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Dealer attention, the speed of quote adjustment to information, and net dealer revenue

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ABSTRACT

Using trade and quote data from the NYSE, we examine the relation between dealer attention, dealer revenue, and the probability of informed trade. We find that dealer revenue net of losses to better-informed traders in NYSE stocks is positively related to the speed at which quotes adjust to full information levels. The speed of quote adjustment is faster for stocks with greater dealer attention, as measured by a stock's relative prominence at its post and panel location on the NYSE floor. The level of dealer attention in turn is positively related to a stock's probability of information-based trading. The results are consistent with a theoretical model we derive in which dealers trade multiple securities and must optimally allocate their limited attention to monitoring order flow to minimize losses to better-informed traders.

1. Introduction

In a large class of theoretical microstructure models, dealers trade with liquidity traders and informed traders. The informed trade strategically to minimize the price impact of their trades and to maximize the rents they earn on their information.[1] Dealers find it difficult to discern all of an informed trader's information in the trader's initial trades, and thus may require more than one quote adjustment to reach the price that fully reflects the trader's private information.[2] A dealer who is slow to detect and incorporate new information into quoted prices faces the risk that on subsequent trades he buys from (sells to) informed traders or even liquidity traders at prices that are too high (low). Conversely, a dealer who detects information and adjusts quoted prices to full information levels more quickly reduces such losses. Empirical evidence indicates that dealers who trade multiple stocks can face limited attention constraints that prevent them from devoting full attention to every stock they trade (Corwin and Coughenour, 2008). Simple intuition suggests that dealers should be able to adjust quotes to full information prices more quickly and lose less to informed traders in stocks to which they can pay more attention, but there are no formal theoretical or empirical analyses of these propositions. In many markets dealers trade multiple securities and the empirical evidence indicates they face constraints on their attention to any one security, so the lack of formal analysis is a significant gap in the literature. In this paper, we begin to fill this gap.

Kahneman (1973) and others in the psychology literature establish the notion that attention is a valuable resource. Several authors study the impact of attention allocation on *investor* behavior and asset pricing (e.g., D'Avolio and Nirenberg, 2003; DellaVigna and Pollet, 2007; Hong et al, 2007; Peng, 2005; Peng and Xiong, 2006). Many of these papers model or find evidence that investors are unable to efficiently extract information from prices because of limits on the amount of attention they can devote to processing information about any one stock or industry.

Given similar constraints on a *dealer's* attention and information processing capacity, we would expect that those stocks to

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[1] See, e.g., Copeland and Galai (1983), Glosten and Milgrom (1985), Kyle (1985), Easley and O'Hara (1987), Admati and Pfleiderer (1988), Foster and Viswanathan (1990, 1993, 1994) and Holden and Subrahmanyam (1992).

[2] In these models, the dealer thinks that he is adjusting the quotes to the full information price with each adjustment (i.e., he uses all of the information he can infer from the order flow), but importantly, he does not necessarily reach the full information price in one move if the informed trader is sufficiently skilled at hiding some of his information.

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which he devotes a greater portion of those resources, ceteris paribus, will trade more efficiently. In those stocks to which the dealer devotes more information processing resources, the dealer should be better able to detect informed trading. This improved detection of informed trading could manifest itself in a couple of ways. First, the prices of those stocks that receive greater attention should reflect new information and converge to the full information price more quickly. Second, because the dealer is better at detecting informed trading in these stocks, we would expect them to lose less to informed traders when trading these stocks than they lose in similar stocks to which they devote less attention. These implications suggest that dealer firms may strategically allocate stocks to individual dealers to optimize the devotion of attention to the stocks they trade. One strategy would be to allocate portfolios of stocks to dealers such that those stocks that are more difficult to trade, e.g., stocks with a high probability of informed trade, are part of a portfolio in which the dealer can allocate his attention to the difficult to trade stocks at low cost – because the rest of the portfolio is "easy" to trade.

We first develop a simple theoretical model to formalize our conjectures and motivate our empirical analysis. In our model, dealers trade with a strategic informed trader and liquidity traders. A key innovation of the model is an attendance parameter that captures the level of attention that each dealer pays to the order flow of each of the multiple stocks they trade. The model predicts that dealer revenue net of losses to informed traders increases in the speed of quote adjustment, that the speed with which a dealer adjusts his quotes to the full information price increases in the attention he pays to order flow, and that a dealer pays more attention to a stock for which he has greater uncertainty about its true value.

Using data on NYSE specialists and the stocks they trade, we test the model's predictions. First, we compute a speed of quote adjustment measure that captures the fraction of the total (5 min) price impact that occurs in the first n seconds after a trade. Consistent with the hypothesis that dealer revenue net of losses increases with the speed of quote adjustment, we find that percentage realized spreads (a common measure of dealer revenue net of losses to better-informed traders) are positively related to the speed of quote adjustments. The effect of speed is large economically – a one-standard-deviation increase in the speed measure increases percentage realized spread by 32% of its mean. This result illustrates the importance to a dealer of detecting informed order flow and incorporating new information into his quotes as quickly as possible.

Second, we test the prediction that the speed of quote adjustment to full information levels increases with the attention the dealer pays to a stock's order flow. We construct a proxy for the attention level that a specialist pays to a stock (its *prominence*) based on the proportion of total trading activity that the stock represents at its respective NYSE post-panel location. Given finite endowments of time and attention, the amount of attention and effort that a specialist can devote to monitoring the order flow of any one stock should depend on the number and activity level of the other stocks that the specialist trades at the same panel. We expect that more prominent stocks receive more attention (see Tinic, 1972; Branch and Freed, 1977; Corwin and Coughenour, 2008). Consistent with the hypothesis that dealers can adjust quoted prices to full information levels more quickly for stocks that receive more attention, we find that the speed of quote adjustment is positively related to a stock's prominence at its respective panel. This effect is robust to controlling for the stock's overall level of trading activity.

Third, we test the model's prediction that stocks with a higher probability of informed trading receive more dealer attention. Specifically, we examine whether attention and the risk of trading with informed traders affect how specialist firms allocate their assigned stocks to their respective post-panel locations on the NYSE floor. There is little empirical evidence on how specialist firms allocate their assigned stocks across their post and panel locations on the NYSE floor. Holding trading activity constant, stocks with a greater probability of information-based trading present greater potential losses to specialists and increase the uncertainty the specialist has about a particular stock's value. Our model predicts that specialists should allocate such stocks to panels so that specialists can pay more attention to them (see also Branch and Freed, 1977). Consistent with this hypothesis, we find that prominence is positively related to the probability of information-based trading (PIN) as measured by Easley et al. (1997).

Collectively, our theoretical and empirical results tell a consistent story. Dealers who can adjust stock quotes to full information levels more quickly lose less to informed traders, so their net revenues are greater in those stocks. The attention a dealer pays to a stock determines (in part) the speed at which the dealer can adjust quotes to full information levels. Given the importance of attention and the resulting speed of quote adjustment and net revenues, specialist firms allocate their assigned stocks across their post and panel locations on the NYSE floor in such a way that specialists can pay more attention to stocks that present a greater risk of trading against informed traders.[3]

Because so much of trading by dealers is human based and thus subject to limited attention constraints, our results should have important implications for financial institutions with trading desks, securities firms and specialist firms, policymakers, and market participants. Our research complements Corwin and Coughenour's (2008) study of the effects of limited attention on bid-ask spreads and price improvement by: showing how dealer attention affects the speed at which quotes adjust to full information prices; showing the effect of the speed of quote adjustment on net dealer revenues; and demonstrating how dealers allocate stocks to trading locations based on the likelihood of trading against better-informed traders.

Our paper also complements the growing body of literature on the effects of limited attention by *investors*. Our results that link the speed of quote adjustment to dealer revenue are related to two prior studies that examine NASDAQ trading through the Small Order Execution System (SOES) and its impact on market maker profits and price discovery. Harris and Schultz (1998) find that market makers who are slow to adjust prices lose money to SOES 'bandits', although SOES bandits infer price trends from other market makers' quotes rather than from superior information. Battalio et al. (1997) examine the relation between volatility and SOES trading and conclude that the trading of SOES bandits causes prices to move to their equilibrium value more quickly. Finally, our results linking specialist firm stock allocation decisions across their post-panel locations to the probability of informed trading add to Corwin's (1999) evidence of differences in performance across NYSE specialist firms and Coughenour and Deli's (2002) evidence on the importance of specialist firm organizational structure.

A static two-period version of our model was first introduced and studied by Dennert (1993), and further developed by Bernhardt and Hughson (1995). The limiting case in which all dealers prescribe the same (infinite) attendance rate to the asset corresponds to the situation in which each dealer perfectly observes the order flow. In this limit, the model reduces to a continuous-time version of Bondarenko (2001). In the competitive limit when the number of dealers goes to infinity, the models discussed above reduce to the static and dynamic versions of Kyle (1985) model, respectively, where the price becomes information efficient. Our

[3] Chung et al. (2008) demonstrate that stock attributes, including extent of information-based trading, help explain the speed of quote adjustment.