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RESEARCH ARTICLE

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The effects of intraday news flow on dealers' quotations, market liquidity, and volatility

Arzé Karam

Department of Economics and Finance, Durham University Business School, Durham, UK

Correspondence
Arzé Karam, Durham University, Mill Hill Lane, Durham DH1 3LB, UK.
Email: arze.karam@durham.ac.uk

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Abstract

Market regulators emphasize that the reduction in dealers' liquidity to today's markets is one of the drivers of extreme behaviour such as flash crash. Yet the challenge is to understand the effects of intraday news flow on dealers' quoting behaviour, high-frequency returns, price volatility, liquidity, and trading activity. This paper addresses these issues shortly before the analyst recommendation changes on the Nasdaq. The sample period is 2004 at times where dealers were frequently displaying their quotations on the system. Results show that dealers remain active in quoting, in particular, in the events when the report is issued by their affiliated analysts. Their activity is associated with lower inside spreads, more trading, a more two-sided market, and lower order imbalance.

KEYWORDS

Dealers' quotations, market liquidity, price volatility, regulation, trading activity

1 | INTRODUCTION

Market liquidity is increasingly the focus among regulators and investors and recognized as potential systemic risk. The current regulatory changes imposed by the Dodd-Frank and Basel III Accords have been initiated to reduce systemic risk in terms of strengthening the balance sheets and funding models of dealers.[1] Although the regulation has made the system less levered, it has also led to a reduction of market liquidity that has been traditionally supported by dealers[2] across many markets, such as equities and bond markets. Without the dealers smoothing trading, certain markets have seen sharper price movements, leading to more volatility overall.

There are now growing concerns regarding the reduced capacity of dealers to provide liquidity and signs of increasing fragility in the market.[3,4] For instance, the reduced liquidity by dealers was one of the potential factors contributing to May 2010 flash crash in the U.S. equity markets,[5] the October 2014 U.S. treasury flash crash[6] and the most recent October 2016 sterling flash crash. During these events, the market experienced a rapid and large price swings and evaporation of liquidity in a short time period. Market authorities claim that the situation might be different if market makers were providing continuous order flow during these times of market stress.[7] They argue that today's markets became fragile and unstable driven by structural imbalance in the ratio of the liquidity provided and liquidity demanded to the markets, and no longer seems to have built-in liquidity shock absorbers.

Therefore, it is important to understand the role of dealers over time periods that predominantly reflect stressful market conditions. This paper answers the following questions: First, how would dealers behave around events that may create crowded exit, for example, unscheduled events? Unlike scheduled announcements, the market is not prepared for these events. Consequently, traders are unwilling to trade, and liquidity evaporates. Second, how would dealers behave around news events where they may have private information?

I evaluate these issues on the Nasdaq market *ca.* 2004. Back then, Nasdaq dealers were less constrained by

regulations as the Securities Exchange Commission deregulated the minimum capital requirements for dealer banks freeing leverage from regulatory constraints. This enabled dealers to maintain a large market presence; see Duffie (2010). In the particular case of the Nasdaq, they were actively providing liquidity on the system (Karam, 2018). The analysis is conducted around analyst recommendation changes. These news events are valuable as shown by Womack (1996), are exhibited with information asymmetry in the market, and are associated with higher trading activity and higher price volatility, as shown by Irvine, Lipson, and Puckett (2007). I consider two types of events: (a) the recommendation changes of affiliated analysts to market makers and (b) the recommendation changes of nontrading analysts (with no affiliation to market makers). I conduct the study on a sample of quotations that identifies dealers' identity collected from Nastraq data. I assess the impact of intraday news flow on intraday volatility, liquidity, trading activity, order imbalance, and dealers' behaviour shortly prior the release of these analyst reports. The first question I address is whether affiliated dealers display liquidity at the inside of the market prior to the news. It is important to disentangle evidence of information asymmetry among dealers at times when affiliated analysts issue the recommendation. I consider the case for dealers with affiliated analysts who are indeed informed and the difference in information that differentiates them from other dealers (the nonaffiliated). My second research question is whether liquidity improved at times when private information among dealers is more important (the case of affiliation). I use the *difference-in-differences* to measure execution costs, price volatility, trading volume, and quote-sidedness for a sample of Nasdaq stocks over the 2 hr before an event where the information is coming from an affiliated analyst as opposed to times where the information is coming from a nontrading analyst (with no affiliation with any market makers).

The analysis across 155 Nasdaq stocks indicates that affiliated dealers increase the time they spent at the inside bid (ask) of the market in the period leading up to the upgrade (downgrade) issued by their affiliated analysts. This implies that affiliated dealers quote aggressively to attract more order flow prior to the news. No similar patterns observed in the nonaffiliated dealers' behaviour. Trading environments where dealers have affiliation with the analyst issuing the recommendation seems to perform better as opposed to environments where they may not be. Findings suggest narrower inside spreads, more trades when the report is issued by affiliated analysts, but higher price volatility shortly before the release of the report. Using the Sarkar–Schwartz's (2009) quote-sidedness, results suggest further that environments where affiliation exists appear to be significantly more two-sided. The implication is that dealers' activity ease price discovery as buyers and sellers are both in the market, and this fact signals liquidity creation around the news' events. The significance of all these results above does not depend on whether the non-news days or earnings announcements are used as the control sample in the *difference-in-differences analysis*.

To obtain further insights, I sort stocks into two groups based on their excess of inside spreads (relative to the average in the non-news sample), and I find that higher affiliated dealers' activity is associated with more trading, greater volatility, and lower order imbalance for low inside spread stocks prior to the analyst report. No similar pattern exists in the event period of the nontrading analyst. Dealers' informational advantage appears to allow them to trade more actively in the event period of their analyst, in particular for the stocks with lower inside spreads. The increase in their displayed liquidity is associated with more trading, lower order imbalance, and more two-sided markets and thus better market quality prior to their analyst report.

The present empirical results focus on a specific period where Nasdaq dealers were voluntarily exposing their quotations on the platform, to gain reputation for good pricing. The importance of clients' relationship provide them incentive to provide market making services even in less profitable markets. Results here suggest further that dealers with affiliation seem to be particularly bound to keep providing liquidity in stressed markets environments, in particular when they have access to their analyst report. Although other factors are behind the reduction in market liquidity to today's markets, one can conjecture that the reduced market making does seem to aggravate the shocks to the markets during periods of stress.

The remainder of the paper is organized as follows. Section 2 reviews the background of the study, and Section 3 provides a general description of the Nasdaq market at the time of the study. Section 4 describes the data and provides descriptive statistics. Section 5 investigates dealer behaviour around news events. Section 6 examines market quality variables prior to the recommendation changes and outlines the econometric methodology. Section 7 concludes the paper.

2 | RELATED REVIEW

In addition to the views expressed by market regulators on the role of dealers in supplying liquidity during times of stress, the academic theoretical literature expects the intraday news flow to impact dealer behaviour, execution costs, price volatility, and trading activity. There is a vast literature on the impact of scheduled earnings announcements;

few studies, however, examine the intraday news effects on trading activity; see, for instance, Ranaldo (2008). I contribute to this literature by considering the impact of the unscheduled news on dealer behaviour and the corresponding market liquidity, volatility, and trading activity. This section draws on the related literature.

Evidence has confirmed information asymmetries among dealers prior to the news coming from affiliated analyst to the market maker. In a market with information asymmetry with one another, market makers differ: One may have the reputation to be more informed than others, thus maintaining presence in the market; others tend to be anonymous or unknown. In asymmetric information setting, theoretical literature assumes that the ability to hide the information by informed dealers deter price competition among dealers, leading to a deterioration of liquidity, as in Calcagno and Lovo (2006). Because the event is hampered by uncertainty about the value of the asset, this magnifies the winner's curse effects among dealers, which increases informed dealers profits and decreases market liquidity. Alternatively, an access to the information might provide dealers an advantage to provide aggressive quotations and yet benefit by attracting order flow. Dealers would forgo opportunities to manipulate the market on the short run and be rather facilitating trades to protect their client relationships for reputational reasons. For instance, an upgrade for the stock may lead to a sequence of limit buy orders as long as the information is partially revealed in the price and assuming that dealers generally place limit orders. In these circumstances, a two-sided market is likely to occur if the market is sufficiently competitive. Another strand of the literature considers the informed dealers will use a mix of limit and market orders to take positions in the transparent markets, as in Boulatov and George (2013). This reduces market making capacity at times of largely one-directional order flow; as a result a, one-sided market is likely to occur if dealers demand liquidity, instead of supplying it. This might be accompanied by a deterioration of market liquidity.

Each of these patterns discussed above are likely to occur depending on dealer motives for trading. I examine dealer behaviour and estimate the patterns of inside spreads, price volatility, number of trades, and market sidedness and order imbalance in the period leading to the release of the affiliated analyst recommendation. I describe the setting in the next section.

3 | NASDAQ ENVIRONMENT IN 2004

At the time of the study, the SuperMontage platform that was launched in 2002 allowed dealers to submit their quotations directly and execute trades through an electronic system but only for direct participants. This includes not only registered dealers but also the few Electronic Communication Networks (ECNs) who have agreed to participate to the system, for example, BRUT, Attain, and Bloomberg Tradebook, and the order entry firms. Instinet and Island, the largest ECNs in terms of market share on the NASDAQ, have merged their platforms in February 2004 and formed INET. Archipelago also offered liquidity outside the Nasdaq system. The nonparticipating ECNs were not reachable at all through SuperMontage. It was only by early 2005 that Nasdaq has been able to provide SuperMontage users the routing of orders out to Archipelago and INET through Brut, which Nasdaq acquired in September 2004. Even though trading was fragmented on the Nasdaq, SuperMontage provided a centralized view of liquidity and executed almost half of the overall volume in NASDAQ 100 index and were the major contributors to liquidity in the less active stocks. Table 1 displays results on trading activity and distribution of volume among these three market centres, SuperMontage, Arca, and Inet. Panel A contains shares of trades divided into trade size categories, Panel B contains similarly divided shares of trading volume. The data reveal that SuperMontage executes about the majority of trades in the sample. The two ECNs, Inet and Archipelago, complete, respectively, about 17% and just under 25% of trades.

Dealers and participating ECNs displayed their quotations at multiple levels via SuperMontage. Only dealers were required to maintain two-sided quotations, which have to be reasonably related to the National Best Bid and Offer (NBBO) without any particular band . Market participants observe the identities associated with these quotations on the platform. For instance, if Goldman Sachs or Knight quote at the bid and ask under their identities, their quotations will be displayed via the TotalView System and the Level II and will be associated to their Market Participants Identifiers (MPIDs), that is, MSCO and NITE, respectively. From the knowledge of the identity of the dealer for this quote, market participants can infer the probable source of the quote. The quotations of dealers who decide to quote anonymously through SuperMontage will be associated with the NSDQ feature, named SIZE at the time of the study. This quoting facility was introduced in 2003 in attempt to compete with ECNs, which provided the anonymous feature for a long time. Dealers can alternatively display anonymous limit orders through ECNs. Order entry firms route also orders to SuperMontage for execution against displayed orders and quotations and for display only under their NSDQ feature. However, their participation to the platform was minimal about 1.5 % at that time so dealers were the main users of the NSDQ feature. Market makers were also executing orders through preferencing and other fixed

TABLE 1 Trade market shares across venues in 2004

	SuperMontage	Arca	Inet	*p* value
Panel A: Share of sample trades by trade size (%)				
All trades	41.88	25.54	32.57	0.000
100–499	39.73	25.66	34.19	0.000
500–4,999	42.6	25.53	31.32	0.000
5,000–9,999	62.25	16.1	20.14	0.000
10,000 or more	79.03	8.65	11.08	0.000
p value	0.000	0.000	0.000	
Panel B: Share of trading volume by trade size (%)				
All trades	60.08	17.75	22.22	0.000
100–499	43.26	24.31	32.51	0.000
500–4,999	66.84	15.64	17.56	0.000
5,000–9,999	87.07	6.56	7.89	0.000
10,000 or more	97.43	2.36	3.02	0.000
p value	0.000	0.000	0.000	

Note. Reported are percentage shares of trades and trading volume on SuperMontage, Archipelago (Arca), and Inet for the sample of stocks. Results contain trades that are reported between 9:30 a.m. and 4 p.m., in the second semester 2004. Panel A contains market shares of trades aggregated into trade size categories; Panel B presents shares of trading volume aggregated by trade sizes. *p* values are for the null hypotheses that market shares across trading venues, and trade sizes are identical. The *p* values are calculated across stock-market and stock-market-trade size observations.

arrangements. It is worth noting that dealers at the time of the study did not have to quote at the NBBO in order to internalize and many internalized trades did not hit dealers' quotations on the Nasdaq. SuperMontage users have the option to submit reserve orders. These orders along with displayed ones are accessible through NASDAQ trading platform but are not displayed. The NASDAQ system is programmed in accordance with a price/time priority algorithm where displayed orders/quotations of market participants are executed prior their reserve orders. Finally, during the market opening, dealers were able but not obliged to display their quotations posted during trading hours to have minimum required quantity, that is, 100 shares, whereas the pre-opening do not. The NASDAQ opening was a complete decentralized process until the implementation of an electronic call auction, referred as Opening Cross in April 2004 and completed in December of that year.

4 | DATA AND DESCRIPTIVE STATISTICS

The study uses 155 Nasdaq stocks in 2004. The period of 2004 is selected because at that time, dealers were displaying frequently but selectively their quotations under their market participant identifiers for reputational reasons on the Nasdaq platform; see Karam (2018). Thus, the feature of the market is of sufficient size to warrant interest on their role in supplying liquidity to the market during market stress.

I collect recommendation changes from the Institutional Brokerage Estimates System (I/B/E/S) files, and earning announcements are used to check the robustness of the results. The sample for the study is constructed by first selecting 155 Nasdaq stocks for which both the date and the timing of the recommendations are available. Each observation in the database I/B/E/S represents a recommendation by a brokerage firm or individual analyst. I classify these recommendations changes into upgrades, downgrades, or reiterations (no changes). I do not take into consideration the level of changes in the classification of recommendation. Most recommendations in the sample occur in the morning hours. Data for companies are collected from the Center of Research in Security Prices (CRSP) and the Nastraq database. The latter reports the best inside quotations in its inside file that I use to measure execution costs and price volatility. Volume is extracted from Nastraq trade files. To purge the data of potential errors, I delete trades and quotations, for which (a) The trade price is zero or missing. (b) The quote is missing or negative. (c) The quoted bid-ask spread is negative. (d) The quoted bid or ask size is negative. (e) The trade and quote price is outside the regular hours. Table 2 shows descriptive statistics for the 155 sample stocks. On average, there are 57 market makers with 15 financial analysts. Price is on average $ 22.28 per share. The total market capitalization, based on closing price and total shares outstanding during November 2004, is on average $5.93 billion. Dealers' identities in Nastraq quote files are used in the matching with the I/B/E/S analyst code. This allows me to recognize the brokerage firms that can provide research coverage and market making for every Nasdaq stock in the

TABLE 2 Descriptive statistics of stocks sample

Variable	Mean	*SD*	Quintile		
			25%	50% (median)	75%
Market Capitalization (in $ billions)	5.93	17.28	0.7	1.81	4.06
Price per share (in $)	22.28	18.95	7.4	18.77	31.73
Volatility (in %)	2.86	1.16	2	2.65	3.54
Daily share volume (in shares)	3,586,530	9,070,623	465,405	1,058,659	2,794,922
Number of market makers	57.35	18.26	43	55	70
Number of financial analyst	15.25	7.37	2	16	35

Note. The table presents descriptive statistics for the 155 stocks in the sample. Market capitalization is computed as the mean daily market capitalization during the second semester of 2004 using CRSP data. Price per share is the mean of closing price during the second semester of 2004. Volatility is the standard deviation of CRSP daily returns during the second semester 2004. Daily share volume is computed using the CRSP data. Daily dollar volume is the volume computed from NASTRAD trade file during the sample period.

sample. I identify the dealers with analyst affiliation and divide the sample into recommendations coming from affiliated analysts to dealers, to the ones coming from a nontrading analyst.

Once I break the sample of market makers using Huang (2002) classification, affiliated dealers in the sample are mostly institutional brokers or wirehouses. Institutional brokers include Bear Stearns, Deutsche Bank, Credit Suisse First Boston, Goldman Sachs, J.P. Morgan, Lehman Brothers, Banc of America, and UBS. The wirehouses include Merrill Lynch and Prudential. Wholesalers such as Knight and all other dealers who do not have research departments are considered in the "nonaffiliated dealers" category. Back in 2004, dealers were less constrained by regulations, thus were taking risks to provide liquidity across a large sample of stocks. Unreported results describe the average market makers in each category, including banks that failed in the crisis, such as Merrill Lynch, Lehman Brothers, and Bear Stearns. Affiliated dealers on average are large in size with a leverage of 25 almost. Once I break the sample into institutional versus wirehouses and wholesalers, results show uniformity across dealers with no significant variation. On average, dealers were large on size with high leverage ratio. Given Schultz (2003) argument that analyst coverage provides an informational advantage to the market maker from the same bank, I can think of the set of affiliated dealers for a given stock of being more informed about the forthcoming report of their analyst and some who are relatively more uninformed about the same report.

5 | UNIVARIATE ANALYSIS AROUND UNPREDICTABLE NEWS

Unlike earnings announcements, analysts' recommendation changes are not scheduled, thus not predictable. Thus, insiders may have private information regarding the time, the content, and the sign of the news. I test the important hypotheses concerning dealer behaviour at times of market stress and the effects this may have on liquidity and efficiency.

5.1 | Dealer behaviour at times of affiliated analyst report

I first test whether the information produced by an affiliated analyst influences the affiliated market maker to quote aggressively, as opposed to the market makers who are not affiliated. If information is what is behind the more active role of the affiliated dealers, differences should emerge on how different market makers react to announcements.

At the level of each bank, I examine the relative timing of the decisions to provide the recommendation and/market making. The two measures of dealers' behaviour used prior and after to the 2 hr of the public release of the affiliated analysts are (a) the relative frequency affiliated dealers quote per interval and the average relative frequency that nonaffiliated dealers quote at the same interval and (b) the proportion of time the affiliated dealer is at the inside and the average proportion of time the nonaffiliated dealers are at the inside. I focus on the difference between the event interval of the variable, *Event Name*, and the *Control Mean*. Differences are computed as raw deviations or as percentage of deviations. I compute the equally weighted average of raw deviations across all recommendations in the upgrade and downgrade samples for ask and bid prices separately.

5.1.1 | Market making around upgrades

Table 3 shows that for upgrades, affiliated market maker's relative frequency at the inside ask decreases significantly.

The other market makers decrease the time they quote at the inside ask around the announcement, but this decrease is not significant during event and control periods. Table 3 shows also that the affiliated dealers quote more aggressively on the bid side before the upgrades. The increase in the relative frequency at the inside bid (3%) and the time at the inside bid are significant (4.37%) in the 2-hr period leading to the announcement. The results for other market makers have less pronounced pattern, an insignificant increase at the inside bid followed by a decrease prior one and half-hour of the announcement and a significant increase at the inside ask. The results suggest that affiliated dealers tend to quote aggressively on the bid side in the period leading to the upgrade. It could be possible that affiliated dealers not only use this strategy but also complementing by quoting anonymously. The results for the anonymous activity show further a slightly increase at the inside bid one hour and a half prior to the announcement and a significant increase at the inside. Recall that even if affiliated dealers choose to quote anonymously, other market makers may use this option too, which may obscure the ask and bid quotations. Results suggest that the relative frequency at both sides of the market in the half-an-hour before the announcement appears to be significantly high anonymously. A plausible explanation is that nonaffiliated dealers may quote more frequently anonymously to explore the market if they notice something.

5.1.2 | Market making around downgrades

Downgrades provide a useful motivation to examine market making during times of market stress. I examine whether dealers decide to limit their exposures rather than absorb inventory from clients looking to sell. Thus, I examine whether the role of dealers as drivers of market making accentuated in anticipation of a sell-off. At these times, market liquidity may deteriorate albeit to a lesser extent than seen during the financial crisis. Before a downgrade, the results of Table 3 show that the proportion of time affiliated dealers quote at the inside ask increases significantly during two intervals out of four prior to the downgrade. On the other hand, results show further that there is a sudden increase on the bid side by affiliated market makers. The reaction of quoting anonymously to a downgrade is more dramatic at the inside ask. The proportion of time market makers quote at the inside ask increases significantly during the 2-hr periods leading to the announcement as much as 9%, compared with the average proportion of time at the inside ask during the control period. The nonaffiliated dealers exhibit a decrease in time at the inside ask and the inside bid prior to the downgrade. The results for downgrades are also consistent with anticipatory quoting behaviour by affiliated dealers prior to the announcement.

5.2 | Dealer behaviour and market performance

The results of previous section confirm that affiliated dealers behaviour is consistent with anticipatory quoting behaviour prior to the announcement of their affiliated analysts. Although they seem to support market liquidity, an important question is whether they were capable to facilitate matching of supply and demand at times of largely one-directional order flow, as inventory risks become more difficult. Back in 2004, dealers were willing to take on inventory risks and were likely to support market liquidity at these times. The importance of client's relationship could explain why they continued to provide liquidity during market stress. Observations from the markets tend to suggest that dealers who need to protect a client's relationship were almost bound to keep providing liquidity in stressed environments as discussed in Beau (2014).

5.2.1 | Market performance in the presence of affiliation

In this section, I argue that the association that execution costs, trading activity, and volatility has with dealers' quoting behaviour provides further insights into the underlying motives of trading where there is affiliation as opposed to periods where there is no affiliation among dealers. I explore again the hypothesis regarding differences in dynamics in dealers' behaviour and the corresponding market performance measures across these news events. I further test the relationships between the measures of order imbalance and dealer behaviour across all events. I compute the order imbalance as the absolute value of buy and sell orders divided by the number of trades in each interval.

The affiliated market maker might use his quotations to signal the direction in which the price should move to reflect the cost of providing liquidity and thus absorb the order imbalance at these times. Thus, the information produced by a bank analyst might be useful of reducing the adverse selection problem for that bank's market maker. To examine this idea further, I sort stocks by the excess inside bid-ask spread, as the difference between the spread at the event time and the spread at the control sample and consider the relationship with volatility, trading activity, dealers' quoting behaviour, order imbalance, and sidedness. Because the interest is in the event in which bid-ask spread has decreased, that is, lower adverse selection, I identify events with an unusually high number of stocks in the low-spread groups. After sorting stocks into two groups, low spread (L) and high spread (H), I estimate the means differences in volatility, number of trades, dealers quoting activity, order imbalance, and sidedness. These

TABLE 3 Dealers' quoting behaviour around the affiliated analyst recommendations

Half-hour	Relative frequency and Proportion of time at the inside Ask						Relative frequency and Proportion of time at the inside Bid					
	Affiliated		Nonaffiliated		Anonymous		Affiliated		Nonaffiliated		Anonymous	
	R-Freq	Ask	R-Freq	Ask	R-Freq	Ask	R-Freq	Bid	R-Freq	Bid	R-Freq	Bid
Upgrade												
−4	−2.35**	0.75*	2.15	0.98	0.92	5.11	2.76**	4.36**	5.25	4.09	−2.86	0.84
−3	−3.23**	−0.73	0.01	−4.66	0.78	7.29	4.13**	1.69**	0.96	−1.07	1.62**	6.50**
−2	−1.98**	−0.54	−3.02	−1.51	0.24	−2.27	0.02**	1.24	−1.62	−0.19	−1.23	−5.73
−1	−2.61**	0.02	−8.57	−5.56	5.03**	−0.53	1.38**	5.39	−6.41	−3.77	2.94**	−1.65
Event	−0.84	0.89	−14.98	−12.05	0.76	6.04	−2.21	−0.75	−11.26	−8.98	−0.68	5.02
+1	−3.10	−0.50	−6.85	−5.92	2.01	7.98	1.39	0.82	−11.93	2.00	3.91	8.23
+2	−1.80	1.79	−6.12	−5.39	5.03	7.38	−1.89	−0.32	−8.17	−7.79	4.92	11.19
+3	−3.07	−0.62	−1.68	0.12	2.10	3.36	−1.91	0.59	−5.77	−2.81	6.34	5.62
+4	−1.54	1.13	−0.45	0.42	2.95	8.02	−2.04	−0.62	−1.57	−1.71	2.36	6.06
Downgrade												
−4	−0.13**	−0.05	−1.39	−1.30	7.94**	9.19**	−0.06	0.26	3.58	0.09	0.54	4.14
−3	4.02**	0.95**	−3.39	−2.13	3.42**	1.95**	−3.66	−1.61	−1.41	−0.84	−3.13	−0.59
−2	−2.54	−0.44	−2.57	−0.43	3.57**	−0.70	5.43**	7.75	1.37	1.96	−0.12	−3.51
−1	6.92**	3.52**	−8.48	−5.16	4.74**	6.10**	−3.29	−1.36	−3.06	0.15	2.32	1.35
Event	−1.86	0.70	−13.9	−11.37	1.33**	6.77	0.59	0.61	−13.62	−11.16	2.65	4.50
+1	−1.75	0.14	−13.43	−11.81	3.71	3.98	−2.30	−0.48	−12.19	−10.18	4.45	3.23
+2	−1.24	0.13	−10.48	−9.95	7.22	7.94	−1.47	0.05	−8.84	−8.56	1.30	4.71
+3	−1.81	0.94	−10.60	−7.30	5.14	3.74	−1.52	0.52	−7.96	−5.96	1.63	1.56
+4	−1.71	3.11	−4.81	−3.34	1.16	1.68	−2.33	−0.78	−2.11	−1.16	1.36	0.09

Note. This table presents descriptive statistics on the relative frequency of quoting (R-Freq), and the proportion of time each category of dealers, that is, affiliated, nonaffiliated, and anonymous, is at the inside ask and bid in the 2 hr before and after the affiliated analyst recommendation for upgrades and downgrades. The cross-sectional means of the raw deviations of the variables during the event period from the time of the day mean during the control period are reported. *Statistical significance at the 10% level. **Statistical significance at the 5% level.

statistics are reported in Table 4 and indicated by $L - H$ (less minus high spread stocks). The results are presented for upgrade and downgrade samples separately. A positive number indicates a higher value for low-spread stocks. In the column named *Non-news*, I show results for the control sample with non-news.

For these events prior to upgrades, stocks in the low-spread group have greater trading volume, higher volatility, and significantly higher affiliated dealers quoting activity on the bid side of the market in the period leading to the affiliated analyst reports, compared with non-news events. Prior to a downgrade, stocks with low-spread group exhibit significant greater trading and higher activity by affiliated dealers at the inside ask. However, there is no particular pattern observed in the nonaffiliated dealers' activity. This is consistent with the possibility that in advance of a private information event, affiliated dealers are more willing to trade in the market, implying more trading and lower order imbalance. An increased participation at the inside ask (bid) by affiliated dealers prior to upgrades (downgrades) appears to be associated with more trading for low-spread stocks. The nonaffiliated dealers quoting patterns are not similar. This suggests that they may be more reluctant to place competitive quotations in the periods of high event uncertainty.

5.2.2 | Affiliated versus nontrading analyst report

To further disentangle the effects of inventory from those of information, I further examine the behaviour of dealers surrounding the announcement coming from nontrading analyst and report the results in the last two columns of Table 4. By comparing the behaviour of both groups of market makers to their behaviour in a control period, strong statements can be made about the role that information plays in separating dealers into two groups, prior to the announcement of the affiliated analyst. Prior to upgrades and downgrades of nontrading analysts, the pre-announcement periods are associated with more frequent trading and lower activity of dealers on both sides of the market, compared with non-news events. However, by comparing the behaviour of both categories of dealers to their behaviour in a control period, results suggest that there were no differences in dealer behaviour. Taken together, the results here suggest that the information produced by the affiliated analyst actually influences the affiliated market maker to trade aggressively by moving the bid and ask quotes, prior to the announcement.

I continue the analysis by examining how the markets perform prior to the announcement of analyst reports,

TABLE 4 Sorting stocks based on spreads prior to news' events

		Affiliated analyst		Nontrading analyst	
	Non-News events	Upgrade	Downgrade	Upgrade	Downgrade
Variable	$L - H$	$L - H$	$L - H$	$L - H$	$L - H$
Ntrades	−49.78**	105**	70*	40.28**	64**
Order Imbalance	−121**	−42**	−13*	−380**	−94**
Volatility	−0.007	0.006**	0.004**	−0.001**	−0.023**
Bid affiliated	0.031	3.280**	0.005	−0.031	0.118
Ask affiliated	0.013	−0.087	4**	–	−0.001
Bid nonaffiliated	0.601**	−0.250**	−0.126**	−0.221**	−0.231**
Ask nonaffiliated	0.96**	−0.261**	0.007	−0.419**	−0.118
Bid anonymous	−5.460**	−0.250**	0.018	0.013	−0.047
Ask anonymous	−4.820**	−2.610**	−1.510*	0.070**	−0.178**
Sidedness	−0.006	0.117	0.090	−0.064	−0.109

Note. This tableshows the difference in the means of number of trades, volatility, and dealers' activity at the inside for each category of dealers, that is, affiliated, nonaffiliated, and anonymous, and quote-sidedness for low and wide spread stocks in the sample of non-news days and of upgrades and downgrades 2 hr prior to the release of affiliated and nontrading analyst reports. *Statistical significance at the 10% level. **Statistical significance at the 5% level.

to draw clearer inferences on the effects of affiliation on execution costs, price volatility, and trading activity.

6 | *DIFFERENCE-IN-DIFFERENCES* ANALYSIS

In the previous section, the results on dealer behaviour and the corresponding market liquidity, volatility, and trading activity provide insights on market performance at times of unpredictable news. Evidence of information asymmetry among market makers suggested at times where affiliated analysts issue the recommendation. I consider the case for dealers with affiliated analysts who might be indeed informed and the difference in information which differentiates them from other market makers. I shed empirical light on how the markets perform when there is affiliation, as opposed to where this affiliation does not exist. The arguments suggest that at times, when some market makers have privileged access to information, execution costs might be narrower relative to those in other event periods, as affiliated dealers quote aggressively. This is consistent with the notion that the analyst's affiliation implies greater sharing of information and thus less information asymmetry in the market. In the absence of this information advantage, execution costs may be higher because of the greater probability of market makers facing informed traders with advance knowledge of the forthcoming report. In general, during unpredictable news events, one usually observes higher trading activity, higher trading volume, and increased volatility exposing market makers to a greater risk of holding undiversified portfolio. In response, market makers widen the bid-ask spreads, resulting in less liquidity available to meet clients' demand. As dealers became more certain about the value of the asset, they will be more likely to provide liquidity, and this leads to narrower spreads, as in Copeland and Galai (1983). Thus, they will be more likely to meet the unexpected demands.

In what follows, I empirically compare market performance for each stock in the cases the change in recommendation is coming from an affiliated analyst to an event where the information is coming from a nontrading analyst. I use the *difference-in-differences* analysis to make this comparison. These strategies are panel data methods applied to sets of variables means in the case that some are in the affiliation sample and others are not (as a control sample). Thus, the affiliation is the cause variable of interest. The object of this methodology is to find some sort of comparison that provides a compelling answer questions about the consequences of affiliation on market performance variables. I use the same sample stocks to make the comparison. The use of the same stocks is very important for identification to estimate what would have happened in the variable when affiliation changes. I describe the methodology for the market inside spread first and then discuss the results for all the variables measuring the quality of the market used in the study. Appendix A details the computation of market microstructure variables I am using here.

$$\begin{aligned} Spread_{i,t} = {} & \beta_1 Changes_t + \beta_2 Affiliation_{i,t} \\ & + \beta_3 Affiliation_{i,t} * Changes_t \\ & + \alpha_i + \delta_t + \epsilon_{i,t}, \end{aligned} \tag{1}$$

where *Spread* is the inside spread of stock *i* computed from the NBBO file (inside file) during the half-hour period that starts at time *t*; refer to the latter period as "interval *t*."

δ_t is a time-specific fixed effect and α_i is a stock-specific fixed effect. I consider the inside spreads of a given stock in the affiliation sample (*Affiliation* = 1) before the news coming from the affiliated analyst and nonaffiliation sample (*Affiliation* = 0) before the news coming from a nontrading analyst, 2 hr prior to the announcement (*Changes* = 1) and 20 days before the event period non-news events (*Changes* = 0). The effect of affiliation β_3 is then obtained by

$$DID = \beta_3 = \left\{ \begin{array}{l} (\mathbb{E}[Spread/Changes = 1, Affiliation = 1] \\ - \\ \mathbb{E}[Spread/Changes = 0, Affiliation = 1]) \\ - \\ (\mathbb{E}[Spread/Changes = 1, Affiliation = 0] \\ - \\ \mathbb{E}[Spread/Changes = 0, Affiliation = 0]) \end{array} \right\}. \quad (2)$$

I include controlling variables in the regression that affect the inside spreads such as the share price volatility, the trade size, and the share price itself, because it is well known that the inside spread is related positively to the price volatility and negatively to the trade size and share price. I also include the number of analyst following the stocks and the number of market makers in order to control for the degree of competition across stocks. Note that the control variables are not orthogonalized. For example, the number of market makers and the number of analysts are correlated. Because they will not affect the *difference-in-differences* coefficient, I prefer to focus on the *Affiliation*Changes* dummy. The model is then presented in Equation 3:

$$\begin{aligned} Spread_{i,t} = {} & \beta_1 Changes_t + \beta_2 Affiliation_{i,t} \\ & + \beta_3 Affiliation_{i,t} * Changes_t \\ & + \beta_4 tradesize_{i,t} + \beta_5 price_{i,t} \\ & + \beta_6 vol_{i,t} + \beta_7 mmcnt + \beta_8 No.analyst \\ & + \sum_{j=1}^{4} \beta_J D_J + \sum_{h=1}^{12} \beta_h H_h + \epsilon_{i,t}. \end{aligned} \quad (3)$$

where *Tradesize* is the log of the trade size of stock i in "interval t." *Price* is the log of the midpoint of the bid-ask quotations of stock i in "interval t"; *vol* is the share price volatility in interval t and provides a measure of the risk faced by market makers when trading stock i; *mmcnt* is the number of daily market makers following the stock. *No.analyst* is the number of analysts following a stock during the whole period of the study. Because the error terms will vary across the stocks, the model is estimated as a fixed panel model, in which case the firm-specific residual may be a dummy variable. Moreover, in order to capture any deterministic component in the intraday dynamics of the spread, I control for the time of the day effect; the first "interval t" starts at 9:30 a.m. and the last ends at 4:00 p.m., which produces 13 intervals per day. I use the last quote prior to the opening of the trading day as the first quote of the day, in order to compute the time-weighted spread of the first quote. Equation 3 includes dummies for each day of the week, *Dj*, in the sample.

6.1 | Bid/ask spreads

I measure the excess announcement trading costs by the inside quoted and effective spreads when there is affiliation. It bears repeating that these spreads are the market spreads computed from the inside file. These are the best bid and ask prices to buy and sell a stock among the competing market makers and other market participants (the NBBO). Having controlled for factors that affect the spreads (size of the trade, price, share price volatility, number of market makers, number of analysts, time of day, and day of the week variations), I estimate the parameters from Equation 2.

Table 5 shows a statistically significant change in the mean inside spread, represented by the *Affiliation*Changes* dummy coefficient. The excess of inside spread prior to the announcement is lower than normal (−4.580) when there is affiliation, suggesting that the environment of affiliation offers lower transaction costs in the period leading to the announcement. I replicate the analysis by measuring the spread 1 hr before the announcement instead of 2 hr. The results are quite similar.

The *Changes* variable used in the regression separated dates on which there was a recommendation change from those on which there was no announcement. As a robustness check, the same study is replicated, where the variable *Changes* takes the value of 0 on earnings days and the value of 1 on days of recommendation changes, as before. With this new *Changes* variable, the same regression Equation 2 is estimated. If the *Affiliation*Changes* turns out to be significant once again, then it provides further support that its significance does not depend on two different types of events (news and non-news days) being used in the regression. Most of the earning announcements in the sample are made in the afternoon. Unreported results are quite similar to the previous ones. Transactions costs are lower when affiliation exists as coefficients are significant. Taken together with the earlier ones, the results suggest that at times where there is information sharing between market makers and their financial analysts, market liquidity increases, that is, lower transaction costs.

TABLE 5 Inside spreads prior to news' events

Variable	Qspread	Espread
Constant	16.003	16.351
	(8.682)	(13.765)
Changes	4.730**	3.111*
	(1.181)	(1.873)
Affiliation	−5.198***	−3.456
	(1.670)	(2.648)
*Affiliation*Changes*	−4.580***	−4.457*
	(1.181)	(2.469)
Price	−0.297***	−1.100***
	(0.109)	(0.174)
Volatility	−0.006***	0.440***
	(0.002)	(0.003)
R^2	0.14	0.40
No. of observations	11,647,855	11,647,855

Note. Time-weighted spreads, effective and quoted, in an interval of 30 min, is regressed on constant and dummy variables in both periods: The first dummy variable, *Changes,* is set to 1 on the 2 hr before the announcement and 0 on hours of non-announcement days. The second dummy variable, *Affiliation*, equals 1 in the cases the observation belongs to the affiliation sample and 0 otherwise 0 in both cases. The third dummy variable is used by multiplication (the interaction term) of the variables *Changes*and *Affiliation*. Control factors added to the regression are price volatility, size of the trade, and the price per share. Thereare recommendation changes for 155 stocks in the sample: 56% of recommendations are coming from nontrading analysts and 43% are done by affiliated analysts to market makers. Other control variables included in the regression also are the time of the day and day of the week effects; coefficients are not reported for brevity. The number in parentheses is the average standard error. The standard errors are corrected for contemporaneous correlation and heteroskedasticity. *Statistical significance at the 10% level. **Statistical significance at the 5% level. ***Statistical significance at the 1% level.

6.2 | Price volatility, number of trades, and market sidedness

Historical returns are now going to be utilized in order to measure the implications on stock return volatility. As in Andersen and Bollerslev (1998), the sum of squared returns (1 min) over 30 min is computed, each return taken over a 1-min time interval, both during the 2 hr, and during the control sample preceding the news release. Returns during the 2 hr preceding the news are very important for the purpose of the study, because critical information concerning the trade process and the impact of dealers' behaviour needs to be taken into account. The midpoint quotations are used to obtain returns of each stock i over the 1-min interval mentioned above. One-minute returns, squared, are summed over 30 min, and the sum is used for obtaining an estimate of volatility. A concern with volatility is that large returns tend to cluster together followed by periods of relatively small returns (GRACH effects). This suggests that volatility is a temporally dependent (heteroskedastic) variable. Therefore, the volatility calculated as previously is likely to exhibit serial correlation. Because returns used in this study are computed using the midquote prices, any existing correlation would not come as a result of bid-ask bounce. In order to take into account the correlation, a separate equation for volatility is used in the regression, which includes autoregressive terms (GARCH equation). I use the trading volume and the spread as control variables. The literature suggests that there is a positive linkage between transaction costs and price volatility. The theoretical support is that the informational arrival has the effect of widening the bid-ask spreads and this induces an increase in volatility. This effect impacts prices, which become more volatile, because price changes are in response to information flow. In Table 6, results show that the pre-announcement price volatility is significantly higher 2 hr before the news release compared with an hour of a non-announcement day. The coefficient of the interaction term is generally less significant but positive. For sensitivity analysis, I examine another measure of intraday volatility, that is, the average volatility. The results are qualitatively the same.

TABLE 6 Price volatility, number of trades, and quote-sidedness prior to news' events

Variable	Volatility	Ntrades	Sidedness
Constant	0.102	0.531***	−0.089
	(0.102)	(0.099)	(0.058)
Changes	−0.044	−0.501***	−0.041*
	(0.029)	(0.028)	(0.022)
Affiliation	0.141***	0.142***	0.014
	(0.041)	(0.04)	(0.022)
*Affiliation*Changes*	0.079**	0.038**	0.065**
	(0.038)	(0.017)	(0.026)
Spread	0.116***		
	(0.009)		
Trade size	0.004		
	(0.009)		
R^2	0.10	0.15	0.08
No. of observations	11,647,855	11,647,855	11,647,855

Note. This table presents results on price volatility, volume, and quote-sidedness 2 hr prior to the release of the recommendation changes with *Affiliation* = 1 is compared with the one corresponding to observations with *Affiliation* = 0. Thereare recommendation changes for 155 stocks in the sample: 56% of recommendations are coming from nontrading analysts, and 43% are done by affiliated analysts to market makers. Other control variables included in the regression also are the time of the day and the fixed effects; coefficients are not reported for brevity. The standard errors in parentheses are corrected for contemporaneous correlation and heteroskedasticity. *Statistical significance at the 10% level. **Statistical significance at the 5% level. ***Statistical significance at the 1% level.

Further results in Table 6 suggest that the affiliation is associated with a significantly higher number of trades. The pre-announcement increase in the number of trades might partially explain the reduction in the spread in the affiliation sample documented earlier. The price volatility increase simply reflects information flows given the predisclosure period has been a period of large revelation. Another plausible reason is that it might result from order arrivals coming on both sides of the market. To investigate this idea further, I use the market sidedness measure introduced by Sarkar and Schwartz (2009). It consists on computing the correlation between the number of seller-initiated trades and buyer-initiated trades in each interval. If the correlation is higher, this implies that the market is two-sided as a result of order arrivals at both sides of the market for the affiliation sample. Otherwise, the market is one-sided if the correlation is negative, suggesting that the arrival is more buy-triggered (sell) trades in the interval and accompanied by the arrival of fewer sell-triggered (buy) trades in the same interval. Results on the sidedness in Table 6 suggest that the market is more two-sided when affiliation exists: The correlation between the number of seller-initiated trades and the number of buyer-initiated trades is higher for the affiliation sample, which signals the creation of liquidity at times when the report is issued with the trading analyst.

7 | CONCLUSIONS

This study examines the extent to which dealers display liquidity on electronic platforms and the corresponding price volatility and execution costs, prior to the release of recommendation changes. I use the affiliation between market makers and their financial analysts as an information-based proxy to detect informed market making empirically. I observe a two-sided market, lower spreads with relatively more trades, and higher volatility when the report is issued from the affiliated analyst as opposed to times where the report is issued from a nontrading analyst. The evidence suggests also that trading appears to be associated with higher affiliated dealers' activity at the inside in the affiliation sample. This result implies that greater activity is associated with higher displayed activity by dealers.

The findings have implications for liquidity creation, for the ability of dealers to supply liquidity through electronic platforms, and for current policy debate in understanding dealers' behaviour when trading is likely to involve informed dealers. The reduction in the inside spread and, thus, the improvement of liquidity when affiliated dealers quote frequently are attributed to informational efficiencies, which come as a result of decreased adverse selection costs. Such improvement in efficiency can indeed generate an annual dollar saving in transaction for investors and thus provide a high market quality. To illustrate, an improvement due the information sharing on 79 million dollars—the average trading volume of sample stocks—adds up to 55 thousands on average per hour in reduced expected costs.

Finally, the platforms recently used for standardized Over-the-Counter (OTC) products are highly dependent on dealers that provide liquidity also outside of these platforms (through internalization), that is, the swap execution facilities. Their use has been growing, although from relatively low levels even in benign periods as noted by the pro-reforms addressed by the Commissioner Giancarlo in January 2015. Market liquidity issues may not be solved by electronic trading only, in particular on those platforms operating on anonymized basis. Looking at the Nasdaq setting in 2004, it seems that more regulatory changes may be required to enhance the participation of dealers on these platforms. For instance, dealers willingness to provide liquidity under their identities on these platforms might be necessary for them to build reputation in the market and maintain presence at times of stress, in line with the conduct of intermediaries on the Nasdaq.

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ENDNOTES

[1] The initiatives are aimed to reduce the probability of banks becoming source of illiquidity contagion and protect from market abuse. In the United States, the trading requirement is implemented as part of the Dodd-Frank Act, with the Commodity Futures Trading Commission and the Securities and Exchange Commission. In Europe, it is implemented by the European Commission.

[2] Market makers and dealers are used interchangeably.

[3] Mark Carney, speech by the Governor of the Bank of England, 2014 Monetary Authority of Singapore Lecture.

[4] Jerome H. Powell, the Governor of the Board of Governors of the Federal Reserve System, "Making markets Fair and Effective for all," January 20, 2015.

[5] The Commodity Futures Trading Commission describes the flash crash as follows: Between 1:41 and 1:44 p.m. CT, the E-mini S&P market price suffered a sharp decline of 3%. Then, at 1:45 p.m. CT, in a matter of 15 s, the E-mini S&P market price declined another 1.7%. The price crash in the E-mini S&P market quickly spread to major U.S. equities indices, which suffered precipitous declines in value of approximately 5% to 6%, with some individual equities suffering much larger declines.

[6] After the U.S. Treasury market opened on October 15, the yield on the 10-year Treasury, which moves in the opposite direction of its price, plunged far below the 2.2% that it had closed at the day before. By 9:36 a.m., it hit 1.9%. Then it snapped right back and, within 15 min, was again trading above 2%.

[7] Mary L. Shapiro, speech by the Securities Exchange Commission Chairman, "Strengthening our equity market structure," Economic Club of New York, September 7, 2010.

ORCID

Arzé Karam http://orcid.org/0000-0002-2012-513X

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APPENDIX A: DESCRIPTION OF VARIABLES

TABLE A1

Variable name	Definition
Bid affiliated	Proportion of time affiliated dealers spend at the inside bid of the market.
Bid nonaffiliated	Proportion of time nonaffiliated dealers spend at the inside bid of the market.
Bid anonymous	Proportion of time an anonymous quote under NSDQ is at the inside bid of the market.
Ask affiliated	Proportion of time an affiliated market spend at the inside ask of the market.
Ask nonaffiliated	Proportion of time nonaffiliated dealers spend at the ask inside of the market.
Ask anonymous	Proportion of time anonymous dealers spend at the ask inside of the market.
BUY	The number of buyer-initiated trades, determined by the Lee, Mucklow, and Ready (1993) algorithm in the interval *t*.
SELL	The number of seller-initiated trades, determined by the Lee et al. (1993) algorithm in the interval *t*.
ZBUY	[BUY-Mean(BUY)]/*SD*(BUY)], where Mean is the sample mean and *SD* is the sample standard deviation of BUY in the interval *t*.
ZSELL	[SELL-Mean(SELL)]/*SD*(SELL)], where Mean is the sample mean and *SD* is the sample standard deviation of BUY in the interval *t*.
Sidedness	The correlation between ZBUY and ZSELL in the interval *t*.
Ntrades	The total number of trades.
Qspread	The average proportional quoted half-spread in an interval *t*, defined as Q*(ask-bid)/M, where M is the quote midpoint, Q is +1(− 1) for a buyer-(seller-) initiated trade
Espread	The average proportional effective half-spread in an interval, defined as Q*(P-M)/M, where M is the quote midpoint, P is the price, Q is +1(− 1) for a buyer-(seller-) initiated trade.
Volatility	Standard deviation of returns in interval *t*, expressed as percentage.
Order Imbalance	The absolute order imbalance of (BUY-SELL)/Number of trades in interval *t*.