JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS Vol. 42, No. 3, Sept. 2007, pp. 735–758

The Value of the Designated Market Maker

Kumar Venkataraman and Andrew C. Waisburd*

Abstract

The proliferation of electronic limit order books operating without dealers raises questions regarding the need for intermediaries with affirmative obligations to maintain markets. We develop a simple model of dealer participation and test it using a sample of less liquid firms that trade on the Paris Bourse. The results indicate that firms with designated dealers exhibit better market quality, and that younger firms, smaller firms, and less volatile firms choose a designated dealer. Around the announcement of dealer introduction, stocks experience an average cumulative abnormal return of nearly 5% that is positively correlated with improvements in liquidity. Overall, these findings emphasize the potential benefits of designing better market structures, even within electronic limit order books, and suggest that purely endogenous liquidity provision may not be optimal for all securities.

I. Introduction

In a seminal paper, Demsetz (1968), p. 35 identifies the lack of "predictable immediacy of exchange in financial markets" as a fundamental trading problem. The problem arises because the arrival of buyers and sellers is not perfectly synchronized. As a result, there may be no counterparties available at the point in time when traders demand liquidity. Demsetz argues that such trading uncertainty can be mitigated by the regular presence of market makers or dealers who fill gaps that arise from asynchronous order arrival. Analytical papers by Garbade and Silber (1979) and Grossman and Miller (1988) provide formal treatment

*Venkataraman, kumar@mail.cox.smu.edu, Edwin L. Cox School of Business, Southern Methodist University, PO Box 750333, Dallas, TX 75275, and Waisburd, andrew.waisburd@harrisbank.com, Harris Investment Management, Inc., 190 S. LaSalle Street, Chicago, IL 60603.
We are grateful to Ananth Madhavan (associate editor and referee) for several suggestions that significantly improved the paper. We thank Stephen Brown (the editor), Amber Anand, Christopher Barry, Robert Battalio, Hendrik Bessembinder, Charles Cao, Shane Corwin, Naveen Daniel, Venkat Eleswarapu, Larry Harris, Jeffrey Harris, Paul Irvine, Robert Jennings, Bruce Lehmann, Larry Lockwood, David Mauer, Stewart Mayhew, Steve Mann, Rex Thompson, Venkatesh Panchapagesan, Chester Spatt, and seminar participants at the 2004 NBER Market Microstructure Conference, the 2002 Financial Management Association Meeting, the University of Arizona, Texas A&M University, and the University of South Florida for valuable comments. We are grateful to Loic Choquet, Socheat Chhay, Lourent Fournier, and Marianne Demarchi of Euronext Paris for valuable discussions and to Pascal Samaran for providing us with data. Venkataraman thanks the Frank and Susan Dunlevy Faculty Research Fellowship at Southern Methodist University for financial support. Any errors are entirely our own. In particular, the comments and opinions contained in this article are those of the authors and do not necessarily reflect those of Harris Investment Management, Inc.

of this fundamental role of the market maker. Specifically, the models demonstrate that market makers reduce the temporal imbalances in order flow and lower investors' price risk of a delayed trade by maintaining a market presence. This paper presents a simple analytical framework for dealer introduction and provides *direct* tests of several theoretical predictions of dealer participation. Specifically, we study the benefit of augmenting the public supply of liquidity with a market maker who has an affirmative obligation to maintain a market presence.

The proliferation of electronic limit order books that operate without designated dealers suggests that liquidity provision can be entirely endogenous. In support, Domowitz and Steil ((2001), p. 325) argue that "For those transactions which require intermediary liquidity provision for immediate execution, the supply of risk capital will emerge naturally from the profit incentive." Glosten (1994) shows that competition for order flow from public liquidity providers in an open consolidated book will make this structure "inevitable" in the sense that any alternative market structure cannot successfully compete with it, and Bloomfield, O'Hara, and Saar (2005) provide experimental support for this view. However, other theoretical research suggests that, under more relaxed assumptions, designated dealers can enhance the supply of liquidity offered by public limit orders (see Seppi (1997), Viswanathan and Wang (2002), and Parlour and Seppi (2003)). This study contributes to a better understanding of the role of designated market makers. We compare market quality for firms that trade with and without a market maker and present empirical evidence on the characteristics of firms that choose a market maker. Further, using an event study approach, we provide *direct* evidence on the impact of market maker introduction on market quality and firm valuation.

The laboratory for the investigation, the Paris Bourse, is well suited for testing theoretical predictions of market maker participation. The Bourse is an electronic limit order market that primarily relies on public orders to supply liquidity. Importantly for the purposes of this study, some firms in Paris choose a designated market maker, but not others. To enhance the power of the investigation, we focus on a sample of less actively traded stocks for which economic theory predicts that the market maker's impact will be the most pronounced. Further, the sample firms that we analyze trade via twice-daily call auctions. This market structure closely resembles that envisioned by theorists (e.g., Garbade and Silber (1979)) and allows us to construct market quality measures akin to those described in these models.[1]

Finally, the theoretical predictions we test suggest that the dealer enhances market quality by simply maintaining a regular market presence. Extant empirical studies of participation by designated dealers have typically focused on market structures (e.g., the New York Stock Exchange (NYSE)) where the role of the dealer is more complex. In particular, several papers in the literature emphasize the dynamics of the trading floor that help the NYSE specialist to enhance price

[1]The electronic limit order structure, also known as automated auctions, is used to trade equities, derivatives, and now bonds in several world markets, including Euronext (Brussels, Amsterdam, Paris), Athens, Lisbon, Madrid, Milan, and Vienna, among others. In addition, the call auction is commonly used by many stock exchanges to trade less liquid securities and to open and/or close trading for all securities.

discovery and prevent market failure.[2] While these additional functions may increase the appeal of the NYSE specialist, they interfere with clean tests of simple models that emphasize the fundamental role of the dealer in resolving order flow imbalance. In contrast, the sole means by which the dealer in Paris directly facilitates trading is by maintaining a market presence. Therefore, we test theoretical predictions of dealer participation in a trading environment that approximates the paradigm in which they were conceived.[3]

Our empirical results strongly support the theoretical predictions on market maker participation. Specifically, we examine market quality for firms partitioned on whether they trade with a designated dealer. As measures of market quality, we estimate the frequency with which call auctions clear and the variability in both returns and trading volume. We also reconstruct estimates of the limit order book following Bessembinder and Venkataraman (2004) and measure the imbalance between the buy and sell sides of the market just prior to the call auction. We find in a cross-sectional analysis that firms with a designated dealer exhibit lower book imbalance, more frequent auction clearing, and less variability in returns and trading volume than firms without a dealer. These findings are statistically significant when we control for various firm characteristics as well as self-selection bias. We document that younger firms, smaller firms, and less volatile firms prefer a dealer. Overall, the results confirm that firms strategically introduce a designated dealer based on expected benefits and costs and that firms with a designated dealer exhibit better market quality.

Using an event study framework, we examine the changes in market quality surrounding the introduction of a market maker. We control for market-wide effects by benchmarking the market quality of sample firms against that of control firms matched on stock price, market size, and trading volume. Following market maker introduction, the book imbalance declines significantly, suggesting that the market maker resolves temporal asynchronies in order flow by selectively providing liquidity where the public supply is insufficient. In addition, the market maker significantly increases the likelihood that auctions clear, thereby reducing the price risk that equilibrium values may shift between order submission and execution. These results suggest that the designated market maker improves upon the terms of trade offered by public limit order traders.

Around the announcement of market maker introduction, the sample firms experience a statistically significant average abnormal return (AR) of 4.9%. We show that the price effects are directly related to improvements in market qual-

[2]Theoretical models include Glosten and Milgrom (1985), Glosten (1989), Benveniste, Marcus, and Wilhelm (1992), and Madhavan and Panchapagesan (2000). See Hasbrouck and Sofianos (1993), Madhavan and Smidt (1993), Cao, Choe, and Hatheway (1997), Corwin (1999), Madhavan and Sofianos (1998), Kavajecz (1999), Madhavan and Panchapagesan (2000), and Goldstein and Kavajecz (2004) among others for empirical evidence from the NYSE. Mayhew (2002) and Anand and Weaver (2006) provide evidence from the CBOE and Kehr, Krahnen, and Theissen (2001) from the Frankfurt Stock Exchange.

[3]Nimalendran and Petrella (2003) study the specialist in the Italian Stock Exchange (ISE), which features an electronic limit order book. However, their paper largely tests models motivated by the NYSE specialist as they characterize the ISE specialist as having trading privileges over other traders. Battalio (2003) argues that the ISE is an inappropriate setting for testing these theories of specialist participation. Our paper is distinguished from the Nimalendran and Petrella (2003) study because we test several hypotheses that their study could or did not.

ity. This suggests that the liquidity improvements associated with market maker introduction lower the risk-adjusted return required by investors, consistent with Amihud and Mendelson (1986). We investigate several other explanations for the observed effects that are unrelated to dealer participation, including firm visibility, capital raising, and certification of firm quality, but find little evidence to support the alternatives.

The significant price effects surrounding market maker introduction, which our study is the first to document, strongly support the theoretical prediction that purely endogenous liquidity provision may not be optimal for all securities. These findings also contribute to the limited empirical literature studying the impact of market structure improvements on asset prices. Amihud, Mendelson, and Lauterbach (1997) find that stocks switching from call trading to continuous trading on the Tel Aviv Stock Exchange experience an AR of 5.5% around the transfer date (see also Muscarella and Piwowar (2002), Kalay, Wei, and Wohl (2002)). The findings in this study suggest that market maker participation represents another priced improvement in market structure.

The remainder of the paper is organized as follows. In Section II, we present a simple analytical framework for dealer participation and develop testable hypotheses for the study. Section III describes the market structure in Paris, the data source, and the market quality measures. Sections IV and V present the results of cross-sectional and time-series analysis of market quality for firms that trade with and without a designated dealer. Section VI presents implications of the study and Section VII summarizes the results.

II. Hypothesis Development and a Simple Analytical Framework

In this section, we present a simple analytical framework to illustrate why it might be beneficial to introduce a designated market maker for some stocks that trade on the Paris Bourse call auction, but not for other stocks.[4] The model considers a potential listing firm that plans to issue a risky security to trade in a call auction. The managers of the firm must choose the optimal market structure based on the expected benefits and costs of trading with a designated market maker.

A. Market Clearing in a Call Auction with Public Participants

We assume that the security value evolves continuously through time following a random walk with an (unknown) value, v_t, and variance, Σ^v. Define τ as the time between auctions. In each trading session, a random number of public traders denoted by $N\ (=\lambda * \tau)$ transact in the market, where λ is the number of public traders that arrive per unit time following a Poisson process and varies across securities.

The process by which public orders enter the market is specified as follows. Suppose there are N_t public traders participating at time t. Each trader could receive a liquidity shock z_i, assumed normally distributed with mean zero and

[4]We are thankful to the referee for providing us with detailed suggestions for the model.

variance Σ^z. Further, each trader may strategically choose to incur a search cost $c_i > 0$ and gather information to form an estimate of value, $v_{i,t}$, assumed normally distributed with mean v_t and variance Σ^s. Information and liquidity shocks are independent of one another and uncorrelated across traders.

Prior to each auction, all traders observe the *indicative* auction-clearing price p_t and the size of the market N_t.[5] The demand function of trader i, Q_i, derived from a mean-variance utility function following Grossman (1976), is determined by the trader's information and by his exogenous liquidity needs,

$$Q_i = \alpha(v_{i,t} - p_t) + z_i. \tag{1}$$

The term, $(v_{i,t} - p_t)$, implies that the strategic trader will buy securities if the market clears at a price lower than his estimate of value, $v_{i,t}$. If it clears at a price higher than $v_{i,t}$, he will be a seller. The aggressiveness with which the strategic trader responds to deviations between his value estimate and the clearing price is captured by $\alpha > 0$ and is assumed constant across market participants. We expect that α will depend on the risk-adjusted rate of return for providing liquidity and will be higher for firms characterized by large public markets and by lower price volatility.

Defining the aggregate liquidity shock, Z, as the sum of individual shocks and setting supply equal to demand, the clearing price for auction t conditional on N_t is

$$p_t = \frac{1}{N}\sum_{i=1}^{N} v_{i,t} + \frac{Z}{\alpha N}. \tag{2}$$

Thus, the valuation error, f_t, can be expressed as

$$f_t = p_t - v_t, \tag{3}$$

where f_t is normally distributed with a mean zero and variance,

$$\sigma_{ft}^2 = \left(\Sigma_t^s + \left(\Sigma_t^z/\alpha^2\right)\right)/\lambda\tau. \tag{4}$$

Notably, a larger value of τ leads to more public traders at each auction, thus lowering the transient deviation of the clearing price from equilibrium value. In many stock markets including Paris, τ is not determined endogenously for each stock as the batch auctions occur at predetermined times for all stocks. From (4), we note that the variance of valuation error is smaller for securities with a large public market (high λ) and with smaller price volatility (high α), suggesting that these securities will benefit less from the introduction of a designated market maker.

In any given auction, with τ, λ, and α fixed, the variability in price around the consensus estimate of v occurs because of liquidity shocks Z, and because of

[5]By assuming that the number of traders is observable in each auction, the equilibrium found in Grossman and Stiglitz (1980) applies. Otherwise, the usual normality assumptions are violated because N is stochastic, thereby destroying the rational expectations equilibrium. An alternative approach is to assume that traders have idiosyncratic valuations for exogenous reasons, such as taxes, that are not modeled. Either of these simplifying assumptions allows for a closed-form solution to the model, which is only intended to provide a framework for the empirical analysis that follows.

variability in the number of strategic traders from one auction to the next. In practice, when the indicative auction-clearing price deviates significantly either from security value (v) or from the prior auction-clearing price, many stock exchanges impose a trading halt. As a result, the auction will not clear, thus increasing the price risk for public traders that the security value might change before the next scheduled auction. For the strategic traders, the expected profit $(= \alpha(v - p)^2)$ is proportional to the variance of the liquidity shock, Σ^z. We assume that strategic traders randomly choose to gather information in each trading session, but on average break even with respect to their costs of information gathering, $c_i > 0$, which fixes the mean N for the stock.

B. Market Clearing with a Designated Market Maker

The designated market maker differs from a strategic trader in that the market maker has an affirmative obligation to maintain a presence at *every* auction and is separately compensated for doing so, while strategic traders voluntarily seek to provide liquidity based on their expected trading profits. Introducing a market maker reduces the variance of the valuation error for two reasons. First, the market maker acts as an *additional* strategic trader and provides liquidity in response to transient imbalances in order flow. Second, and more importantly, the fact that the market maker is *always* present reduces the auction-to-auction variation in the number of strategic traders, which further lowers the variability in clearing price. We hypothesize that the average transaction costs are proportional to price volatility and that firm value increases with lower mean transactions costs, as described in Amihud and Mendelson (1986). Thus, any improvement in market structure will enable the corporate manager to lower the firm's cost of equity capital.

Introducing the market maker, however, imposes additional costs on the firm. Specifically, for strategic traders, the regular presence of the market maker can reduce incentives to gather information and impose costs that deter entry. Additionally, if market makers have short-term information or charge significant commissions from public traders for their services, their presence might extract rents from liquidity traders. In either case, market maker participation might *worsen* firm liquidity. Moreover, the market maker will need additional compensation outside of trading revenues for maintaining a market presence. This is because the affirmative obligations require him to provide liquidity in circumstances when other public traders would not as liquidity provision is not profitable in those instances. Because the listing firm enjoys a positive externality of market maker presence (in the form of a lower cost of capital), one obvious source for subsidizing market maker revenues is the listing firm itself. Alternatively, the stock exchange might distribute revenues from the sale of transaction data to market makers willing to commit capital. In Paris, the listing firm makes direct payments to the market maker in part as an annual fee but mostly in the form of future investment banking business. To the extent that such compensation offsets the market maker's cost of being present at all times and the cost of gathering information, the market maker's α coefficient might be higher than that of a typical strategic

trader, further adding to the liquidity benefit, but possibly extracting rents from other strategic traders.

The trade-off between corporate benefits (improved market quality) and costs (market maker compensation, and possibly worsening liquidity, due to the market maker rents) will lead some firms to prefer a designated market maker, but not others. Empirically, we expect that the benefits from market maker participation will exceed costs for firms with a small number of active market participants (small λ) or with high volatility of equilibrium prices (small α and large c), or for firms with large anticipated investment banking business, such as young firms and growth firms. Other firms that enjoy large public markets are likely to opt out of choosing a designated market maker. Based on earlier discussions, we also expect that firms that choose a market maker would experience an improvement in market quality (for example, higher frequency of auction clearing) and an increase in firm valuation surrounding the introduction of the market maker.

These discussions support the following testable hypotheses.

Hypothesis 1. Smaller firms, younger firms, less liquid firms, and more volatile firms are more likely to introduce a designated market maker.

Hypothesis 2. Firms that self-select to trade with a market maker will experience improvements in market quality surrounding the introduction of the market maker.

Hypothesis 3. Firms that self-select to trade with a market maker will experience an increase in firm valuation surrounding the introduction of the market maker.

III. Institutional Background, Data Source, and Market Quality Measures

A. Institutional Background

The Paris Bourse is an open electronic limit order market.[6] Orders are submitted from 8:30 AM through 5:00 PM to a transparent electronic limit order book that is observable by all market participants. Orders are executed automatically according to strict price, exposure, and time priority rules. Trading takes place continuously for the more liquid securities. Less active stocks trade only twice a day via call auctions at 11:30 AM and 4:00 PM with no trading between auctions. Executions in the call auction are based on the single price that maximizes trading volume. If there is insufficient trading interest on one or both sides of the market at the time of the scheduled auction, or if the clearing price deviates significantly from prior auction price, the auction will not clear and no trade takes place. Prior to the call auction, traders can place, modify, and cancel orders, and observe the indicative market-clearing price and trading volume that would result

[6]The time period analyzed in our study predates the September 2000 merger of the Paris Bourse, the Amsterdam Stock Exchange, and the Brussels Stock Exchange to form Euronext. The institutional details described in this section apply to the Paris Bourse during the analysis period. See Biais, Hillion, and Spatt (1995), (1999), Harris (1996), Venkataraman (2001), Pagano and Schwartz (2003), and Bessembinder and Venkataraman (2004) for detailed descriptions of the Paris Bourse market structure.

from the current book without any trades actually taking place (see Biais, Billion, and Spatt (1999) for a detailed description).

According to exchange officials, some continuously traded stocks experienced wide bid-ask spreads and some call auctions stocks experienced infrequent auction clearing when liquidity was provided strictly by public limit orders. In 1992, the Paris Bourse initiated a program to allow designated market makers (known as animateurs) to facilitate trade in certain less liquid securities. In 1994, the program was extended such that more actively traded issues were also eligible. The exchange neither mandates that any stock trade under the auspices of a designated dealer, nor is it involved in the process of selecting the intermediary. Both decisions are made by the listed firm. The exchange merely acts as an agent by providing firms with a list of eligible market makers and their prior performance rankings.

The designated market maker in Paris is required by the Bourse to maintain a regular market presence, i.e., quote a maximum bid-ask spread and a minimum depth and execute, to a certain extent, orders partially or totally unmatched during the call auction. The exchange surveillance team monitors and ranks the market maker and may terminate his service for poor performance. In return for providing liquidity, the market maker pays no exchange fees on market making related trades and is recognized as the primary facilitator for block transactions in the security. In contrast with the NYSE specialist, the designated dealer in Paris is not granted the opportunity to condition his price schedule on the arriving order flow. That is, the Paris dealer has no last mover advantage.

In the absence of trading privileges, it is unclear whether professional liquidity provision is a profitable enterprise, especially for infrequently traded stocks. So, why become a market maker in Paris? First, the market maker and the listing firm typically negotiate a private liquidity agreement wherein the market maker is provided with an inventory of shares for making markets and is paid an annual fee for his services. Second, and more importantly, the market maker is often the executor of the listed firm's investment banking ventures, which indirectly subsidize the market making business. Thus, a high performance rating from the Paris Bourse provides the dealer with a powerful marketing tool for the investment banking business and is a major incentive to perform well as a liquidity provider.

B. Data Source

Trade, order, and quote data are obtained from the Paris Bourse's Base de Données de Marche (BDM) database beginning January 1995. The BDM database does not distinguish orders submitted by market makers from those submitted by public traders. The Paris Bourse provided us with data on all market maker introductions between January 1992 and December 1998, and we subsequently cross-checked the information on *Avis*, the official publication of the exchange. The data contains information on firm name, ticker symbol, and the exact date on which the designated market maker was introduced.

C. Measures of Market Quality

The analytical framework (Hypothesis 2) suggests that the designated dealer will affect market quality measures, such as book imbalance and frequency of market clearing. To test these predictions, we construct corresponding measures of market quality. The BDM database contains order level data for all stocks, which includes information on the firm symbol, date and time of order submission, a buy or sell indicator, the size of the order, and other fields to track order modifications, executions, and expirations. We follow the approach described in Appendix B of Bessembinder and Venkataraman (2004) to reconstruct from the BDM data estimates of the limit order book just prior to the auction. We define Relative Imbalance$_{i,t}$ as the absolute difference between the cumulative number of shares posted on the buy and sell sides of the limit order book for firm i just prior to auction t, scaled by the average book depth during the sample period, where book depth is the cumulative number of shares on both sides of the book. To measure auction clearing, we set an indicator variable Clear$_{i,t}$ to equal one if we observe an auction-clearing price in auction t, and to zero otherwise.

IV. Cross-Sectional Analysis

In this section, we use a regression framework to examine whether firms that trade with a designated market maker exhibit better market quality than firms that trade without a market maker. The theoretical framework from Section II presents the possibility that firms may self-select to introduce a market maker after assessing the costs and benefits of the intermediary's presence. To correct for the possible endogenous choice of market maker participation, we estimate a two-stage model (see Heckman (1978)), which has been used in the literature to correct for selection bias.

A. Sample Selection

The theoretical literature predicts that the designated dealer will play a more vital role for less liquid securities. Therefore, we restrict our analysis to (296) French common stocks that trade in twice-daily call auctions (conducted for less active stocks) from July 1, 1998 to December 31, 1998. We remove four stocks that introduced a designated market maker during this period. Also, we remove 11 stocks with insufficient data to calculate market quality measures and nine stocks with stock price less than French Francs (FF) 5 or greater than FF 5,000.[7] Using data on market maker introductions, we identify 75 firms (MM sample) that trade with a designated market maker during this period. The remaining (197) firms are classified as those trading without a market maker (non-MM sample).

Table 1 reports summary statistics for the MM and non-MM samples. While comparing firm size and stock price, it is evident that the non-MM sample contains a few (outlier) firms with high price and/or market size. The median firm

[7]Three stocks have no trade observations and an additional eight stocks do not have enough sequential trades to compute return volatility. Note that the results are similar if the screen based on stock price is not implemented.

size (FF 211 million for non-MM firms versus FF 174 million for MM firms) and stock price (FF 289 for non-MM firms versus FF 178 for MM-firms) are more comparable across the two samples although these firm characteristics continue to be lower for firms with a dealer. The trading volume and return volatility is, on average, quite similar across the two samples. Finally, firms with a dealer tend to be younger (4.5 years versus 9.9 years) and tend to have a deeper limit order book just prior to a call auction (4,210 shares versus 3,040 shares).

TABLE 1

Summary Statistics for Cross-Sectional Analysis

Summary statistics are reported for 272 French commons stocks that traded in the twice-daily call auction between July 1, 1998 and December 31, 1998. Size is the average market capitalization as of July 1, 1998, and Volume is the average daily trading volume during the sample period. Book depth is the average cumulative number of shares posted on the buy and sell sides of the limit order book prior to the call auction. Volatility is the standard deviation of continuously compounded daily returns computed from closing trade prices. Price is the average closing transaction price (in FF). Age is the number of years that the stock has shares listed in the BDM database as of July 1, 1998.

Variable	Market Maker	N	Mean	Median	Std. Dev.	Min.	Max.
Size (in FF millions)	Yes	75	205.9	174.1	153.9	13.4	732.2
	No	197	500.0	208.2	1,227.7	3.9	14,815.0
Volume (in FF thousands)	Yes	75	59.7	37.9	71.4	1.6	510.0
	No	197	69.0	25.4	156.9	223.0	1,380.7
Average book depth (in 00s of shares)	Yes	75	42.1	27.4	70.3	0.3	584.7
	No	197	30.4	11.2	61.6	0.3	611.6
Volatility (%)	Yes	75	2.4	2.3	0.6	1.2	4.1
	No	197	2.6	2.6	1.1	0.0	7.3
Price (in FF)	Yes	75	202.7	178.0	149.0	26.7	732.2
	No	197	516.3	288.6	710.7	8.1	4,899.0
Age (in years)	Yes	75	4.5	3.8	4.0	0.0	18.9
	No	197	9.5	6.0	8.5	0.0	25.8

B. An Empirical Model of Dealer Selection

The theoretical framework presented in Section II predicts that the designated market maker will be preferred by smaller, younger, less liquid and more volatile firms (Hypothesis 1). To test this hypothesis, we estimate the following cross-sectional probit model:

$$\begin{aligned}(5)\qquad \Pr[\mathrm{MM}_i = 1] \;=\; & \Phi(\gamma_0 + \gamma_1 \mathrm{Log}(\mathrm{Price}_i) + \gamma_2(\mathrm{Shares\ Out}_i) \\ & + \gamma_3 \mathrm{Volatility}_i + \gamma_4 \mathrm{Turnover}_i + \gamma_5 \mathrm{Age}_i),\end{aligned}$$

where $\Phi(.)$ is the cumulative standard normal distribution, and the dependent variable, MM_i, is an indicator variable that equals one if firm i trades with a designated dealer and equals zero otherwise. Explanatory variables include firm characteristics such as the log of stock price, the number of shares outstanding, return volatility based on closing transaction prices, stock turnover defined as daily volume in FF divided by firm size in FF, and firm age (in years).[8]

Results of the estimated probit model are reported in Panel A of Table 2. Consistent with Hypothesis 1, we document that in model 1 the coefficients on

[8]The closing quote for call auctions stocks in the BDM database is not reliable and is therefore not used to calculate the daily return volatility measure.

shares outstanding and firm age are -0.24 (p-value $= 0.00$) and -0.08 (p-value $= 0.00$), respectively, suggesting that smaller and younger firms are more likely to introduce a designated dealer. Also, firms with lower prices are more likely to trade with a dealer, while turnover has no significant impact on dealer selection in the presence of other firm characteristics. In model 2, the coefficient on return volatility is -0.31 (p-value $= 0.01$), suggesting that more volatile firms are less likely to trade with a designated dealer. The latter result is surprising. A possible explanation is that return volatility based on transaction price will capture pricing errors, and if so, the negative coefficient on return volatility indicates that firms with dealers have fewer pricing errors. The results of the regression analysis presented in Panel B of Table 2 are consistent with this explanation.

C. Regression Analysis

Panel B of Table 2 reports coefficient estimates from ordinary least square (OLS) regressions of market quality measures on firm characteristics such as shares outstanding, daily turnover, stock price, return volatility, and on the market maker (MM) indicator variable. The dependent variable is the firm-specific estimate of market quality during the sample period. The objective of the cross-sectional regression is to assess whether firms that trade with a dealer exhibit better market quality after controlling for economic variables that might also affect liquidity.

The first measure of market quality is the average relative book imbalance estimated across all auctions for the firm. We expect that firms that trade with dealers should exhibit smaller book imbalance just prior to an auction if the dealer selectively provides liquidity on the thin side of the book. The second measure is the percentage of call auctions for which we observe an auction-clearing price during the sample period. The theoretical model predicts that the dealer will lower the pricing error by posting liquidity when public supply is lacking, thus lowering the likelihood of a trading halt. Thus, we anticipate that firms with dealers will exhibit a higher percentage of auction clearing. The third measure is the coefficient of variation in volume, defined as the standard deviation of auction trading volume divided by the average trading volume for the firm during the sample period. The last measure is the auction-to-auction return volatility, measured as the absolute value of log returns from one auction to the next. We expect that the dealer will fill gaps that arise from asynchronous order arrival and thus reduce the variability in both returns and trading volume for the MM sample.

The coefficient estimates reported in the first four columns of Panel B in Table 2 strongly support the notion that firms with a designated dealer exhibit better market quality. From column (1), we see that the coefficient on the MM variable is -0.09 (p-value $= 0.00$), suggesting that firms with market makers exhibit lower book imbalances just prior to auction clearing than firms without market makers. The positive and highly significant coefficient (p-value $= 0.00$) of the MM variable in column (2) indicates that auctions clear more frequently for the MM sample than for the non-MM sample. Finally, from columns (3) and (4), we observe that the non-MM sample exhibits smaller variability in auction

TABLE 2

Cross-Sectional Regression Models of Market Quality on Firm Characteristics and Market Maker Indicator Variable

Panel A presents coefficient estimates (with standard errors in parentheses) from a cross-sectional probit model, where the dependent variable, MM, equals one if the firm trades with a designated dealer and equals zero otherwise. Explanatory variables include the log of stock price, the number of shares outstanding, return volatility based on closing transaction prices, stock turnover defined as daily volume in French Francs divided by firm size in French Francs, and firm age. Panel B reports coefficient estimates (with standard errors in parentheses) from a cross-sectional regression of market quality measures on firm characteristics and the MM indicator variable. The market quality measures include relative book imbalance, measured as the absolute difference in cumulative buy and sell depth just prior to the auction scaled by the average cumulative depth, the percentage of auctions that clear, the coefficient of variation (CV) in volume, and auction-to-auction return volatility. In columns (1) through (4), the model is estimated using ordinary least squares (OLS). In columns (5) through (8), the model is estimated using a two-stage procedure in which the inverse Mills ratio, obtained from the first-stage probit regression, is included as an explanatory variable in the second-stage OLS. ***, **, and *: Significant at the 1%, 5%, and 10% levels, respectively.

Panel A. Probit Analysis of the Decision to Introduce a Designated Market Maker

	Constant	Price (log)	Number of Shares (in millions)	Volatility (daily)	Turnover (daily in %)	Firm Age (years)
Model 1	1.73***	−0.27***	−0.24***		−0.34	−0.08***
	(0.54)	(0.09)	(0.08)		(2.47)	(0.02)
Model 2	2.74***	−0.32***	−0.23***	−0.31***	0.44	−0.08***
	(0.65)	(0.09)	(0.08)	(0.11)	(2.44)	(0.01)

Panel B. OLS and Selectivity-Adjusted Analysis of Market Quality on Firm Characteristics

	OLS Analysis				Selectivity-Adjusted Analysis			
	Relative Book Imbalance (1)	Auction Clearing (%) (2)	Std. Dev. of Relative Volume (3)	|Return| Auction-to-Auction (4)	Relative Book Imbalance (5)	Auction Clearing (%) (6)	Std. Dev. of Relative Volume (7)	|Return| Auction-to-Auction (8)
Constant	0.52***	32.79***	3.28***	4.85***	0.60***	−6.49	4.60***	5.34***
	(0.07)	(9.20)	(0.58)	(0.46)	(0.10)	(16.06)	(0.89)	(0.65)
Price (log)	0.01	2.03	−0.08	−0.42***	−0.01*	5.88***	−0.21**	−0.48***
	(0.01)	(1.29)	(0.08)	(0.01)	(0.01)	(1.94)	(0.11)	(0.01)
Number of shares outstanding (in millions)	−0.03	1.94***	−0.06**	−0.08***	−0.04	2.75***	−0.08**	−0.10***
	(0.03)	(0.45)	(0.02)	(0.03)	(0.04)	(0.60)	(0.03)	(0.03)
Volatility (daily)	−0.01	−2.79**	−0.09		−0.01	0.06	−0.19*	
	(0.01)	(1.41)	(0.09)		(0.01)	(1.92)	(0.11)	
Turnover (daily in %)	−0.01	2.38***	0.05*	−0.07***	−0.17**	2.10***	5.56**	−0.07***
	(0.28)	(0.38)	(0.03)	(0.02)	(0.07)	(0.48)	(2.64)	(0.02)
Market maker indicator	−0.09***	25.52***	−1.00***	−1.02***	−0.17**	63.37***	−2.28***	−1.63***
	(0.02)	(3.17)	(0.20)	(0.19)	(0.07)	(11.68)	(0.65)	(0.60)
Covariance (sigma)					0.05	−25.17***	0.85**	0.41
					(0.04)	(7.12)	(0.41)	(0.37)

trading volume and returns over the period, which is consistent with the notion that the dealer fills gaps arising from asynchronous arrival of buy and sell orders.

The theoretical framework discussed in Section II and the empirical results presented in Panel A of Table 2 suggest that firms may self-select to introduce a designated dealer based on an assessment of expected benefits and costs. Although the regression analysis controls for economic variables that might affect market quality, there exists the possibility that the endogenous choice of dealer introduction is not fully captured by the specification. To address this possibility, we introduce a two-stage technique to correct for the self-selection of dealer introduction more directly (see, for example, Maddala (1983), Madhavan and Cheng (1997), and Bessembinder and Venkataraman (2004)). In the first stage (equation (5)), the firm's choice to introduce a designated dealer is modeled as a structured

probit. The results of this estimation are presented in Panel A of Table 2 and described in detail in Section IV.B. In the second stage, the impact of the dealer's presence on market quality is estimated while correcting for the selection bias as,

$$z_i = \delta_0 + \delta_1 \text{InvPrice}_i + \delta_2 \text{Ln}(\text{Size}_i) + \delta_3 \text{Volatility}_i + \delta_4 \text{Turnover}_i + \delta_5 \text{MM}_i + \delta_6 \text{IMR}_i + \eta_i, \quad (6)$$

where z_i represents market quality for firm i. To allow valid inference, we estimate the first-stage probit and the second-stage regressions simultaneously, using maximum likelihood estimation. In addition to the control variables that are included in the OLS regression, the self-selection model corrects for selection bias by incorporating the inverse Mills ratio (IMR), which is simply a nonlinear combination of variables used to predict the choice of dealer selection.

The selectivity bias-adjusted regression coefficients are reported in the last four columns of Panel B in Table 2.[9] In columns (6) and (7), the coefficient on IMR is highly significant, empirically confirming that firms strategically choose to introduce a designated dealer. More importantly, the results indicate that allowing for the possible endogenous choice of dealer selection on market quality does not alter the key conclusion that firms with a designated dealer exhibit better market quality. The estimated coefficient on MM in the book imbalance regression continues to be negative and highly significant. The corresponding estimates for the market clearing and variability in volume and returns are similar to the OLS specification (all significant at the 1% level). Overall, we conclude that firms with designated market makers exhibit superior market quality along many dimensions—lower book imbalances, more frequent auction clearing, and less variability in returns and trading volume.

V. Event Study

In this section, we study market quality and price effects for a sample of French firms during a short window surrounding the introduction of a designated market maker. The "event study" design mitigates the possibility that the cross-sectional difference in market quality that we attribute to market maker participation in Section IV may in fact be driven by some other unobservable variable. Moreover, a study of price effects surrounding the announcement of market maker introduction provides an alternative approach to estimating the value of market maker participation. Unfortunately, the event study approach significantly reduces the number of observations and hence limits the tests that we can perform.

A. Sample Selection

We focus on (61) French common stocks that trade in twice-daily call auctions and for which the market maker is introduced for the first time between January 1995 to December 1998. Market makers are sometimes introduced shortly

[9] The selectivity-adjusted analysis for the variability in returns (reported in column (8) of Panel B) uses model 1 from Panel A in the first stage. That is, the first-stage probit specification does not include return volatility as an explanatory variable.

after a security first appears in the BDM database. We therefore exclude from the analysis 10 trade days following each stock's initial appearance to control for the potential confounding effect of security listing. We denote the *announcement day* of the market maker introduction by "A" and the market maker *introduction day* by "I." The pre-period is defined as days A − 34 through A − 5, and the post-period extends from days I + 5 through I + 34. We screen the sample for sufficient activity by deleting any stock with less than 20 trades in both periods. The final sample consists of 36 securities.

To control for time-series variations in liquidity unrelated to dealer introduction, we benchmark market quality for sample firms against those for control stocks that are selected following the approach in Huang and Stoll (1996). For each sample stock, the control stocks are selected from the pool of all French common stocks that trade without a designated dealer in the call market on the dealer introduction day. After screening control stocks for trading activity, we compute the following score for each pair of sample and control stocks:

$$\sum_{i=1}^{3} \left(\frac{x_i^{\text{control}} - x_i^{\text{sample}}}{\left(x_i^{\text{control}} + x_i^{\text{sample}} \right) / 2} \right)^2, \tag{7}$$

where x_i is either average price in FF, average daily share volume, or market capitalization during the pre-period. We then match (without replacement) each control stock to the sample stock that yields the lowest score.

Table 3 presents summary statistics for sample and control firms in the period before dealer introduction. The distribution of stock price is very similar across sample and control stocks. The average stock price is FF 213 for sample stocks and FF 228 for control stocks. On average, sample stocks have higher daily trading volume (FF 222,500 versus FF 154,900) and book depth (8,100 shares versus 5,250 shares), but lower market size (FF 242 million versus FF 327 million) relative to those for control stocks. Market makers are typically introduced less than two trading days after their introductions are announced. The median number of stocks per introduction is one, suggesting that market makers are by and large introduced on a stock-by-stock basis.

B. Regression Analysis

We employ a pooled time-series, cross-sectional regression approach to examine market quality before and after dealer introduction. Specifically, for each market quality measure, $y_{i,t}$, we estimate the following regression model over all auctions before and after dealer introduction:

$$y_{i,t} = \beta_0 + \beta_1 \text{Control}_i + \beta_2 \text{Post}_{i,t} + \beta_3 (\text{Post}_{i,t} * \text{Control}_i) + \varepsilon_i, \tag{8}$$

where Control_i is an indicator variable that equals one if stock i is a control stock and equals zero otherwise, and $\text{Post}_{i,t}$ equals one if auction t occurs in the period after dealer introduction and equals zero otherwise. The coefficients of equation (8) have the following economic interpretation. A significantly positive β_2 coefficient indicates that, all else equal, the market quality measure has increased

TABLE 3

Summary Statistics around Market Maker Introduction

Summary statistics are reported for 36 stocks that introduced designated market makers between 1995 and 1998 and for the matched sample of control stocks that did not introduce market makers. All statistics are computed over a 30-day period just prior to market maker introduction. Stocks per introduction is the total number of stocks introduced on each market maker introduction day (I). Days is the number of trading days between the market maker announcement day (A) and the introduction day. Age is the number of years that the stock has shares listed in the BDM database as of the market maker introduction day. Size is the average market capitalization (in FF millions) based on the number of shares outstanding on the introduction day. Volume is the average daily trading volume (in 000s of FF). Book depth is the cumulative number of shares posted on the buy and sell side of the limit order book prior to the call auction. Volatility is the standard deviation of continuously compounded daily returns computed from closing trade prices. Price is the average transaction price (in FF).

Variable		Mean	Median	Std. Dev.	Min.	Max.
Stocks per introduction		1.3	1.0	0.9	1.0	5.0
Days [A, I]		1.6	2.0	0.5	1.0	3.0
Size (in FF millions)	Sample	242.2	183.1	235.8	70.0	1,499.1
	Control	327.1	217.7	413.4	50.0	2,357.1
Volume (in FF thousands)	Sample	222.5	115.2	261.1	5.0	1,238.1
	Control	154.9	81.4	191.1	5.9	879.7
Average book depth	Sample	81.1	60.3	59.2	12.3	198.6
(in 00s of shares)	Control	52.5	45.1	43.4	12.8	188.7
Volatility (%)	Sample	2.1	1.8	0.9	0.6	4.4
	Control	2.4	2.2	1.1	0.7	6.0
Price (in FF)	Sample	213.0	202.6	110.2	72.9	581.1
	Control	228.1	202.8	149.3	64.2	763.9

for sample stocks following dealer introduction. A significantly negative β_3 coefficient indicates that the increase in market quality measure is larger for sample stocks relative to those for control stocks. The models are estimated using OLS regressions for relative imbalance and using logistical regressions for auction clearing.

As robustness checks, we expand equation (8) to control for economic variables that could potentially affect market quality. First, we estimate a firm-pair fixed effects model where an indicator variable equals one for each sample/control pair, and equals zero otherwise. In this specification, the regression's coefficients will capture the average difference in market quality *between* matched sample and control stocks after accounting for cross-sectional differences *across* firm-pairs. Second, we include firm characteristics that might affect market quality, such as stock price, trading volume, shares outstanding, volatility, and firm age as additional control variables in the regression.[10]

Column (1) of Table 4 reports the results of estimating equation (8) for the Relative Imbalance measure. The coefficient of the Post indicator variable (β_2) is -0.14 (p-value $= 0.00$), suggesting that, all else equal, the relative book imbalance for sample stocks has declined by 14% (or approximately 850 shares based on median book depth) following the introduction of the dealer. During the same period, the control firms experience no change in book imbalance ($\beta_2+\beta_3=-0.02$; p-value $= 0.18$). More importantly, the coefficient on the interaction term Control$*$Post (β_3) is 0.12 (p-value $= 0.00$), indicating that the reduction in book imbalance for sample stocks is significantly larger than those for control firms. The results in columns (2) and (3) of Table 4 indicate that allowing for

[10]Results are similar if we exclude firm age as an explanatory variable or use market capitalization rather than shares outstanding.

the possible effects of firm characteristics on book imbalance does not alter the conclusions discussed above. That is, after controlling for firm effects, the book imbalance has declined for sample firms after dealer introduction, and the decline for sample firms is significantly larger than that for control firms. Overall, these results provide *direct* support for the prediction that designated dealers help resolve temporal asynchronies in order flow by selectively providing liquidity on that side of the book where the public supply is insufficient (Hypothesis 2).

TABLE 4

Pooled Regression Models of Changes in Market Quality around Market Maker Introduction

Regression coefficients (with standard errors in parentheses) are reported for the following pooled time-series, cross-sectional regression model:

$$y_{i,t} = \beta_0 + \beta_1 \text{Control}_i + \beta_2 \text{Post}_{i,t} + \beta_3 (\text{Post}_{i,t} * \text{Control}_i) + \varepsilon_{i,t},$$

where $y_{i,t}$ is either Relative Book Imbalance$_{i,t}$, Clear$_{i,t}$, or Buy Orders$_{i,t}$. Relative Book Imbalance$_{i,t}$ is the absolute difference between the cumulative number of shares posted on the buy and sell sides of the limit order book for stock i just prior to auction t scaled by the average number of shares posted on the limit order book for stock i during the sample period. Clear$_{i,t}$ equals one if auction clears and zero otherwise. Buy Orders$_{i,t}$ is the number of buy orders for stock i in auction t. Control$_i$ equals one for control stocks and zero otherwise, Post$_{i,t}$ equals one if auction t occurs in the post-period and zero otherwise. Firm dummies are binary indicator variables for each sample/control pair. Price$_i$ is the average transaction price (in FF). Volume$_i$ is the average daily trading volume (in 000s of FF). Volatility$_i$ is the standard deviation of daily returns from closing trade prices. Shares is the shares outstanding on the market maker introduction day. Age$_i$ is the number of years that the stock has shares listed in the BDM database as of the market maker introduction day. Reported F-statistics test the null hypothesis of no change in market quality for control stocks. The models are estimated using OLS regressions for Relative Book Imbalance and Buy Orders measures and using logistical regressions for the Clear measure. Specifications (4) through (6) are estimated for 36 sample and 36 control stocks. Specifications (1) to (3) and (7) to (9) are estimated for 24 sample and 24 control stocks for which order level data is available to reconstruct the limit order book. ***, **, and *: Significant at the 1%, 5%, and 10% levels, respectively. † indicates generalized and rescaled coefficient of determination.

	Relative Book Imbalance			Clearing Likelihood			Buy Orders		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept	0.53***	0.56***	0.53***	1.55***	2.47***	−1.48**	5.00***	8.39***	−11.95***
	(0.01)	(0.04)	(0.18)	(0.06)	0.29	(0.67)	(0.14)	(0.51)	(1.55)
Control dummy (β_1)	−0.13***	−0.12***	−0.19***	−0.72***	−0.77***	−0.16*	−1.62***	−1.63***	−0.37*
	(0.02)	(0.02)	(0.02)	(0.08)	(0.08)	(0.09)	(0.20)	(0.18)	(0.20)
Post dummy (β_2)	−0.14***	−0.13***	−0.14***	0.24***	0.19**	0.20**	0.52***	0.22	0.33*
	(0.02)	(0.02)	(0.02)	(0.09)	(0.09)	(0.09)	(0.19)	(0.18)	(0.18)
Control * Post (β_3)	0.12***	0.12***	0.12***	−0.22**	−0.24**	−0.22*	−0.18	−0.17	−0.10
	(0.02)	(0.02)	(0.02)	(0.11)	(0.12)	(0.12)	(0.27)	(0.25)	(0.25)
Control									
Price (×1000)			−0.02			0.44*			2.93***
			(0.07)			(0.27)			(0.60)
Log(Volume)			−0.03***			0.47***			1.64***
			(0.01)			(0.03)			(0.06)
Volatility			0.03***			−0.20***			0.15*
			(0.01)			(0.04)			(0.09)
Log(Shares)			0.02			−0.14***			−0.20*
			(0.01)			(0.05)			(0.12)
Age			0.01***			−0.06***			−0.10***
			(0.00)			(0.01)			(0.02)
Firm dummies	No	Yes	No		Yes	No	No	Yes	No
F-statistic: $\beta_2 + \beta_3 = 0$	1.82	0.47	0.76	0.14	0.56	0.06	3.04*	0.07	1.61
Adjusted R^2	0.02	0.06	0.04	0.05†	0.17†	0.16†	0.02	0.18	0.17

Next, in column (4) of Table 4, we estimate logistical regressions to test the theoretical prediction that the market will clear more frequently in the presence of a designated dealer (Hypothesis 2). In support, the results indicate a statistically significant increase in the likelihood that call auctions clear for sample firms after a dealer is introduced ($\beta_2 = 0.24$). The probability of market-clearing

increases from 82.5% ($=\exp(1.55)/(1+\exp(1.55))$) without a dealer to 85.7% ($=\exp(1.55+0.24)/(1+\exp(1.55+0.24))$) with a dealer. Importantly, control stocks experience no improvement in market clearing during this period (p-value of $\beta_2+\beta_3$ is 0.71), and the improvement in auction clearing for sample stocks exceeds that for control stocks ($\beta_3=-0.22$; p-value $=0.05$). The estimated point estimates obtained from columns (5) and (6) of Table 4 suggest that the improvements in auction clearing obtained after dealer introduction are robust to the inclusion of other control variables that might also affect market quality. Overall, the results provide strong support for the theoretical prediction in Garbade and Silber (1979) and Grossman and Miller (1988) that the designated dealer can reduce investors' price risk by increasing the likelihood that they will transact quickly.

Observing that the book imbalance declines and market-clearing increases for sample firms but not for otherwise similar control firms suggests that the designated dealer participates in circumstances when public limit order traders are unwilling to do so. These results complement empirical findings in the literature on the behavior of the NYSE specialist. For example, Madhavan and Sofianos (1998) document that specialist participation rates are highest for thinly traded stocks, when volatility is high and bid-ask spreads are wide. Similarly, Kavajecz (1999) and Goldstein and Kavajecz (2004) document that participation by the NYSE specialist increases relative to that of limit order traders around the time of earnings announcements and extreme market movements.

C. Other Roles of Market Makers in Paris

The results thus far suggest that dealer introduction enhances market quality. We choose to attribute liquidity improvements to the regular presence of the dealer and his ability to facilitate the trading process. An alternative, however, is that some or all of the improvements in liquidity are attributable to other activities of the intermediary. Specifically, liquidity agreements between the dealer and listed firm also stipulate that the dealer engage in other non-trading functions that heighten investor interest and stimulate trading in the listed firm.[11] These can include the production and dissemination of (positive) research reports or the distribution of the corporation's annual report. There is mounting evidence in the literature (e.g., Grullon, Kanatas, and Weston (2004)) that firm visibility has important effects on investor participation and stock market liquidity, consistent with Merton's (1987) "investor recognition hypothesis."

Furthermore, even if the market maker were not to actively promote a firm, the news that he has entered into a liquidity agreement with the listing firm may elicit positive interest in the company. This can occur because dealer introduction is the outcome of a mutual choice process between the listed and market making firms (see Fernando, Gatchev, and Spindt (2005)). Market makers are most likely to select good prospects that will provide substantial future trading and investment banking business. Thus, the establishment of a market making relation may

[11] This relation is not entirely unlike those observed in the U.S. market where firms provide investment banking business to security analysts as a reward for obtaining research coverage and (favorable) ratings.

certify the quality of the listing firm, thereby garnering positive interest among investors.

To assess these possibilities, we study the impact of market maker introduction on the number of buy orders submitted between auctions—a simple proxy for investor interest. The intuition is that buy order flow will increase after market maker introduction as a result of the promotional efforts undertaken by the market maker. Column (7) of Table 4 reports the coefficients of estimating expression (8), where the dependent variable is the number of buy orders between auctions. Consistent with heightened investor interest, we find that the coefficient on the Post variable (β_2) is 0.52 (p-value = 0.01). However, we find that control firms also experience an increase in buy order flow during the period and that the difference between sample and control firms is not statistically significant. Further, the results in columns (8) and (9) of Table 4 suggest that the increase in buy order flow for sample firms after dealer introduction is not statistically significant after controlling for firm effects. Combined, these results provide little support for the notion that market maker introduction significantly increases investor interest for sample firms relative to control firms.

Another possibility is that liquidity improves because the market maker helps raise additional equity for the firm, thus increasing firm size. To test this explanation, we calculate the percentage change in shares outstanding for sample firms from the beginning of the pre-period to the end of the post-period, $\text{Cap}_{30\text{DAY}}$ (results are not tabulated). We find that only one firm raised additional equity during this period. Moreover, the percentage change in shares outstanding is no different for sample and control firms, providing little support for the capital raising explanation. In addition, we track equity issuance during the first year after market maker introduction, $\text{Cap}_{1\text{YEAR}}$, and find that only seven firms raised equity during this period. Again, the percentage change in shares outstanding is no different for sample and control firms. These findings provide little support for the capital raising explanation.

D. Price Effects

To test whether the introduction of the market maker increases stock valuation (Hypothesis 3), we measure the cumulative abnormal returns (CARs) surrounding market maker introduction. Daily returns are computed using continuous compounding based on closing trade prices. The event window extends from A − 5 to I + 22. The days between announcement and introduction, which varied by stock, were combined. The market model is estimated from I + 23 through I + 154 employing Scholes-Williams betas to adjust for infrequent trading and using the value-weighted SBF 120 Index as a proxy for the market portfolio. Since market makers may be announced for multiple securities on a single calendar date, cross-sectional correlation in returns could bias the results. Therefore, we form equally weighted portfolios of securities that have identical announcement dates and treat the portfolio returns as those of a single security. Test statistics, computed following Brown and Warner (1985), test the null hypothesis of zero ARs against the alternative that the returns are positive.

Table 5 reports the analysis of price effects around market maker introduction. For the sample stocks, the announcement of market maker introduction yields an immediate and positive average CAR of 3.33% that is statistically significant at the 1% level. The announcement day price increase reflects, in large part, the average ARs of 1.30% and 1.11% (both significant at the 1% level) on the days immediately prior to the announcement, suggesting that there was some information leakage. The effect persists over the next trading month during which time prices drift upward by approximately 1.6%, and at day I + 22, the CAR of 4.93% continues to be statistically significant at the 5% level.[12,13] In contrast, the announcement appears to have little effect for control stocks. Average CARs of 0.21% just prior to announcement and 0.63% on the announcement day are not significantly different from zero. Although we observe a slight upward drift in prices over the next month, the CAR continues to remain insignificant throughout the event period (with the exception of I + 5).

TABLE 5

Cumulative Abnormal Returns around Market Maker Introduction

Average abnormal returns (AR) and cumulative average abnormal returns (CARs) are reported for 36 stocks that announced the introduction of designated market makers between 1995 and 1998 and for 36 matched control stocks that did not. The event window extends from five days before the announcement day (A) to 22 days after the market maker introduction day (I). Event day I aggregates the period from A through I (the number of days in this period varies). The table reports ARs for days A − 5 through I + 10 and for I + 15 and I + 22. The market model is estimated over a 132-day period that begins 23 days after the introduction day. Scholes-Williams betas are computed using the value-weighted SBF 120 Index as a proxy for the market. Continuously compounded daily returns are calculated from closing prices (adjusted for dividends, splits, and other corporate actions). Stocks with identical introduction days are formed into equally weighted portfolios. Test statistics are computed following Brown and Warner (1985). ***, **, and *: Significant at the 1%, 5%, and 10% levels, respectively (one-tailed).

	Sample Firms		Control Firms	
Day	AR	CAR	AR	CAR
−5	−0.01	−0.01	−0.67*	−0.67*
−4	0.32	0.31	0.82**	0.09
−3	0.59	0.87	−0.19	−0.08
−2	1.30***	2.07**	0.35	0.20
−1	1.11***	3.11***	0.21	0.36
A	0.24	3.33***	0.63	0.90
I	−0.46	2.90***	−0.21	0.73
1	−0.75*	2.23**	0.79*	1.38
2	−0.29	1.96*	−0.10	1.28
3	0.63*	2.59**	0.18	1.43
4	0.19	2.78**	−0.10	1.36
5	0.28	3.05**	1.05**	2.22*
6	−0.03	3.02**	0.05	2.26
7	1.05**	4.07**	−0.59	1.75
8	0.52	4.59***	0.01	1.76
9	0.27	4.86***	0.00	1.76
10	−0.60	4.28**	−0.34	1.48
15	0.39	3.99**	0.41	1.49
22	−0.16	4.93**	−0.49	1.57

[12]The price increase is unlikely to reflect inventory accumulation by the market maker. As discussed earlier, the listing firm typically provides shares to the market maker as part of the liquidity agreement. Furthermore, the price change due to inventory accumulation would not be permanent.

[13]We searched the Dow Jones News Wire and two key French daily business newspapers, *Le Figaro* and *Les Echos*, for other corporate events around the time of market maker introduction. We found announcements for eight stocks in all, but only two of these announcements occurred on dates where we observe ARs (A − 2 and A − 1). Results are qualitatively similar when we remove the two stocks from the sample.

The remarkable increase in stock market valuation for sample firms of nearly 5% is similar in magnitude to the price effects documented by Amihud, Mendelson, and Lauterbach (1997) of 5.5% for stocks switching from call auctions to continuous trading on the Tel Aviv Stock Exchange. The results offer strong support for the joint hypothesis that liquidity is priced (Amihud and Mendelson (1986)) and that purely endogenous liquidity provision may not be the optimal market structure for all securities. Furthermore, the increase in market valuation is consistent with the reasoning that the expected benefits of dealer intermediation to market participants outweigh the potential agency conflicts inherent in direct liquidity arrangements between the dealer and the listed firms.

Next, we estimate cross-sectional regressions of CARs on changes in the variables of interest (Change) for sample firms, where Change is the slope coefficient from stock-by-stock regressions of clearing frequency, or buy order flow on the Post indicator variable. For $\text{Cap}_{30\text{DAY}}$ and $\text{Cap}_{1\text{YEAR}}$ measures, Change is simply computed as the percentage change in shares outstanding during the relevant period. The regression model is:

$$\text{CAR}_i = \gamma_0 + \gamma_1 \text{Change}_i + \xi_i. \tag{9}$$

Hypothesis 3 predicts that firms experiencing greater improvements in auction clearing will exhibit larger CARs. If, instead, the price effects reflect realized changes in firm size or expectations of future capital raising, then we should observe a direct relation between ARs and $\text{Cap}_{30\text{DAY}}$ or $\text{Cap}_{1\text{YEAR}}$, respectively. Another possibility is that ARs are explained by increased interest in the stock either because the liquidity agreement certifies firm quality or because the market maker engages in activities to promote the stock. In either case, we expect to observe a positive cross-sectional relation between ARs and change in buy order flow.

Table 6 presents the results. From column (1), we see that the changes in market clearing explain 24% of the cross-sectional variation in ARs. The γ_1 coefficient estimate is positive and statistically significant (p-value = 0.00), indicating that stocks experiencing improvements in auction clearing following dealer introduction also experience larger ARs. In sharp contrast, the coefficients on changes in buy order flow and shares outstanding (columns (2) through (4)) are statistically insignificant. Finally, from columns (5) through (7), we note that the change in market clearing continues to explain ARs around dealer introduction after controlling for other factors. Thus, there is little support for the notion that the price effects are explained by the alternative roles of the market maker. That auction clearing is highly significant in the regressions with only 30 observations provides strong support for theoretical predictions that dealer participation improves market quality and that liquidity is priced.

VI. Policy Implications

This study is of particular interest to regulators, corporations, and stock exchanges. The key implication is that liquidity provision will likely not evolve endogenously from a pure profit motive for all securities at all times. Stock exchanges therefore have to address the fundamental trading problem of asynchronous order flow, especially for less liquid stocks, as markets move toward a

TABLE 6

Cross-Sectional Regressions of CAR on Changes in Firm Characteristics

Coefficient estimates (with standard errors in parentheses) are reported for cross-sectional regressions of (I + 10) CARs on changes in firm characteristics (Change). Change is the slope coefficient from a stock-by-stock regression of $\text{Clear}_{i,t}$, or $\text{Buy Orders}_{i,t}$ on an indicator variable that equals one in the post-period and zero otherwise. Logistical regressions are estimated for the Clear measure and OLS regressions are estimated for Buy Orders. For $\text{Cap}_{30\text{DAY}}$ and $\text{Cap}_{1\text{YEAR}}$, Change is the percentage change in shares outstanding from the beginning of the pre-period to the end of the post-period and to one calendar year from the beginning of the pre-period, respectively. $\text{Clear}_{i,t}$ equals one if auction t for stock i clears and zero otherwise, and $\text{Buy Orders}_{i,t}$ is the number of buy orders submitted for stock i in auction t. The sample consists of 36 stocks that introduced designated market makers between 1995 and 1998. ***, **, and *: Significant at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	1.89 (1.26)	3.86** (1.54)	4.15*** (1.54)	4.42*** (1.58)	1.90 (1.29)	1.96 (1.31)	2.29* (1.33)
Clearing	4.04*** (1.28)				3.98** (1.57)	3.99*** (1.33)	4.01*** (1.28)
Buy Orders		−0.17 (0.35)			0.04 (0.47)		
$\text{Cap}_{30\text{DAY}}$			−2.11 (3.00)			−0.52 (2.27)	
$\text{Cap}_{1\text{YEAR}}$				−0.20 (0.21)			−0.15 (0.16)
N	30	36	36	36	30	30	30
Adjusted R^2	0.24	−0.02	−0.01	0.00	0.21	0.21	0.23

model of electronic trading with no intermediation. Our finding that the designated market maker resolves temporal order imbalances suggests that there continues to be an important role for intermediaries in the landscape of the modern financial market. Consistent with this conclusion, several foreign stock exchanges, including the Toronto Stock Exchange and the Paris Bourse, which adopted fully automated auctions with no intermediaries in the early 1990s, have gradually reintroduced designated market makers. More recently, in April 2005 Arca, the all-electronic trading platform of the NYSE, began to supplement its public electronic limit order book with liquidity supplied by designated market makers.

A second important policy issue faced by both exchange officials and market regulators concerns the manner in which designated liquidity providers are compensated for assuming affirmative obligations to maintain markets. In general, liquidity provision represents a positive externality in that traders who commit capital to make markets are not fully compensated for their liquidity services. While the usual solution to this inefficiency is a Pigovian subsidy, the form that this payment should take is less clear. In the NYSE model, the specialist is largely subsidized by trading profits earned from uninformed traders. But this form of specialist compensation has become controversial in light of the recent allegations that the NYSE specialist firms have abused their trading privileges.[14] As an alternative, stock exchanges might consider subsidizing liquidity providers directly. For example, market centers in the U.S. receive revenues from the sale

[14]Stoll and Whaley (1990), Rock (1997), and Ready (1999) suggest that there are implicit costs to this form of specialist compensation. Glosten (1989) characterizes the specialist with trading privileges as an information monopolist. Note that this characterization is not merely academic. For example, Greenberg (WSJ, December 18, 2003, p. A18) says "Under the current rules, NYSE specialists have been granted a virtual monopoly... the specialist positions himself as a gatekeeper who has an unfair view of the direction in which bid and ask traffic is flowing and is likely to flow. He can trade accordingly."

of their transaction data and these revenues could be used to compensate traders for providing liquidity, as is the case on several U.S. exchanges.[15] Many of these markets also directly compensate liquidity suppliers by providing credits to trade participants who post limit orders on their books. This paper considers whether the listed firm represents another important source of subsidy, an idea originally proposed by Schwartz (1988) who argues that corporations could directly realize the benefit of a lower cost of capital that a third-party market maker could not. Our findings directly support Schwartz (1988), suggesting that stock exchanges can enhance market quality for thinly traded securities by actively engaging their listing firms in the process of providing liquidity.

The paper offers a complementary message to financial managers. For less actively traded stocks, financial managers may increase firm value by making investments in liquidity enhancing projects. In the context of the Paris Bourse, financial managers directly invest in designated liquidity providers by entering into liquidity agreements, which are contracts between the firm and the market maker to supply liquidity. While such an arrangement may not be available or even permissible in all markets, financial managers can often determine whether a market maker will facilitate the trading of the firm's shares through the choice of listing venue. The results of this study suggest that an important factor for firms to consider when deciding where to list is the availability of a designated market maker.

VII. Conclusions

A number of electronic exchanges around the world have recently introduced designated market makers, or dealers, to facilitate trading in their stocks. These agents, in contrast to their NYSE counterparts, possess no trading privileges over other market participants and are directly compensated by the listing firm. Using data from the Paris Bourse, this study presents empirical evidence on the value of such a designated market maker. The results suggest that the designated market maker resolves temporal imbalances in order flow and reduces investor price risk by increasing the likelihood that trade will occur. We conclude that the designated market maker can improve the terms of trade offered by public limit orders, at least for less liquid securities, by simply maintaining a market presence.

Our study is the first, as far as we know, to document an increase in market valuation around the introduction of the designated market maker. Cross-sectionally, the price effects are positively related to improvements in market clearing, suggesting that the resolution of price risk is an important benefit of market maker participation. The increase in market valuation of nearly 5% around market maker introduction emphasizes the potential benefits of designing better market structures, even within electronic limit order markets.

While our findings suggest a valuable role for designated market makers, several related issues are not addressed in this study. First, alternative mechanisms to subsidize liquidity providers also exist. For instance, stock exchanges

[15]The SEC's recently proposed Regulation NMS distributes market data revenues based on the market center's contribution to public price discovery (see, for details, http://www.sec.gov/rules/proposed/34-49325.htm).

might distribute revenues from the sale of transaction data to individuals willing to commit capital to the market. Thus, while we describe one mechanism of compensation, the analysis has little to say with regard to the optimal mechanism for compensating liquidity providers. Second, the analysis in this study is restricted to securities that trade in call auctions. As economic theory often models continuous trading as a special case of the call market, the literature predicts that the insights provided by this study are relevant for continuous markets as well. However, the extent of applicability is an empirical question. Finally, we do not assess the value of the market maker for actively traded securities or the profitability of liquidity arrangements for market making firms. We believe that these questions provide interesting avenues for future research.

References

Amihud, Y., and H. Mendelson. "Trading Mechanisms and Stock Returns: An Empirical Investigation." *Journal of Finance*, 42 (1986), 533–553.

Amihud, Y.; H. Mendelson; and B. Lauterbach. "Market Microstructure and Securities Value: Evidence from Tel Aviv Stock Exchange." *Journal of Financial Economics*, 45 (1997), 365–390.

Anand, A., and D. Weaver. "The Value of a Specialist: Empirical Evidence from the CBOE." *Journal of Financial Markets*, 9 (2006), 100–118.

Battalio, R. Discussion of "Do 'Thinly-Traded' Stocks Benefit from Specialist Intervention?" by M. Nimalendran and G. Petrella, *Journal of Banking and Finance*, 27 (2003), 1855–1857.

Benveniste, L.; A. Marcus; and W. Wilhelm. "What's Special about the Specialist?" *Journal of Financial Economics*, 32 (1992), 61–86.

Bessembinder, H., and K. Venkataraman. "Does an Electronic Stock Exchange Need an Upstairs Market?" *Journal of Financial Economics*, 73 (2004), 3–36.

Biais, B.; P. Hillion; and C. Spatt. "An Empirical Analysis of the Limit Order Book and the Order Flow in the Paris Bourse." *Journal of Finance*, 50 (1995), 1655–1689.

Biais, B.; P. Hillion; and C. Spatt. "Price Discovery and Learning during the Pre-Opening Period in the Paris Bourse." *Journal of Political Economy*, 107 (1999), 1218–1248.

Bloomfield, R.; M. O'Hara; and G. Saar. "The 'Make or Take' Decision in an Electronic Market: Evidence on the Evolution of Liquidity." *Journal of Financial Economics*, 75 (2005), 165–199.

Brown, S., and J. Warner. "Using Daily Stock Returns: The Case of Event Studies." *Journal of Financial Economics*, 14 (1985), 3–31.

Cao, C.; H. Choe; and F. Hatheway. "Does the Specialist Matter? Differential Execution Cost and Inter-Security Subsidization on NYSE." *Journal of Finance*, 52 (1997), 1615–1640.

Corwin, S. "Differences in Trading Behavior across NYSE Specialist Firms." *Journal of Finance*, 54 (1999), 721–745.

Demsetz, H. "The Cost of Transacting." *Quarterly Journal of Economics*, 82 (1968), 33–53.

Domowitz, I., and B. Steil. "Securities Trading." In *Technological Innovation and Economic Performance*, B. Steil, D. Victor, and R. Nelson, eds. Princeton, NJ: Princeton University Press (2002).

Fernando, C.; V. Gatchev; and P. Spindt. "Wanna Dance? How Firms and Underwriters Choose Each Other." *Journal of Finance*, 53 (2005), 285–311.

Garbade, K., and W. Silber. "Structural Organization of Secondary Markets: Clearing Frequency, Dealer Activity, and Liquidity Risk." *Journal of Finance*, 34 (1979), 577–593.

Glosten, L. "Insider Trading, Liquidity, and the Role of the Monopolistic Specialist." *Journal of Business*, 62 (1989), 211–236.

Glosten, L. "Is the Electronic Open Limit Order Book Inevitable?" *Journal of Finance*, 49 (1994), 1127–1161.

Glosten, L., and P. Milgrom. "Bid, Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders." *Journal of Financial Economics*, 14 (1985), 71–100.

Goldstein, M., and K. Kavajecz. "Trading Strategies during Circuit Breakers and Extreme Market Movements." *Journal of Financial Markets*, 7 (2004), 301–333.

Greenberg, M. "Lose the Specialists." *The Wall Street Journal*, December 18, 2003, A18.

Grossman, S. "On the Efficiency of Competitive Stock Markets Where Trades Have Diverse Information." *Journal of Finance*, 31 (1976), 573–585.

Grossman, S., and M. Miller. "Liquidity and Market Structure." *Journal of Finance*, 43 (1988), 617–633.

Grossman, S., and J. Stiglitz. "On the Impossibility of Informationally Efficient Markets." *American Economic Review*, 70 (1980), 393–408.
Grullon, G.; G. Kanatas; and J. Weston. "Advertising, Breadth of Ownership and Liquidity." *Review of Financial Studies*, 14 (2004), 243–276.
Harris, L. "Does a Large Minimum Price Variation Encourage Order Exposure?" Working Paper, University of Southern California (1996).
Hasbrouck, J., and G. Sofianos. "The Trades of Market Makers: An Analysis of NYSE Specialists." *Journal of Finance*, 48 (1993), 1565–1594.
Heckman, J. "Dummy Endogenous Variables in a Simultaneous Equation System." *Econometrica*, 46 (1978), 931–959.
Huang, R., and H. Stoll. "Dealer versus Auction Markets: A Paired Comparison of Execution Costs on Nasdaq and NYSE." *Journal of Financial Economics*, 41 (1996), 313–357.
Kalay, A.; L. Wei; and A. Wohl. "Continuous Trading or Call Auctions: Revealed Preferences of Investors at the Tel Aviv Stock Exchange." *Journal of Finance*, 57 (2002), 523–542.
Kavajecz, K. "A Specialist's Quoted Depth and the Limit Order Book." *Journal of Finance*, 54 (1999), 747–771.
Kehr, C.; J. Krahnen; and E. Theissen. "The Anatomy of a Call Market: Evidence from Germany." *Journal of Financial Intermediation*, 10 (2001), 249–270.
Maddala, G. *Limited Dependent and Qualitative Variables in Econometrics.* Cambridge, MA: Cambridge University Press (1983).
Madhavan, A., and M. Cheng. "In Search of Liquidity: Block Trades in the Upstairs and Downstairs Market." *Review of Financial Studies*, 10 (1997), 175–203.
Madhavan, A., and V. Panchapagesan. "Price Discovery in Auction Markets: A Look Inside the Black Box." *Review of Financial Studies*, 13 (2000), 627–658.
Madhavan, A., and S. Smidt. "An Analysis of Changes in Specialist Quotes and Inventories." *Journal of Finance*, 48 (1993), 1595–1628.
Madhavan, A., and G. Sofianos. "An Empirical Analysis of NYSE Specialist Trading." *Journal of Financial Economics*, 48 (1998), 189–210.
Mayhew, S. "Competition, Market Structure and Bid-Ask Spreads in Stock Options Markets." *Journal of Finance*, 57 (2002), 931–958.
Merton, R. "A Simple Model of Capital Market Equilibrium with Incomplete Information." *Journal of Finance*, 42 (1987), 483–510.
Muscarella, C., and M. Piwowar. "Market Microstructure and Securities Values: Evidence from the Paris Bourse." *Journal of Financial Markets*, 4 (2001), 209–229.
Nimalendran, M., and G. Petrella. "Do 'Thinly-Traded' Stocks Benefit from Specialist Intervention?" *Journal of Banking and Finance*, 27 (2003), 1823–1854.
Pagano, M., and R. Schwartz. "A Closing Call's Impact on Market Quality at Euronext Paris." *Journal of Financial Economics*, 68 (2003), 439–484.
Parlour, C., and D. Seppi. "Liquidity-Based Competition for Order Flow." *Review of Financial Studies*, 16 (2003), 301–343.
Ready, M. "The Specialist's Discretion: Stopped Orders and Price Improvement." *Review of Financial Studies*, 12 (1999), 1075–1112.
Rock, K. "The Specialist's Order Book and Price Anomalies." Working Paper, Harvard University (1996).
Schwartz, R. "A Proposal to Stabilize Stock Prices." *Journal of Portfolio Management*, 15 (1988), 4–11.
Seppi, D. "Liquidity Provision with Limit Orders and a Strategic Specialist." *Review of Financial Studies*, 10 (1997), 103–150.
Stoll, H., and R. Whaley. "Stock Market Structure and Volatility." *Review of Financial Studies*, 3 (1990), 37–71.
Venkataraman, K. "Automated versus Floor Trading: An Analysis of Execution Costs on the Paris and New York Exchanges." *Journal of Finance*, 56 (2001), 1445–1485.
Viswanathan, S., and J. Wang. "Market Architecture: Limit-Order Books versus Dealership Markets." *Journal of Financial Markets*, 5 (2002), 127–167.