Geographic Proximity and Price Discovery: Evidence from Nasdaq*

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ABSTRACT

We use the Nasdaq market making context to study the role of geographic proximity in the price discovery of a firm's stock. We show that market makers closer to the firm's headquarters provide more informative bid and ask quotes, contribute more to the price changes of the firm's stock, and account for greater information share relative to other market participants. We provide significant evidence that the stronger imprint of local market makers on prices is due to their information advantage relative to non-local market makers. We argue that geographic proximity between the firm and its investors promotes more efficient price discovery in public markets.

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ABSTRACT

We use the Nasdaq market making context to study the role of geographic proximity in the price discovery of a firm's stock. We show that market makers closer to the firm's headquarters provide more informative bid and ask quotes, contribute more to the price changes of the firm's stock, and account for greater information share relative to other market participants. We provide significant evidence that the stronger imprint of local market makers on prices is due to their information advantage relative to non-local market makers. We argue that geographic proximity between the firm and its investors promotes more efficient price discovery in public markets.

A growing body of research in financial economics argues that geographic proximity to firms poses an information advantage for investors, security analysts, and acquirers.[1] These studies suggest that geography might be an important factor affecting the price discovery process in capital markets. The question of how prices incorporate private information and communicate this information to market participants is recognized as one of the central questions in financial economics with direct implications for investors, firms, and regulators. The lack of comprehensive data on the identity, location, and trading of investors, however, makes it difficult to directly address the significance of geographic location for price discovery in public markets.

In this study we overcome the above data limitation by examining the quotes of all Nasdaq market makers in a large cross-section of stocks. Examining Nasdaq market makers benefits our analysis for at least two reasons. First, market makers are the predominant channel for order flow of Nasdaq securities. As a result, market makers can incorporate information from observed order flow into their quotes. In addition, market makers have a strong incentive to independently acquire information and incorporate this information into their quote setting process.[2] Second, firms and market makers on Nasdaq are widely dispersed across the U.S. making the Nasdaq context particularly fitting for a study of the effect of geographic proximity on price discovery.

We explore the implications of market maker geographic proximity for price discovery based on three different price discovery measures. The first one estimates the proportion of time in a day that a

[1] Coval and Moskowitz (2001) find that firm ownership by nearby investors is positively related to the firm's future returns. Ivković and Weisbenner (2005) show that the average household generates an additional return of 3.7% per year from its local holdings relative to its non-local holdings. Malloy (2005) shows that geographically proximate analysts are more accurate in their earnings estimates than distant analysts. Bae, Stulz, and Tan (2007) find that domestic stock analysts have information advantage over foreign analysts and that the extent to which U.S. investors underweight a country's stock is positively related to that country's local analyst advantage. Kang and Kim (2007) and Kedia, Panchapagesan, and Uysal (2007) show that geographic proximity provides an information advantage in acquisitions.

[2] Existing literature shows that proprietary trading by intermediaries contains information. For example, Saar (2001) shows that market intermediaries possess important order flow information which gives them an information advantage relative to other market participants. Anand and Subrahmanyam (2007) find that intermediaries, while initiating fewer trades and volume relative to other institutional and individual investors, account for greater price discovery. Madhavan and Smidt (1993) and Hasbrouck and Sofianos (1993) find that specialists' trades have an investment motive.

market maker provides the best bid quote, the best ask quote, and the best bid-ask quotes. The second one is the weighted price contribution measure of Barclay and Warner (1993). The third measure uses the information shares approach developed by Hasbrouck (1995) to estimate the information share of market makers that are geographically close to the firm.[3] All three measures complement each other and allow us to conduct different types of analyses. For instance, the Hasbrouck (1995) information shares approach directly captures contributions to price discovery by focusing on the evolution of a security's efficient price while removing distortions induced by temporary price moves. The estimation of this measure, however, can not be implemented at the level of individual market makers. Our other two measures, in contrast, are calculated for each stock-market maker pair which allows a more detailed analysis of the determinants of price discovery.

For all three measures we find that local market makers (located within 250 miles of the firm's headquarters) contribute more to price discovery than non-local market makers (located further than 250 miles from the firm's headquarters).[4] For example, using the information shares methodology of Hasbrouck (1995), we find that for the average firm, the information share of local market makers is around 56% while the information share of non-local market makers is around 29%. ECNs are responsible for the remaining 15% information share in our sample stocks.[5] Market maker contribution to price discovery is positively related to geographic proximity even after controlling for a variety of firm and market maker characteristics. We also find that a market maker's contribution to price discovery in a particular stock is positively related to that market maker's proximity to other firms in the

[3] Huang (2002) uses the measures of Barclay and Warner (1993) and Hasbrouck (1995) to examine the price discovery of ECNs in the 30 largest Nasdaq stocks.

[4] Market makers on Nasdaq exhibit a strong preference for stocks of companies that are located close to them. For example, the average market maker in our sample provides quotes for 4.45% of the firms that are within 250 miles and only for 2.25% of the firms that are further than 250 miles away (see also Schultz (2003)). In our analysis we control for the resulting sample selection bias.

[5] Our findings attributing the majority of price discovery to local market makers seem to be at odds with the results in Huang (2002) which credits ECNs with the largest information share. However, this difference arises because of differences in the samples used. We confirm that ECNs account for the largest information share in Huang's (2002) sample of the 30 largest Nasdaq stocks.

same industry, suggesting that geographic proximity facilitates the information acquisition at both firm and industry levels.

We propose three general channels through which local market makers could acquire superior information about the firm: direct acquisition, local order flow, and investment banking activities (e.g., equity issues and M&A transactions). Direct information acquisition by local market makers is consistent with a growing body of research showing that investors have an information advantage about nearby firms (e.g., Coval and Moskowitz (2001) and Ivković and Weisbenner (2005)). Market makers may not be different from other local investors in discovering local information first. Another reason that local market makers may be better informed than non-local market makers is that they could observe the informed order flow of other local investors. Such order flow information could reach local market makers from affiliated brokerage houses or other brokerage houses in the local community. We refer to this as the order flow hypothesis. Finally, local market makers may be better informed than non-local market makers as a result of information spillovers within the investment bank of the market maker. Existing literature recognizes that through their investment banking services (e.g., equity issues underwriting and M&A advising) investment banks generate information about the firm. It is possible that local market makers have privileged access to this information (e.g., Ellis, Michaely, and O'Hara (2000)). Admittedly, the three channels of acquiring information are not mutually exclusive.

To investigate the relative importance of the above three information channels in explaining the superior performance of local market makers, we examine how the link between geographic proximity and price discovery is related to several firm and market maker characteristics. Overall, we find significant support for the direct information acquisition hypothesis and the investment banking hypothesis but not for the local order flow hypothesis.

Consistent with the direct information acquisition hypothesis, we show that geographic proximity is more important for the price discovery of firms with less public information, such as firms in remote areas, firms not in the S&P 500 index, and firms of smaller market capitalization. Consistent with the investment banking hypothesis, we find that, relative to other market makers, market makers

who were also lead underwriters in past IPOs or SEOs of the firm or advised the firm in past M&A deals play a more important role in the price discovery process. Interestingly, past investment banking relationships with the firm become even more important for price discovery of affiliated market makers when they are more closely located. This result suggests that the information advantage of geographic proximity could be partially explained by information spillovers in the financial services industry.

To test the local order flow hypothesis, we investigate whether market makers who handle institutional order flow contribute more to price discovery than market-makers who work with retail investors. Institutional investors are generally considered more informed and sophisticated than retail investors. As a result, under the order flow hypothesis, market makers processing institutional order flow would benefit more from their proximity to the firm's headquarter than market makers processing retail order flow. We show, however, that the price discovery of market makers dealing with institutional investors is not statistically different from the price discovery of market makers dealing with retail investors.

We also find that distance not only to the firm but to other firms from the same industry matters for price discovery, indicating that a significant part of firms' information production happens at the industry level. This finding shows that the importance of proximity for price formation is particularly strong, given that it discriminates between both firm-specific and industry-specific information. Overall, our results are consistent with the idea that geographic proximity between the firm and its market makers affects price discovery in the firm's stock.

As further evidence on the informational advantage of geographic proximity, we analyze whether the quotes of local market makers contain more information about future (short-term) returns than the quotes of non-local market makers. We create a variable, the "bid bias," that measures the difference between the time a market maker's quote is at the best bid and the time the market maker's quote is at the best ask. Market makers that quote disproportionately more at the best bid relative to the best ask increase the risk of trading against informed traders with negative information about the firm. If local market makers are better informed than non-local market makers, then the difference in bid biases

between local and non-local market makers should predict subsequent price changes of a stock. We indeed find that the difference between local and non-local bid biases is positively related to the cross-section of short-term future returns.

The paper also contributes to the literature on firm headquarters location and agglomeration. Extensive research in economics and industrial organization studies the determinants of headquarter agglomerations and the underlying economic base of many larger metropolitan areas (see Marshall (1980), Glaeser, Kallal, Scheinkman, and Shleifer (1992), and Lovely, Rosenthal and Sharma (2005)). Researchers have identified a variety of reasons for agglomeration, such as better services from specialists in law, advertising, and finance due to face-to-face interaction; close spatial proximity between buyers and sellers; better information exchange with other firms about production, input, and technology. Our results suggest that headquarter agglomeration, especially within the same industry groups, could lower the cost of information acquisition for investors, which could promote more efficient prices of firm's securities.

Our analysis has implications for the theory of market microstructure. Traditional market microstructure literature (e.g., Kyle (1985) and Glosten and Milgrom (1985)) largely views market makers as uninformed traders. More recent work (Saar (2001)) shows that market intermediaries possess important order flow information which gives them an information advantage. Madhavan and Smidt (1993) and Hasbrouck and Sofianos (1993) find that specialists have an investment motive to their trades, while Anand and Subrahmanyam (2007) show that intermediaries account for greater price discovery than other institutional and individual investors. We argue that the information set of market makers extends beyond past prices and reflects the demographical aspects of trading, such as proximity to firm's headquarter or other firms from the same industry.

The rest of the paper is organized as follows. Section I provides a short discussion on Nasdaq market structure, Section II discusses the measures of price discovery, and Section III presents the sample and data. In Section IV we examine the link between geographic proximity and price discovery.

Section V explores the determinants of local price discovery, while Section VI performs an additional test of whether our results are related to information. We conclude in Section VII.

I. Market Structure of Nasdaq

Nasdaq is an electronic quote-driven market with various market makers providing liquidity in Nasdaq listed securities. The Nasdaq market making business is characterized by relatively easy entry and exit. Market makers can begin making a market in any stock following a one day registration period and stop making a market with a short, 30 minute notice. When a market maker exits market making in a stock, she is not allowed to re-enter market making in that stock for 30 days. Wahal (1997) finds that entry and exit into market making of different stocks is indeed commonplace.

Ellis, Michaely, and O'Hara (2002) and Huang (2002) document a considerable heterogeneity in market making firms. In our analysis, we use the classification of market makers by Huang (2002) into wholesalers, wire houses, institutional brokers, and other market makers. Wire houses tend to be integrated retail and full service brokers such as Merrill Lynch. Wholesalers tend to be very large market makers but do not have an underwriting or brokerage operation (e.g. Knight Securities). Institutional brokers tend to be associated with underwriters. Goldman, Sachs and Co. and Bear Stearns are two examples of market makers in this category. Griffin, Harris and Topaloglu (2003) contend that wire houses and institutional brokers are more likely to deal with institutional order flow, while wholesalers predominantly attract retail order flow. We use this insight in our subsequent analysis.

Beginning with the implementation of the order handling rules in 1997, which mandated the inclusion of ECN quotes in the Nasdaq quote montage and hence the calculation of the best bid and offer quotes, Electronic Communication Networks (ECNs) gained increased market share for Nasdaq stocks. As Simaan, Weaver and Whitcomb (2003) discuss, while market maker quotes show up in the Nasdaq montage associated with the market maker ID, quotes posted in ECNs carry the ECN identifier. Hence, ECNs offer market makers the ability to post their quotes anonymously.

Given our interest in local versus non-local market makers, the inability to identify whether an ECN bid or ask quote is associated with a particular market maker could be an issue if ECNs are the predominant source of price discovery, or if market makers strategically choose ECNs for their more informative quotes. As we discuss later, we do not find that in the overall sample of Nasdaq firms ECNs are the predominant information channels. Furthermore, competitive market makers are likely to use their information in setting their own quotes as well as in submitting orders to ECNs.

Another feature of Nasdaq during our sample period is the prevalence of payment for order flow arrangements. Under the terms of these arrangements, brokers route orders to select market makers with the understanding that the market makers will execute the orders at the National Best Bid or Offer (NBBO) quote in the market. In return, the market maker pays the broker a small compensation for routing the order. The existence of payment for order flow arrangements may lower the incentives of market makers to post better prices (e.g., Chordia and Subrahmanyam (1995)). However, we have no reason to expect such arrangements to affect local and non-local market makers differently.

II. Measuring Price Discovery

In the Glosten and Milgrom (1985) framework, market makers set bid and ask quotes such that resulting transaction prices reflect the information possessed by investors they trade with. In other words, market makers set the bid quote conditional on the next trader wanting to sell and the ask quote conditional on the next trader wanting to buy. Thus, bid and ask quotes reflect a market maker's assessment of the value of the stock as well as her assessment of the probability of informed trading. This gives rise to our first set of measures of price discovery for each market maker -- the proportion of time (between 9:30 a.m. to 4:00 p.m.) the market maker is quoting at the best bid quotes, the best ask quotes, and both the best bid and ask quotes during the trading day. Market makers who quote more frequently at the best prices contribute more to the price discovery of the stock because transaction prices are more closely related to the inside quotes relative to other quotes. Furthermore, such market

makers would also be better informed. Consistent with this conjecture, Bloomfield, O'Hara, and Saar (2005) show that informed investors are able to make better markets based on their information.

While best quotes capture one aspect of a market maker's contribution to price discovery, they do not assess whether a market maker is actively discovering the price of the stock or just passively matching the best price in the market. To better examine the source of price movements in a stock, we use the Barclay and Warner (1993) weighted price contribution measure, as modified by Huang (2002). Barclay and Warner (1993) use this measure to identify which trades (small, medium, or large) move prices. In a context similar to ours, Huang (2002) uses the weighted price contribution to examine the role of ECNs in price discovery (see also the references therein). The weighted price contribution of market maker j in stock i is:

$$\textit{Weighted Price Contribution}_{i,j} = \sum_{t=1}^{T} \left(\frac{\left|\Delta p_t^i\right|}{\sum_{t=1}^{T} \left|\Delta p_t^i\right|} \right) \left(\frac{\Delta p_t^{i,j}}{\Delta p_t^i} \right), \tag{2}$$

where p_t^i is the inside bid quote of each stock i.[6] The term Δp_t^i is the overall change in the inside bid quote of stock i on day t while $\Delta p_t^{i,j}$ is the sum of all inside bid quote changes initiated by market maker j for firm i on day t.[7] Noting that Δp_t^i is also equal to the sum of $\Delta p_t^{i,j}$ across all market makers ($j = 1$ to J), the expression $\left(\frac{\Delta p_t^{i,j}}{\Delta p_t^i} \right)$ measures the relative contribution of market maker j to the quote change of stock i on day t. The price contribution for each firm-market maker pair i, j is calculated for each day t in our sample. We then calculate a weighted average (averaged over all days) to obtain a measure of the $\textit{Weighted Price Contribution}_{i,j}$. The weight is the absolute quote change during day *t* relative to the cumulative absolute quote change over the entire month period.

[6] We have also defined the measure based on ask quotes and the results are qualitatively similar.
[7] If more than one market maker initiates the change of inside quotes at the same moment in time, then the change is equally allocated across all market makers associated with the change.

Our third and final measure of price discovery is the information shares measure developed by Hasbrouck (1995). The information shares approach has been used to examine the contribution of different markets to the price discovery in the stock market (Hasbrouck (1995)), in the futures market (Hasbrouck (2003)), across stock and options markets (Chakravarty, Gulen, and Mayhew (2003)), and within different trader groups in a market (Kurov and Lasser (2004) and Anand and Subrahmanyam (2007)). Our application of the information shares methodology assumes that quotes from local market makers, non-local market makers, and ECNs, for the same stock, share a common random walk component -- also referred to as the efficient price. The information share of a particular group is then measured as that group's contribution to the total variance of innovations of this efficient price.

It would appear natural to define each market maker as a separate market in which price discovery occurs and then estimate the information share of each market maker. However, a successful estimation of the methodology of Hasbrouck (1995) requires price series with significant time variation. This prevents us from using the measure at the market maker level, because many market makers update their quotes infrequently. Therefore, for each firm we group quotes from three sources -- ECNs, market makers within 250 miles of the firm, and market makers further than 250 miles from the firm. We then construct best quotes for each of the three groups on a second by second basis for our estimations. Using the empirical methodology of Hasbrouck (1995), we estimate the information share of each of these three prices (second-by-second best bid quotes within each market) in discovering the underlying efficient price of the security.

The cut-off of 250 miles, while in line with existing literature (e.g., Ivković and Weisbenner (2005)), is somewhat arbitrary. We replicate our tests using a firm-specific cut-off -- the median distance from firm i to all of its market makers. The results are similar and available upon request. For each stock over each trading day, we then estimate the information share of local market makers, non-local market makers, and ECNs. We follow Hasbrouck ((1995) and (2003)) in excluding any overnight price changes. Thus, the analysis yields a set of information share estimates for each stock on each trading day that is included in the sample. We then average the information shares at the firm level and

report the means and medians of these firm-level estimates. Tests of significance are based on standard errors of the firm-level means.

III. Data and Summary Statistics

A. Sample

The main sample comes from the Nastraq database. For Nasdaq traded issues, Nastraq provides data on trades, inside quotes, and individual market maker bid and ask quotes. The identity of the market makers posting the quotes is also disclosed in the data. We conduct our analysis using data from June 1999 (22 trading days). We use only quotes between 9:30 a.m. and 4:00 p.m. For June 1999, Nastraq provides quotes for 5,578 common stocks covered by 490 market makers and ECNs. We restrict our sample to the common stock of firms headquartered in the continental U.S. with available data from the Compustat annual files and the CRSP monthly files.[8] Because the source of the quotes is anonymous in ECNs, we exclude ECNs from those portions of our analyses where the focus is on the level of individual market makers. The above requirements lead to a sample of 3,884 firms and 463 distinct market makers that provide quotes in these firms.

We define firm location as the location of the firm's headquarters (see Coval and Moskowitz (1999) and (2001), Ivković and Weisbenner (2005), and Loughran and Schultz (2004)). Corporate headquarters are close to corporate core business activities. More importantly, corporate headquarters are the center of information exchange between the firm and its suppliers, service providers, and investors (see Davis and Henderson (2004) for a detailed discussion on the role of corporate headquarters). Market maker location is defined analogously as the location of the market maker's headquarters.

[8] To mitigate the effect of outliers on subsequent tests, we exclude three firms headquartered in Alaska, seven firms headquartered in Hawaii, four firms headquartered in Puerto Rico, and one firm headquartered in the Virgin Islands. Including these 15 firms, however, does not change our findings.

Firm and market maker locations are identified at the level of zip codes. We obtain zip codes for company headquarters from the Compustat annual research files and correct them for historic changes using Compact Disclosure. We manually collect market maker location zip codes from the July 1999 directory of the National Securities Clearing Corporation (NSCC) and from the Financial Industry Regulatory Authority (FINRA) where NSCC data are missing. We obtain the latitude and longitude for each zip code from the U.S. Census Bureau's Gazetteer Place and Zip Code Database, and measure the distance between firm i and market maker *j* as:

$$\begin{aligned} d_{i,j} = \arccos\{&\cos(lat_i)\cos(lon_i)\cos(lat_j)\cos(lon_j) \\ &+ \cos(lat_i)\sin(lon_i)\cos(lat_j)\sin(lon_j) \\ &+ \sin(lon_i)\sin(lat_j)\}2\pi r/360, \end{aligned} \tag{1}$$

where *lat* and *lon* are the latitudes and longitudes (measured in degrees) of company headquarters and market maker locations and *r* is the radius of the earth (≈ 3,961 miles) (see also Coval and Moskowitz (1999) and Ivković and Weisbenner (2005)).

Figure 1 presents the geographic distribution of U.S. companies and market makers for June of 1999. The figure plots the headquarter locations of 3,884 companies in our sample and the main office locations of the 463 market makers (excluding ECNs) that make markets in these companies. The horizontal axis shows the actual longitude (in degrees) while the vertical axis shows the actual latitude (in degrees) of firm and market maker locations. Overall, there appears to be clustering of firms and market makers along the coast lines and borders and in large metropolitan areas. This pattern is not surprising, because coast lines, borders, and large metropolitan areas are the most heavily populated areas of the United States (i.e., these areas have the highest supply of human capital). The above mentioned clustering notwithstanding, there are significant numbers of firms and market makers widely dispersed throughout the United States.

[Insert Figure 1 about here]

What is the geographic composition of firm's market makers? Without seeking generality, in Figure 2 we look at two firms -- one large (Dell Inc.) and one small (Santa Barbara Restaurant Group) --

and their market makers. The computer manufacturer Dell, headquartered in Texas, has multiple market makers in the state of Texas while Santa Barbara Restaurant Group, headquartered in California, has multiple market makers in the state of California. Dell also has market makers located in the Silicon Valley (the base for the technology industry in the U.S.), while Santa Barbara Restaurant Group has no market makers in the state of Texas. Both firms have market makers located in New York -- a focal point for the financial industry.

[Insert Figure 2 about here]

Table I provides summary statistics for nine geographical regions (ten regions when we separate California from the Pacific region) as defined by the U.S. Bureau of the Census. The table reports the number of firms, the number of market makers, and the number of different industries located in each region. We define industries based on 2-digit SIC codes. The Pacific region is the region with the highest number of firms (922 firms, with 779 firms in California only), followed by the Middle Atlantic (738 firms), South Atlantic (488 firms), and East north central (423 firms) regions. Correspondingly, these regions also have the highest number of market makers with the Middle Atlantic region having disproportionately more market makers (218 market makers) than any other region. The relatively high number of market makers in the Middle Atlantic region is mostly due to New York with 164 market makers. The East south central region has the fewest number of firms (116) and the fewest number of market makers (7). All regions are well diversified across industries with a minimum of 36 industries in the East south central region and a maximum of 56 industries in the Middle Atlantic region.

Table I also allows us to examine for a possible local bias of market makers (i.e., a preference of market makers to cover firms in the same region). For that purpose, we compare the total number of market makers in a firm out of the whole population to the number of regional market makers in the firm out of the whole region. For example, 24 out of the 25 (96%) market makers located in New England make markets in at least one firm located in New England. Overall, 304 of the total 463 (65.66%) market makers cover at least one firm located in New England. A similar "bias" of same-region market makers exists in all regions. On average for all nine regions, 86.75% of a region's market

makers cover firms in the same region while 63.79% of all 463 market makers cover firms in that region. Using all nine differences for the nine major regions, a simple *t*-test shows that the average difference of 22.96% is significant at the 0.01 level. The difference between same-state market maker coverage and total market maker coverage is highest for the East south central region (51.80%) and lowest for the South Atlantic region (6.07%).

[Insert Table I about here]

Our sample includes market makers from 36 different states. Table II reports the market makers with the highest number of firms for each of the 36 states. Knight Equity Markets, L.P. (located in Jersey City, NJ) is the market maker that provides quotes in the highest number of firms (3,597) in both the state of New Jersey and the whole sample. The table also shows the overall rank of the market maker (based on number of firms covered) and the number of market makers in each state. As mentioned above, the highest number of market makers (164) is in New York, with its largest market maker, Spear Leeds & Kellogg Capital Markets, quoting 3,586 firms and ranking second in the U.S. in terms of total number of quoted firms. Some other states with relatively high number of market makers are California, Florida, Texas, and Illinois. A few states have a single market maker. For example, the state of Maine has only one market maker, Bangor Securities, Inc., which quotes 4 different firms.

[Insert Table II about here]

B. Summary Statistics

In this section we review the characteristics of firms and market makers in our sample. In the subsequent analysis we use these firm and market maker characteristics to examine how they relate to the Nasdaq price discovery process.

B.1. Firm Variables

Table III, Panel A reports the mean, median, and standard deviation of variables related to our sample firms. We split the sample in two groups of high- and low-concentration of local market makers,

depending on the excess proportion of local market makers (within 250 miles of the firm's headquarter). The excess proportion of local market makers for firm i is calculated as:

$$Excess\ Proportion\ of\ Local\ Market\ Makers_i = \left(\frac{N_i^{Local}}{N_i^{All\ Local}} \right) - \left(\frac{N_i}{N_i^{All}} \right), \quad (3)$$

where N_i^{Local} is the number of local market makers quoting the firm, $N_i^{All\ local}$ is the number of all local market makers (those that quote as well as those that do not quote the firm), N_i is the total number of market makers that quote the firm, and N_i^{All} is equal to 463 -- the number of all market makers in our sample. Firms with excess proportion of local market makers below the 75th percentile of the distribution of this variable are included in the first sample (low-concentration sample) while firms with excess proportion of local market makers above the 75th percentile are included in the second sample (high-concentration sample).

Firms with high concentration of local market makers have around 9 market makers while firms with low concentration of local market makers have around 13 market makers. Firms with high concentration of local market makers also have smaller market capitalization ($160 million) relative to firms with low concentration of local market makers ($730 million). We also find that 10% (26%) of firms with high (low) concentration of local market makers are in remote areas. Remote areas are U.S. areas further than 250 miles from the 20 most populated cities. It is possible that there are fewer market makers in remote areas and so the market makers of firms in such areas are further away.

A high percentage of the sample firms have an IPO or SEO within the past five years -- 55% for the below-75th percentile sample and 41% for the above-75th percentile sample. Similarly, a high percentage of the firms have been a target or an acquirer in a potential M&A transaction within the past five years -- 23% for the below-75th percentile sample and 19% for the above-75th percentile sample. We collect IPO, SEO, and M&A transactions data from the SDC database of Thomson Financial.

B.2. Market Maker Variables

The summary statistics of market maker variables are presented in Panel B of Table III. The average (median) market maker in our sample provides quotes for 102.31 (20) firms. We further collect information on the founding date of each market maker from the Financial Industry Regulatory Authority (FINRA). At the time of our sample period, the average market making firm has been in existence for around 29 years.

The average distance between all market makers and all firms is 1,166 miles. The average distance between market makers and the firms in which they make a market is a significantly (at the 0.01 level) lower 1,110 miles. In the five years prior to our sample period, around 28% of our market makers are involved in at least one equity issue (IPO or SEO) as lead underwriters and a smaller 16% are involved in at least one M&A transaction as advisors of the sample firms.

[Insert Table III about here]

IV. Geographic Proximity and Price Discovery

In this section we explore the importance of market maker geographic proximity for price discovery. Specifically, we examine whether and how geographic proximity affects (i) the decision of market makers to make markets in firms, (ii) the proportion of time a market maker offers the best bid, best ask, and best bid and ask quotes, (iii) the weighted price contributions of market makers, and (iv) the information shares of local and non-local market makers.

A. Price Discovery by Local Market Makers

Table IV reports summary statistics of the price discovery measures for local and non-local market makers, where local market makers are located within 250 miles of the firm's headquarter, and non-local market makers are located further than 250 miles of the firm headquarter. There are significantly fewer observations (13,863 versus 33,505) for the sample where firms and market makers are within 250 miles distance. For firm-market maker pairs within 250 miles, the bid quotes of the

average (median) market maker are equal to the best bid in the market 9.70% (4.87%) of the time. For firm-market maker pairs further than 250 miles apart, the bid quotes of the average (median) market maker are at the best bid 8.50% (4.00%) of the time. The differences in means and medians between the two samples are significant at the 0.01 level. The results for the proportion of time at best ask quotes are similar. The difference between the average proportions of time at the best bid-ask quotes in the two samples is lower than the average proportion of time at the best bid (or ask) quotes but the difference here is still highly statistically significant.

Table IV further reports the mean and median weighted price contribution for firm-market maker pairs within 250 miles and for pairs further than 250 miles apart. We again exclude ECNs from the analysis because the source of the quotes in ECNs is anonymous. For firm-market maker pairs within 250 miles the average (median) market maker has a weighted price contribution of 5.89% (1.12%), while for firm-market maker pairs further than 250 miles apart the average (median) market maker has a significantly smaller (at the 0.01 level) weighted price contribution of 4.64% (0.62%).

Finally, Table IV presents the estimated lower and upper bounds of the Hasbrouck (1995) information shares of local market makers non-local market makers, and ECNs. We are able to estimate the information shares of these three trading venues for 1,715 firms. For the average firm, we are able to estimate the information shares for 9.25 days out of the 22 trading days. The loss in observations is due to two main reasons. First, the estimation methodology fails to converge for some firms and days, and second, some firms have at least one of the three price series (local market makers, ECNs, or non-local market makers) missing on a particular day.[9]

The lower bound for the information share of local market makers for the average firm is 55.36% while the upper bound of the information share of non-local market makers is significantly (at the 0.01 level) lower 28.77%. The upper bound of ECNs is 16.09%. The medians lead to similar

[9] When we use the median distance from a firm to its market maker as a cut-off point, we are able to estimate the information shares of the three groups (local market makers, non-local market makers, and ECNs) for 2,507 firms. For the average firm the information shares are estimated in 11.54 days out of the 22 trading days. The results from the analysis using medians as the cut-off yield similar inferences as the ones presented here, and are available from the authors.

conclusions. Huang (2002) reports significantly higher information shares for ECNs in his sample. The difference is due to the fact that our sample firms are significantly smaller. When we isolate the 30 stocks examined by Huang (2002), our information share estimates confirm Huang's findings that ECNs are the main contributors to price discovery for those 30 stocks.

[Insert Table IV about here]

While the results in this section are based on simple comparisons of averages, they do indicate that geographic proximity of market makers to firms is associated with (i) better bid, ask, and bid-ask quotes, (ii) higher weighted price contributions, and (iii) higher information shares of market makers.

B. The Local Preference of Nasdaq Market Makers

Market makers do not make markets in all firms. In this section we examine the choice of market makers to make markets in firms. Our objective is twofold. First, market makers possibly make markets in firms in which they have a competitive advantage (e.g., Schultz (2003)). This is important for our study because failure to control for the underlying sample selection could lead to biased conclusions about the effects of geographic proximity (and the other explanatory variables) on the price discovery in stocks. In our subsequent analysis we incorporate this sample selection using Heckman's (1979) two-stage approach. In the first stage we estimate a probit model to determine whether a market maker provides quotes for a given firm. Second, we examine how geographic proximity to the industry as well as the firm affects the market maker's decision to make a market in firms.

Schultz (2003) argues that whether or not a market maker trades in a given stock depends on the dealer's competitive advantages in obtaining order flow and information about that stock. For example, he finds that market makers that are in the same state as the firm, that are the firm's IPO underwriter, and that trade other firms from the same industry are more likely to trade in the firm. Schultz also argues that institutional brokers would be less likely than wholesalers to make markets in a stock, because institutional brokers rely on order flow from institutional investors which trade selectively in large

firms. We include all of the above cross-sectional determinants of market maker activity in the subsequent analysis.

Table V presents the results from a probit model to explain whether a market maker provides quotes in a given firm. The sample consists of all 1,798,292 possible pairs between the 3,884 firms and the 463 market makers in our sample. Consistent with Schultz (2003), we find that market makers are more likely to provide quotes for firms they underwrite at the IPO and for firms in the same industries as their other quoted firms. The average marginal effect for geographic distance is -0.003 indicating that a doubling of the distance between a firm and a market maker reduces the probability of the market maker to cover the firm by approximately 30 basis points. For the average firm-market maker pair the probability of a match then declines from 2.634% to 2.334%.

Extending the findings of Schultz (2003), we also find that market maker proximity to other firms from the same industry (based on 2-digit SIC codes) affects positively the probability of a market maker to cover a firm. In fact, the coefficient estimate for the distance from a market maker to the average firm in the industry has a similar magnitude as the coefficient estimate for the distance from the market maker to the firm itself. We further find that market makers that were M&A advisors for the firm over the previous five years are more likely to provide quotes for that firm. The rest of the control variables have coefficient estimates consistent with expectations. For example, market makers are more likely to provide quotes in larger firms and firms with lower share prices (i.e., higher tick sizes). Furthermore, New York market makers are less likely to make markets in firms possibly because New York is a focal point for the financial industry and market makers may locate in New York for reasons other than direct acquisition of firm-specific information.

[Insert Table V about here]

C. Best Quotes and Contributions to Price Discovery

We now proceed to examine in more detail how geographic proximity affects price discovery. For that purpose we estimate four regression models in which the dependent variables are each market

maker's proportion of time at best bid, best ask, and best bid and ask, and her weighted price contribution.[10] As explanatory variables we use the variables from the selection model of Table V. Since we do not observe the dependent variables for firm-market maker pairs if market makers do not provide quotes for the firm, we control for this sample selection using Heckman's (1979) two-stage approach by including the inverse Mill's ratio from the model in Table V. To mitigate the influence of outliers when the dependent variable is the weighted price contribution, we exclude 87 firm-market maker observations (0.18% of the sample) with weighted price contributions below -1.00 and above 1.00.

The proportion of time at bid, ask, and bid-ask quotes and the weighted price contribution measures, when aggregated at the firm level, are inversely related to ECN participation in firms. For example, firms with high levels of ECN participation will have on average lower price contributions by other market makers. To correct for a potential bias, where the results may be driven by differences in ECN participation at the firm level rather than by differences in local versus non-local market maker price discovery, we standardize the dependent variables by subtracting the firm-specific mean and dividing by the firm-specific standard deviation. This adjustment further allows us to compare the results for the different measures of price discovery.

The results from all four models are presented in Table VI. All four price discovery measures are inversely and significantly (mostly at the 0.01 level) related to the distance between the market maker and the firm. For example, market makers that are closer to (further away from) a firm, spend more (less) time at the inside bid, ask, and bid-ask quotes. Also, market makers closer to the firm have higher weighted price contributions. Because all dependent variables are standardized, we can compare the coefficients from the different models. We find that when the dependent variables are the proportion of time a market maker's quotes are at the best bid, ask, or bid-ask the coefficients are quite similar -- a doubling of the distance between the firm and its market maker leads to a reduction in these variables of

[10] We do not estimate this model for information shares because information shares are not estimated at the individual market maker level.

approximately 0.07 to 0.08 standard deviations. The effect of geographic proximity on weighted price contributions is significantly lower in magnitude.

Industry-specific information also plays a significant role in market maker contribution to price discovery. The average distance from the market maker to all firms in the firm's industry is inversely and significantly (at the 0.01 level) related to all four measures of price discovery. The estimates suggest that the geographic proximity to the firm's industry group affects price discovery even more than does geographic proximity to the firm itself. Furthermore, market makers that are more focused in the industry of the firm spend more time at the best bid, ask and bid-ask quotes of that firm than other market makers. Market maker industry focus, however, is not significantly related to the market maker's weighted price contribution in the stock.

Different market maker types have different impact on price discovery. We distinguish among four major types of market makers -- wholesalers, wire houses, institutional brokers, and other market makers. Wholesalers handle primarily retail order flow, while wire houses, and institutional brokers deal with institutional investors (see Griffin, Harris, and Topaloglu (2003)).

If the primary source of information for market makers is their order flow, then we would expect market makers with more informative order flow to contribute more to price discovery. Because wholesalers handle primarily retail order flow while wire houses and institutional brokers deal with institutional order flow, we expect institutional brokers and wire houses to have the highest contribution to price discovery. We do not find support for this conjecture. On the one hand, relative to other market makers, wholesalers, wire houses, and institutional brokers spend more time at the best bid, ask, and bid-ask quotes. Furthermore, wholesalers and wire houses have higher weighted price contributions than other market makers. On the other hand, however, when examining the magnitude of the coefficients for wholesalers, wire houses, and institutional brokers, we find that wholesalers contribute significantly more to price discovery relative to wire houses and institutional brokers. For example, wholesalers spend approximately two times more time at the inside quotes than wire houses and nine times more time than institutional brokers. We reach to a similar conclusion when we examine the weighted price

contribution of the three categories. As discussed earlier, the order flow hypothesis predicts the opposite result (a higher contribution from wire houses and institutional brokers).

Market maker size (as measured by total number of firms covered) is positively related to price discovery. There are several possible interpretations of this finding. For example, market maker size may be positively related to market maker ability, which in turn would affect price discovery. Alternatively, market makers may face economies of scale, such as information spillovers across related securities. Another explanation could be that larger market makers are more likely to have branch offices located closer to the firm and so market maker size is effectively proxying for geographic proximity to firms. The number of market makers per firm is also positively related to price discovery.

Finally, market makers that are the firm's lead IPO or SEO underwriter or M&A advisor within five years prior to the sample period, contribute more to price discovery. This result suggests that past relations with the firm could generate firm-specific information that market makers could use in their quote setting process.

[Insert Table VI about here]

Overall, our results provide strong evidence that the contribution of a market maker to price discovery is positively related to her geographic proximity to the firm, as well as other firms from the same industry. Better price discovery is also provided by market makers with industry focus, prior relationships with the firm, and greater size. We also find that wholesalers, wire houses, and institutional brokers contribute significantly more to price discovery than other market makers.

V. Determinants of Local Price Discovery

We have shown so far that local market makers contribute more to price discovery of a stock than non-local market makers do. In this section we will try to understand the underlying sources of such an information advantage.

We consider three channels through which market makers may acquire information -- direct information acquisition, information acquisition through order flow, and information acquisition

through investment banking relationships. With respect to the first channel, local market makers, like any other market participant, can acquire information about the firm directly in which case geographic proximity would be an advantage (e.g., Ivković and Weisbenner (2005), Coval and Moskowitz (1999 and 2001), Hong, Kubik, and Stein (2005)). With respect to the second channel, unlike other market participants, market makers may obtain information through their order flow. If local (i.e., better informed) investors trade disproportionately more through the brokers of local market makers then local market makers would have an advantage over non-local market makers in observing this informed order flow. Furthermore, if local investors have easier access to local brokers then the limit orders of local investors are also likely to show up as the quotes of that broker's market maker. Finally, market makers could acquire information about the firm through existing investment banking relationships between the market maker's investment bank and the firm. In this case, geographic proximity to the firm may promote stronger relationships due to more frequent interactions, and, as a result, more active information acquisition.

To test the above hypotheses, we extend the regression models estimated in Table VI by adding interaction effects between the distance variable and several firm and market maker characteristics. Our firm variables are related to the information environment of the firm, while our market maker variables indicate whether the market maker is a wholesaler, a wire house, an institutional broker, IPO/SEO lead underwriter of the firm, and its M&A advisor. The estimated interaction coefficients are presented in Table VII.

The advantage of local market makers is stronger for smaller firms, firms located in remote areas (more than 250 miles from the 20 largest U.S. cities), firms not in the S&P500, and firms with higher R&D expenses. For all these firms, local market makers are consistently associated with better bid, better ask, and better bid-ask quotes. With respect to the weighted price contribution measure, the remote area and the S&P 500 interactions with distance have the expected sign but are not statistically significant.

We also find that wholesalers, wire houses, and institutional brokers benefit less from geographic proximity than other market makers. This relationship is especially well pronounced when we look at the time a market maker is at the best bid, best ask, or best bid-ask quotes. The similarity of our findings across market makers dealing with institutional order flow (wire houses and institutional brokers) and market makers dealing with the, presumably, less informed retail order flow (wholesalers) confirms our earlier findings that order flow is not a major information source for local market makers. It is important to note that our findings only indicate that the value of order-flow information is unrelated to the geographic distance between the firm and its market makers, and do not have any implications for the importance of order flow as a source of information for market makers.

Next, we show that market makers, whose investment bank was the lead underwriter of the firm's IPO/SEO deals, benefit more from their geographic proximity to the firm. This indicates that proximity facilitates the information exchange between the firm and its investment bank.

[Insert Table VII]

We also examine the relations documented above using the robust information shares methodology of Hasbrouck (1995). As noted earlier, the estimation yields upper and lower bounds of the information shares of local market makers, non-local market makers, and ECNs. We now estimate regression models where the dependent variables are the lower bounds of the information shares of local market makers and the independent variables are several firm-specific characteristics related to the information environment of the firm. We use two different cut off points for local market makers -- 250 miles and the median distance between a firm and its market makers. As discussed earlier, using median distances as cut offs leads to larger sample size. The results are presented in Table VIII.

Consistent with our previous findings, larger firms have lower information share of local market makers. However, we also find that the information share of market makers within 250 miles is smaller for firms in remote areas versus firms not in remote areas. It is possible that, by construction, firms in remote areas have very few local market makers leading to small information shares of local market

makers.[11] Indeed, when the cut off point for local market makers is the median distance from the firm to its market makers then we do not find a significant relation between the remote area dummy and the information share of local market makers. Consistent with our previous findings, firms not in S&P 500 have higher information share of local market makers when local versus non-local market makers are defined based on the median differences between a firm and its market maker. Overall, the results, although somewhat weaker, are again consistent with the idea that firms with higher information uncertainty (i.e., higher marginal benefit of information) benefit more from local market makers.

[Insert Table VIII about here]

In sum, we find that the price discovery of market makers that are closer to the firm is more important for firms with higher information uncertainty such as firms in remote areas, smaller firms, firms with higher R&D expenses, and firms not in S&P500. The results also suggest that information advantages obtained through existing investment banking relationships with the firm are enhanced when the firm and the market maker are geographically closer to each other. Overall, we do not find evidence that the information advantage of local market makers is driven by order flow.

VI. An Alternative Test of the Information Content of Local Market Maker Quotes

In this section we develop an alternative test of whether geographic proximity to firms is an informational advantage to market makers. The test uses the fact that a given market maker does not have to participate symmetrically at the best bid and the best ask quotes. If local market makers are better informed relative to non-local market makers and if future prices eventually incorporate that information, then disproportionate participation of local market makers at inside bid or inside ask quotes would predict future returns.

[11] When comparing this result to the results in Table VII, it is important to remember that the dependent variables in Table VII are calculated for each firm-market maker pair, while the information share is an aggregated measure. Hence, it is possible to have a high estimate for each market maker on average, while having a lower aggregated estimate if the number of market makers in a group is small.

To construct the test, for each day t and firm i we first construct a variable that measures the bid bias of each market maker j as:

$$Bid\ Bias_{i,j,t} = \frac{Proportion\ of\ time\ at\ best\ bid_{i,j,t} - Proportion\ of\ time\ at\ best\ ask_{i,j,t}}{\left(Proportion\ of\ time\ at\ best\ bid_{i,j,t} + Proportion\ of\ time\ at\ best\ ask_{i,j,t}\right)/2}. \quad (4)$$

A positive bid bias for market maker j indicates that this market maker posts disproportionately more quotes at the inside bid rather than the inside ask thus exposing herself to downside risk -- i.e., investors with negative information about the firm will be more likely to trade against that market maker and increase the long position of the market maker. The opposite is true when this measure is highly negative. As a result, the bid bias has to be positively related to the market maker's expectation about the value of the firm with respect to his current information.

To examine the information content of bid and ask quotes of local market makers relative to non-local market makers, for each day t we calculate the difference between the average bid bias of local market makers and the average bid bias of non-local market makers. We define local market makers based on the 250 miles cut-off point.[12] We then examine how this difference in bid biases relates to the returns of stock i for days $t+1$ to $t+4$.[13]

We take two approaches in relating the bid bias to future stock returns. The first approach is a cross-sectional regression where future returns are regressed on the current difference of bid biases between local and non-local market makers and control variables. Panel A of Table IX reports the time-series averages of the 22 cross-sectional coefficient estimates and their t-statistics.

The second approach is a portfolio approach where for each day t we construct two portfolios: a portfolio of firms with positive local bid bias and a portfolio of firms with negative local bid bias. We

[12] We also use the median distance between a firm and its market makers and a narrower 100 miles cut off point. Relative to the results presented here, when we use the median cut off point we get estimates that have the same signs but are insignificant. Using the 100 miles cut off point the magnitude and statistical significance of the estimates is higher than the results in Table IX.

[13] We further examine returns for up to two weeks after the measurement of the bid bias and in general do not find significant results beyond day $t+4$.

then examine the difference in the two portfolio returns over days $t+1$ to $t+4$. Panel B of Table IX reports the average returns over the 22 trading days of our sample and their t-statistics.

Both the regression and the portfolio results show that stocks with higher bid bias of local market makers versus non-local market makers have significantly higher returns in days $t+1$ and $t+4$. For days $t+2$ and $t+3$, the corresponding returns are still higher, although the difference is not statistically significant at conventional levels. Interpreting our portfolio results, we find that a portfolio that is long in firms with positive local bid bias and short in firms with negative local bid bias returns 0.11% on the following day. This daily return will cumulate to approximately 32% for the 252 trading days in a year. We note, however, that the high transaction costs of day-to-day trading should diminish this return substantially. Transaction costs notwithstanding, we find that the quotes of local market makers contain superior information relative to the quotes of non-local market makers that is economically significant.[14]

[Insert Table IX about here]

VII. Conclusion

The well documented bias of investors towards local companies extends to the dealers on the Nasdaq stock market. This local bias is surprisingly strong, given that Nasdaq is a decentralized electronic market and entry and exit into and out of the market making business have low costs. We also show that market makers that are closer to the firm's headquarters are associated more frequently with more informative bid and ask quotes, contribute more to the price discovery of stocks, and account for greater information share relative to other market participants. In summary, local market makers on Nasdaq contribute more to price discovery relative to non-local market makers.

The better price discovery provided by local market makers is consistent with the explanation that they exploit an informational advantage relative to non-local market makers. For example, we show

[14] Whether market makers exploit their information advantage is beyond the scope of the current paper. We leave this question to future research.

that the quotes posted by local dealers predict better subsequent stock returns than the quotes posted by non-local dealers. Consistent with information advantage, we also find that the benefits that firms derive from local market makers are stronger for smaller less visible firms and for firms in remote areas possibly because information diffusion for such firms is slower. Geographic proximity is even more important for price discovery when the market maker is the firm's IPO or SEO lead underwriter in prior equity issues. This finding implies that ongoing relationships between firms and financial intermediaries benefit from geographic proximity.

Consistent with the generally accepted idea that industry-specific information is relevant for asset pricing, we find that proximity to other firms from the same industry also improves the price discovery of Nasdaq market makers.

Our results have implications for the theory of market microstructure. Traditional models in market microstructure assume that market makers are passive investors who do not engage actively in the collection of information. In reality, however, market makers have strong incentives to collect information in order to minimize expected losses to informed traders. Our results show that the nature of this information goes beyond past prices and order flow and new theoretical models may be necessary to explain the behavior of market makers and of market prices.

Generally, localized trading is viewed as disadvantageous to firms and investors. Existing theories predict that segmented capital markets would be associated with lower liquidity and higher cost of capital than integrated capital markets. This view has become increasingly popular with the recent trend towards market globalization. Our results present evidence that the benefits of market integration may be limited by the information advantages that geographic proximity provides.

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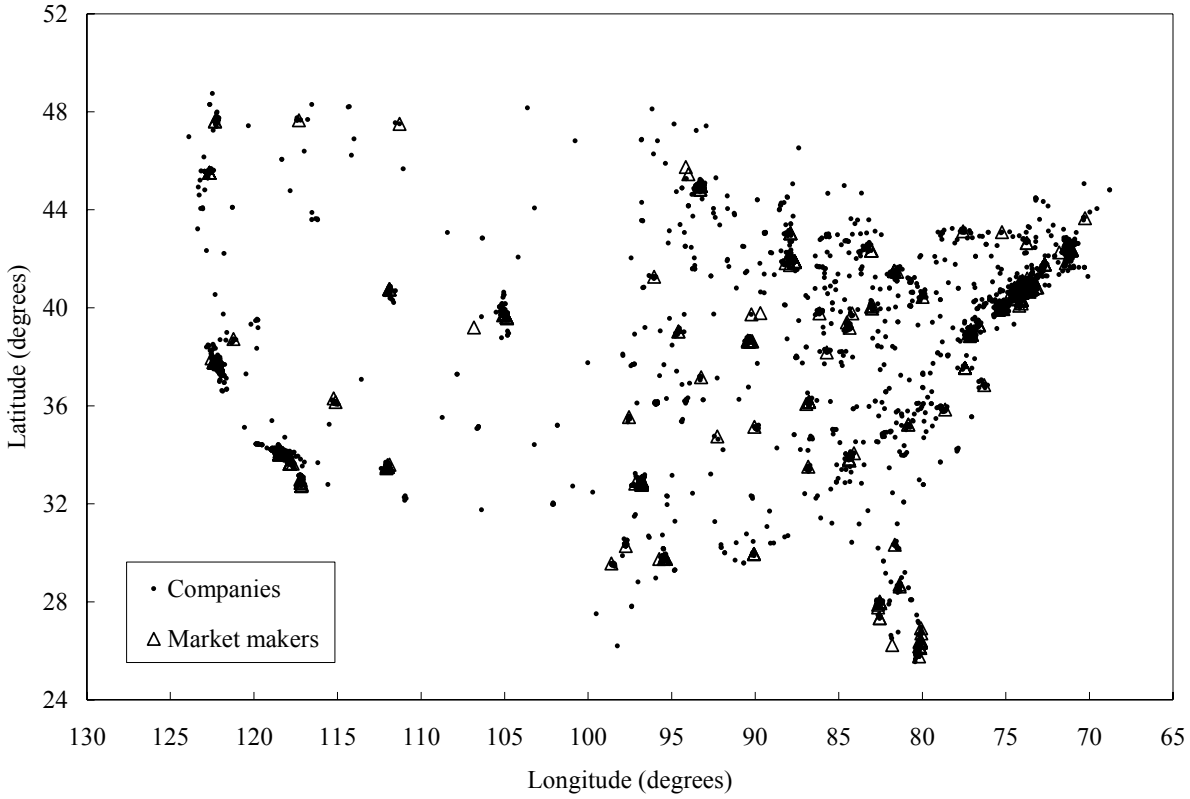

Figure 1. Geographic distribution of U.S. companies and market makers for June of 1999. The figure plots the headquarters location of 3,884 companies in our sample and the location of the 463 market makers (excluding ECNs) that make markets in these companies. Only companies and market makers located in the continental United States are in the sample. Zip codes for company headquarters are obtained from the Compustat Annual Research Files and corrected for historic changes using Compact Disclosure. Market maker location zip codes come from the July 1999 directory of the National Securities Clearing Corporation (NSCC) and from the Financial Industry Regulatory Authority (FINRA) where NSCC data is missing. The latitude and longitude for each zip code is from the U.S. Census Bureau's Gazetteer Place and Zip Code Database. The horizontal axis shows the actual longitude (in degrees) of firm and market maker locations. The vertical axis shows the actual latitude in degrees.

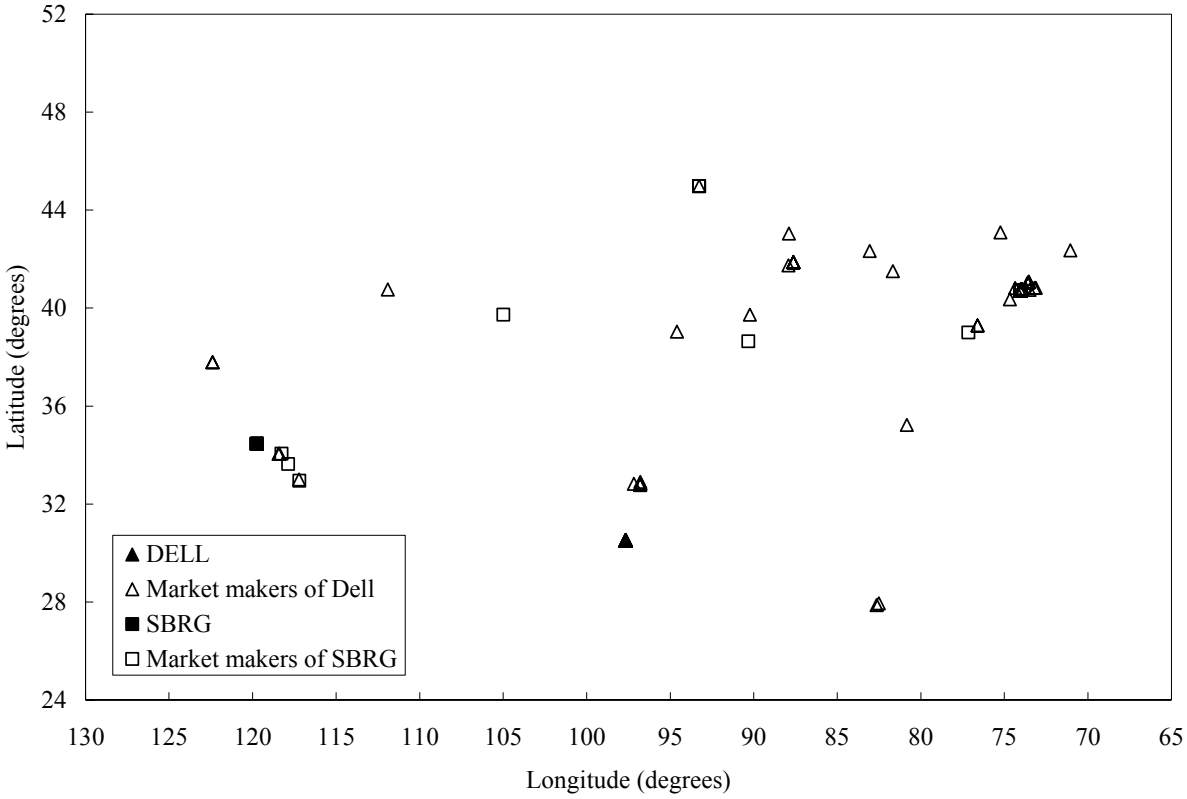

Figure 2. Geographic distribution of market makers of Dell Inc (DELL) and Santa Barbara Restaurant Group (SBRG) for June of 1999. The figure plots the headquarters location of Dell Inc and Santa Barbara Restaurant Group and the location of the market makers of both firms (excluding ECNs). Zip codes for company headquarters are obtained from the Compustat Annual Research Files and corrected for historic changes using Compact Disclosure. Market maker location zip codes come from the July 1999 directory of the National Securities Clearing Corporation (NSCC) and from the Financial Industry Regulatory Authority (FINRA) where NSCC data is missing. The latitude and longitude for each zip code is from the U.S. Census Bureau's Gazetteer Place and Zip Code Database. The horizontal axis shows the actual longitude (in degrees) of firm and market maker locations. The vertical axis shows the actual latitude in degrees.

Table I
Firms and Market Makers by Geographic Region

The table provides sample statistics by geographic region. We report the number of firms, the number of market makers, and the number of different industries for each region. Industries are defined based on 2-digit SIC codes. We further report the number of market makers from all regions that make markets in the firms in a given region and the number of market makers that are in the region and make markets in firms from that region (same-region market makers). We break the sample into nine regions, as defined by the U.S. Bureau of the Census (10 regions when we separate California from the Pacific region).

Region	Firms	Market makers	Industries (2-digit SIC code)	All market makers of firms in region	Same-region market makers of firms in region
New England: CT, ME, MA, NH, RI, VT	357	25	45	304	24
Middle Atlantic: DE, DC, MD, NJ, NY, PA	738	218	56	381	198
South Atlantic: FL, GA, NC, SC, VA, WV	488	43	53	338	34
East north central: IL, IN, OH, MI, WI	423	38	55	273	34
East south central: AL, KY, MS, TN	116	7	36	157	6
West north central: IA, KS, MN, MO, NE, ND, SD	280	24	47	243	20
West south central: AR, LA, OK, TX	314	25	55	298	23
Mountain: AZ, CO, ID, MT, NV, NM, UT, WY	246	26	45	282	19
Pacific: CA, OR, WA	922	57	55	382	52
Pacific—exclude CA	143	7	32	214	5
CA	779	50	51	371	44
All regions	3,884	463	66	463	463

Table II
Market Makers with Most Firms by State

For each state represented in our sample, the table shows the market makers that make markets to the largest number of firms. The table further reports the number of firms the market maker makes markets in, the overall rank of the market maker in terms of number of firms, and the total number of market makers in a state.

MMID	Market maker name	State	City	Number of firms	Number of firms overall rank	Market makers in state
NITE	Knight Equity Markets, L.P.	NJ	Jersey City	3,597	1	34
SLKC	Spear Leeds & Kellogg Capital Markets	NY	New York	3,586	2	164
JEFF	Jefferies Group, Inc.	CA	Los Angeles	569	8	50
NAIB	North American Institutional Brokers	FL	Fort Lauderdale	473	13	28
SWST	Southwest Securities, Inc.	TX	Dallas	463	14	20
MWSE	Chicago Stock Exchange	IL	Chicago	415	19	21
BTAB	DB Alex. Brown LLC	MD	Baltimore	375	26	7
PIPR	Piper Jaffray & Co.	MN	Minneapolis	373	27	12
WEED	Weeden & Co. L.P.	CT	Greenwich	293	41	12
FCAP	First Union Capital Markets Corp.	NC	Charlotte	261	45	3
FBRC	Friedman, Billings, Ramsey & Co., Inc.	VA	Arlington	247	48	8
ADAM	Canaccord Adams Inc.	MA	Boston	233	54	11
TGUL	Tucker Anthony Cleary Gull	WI	Milwaukee	229	55	3
WDCO	Wilson-Davis & Co., Inc.	UT	Salt Lake City	185	61	4
RHCO	SunTrust Capital Markets, Inc.	GA	Atlanta	183	63	4
BRAD	J.C. Bradford & Co.	TN	Nashville	183	62	5
AGED	A.G. Edwards & Sons, Inc.	MO	St. Louis	165	66	11
MDLD	McDonald Investments Inc.	OH	Cleveland	159	68	10
HDLY	J.J.B. Hilliard, W.L. Lyons, Inc.	KY	Louisville	144	75	1
OLDE	H&R Block Financial Advisors, Inc.	MI	Detroit	109	89	3
JANY	Janney Montgomery Scott Inc.	PA	Philadelphia	106	93	11
SPHN	Stephens Inc.	AR	Little Rock	102	95	1
PACS	Pacific Crest Securities Inc.	OR	Portland	97	98	4
FBWA	Ferris, Baker Watts Incorporated	DC	Washington	91	101	2
CASS	Cohig & Associates, Inc.	CO	Englewood	60	122	13
DADA	D.A. Davidson & Co.	MT	Great Falls	60	123	1
SALI	Sterne, Agee & Leach, Inc.	AL	Birmingham	52	131	1
NATL	National Securities Corporation	WA	Seattle	51	134	3
KPSP	KirkPatrick Pettis	NE	Omaha	37	165	1
JRCO	Johnson Rice & Company LLC	LA	New Orleans	31	178	3
BARR	Barrett & Company	RI	Providence	23	212	1
NATC	National Capital LLC	OK	Oklahoma City	15	257	1
PARA	Paradise Valley Securities, Inc.	AZ	Phoenix	13	269	6
CITY	City Securities Corporation	IN	Indianapolis	9	310	1
WUSA	West America Securities Corp	NV	Las Vegas	5	374	2
LAVA	Bangor Securities, Inc.	ME	Portland	4	386	1

Table III
Summary Statistics

The table reports the mean, median, and standard deviation of firm variables (Panel A) and market maker and other variables (Panel B). Panel A reports firm summary statistics for number of market makers per firm, number of local (within 250 miles) market makers, number of all local market makers (even if they do not provide quotes), the excess proportion of local market makers providing quotes (the proportion of local firm market makers to total firm market makers minus the proportion of all local market makers to all 463 market makers), firm market capitalization, research and development expense relative to assets, whether a firm is in a remote area (further than 250 miles from the 20 most populated cities), whether a firm is in the S&P 500, whether a firm is involved in an IPO or SEO within the past five years, and whether the firm is involved in a M&A transaction within the past five years. Panel B reports the number of firms per market maker, the age of each market maker since founding, whether the market maker is a lead IPO/SEO underwriter within the past five years, whether the market maker is a M&A advisor within the past five years, the distance (in miles) from all firms to all market makers, and the distance (in miles) from firms to market makers that cover those firms.

Panel A: Firm statistics (3,884 firms)

	Firms below 75th percentile excess proportion of local market makers (2,919 firms)		Firms above 75th percentile excess proportion of local market makers (965 firms)	
Variable	Mean	Median	Mean	Median
Number of market makers for firm	13.17	11.00	9.26	8.00
Number of local market makers for firm	2.29	1.00	7.44	7.00
Number of all local market makers	50.51	21.00	186.39	245.00
Excess proportion of local market makers for firm	0.06	0.04	0.38	0.36
Firm market capitalization (billions of U.S. dollars)	0.73	0.09	0.16	0.05
Research and development-to-assets	0.16	0.09	0.15	0.07
Remote area dummy	0.26	0.00	0.10	0.00
S&P 500 member	0.01	0.00	0.00	0.00
IPO or SEO in last five years dummy	0.55	1.00	0.41	0.00
M&A in last five years dummy	0.23	0.00	0.19	0.00

Panel B: Market maker (463 market makers) and other statistics

Variable	Mean	Median	Std. dev.	Observations
Number of firms per market maker	102.31	20.00	335.88	463
Market maker age since founding (years)	28.72	15.00	33.35	463
Market maker is IPO or SEO lead dummy	0.28	0.00	0.45	463
Market maker is M&A advisor dummy	0.16	0.00	0.37	463
Distance (miles) from firms to market makers (all)	1,165.66	1,016.49	830.69	1,798,292
Distance (miles) from firms to market makers (actual)	1,109.84	888.42	940.86	47,368

Table IV
Measures of Price Discovery

The table reports the mean, median, and standard deviation of variables measuring price discovery for firm-market maker pairs. For a firm-market maker pair each measure is calculated as the average of the 22 daily measures. The table reports the proportion of time the market maker is at best bid quote, ask quote, and bid-ask quotes, and the weighted price contribution of a market maker for firm-market maker pairs within 250 miles and for firm-market maker pairs more than 250 miles apart. The table further uses a sample of 1,715 firms and reports the upper and lower bounds of information shares of market makers within 250 miles of firm (local), market makers further than 250 miles of firm (non-local), and ECNs. The information share estimate for a firm is the average daily estimate for that firm. For the average firm, the information shares are estimated for 9.25 days out of 22 trading days.

Variable	Mean	Median	Std. dev.
Firm-market maker pairs within 250 miles (13,863 pairs)			
Time at best bid	0.0970***	0.0487***	0.1302
Time at best ask	0.0910***	0.0454***	0.1218
Time at best bid-ask	0.0198***	0.0001***	0.0571
Weighted price contribution	0.0589***	0.0112***	0.1732
Firm-market maker pairs more than 250 miles apart (33,505 pairs)			
Time at best bid	0.0850	0.0400	0.1187
Time at best ask	0.0808	0.0374	0.1148
Time at best bid-ask	0.0164	0.0001	0.0502
Weighted price contribution	0.0464	0.0062	0.2015
Information share for local (≤ 250 miles) and non-local (> 250 miles) market makers and for ECNs (1,715 firms)			
Upper bound (UB) of information share of local market makers	0.5600	0.5783	0.2057
Lower bound (LB) of information share of local market makers	0.5536	0.5700	0.2069
Upper bound (UB) of information share of non-local market makers	0.2877	0.2667	0.1814
Lower bound (LB) of information share of non-local market makers	0.2814	0.2600	0.1793
Upper bound (UB) of information share of ECNs	0.1609	0.1383	0.1294
Lower bound (LB) of information share of ECNs	0.1565	0.1352	0.1270
p-value (LB local market makers – UB non-local market makers)	(< 0.0001)	(< 0.0001)	

***, **, * indicate difference between local and non-local measures is significant at the 0.01, 0.05, and 0.10 levels

Table V
Geographic Proximity and the Probability of Firm-Market Maker Match

The table reports coefficient estimates (p-values in parentheses) from a probit regression explaining whether a market maker makes a market in a firm. The sample consists of all 1,798,292 possible pairs of the 3,884 firms and the 463 market makers with available data. As explanatory variables we use the distance between the firm's headquarters and the market maker, the average (firm market value-weighted) distance from the market maker to all firms in the firm's industry (two-digit SIC code), the number of firms quoted by the market maker, the age of the market maker since founding, the number of market makers providing quotes for the firm, a dummy indicating whether the market maker is in New York, dummies indicating whether the market maker is a wholesaler, a wire house, or an institutional broker, the market capitalization and share price of the firm, the proportion of firms quoted by the market maker that are in the firm's industry, and variables indicating whether the market maker is the firm's lead IPO/SEO underwriter or a M&A advisor within the past five years. The table also reports the number of observations, the number of actual firm-market maker pairs, and the pseudo R-square of the regression.

Dependent variable is whether a market maker provides quotes for a firm's shares	
Intercept	– 4.9356*** (< 0.0001)
Distance (miles, log)	– 0.0866*** (< 0.0001)
Average distance (firm value-weighted) from market maker to all firms in firm's 2-digit SIC code (miles, log)	– 0.0778*** (< 0.0001)
Number of firms quoted by market maker (log)	0.4953*** (< 0.0001)
Market maker age since founded (years, log)	– 0.0239*** (< 0.0001)
Number of market makers that quote the firm (log)	0.7181*** (< 0.0001)
Market maker located in New York dummy	– 0.0707*** (< 0.0001)
Market maker is wholesaler dummy	1.1318*** (< 0.0001)
Market maker is a wire house dummy	0.0168 (0.2453)
Market maker is an institutional broker dummy	– 0.0521*** (< 0.0001)
Firm market capitalization (millions, log)	0.0030 (0.4637)
Share price (log)	– 0.0326*** (< 0.0001)
Proportion of firms for market maker in 2-digit SIC code of firm	1.5369*** (< 0.0001)
Market maker is IPO/SEO lead underwriter dummy	2.7548*** (< 0.0001)
Market maker is M&A advisor dummy	1.4275*** (< 0.0001)
Observations	1,798,292
Actual matches	47,368
Pseudo R-square	0.4605

***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels from a two-tailed *t*-test

Table VI

Geography, Proportion of Best Bid and Ask Spreads, and Price Contribution

The table reports the coefficient estimates (p-values in parentheses) from OLS regressions to explain the proportion of time a market maker provides the best bid quotes, the best ask quotes, the best bid-ask quotes, and the weighted price contribution of each market maker for a stock. Weighted price contribution is calculated based on bid quotes. When the dependent variable is the weighted price contribution we exclude firm-market maker observations with weighted price contribution below -1.00 and above 1.00. We standardize all dependent variables by subtracting the firm-specific mean and dividing by the firm-specific standard deviation. As explanatory variables we use the distance between the firm's headquarters and the market maker, the average (firm market value-weighted) distance from the market maker to all firms in the firm's industry (two-digit SIC code), the number of firms quoted by the market maker, the age of the market maker since founding, the number of market makers providing quotes for the firm, a dummy indicating whether the market maker is in New York, dummies indicating whether the market maker is a wholesaler, a wire house, or an institutional broker, the market capitalization and share price of the firm, the proportion of firms quoted by the market maker that are in the firm's industry, and variables indicating whether the market maker is the firm's lead IPO/SEO underwriter or an M&A advisor within the past five years. We control for selection by including the inverse Mill's ration from the selection model in Table V.

	Dependent Variable			
	Proportion of time best bid	Proportion of time best ask	Proportion of time best bid-ask	Weighted price contribution
	(1)	(2)	(3)	(4)
Intercept	– 5.3133*** (< 0.0001)	– 5.1062*** (< 0.0001)	– 4.5580*** (< 0.0001)	0.0688 (0.7231)
Distance (miles, log)	– 0.0799*** (< 0.0001)	– 0.0767*** (< 0.0001)	– 0.0670*** (< 0.0001)	– 0.0079** (0.0184)
Average distance (firm value-weighted) from market maker to all firms in firm's 2-digit SIC code (miles, log)	– 0.1439*** (< 0.0001)	– 0.1385*** (< 0.0001)	– 0.1274*** (< 0.0001)	– 0.0431*** (< 0.0001)
Number of firms quoted by market maker (log)	0.5383*** (< 0.0001)	0.5341*** (< 0.0001)	0.4785*** (< 0.0001)	0.0378** (0.0213)
Market maker age since founded (years, log)	– 0.0536*** (< 0.0001)	– 0.0563*** (< 0.0001)	– 0.0771*** (< 0.0001)	– 0.0290*** (< 0.0001)
Number of market makers that quote the firm (log)	0.6849*** (< 0.0001)	0.6665*** (< 0.0001)	0.5993*** (< 0.0001)	0.0691*** (0.0017)
Market maker located in New York dummy	– 0.2536*** (< 0.0001)	– 0.2926*** (< 0.0001)	– 0.3019*** (< 0.0001)	– 0.1415*** (< 0.0001)
Market maker is wholesaler dummy	0.9935*** (< 0.0001)	0.9607*** (< 0.0001)	0.8407*** (< 0.0001)	0.1542*** (< 0.0001)
Market maker is a wire house dummy	0.4440*** (< 0.0001)	0.5213*** (< 0.0001)	0.4234*** (< 0.0001)	0.1322*** (< 0.0001)
Market maker is an institutional broker dummy	0.1190*** (< 0.0001)	0.1231*** (< 0.0001)	0.0818*** (< 0.0001)	– 0.0602*** (0.0004)
Firm market capitalization (millions, log)	– 0.0131** (0.0331)	– 0.0202*** (0.0007)	– 0.0095 (0.1282)	– 0.0065 (0.3206)
Share price (log)	– 0.0177** (0.0252)	– 0.0067 (0.3827)	– 0.0121 (0.1283)	0.0110 (0.1875)
Proportion of firms for market maker in 2-digit SIC code of firm	1.5095*** (< 0.0001)	1.3263*** (< 0.0001)	1.2595*** (< 0.0001)	0.0074 (0.8881)
Market maker is IPO/SEO lead underwriter dummy	2.2602*** (< 0.0001)	2.1209*** (< 0.0001)	1.9303*** (< 0.0001)	0.1743*** (0.0097)
Market maker is M&A advisor dummy	1.1055*** (< 0.0001)	0.9744*** (< 0.0001)	0.9032*** (< 0.0001)	– 0.0121 (0.8265)
Inverse Mill's ratio	1.0823*** (< 0.0001)	0.9920*** (< 0.0001)	0.9385*** (< 0.0001)	– 0.0297 (0.4358)
Observations	47,327	47,349	47,127	47,155

***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels from a two-tailed *t*-test

Table VII
What Can Explain the Price Discovery of Local Market Makers?

The table reports the coefficient estimates (p-values in parentheses) from OLS regressions to explain the proportion of time a market maker provides the best bid quotes, the best ask quotes, the best bid-ask quotes, and the weighted price contribution of each market maker for a stock. Weighted price contribution is calculated based on bid quotes. When the dependent variable is the weighted price contribution we exclude firm-market maker observations with weighted price contribution below -1.00 and above 1.00. We standardize all dependent variables by subtracting the firm-specific mean and dividing by the firm-specific standard deviation. The starting model in each case is the one estimated in Table VI. We further interact the distance between firms and market makers with firm market capitalization, R&D as a proportion of assets, and dummy variable indicating whether a firm is in a remote area (more than 250 miles from the 20 most populated cities), whether the market maker is a wholesaler, whether the market maker is a wire house, whether the market maker is an institutional broker, whether the market maker is the firm's IPO/SEO lead underwriter, whether the market maker is an M&A advisor for the firm, and whether a firm is in the S&P 500. We also include these variables separately as explanatory variables. The table also reports the number of observations in each model.

	Dependent Variable			
	Proportion of time best bid	Proportion of time best ask	Proportion of time best bid-ask	Weighted price contribution
	(1)	(2)	(3)	(4)
Intercept	– 5.5283***	– 5.2555***	– 4.6953***	0.1028
	(0.0001)	(0.0001)	(0.0001)	(0.6134)
Distance (miles, log)	– 0.1429***	– 0.1491***	– 0.1140***	– 0.0347***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Firm market capitalization * Distance	0.0058***	0.0068***	0.0042***	0.0040***
	(0.0001)	(0.0001)	(0.0030)	(0.0067)
Remote area dummy * Distance	– 0.0463***	– 0.0366***	– 0.0325***	– 0.0082
	(0.0001)	(0.0001)	(0.0001)	(0.3186)
R&D expenses relative to assets * Distance	– 0.0132	– 0.0153	0.0053	– 0.0244**
	(0.1787)	(0.1114)	(0.5947)	(0.0197)
Market maker is a wholesaler dummy * Distance	0.0788***	0.0797***	0.0598***	0.0209***
	(0.0001)	(0.0001)	(0.0001)	(0.0005)
Market maker is a wire house dummy * Distance	0.0459***	0.0415***	0.0327**	– 0.0116
	(0.0003)	(0.0008)	(0.0109)	(0.3894)
Market maker is an institutional broker dummy * Distance	0.0468***	0.0375***	0.0269***	0.0097
	(0.0001)	(0.0001)	(0.0024)	(0.2955)
Market maker is IPO/SEO lead underwriter dummy * Distance	– 0.0602***	– 0.0364***	– 0.0547***	– 0.0437***
	(0.0001)	(0.0061)	(0.0001)	(0.0025)
Market maker is M&A advisor dummy * Distance	– 0.0083	– 0.0196	– 0.0076	– 0.0060
	(0.7262)	(0.3975)	(0.7515)	(0.8114)
Firm is in S&P 500 * Distance	0.0130***	0.0143***	0.0103***	0.0001
	(0.0005)	(0.0001)	(0.0064)	(0.9702)

Table VII - *Continued*

	Dependent Variable			
	Proportion of time best bid	Proportion of time best ask	Proportion of time best bid-ask	Weighted price contribution
	(1)	(2)	(3)	(4)
Firm market capitalization (millions, log)	– 0.0604***	– 0.0740***	– 0.0442***	– 0.0334***
	(0.0001)	(0.0001)	(0.0001)	(0.0034)
Remote area dummy	0.3191***	0.2567***	0.2231***	0.0564
	(0.0001)	(0.0001)	(0.0001)	(0.3112)
R&D expenses relative to assets	0.0584	0.0762	– 0.0594	0.1576**
	(0.3931)	(0.2526)	(0.3892)	(0.0297)
Market maker is IPO/SEO lead underwriter dummy	2.7768***	2.4930***	2.3666***	0.4627***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Market maker is M&A advisor dummy	1.2145***	1.1476***	0.9888***	0.0352
	(0.0001)	(0.0001)	(0.0001)	(0.8239)
Avg. dist. (firm value-weighted) from mkt. maker to all firms in firm's 2-digit SIC code (miles, log)	– 0.1494***	– 0.1428***	– 0.1319***	– 0.0439***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Number of firms quoted by market maker (log)	0.5843***	0.5786***	0.5124***	0.0464***
	(0.0001)	(0.0001)	(0.0001)	(0.0059)
Market maker age since founded (years, log)	– 0.0380***	– 0.0388***	– 0.0646***	– 0.0205***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Number of market makers that quote the firm (log)	0.7543***	0.7345***	0.6491***	0.0822***
	(0.0001)	(0.0001)	(0.0001)	(0.0003)
Market maker located in New York dummy	– 0.2674***	– 0.3090***	– 0.3212***	– 0.1519***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Market maker is a wholesaler dummy	0.5811***	0.5432***	0.5344***	0.0485
	(0.0001)	(0.0001)	(0.0001)	(0.2751)
Market maker is a wire house dummy	0.1687**	0.2747***	0.2315***	0.2179**
	(0.0483)	(0.0010)	(0.0073)	(0.0162)
Market maker is an institutional broker dummy	– 0.1742***	– 0.1116*	– 0.0824	– 0.1196*
	(0.0029)	(0.0505)	(0.1632)	(0.0540)
Share price (log)	– 0.0139*	– 0.0027	– 0.0093	0.0109
	(0.0892)	(0.7310)	(0.2612)	(0.2094)
Proportion of firms for market maker in 2-digit SIC code of firm	1.6320***	1.4414***	1.3462***	0.0310
	(0.0001)	(0.0001)	(0.0001)	(0.5614)
Inverse Mill's ratio	1.1858***	1.0934***	1.0118***	– 0.0097
	(0.0001)	(0.0001)	(0.0001)	(0.8044)
Observations	47,327	47,349	47,127	47,155

***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels from a two-tailed *t*-test

Table VIII
What Can Explain the Information Share of Local Market Makers?

The table reports coefficients (p-values in parentheses) from OLS regressions to explain the information share of local market makers. We use the methodology developed by Hasbrouck (1995) to calculate the upper and lower bounds of the information shares of local market makers, non-local market makers, and ECNs. The dependent variables are the lower bounds of the information shares of local market makers. Results are similar if we use the upper bounds rather than the lower bounds. Local market makers are first defined as market makers within 250 miles of a firm and then as market makers that are below the median distance for a given firm. As independent variables we use firm market capitalization, whether a firm is in a remote area (more than 250 miles from the 20 most populated cities), R&D as a proportion of assets, and whether a firm is in the S&P 500.

	Information share of market makers within 250 miles (lower bound)	Information share of market makers below median distance (lower bound)
Intercept	0.7391***	0.7124***
	(0.0001)	(0.0001)
Firm market capitalization	– 0.0321***	– 0.0260***
	(0.0001)	(0.0001)
Remote area dummy	– 0.0257**	– 0.0059
	(0.0421)	(0.5058)
R&D expenses divided by assets	0.0162	– 0.0019
	(0.6483)	(0.9380)
S&P 500 member	– 0.0305	– 0.1631***
	(0.4299)	(0.0001)
Observations	1,715	2,507
Adjusted R-square	0.0601	0.0661

***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels from a two-tailed *t*-test

Table IX

Best Bid versus Best Ask Quotes of Local Market Makers and Stock Returns

For each firm in our sample, for each day *t* of the 22 trading days of June 1999, we calculate the average bid bias of local market makers (within 250 miles) minus the average bid bias of non-local market makers (further than 250 miles). The bid bias of a market maker *j* for firm *i* in a given day *t* is equal to:

$$\frac{\textit{Proportion of time at best bid}_{i,j,t} \; - \; \textit{Proportion of time at best ask}_{i,j,t}}{\left(\textit{Proportion of time at best bid}_{i,j,t} \; + \; \textit{Proportion of time at best ask}_{i,j,t}\right)/2}.$$

The local minus non-local bid bias is missing for firms with no local or no non-local market makers and is 0.0 for market makers with both bid and ask proportions equal to 0.0. Panel A of the table reports average coefficient estimates (p-values in parentheses) from 22 cross-sectional OLS regressions of daily stock returns (for days *t*+1, *t*+2, *t*+3, and *t*+4) on the local minus non-local bid bias and several control variables -- firm market capitalization, book-to-market of firm's equity, and the returns of the firm for the previous five days. For Panel B we calculate the averages daily returns for two portfolios -- firms with positive local minus non-local bid bias and firms with negative local minus non-local bid bias. For each of the 22 daily observations we then calculate the difference in average daily stock returns (for days *t*+1, *t*+2, *t*+3, and *t*+4) between the two portfolios. The table reports the average of the 22 differences (p-values in parentheses).

	Return for day *t*+1	Return for day *t*+2	Return for day *t*+3	Return for day *t*+4
Panel A: Regression approach				
Intercept	0.0023	0.0028	0.0032	0.0031
	(0.4281)	(0.2752)	(0.2641)	(0.2881)
Market cap (log)	0.0004	0.0004	0.0004	0.0003
	(0.4237)	(0.4482)	(0.4463)	(0.6085)
Book-to-market	– 0.0008	– 0.0013	– 0.0022*	– 0.0020*
	(0.5516)	(0.2286)	(0.0549)	(0.0619)
Return $_{-1}$	– 0.0748***	– 0.0747***	– 0.0845***	– 0.0725***
	(0.0003)	(0.0001)	(0.0001)	(0.0002)
Return $_{-2}$	– 0.0556***	– 0.0453***	– 0.0422***	– 0.0358***
	(0.0011)	(0.0012)	(0.0026)	(0.0072)
Return $_{-3}$	– 0.0325***	– 0.0243**	– 0.0260**	– 0.0178
	(0.0011)	(0.0210)	(0.0123)	(0.1262)
Return $_{-4}$	– 0.0231**	– 0.0163	– 0.0201**	– 0.0238***
	(0.0230)	(0.1715)	(0.0370)	(0.0091)
Return $_{-5}$	– 0.0110	– 0.0074	– 0.0076	– 0.0065
	(0.4134)	(0.5670)	(0.4984)	(0.5072)
Local minus non-local bid bias	0.0002*	– 0.0002	0.0001	0.0004**
	(0.0528)	(0.3235)	(0.4640)	(0.0117)
Panel B: Portfolio approach				
Avg. difference in returns	0.0011*	– 0.0004	0.0005	0.0012**
	(0.0848)	(0.4396)	(0.2771)	(0.0148)

***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels from a two-tailed *t*-test