NYSE Specialists' Participation in the Posted Quotes

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Abstract:

Using 2001 NYSE system order data in the decimal pricing environment, we analyze how the specialists react to the changes in market variables while making participation decisions to the posted quotes. We analyze the specialists' decision to undercut or add depth to the limit order book. We distinguish bid and ask side of the quotes. We find that the primary factors that affect the participation strategy of the specialists to the current posted quotes are the changes in the best prices and depths on the limit order book since the previous quotes. In addition, specialists participate to the posted quotes more for low-volume stocks. Unlike some previous studies, we find significant inventory effects providing some evidence that the specialists actively manage their inventories.

Keywords: *NYSE Specialists, Dealer Trading, Market Makers, Limit Order Book, Posted Quotes.*

Introduction

New York Stock Exchange (NYSE) specialists are responsible for making markets for the stocks assigned to them. Briefly, they should be willing to trade when other traders are unwilling to trade, the bid-ask spread should not be too wide, they should intervene to prevent large price jumps, and create price continuity. Specialists cannot trade for their own accounts if there exist public orders at the same price or better. In addition, they should not trade with limit orders in order not to take the liquidity available to public traders.

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In this paper, using proprietary 2001 NYSE system order data[2] in the decimal pricing environment, we analyze the determinants of specialist participation in the posted quotes over time and across stocks by partitioning posted depth into the specialist's contribution and the limit order book's (LOB) contribution. To calculate the net specialist contribution, we first estimate the LOBs at each point in time by using the method described in Kavajecz (1999). Then we compare the LOB to the posted quotes to determine the net specialist participation in the posted quotes. The posted depth might be coming from the LOB, specialist or both.

Analyzing specialist participation is very important because the information about a particular stock is disseminated to the market by specialist quotes. In addition, they oversee a huge trading activity and there are potential conflict of interests between the specialists desire to make profits for themselves and their obligation to be fair to all public traders. Our aim is to contribute to the debate about the role of specialists in the trading business and address the question of whether they participate to the posted quotes in a manner consistent with their affirmative obligations.

As discussed above, we define ''the specialist participation to the posted quotes'' as their contribution to the posted quotes in addition to the LOB. A specialist has three choices for both sides of the posted quotes. He may not participate and let the posted quotes reflect the prices and depths on the LOB (0% contribution to the posted quotes from the specialist); he may add depth to the LOB at the best prices on the book (specialist percentage contribution is positive and less than 100%); and he may undercut the LOB which implies that the posted quotes fully reflect the trading interest of the specialist (100% contribution from the specialist). As the previous theoretical and empirical literature show, the specialists use all components of the posted price schedule while making the market for their stocks.[3] Accordingly, we examine the specialists' participation strategy to the posted quotes by taking the simultaneity of the bid and ask side into account.

This work is related to a number of papers in the previous literature. Kavajecz (1999) examines whether specialists manage quoted depth to reduce adverse selection risk. Kavajecz and Odders-White (2001) investigates how specialists update the price schedules consisting of bid quotes, ask quotes, bid depths, and ask depths. The changes in the price schedules posted by specialists reflect the combined strategies of the limit order traders, specialist, and floor brokers, but not the specialist's contribution alone. Therefore, changes in the price schedules are not informative about the strategy of the specialist. Chung, Van Ness and Van Ness (1999) analyze the role of the limit-order traders and specialists by using the TORQ dataset. They examine the effect of the quote type on spread, but they do not formally control for the exogenous variables that might

[2] The NYSE's SOD dataset gives detailed information on the entry and processing of orders. Our sample has 148 securities for the period April 2nd, 2001 – June 29th, 2001. The original sample was selected by systematic random sampling to ensure that all NYSE stocks are represented in the sample in terms of volume and price.

[3] See Lee, Mucklow and Ready (1993), Harris (1994), and Kavajecz (1999).

drive the specialist quotes and they do not distinguish between the bids and ask quotes. Finally, Köksal (2010) also analyzes the net specialist participation to the posted quotes by using a multinomial logit framework.

Our results provide evidence that the specialists participate to the posted quotes in a manner, which is consistent with their affirmative obligations. Changes in the differences between best limit prices and quote midpoint are statistically and economically significant. When the difference between best limit bid (ask) price and quote midpoint increases, causing a decrease in liquidity from bid (ask) side of the LOB, more than half of the specialists step in to provide additional liquidity. Other primary variables that affect the strategy of the specialists are the changes in best LOB prices and the LOB depths at those prices. Specialists' participation to the posted quotes decreases by transaction volume suggesting that specialist services are needed more for low-volume stocks. Finally, we find significant inventory effects for some specialists providing evidence that the specialists actively manage their inventories.

The rest of the paper is organized as follows. Section 2 presents methodology and results for simultaneous equations analysis. We discuss cross sectional analysis and its results in Section 3 and section 4 concludes.

Stock by Stock Analysis: Simultaneous Equations Model

Empirical Methodology: Previous theoretical literature show that the possibility of informed trading, specialist inventory, time between trades, volatility of the asset value, and LOB variables are important determinants of the market maker behavior.[4] In addition, there are some performance variables that the NYSE uses to evaluate specialist performance, such as average width of the quoted bid/ask spread and average depth of the quotes. Accordingly, we use the following variables for the stock by stock time series analysis. We will only discuss the liquidity provider's bid side variables, as ask side variables are similarly defined.

LOB variables.

Change in the Best Limit Bid Price is the current best limit bid price minus previous best limit bid price;

Change in the Best Limit Bid Size is the current best limit bid depth minus previous best limit bid depth;

LOB Asymmetry is the total size of the sell limit orders minus total size of the buy limit orders in the LOB;

[4] See for example, Kyle (1985), Stoll (1978), Ho and Stoll (1981, 1983), Easley and O'Hara (1992), Dupont (2000), Bondarenko and Sung (2003), Seppi (1997).

Change in the % Best Limit Bid Gap is the defined as the change in the ratio of the difference between posted quote midpoint and best limit bid price to the posted quote midpoint since the last quote revision (i.e., Δ(Midquote-Best Limit Bid)/Midquote));

(The relevant variable for sell side is Change in the % Best Limit Ask Gap and defined similarly; Δ(Best Limit Ask - Midquote)/Midquote));

Buy Order Placement is the sum of buy limit orders placed since the last quote revision;

Buy Cancellation Activity is the sum of buy limit orders cancelled since the last quote revision;

Other Variables.

Buy volume since the last quote revision is the total buy transaction size since the last quote revision;

Change in the Specialist's Inventory since the last quote revision. This variable is positive if the specialist has increased his inventory, i.e., he has bought more shares than he has sold, since the last quote revision;

Volatility is the coefficient of variation of the transaction prices during the last ten minutes before the current quote;

LOB idle time is the time in seconds between the last two LOB revisions;

Previous Percentage Spread is the ratio of the spread to quote midpoint in the previous quotes;

Previous Posted Bid Depth is the posted bid depth in the previous quotes;

Previous Posted Ask Depth is the posted ask depth in the previous quotes.

As discussed in the introduction, the specialist uses all variables in the posted quotes while determining his strategy. In addition, previous literature finds that there exist asymmetric effects of the independent variables on bid and ask side of the posted quotes.[5] Accordingly, we model the revision process of the specialist participation to posted quotes as a system of two simultaneous equations, where the dependent variables are the changes in percentage specialist participation at the bid and ask since the last quote revision. Percentage specialist participation at the bid (ask) is simply the percentage of the depth that belongs to the specialist in the current total posted bid (ask) depth. These two choice variables reduce the dimensionality of the specialist's decision problem. Table 1 displays the equations and variables of the simultaneous equations system.

[5] See, for example Madhavan and Smidt (1991), and Panayides (2004).

Table 1. Equations that are estimated by simultaneous equations model

	Endogenous Variables	
Explanatory Variables	Change in % Specialist Participation at the Bid	Change in % Specialist Participation at the Ask
Intercept	X	X
Δ in % Spec. Partc. at the Bid		X
Δ in % Spec. Partc. at the Ask	X	
Δ in the Best Limit Bid Price	X	X
Δ in the Best Limit Ask Price	X	X
Δ in the Best Limit Bid Size	X	X
Δ in the Best Limit Ask Size	X	X
Δ in the % Best Limit Bid Gap	X	X
Δ in the % Best Limit Ask Gap	X	X
Δ in the LOB Asymmetry	X	X
Cumulative Limit Buy Order Placement	X	X
Cumulative Limit Sell Order Placement	X	X
Cumulative Cancelled Limit Buy Orders	X	X
Cumulative Cancelled Limit Sell Orders	X	X
Elapsed time between last two LOB revisions	X	X
Volatility	X	X
Buy volume since the last quote revision	X	X
Sell volume since the last quote revision	X	X
Δ in the Specialist's Inventory	X	X
Previous Percentage Spread	X	X
Previous Posted Bid Depth	X	
Previous Posted Ask Depth		X

X indicates a right hand side variable included in the relevant equation.

Identification is an important problem in estimating the simultaneous equations models. Identification is not a problem in our model, because the previous posted bid (ask) depth variable appears only in the bid-side (ask-side) equation and the model is exactly identified. We estimated our model for each stock in our sample by using OLS and adjusted the standard errors using the Newey-West autocorrelation consistent covariance estimator.[6]

[6] Other methods like 2SLS or 3SLS produced similar results.

Results

The results from the simultaneous equations analysis are presented in Table 2. We report the mean and median of estimated coefficients for all stocks. The last column reports the percentage of significant coefficients at the 5% level.

Table 2. Simultaneous Equations Model Results for stock by stock estimation

For each explanatory variable in each equation, the mean and median of all coefficient estimates across the stocks in the sample are provided. % column reports the percentage of significant coefficients at the 5% level. All numbers for explanatory variables with a * are multiplied by 100000.

	Equations					
	Δ in % Spec. Partc. at the Bid			Δ in % Spec. Partc. at the Ask		
Exogenous variables	Mean	Median	5%	Mean	Median	5%
Intercept	-0.05	-0.03	56.94	-0.03	-0.02	59.72
Δ in % Spec. Partc. at the Bid				0.43	0.27	45.83
Δ in % Spec. Partc. at the Ask	-0.48	0.09	35.42			
Δ in the Best Limit Bid Price	3.18	0.24	39.58	-11.43	-4.04	59.72
Δ in the Best Limit Ask Price	-3.27	-0.05	36.81	9.97	2.37	52.78
Δ in the Best Limit Bid Size*	9.20	0.27	70.14	-0.46	-0.17	46.53
Δ in the Best Limit Ask Size*	-12.00	-0.10	31.94	1.20	0.32	72.92
Δ in the % Best Limit Bid Gap	126.62	80.31	54.86	-484.03	-228.35	65.28
Δ in the % Best Limit Ask Gap	49.11	-23.86	39.58	-33.24	21.72	54.17
Δ in the LOB Asymmetry*	9.70	0.57	55.56	-1.00	-0.67	73.61
Cumulative Limit Buy Order Placement*	8.80	-0.07	33.33	0.63	-0.13	45.83
Cumulative Limit Sell Order Placement*	12.00	-0.14	41.67	-0.54	0.02	40.28
Cumulative Cancelled Limit Buy Orders*	-0.49	0.33	41.67	-0.96	0.29	49.31
Cumulative Cancelled Limit Sell Orders*	-17.00	0.30	36.11	2.40	0.03	40.28
Elapsed time between last two LOB revisions*	39.70	3.40	32.64	11.30	1.50	34.03
Volatility	-0.12	-0.01	22.22	-0.01	-0.01	22.92
Buy volume since the last quote revision*	-8.00	-0.04	26.39	0.51	0.00	26.39
Sell volume since the last quote revision*	-10.00	0.00	25.69	-0.85	-0.06	29.86
Δ in the Specialist's Inventory*	-13.00	-0.08	21.53	0.96	0.05	31.94
Previous Percentage Spread	12.44	4.48	41.67	5.37	3.24	55.56
Previous Posted Bid Depth*	2.70	0.20	60.42			
Previous Posted Ask Depth*				0.78	0.05	62.50

Endogenous variables have negative (positive) coefficients in the bid-side (ask-side) equation. Positive coefficients imply that when specialists increase their participation on one side of the market because of their updated beliefs about the stock value, they also increase their participation to the other side of the market to support that relatively weak side of the market and to maintain price continuity. Negative coefficients indicate that specialists use both sides of the market to implement their strategies. As an example, let's say that a specialist updates his beliefs about the value of the stock downwards or his inventory is above his target and he wants to decrease his inventory. He increases his participation to the ask side (to decrease his holdings of the stock), and he decreases his participation to the bid-side (to avoid buying the stock). For example, when the specialist's participation to the ask-side increase by 10 percentage points, the effect of this on the bid-side is a decrease in his participation in bid side by 4.8 percentage points. The reason why he uses both the bid and ask quotes to implement his strategy when he wants to decrease his holdings might be that if he is caught with a large positive inventory when the stock prices are declining, he would suffer big losses, so price continuity motive is not very strong in this case, causing a decrease in participation to the bid-side.

On the other hand, let us say that the specialist updates his beliefs about the value of the stock upwards. Then he increases his participation to the bid-side (to increase his holdings of the stock and/or to minimize his losses to informed traders), and ask-side (to maintain price continuity). For example, when specialist's participation to the bid-side increases by 10 percentage points, the effect of this increase on the ask-side is an increase in his participation by 4.3 percentage points. There is a strong price continuity motive in this case, because after he buys the stock, if he ends up selling the stock (because of relatively high participation to the ask-side) he only loses profit opportunities from high future prices, rather than suffering direct losses.

One of the most important players in the posted quotes is the limit order book (LOB). We use several LOB variables in our analyses. As the intuition suggests, bid-side (ask-side) LOB variables are more significant in explaining the participation of the specialists to the bid (ask) quotes, because bid-side (ask-side) LOB variables have a direct effect on the bid (ask) quotes. Consistent with prior expectations, specialists use all available variables to implement their strategies.

The specialist increases (decreases) his percentage contribution to the bid-side (ask-side) when the best limit bid price increases consistent with the profit motive. For example, a 1-cent increase in the best limit bid causes the specialist to decrease his participation to the ask quotes by 11.43 percentage points ($0.01 x 11.43). This implies that he uses information from the LOB, i.e., he updates his beliefs about the stock value

upwards and decreases his participation to the ask-side to decrease the probability that he sells the stock. On the other hand, the specialist increases his percentage contribution to the ask-side when best limit ask price increases. Therefore, consistent with his affirmative obligations, he supports the relatively weak ask-side in this case.

Besides the changes in the best limit prices, changes in the sizes at those prices are significant too. When the best limit bid (ask) size increases, the specialist increases (decreases) his contribution to the bid quotes. There might be two explanations. First, the specialist might update his belief about the stock value upwards (downwards) and increase (decrease) his participation to the posted bid quotes accordingly to increase (decrease) the probability that he buys. Second, when the size at the best prices increases, the specialist can hide behind this size and safely increase his participation to the posted quotes, which improves his performance by increasing the average depth that he quotes.

The most direct way to see if the specialists participate to the quotes in a manner consistent with their affirmative obligations is by looking at the best limit bid and ask gap variables. A large gap between best limit bid (ask) price and posted quote midpoint indicates a weak bid (ask) side that needs support from the specialist. In addition, if the LOB provides some information about the future movements of the price, a large gap between best limit bid (ask) price and posted quote midpoint might provide bad (good) news for the stock since the limit order traders are less willing to buy (sell) the stock. The median of estimated coefficients for the best limit bid (ask) gap is positive for the bid (ask) side, showing that when the liquidity from the LOB is not sufficient, specialists step in to provide additional liquidity. The magnitudes of the estimated coefficients are also large indicating that these ''gap variables'' are two primary variables that the specialist looks at while determining his strategy.

We use some activity variables from the LOB. These variables are cumulative buy and sell order placement and cancellation since the last quote revision. Limit buy (sell) order placement variable is positive for the ask (bid) side equation indicating that, as cumulative size of limit buy (sell) orders placed increases, the specialist increases his contribution to the ask (bid) quotes because ask-side(bid-side) of the market is relatively weak and needs support from the specialist. Similarly, as cumulative size of cancelled limit buy (sell) orders increases, the specialist adds more depth from his own inventory to the posted bid (ask) as the median of the estimated coefficients indicate.

Harris and Panchapagesan (2005) and Köksal (2010) find that an asymmetry in the LOB has significant explanatory power in predicting the future price movements. ''LOB Asymmetry'' variable is defined as total size of limit sell orders minus limit buy orders and measures the overall asymmetry in the LOB. When LOB asymmetry increases

because of a relative increase (decrease) in limit sell (buy) orders, the specialist decreases (increases) his participation to the posted ask (bid) quote, because ask-side (bid-side) of the market is relatively strong (weak) now. This provides evidence that specialists do not try to undercut a heavy LOB on the sell-side. The economic effect of the LOB asymmetry is small though, as the magnitudes of the estimated coefficients indicate.

As the volatility of the security price increases, the specialists decrease their percentage contribution to both sides of the quotes indicating insufficient price stabilization activity. This provides evidence in support of the theoretical results of the Bondarenko and Sung (2003) who find that higher volatility increases the risks associated with carrying inventory which will result in less specialist contribution to depth.

The coefficient of ''Elapsed time between the last two LOB revisions'' variable is positive. This result provides evidence in favor of the finding of the Easley and O'Hara (1992) that if no activity occurs in some time interval, the market maker raises his probability that no information event has occurred. Accordingly, he increases his participation to the bid and ask quotes. The mean elapsed time between the last two LOB revisions is around 10 and 140 seconds for high- and low-volume stocks, respectively. A 1 minute (60 seconds) no activity time causes the specialist to increase his participation to the bid (ask) quotes by 2.38 (0.678) percentage points.

Mean coefficient for the inventory variable is negative (positive) for the bid (ask) side. Therefore, when the inventory increases, specialists decrease (increase) their participation to the bid (ask) side to reduce the inventory.

The mean of the estimated coefficients for the percentage bid-ask spread in the last period is positive for both bid- and ask-quotes. Bid-ask spread is an important measure of the specialist performance. Hence, specialists decrease the current bid-ask spread when the previous bid-ask spread is large. The estimated coefficients are economically significant too. When the percentage bid-ask spread in the previous period increases by 0.01, the specialist increases his participation to the bid (ask) quotes by 12.44 (5.37) percentage points. Therefore, when the spread is large in the previous period, the specialist tries to narrow the spread by increasing his participation in the posted quotes.

As the posted bid (ask) depth in the previous period gets larger, the specialist adds more depth to the posted bid (ask) in the current period. One possible explanation is that the specialist completes his buying or selling strategy in several steps. Another explanation might be that an increase in the previous posted bid (ask) depth signals an increase (decrease) in the security price and the specialist increases his participation to the bid-side (ask-side) of the market.

Cross Sectional Analysis

Empirical Methodology: Existing literature suggests that specialists' services are more valuable for illiquid stocks.[7] Based on this and other theoretical literature discussed in Section 2.1, we use the following variables to analyze how the specialists' participation decisions to posted quotes vary across stocks.

Log Mean Daily Volume is the logarithm of average daily volume over the sample period;

Log Market Capitalization is the logarithm of market capitalization as calculated by shares outstanding times stock price.

Relative Tick is the tick size (=$0.01) divided by the mean price over the sample period;

Volatility is the average of the volatility variable discussed in Section 2.1 over the sample period;

Average Percentage Spread is the average ratio of the spread to quote midpoint during the whole sample period for each stock.

To analyze how participation of the specialists to the posted quotes varies across stocks, we estimate the following cross-sectional regression model:

$$SpecPart_i = \beta_0 + \beta_1 LogMeanDailyVol_i + \beta_2 LogMarketCap_i + \beta_3 RelTick_i + \beta_4 Volatility_i + \beta_5 AvePercSpread_i + \varepsilon_i \quad (1)$$

where, for stock i, $SpecPart_i$ is the sum of average percentage specialist participation at the bid and ask, $LogMeanDailyVol_i$ is the log of average daily volume, $LogMarketCap_i$ is the log of market capitalization, $RelTick_i$ is the tick size divided by the average stock price over the sample period, $Volatility_i$ is the average volatility of the transaction prices from the time series analysis, $AvePercSpread_i$ is the average percentage spread over the sample period and ε_i is the error term.

Results

Table 3 presents the coefficient estimates of our cross sectional regression analysis. Coefficient of logarithm of mean daily volume is significantly negative indicating that specialist participation to the posted quotes decreases as transaction

[7] See for example, Grossman and Miller (1988), Glosten (1989), Huang and Liu (2004).

volume increases. This might indicate either that specialist services are needed more for thinly traded, illiquid stocks or participating to posted quotes for low-volume stocks is more profitable.

Table 3. OLS Results from Cross-sectional Regression of Specialist Participation

This table reports results from estimation of equation (1). Heteroskedasticity robust standard errors are reported in parentheses. ***, and ** denotes significance levels at the 1%, and 5% levels, respectively. Dependent variable is the sum of average percentage specialist participation at the bid and ask.

Dependent Variable		
Sum of average percentage specialist participation at the bid and ask		
Exogenous Variables	**Coefficients**	
Intercept	0.2305	
	(0.2349)	
Log Mean Daily Volume	-0.0929	**
	(0.0403)	
Log Market Capitalization	0.0852	***
	(0.0315)	
Relative Tick	-4.5804	
	(12.7732)	
Volatility (Coefficient of Variation of the Transaction Prices)	0.0150	**
	(0.0066)	
Average Percentage Spread	0.0271	***
	(0.0075)	
Sample Size	120	
R^2	0.42	

Log of market capitalization has a significantly positive coefficient implying that the specialist participation is higher for larger firms. One explanation might be that the possibility of informed trading is lower for larger firms because better public

information is available. Hence it is more profitable for the specialist to participate in the trades for these stocks to collect the bid ask spread.

In addition, there is a positive relationship between the volatility of the stock and the average percentage specialist participation providing evidence that specialists increase their participation to smooth prices for volatile stocks. Finally, we find a positive relationship between percentage spread and the specialist participation. A wide spread leaves a lot of room for the specialist to undercut the LOB, therefore the specialist participation increases as the spread becomes wider.

Conclusion

We examine how the specialists react to the changes in market variables while making participation decisions to the posted quotes. Results indicate that the primary factors that affect the participation strategy of the specialists to the current posted quotes are the changes in the best prices and depths on the limit order book since the previous quotes. In addition, specialists participate to the posted quotes more for low-volume stocks. We also find significant inventory effects providing some evidence that the specialists actively manage their inventories.

Our results indicate that *on average* specialists' participation to the posted quotes is consistent with their affirmative obligations. There exist some heterogeneity across stocks, however, as reflected by differences in signs and magnitudes of the estimated coefficients, indicating that some specialists' quoting strategies are costly for investors.

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