Does the Tick Size Affect Stock Prices? Evidence from the Tick Size Pilot Announcement of the Test Groups and the Control Group

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Abstract

The Tick Size Pilot ("Pilot") increased the tick size from $0.01 to $0.05 for certain small capitalization stocks randomly assigned to three Test Groups. We find that the announcement of the assignment of stocks to the Test Groups and the Control Group did not generate significant abnormal returns for stocks in the Test Groups, neither in absolute terms nor relative to stocks in the Control Group. These results hold even when we limit the analysis to stocks with pre-Pilot quoted spreads smaller than $0.05. Our findings suggest that the market did not expect the Pilot to affect stock prices of companies in the Test Groups. Under the standard assumption that the market's expectations about the effects of the Pilot were correct, this result indicates that the increase in tick size associated with the Pilot had no impact on stock prices. Thus, from a policy perspective, our findings cast doubt on the idea that similar changes in tick size can affect cost of capital of small capitalization companies. In particular, our findings are inconsistent with the view that the increase in tick size harmed companies in the Test Groups because reduced liquidity of their stocks led to lower investor demand and lower stock prices. At the same time, our findings are also inconsistent with the view that the increase in tick size benefited companies in the Test Groups because stronger incentives of market makers to promote their stocks led to higher investor demand and higher stock prices.

[1] The U.S. Securities and Exchange Commission, as a matter of policy, disclaims responsibility for any private publication or statement of any of its employees. The views expressed herein are those of the authors and do not necessarily reflect the views of the Commission or of the authors' colleagues upon the staff of the Commission. We prepared this white paper as a part of the Division of Economic and Risk Analysis (DERA) White Paper series.

I. Introduction

To assist in evaluating the impact of widening the tick size on the securities of smaller capitalization companies, the Commission ordered the Financial Industry Regulatory Authority ("FINRA") and the National Securities Exchanges (collectively called "the Participants") to act jointly in developing a plan to implement a pilot program that would widen the quoting and trading increment for certain small capitalization stocks.[2] In a press release issued in June 2014, the Commission stated that it will use the pilot program to assess whether these changes would enhance market quality to the benefit of U.S. investors, issuers and other market participants.[3] To comply with the Commission's order, on August 25, 2014, the Participants proposed, and on May 6, 2015, the Commission approved what is known as the Tick Size Pilot ("Pilot").[4]

The Pilot began on October 3, 2016 and ran until September 28, 2018.[5] It consisted of a Control Group which contained approximately 1,200 stocks and three Test Groups, which contained approximately 400 stocks each. The stocks in the Control Group were quoted and traded in price increments that are currently permitted. That is, in general, these stocks continued to be quoted in $0.01 increments[6] and had no minimum trading increment. The stocks in Test Group 1 had to be quoted in $0.05 increments and had no minimum trading increment. The stocks in Test Group 2 had to be quoted and traded in $0.05 increments. The stocks in Test Group 3 had to be quoted and traded in $0.05 increments and were also subject to a "trade-at" requirement, which prevented price matching by trading centers that

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2 See "Order Directing the Exchanges and the Financial Industry Regulatory Authority to Submit a Tick Size Pilot Plan": https://www.sec.gov/rules/other/2014/34-72460.pdf

3 See "SEC Announces Order for Tick Size Pilot Plan": https://www.sec.gov/news/press-release/2014-126

4 See "Order Approving the National Market System to Implement a Tick Size Pilot Program" ("Approval Order"): https://www.sec.gov/rules/sro/nms/2015/34-74892.pdf

5 The Pilot was originally scheduled to end at the end of trading on October 2, 2018. However, based on an exemption issued by the Commission on September 10, 2018, the quoting and trading requirements of the Pilot ceased to be in operation after the end of trading on Friday, September 28, 2018. See "Exemption Under Rule 608(e) of Regulation NMS under the Securities Exchange Act of 1934 from Certain Provisions of the "Plan to Implement a Tick Size Pilot Program"": https://www.sec.gov/divisions/marketreg/mr-noaction/2018/tick-size-pilot-exemption-091018-608e.pdf

6 See Rule 612 of Regulation NMS.

were not already displaying a quotation at that price.[7]

Existing evidence suggests that the Pilot increased quoted, effective and realized spreads for stocks in the Test Groups, especially for stocks with pre-Pilot quoted spreads smaller than $0.05 (e.g., Griffith and Roseman, 2017; Hansen et al., 2017; Hu et al., 2018; Penalva and Tapia, 2017). While this evidence may indicate that the Pilot reduced market quality, it remains unclear how the increase in spreads resulting from the Pilot affected issuers. In this paper, we attempt to fill this gap in the literature by studying the effects of the Pilot on stock prices.

From a theoretical standpoint, the Pilot could have two competing effects on stock prices of companies in the Test Groups. First, higher spreads made stocks in the Test Groups less liquid, which could lead to lower investor demand and lower stock prices (Amihud and Mendelson, 1986). We call this the Liquidity Effect. Second, higher spreads increased the profit margins of market makers for stocks in the Test Groups, which could increase their incentives to promote these stocks. Stronger promotion of these stocks could in turn increase investor demand and increase stock prices (Merton, 1987; Angel, 1997; Schultz, 2000). We call this the Stock Promotion Effect.

These two effects can generate two competing views about the expected overall impact of the Pilot on stock prices of companies in the Test Groups. If the Liquidity Effect dominates the Stock Promotion Effect, then the Pilot would harm companies in the Test Groups by reducing their stock prices. We call this the Liquidity View. In contrast, if the Stock Promotion Effect dominates the Liquidity Effect, the Pilot would benefit companies in the Test Groups by increasing their stock prices. We call this the Stock Promotion View.

To assess the relative merits of these views and provide evidence on the effects of the Pilot on stock prices, we conduct an event study around the announcement of the assignment of stocks into the Test Groups and the Control Group, which occurred about one month before the beginning of the Pilot.[8] As is customary in the event-study literature, we assume that the market had correct expectations about the effects of the forthcoming Pilot, and that these expectations were reflected in the prices of Pilot stocks before the Pilot

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[7] See "Plan to Implement a Tick Size Pilot Program" ("the Plan"), Exhibit A of the "Approval Order": https://www.sec.gov/rules/sro/nms/2015/34-74892-exa.pdf The Plan also provided certain exceptions to these quoting and trading requirements. See the Plan at 14-18 for details.

[8] See Section II for more details about this announcement.

began. Under these assumptions, if the increase in tick size associated with the Pilot had an impact on stock prices, we should observe abnormal returns for Pilot stocks around the announcement of their assignment into the Test Groups and the Control Group.

In particular, under the Liquidity View, we expect to observe negative abnormal returns[9] around the announcement for stocks assigned to the Test Groups; positive abnormal returns around the announcement for stocks assigned to the Control Group (because these stocks could have been assigned to the Test Groups but were not); and negative abnormal returns for stocks assigned to the Test Groups relative to stocks assigned to the Control Group.

In contrast, under the Stock Promotion View, we expect to observe exactly the opposite. That is, we expect to observe positive abnormal returns around the announcement for stocks assigned to the Test Groups; negative abnormal returns around the announcement for stocks assigned to the Control Group (because these stocks could have been assigned to the Test Groups but were not); and positive abnormal returns for stocks assigned to the Test Groups relative to stocks assigned to the Control Group.

Furthermore, under both the Liquidity View and the Stock Promotion View, we should be more likely to find the expected effects of the announcement on abnormal returns for stocks with pre-Pilot quoted spreads smaller than $0.05. This is because under both views the increase in tick size from $0.01 to $0.05 is expected to affect stock prices by increasing spreads. For stocks with pre-Pilot quoted spreads smaller than $0.05, the new tick size of $0.05 is binding, and the increase in tick size from $0.01 to $0.05 should indeed cause an unambiguous (and mechanical) increase in spreads. In contrast, for stocks with pre-Pilot quoted spreads greater than $0.05, the effect of the increase in tick size from $0.01 to $0.05 is theoretically ambiguous with some theories predicting an increase in spreads but other theories suggesting the possibility of a decrease in spreads.[10] Moreover, even if the increase

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9 Abnormal return for a given stock is the difference between the actual return for that stock and the predicted return for that stock, measured by an asset pricing model such as the Fama-French three-factor model. See Section III for more details.

10 In particular, theoretical models that assume perfect competition for liquidity provision tend to predict that a larger tick size would increase spreads by making it more difficult for liquidity providers to post quotes close to their reservation value (e.g., Kadan, 2006; Goettler, Parlour and Rajan, 2005). In contrast, Kadan (2006) shows that when the number of liquidity providers in the market is small, a larger tick size may reduce spreads by making it more difficult for liquidity providers to exploit their market power. Theoretical models of Cordella and Foucault (1999), Foucault, Kadan and Kandel (2005), and Werner et al. (2015) also suggest that a larger tick size may reduce spreads under some circumstances.

in tick size from $0.01 to $0.05 were to increase spreads for stocks with pre-Pilot quoted spreads greater than $0.05, such increase in spreads would on average be smaller in percentage terms than the corresponding increase in spreads for stocks with pre-Pilot quoted spreads smaller than $0.05.[11][12]

To preview our results, we find that the announcement of the assignment of stocks to the Test Groups and the Control Group did not have an impact on their prices. In particular, the announcement did not generate significant abnormal returns for stocks assigned to the Test Groups, neither in absolute terms nor relative to stocks assigned to the Control Group. These results hold even when we limit the analysis to stocks with pre-Pilot quoted spreads smaller than $0.05.[13]

Our findings suggest that the market did not expect the Pilot to affect stock prices of companies in the Test Groups. As discussed above, in line with the event-study literature, we assume that the market's expectations about the effects of the Pilot were correct. We therefore interpret our findings as indicating that the increase in tick size associated with the Pilot had no impact on stock prices. Thus, from a policy perspective, our results cast doubt on the idea that similar changes in tick size can affect cost of capital of small capitalization companies.

In particular, our findings are inconsistent with the Liquidity View (whereby the increase in tick size associated with the Pilot harmed companies in the Test Groups by reducing their stock prices), and they are also inconsistent with the Stock Promotion View (whereby the increase in tick size associated with the Pilot benefited companies in the Test Groups by increasing their stock prices). Instead, our finding that the market did not expect the Pilot

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11 For example, if a stock in the Test Groups had a pre-Pilot quoted spread of $0.02 and the spread increased to $0.05 as a result of the Pilot, this would represent a 150 percent increase in spread. In contrast, if a stock in the Test Groups had a pre-Pilot quoted spread of $0.07 and the spread increased to $0.10 as a result of the Pilot, the same $0.03 increase in spread would correspond to only a 43 percent increase in spread. More generally, this logic suggests that the average percentage increase in spreads as a result of the Pilot would likely be smaller for stocks with pre-Pilot quoted spreads greater than $0.05 relative to stocks with pre-Pilot quoted spreads smaller than $0.05 (even if the Pilot were indeed to increase spreads for the former subset of stocks).

12 In line with the discussion in this paragraph, existing empirical studies provide strong evidence that the Pilot increased spreads for Test-Group stocks with pre-Pilot quoted spreads smaller than $0.05, but find much weaker effects of the Pilot on spreads for Test-Group stocks with pre-Pilot quoted spreads greater than $0.05 (see, e.g., Hu et al., 2018; Penalva and Tapia, 2017).

13 In a robustness check, we also conduct our analysis for stocks with pre-Pilot quoted spreads smaller than $0.03 and find that our results remain robust.

to affect stock prices of companies in the Test Groups raises two theoretical possibilities. One possibility is that the market expected the Liquidity Effect and the Stock Promotion Effect of the Pilot on stock prices of companies in the Test Groups to cancel each other out. Another possibility is that the market expected each of these two effects to be negligible.

The rest of the paper is organized as follows. Section II provides some background information about the Pilot. Section III describes the data and methodology. Section IV presents the empirical results. Finally, Section V concludes.

II. The Tick Size Pilot Announcement of the Test Groups and the Control Group

According to the Tick Size Pilot Plan ("the Plan"), the total population of securities that would be part of the Tick Size Pilot were to consist of NMS stocks that satisfied the following criteria:[14] (1) a market capitalization of $3 billion or less on the last day of the Measurement Period;[15] (2) a closing price of at least $2.00 on the last day of the Measurement Period; (3) a closing price on every U.S. trading day during the Measurement Period that is not less than $1.50; 4) a Consolidated Average Daily Volume ("CADV") during the Measurement Period of one million shares or less;[16] and 5) a Measurement Period Volume-Weighted Average Price ("Measurement Period VWAP") of at least $2.00.[17] The Plan defined the "Measurement Period" as the U.S. trading days during the three-calendar-month period ending at least 30 days prior to the effective date of the Pilot Period (which was October 3, 2016).[18]

After determining the population of Pilot stocks based on the criteria above, the Participants used a stratified random sampling process to assign these stocks to the three Test Groups and the Control Group. In this process, the Participants formed sampling strata based on the following variables: (1) share price based on the Measurement Period VWAP; (2)

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[14] See the Plan, supra note 7, at 11-12.

[15] Market capitalization is calculated by multiplying the total number of shares outstanding on such day by the closing price of the stock on such day.

[16] CADV is calculated by adding the single-counted share volume of all reported transactions in the stock during the Measurement Period and dividing by the total number of U.S. trading days during the Measurement Period.

[17] Measurement Period VWAP is determined by calculating the VWAP for each U.S. trading day during the Measurement Period, summing the daily VWAP across the Measurement Period, and dividing by the total number of U.S. trading days during the Measurement Period.

[18] See the Plan, supra note 7, at 3.

market capitalization based on the last day of the Measurement Period; and (3) trading volume based on the CADV during the Measurement Period.[19]

Then, at various times between 6:46pm on Friday, September 2, 2016 and 3:04pm on Tuesday, September 6, 2016, NASDAQ, NYSE, and FINRA publicly announced the assignment of stocks to the Test Groups and the Control Group.[20] Specifically, for NASDAQ-listed stocks, NASDAQ posted the group assignment file on September 2, 2016 at 6:46pm, and subsequently published a trader alert on September 6, 2016 at 12:27pm. For NYSE and NYSE MKT-listed stocks, NYSE posted the group assignment file on September 6, 2016 at 9:03am, and subsequently published a trader alert on September 6, 2016 at 3:04pm.[21] Additionally, FINRA posted the combined group assignment file for NASDAQ, NYSE, and NYSE MKT-listed stocks on September 6, 2016 at 1:29pm.

In this paper, we jointly refer to all these data postings and trader alerts as the "announcement" of the assignment of stocks to the Test Groups and the Control Group. Because all these data postings and trader alerts occurred between the market close on Friday, September 2, 2016 and the market close on Tuesday, September 6, 2016 (with Monday, September 5, 2016 being a Labor Day holiday), we define September 6 as the "announcement day" in our empirical analysis. In particular, we consider the return from the market close on Friday, September 2, 2016 to the market close on Tuesday, September 6, 2016 as the "announcement day return".

III. Data and Methodology

When NASDAQ, NYSE, and FINRA announced which stocks would be part of the Test Groups and the Control Group as discussed in the previous section, the announcement consisted of assigning 2,398 Pilot stocks to the Test Groups and the Control Group. In our analysis, we

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[19] See the Plan, supra note 7, at 12-14 for further details on the stratified random sampling process used to assign Pilot stocks to the Test Groups and the Control Group.

[20] The information in this paragraph is based on our conversations with NASDAQ, NYSE and FINRA.

[21] The trader alerts published by NASDAQ and NYSE as discussed in this paragraph were not specifically about the assignment of stocks to the Test Groups and the Control Group, but covered a broader set of issues related to the implementation of the Tick Size Pilot (scheduled to begin on October 3, 2016). However, these were the first trader alerts that provided links to the group assignment files recently posted on the NASDAQ and NYSE respective websites. The NASDAQ and NYSE trader alerts are available at http://www.nasdaqtrader.com/TraderNews.aspx?id=ETA2016-210 and https://www.nyse.com/publicdocs/nyse/markets/nyse/Tick_Pilot_Rollout_and_Industry_Test.pdf.

focus on Pilot stocks classified as U.S. common stocks in the Center for Research in Security Prices ("CRSP") database (i.e., stocks with CRSP share codes 10 and 11).[22] As a result, in our analysis we use 2,059 stocks, of which 351 were assigned to Test Group 1, 346 were assigned to Test Group 2, 335 were assigned to Test Group 3, and 1,027 were assigned to the Control Group.

The dependent variable in our analysis is the cumulative abnormal return ("CAR") measured over trading days in event windows [0], [0,1], and [0,2], where the numbers correspond to the number of trading days after the announcement day. Specifically, [0] refers to the announcement day of September 6, 2016; [0,1] refers to September 6-7, 2016; and [0,2] refers to September 6-8, 2016. Because Monday, September 5, 2016 was a Labor Day Holiday, the CARs for event windows [0], [0,1], and [0,2] measure the abnormal returns from the market close on Friday, September 2, 2016 to the market close on Tuesday, September 6, 2016, the market close on Wednesday, September 7, 2016, and the market close on Thursday, September 8, 2016 respectively.

To calculate CARs, we first estimate the coefficients on the portfolio return factors of the Fama-French three-factor model by running the following regression for each stock:

$$r_t - r_{f,t} = \alpha + \beta_{MKT}\left(r_{MKT,t} - r_{f,t}\right) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \varepsilon_t \qquad (1)$$

r_t is the stock's daily return; $r_{f,t}$ is the one-month Treasury Bill Rate—a proxy variable for the risk-free rate; $r_{MKT,t} - r_{f,t}$ is the excess return on the market; SMB_t ("Small Minus Big") is the average return on the three small portfolios minus the average return on the three big portfolios; HML_t ("High Minus Low") is the average return on the two value portfolios minus the average return on the two growth portfolios; β_{MKT}, β_{SMB}, and β_{HML} are the coefficients on the excess return on the market, Small Minus Big, and High Minus Low portfolio return factors respectively.[23] We obtain daily stock returns from CRSP, and the excess return on the market, Small Minus Big, and High Minus Low portfolios are obtained from Kenneth French's website.[24]

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[22] Unless noted otherwise, in this paper we use the terms "CRSP" and "the CRSP database" to refer to the CRSP Daily Stock database ©2017 Center for Research in Security Prices (CRSP®), The University of Chicago Booth School of Business.

[23] For more description and details of how the return factors are constructed and the data used, see Fama and French (1993).

[24] See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

As is customary in the event-study literature, we estimate the regression model (1) over a time period prior to the announcement, namely, from August 8, 2015 to August 8, 2016. Using the estimated coefficients for each stock from (1), we then estimate the predicted return for each stock over the relevant event window as follows:

$$\widehat{r_t} = r_{f,t} + \hat{\alpha} + \hat{\beta}_{MKT}\left(r_{MKT,t} - r_{f,t}\right) + \hat{\beta}_{SMB}SMB_t + \hat{\beta}_{HML}HML_t \quad (2)$$

Using the predicted return for each stock from (2), we calculate the abnormal return for each stock over the relevant event window as follows:

$$AR_t = r_t - \widehat{r_t} \quad (3)$$

We then winsorize daily abnormal returns from (3) at the 0.1% and the 99.9% level each trading day to mitigate the effect of outlier observations driving our results. Finally, we calculate the CAR for each stock as the sum of the winsorized daily abnormal returns over the relevant event window as follows:

$$CAR_{t,t+j} = \sum_{j=0}^{T} AR_{t+j} \quad (4)$$

To examine the effect of the announcement of the assignment of stocks to the Test Groups and the Control Group, we estimate the following cross-sectional regressions across all stocks over the relevant event windows:

$$CAR_i = \beta_1 Test1_i + \beta_2 Test2_i + \beta_3 Test3_i + \gamma Control_i + \varepsilon_i \quad (5)$$

$$CAR_i = \alpha + \theta_1 Test1_i + \theta_2 Test2_i + \theta_3 Test3_i + \varepsilon_i \quad (6)$$

$Test1_i$ is a dummy variable that equals 1 if a stock belongs to Test Group 1, and equals 0 otherwise; $Test2_i$ is a dummy variable that equals 1 if a stock belongs to Test Group 2, and equals 0 otherwise; $Test3_i$ is a dummy variable that equals 1 if a stock belongs to Test Group 3, and equals 0 otherwise; $Control_i$ is a dummy variable that equals 1 if a stock belongs to the Control Group, and equals 0 otherwise.

In (5), the coefficients β_1, β_2, β_3, and γ measure the average CARs for stocks in Test Group 1, Test Group 2, Test Group 3, and the Control Group respectively. In (6), the coefficients θ_1, θ_2, and θ_3 measure the average CARs for stocks in Test Group 1, Test Group 2, and Test Group 3 respectively, relative to stocks in the Control Group (which is the omitted group in this regression). In all our regressions, we use White robust standard errors to account for heteroscedasticity.

We estimate (5) and (6) for each of the relevant event windows, namely [0], [0,1], and [0,2]. Furthermore, in addition to estimating (5) and (6) for our full sample of stocks, we also estimate these equations separately for stocks that had an average pre-Pilot quoted spread (*SPREAD*) smaller or larger than $0.05 in August 2016.[25]

IV. Results

a. Descriptive Statistics

Using the sample of 2,059 stocks, we calculate descriptive statistics in the month before the tick size announcement, that is, in August 2016. We use data from the CRSP database to calculate the average closing price (*PRICE*), average market capitalization (*SIZE*), average daily trading volume (*VOLUME*) across all trading days in August 2016. We also use data from the TAQ database to calculate *SPREAD*.[26] We then take equally-weighted averages for each of these characteristics across all stocks in Test Group 1, Test Group 2, Test Group 3, and the Control Group.

Table 1 reports the summary statistics. Except for one exception, there are no significant differences between each respective Test Group and the Control Group for each of these characteristics, [27] both when unconditioned and also when conditioned on *SPREAD* being less than or greater than $0.05. Together, these results show that the sampling of stocks did not result in certain Test Groups and the Control Group having on average statistically different characteristics than other groups.

b. Main Results

Table 2 presents the results of regressions (5) and (6) for the CARs in event windows [0], [0,1], and [0,2] when these regressions are estimated using all stocks in our sample, irrespective of their pre-Pilot quoted spreads. The top part of Table 2 presents the average CARs for stocks in each Test Group and the Control Group (estimated in equation (5)), while

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[25] Using data on quotes from the New York Stock Exchange's Trade and Quote ("TAQ") database, we first calculate the time-weighted average spread for each stock/trading day pair in August 2016. We then take the equally-weighted average for each stock across all trading days in August 2016 to calculate the pre-Pilot quoted spread (*SPREAD*).

[26] See id.

[27] For stocks with *SPREAD* < $0.05, the difference in *SPREAD* between Test Group 3 and the Control Group is $0.0018, and is statistically significant at the 10% level.

the bottom part of Table 2 presents the CARs for stocks in each Test Group relative to stocks in the Control Group (estimated in equation (6)).

The top part of Table 2 shows that for all Groups of stocks and all event windows, the estimated average CARs are statistically insignificant. In addition, the magnitude of these CARs, ranging between 1 and 37 bps in absolute value, is quite small relative to the CARs found in other event studies.[28] These results suggest that the announcement of the assignment of stocks into the Test Groups and the Control Group did not have an impact on their prices.

Furthermore, the CARs in the top part of Table 2 tend to have inconsistent signs both across the different Test Groups and across the various event windows. In particular, in event window [0], the average CAR for stocks in Test Group 1 is negative, while the average CARs for stocks in Test Group 2 and Test Group 3 are positive. This pattern is reversed in event window [0,1] where the average CAR for stocks in Test Group 1 is positive, while the average CARs for stocks in Test Group 2 and Test Group 3 are negative. Because these inconsistent patterns do not uniformly line with either the Liquidity View or the Stock Promotion View,[29] we view them as additional evidence that the announcement of the assignment of stocks into the Test Groups and the Control Group did not have an impact on their prices.

The bottom part of Table 2 shows that when the CARs of stocks in each Test Group are compared to the CARs of stocks in the Control Group, the difference is quantitatively small and statistically insignificant for all the Test Groups and all event windows. These results are also consistent with the conclusion that the announcement of the assignment of stocks to the Test Groups and the Control Group did not have an impact on their prices.

As discussed in the Introduction, under both the Liquidity View and the Stock Promotion View, the announcement of the assignment of stocks to the Test Groups and the Control

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[28] While event studies which analyze market reactions to earnings generally have large CARs (e.g., CAR[0,1] ≈ 300 bps in Hirschleifer et al. (2009)), the academic literature has documented other types of events that generate large market reactions. For instance, Luechinger and Moser (2014) find that CAR[0,1] ≈ 130 bps after announcements of the political appointments of board members to senior positions in the Department of Defense; and Yermack (2011) finds that CAR[0,4] ≈ 170 bps for design and retail firms after Michelle Obama wore their clothing at a major event.

[29] In particular, under both the Liquidity View and the Stock Promotion View, we expect the effects of the announcement of the Test Groups and the Control Group on prices of stocks assigned to Test Group 1, Test Group 2, and Test Group 3 to have the same sign.

Group should be more likely to generate the expected effects on stock prices for stocks with pre-Pilot quoted spreads smaller than $0.05. Therefore, the announcement could have a significant impact on prices for this subset of stocks even if its overall impact on prices for all stocks, irrespective of the pre-Pilot quoted spread, was small.

We assess this possibility in Table 3, where we split our sample and estimate regressions (5) and (6) separately for stocks with pre-Pilot quoted spreads smaller than $0.05 and for stocks with pre-Pilot quoted spread larger than $0.05. While we are primarily interested in the results for the former sub-sample of stocks, we present the results for the latter sub-sample of stocks for completeness. Like Table 2, Table 3 presents the regression results for the CARs in event windows [0], [0,1], and [0,2].

Table 3 shows that the results for stocks with pre-Pilot quoted spreads smaller than $0.05 are similar to the results for all stocks in Table 2. In particular, regardless of whether we examine the average CARs for stocks in the Test Groups and the Control Group (presented in the top part of Table 3) or the average CARs for stocks in the Test Groups relative to stocks in the Control Group (presented in the bottom part of Table 3), the estimated coefficients for the sub-sample of stocks with pre-Pilot quoted spreads smaller than $0.05 tend to remain quantitatively small and statistically insignificant. Furthermore, for this sub-sample of stocks, the average CARs in the top part of Table 3 continue to have inconsistent signs across the different Test Groups and across the various event windows.[30]

Taken together, the results in Tables 2 and 3 suggest that the announcement of the assignment of stocks to the Test Groups and the Control Group did not have an impact on their prices, regardless of whether we consider all of the stocks (irrespective of the pre-Pilot quoted spread) or limit the analysis to stocks with pre-Pilot quoted spread smaller than $0.05. In particular, in each of these cases, the results in Tables 2 and 3 show that the announcement did not generate significant abnormal returns for stocks in the Test Groups, neither in absolute terms nor relative to stocks in the Control Group.

These findings suggest that the market did not expect the Pilot to affect stock prices of companies in the Test Groups. As discussed in the Introduction, in line with the event-study literature, we assume that the market's expectations about the effects of the Pilot were

[30] Table 3 also shows equally weak results for stocks with pre-Pilot quoted spreads greater than $0.05. Once again, the estimated CARs are statistically insignificant, have inconsistent signs across the Test Groups and the event windows, and are small in magnitude.

correct. We therefore interpret the results in Tables 2 and 3 as indicating that the increase in tick size associated with the Pilot had no impact on stock prices.

From a theoretical perspective, the results in Tables 2 and 3 are inconsistent with the Liquidity View whereby the increase in tick size associated with the Pilot harmed companies in the Test Groups because reduced liquidity of their stocks led to lower investment demand and lower stock prices. At the same time, the results in Tables 2 and 3 are also inconsistent with the Stock Promotion View whereby the increase in tick size associated with the Pilot benefited companies in the Test Groups because stronger incentives of market makers to promote their stocks led to higher investment demand and higher stock prices.

Instead, the finding that the market did not expect the Pilot to affect stock prices of companies in the Test Groups raises two theoretical possibilities. One possibility is that the market expected the Liquidity Effect and the Stock Promotion Effect of the Pilot on stock prices of companies in the Test Groups to cancel each other out. Alternatively, the market may have expected each of these two effects of the Pilot on stock prices of companies in the Test Groups to be negligible.

c. Robustness

We subject the results in Tables 2 and 3 to three robustness tests.

First, we exclude from the analysis 79 stocks (across all Pilot Groups) that had an earnings announcement ±5 trading days around September 6, 2016.[31] Excluding stocks that have earnings announcements mitigates the concern that our results are affected by confounding company-specific news around the tick size announcement. Second, when estimating the CARs of stocks in the Test Groups relative to stocks in the Control Group, we control for industry fixed effects based on the Fama-French 49-industry classification.[32] This mitigates the concern that our results are confounded by industry-specific news around the tick size announcement that differentially affected stocks assigned to the Test Groups and

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[31] We extract the list of stocks which had earnings announcement dates ±5 trading days around Tuesday September 6, 2016 from the I/B/E/S Summary file. We focus on earnings-per-share ("EPS") forecasts and do not place any restrictions on the period for which the forecast is made.

[32] We obtain the Fama-French 49-industry classification from Ken French's website: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. This classification aggregates Standard Industry Classification ("SIC") codes into 49 broader industry categories. We use SIC codes from Compustat. When Compustat SIC codes are not available, we use SIC codes from CRSP. (We obtain the Compustat SIC codes from the CRSP Compustat Merged database ©2017 Center for Research in Security Prices (CRSP®), The University of Chicago Booth School of Business.)

the Control Group. Third, we limit the analysis to stocks with pre-Pilot quoted spreads smaller than $0.03. We do this to account for the possibility that the tick size announcement could have an important impact on prices for stocks whose pre-Pilot quoted spread was significantly smaller than the new tick size of $0.05.

We find that the results from these robustness tests remain similar to those presented in Tables 2 and 3.[33] That is, the estimated CARs remain small in magnitude and statistically insignificant, and they continue to have inconsistent signs across the Test Groups and the event windows. These findings provide further support to the conclusion that the announcement of the assignment of stocks to the Test Groups and the Control Group did not have an impact on their prices.

d. Pre-Announcement Period

So far, we analyzed the abnormal returns *after* the public announcement of the stocks to the Test Groups and the Control Group (i.e., the abnormal returns on or after September 6, 2016). However, in the event-study literature, it is also customary to examine abnormal returns *before* public announcements, to account for the possibility of information leakage. In particular, the Participants could have internally completed the assignment of stocks to the Test Groups and the Control Group a few days before the public announcement, and, in theory, this information could have been leaked to the market.

While we think that such information leakage was highly unlikely, we still check for evidence. This is important because, when discussing the results in Tables 2 and 3, we interpreted the lack of market reaction to the announcement of stocks in the Test Groups and the Control Group as evidence that the market did not expect the Pilot to affect stock prices of companies in the Test Groups. However, if the information about the assignment of stocks into the Test Groups and the Control Group reached the market (and was incorporated into stock prices) before the public announcement, this interpretation would no longer be valid.

To examine the possibility of information leakage before the announcement, we estimate regressions (5) and (6) using the CARs for event windows [-2] and [-2,-1] (which correspond to September 1, 2016 and September 1-2, 2016, respectively). In Table 4, Panel A, we present the regression results for all stocks in our sample, irrespective of their pre-Pilot quoted spread. In Table 4, Panel B, we present separate results for stocks with pre-Pilot

[33] While we do not present the tables with the results from these robustness tests, they are available from the authors upon request.

quoted spreads smaller than $0.05 and for stocks with pre-Pilot quoted spreads greater than $0.05. As in Tables 2 and 3, the top part of each panel presents the average CARs for stocks in each Test Group and the Control Group, while the bottom part of each panel presents the CARs for stocks in each Test Group relative to stocks in the Control Group.

Table 4, Panel A shows that while the average CAR for stocks in the Control Group in event window [-2, -1] is negative and statistically significant at the 5% level, the average pre-announcement CARs for stocks in each of the Test Groups are statistically insignificant. In addition, the pre-announcement CARs for stocks in the Test Groups relative to stocks in the Control Group are also statistically insignificant for each Test Group. Furthermore, all point estimates reported in Table 4, Panel A are quantitatively small, ranging between 1 and 25 bps in absolute value. Table 4, Panel B shows that the results for the sub-samples of stocks with pre-Pilot quoted spreads smaller than $0.05 or pre-Pilot quoted spreads larger than $0.05 are also weak, both statistically and economically.

Overall, the results in Table 4 suggest that the assignment of Pilot stocks into the Test Groups and the Control Group did not generate significant market reaction prior to the public announcement. Therefore, these results provide no evidence that the information about the assignment was leaked to the market.

V. Conclusion

In this paper, we assess the effects of the Tick Size Pilot on stock prices. We do so by conducting an event study around the announcement of the assignment of stocks to the Tests Groups and the Control Group. We find that the announcement did not have an impact on prices of these stocks. In particular, the announcement did not generate significant abnormal returns for stocks assigned to the Test Groups, neither in absolute terms nor relative to stocks assigned to the Control Group. These results hold even when we limit the analysis to stocks with pre-Pilot quoted spreads smaller than the new tick size of $0.05.

Our findings suggest that the market did not expect the Pilot to affect stock prices of companies in the Test Groups. As discussed in the Introduction, in line with the event-study literature, we assume that the market's expectations about the effects of the Pilot were correct. We therefore interpret our findings as indicating that the increase in tick size associated with the Pilot had no impact on stock prices. Thus, from a policy perspective, our results cast doubt on the idea that similar changes in tick size can affect cost of capital of small capitalization companies.

In particular, our findings are inconsistent with the Liquidity View whereby the increase in tick size associated with the Pilot harmed companies in the Test Groups because reduced liquidity of their stocks led to lower investment demand and lower stock prices. At the same time, our findings are also inconsistent with the Stock Promotion View whereby the increase in tick size associated with the Pilot benefited companies in the Test Groups because stronger incentives of market makers to promote their stocks led to higher investment demand and higher stock prices.

Instead, our finding that the market did not expect the Pilot to affect stock prices of companies in the Test Groups raises two theoretical possibilities. One possibility is that the market expected the Liquidity Effect and the Stock Promotion Effect of the Pilot on stock prices of companies in the Test Groups to cancel each other out. Another possibility is that the market expected each of these two effects to be negligible.

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Table 1
Pre-Pilot Descriptive Statistics

This table presents the average price (*PRICE*), average market capitalization (*SIZE*), average daily trading volume (*VOLUME*), and average pre-Pilot quoted spread (*SPREAD*) of stocks in Test Group 1, Test Group 2, Test Group 3, and the Control Group, as well as Test Group 1, Test Group 2, and Test Group 3 relative to the Control Group in August 2016. *SPREAD* is measured for each stock as the equally-weighted average time-weighted quoted spread across all trading days in August 2016. Each of these variables is also conditioned on *SPREAD* < $0.05 and *SPREAD* ≥ $0.05. White heteroscedasticity-robust standard errors are reported in parentheses. *, **, *** denote 10%, 5%, and 1% levels of statistical significance.

	AVERAGE *PRICE* ($)			**AVERAGE *SIZE* ($ million)**			**AVERAGE *VOLUME* (shares)**			**AVERAGE *SPREAD* ($)**		
	All *SPREAD*	*SPREAD* < $0.05	*SPREAD* ≥ $0.05	All *SPREAD*	*SPREAD* < $0.05	*SPREAD* ≥ $0.05	All *SPREAD*	*SPREAD* < $0.05	*SPREAD* ≥ $0.05	All *SPREAD*	*SPREAD* < $0.05	*SPREAD* ≥ $0.05
Test1	24.20 N=351	15.15 N=158	31.60 N=193	691.2 N=351	772.4 N=158	624.8 N=193	207,078 N=351	352,371 N=158	88,133 N=193	0.1435 N=351	0.0288 N=158	0.2374 N=193
Test2	22.08 N=346	15.18 N=146	27.13 N=200	628.0 N=346	765.9 N=146	527.4 N=200	204,530 N=346	369,107 N=146	84,388 N=200	0.1345 N=346	0.0280 N=146	0.2122 N=200
Test3	25.85 N=335	15.38 N=142	33.55 N=193	708.1 N=335	818.7 N=142	626.7 N=193	206,027 N=335	369,402 N=142	85,824 N=193	0.1519 N=335	0.0268 N=142	0.2439 N=193
Control	23.67 N=1,027	15.17 N=431	29.82 N=596	660.2 N=1,027	757.6 N=431	589.8 N=596	193,312 N=1,027	332,859 N=431	92,397 N=596	0.1523 N=1,027	0.0287 N=431	0.2417 N=596
Test1 minus Control	0.53 (1.51)	-0.02 (1.06)	1.78 (2.42)	31.0 (45.3)	14.8 (67.4)	35.0 (60.7)	13,766 (15,238)	19,512 (25,864)	-4,265 (11,090)	-0.0088 (0.0190)	0.0001 (0.0011)	-0.0043 (0.0320)
Test2 minus Control	-1.59 (1.42)	0.01 (1.04)	-2.69 (2.24)	-32.2 (42.6)	8.3 (65.5)	-62.4 (55.0)	11,218 (16,058)	36,248 (28,668)	-8,009 (11,105)	-0.0178 (0.0159)	-0.0007 (0.0011)	-0.0295 (0.0255)
Test3 minus Control	2.18 (2.39)	0.20 (1.08)	3.73 (3.96)	47.9 (46.3)	61.2 (71.3)	36.9 (60.1)	12,715 (15,883)	36,542 (28,085)	-6,573 (5,950)	-0.0005 (0.0220)	-0.0019 (0.0010)*	0.0022 (0.0363)

Table 2
Cumulative Abnormal Returns after the Tick-Size Announcement
(All Stocks)

This table presents the average cumulative abnormal returns for stocks in Test Group 1, Test Group 2, Test Group 3, and the Control Group, as well as Test Group 1, Test Group 2, and Test Group 3 relative to the Control Group, for the [0], [0,1], and [0,2] event windows. The table also presents the sample size of each of the Test Groups and the Control Group, conditioned on the event window. White heteroscedasticity-robust standard errors are reported in parentheses. *, **, *** denote 10%, 5%, and 1% levels of statistical significance.

Event window Dates	[0] SEP 6	[0,1] SEP 6-7	[0,2] SEP 6-8
Test1	-0.0010 (0.0014)	0.0011 (0.0019)	0.0037 (0.0024)
Test2	0.0020 (0.0016)	-0.0003 (0.0019)	0.0018 (0.0024)
Test3	0.0025 (0.0017)	-0.0001 (0.0019)	0.0029 (0.0026)
Control	0.0001 (0.0008)	-0.0019 (0.0012)	0.0016 (0.0015)
Test1 minus Control	-0.0011 (0.0016)	0.0030 (0.0022)	0.0021 (0.0028)
Test2 minus Control	0.0019 (0.0018)	0.0016 (0.0022)	0.0002 (0.0028)
Test3 minus Control	0.0024 (0.0019)	0.0018 (0.0022)	0.0013 (0.0030)
N (Test1)	351	351	351
N (Test2)	346	346	346
N (Test3)	335	335	335
N (Control)	1,027	1,027	1,026
N (Total)	2,059	2,059	2,058

Table 3
Cumulative Abnormal Returns after the Tick-Size Announcement
(Conditioned on *SPREAD*)

This table presents the average cumulative abnormal returns for stocks in Test Group 1, Test Group 2, Test Group 3, and the Control Group, as well as Test Group 1, Test Group 2, and Test Group 3 relative to the Control Group, conditioned on *SPREAD* < $0.05 and *SPREAD* ≥ $0.05, for the [0], [0,1] and [0,2] event windows. *SPREAD* is the pre-Pilot quoted spread, measured for each stock as the equally-weighted average time-weighted quoted spread across all trading days in August 2016. The table also presents the sample size of each of the Test Groups and the Control Group, conditioned on *SPREAD* and the event window. White heteroscedasticity-robust standard errors are reported in parentheses. *, **, *** denote 10%, 5%, and 1% levels of statistical significance.

	***SPREAD* < $0.05**			***SPREAD* ≥ $0.05**		
Event window	[0]	[0,1]	[0,2]	[0]	[0,1]	[0,2]
Dates	SEP 6	SEP 6-7	SEP 6-8	SEP 6	SEP 6-7	SEP 6-8
Test1	-0.0008	0.0005	0.0050	-0.0011	0.0016	0.0026
	(0.0021)	(0.0029)	(0.0041)	(0.0019)	(0.0024)	(0.0028)
Test2	0.0005	-0.0025	-0.0024	0.0031	0.0012	0.0048
	(0.0024)	(0.0025)	(0.0032)	(0.0023)	(0.0027)	(0.0034)
Test3	0.0030	0.0007	0.0065	0.0022	-0.0008	0.0003
	(0.0027)	(0.0031)	(0.0041)	(0.0023)	(0.0024)	(0.0034)
Control	-0.0007	-0.0029	0.0024	0.0007	-0.0012	0.0010
	(0.0012)	(0.0017)*	(0.0023)	(0.0011)	(0.0016)	(0.0019)
Test1 minus Control	-0.0001	0.0034	0.0025	-0.0019	0.0028	0.0016
	(0.0024)	(0.0034)	(0.0047)	(0.0022)	(0.0029)	(0.0034)
Test2 minus Control	0.0012	0.0005	-0.0048	0.0024	0.0024	0.0038
	(0.0027)	(0.0030)	(0.0039)	(0.0025)	(0.0031)	(0.0039)
Test3 minus Control	0.0037	0.0037	0.0040	0.0015	0.0004	-0.0008
	(0.0029)	(0.0035)	(0.0047)	(0.0025)	(0.0029)	(0.0039)
N (Test1)	158	158	158	193	193	193
N (Test2)	146	146	146	200	200	200
N (Test3)	142	142	142	193	193	193
N (Control)	431	431	430	596	596	596
N (Total)	877	877	876	1,182	1,182	1,182

Table 4
Cumulative Abnormal Returns before the Tick-Size Announcement

Panel A presents the average cumulative abnormal returns for stocks in Test Group 1, Test Group 2, Test Group 3, and the Control Group, as well as Test Group 1, Test Group 2, and Test Group 3 relative to the Control Group, for the [-2] and [-2,-1] event windows. Panel B presents results similar to Panel A, except that the average cumulative abnormal returns are conditioned on *SPREAD* < $0.05 and *SPREAD* ≥ $0.05. *SPREAD* is the pre-Pilot quoted spread, measured for each stock as the equally-weighted average time-weighted quoted spread across all trading days in August 2016. Both panels present the sample size of each of the Test Groups and the Control Group. White heteroscedasticity-robust standard errors are reported in parentheses. *, **, *** denote 10%, 5%, and 1% levels of statistical significance.

Panel A: All Stocks

Event window Dates	[-2] SEP 1	[-2,-1] SEP 1-2
Test1	0.0010 (0.0010)	0.0006 (0.0013)
Test2	-0.0001 (0.0014)	-0.0002 (0.0017)
Test3	-0.0008 (0.0012)	0.0008 (0.0016)
Control	0.0002 (0.0007)	-0.0017 (0.0008)**
Test1 minus Control	0.0008 (0.0012)	0.0023 (0.0016)
Test2 minus Control	-0.0003 (0.0015)	0.0015 (0.0019)
Test3 minus Control	-0.0011 (0.0013)	0.0025 (0.0018)
N (Test1)	351	351
N (Test2)	346	346
N (Test3)	335	335
N (Control)	1,028	1,027
N (Total)	2,060	2,059

Panel B: Stocks Conditioned on *SPREAD*

	***SPREAD* < $0.05**		***SPREAD* ≥ $0.05**	
Event window Dates	[-2] SEP 1	[-2,-1] SEP 1-2	[-2] SEP 1	[-2,-1] SEP 1-2
Test1	0.0001 (0.0015)	0.0009 (0.0022)	0.0018 (0.0012)	0.0004 (0.0016)
Test2	-0.0010 (0.0023)	-0.0032 (0.0028)	0.0005 (0.0017)	0.0020 (0.0022)
Test3	-0.0009 (0.0019)	0.0008 (0.0024)	-0.0008 (0.0015)	0.0009 (0.0020)
Control	0.0004 (0.0010)	-0.0014 (0.0012)	0.0001 (0.0009)	-0.0020 (0.0011)*
Test1 minus Control	-0.0003 (0.0018)	0.0023 (0.0025)	0.0017 (0.0015)	0.0024 (0.0019)
Test2 minus Control	-0.0014 (0.0025)	-0.0018 (0.0031)	0.0004 (0.0019)	0.0040 (0.0024)
Test3 minus Control	-0.0013 (0.0021)	0.0021 (0.0027)	-0.0009 (0.0017)	0.0028 (0.0023)
N (Test1)	158	158	193	193
N (Test2)	146	146	200	200
N (Test3)	142	142	193	193
N (Control)	431	431	597	596
N (Total)	877	877	1,183	1,182