Optimal Market Structure: Does One Shoe Fit All?*

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There is a growing realization among regulators and managers of competing trading venues (incumbent stock exchanges, in particular) that the design of the trading mechanism is the most important determinant of a market's ability to compete for order flow. To understand how different trading venues succeed in capturing trading activity in a particular security, one has to understand which attributes of the trading venue are most important for trading activity. Moreover, the ability of different trading mechanisms to offer lower trading costs to an investor depends critically on the trading needs or characteristics of the investors themselves. Given that investors seek best execution of their trades, and best execution encompasses traded price, market impact, immediacy, timing, anonymity, and commissions, it is not surprising to see investors choose different trading venues based on how well each venue fulfills different combinations of these aspects' execution quality.

Our paper seeks to answer the following question: If customers could choose the market structure to trade in ex ante, which market structure would they choose? That is, what determines a market participant's choice of trading in an order-book market versus trading in a dealership market? We also seek to analyze how the trading environment and customer trading characteristics affect the choice of trading mechanism.

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Despite the fact that new trading systems have come along and attracted significant trading activity, little theoretical or empirical work has examined the considerations that determine a participant's choice of market mechanism. That investors are observed to send their orders to different trading systems (Conrad, Johnson, and Wahal 2001) has been the focus of little research. Most research has concentrated on modelling one trading mechanism and often simply examines mechanism efficiency in terms of price discovery. O'Hara (1995) provides a survey on continuous order-book and dealership models. Since each study surveyed used different modelling techniques, however, it is difficult to compare their results.

While it is desirable to examine which market structure best serves individual investor needs in terms of execution quality, it is generally very difficult to study both dealership and limit-order-book structures in a unified analytical framework using standard market microstructure modelling techniques. Empirical research that carries out intermarket comparison is very difficult as well, because actual market structures are more complicated than the models on which empirical tests are based. Furthermore, existing empirical research has carried out intermarket comparison based largely on a measure of the bid-ask spread, which is only one dimension of execution quality. These studies fail in general to examine other measures of execution quality that could help explain why various market structures coexist. Empirical research is also impeded by a lack of detailed data surrounding events where the market structure has undergone a regime change. Such data would allow researchers to more directly test theoretical hypotheses; see Madhavan (2000) for more on this.

To examine the optimal market structure preferred by market participants, this study constructs an agent-based computational model of both a dealership and limit-order market. (See LeBaron 1999, 2001, and 2002 for a review of agent-based modelling.) This methodology starts where theoretical market microstructure models leave off, in that it allows researchers to examine questions that are analytically intractable in a purely theoretical construct. In our study, the agent-based simulation methodology is structurally grounded by an analytical model that guides the behaviour of the artificial or simulated traders. One of our goals is to illustrate the applicability of the artificial financial markets approach in the study of market design issues.[1]

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1. This methodology should not be confused with the experimental markets studies that use human participants in a laboratory setting, such as Bloomfield and O'Hara (1999, 2000), Flood et al. (1999), and Theissen (2000). Although studies such as these allow researchers to examine the effects of changes in market structure on measures of execution quality, as is the case in our agent-based artificial market framework, this type of research also has the disadvantage of being sensitive to how the experiments are set up, how the human participants are chosen, or how they learn to play the experimental game.

The analytical framework on which the agent-based simulation is constructed is based on a market microstructure modelling approach. First, an institutional feature of many equity markets, such as the TSE and the Paris Bourse, is that trading is organized as a continuous limit-order-book system. We model the limit-order-book market as a double auction, where market participants submit bid and ask orders to the system. The trading system then clears the market and determines the price. Each risk-averse market participant is rational and seeks to maximize expected utility from trading. As such, market participants realize, to the extent that they are the marginal buyer or seller in the system, the impact that their orders have on price, and they act strategically.

Second, we model the dealership trading architecture as a two-stage trading process. This captures a key institutional feature of dealership markets such as foreign exchange and fixed-income markets. In the first stage, dealers trade with rational, liquidity-motivated public investors. These dealers post bid and ask prices and are committed to trade for any quantity at these prices. After observing their liquidity shock, each public investor chooses the size of order to submit against a dealer's quotes. The risk-averse dealers subsequently retrade in the interdealer market via interdealer-broker systems to lay off the inventory risk they obtained in the first stage of trading.

In the first stage of trading, dealers compete for customer order flow on price, à la Bertrand competition, while second-stage interdealer trading is modelled as a limit-order trading mechanism. Therefore, the interdealer trading system is specified in an identical manner to the stand-alone limit-order market structure described above. Only dealers trade in this market, however, and they are motivated by their desire to lay off their unwanted inventory positions. Dealers realize the impact that their orders have on their share of the total surplus among dealers and act strategically to maximize it. This two-stage trading process implies that the dealership market is actually a combination of two market structures. In turn, the dealer's quotation strategy in the first stage, when facing public investors, is a function of the trading environment that the dealers face in the second stage of trading.

We compare the welfare of rational public investors who trade in a dealership market with those who trade in a limit-order market. Although policy-makers and market designers are generally interested in the standards of execution quality that different market structures provide, we assume that the multi-dimensional nature of execution quality can, in the end, be summarized by its impact on investor welfare. We consider a framework where utility-maximizing public investors (customers) supply orders to the market based on the liquidity shock they receive just prior to entering the market. In essence, customer trading is motivated by the desire to share

liquidity risk among a greater set of participants. Given that customers are identical except for their realization of the liquidity shock, the degree of customer heterogeneity is defined over their liquidity shocks. Adjusting the distribution from which the liquidity shocks are drawn allows us to vary customer characteristics related to order size. Customers are also characterized by the correlation of their trading needs. When this correlation is high, customer orders tend to be on one side of the market.

By varying customer characteristics, we examine a range of market-structure issues. As noted in Viswanathan and Wang (2002) and Gravelle (2002), markets that primarily involve institutional traders who tend to generate large order flow, such as fixed-income and foreign exchange markets, are organized as dealership markets. On the other hand, markets that handle primarily small orders generated mainly by retail stock-trading investors, such as the downstairs segments of NYSE, the TSE, and the Paris Bourse, are structured as limit-order-book markets. Our study investigates how the optimal market structure for customers whose order size is sometimes large and varies considerably may differ from that for customers characterized by relatively small, homogeneous order flow.

Another concern of this study is to examine customer choice of market architecture under different trading environments. The trading environment is defined over the thickness of the market, the number of market-makers, the degree of market-maker heterogeneity, and the risk-aversion differential between market-makers and customers. Different market structures could be better suited to overcome various coordination or trading frictions in financial markets. For example, a feature of fixed-income and, to a somewhat lesser extent, foreign exchange markets, that differs markedly from equity markets, is their thickness: the number of buyers and sellers trading in the market at any one time.[2] As such, the observation that these markets are relatively thin might explain why the public trading segment of fixed-income and foreign exchange markets is structured as dealership systems.

Our findings suggest that the trading environment has an important impact on the optimal market structure. The public investor's choice to trade in a particular market will depend on thickness of the market measured in terms of the number of customers active in the market within a short time span. The dealership market structure is preferred by customers when there are few customers potentially available to trade. As the number of potential public investors increases, there comes a point where the number of

2. The fixed-income market is largely a wholesale market consisting of a relatively small number of large institutional investors. On the other hand, equity markets consist of thousands of traders, a large proportion of which are small retail investors.

investors exceeds a critical threshold, so that these investors prefer to trade in the order-book market structure.

We find that as the number of dealers decreases or as the risk appetite of the dealers decreases relative to that of the customers, the risk-bearing capacity of the dealership market decreases, making this market structure less attractive to liquidity-motivated public traders. As a result, the critical number of customers necessary for the limit-order-book market to prevail decreases. Increasing dealer heterogeneity is found to increase the likelihood of the dealership system prevailing.

Customers who are subject to larger and more volatile liquidity shocks will prefer to trade in a dealership system. Specifically, customers characterized as generators of large-sized order flow—which is a trait of institutional investors—are more likely to submit their orders to dealership systems than are small-sized, homogeneous order-flow suppliers. This is consistent with the observed regularity in capital markets, where markets dominated by a small number of large institutional investors tend to be organized as dealership markets.

References

Bloomfield, R. and M. O'Hara. 1999. "Market Transparency: Who Wins and Who Loses?" *The Review of Financial Studies* 12 (1): 5–35.

———. 2000. "Can Transparent Markets Survive?" *Journal of Financial Economics* 55 (3): 425–59.

Conrad, J., K.M. Johnson, and S. Wahal. 2001. "Alternative Trading Systems." Working Paper.

Flood, M.D., R. Huisman, K.G. Koedijk, and R.J. Mahieu. 1999. "Quote Disclosure and Price Discovery in Multiple-Dealer Financial Markets." *The Review of Financial Studies* 12 (1): 37–59.

Gravelle, T. 2002. "The Microstructure of Multiple-Dealer Equity and Government Securities Markets: How They Differ." Bank of Canada Working Paper No. 2002–9.

LeBaron, B. 1999. "Agent-Based Computational Finance: Suggested Readings and Early Research." *Journal of Economic Dynamics and Control* 24 (5–7): 679–702.

———. 2001. "A Builder's Guide to Agent-Based Financial Markets." *Quantitative Finance* 1 (2): 254–61.

———. 2002. "Building Financial Markets with Artificial Agents: Desired Goals and Present Techniques." Forthcoming.

Madhavan, A. 2000. "Market Microstructure: A Survey." *Journal of Financial Markets* 3 (3): 205–58.

O'Hara, M. 1995. *Market Microstructure Theory.* Blackwell Publishers.

Theissen, E. 2000. "Market Structure, Informational Efficiency and Liquidity: An Experimental Comparison of Auction and Dealer Markets." *Journal of Financial Markets* 3 (4): 333–63.

Viswanathan, S. and J.J.D. Wang. 2002. "Market Architecture: Limit-Order Books Versus Dealership Markets." *Journal of Financial Markets* 5 (2):127–67.