



## The strategic specialist and imperfect competition in a limit order market

Ariadna Dumitrescu\*

ESADE Business School, Av. Pedralbes, 60-62, Barcelona 08034, Spain

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### ABSTRACT

The empirical literature suggests that the limit order book contains information that might be used by the specialist to his own advantage. I develop a model where there is a strategic specialist who competes against a limit order book and has information about supply. The presence of a strategic specialist in an imperfectly competitive limit order book market induces non-monotonicity of market indicators with respect to the variance of liquidation value. Moreover, the existence of private information about supply significantly affects market performance as it induces, among other effects, lower market liquidity. Finally, this model suggests another link between Kyle's (1985, 1989) [Kyle, A., 1985. Continuous auctions and insider trading. *Econometrica* 53, 1315–1336, Kyle, A., 1989. Informed speculators with imperfect competition. *Review of Economic Studies* 56, 317–356] and Glosten and Milgrom's (1985) [Glosten, L., Milgrom, P., 1985. Bid, ask and transaction prices in a specialist market with heterogeneously informed markets. *Journal of Financial Economics* 14, 71–100] models by allowing for strategic behaviour of the specialist.

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### 1. Introduction

The creation of new markets in recent years has given rise to a debate on the relation between market performance and market design, which, in turn, has led to important changes in the regulation and structure of securities markets. One of the most studied problems is the ability of traders to observe information during their trading. Traders may have access to different sources of information. On the one hand, there are agents in the market who acquire information about fundamentals, which are predictors of future prices. On the other hand, there are agents who, due to their position in the market, have access to the order book and can, therefore, gather information about the supply side of the market. These traders are in general intermediaries but their responsibilities might differ depending on the trading system of each exchange. For instance, the trader might be a NYSE specialist, a "Makler" at the Frankfurt Stock Exchange or a "Saitori" at the Tokyo Stock Exchange. The most important common feature in all the exchanges is their role as liquidity suppliers. Since these specialists can see the limit order book, they can see the incoming orders before anyone else and, therefore, enjoy an informational advantage. Kyle (1985, 1989) shows that in an imperfectly competitive setup, traders exploit their private information about the liquidation value of the asset. They do so by taking into account that the quantity they choose affects both the asset's price and the

strategy adopted by other traders. In specialist markets, the specialists receive private information about order flow. This implies that in this type of market, traders are not the only agents that use their private information strategically: the specialist also exploits his informational advantage on the order flow. This paper investigates how the strategic use of information on order flow by specialists may affect the market outcome, and particularly, how this information together with information about liquidation value incorporates into prices.

I develop a model in which a strategic specialist competes against a limit order book in an imperfectly competitive market, and show that allowing both the specialist and the informed limit order traders to behave strategically has important effects on market-making and on information aggregation. The presence of a strategic specialist who has private information about a component of the order flow worsens market performance: it decreases market depth and price informativeness, and increases price volatility. Moreover, unlike in the perfectly competitive case, the specialist also makes positive profits. The intuition for this negative effect on market performance is the following. When the strategic specialist observes an increase in price, he understands that the value-informed traders have good information about the liquidation value of the asset. He observes the supply, so he knows that this increase in price cannot be due to a decrease in supply. Since he is also trading on his own account, when he sees an increase in price that is not associated with a decrease in supply, he increases his demand. This increase in demand further increases the price. As a result, the trade of a value-informed trader has more price impact

\* Tel.: +34 934 952 191; fax: +34 932 048 105.

E-mail address: [ariadna.dumitrescu@esade.edu](mailto:ariadna.dumitrescu@esade.edu)

(the market is less liquid) where there is a strategic specialist who also trades on his own account. The decrease in market liquidity is a similar result to the one in the dual trading literature because despite initially possessing only one type of information, both value-informed traders and the specialist end up trading on the two types of information, as the broker–dealers do in the dual trading literature.<sup>1</sup> However, unlike in the dual trading literature, in this model I also obtain other important implications with respect to market performance: lower informativeness of prices and higher price volatility. These differences are triggered by the strategic use of the two types of information both by the specialist and value-informed traders. The specialist makes use of his monopolistic position on the information about the limit order book and the value-informed traders use their informational advantage concerning the liquidation value of the asset and trade more aggressively on this information than in the case in which there is no specialist. As a result, they reveal more of the information they own through trading and all the revealed information is aggregated in the price. Since the price now aggregates both information about the fundamentals and information about supply, it is more volatile and less informative about the liquidation value of the asset.

This model predicts that the volume of trading depends on the stock volatility not only on the asymmetry of information with respect to the liquidation value. This result, which is consistent with results found in empirical studies, is explained by the fact that the specialist here tries to offset the effect of the informed trades (to overcome the adverse selection problem), but also seeks to make profits. When the asymmetry of information increases, the specialist not only trades more actively on his own account but he also induces the other traders to trade aggressively using their private information, so the volume of trading increases.

The model also predicts that the interaction between the strategic specialist and a limit order book populated by strategic informed limit order traders induces non-monotonicity of the market depth and other market indicators with respect to the asymmetry of information (variance of liquidation value). The non-monotonicity of market liquidity is due to the process of information aggregation and information revelation. More specifically, there is a flow of information about the liquidation value of the asset from value-informed traders towards the specialist and a flow of information about supply from the specialist towards the value-informed traders. The asymmetry of information about the liquidation value of the asset affects this bidirectional flow of information and the informational advantage of all traders. When the asymmetry of information is low, both the trades of the specialist and value-informed traders have high price impact because their trades are easily identified. However, as the asymmetry of information increases the specialist faces a trade-off. On the one hand, it is more difficult for the other traders to infer his private information, so he has high informational advantage about supply. On the other hand, the signal he extracts from price becomes less informative about the liquidation value of the asset. Since the value-informed traders anticipate he relies less on this signal, they can infer a better signal about supply from price, and therefore his trades have a bigger price impact.

This paper brings together two strands of the literature. On the one hand, it builds on the literature concerned with strategic behaviour of traders who submit limit orders. This literature has been initiated by Kyle (1989) who models a limit order book in an imperfectly competitive setup.<sup>2</sup> He shows that a strategic trader acts

as he trades against a residual supply curve. This implies lower quantities relative to the competitive rational expectations equilibrium case and, consequently, in equilibrium prices reveal less information than in the competitive case. I exploit this strategic behaviour of the traders, but in a more complex setup. I allow here for the existence of a specialist who has monopolistic knowledge of the limit order book (all orders which are entered electronically into the system and the intentions of floor brokers) as a privilege that compensates him for his obligations as liquidity provider, and who trades on his own account using limit orders. Since the specialist receives a signal about supply, he actually infers from prices and from his signal information about the limit order book. The existence of an agent who has information about supply is used by Genotte and Leland (1990), who consider a perfect competition model where speculators possess private and diverse information. They consider price-taker speculators who gather information either about prices or about supply and show that these informational differences can cause financial markets to be relatively illiquid. Röell (1990) uses a similar assumption to model dual trading. Unlike Röell (1990) study, in this paper there is no need to impose the rule that agents share the information they own. Even if initially they own only one type of information, they infer the other type through trading. The results show that the existence of the specialist and the existence of two sources of private information (about supply and about the liquidation value of the asset) alters the trading strategies of all traders and worsens market performance.

On the other hand, my work is linked to the literature that studies the role of a specialist with market power. Glosten (1989) studies the strategic behaviour of the specialist when setting the prices and emphasises the role played by a monopolistic rather than competitive specialist on social welfare. Seppi (1997) studies the case of a strategic specialist who competes against a competitive limit order book that is common knowledge. Unlike these papers, the strategic specialist in this model interacts with a limit order book in an imperfectly competitive setup, both the specialist and value-informed limit order traders behaving strategically. The specialist in this model not only anticipates that the other traders behave strategically but also uses the private information he has on the order flow strategically. These features permit, therefore, a general and realistic modelling of the financial market and a comparison with the empirical literature that studies the role played by the specialist. The model provides results consistent with the empirical implications of the role of the specialist provided by Madhavan and Sofianos (1998), Kavajecz (1999), Chung et al. (1999), Ready (1999), Nimalendran and Petrella (2003) and Harris and Panchapagesan (2005) who study the impact of specialist intervention and show that the specialist's role varies with size, liquidity or trade frequency of the stock.<sup>3</sup> Finally, this paper is related to the closed book model in Baruch (2005) in that there exists a strategic specialist who observes a component of the order flow. Baruch (2005) studies the effects of pre-trade transparency on market performance in a setup with a strategic specialist and a competitive limit order book. However, this model differs from Baruch (2005) in three important ways. First, the goal of this paper is to study the interaction of the strategic specialist with a limit order book in an imperfectly competitive setup and not the effects of opening the limit order book. In this model only the specialist observes the inelastic component of the order flow and uses his information on the order flow strategically, taking into account the effect that trading on this information has both on price and the other traders' demand.<sup>4</sup> Second, modelling the interaction of the strategic specialist with the limit

<sup>1</sup> Some examples of dual trading models include Röell (1990) and Fishman and Longstaff (1992). In these models the dealer–brokers have information both on the liquidation value and on a component of the order flow.

<sup>2</sup> The theoretical and empirical literature that studies the effects of limit orders on market liquidity is very rich: Glosten (1994), Parlour (1998), Foucault et al. (2005), Hasbrouck and Saar (2002), Rakowski and Wang Beardsley (2008).

<sup>3</sup> For empirical evidence on the role of the specialist in European markets see Gajewski and Gresse (2007) and Frino et al. (2008).

<sup>4</sup> In a related paper, Dumitrescu (forthcoming) studies the effects of different degrees of pre-trade transparency on market performance in a hybrid market where the strategic specialist competes against a limit order book in an imperfectly competitive market.

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