceled orders also play a significant role in price discovery.

We find each of the four phases of preopening, including the Pre-Launch Period, contributes to significant incremental price discovery. The pattern of price discovery for hot IPOs is different from that of cold IPOs. For hot IPOs almost all the price adjustment from offer-to-close return on day 1 takes place during preopening. In contrast, for cold IPOs, only about half of the offer-to-close return on day 1 takes place during preopening, with the remaining taking place after the IPO starts trading. Underwriters are likely to stabilize cold IPOs in the aftermarket, and this contributes to price discovery after the stock starts trading.

The preopening of IPOs also provides an opportunity to examine the role of retail investors. Retail investors made up 7.42% of all displayable executed orders during preopening in 2014; this increased to 41.44% in 2020. We find a similar pattern for the number of shares ordered. The average number of shares ordered during the preopening by all retail investors in an IPO increased from 867.8 shares in 2014 to 13,415.8 shares in 2020. These patterns are consistent with the increased role of retail investors in recent years. We find that even though participation by retail investors has increased during preopening, their role in price discovery, on average, is limited. This is because the number of shares transacted by them is far smaller than that of institutional investors. However, retail investors do play a significant role in the preopening of specific IPOs, such as Robinhood, where they are given large allocations. Contrary to popular belief, our results based on sell orders, suggest that

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<sup>4</sup>We also examine special purpose acquisition company (SPACs) as a natural control group and find the preopening for them to be different from that of traditional IPOs.

institutions sell and flip shares in the IPO Cross, however, we do not find evidence of flipping by retail investors.<sup>5</sup>

Barry and Jennings (1993) and Schultz and Zaman (1994) report that almost the entire initial return (underpricing) is reflected in the opening trade price, and therefore investors who buy a stock at the open are not able to take advantage of the first day's pop. The objective of these studies was not to examine how the IPO price changes from the offer price to the price of the first trade. The five-minute preopening process that existed in 1997 is examined by Aggarwal and Conroy (2000). Almost half the IPOs had a preopening period that lasted less than three minutes far smaller than the 77.23 minutes in 2020. Cao, Ghysels, and Hatheway (2000) conclude that quotes during preopening result in significant price discovery for Nasdaq stocks. Similarly, Biais, Hillion, and Spatt (1999) find that significant learning takes place during preopening on the Paris Bourse. Our paper studies how the price changes from offer to open in the preopening and the role of the IPO Cross. A number of studies have shown the advantages of consolidating orders during periods of extreme liquidity shocks.<sup>6</sup> Papers have also examined the introduction of closing auctions in U.S. equity markets, and find they improve market liquidity.

Ellis, Michaely, and O'Hara (2000) discuss the role of the lead underwriter who was always a market maker in Nasdaq IPOs. In its role as a market maker, the lead underwriter decided at what price to start quoting and trading the stock. In contrast, in the current IPO Cross system, there is no quoting by market makers, including the lead underwriter; anyone can place buy and sell orders, and the official opening price is determined using an auction. The role of institutional investors, specifically clients of the lead underwriter is examined by Griffin, Harris, and Topaloglu (2007). They

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<sup>5</sup>The selling could also be related to short selling, as discussed by Edwards and Hanley (2010).

<sup>6</sup>For example, Barclay, Hendershott, and Jones (2008), Madhavan (1992), Pagano and Schwartz (2005), Ellul, Shin, and Tonks (2005), Jegadeesh and Wu (2022).

find the net buying by clients of the lead underwriter and suggest that the pattern is consistent with quid pro quo arrangements. Aggarwal (2000) shows that underwriters can stabilize the aftermarket price of an IPO using the over-allotment option and aftermarket short covering. We add to the empirical literature that studies the role of institutional and retail investors in IPOs (see, Aggarwal, Prabhala, and Puri (2002); Aggarwal (2003); Field and Lowry (2009); Chemmanur, Hu, and Huang (2010); Ofek and Richardson (2003); and Chan (2010)). Lowry, Michaely, and Volkova (2017) provide a comprehensive review of the theoretical and empirical literature.

## 1. Preopening Process and IPO Cross Timeline

Nasdaq introduced the IPO Cross on May 30, 2006 after getting approval from the Securities and Exchange Commission (SEC). The IPO Cross is conducted before releasing an IPO for trading. The exchange cited the following benefits in its press release:

- Providing fair executions at a single price that is reflective of supply and demand in the market;
- Maximizing transparency at IPO opens by disseminating timely information to all investors; and by
- Creating an efficient, open process in which all investors have the ability to enter orders and participate in price discovery.<sup>7</sup>

[INSERT FIGURE 1 HERE]

We categorize the current preopening process into the following four phases as shown in Figure 1: 1) System Start-Up, 2) Display Only Period, 3) Pre-Launch Period, and the 4) IPO Cross.

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<sup>7</sup><http://ir.nasdaqomx.com/news-releases/news-release-details/nasdaq-announces-new-ipo-cross>

### *System Start-Up*

At 4 a.m. (7 a.m. before 2013<sup>8</sup>) Nasdaq starts accepting orders that are placed in a “holding bin” until the beginning of the next phase, the Display Only Period. Even though Nasdaq starts accepting orders at 4 a.m., brokerages typically start sending orders only at 8 a.m.

### *Display Only Period*

The underwriter coordinates with Nasdaq to decide when to start the DOP. During the DOP, members can submit the price and quantity of shares they are willing to buy and sell, entered orders can be canceled or replaced, and no executions occur. Information about quotes, indicative clearing price, paired shares, and imbalance information is displayed to the market during this period. Indicative clearing price is the price at which the opening book would clear based on current orders. Paired shares are the number of shares matched for execution. Imbalance information includes the number of imbalance shares and the side (buy/sell) of imbalance.

In 2006, the minimum DOP was 15 minutes with allowance for up to six five-minute extensions in case of order imbalance or excess volatility immediately before the IPO Cross.<sup>9</sup> Volatility is defined as a movement of 10% or 50 cents (whichever is greater) based on the price immediately prior to the cross and the dissemination 15 seconds prior to the cross. In coordination with the lead underwriter, Nasdaq also has the authority to manually extend the period for five minutes, if needed.

On May 18, 2012 at 7:56 a.m., Nasdaq announced that the DOP for Facebook would begin at 10:45 a.m., and that secondary trading would begin at approximately 11:00 a.m. At 10:45 a.m., indicative price and volume information started to be

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<sup>8</sup><https://www.sec.gov/rules/sro/nasdaq/2013/34-69151.pdf>

<sup>9</sup>[http://www.nasdaqtrader.com/content/productsservices/trading/ipohalt/ipo\\_faq.pdf](http://www.nasdaqtrader.com/content/productsservices/trading/ipohalt/ipo_faq.pdf)

disseminated. The indicative price showed the price at which Facebook shares would be traded if the IPO Cross occurred then; the number of shares (buys and sells) that would be matched were also provided. The criteria for five-minute extensions to the DOP based on volatility and imbalance were not met, therefore there was no extension to the minimum DOP of 15 minutes. However, due to glitches, the IPO Cross did not take place until 11:30:09 a.m. At 1:50 p.m. Nasdaq became aware that the cross was inaccurate and had not included 19 minutes of orders in the price/volume calculation, resulting in the exchange holding a short position of 3 million shares valued at \$ 129 million.<sup>10</sup>

After the many problems with the Facebook IPO, a number of major changes were made to the preopening process. In 2013, the five-minute extensions to the initial minimum 15-minute DOP were eliminated; instead, a Pre-Launch Period was added. Underwriters were given more say in the timing of the IPO Cross and trading. In an unrelated move, the DOP of 15 minutes was reduced to 10 minutes in 2017 based on the argument that many IPOs did not need to wait for a full 15-minute period to start trading. The reduced length gives the underwriter greater flexibility to initiate trading quickly when needed, and yet the process allows for a longer preopening when more time is needed.

#### *Pre-Launch Period*

Introduced in August 2013, the Pre-Launch Period immediately follows the Display Only Period. There is no minimum or maximum specified time for this phase. The change was designed to facilitate price discovery and foster increased coordination between Nasdaq and the lead underwriter in the timing of releasing a new issue for trading. This change gives the lead underwriter more input and flexibility in the

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<sup>10</sup>For details see the SEC Administrative Proceeding File No. 3-15339, <https://www.sec.gov/litigation/admin/2013/34-69655.pdf>.

timing of the commencement of the IPO Cross and trading. According to the SEC, the underwriter's involvement in timing the commencement of trading is consistent with current practice. In administering the IPO cross process since 2006, NASDAQ has found that underwriters possess valuable information about the pending IPO given their unique position in the market, including the status of IPO orders on the underwriter's book. NASDAQ believes that it is in the best interest of the markets to give underwriters input into the timing of the IPO Halt Cross to help to ensure the fair and orderly launch of trading in the IPO security.<sup>11</sup>

During Pre-Launch, the lead underwriter coordinates with Nasdaq to determine whether additional time is needed for price discovery before the IPO Cross can occur and trading begin.<sup>12</sup> The lead underwriter can decide when to launch the IPO Cross. However, the cross cannot take place if there is an imbalance or excess volatility requiring additional time for price discovery. The change to allow an underwriter to postpone and reschedule an IPO with the concurrence of Nasdaq gives flexibility in case of unforeseen market events that make it inadvisable to proceed with the IPO. Orders can be placed and canceled during this phase also.<sup>13</sup>

#### *IPO Cross and Commencement of Trading*

After the Pre-Launch Period, IPOs are opened using the IPO Cross, an open auction process in which all orders participate and help determine the opening price. The lead underwriter communicates to Nasdaq when the IPO is ready for the IPO Cross and trading. The IPO Cross auction based on price/time priority sets the official opening price and a bulk order is sent to the tape. After the IPO Cross takes place trading begins.

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<sup>11</sup><https://www.sec.gov/rules/sro/nasdaq/2013/34-69897.pdf>

<sup>12</sup>[https://www.nasdaqtrader.com/content/productsservices/trading/IPOCross\\_fs.pdf](https://www.nasdaqtrader.com/content/productsservices/trading/IPOCross_fs.pdf)

<sup>13</sup><https://www.sec.gov/rules/sro/nasdaq/2013/34-69897.pdf>

## 2. Data

We use the Securities Data Company (SDC platinum) new issues database to identify all IPOs that started trading on Nasdaq during the period from March 2010 to December 2020. The key variables obtained from SDC include issuer name, IPO date, issue date, CUSIP, offer price, shares offered, underwriter name's, SIC code, and whether the IPO is venture-backed. We also obtain data on the age of issuer firms and underwriter reputation rankings.<sup>14</sup>

The analysis is limited to IPOs that are listed on Nasdaq because IPO Cross data is only available from Nasdaq. The NYSE started disseminating auction imbalance information for IPO for a temporary period in 2020.<sup>15</sup> Following the literature, we exclude unit offerings, American Depositary Receipts, closed end funds, natural resource limited partnerships, REITs, bank and S&L IPOs, and best efforts offerings. We also exclude stocks with an offer price less than \$5. Hot IPOs are defined as those with an offer price less than the first day's closing price; cold IPOs are those with an offer price greater than the first day's closing price. The sample consists of 824 IPOs<sup>16</sup> The official opening and closing price for IPOs is from millisecond Trade and Quote (TAQ) data.

We obtain disseminated information during preopening for both IPOs from Net Order Imbalance Indicator (NOII) data from Nasdaq. The NOII shows the supply, demand, and order imbalance information during preopening prior to the opening cross. The components of the NOII include number of paired shares, number of imbalance shares, imbalance side, and indicative clearing price, and are updated every

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<sup>14</sup><https://site.warrington.ufl.edu/ritter/ipo-data/>

<sup>15</sup><https://nyseguide.srorules.com/rules/document>

<sup>16</sup>We examine the preopening process for SPACs in Nasdaq. SPACs provide a useful contrast to traditional IPOs on a number of dimensions.

second.<sup>17</sup> Specifically, paired shares represent the total number of shares that are eligible to be matched at the current reference price is determined with the goal of maximizing the number of shares paired and minimizing the imbalance shares. Imbalance shares represents the total number of marketable shares that are not matched. Imbalance side indicates the market side for the imbalance where “B” represents Buy-side imbalance, “S” represents Sell-side imbalance, and “N” represents when the buy side equals the sell side. In the case of non-IPO stocks, the information starts to be disseminated two minutes before the market opens. However, the preopening process for IPOs is very different and information starts to be disseminated when the Display Only Period starts, and continues until the IPO is released for trading. In 2020, on average, 77.23 minutes were spent in preopening and the information was disseminated for the length of this period.

We use the Nasdaq TotalView ITCH data to obtain orders that are placed for IPO stocks on the first day of trading. Nasdaq TotalView ITCH data displays the full order book depth on Nasdaq, including every order at every price level. We identify all IPO stock-related orders that were entered in the Nasdaq system. The order message includes timestamp, the number of shares associated with the order, whether the order is a buy or sell order, and a day-unique order reference number used by Nasdaq to track the order. We exclude orders that are canceled or deleted later based on the order reference number. Our analysis focuses on IPOs and does not include SPACs or direct listings unless specifically noted.

[INSERT TABLE 1 HERE]

Table 1 provides descriptive statistics by year and also for the full sample for the 824 IPOs on Nasdaq during the 2010 to 2020 period. There were fewer IPOs in the

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<sup>17</sup><https://nasdaqtrader.com/content/TechnicalSupport/UserGuides/TradingProducts/noi/noiiguide.pdf>



years after the financial crisis of 2008–2009. However, activity picked up in 2013. The lowest number of IPOs was 32 in 2010 and the highest was 136 in 2020.<sup>18</sup> The mean and median offer prices are \$14.63 and \$15.00, respectively. The average offer price has been higher in recent years at 14.68 (2018), 16.83 (2019), and 16.83 (2020). The mean and median issue size are \$165.52 million and \$89.45 million.

On average, the auction price determined in the IPO Cross is 20.23% higher than the offer price (with a median of 11.11%). There is only a small change from the open price determined by the IPO Cross to the close price on the first day of trading. The mean offer-to-close return is 22.03% (median of 12%). These changes in price indicate that the preopening process is important for initial price discovery and captures almost all of the first day return.

### **3. An Example of a Preopening: Dropbox IPO**

We use the Dropbox IPO to illustrate the preopening process, as shown in Figures 2–5. Dropbox went public on March 23, 2018 at an offer price of \$21. Goldman Sachs and J.P. Morgan Securities were the lead underwriters. The Nasdaq Start-Up system started accepting orders at 4 a.m. The Display Only Period commenced at 10:35:03 a.m., at which time information started to be disseminated about the indicative clearing price. The preopening period from the start of the Display Only Period to the IPO Cross, lasted for 1 hour and 15 seconds. Ten minutes of this time was the minimum required Display Only Period, and the remaining 50 minutes was the Pre-Launch Period. The first indicated open price disseminated to the market was \$27, as shown in Figure 2, and the order imbalance, defined as buy-minus-sell orders as a percentage of total orders placed was 5.72%, implying that there were 5.72% more buy orders

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<sup>18</sup>Dambra, Field, and Gustafson (2015) show that the JOBS Act helped to revitalize the IPO market.

than sell orders. In the first 10 minutes, order imbalance dropped to almost zero and the indicated open price moved to \$28. During preopening, the indicated open price fluctuated between a high of \$29 to a low of \$27, and the order imbalance varied between a high of +22.36% (more buys) to -11.59% (more sells).

[INSERT FIGURES 2-5 ]

Orders continued to accumulate over the preopening period, as shown in Figure 3. The opening price determined by the IPO Cross auction was \$29. Of a total of 56.11 million shares traded on the first day, 7.79 million shares were executed in the cross, representing 21.64% of shares offered and 13.88% of the first day's trading volume. The closing price on day 1 of trading settled at \$28.48, an increase of 35.62% from the offer price.

We define retail orders as those with 100 shares or less, and institutional orders are those with 2,000 or more shares. [Griffin, Harris, and Topaloglu \(2007\)](#) attribute transactions of 1000 shares or more to institutional investors. Our results hold using a cutoff of 1000 shares. In Figure 4, we show the activity of small orders (100 shares or less) and large orders (2,000 shares or more). Even though Nasdaq starts accepting them at 4 a.m., orders did not start coming in until about 8 a.m. because this is when brokerage firms actually start entering them in the Nasdaq system. The timing of orders placed by retail investors (proxied by small orders) is quite similar to that of orders placed by institutional investors (proxied by large orders). However, the magnitude of retail participation versus institutional participation is very different. At the IPO Cross, 50,000 shares of retail orders and 2.7 million shares of institutional orders were executed. If we include orders between 100 and 2,000 shares, a total of 4 million displayable shares were executed during the cross.<sup>19</sup> There are large jumps in

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<sup>19</sup>These numbers are based on displayable orders in Nasdaq. A total of 7.79 million shares were executed in the cross if non-displayable orders are included. However, the Nasdaq ITCH data does not include non-displayable information.

order placement by both groups when DOP starts at 10:35:05 and the minutes leading up to the IPO Cross. A comparison of Panels A and B of Figure 5 shows more selling activity by institutional investors relative to retail investors suggesting institutions do more flipping.

## **4. Activity during Preopening**

Table 2 reports the mean and median trading volume in the IPO Cross relative to the percentage of shares offered in the IPO and also as a percentage of the first day's trading volume by year. The average trading volume as a proportion of shares offered varies from 7.2% to 10.2%. For the full sample period, the average number of shares executed in the cross is 8.3% of those offered. The mean volume cleared in the IPO Cross relative to the first day's trading volume ranged from 13.8% to 18.8%. For the full sample period, the average number of shares executed in the cross is 15.3% of those traded on day 1. The proportion of shares executed in the IPO Cross is significant and far more than what is observed for open or close auctions in non-IPO stocks. It is clear that the IPO Cross system plays an important role in the price discovery of IPOs. This preliminary evidence on order executions based on the magnitude of order flow and executions supports the learning hypothesis.

[INSERT TABLE 2 HERE]

### **4.1. Time Spent in Preopening**

An IPO, on average, spends 34.41 minutes in preopening, as shown in Table 3. This is much longer than the minimum Display Only Period required by Nasdaq rules. The time spent in preopening has increased steadily from 20 minutes in 2010 to 77.23

minutes in 2020. The largest number of IPOs during our sample period took place in 2020 as it was a “hot” IPO year.

[INSERT TABLE 3 HERE]

After 2017, the minimum Display Only Period was reduced from 15 to 10 minutes. The rationale for the change was that many IPOs were ready to start trading before the expiration of the 15-minute requirement, and underwriters wanted to have the flexibility to commence trading in these IPOs without having to wait for 15 minutes. Underwriters did use this flexibility, as is evident from the drop in the 10th percentile values from 15 to 10 minutes in 2018 and 2019. However, 2020 was a hot IPO year with high initial returns, and even IPOs in the 10th percentile, on average, took 25 minutes to start trading. Until August 2013, the minimum Display Only Period could increase only in increments of five minutes and there was no Pre-Launch Period. Therefore, we find the mean, median, 10th percentile, 90th percentile, and maximum to be multiples of five until the change took place.<sup>20</sup>

## 4.2. Time Spent in Preopening and IPO Returns

We next examine the relations between the offer-to-open return as the dependent variable and time spent in preopening as the independent variable along with other controls.

$$\text{Ret}_{\text{preopening},i} = a + \beta_1 \ln(\text{Additional Time in Preopening})_i + \beta_2 \text{Controls} + \varepsilon_0, \quad (1)$$

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<sup>20</sup>In the appendix, we report results SPACs, we find that the mean time spent in preopening for SPACs ranged from a low of 11.68 minutes in 2018 to a high of 23.93 minutes in 2020. The median is generally close to the minimum Display Only Period requirement of 15 minutes until 2017. After the minimum Display Only Period changed to 10 minutes in 2018, the median is lower at 11 minutes (2018) and 12 minutes (2019). Unlike IPOs, SPACs typically don’t require additional time in preopening and the price of SPACs barely changes from the offer price as shown by [Gahng, Ritter, and Zhang \(2021\)](#).

where  $\text{Ret}_{\text{preopening},i}$  is the (Offer-to-Open)/Offer for IPO  $i$  expressed in percentage terms;  $\ln(\text{Additional Time in Preopening})_i$  is the natural logarithm of one plus the number of minutes spent in preopening in addition to the minimum required DOP. We adjust for the required DOP interval by subtracting 15 minutes from the total time spent in the preopening for IPOs before December 2017 and subtract 10 minutes for IPOs after December 2017 based on the regulatory change in the minimum required DOP. We control for IPO characteristics that have been found to be important in other studies of IPO underpricing. We include  $\ln(\text{assets})$ , defined as the natural logarithm of total assets; VC Backing, an indicator for whether the issuer has venture capital backing; Share Overhang, defined as the natural logarithm of  $(1 + \text{ratio of retained shares to shares offered})$ ; Price Revision, calculated as the price change from the middle of the filing price to the offer price; Age, the natural logarithm of one plus the age of the firm in years at the time of the IPO, following [Loughran and Ritter \(2004\)](#).

[INSERT TABLE 4 HERE]

Table 4 shows the coefficient of  $\ln(\text{Additional Time in Preopening})_i$  to be positive and statistically significant at the 1% level. IPOs that spend more time in the preopen are associated with a larger percentage price change from the offer price to the official open price determined by the IPO Cross. It is not surprising that hot IPOs require more time for price discovery. We repeat the analysis with the return in the secondary market as the dependent variable.

$$\text{Ret}_{\text{secondary},i} = a + \beta_1 \ln(\text{Additional Time in Preopening})_i + \beta_2 \text{Controls} + \varepsilon_0, \quad (2)$$

where  $\text{Ret}_{\text{secondary},i}$  is the percentage change from the official opening price to the closing price on day 1 for IPO  $i$ . We control for the same set of variables as those used above for equation (1). As seen in Table 4, there is no relation between the

length of the preopening period and price change after the IPO starts trading in the secondary market on day 1. The length of the preopening period is not related to returns in aftermarket trading. This is again evidence of a well-functioning preopening mechanism that accounts for most of the price adjustment on day one.

### **4.3. Start of Display Only Period and Trading**

The start of the DOP is important because this is when transparency comes into the market and relevant information is disseminated. Information about quotes, indicative clearing price, paired shares, and imbalance information is now displayed by the exchange to the market. Indicative clearing price is the price at which the opening book would clear based on current orders. During the DOP, members can continue to submit orders with the price and quantity of shares they are willing to buy and sell, entered orders can be canceled or replaced, and no executions occur therefore raising the question whether the orders are just noise.

[INSERT TABLE 5 HERE]

The DOP starts between 9:30 and 10:00 a.m. for 106 IPOs, 10:00 and 10:30 a.m. for 338 IPOs, and 10:30 and 11 a.m. for 219 IPOs, as shown in Table 5. For a large proportion of IPOs, the Display Only Period commences soon after the market opens. However, for a handful of IPOs the DOP starts much later, after 12:30 p.m. The open-to-offer returns for IPOs with DOP after 12:30 p.m. is close to zero or negative. The DOP could be extended in increments of five minutes until August 1, 2013, and after that date the five-minute extension periods were eliminated, and instead, the Pre-Launch Period was added. The Pre-Launch Period gives the underwriter more control in deciding when and how to extend preopening before releasing the IPO for trading in the secondary market.

Even though DOP starts soon after the market opens, trading in most offerings starts later. The 184 IPOs that start trading between 9:30 and 10:30 a.m. have low open-to-offer returns, as shown in Table 5. A large number of IPOs start trading between 10:30 a.m.1:00 p.m., they have higher open-to-offer returns. Only 22 IPOs start trading after 1:00 p.m. and their open-to-offer returns are fairly low. We conclude that, even though DOP starts soon after markets open, “hot” IPOs take longer for price discovery and need an extended preopening period; therefore, the preopening period is longer and actual trading commences later.

## **5. Price Discovery - Noise versus Learning**

Next, we examine the noise versus learning hypothesis more precisely by estimating unbiased regressions following the approach of [Baruch, Panayides, and Venkataraman \(2017\)](#), [Biais, Hillion, and Spatt \(1999\)](#), and [Boguth, Grégoire, and Martineau \(2022\)](#). We regress the return from the offer price to the first day’s closing price assuming that the closing price is the equilibrium value of the security.

### **5.1. Price Discovery during Different Phases of Preopening**

We next examine the extent of price discovery that takes place during the different phases of preopening as the price moves from the IPO offer price to opening price, and finally the first day’s closing price. This analysis allows us to study the role played by each phase of the preopening period and test the three hypotheses about price discovery in the preopening period. The “pure noise” hypothesis postulates that there is no information during the particular preopening phase, whereas the “pure learning” hypothesis states that preopening orders are informative. The “noisy

learning” hypothesis states that because of countervailing incentives, the opening price should reflect a combination of the martingale from pure learning and the noise from pure noise. The following regression model is estimated to study whether there is pure learning, pure noise, or noisy learning during each phase of preopening:

$$(\text{Close}-\text{Offer})/\text{Offer} = a + \beta_t ((\text{Price}_t - \text{Offer}) / \text{Offer}) + \varepsilon_t \quad (3)$$

where  $\text{Price}_t$ , is the indicative price during the preopening period at time  $t$ ; Close is the closing price on the first trading day, and Offer is the IPO’s offer price. We estimate empirically the cross-sectional regression in equation 1 for each 30-second period of the preopening period. The learning process will vary across and within different phases. The 30-second period allows us to take this nonstationarity into account.

[INSERT TABLE 6 HERE]

Table 6 reports the coefficients from the regression for the four phases of pre-opening. The four phases are: 1) offer to first order, 2) first order to DOP start, 3) DOP start to DOP end, and 4) DOP end to official open. DOP end to official open encompasses the Pre-Launch Period and the IPO Cross. Panel A reports results for all IPOs in the post-August 2013 period. There is significant price discovery from the offer price to the very first order placed in the system even though the indicative price is not disseminated at this stage. As we discussed earlier, even though the Nasdaq system starts accepting orders at 4 a.m., orders do not start coming in until about 8 a.m. For our sample of IPOs, 17.30% of the change in offer price to close price on day 1 is captured by the first order. This is far less than the information captured in the first quote in the pre-IPO Cross system, as reported by [Aggarwal and Conroy \(2000\)](#). The current system has many more phases and price discovery continues in these phases. In the second phase, from the first order to the start of DOP, an additional



32.78% of price discovery takes place; the third phase, DOP start to end, contributes an additional 34.55%; and, finally, DOP end to official open accounts for 22.34%. The incremental contribution of each phase is significantly different from zero, as indicated by the t-statistic for each phase. Price discovery during preopening accounts for almost 100% of the price movement from offer to close.

Our results provide evidence for the learning hypothesis. The estimate of the slope coefficient increases from the initial phases to the final phase, indicating an increase in informational efficiency as opening approaches. There is considerable price discovery even during phases when transparency is limited. We also find that a lot more orders come in just prior to the opening auction, and yet, a lot of the price discovery has already taken place. These larger number of orders do not result in far more price discovery. Each phase of preopening plays a significant role in learning and price discovery. The Preopening period offers a process for market participants to progressively learn about pricing by observing the evolution of indicative prices.

Orders placed during preopening and the 15.3% of the first day's volume that clears during the preopening play an important role in price discovery on the first day, while the 85.3% of orders executed after trading commences in the secondary market, contribute far less to price discovery on day 1. We conclude that investors participate actively in the preopening even though no trades are actually executed. We find that each phase of preopening contributes to price discovery and it is not limited to the last few minutes before the market opens. These findings are consistent with the learning hypothesis.

We repeat the above analysis separately for 506 IPOs that require a Pre-Launch Period and 148 IPOs that do not require one. The existence of a Pre-Launch Period implies that the IPO is not ready to start trading at the end of the mandatory minimum DOP. For this group of IPOs, each of the four phases of preopening plays a significant

role in price discovery. However, for IPOs that do not require a Pre-Launch Period, the contribution of phase 1 (offer to first order) to price discovery is not significant implying that price discovery starts only when the clearing price is disseminated with the start of the DOP.

Next, we examine price discovery for hot and cold IPOs separately. Results are again separated for IPOs that require additional time, and therefore a Pre-Launch Period, versus those that do not require an extension and hence no Pre-Launch Period. Hot IPOs are defined as those with an offer price less than the first day's closing price; cold IPOs are those with an offer price greater than the first day's closing price.<sup>21</sup> As shown in Panel A of Table 7, of the 462 hot IPOs, 367 required additional time in preopening, and 94 did not. Similar to the full sample, 13.96% of the offer-to-close return is accounted for by the offer to the first order; an additional 29.17% of the price change takes place during first order to start of DOP, 33.09% from DOP start to end and 24.36% from DOP end to official open. All four phases are statistically and economically significant in price discovery. For hot IPOs with no Pre-Launch Period, price discovery from offer to first order is not significant.

[INSERT TABLE 7 HERE]

Panel B of Table 7 reports results for cold IPOs. There is a total of 192 cold IPOs; 127 have a Pre-Launch Period and 65 do not. Even for cold IPOs, there is price fluctuation during preopening and the underwriter can decide to extend preopening beyond the minimum DOP. In addition, no IPO can commence trading if there is excess volatility or order imbalance, as determined by Nasdaq's rules. The pattern of price discovery in cold IPOs is quite different from that of hot IPOs. In total, 50.96% of the offer-to-close return takes place during preopening, implying that almost 50%

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<sup>21</sup>Defining hot and cold IPOs based on price revisions yields similar results.

of the first day's price discovery happens after the IPO starts trading. The first two phases account for little price discovery.

We plot the coefficients from the regression along with 95% confidence bands in Figure 6 for the 30-minute period after DOP starts. It can be seen that, for the full sample of IPOs, price discovery takes place throughout the period. Towards the end of preopening, the coefficient is almost close to one, implying that 100% of the price movement from offer to close has taken place during preopening. Figure 7 splits the sample into hot and cold IPOs. Price discovery for hot IPOs follows the same pattern as all IPOs with the coefficient leveling off around one. This implies that most of the price movement from offer to close on day 1 takes place during preopening. For cold IPOs, 50% of the price discovery takes place during preopening with the remaining being determined by secondary market activity. On average, cold IPOs need a shorter preopening and significant price discovery continues to take place in the aftermarket. Underwriters might stabilize cold IPOs in the aftermarket, as discussed by [Aggarwal and Conroy \(2000\)](#), and this contributes to price discovery after the stock starts trading. These results suggest that price discovery varies considerably across different types of IPOs. Our results suggest that the IPO Cross system introduced in 2006, and particularly the changes implemented in 2013 that give the underwriter more flexibility in deciding when to release an IPO for trading, are beneficial for price discovery.

## **5.2. Activity of Retail and Institutional Investor**

Under the preopening process prior to 2006, only market makers could enter quotes. However, under the current system, any investor, including retail investors, can enter orders. In recent years, with the introduction of commission-free trading apps, retail

investors have started to play an increased role in the markets. The preopening of IPOs provides a unique opportunity to examine the role of retail investors. We assume that orders of less than 100 shares are entered by retail customers, and orders of 2,000 or more shares are placed by institutional investors.<sup>22</sup>

[INSERT TABLE 8 HERE]

Panel A of Table 8 shows the activity of retail investors during preopening. Retail investors, on average, place 24.8 orders per IPO during the preopening period in 2014. However, by 2019 this number increased to 240.5, reaching a peak of 748.5 orders in 2020. Retail investors make up 7.42% of all displayable executed orders during preopening in 2014; this increased to 41.44% in 2020. We find a similar pattern in terms of number of shares ordered. The average number of shares ordered by all retail investors is 867.8 in 2014 and 13,415.8 in 2020. The corresponding numbers as a percent of total shares ordered are 0.16% in 2014 and 1.67% in 2020. These patterns are consistent with the increased role of retail investors in recent years. It is also worth noting that the size of firms going public and size of IPOs has increased dramatically in recent years. Therefore, more information is available about these firms to retail investors. However, retail investors still account for a very small percentage of total orders.

The number of large orders (equal to or greater than 2,000 shares) is relatively small with a mean and median of 32 and 20 orders, respectively, as shown in Panel B of Table 8. These large orders, on average, account for 13.21% of all orders. However, in terms of number of shares, they make up 75.27% of total shares executed

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<sup>22</sup>As discussed by Cready, Kumas, and Subasi (2014) and others, trade size during secondary market trading is no longer an effective proxy for investor sophistication because large equity traders can execute trades as a series of smaller transactions. However there is no trading during preopening, and based on our conversation with market participants, algorithmic trading is not an issue during preopening and small size is a reasonable proxy for retail participation.

in preopening. Assuming that these large share orders are placed by institutional investors, these results point out the important role played by institutional investors in price discovery.

There is considerable interest in the extent to which retail or institutional investors flip allocated shares. The preopening provides a unique setting in which to examine flipping activity of retail and institutional investors. Table 9 provides information on the selling activity of retail and institutional investors. Trades of 100 shares or less are considered retail trades and those that are equal to or greater than 2,000 shares are assumed to be institutional. The proportion of sell orders by retail (institutional) investors has increased (decreased) over the years. The proportion has also seen some increase based on the number of shares. Large-size sell orders make up almost 75% of all sell transactions. We also compare the sell-side activity of retail and institutional investors relative to their total (buy+sell) activity. No particular time trend is observed based on this comparison, as seen in Table 9. In unreported results, we do find that institutional investors are more likely to flip hot IPOs. For hot (cold) IPOs, large-size sell shares make up 76.48% (70.97%) of total sell shares executed; the difference is statistically significant. Based on orders executed during preopening, we conclude that institutional investors start flipping shares in the preopening. We acknowledge that all selling activity is not due to flipping of allocated shares, but could also include short selling.

[INSERT TABLE 9 HERE]

In some IPOs, retail investors have started to play an even bigger role, they have received large allocations, and are more active in trading the stock. An example is the IPO of Robinhood, the company went public on July 29, 2021. 25.03% of shares offered and 12.80% of the first day's volume were transacted during preopening. In

comparison, the averages were 8.3% and 15.3%, for the full sample. Small orders made up 91.28% of all orders and 19.94% of total shares ordered during preopening, in contrast to 20.95% and 0.65% for the full sample. These are clear indications of much higher retail activity in the Robinhood IPO during preopening. In contrast, large orders ( $\geq 2000$  shares) made up only 0.20% of all orders and 40.55% of shares traded. These numbers are far lower than those reported for the full sample in Table 8. Active retail participation is not surprising given that a significant proportion of shares were held for retail investors on Robinhood's platform. Based on preopening transactions, the number of shares sold by retail investors as a percentage of total small shares transacted is only 0.30% for Robinhood compared to 18.72% for all IPOs. In contrast, shares sold by institutional investors is 64.48% of total large shares transacted, much higher than the 37.28% for the full sample as shown in Table 9. This suggests institutional investors were actively flipping their stock while retail investors were buying.

### **5.3. Executed versus Canceled Orders by Retail and Institutional Investor**

The IPO preopening process provides a unique opportunity to examine the role of both executed trades and also canceled orders.<sup>23</sup>

[INSERT TABLE 10 HERE]

Large canceled orders far outpace large executed orders as seen in Panel A of Table 10. On average, for every executed order there are 4.16 canceled orders. There is considerable variation with the proportion from varying lows of 1.81 in 2017 and 2.27

<sup>23</sup>See [Biais, Bisière, and Pouget \(2014\)](#) for a discussion of canceled orders when there is no asymmetric information.

in 2016 to highs of 7.79 in 2019 and 6.62 in 2015. Large orders are likely placed by institutional investors that can include underwriters, market makers, hedge funds, and others. [Chiang, Lowry, and Qian \(2019\)](#) use detailed data from Taiwan and provide evidence that the post-IPO proprietary trades of lead underwriter banks are superior to those of other market participants. Lead underwriter banks can also enter orders during the preopen and potentially use preopening to stabilize an offering.

The number of small canceled orders increased dramatically in 2020 as retail investors got more active in the markets. For every executed order 2.14 orders were canceled. Retail investors are far less likely to cancel their orders. This is also reflected in the proportion of small orders canceled relative to all executed orders. Next, we estimate the following model in order to examine the role of small and large executed and canceled orders in price discovery:

$$(\text{Offer-to-Open})/\text{Offer} = \alpha + \beta_1 \text{Type of Orders} + \beta_2 \text{Controls} + \varepsilon_0 \quad (4)$$

The dependent variable captures price discovery during preopening. The main independent variables of interest are: *Large Executed Orders as % of All Orders* are orders of 2,000 or more shares and are considered to be large orders placed by institutional investors; *Small Executed Orders as % of All Orders* are orders of 100 or less shares and are considered to be small orders placed by retail investors; *Large Canceled Orders as % of All Orders* are canceled orders of 2,000 or more shares; and *Small Canceled Orders as % of All Orders* are canceled orders of 100 or less shares.

[INSERT TABLE 11 HERE]

The results of the model estimate are reported in Table 11. The coefficient of *Large Executed Orders as % of All Orders* is not significant in explaining offer-to-open returns,

however, the coefficient of *Large Canceled Orders as % of All Orders* is positive and significant as shown in column 1. These results suggest that canceled orders by large institutional investors play an important role in the price discovery process. Column 2 of Table 11 includes *Small Executed Orders as % of All Orders* and *Small Canceled Orders as % of All Orders*. In this case, the results reverse and small executed orders have a significant relation with the opening return but not canceled orders. The coefficient of *Small Executed Orders as % of All Orders* is negative and significant. This is not surprising given that retail investors are more likely to receive allocations in cold IPOs, and therefore their larger activity is associated with lower returns. Finally, when we include activity by both retail and investors in the model, large canceled orders are associated with higher opening returns and small executed orders are associated with lower returns as seen in column 3. Our results indicate that both canceled orders and executed orders contribute to the price discovery process.

#### **5.4. Role of the Underwriter**

Underwriters play a different role under the IPO Cross system, relative to the pre-opening process that existed before the IPO Cross. In our sample, J.P. Morgan led the underwriter for the largest number of IPOs, at 184 during our sample period, followed by Goldman Sachs (165) and Morgan Stanley (144).

Trading cannot commence until Nasdaq's rules about excess volatility and order imbalance are met, as discussed earlier. In addition, post-August 2013, underwriters were given a bigger role in deciding when to start trading. We examine whether lead underwriters use the flexibility provided to them in the regulatory changes made in 2013. Underwriters possess valuable information about an offering, including information available in their own order book. Therefore, Nasdaq eliminated extensions to



DOP and instead introduced a Pre-Launch Period. Underwriters have the flexibility to extend preopening by using this period. This time is also used to coordinate with Nasdaq to conduct the IPO Cross and commence trading.

We examine the role of the underwriter pre- and post-August 2013 in determining the total time spent in preopening. We estimate the following model:

$$\ln(\text{Additional Time in Preopening})_i = \alpha + \beta_1 \text{DPOST}_i + \beta_2 \text{TopTierUW}_i + \beta_3 \text{DPOST}_i \times \text{TopTierUW}_i + \text{Controls} + \varepsilon_0 \quad (5)$$

where the dependent variable  $\ln(\text{Additional Time in Preopening})_i$  is the natural logarithm of one plus minutes spent in preopening in addition to the minimum required DOP. The independent variable  $\text{DPOST}_i$  is an indicator variable that is equal to one if the IPO went public after August 1, 2013, and zero otherwise.  $\text{TopTierUW}_i$  is defined as an indicator for whether the lead underwriter's rank is greater than or equal to eight (Carter and Manaster (1990)). The interaction between  $\text{DPOST}_i$  and  $\text{TopTierUW}_i$  is included to capture whether, after August 2013, top-tier underwriters are more likely to extend preopening time. The control variables described earlier are also included.

[INSERT TABLE 12 HERE]

As shown in Table 12, for the full sample the  $\text{DPOST}_i$  and  $\text{TopTierUW}_i$  dummy variables are not significant. However, the interaction term  $\text{DPOST}_i \times \text{TopTierUW}_i$  is positive and significant at the 1% level. This implies that after being given more flexibility, top-tier underwriters used it to extend the preopening time. We also split the sample based on pre- and post-August 2013 IPOs. We find no relation between  $\text{TopTierUW}$  and time spent in preopening before the regulatory change; however,

the relation is significant in the post-August 2013 period. Earlier, we showed that in December 2017, when the required DOP changed from 15 to 10 minutes, underwriters were able to use the flexibility to release some IPOs for trading before the 15-minute window. Some IPOs were released for trading immediately after the required 10-minute period was over. We conclude that the changes introduced in 2013 and 2017 that gave underwriters more flexibility in releasing IPOs for trading were useful and were actually used by them to decide when to release the stock for secondary market trading.

## **6. Summary and Conclusion**

The IPO preopening process provides us a unique opportunity to examine the role of retail versus institutional investors, and executed versus canceled orders in price discovery process. We examine the price discovery that takes place during the preopening process after the introduction of the Nasdaq IPO Cross system. We also examine the impact of the additional changes made to the process in 2013 and 2017. The current process consists of four phases: 1) System Start-Up during which orders can be entered; 2) a required minimum Display Only Period, during which orders can be entered and information about quotes, indicative clearing price, and imbalance is disseminated; 3) the Pre-Launch Period that can extend the preopening period, and during which the lead underwriter coordinates with Nasdaq to determine the IPO Cross time and the start of trading; and, finally, 4) the IPO Cross, in which an auction is conducted and the official open price determined.

We find that each of the four phases of preopening contributes to significant incremental price discovery. The first order captures 17.30% of the change in offer price to closing price return on day one. In the second phase, from the first order to

the start of DOP, an additional 32.78% of price discovery takes place. The information disseminated by the exchange about indicative price and order imbalance starts with the third phase. The third phase, DOP start to end, contributes an additional 34.55%. This suggests that the exchange's objective of providing transparency helps with price discovery. Finally, DOP end to official open, accounts for 22.34% of the offer price to close price return.

We find the pattern of price discovery for cold IPOs to be quite different from that of hot IPOs. About half of the offer-to-close return takes place during preopening and the remaining half of the first day's price discovery takes place after the IPO starts trading. The first two phases account for little price discovery. Underwriters are likely to stabilize cold IPOs in the aftermarket, and this may contribute to more price discovery after the stock starts trading.

Retail investors made up 7.42% of all displayable executed orders during preopening in 2014; this increased to 41.44% in 2020. We find a similar pattern for the number of shares ordered. The average number of shares ordered by all retail investors in an IPO increased from 867.8 in 2014 to 13,415.8 in 2020. These patterns are consistent with the increased role of retail investors in recent years. We find that even though participation by retail investors has increased during preopening, their role in price discovery is limited because the number of shares transacted by them is far smaller than that of institutional investors. There is considerable interest in who is allocated IPO shares and who flips them as soon as the stock starts trading. We find that a significant number of large orders are sell orders, particularly for hot IPOs. The selling is likely to be a combination of allocated shares being flipped and short selling. We find both canceled and executed orders play a role in price discovery. However, the impact of orders executed/canceled by retail investors differs from that of institutional investors.

Our analysis shows that considerable incremental price discovery takes place during each phase of the IPO preopening process with little occurring in the aftermarket after secondary market trading starts. There is price discovery even before information is disseminated by the exchange. We find evidence that a large number of orders come in just before the IPO Cross, however, considerable price discovery has already taken place in the earlier phases and is not simply concentrated in the last few minutes before opening. We believe this is also due to the increased role of underwriters in determining when an IPO should start trading. Our findings suggest an orderly price discovery process consistent with the learning hypothesis. They also indicate that the exchange was able to achieve the goal of fair executions at the single opening auction price based on supply and demand. We conclude that a preopening process that allows supply and demand to determine the opening price is important for price discovery.

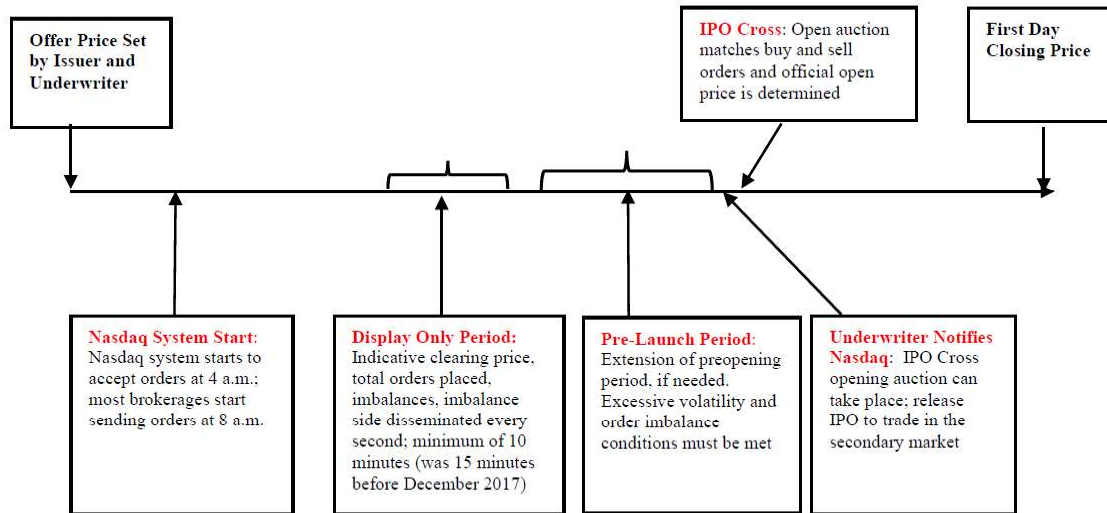
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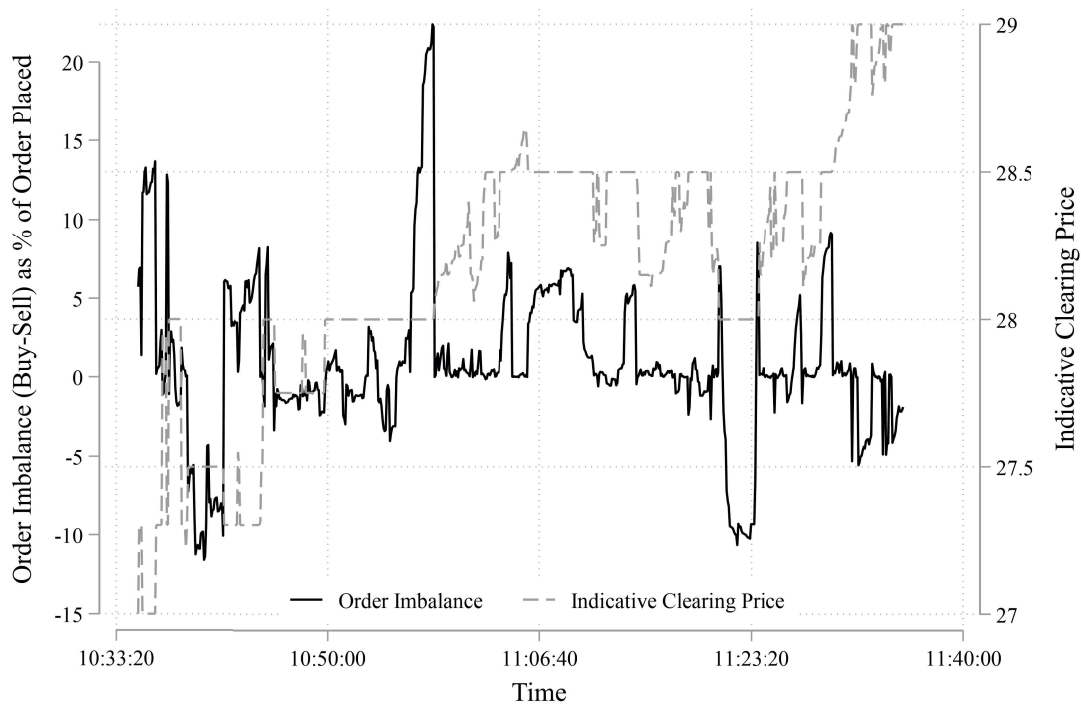
**Figure 1. Preopening Process and IPO Cross**

The figure describes the different phases of the preopening process for IPOs on Nasdaq before the stock is released for trading in the secondary market.



**Figure 2. Example of the Preopening Process: Dropbox IPO**

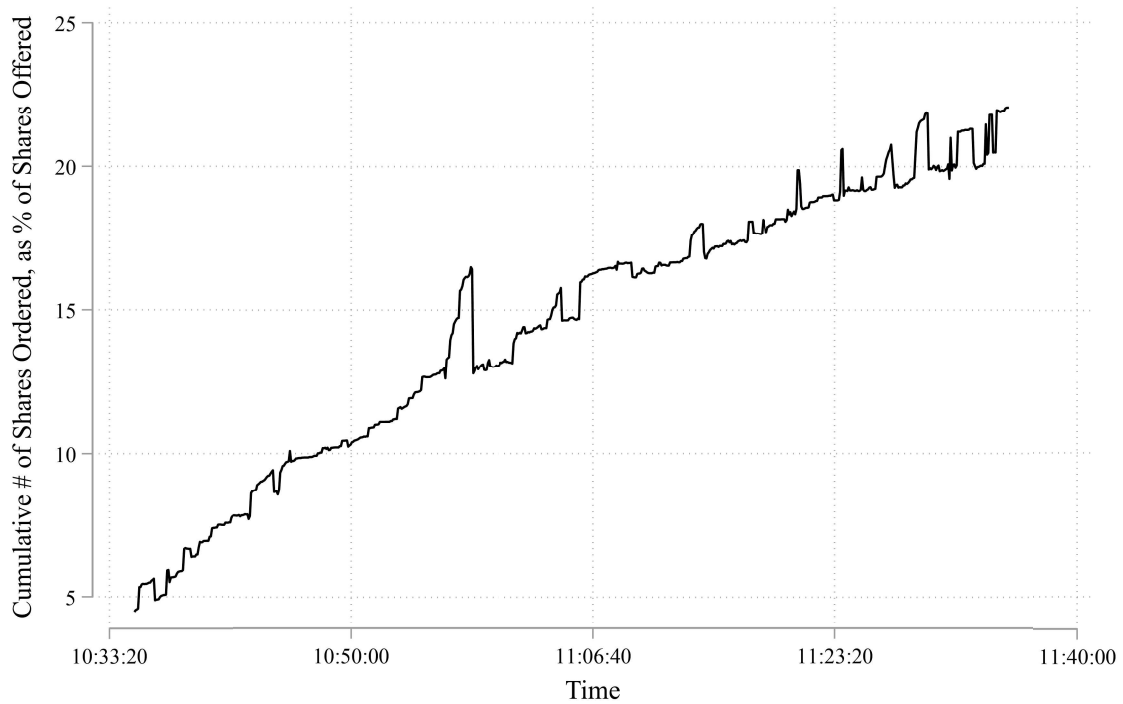
The figure shows the indicative clearing price, order imbalance, and accumulative orders during the preopening process for Dropbox IPO. Indicative clearing price is the price at which the book would clear based on current orders. Dropbox.com went public on March 23, 2018 at an offer price of \$21. The Display Only Period started at 10:35:03 a.m. with the first indicative clearing price of \$27. The first 10 minutes is the minimum required Display Only Period and the remaining 50 minutes is the Pre-Launch Period. The IPO Cross occurred at 11:35:23 a.m. The order imbalance is defined as buy-minus-sell orders as a percentage of total orders placed.





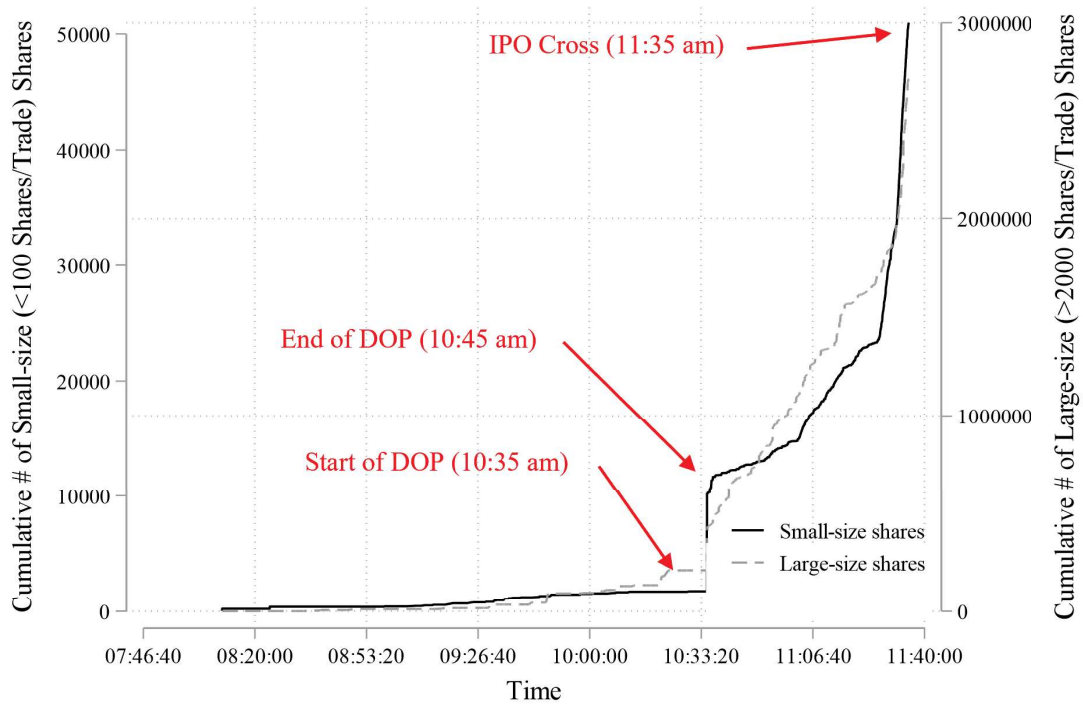
**Figure 3. Price Discovery during Preopening: Dropbox**

The plot shows the cumulative number of shares ordered as a percentage of shares offered during preopening for Dropbox. The Display Only Period started at 10:35:03 a.m. with the first indicative clearing price of \$27. The first 10 minutes is the minimum required Display Only Period and the remaining 50 minutes is the Pre-Launch Period. The IPO Cross occurred at 11:35:23 a.m.; 36 million shares of Dropbox were offered in the IPO.



**Figure 4. Price Discovery during Preopening: Dropbox**

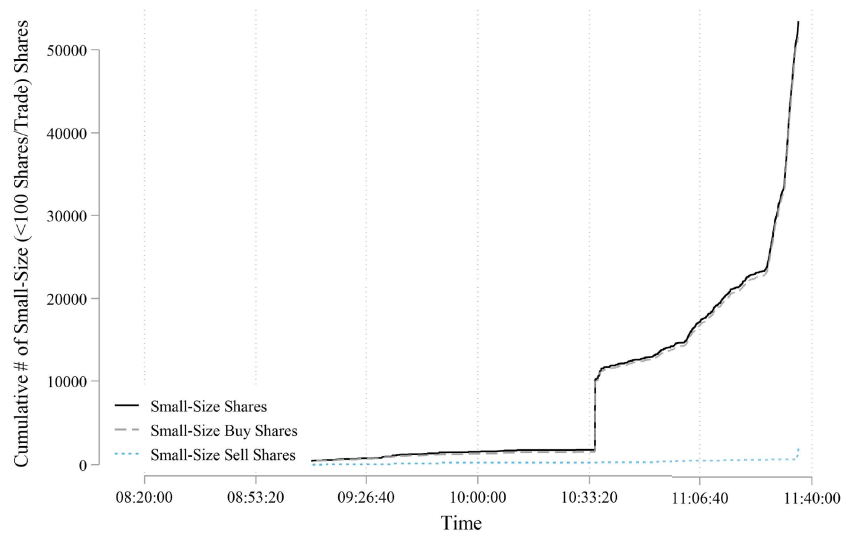
The figure shows the cumulative number of shares ordered in the Nasdaq system during the preopening process for the Dropbox IPO. Dropbox.com went public on March 23, 2018 at an offer price of \$21. Orders are received and accepted by the Nasdaq system starting 8:10 a.m. The orders that have less than 100 shares are classified as small-size orders and those with 2,000 or more shares are classified as large-size orders.



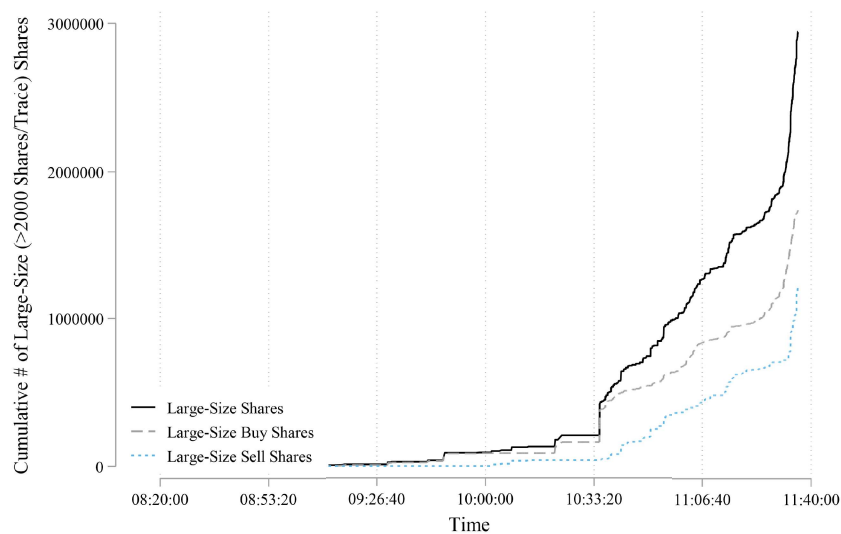
**Figure 5. Buy and Sell Orders during Preopening: Dropbox**

The figure shows the cumulative number of shares for buy versus sell orders received in the Nasdaq system during the preopening process for the Dropbox IPO. Dropbox.com went public on March 23, 2018 at an offer price of \$21. Orders were received and accepted by the Nasdaq system starting at 8:10 a.m. The orders that have less than 100 shares are classified as small-size orders and those with 2,000 or more shares are classified as large-size orders. We assume that retail investors enter small-size orders and institutional investors enter large-size orders.

**Panel A: The Cumulative Number of Shares in Buy/Sell Orders for Small-Size ( $\leq 100$  shares) Orders**

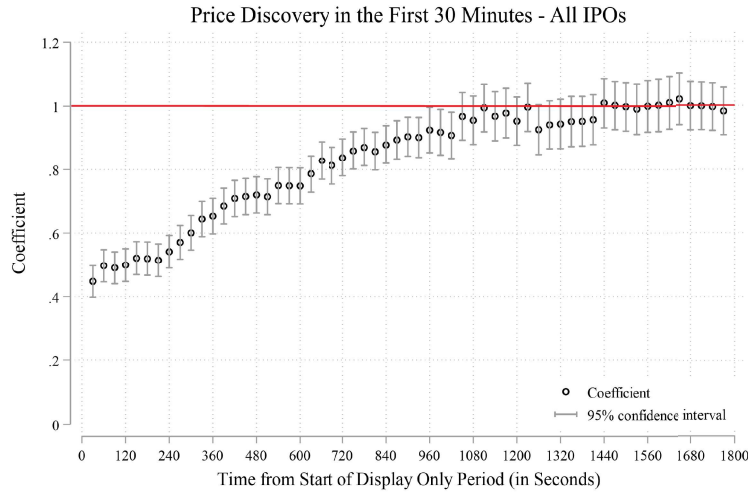


**Panel B: The Cumulative Number of Shares in Buy/Sell Orders for Large-Size ( $\geq 2,000$  shares) Orders**



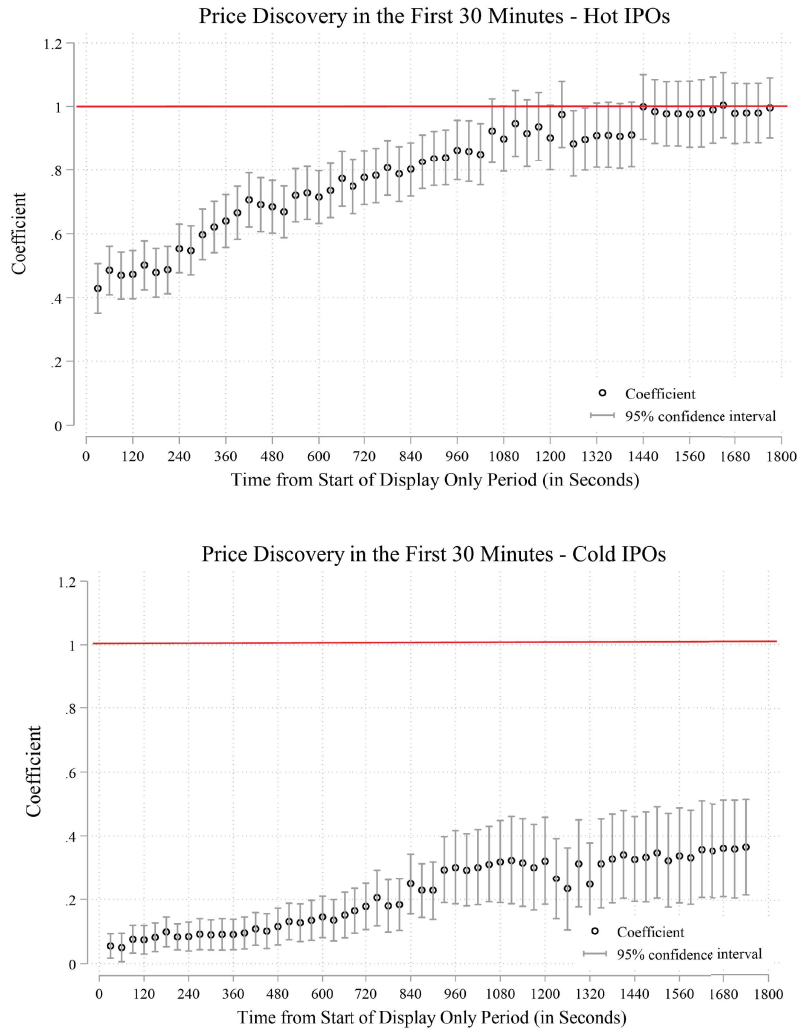
**Figure 6. Price Discovery during Preopening: All IPOs**

The figure presents the slope coefficients and the 95% confidence interval from the regression  $(Close - Offer)/Offer = \alpha + \beta_t((Price_t - Offer)/Offer) + \epsilon_t$  every 30 seconds during the first 30-minute period after the DOP starts. The new equilibrium value of the stock is proxied by the closing price on day 1, the offer price is the proxy for the previous equilibrium price, and the indicative price at time  $t$  is  $Price_t$ . The indicative price at time  $t$  is based on the indicative clearing price from the Nasdaq Net Order Imbalance Indicator data. If the preopening is efficient, then the slope coefficient should equal one (the red horizontal line) by the end of preopening.



**Figure 7. Price Discovery during Preopening: All IPOs**

The figure presents the slope coefficients and the 95% confidence interval from the regression  $(Close - Offer)/Offer = \alpha + \beta_t((Price_t - Offer)/Offer) + \epsilon_t$  every 30 seconds during the first 30-minute period after the DOP starts for hot (top panel) and cold Nasdaq IPOs (bottom panel). Hot IPOs are defined as those with an offer price less than the first day's closing price; cold IPOs are those with offer price greater than the first day's closing price. The new equilibrium value of the stock is proxied by the closing price on day 1, the offer price is the proxy for the previous equilibrium price, and the indicative price at time t is  $Pricet$ . The indicative price at time t is based on the indicative clearing price from the Nasdaq Net Order Imbalance Indicator data. If the preopening is efficient, then the slope coefficient should be equal to one (the red horizontal line) by the end of preopening.



**Table 1. Descriptive Statistics for Nasdaq IPOs**

The sample consists of 824 Nasdaq IPOs during the period from 2010 to 2020, after excluding those with an offer price below \$5 per share, unit offers, ADRs, closed-end funds, SPACs, natural resource limited partnerships, bank and S&L IPOs, REITs, and best efforts offerings. The table provides mean and median statistics for the offer price and issue size. N is the number of observations. Offer-to-Open Return is the percentage difference between the opening price on day 1 and the offer price; Offer-to-Close Return is the percentage difference between the closing price on day 1 and the offer price. Issue Size does not include an underwriter over-allotment option.

Year	N	Offer Price (\$)		Issue Size (Millions \$)		Offer-to-Open Ret (%)		Offer-to-Close Ret (%)	
		Mean	Median	Mean	Median	Mean	Median	Mean	Median
2010	32	13.17	11.25	129.17	87.05	10.37	3.35	13.07	9.98
2011	40	13.65	13.00	181.23	106.45	19.16	10.00	17.94	16.58
2012	40	12.28	11.25	103.97	74.15	10.24	6.30	11.55	5.66
2013	80	14.08	14.00	138.26	78.00	21.07	9.33	25.01	15.93
2014	127	12.69	12.00	113.03	65.01	16.20	7.08	16.54	6.82
2015	80	13.68	14.00	125.60	79.15	16.67	9.69	18.51	6.89
2016	47	13.29	13.00	89.41	79.00	14.54	7.86	16.74	3.57
2017	64	13.50	14.00	102.27	79.00	12.83	8.71	14.91	11.46
2018	91	14.68	15.00	137.96	96.00	18.24	11.00	18.24	8.17
2019	87	16.83	16.00	225.76	90.00	15.26	10.00	20.78	12.13
2020	136	18.18	18.00	311.21	190.00	41.15	27.92	42.40	26.29
ALL	824	14.63	15.00	165.52	89.45	20.23	11.11	22.03	12.00

**Table 2. Trading Volume during Opening IPO Cross**

The table reports the trading volume cleared in the IPO Cross for the 824 Nasdaq IPOs during the period from 2010 to 2020. The table provides mean and median statistics for the opening trading volume as a percentage of shares offered and also as a percentage of the first day's trading volume. Opening trading volume is obtained from TAQ data with a sale condition of "O" for the first day of trading, shares offered is from SDC data, and the first day's trading volume is from CRSP daily files.

Year	Opening Trading Volume Cleared in IPO Cross			
	as % of Shares Offered		as % of First Day's Trading Volume	
	Mean	Median	Mean	Median
2010	8.1%	6.3%	13.8%	12.6%
2011	10.2%	10.1%	17.0%	15.1%
2012	8.1%	6.3%	15.5%	15.2%
2013	9.7%	9.5%	18.8%	14.5%
2014	8.7%	7.7%	13.2%	13.5%
2015	9.9%	8.0%	15.9%	15.0%
2016	8.3%	7.3%	14.3%	15.2%
2017	7.5%	7.3%	14.0%	13.5%
2018	7.2%	6.2%	15.7%	15.9%
2019	7.5%	6.0%	15.8%	16.6%
2020	7.6%	7.3%	15.0%	15.4%
ALL	8.3%	7.3%	15.3%	14.7%

**Table 3. Time Spent in Preopening: NASDAQ IPOs**

The table reports the number of minutes spent in preopening. N is the number of observations. Mean, standard deviation, 10th percentile (P10), median (P50), 90th percentile (P90), and maximum minutes are reported. Until August 2013, the minimum preopening period of 15 minutes could change only in increments of 5 minutes. In 2018, Nasdaq reduced the required minimum preopening period from 15 to 10 minutes. Therefore, before 2018 the minimum time spent in preopening was 15 minutes or more.

Year	N	Mean	Std Dev	P10	Median	P90	Max
2010	32	20.00	5.54	15	20	30	35
2011	40	18.13	4.03	15	15	25	30
2012	40	18.48	3.75	15	20	25	25
2013	80	19.51	7.07	15	15	26	51
2014	127	19.69	7.69	15	17	29	53
2015	80	22.35	11.12	15	17.5	37.5	58
2016	47	24.77	13.73	15	20	49	58
2017	64	27.69	15.41	15	21.5	49	85
2018	91	31.53	21.08	10	26	61	118
2019	87	47.02	31.09	10	40	91	137
2020	136	77.23	41.67	25	79	131	208
ALL	824	34.41	30.39	15	20	79	208



**Table 4. IPO Returns and Time Spent in Preopening**

The table reports coefficient estimates for regressing IPO returns during different periods on the first day on time spent in preopening. The key independent variable  $\ln(\text{Additional Time in Preopening})_i$  is the natural logarithm of one plus minutes spent in preopening in addition to the minimum required DOP. The dependent variable is Offer-to-Open Return in the first column and Open-to-Close Return in the second column. Other variables included are: Size, the natural logarithm of total assets; VC Backing, an indicator for whether the issuer has venture capital backing; Share Overhang, the ratio of retained shares to the public float (the number of shares issued); Price Revision, calculated as the price change from the middle of the file price to the offer price; Age, the natural logarithm of one plus the age of the firm in years at the time of the IPO. Year fixed effects based on the IPO year and industry fixed effects based on the 48 Fama-French industries are included. The t-statistics (in parentheses) are computed using heteroskedasticity-consistent standard errors that are corrected for clustering. \*, \*\*, and \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Offer-to-Open Return	Open-to-Close Return
$\ln(\text{Additional Time in Preopening})$	5.278*** (6.34)	0.274 (0.63)
Size	-1.629*** (-2.63)	-0.199 (-0.44)
VC Backing	2.089 (1.47)	0.852 (0.97)
Share Overhang	0.820* (1.78)	0.175 (0.64)
Price Revision	0.671*** (8.32)	0.00893 (0.24)
Age	0.459 (0.33)	0.474 (0.78)
Year Fixed Effect	Yes	Yes
Industry	Yes	Yes
N	815	815
Adj. R-squared	0.320	0.004

**Table 5. IPO Opening Time**

The table provides information on IPOs based on the Display Only Period and when trading starts in the secondary market. Start time is the half-hour time interval in which the first disseminated information regarding IPO Cross occurs (left panel) and the half-hour time interval in which the IPO Cross occurs (right panel), N is the number of IPOs during the half-hour period, and mean and median are reported for offering size (proceeds) in million dollars and for Open-to-Offer Returns as a percent.

Start of Display Only Period						Start of Trading in Secondary Market					
		Offering Size		Open-to-Offer Return				Offering Size		Open-to-Offer Return	
Start Time	N	Mean	Median	Mean	Median	N	Mean	Median	Mean	Median	
9:30–10:00	106	185.99	90.00	24.68	8.36	3	67.50	37.50	7.24	9.21	
10:00–10:30	338	193.95	100.00	23.49	16.11	181	100.61	70.45	12.74	5.00	
10:30–11:00	219	166.60	90.00	19.12	11.11	263	130.78	88.00	18.50	12.50	
11:00–11:30	130	93.53	74.70	13.05	5.23	190	171.60	96.65	21.42	11.79	
11:30–12:00	15	61.09	60.00	11.42	3.33	98	261.35	125.00	26.75	22.97	
12:00–12:30	2	274.55	274.55	37.39	37.39	52	299.25	160.50	32.64	16.45	
12:30–1:00	2	65.00	65.00	0.83	0.83	15	245.95	202.00	50.49	30.00	
1:00–1:30	2	341.95	341.95	-7.18	-7.18	9	254.16	178.20	23.30	8.79	
1:30–2:00	3	15.87	15.10	-0.95	0.00	5	734.30	15.10	24.03	0.00	
2:00–2:30	4	8.60	8.50	1.43	-1.60	1	25.00	25.00	0.00	0.00	
2:30–3:00	3	22.20	12.00	-1.38	0.00	4	8.60	8.50	1.43	-1.60	
3:00–3:30	0					3	22.20	12.00	-1.38	0.00	

**Table 6. Price Discovery during Different Phases of Preopening**

The table reports the extent of price discovery that takes place during the different phases of preopening for Nasdaq IPOs between August 2013 and 2020 by running the following regression model:  $(\text{Close} - \text{Offer}) / \text{Offer} = a + \beta_t ((\text{Price}_t - \text{Offer}) / \text{Offer}) + \varepsilon_t$ , where the true value of the stock is proxied by the closing price on day 1, the offer price is the proxy for the previous equilibrium price, and the indicative price at time t is Price t. The indicative price for the first order is based on the displayed price from the first order received by the Nasdaq (identified using Nasdaq TotalView ITCH). The indicative price for the DOP start and DOP end is based on the indicative clearing price from the disseminated NOII data. The coefficients are reported for the full sample and for the sample split based on whether a Pre-Launch Period was needed.

Price Discovery: All IPOs									
	Coefficient	Incremental	t-stat	Coefficient	Incremental	t-stat	Coefficient	Incremental	t-stat
	Contribution			Contribution			Contribution		
	All IPOs (N=654)			All IPOs with Pre-Launch Period (N=506)			All IPOs with No Pre-Launch Period (N=148)		
Offer to First Order	17.30%	17.30%	7.7	19.78%	19.78%	7.4	4.49%	4.49%	1.49
First Order to DOP Start	50.07%	32.78%	8.64	50.95%	31.17%	7.06	30.77%	26.28%	4.15
DOP Start to End	84.62%	34.55%	7.55	82.03%	31.08%	5.96	118.10%	91.82%	9.32
DOP End to Open	106.96%	22.34%	5.31	106.16%	24.13%	5.08			

**Table 7. Price Discovery during Different Phases of Preopening: Hot and Cold IPOs**

The table reports the extent of price discovery that takes place during the different phases of preopening for Nasdaq hot and cold IPOs between August 2013 and 2020 by running the following regression model:  $(\text{Close} - \text{Offer}) / \text{Offer} = a + \beta_t ((\text{Price}_t - \text{Offer}) / \text{Offer}) + \varepsilon_t$ , where the true value of the stock is proxied by the closing price on day 1, the offer price is the proxy for the previous equilibrium price, and the indicative price at time t is Price t. The indicative price for the first order is based on the displayed price from the first order received by the Nasdaq (identified using Nasdaq TotalView ITCH). The indicative price for the DOP start and DOP end is based on the indicative clearing price from the disseminated NOII data. The sample split based on whether a Pre-Launch Period was needed. Coefficients are reported separately for subsamples of IPOs with positive (hot IPOs) and negative (cold IPOs) price movement over the first trading day in Panels A and B, respectively.

Panel A: Price Discovery: Hot IPOs									
	Hot IPOs (N=462)			Hot IPOs with Pre-Launch Period (N=367)			Hot IPOs with No Pre-Launch Period (N=94)		
Offer to First Order	13.96%	13.96%	5.41	16.77%	16.77%	5.66	-0.80%	-0.80%	-0.22
First Order to DOP Start	43.13%	29.17%	6.22	43.49%	26.72%	5.01	22.56%	23.36%	2.86
DOP Start to End	76.21%	33.09%	5.75	73.45%	29.96%	4.63	101.37%	78.01%	5.67
DOP End to Open	100.58%	24.36%	4.57	100.40%	26.95%	4.52			
Panel B: Price Discovery: Cold IPOs									
	Cold IPOs(N=192)			Cold IPOs with Pre-Launch Period (N=127)			Cold IPOs with No Pre-Launch Period(N=65)		
Offer to First Order	2.32%	2.32%	1.93	2.58%	2.58%	1.76	1.85%	1.85%	0.88
First Order to DOP Start	5.72%	3.40%	1.46	6.45%	3.87%	1.45	1.77%	-0.08%	-0.02
DOP Start to End	16.35%	10.63%	2.51	15.14%	8.69%	1.94	70.47%	70.55%	4.02
DOP End to Open	50.96%	34.61%	4.99	48.32%	33.19%	4.48			

**Table 8. Retail and Institutional Activity**

The table provides information on small- and large-size orders during preopening. Orders of 100 shares or less are classified as small-size transactions to proxy for retail investors, and 2,000 shares or more as large-size orders to proxy for institutional shares. We only include orders that are not canceled, deleted, or altered based on the message information from Nasdaq TotalView ITCH data. Number of Orders is the number of orders placed during the preopening and Number of Shares Ordered is the total number of shares placed during the preopening; mean and median statistics are reported for the number of orders, number of orders as a percent of total orders, number of shares ordered, and the number of shares ordered as a percent of total shares ordered. Panel A reports the statistics for small-size orders and Panel B for large-size orders.

Panel A: Small-Size ( $\leq 100$ shares) Orders during Preopening									
Year	N	Number of Orders		Number of Orders as % of Total Orders		Number of Shares Ordered		Number of Shares Ordered as % of Total Shares Ordered	
		Mean	Median	Mean	Median	Mean	Median	Mean	Median
2014	89	24.8	9	7.42%	6.18%	867.8	339	0.16%	0.07%
2015	78	36.1	17	13.23%	11.90%	1,226.70	582	0.28%	0.18%
2016	45	23.4	17	11.44%	11.11%	789.3	548	0.27%	0.19%
2017	64	33.8	10	11.70%	10.23%	928.5	330	0.25%	0.17%
2018	91	62.8	21	19.27%	15.92%	1,723.90	692	0.47%	0.29%
2019	83	240.5	31	24.79%	22.22%	5,081.50	919	0.63%	0.49%
2020	130	748.5	96	41.44%	38.54%	13,415.80	2,338.50	1.67%	0.84%
<b>ALL</b>	<b>580</b>	<b>226.2</b>	<b>23</b>	<b>20.95%</b>	<b>15.80%</b>	<b>4,466.40</b>	<b>758</b>	<b>0.65%</b>	<b>0.28%</b>
Panel B: Large-Size ( $\geq 2,000$ ) Orders during Preopening									
Year	N	Number of Orders		Number of Orders as % of Total Orders		Number of Shares Ordered		Number of Shares Ordered as % of Total Shares Ordered	
		Mean	Median	Mean	Median	Mean	Median	Mean	Median
2014	89	39.3	26	17.57%	16.03%	665,660	336,000	76.92%	82.05%
2015	78	37.4	23	15.22%	13.81%	623,528	265,875	77.23%	81.46%
2016	45	28.7	23	15.63%	14.65%	374,671	206,950	75.02%	79.42%
2017	64	28.1	23	16.19%	15.32%	384,521	238,445	75.42%	78.05%
2018	91	25.4	15	13.50%	12.59%	329,810	159,954	75.40%	79.25%
2019	83	31.8	16	11.17%	10.61%	680,198	180,520	74.45%	77.55%
2020	130	32.2	19	7.83%	6.81%	551,710	231,367	73.42%	78.64%
<b>ALL</b>	<b>580</b>	<b>32.1</b>	<b>20</b>	<b>13.21%</b>	<b>12.35%</b>	<b>530,241</b>	<b>237,566</b>	<b>75.27%</b>	<b>79.20%</b>

**Table 9. Flipping by Retail and Institutional Investors**

The table provides information on small- and large-size sell orders during preopening. Orders of 100 shares or less are classified as small-size transactions to proxy for retail investors, and 2,000 shares or more as large-size orders to proxy for institutional shares. We only include orders that are not canceled or deleted or altered based on the message information from Nasdaq TotalView ITCH data. Number of Small (Large) Sell Orders is the number of small-size (large-size) sell orders placed during the preopening and Number of Small (Large) Sell Shares is the total number of shares placed for small-size (large-size) sell orders during the preopening; mean statistics are reported for the number of orders as a percent of total sell orders, number of shares as a percent of total sell shares, number of orders as a percent of total small (large) orders, and the number of shares ordered as a percent of total small (large) shares ordered. Panel A reports the statistics for small-size orders and Panel B for large-size orders.

Panel A: Small-Size ( $\leq 100$ shares) Sell Orders during Preopening					
Year	N	Number of Small Sell Orders as % of Total Sell Orders	Number of Small Sell Shares as % of Total Sell Shares	Number of Small Sell Orders as % of Total Small Orders	Number of Small Sell Shares as % of Total Small Shares
2014	89	3.10%	0.06%	17.94%	18.72%
2015	78	5.25%	0.13%	17.33%	18.71%
2016	45	5.53%	0.13%	19.72%	20.62%
2017	64	2.52%	0.06%	8.67%	10.77%
2018	91	4.56%	0.19%	13.06%	15.78%
2019	83	6.75%	0.32%	14.48%	18.02%
2020	130	12.92%	0.47%	10.00%	14.15%
ALL	580	6.47%	0.23%	13.92%	18.72%
Panel B: Large-Size ( $> 2,000$ shares) Sell Orders during Preopening					
Year	N	Number of Large Sell Orders as % of Total Sell Orders	Number of Large Sell Shares as % of Total Sell Shares	Number of Large Sell Orders as % of Total Large Orders	Number of Large Sell Shares as % of Total Large Shares
2014	89	24.51%	77.41%	38.27%	34.21%
2015	78	22.39%	77.21%	41.10%	37.06%
2016	45	24.29%	77.60%	41.35%	41.21%
2017	64	20.96%	75.16%	36.66%	36.83%
2018	91	18.06%	74.19%	38.46%	39.19%
2019	83	14.13%	64.94%	33.62%	29.20%
2020	130	15.08%	77.02%	43.03%	42.19%
ALL	580	19.21%	74.79%	39.14%	37.28%

**Table 10. Role of Large and Small Canceled Orders in Price Discovery**

The table provides information on and large- and small-size canceled orders during preopening. Orders of 100 shares or less are classified as small-size transactions to proxy for retail investors, and 2,000 shares or more as large-size orders to proxy for institutional shares. Identified canceled orders are based on the message information from Nasdaq TotalView ITCH data. Number of Small (Large) Canceled Orders is the number of small-size (large-size) canceled orders placed during the preopening; Panel A reports the mean and median statistics for the number of *canceled large orders*, the number of canceled large orders as a percent of total executed *large-size* orders, and as a percent of total executed orders. Panel B reports the mean and median statistics for the number of *canceled small-size orders*, the number of canceled small-size orders as a percent of total executed *small-size* orders, and as a percent of total executed orders.

Panel A: Small Orders Canceled							
Year	N	# of Small canceled Orders		# of Small Canceled Orders /# of Small Executed Orders		# of Small Canceled Orders /# of All Executed Orders	
		Mean	Median	Mean	Median	Mean	Median
2014	71	20.96	3	0.79	0.35	0.04	0.02
2015	62	25.82	6	0.43	0.25	0.05	0.03
2016	36	19.78	6	0.74	0.4	0.06	0.04
2017	56	28.2	6.5	0.93	0.55	0.1	0.06
2018	82	90.29	11	1.01	0.53	0.14	0.09
2019	81	435.57	21	1.38	0.84	0.3	0.17
2020	130	2289.05	105	2.14	1.31	0.76	0.39
All	518	667.26	15	1.23	0.56	0.29	0.1

Panel B: Large Orders Canceled							
Year	N	# of Large canceled Orders		# of Large Canceled Orders /# of Large Executed Orders		# of Large Canceled Orders /# of All Executed Orders	
		Mean	Median	Mean	Median	Mean	Median
2014	89	101.48	62	3.44	2.25	0.55	0.38
2015	77	149.64	75	6.62	2.26	0.7	0.34
2016	43	68.74	37	2.27	1.83	0.32	0.3
2017	63	55.13	29	1.81	1.57	0.29	0.22
2018	90	75.47	39	3.35	2.16	0.42	0.32
2019	81	200.05	84	7.79	4.33	0.71	0.37
2020	129	112.42	39	3.28	2.11	0.22	0.14
All	572	112.73	47	4.16	2.14	0.45	0.26

**Table 11. Price Discovery in Preopening and Activity of Institutional Investors**

The dependent variable in each case is *Offer-to-Open Return* captures price discovery during preopening. The main independent variables of interest are: *Large Executed Orders as % of All Orders* are orders of 2,000 or more shares are considered to be large orders placed by institutional investors; *Small Executed Orders as % of All Orders* are orders of 100 or less shares are considered to be small orders placed by retail investors; *Large canceled Orders as % of All Orders* are canceled orders of 2,000 or more shares; and *Small canceled Orders as % of All Orders* are canceled orders of 100 or less shares. Control variables are included but not reported: Size is the natural logarithm of total assets, VC Backing is an indicator for whether the issuer has venture capital backing, Share Overhang is the ratio of retained shares to the public float (the number of shares issued), Price Revision is calculated as the price change from the middle of the file price to offer price, and Age is the natural logarithm of one plus the age of the firm in years at the time of the IPO. Year fixed effects based on the IPO year and industry fixed effects based on the 48 Fama-French industries are included. The t-statistics (in parentheses) are computed using heteroskedasticity-consistent standard errors that are corrected for clustering across year and industry. \*, \*\*, and \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)
Large Executed Orders as % of All Orders	12.21 (1.01)		11.30 (0.39)
Small Executed Orders as % of All Orders		-33.56*** (-3.22)	-30.79** (-2.25)
Large canceled Orders as % of All Orders	1.955** (1.97)		1.472** (2.06)
Small canceled Orders as % of All Orders		-1.755 (-0.28)	-1.720 (-0.28)
N	568	511	507
Adj. R-squared	0.036	0.050	0.048
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes



**Table 12. Increased Role of the Underwriter in Releasing IPOs for Trading**

The table reports coefficient estimates for the determinants of additional time spent in IPO preopening. The dependent variable,  $\ln(\text{Additional Time in Preopening})_i$ , is the log of one plus minutes spent in preopening in addition to the minimum required DOP. The independent variable,  $DPOST_i$ , is an indicator variable that equals one if the IPO went public after August 1, 2013, and zero otherwise.  $TopTierUW_i$  is defined as an indicator for whether the lead underwriter's Carter and Manaster (1990) rank is greater than or equal to eight. Other variables included are: Size, the natural logarithm of total assets; VC Backing, an indicator for whether the issuer has venture capital backing; Share Overhang, the ratio of retained shares to the public float (the number of shares issued); Price Revision, calculated as price change from the middle of the file price to the offer price; Age, the natural logarithm of one plus the age of the firm in years at the time of the IPO. Year fixed effects based on the IPO year and industry fixed effects based on the 48 Fama-French industries are included. The t-statistics (in parentheses) are computed using heteroskedasticity-consistent standard errors that are corrected for clustering across year and industry. \*, \*\*, and \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Full Sample		Post-August 2013		Pre-August 2013	
	(1)	(2)	(3)	(4)	(5)	(6)
$DPOST_i$	-0.0195 (-0.07)	-0.150 (-0.52)				
$DPOST_i \times TopTierUW_i$	0.932*** (3.33)	0.935*** (3.82)				
$TopTierUW_i$	0.217 (0.98)	-0.165 (-0.83)	1.157*** (7.12)	0.711*** (5.31)	0.271 (1.13)	0.104 (0.45)
Size		0.141*** (4.22)		0.185*** (5.82)		-0.052 (-0.85)
VC Backing		0.148** (1.99)		0.165* (1.81)		0.073 (0.46)
Overhang		0.033** (2.45)		0.032** (2.14)		0.063** (2.54)
Price Revision		0.015*** (5.27)		0.014*** (4.60)		0.016*** (3.18)
Age		-0.041 (-0.59)		-0.0709 (-0.88)		0.092 (0.64)
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
N	815	815	662	662	147	147
Adj. R-squared	0.529	0.593	0.523	0.581	0.189	0.276

**Table A1. Time in Preopening: Nasdaq SPACs**

The table reports the number of minutes spent in preopening. N is the number of SPACs. There are less than 10 SPACs per year before 2014 and therefore all offerings during the 2010–2013 period have been lumped together. Mean and median statistics are reported for the time spent in preopening, offer price, and offer-to-open return. In December 2017, Nasdaq reduced the required minimum preopening period from 15 to 10 minutes. Therefore, before 2018 the time spent in preopening has to be 15 minutes or more.

		Time in Preopening		Offer Price		Offer-to-Open Return	
		(minutes)		(\$)		(%)	
Year	N	Mean	Median	Mean	Median	Mean	Median
2010–2013	18	15.44	15	9.56	10	-0.06	0
2014	10	17.7	15	10	10	-0.39	0
2015	17	16.24	15	10	10	0.14	0
2016	11	19	17	10	10	-0.26	0
2017	22	18.73	16	10	10	0.66	0.65
2018	28	11.68	11	10	10	0.39	0.2
2019	31	12.74	12	10	10	0.53	0.5
2020	126	23.93	20	10	10	1.43	0.45
<b>ALL</b>	<b>263</b>	<b>19.35</b>	<b>15</b>	<b>9.97</b>	<b>10</b>	<b>0.82</b>	<b>0.2</b>