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The Price of Street Friends: Social Networks, Informed Trading, and Shareholder Costs

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Abstract

Recent studies suggest the transfer of privileged information via social ties but do not explicitly examine the cost of these ties to shareholders. We document a significant positive relation between stock transaction costs and a company's social ties to the investment community. Social ties based on education and leisure activities, stronger ties, and ties to individuals responsible for trading have greater effects. Using investment connection deaths as natural experiments, we document that exogenous severance of ties reduces trading costs and trading activities by connected parties. Our evidence illustrates an important and previously undocumented consequence of social ties.

I. Introduction

A new and expanding literature in finance examines the role of social networks in the transfer of private information. Of particular importance is the work of Cohen, Frazzini, and Malloy (2008), who document that mutual fund managers make more profitable trades on firms with which they are socially connected. They conclude that such social ties often serve as channels for the flow of inside information.

It is intuitive that timely access to new information benefits the recipients. For example, the mutual fund managers in the research of Cohen et al. (2008) are able to earn higher trading profits with information obtained through their social connections. Nevertheless, the increased probability of informed trading via social ties could also impose costs on shareholders.

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The microstructure literature notes that informed trading accounts for a significant aspect of transaction costs (e.g., Bagehot (1971), Stoll (1989), and Easley and O'Hara (1987), among others). As Stoll (2000) notes, "informed traders gain at the expense of suppliers of immediacy" (p. 1482). Recognizing this, market makers seek to protect themselves by increasing the bid–ask spread for stocks more likely to have informed trades (Bagehot (1971)). Note that market makers are unlikely to be aware of the channel of information between a public firm and the investment community. In fact, they likely do not know which orders are submitted by informed traders when they adjust the bid–ask spread. Market makers may simply observe orders and adjust the spreads to break even (or earn an expected return). When they experience losses from informed trades in a stock, they widen the bid–ask spread of this stock to recoup the losses from uninformed traders.

Cohen et al. (2008) document that social networks surrounding a firm alter the probability of informed trades in that company's stock. If market makers adjust for this probability, the cost of trading for shareholders increases, which represents a transfer of wealth from uninformed shareholders to parties that trade on private information obtained via such networks. The link between social ties and trading costs has not been explored in previous literature. The objective of this research is to examine shareholder costs associated with a firm's social ties to investment firms, which include those classified by BoardEx as "investment companies," "private equity," or "specialty and other finance," excluding major investment banks and market-making firms.[1] Note that our analysis does not provide direct evidence of informed trades, nor is it the objective of this paper. Instead, given the direct evidence of information transfer via social connections established in the literature, we take the link between informed trading and social ties as given and focus on an important consequence of such a link: increased trading costs.

We test our hypotheses using a sample of 18,482 nonfinancial, public firm-year observations representing 3,693 unique firms during the period 2000–2008. Using data from BoardEx, we identify social ties between a public firm's executives and directors and investment firms. There are numerous avenues for social connections; we examine three: employment, education, and leisure activities. To preview our results, we find that the social connections linking a public firm's directors and executives with investment firms are associated with significantly higher trading costs of the firm's stock. One additional connected executive or director is, on average, associated with a bid–ask spread for his or her firm's stock that is 1 basis point (bp) higher. We next calculate for each firm the incremental trading cost associated with social ties to investment firms. For the median firm, the cost associated with social ties accounts for about 15% of the stock's overall transaction costs, or about $459,000 annually. This figure can also be interpreted as a lower bound on the potential profit to informed traders who have

[1]The investment firms in our sample are mostly asset management firms, mutual funds, private equity firms, and other trading companies. We exclude market makers because an informed market maker may have the incentive to narrow the spread. We exclude investment banks because they may have other business relationships with a public firm. Our results are robust if market-making firms and investment banks are included.

social ties with a public company's directors and executives. Comparing to the sample firms' median annual trading volume of $800 million, the magnitude of $459,000 of informed trading profit is very plausible. The magnitude of this figure is also economically meaningful. Using the average risk-free rate (3.07%) during our sample period as the discount rate, we estimate the median present value of the additional trading costs associated with social ties to be $15 million, which represents 3.2% of the median market capitalization of our sample firms, $460 million.[2]

Next, we test whether more intense ties are associated with a more significant increase in trading costs. First, local ties may facilitate direct communication, which allows nonverbal social cues and leaves little detectable traces. We hypothesize that local ties are associated with a larger increase in trading costs than are long-distance ties. Our empirical evidence shows that ties within 100 miles are associated with significantly higher trading costs than the other ties.

Second, public firm directors and executives with multiple ties to the investment community have a greater chance of leaking privileged information (even inadvertently), and they are consequently associated with higher cost of trading than those with only one tie. In addition, long-lasting ties and ties established through multiple channels can promote more trust between the connected individuals and facilitate the transfer of private information. We find empirical evidence consistent with these predictions.

Third, investment firm executives who are directly responsible for trading may be more sensitive to valuable private information and have a larger amount of capital to take advantage of such information. We therefore separate the investment firms and individuals into those who are directly involved in trading and those who are not. We find that a public firm's social ties with investment firms or individuals directly involved in equity trading are associated with significantly higher bid–ask spreads. This evidence suggests that informed trading is most likely the link between social ties and bid–ask spreads. These tests suggest that the relation between social ties and cost of trading is stronger for the more intense ties.

To establish the causality between social ties and the increased cost of trading, we examine a sample of social connections severed by exogenous shocks: the deaths of connected individuals at investment firms. Such deaths result in no change to the public firms' board or executive team; only their social ties to the investment firms are severed. Investigation of these exogenous events helps us to address the issues of omitted variables and endogeneity. We document that by 1 year after the "death events," the affected public firms on average have experienced a significant 9-bp reduction in their industry-adjusted bid–ask spread.[3]

[2]Although we document significant costs to firms with social ties to the investment community, the literature documents benefits associated with social ties. Therefore, our results do not necessarily imply that social ties with investment firms destroy shareholder wealth. Rather, our evidence illustrates one of the costs of being socially connected with investment firms. A comprehensive analysis on the optimal social network design of a firm, however, is beyond the scope of this study.

[3]This comparison of the average bid–ask spread in year $t + 1$ to that in $t - 1$ allows market makers, who are unlikely to be aware of the death events, more than 1 year of time to detect the changes in informed trading and adjust their spreads. As noted earlier, consistent with Garfinkel

In addition, we find that the magnitude of reduction in the public firm's trading costs is significantly related to the proportion of social ties to investment firms being severed by these deaths. Furthermore, the reduction of trading costs is higher when the severed social ties are local or when the deceased connection is a person directly involved in trading.

More importantly, we use a difference-in-differences analysis to provide direct evidence that the investment firms significantly reduce trading activities in the once-connected public firms after the severance of their social ties. Our evidence in this natural experiment suggests that stronger social ties with the investment community lead to higher trading costs, rather than the other way around, and that this relation is unlikely to be driven by omitted variables. This evidence also addresses the concern that social ties may coincide with business relationships.[4,5]

In addition, any potentially omitted variables are likely to be correlated with a firm's general social connections (with other firms). To examine this possibility, we conduct a falsification test. Specifically, we estimate the social ties between a public firm and a random set of noninvestment firms and use these measures as the main explanatory variables in the baseline regressions. If our main findings were driven by omitted variables, these social ties to noninvestment firms would also have significant coefficients; we find no evidence of this in the data.

A summary of all of our tests regarding the relation of social ties to information transfer is shown in the Appendix. In all, we conduct 17 separate tests linking the extent and nature of social ties to bid–ask spreads. Although we cannot directly observe informed trading, our cumulative evidence, along with that of the previous studies, is consistent with privileged information passing through social networks to the stock market and being reflected in higher trading costs to investors.

Our analysis adds to the growing literature on social networks and extends the literature on the determinants of firms' trading costs. Our evidence illustrates the consequences for shareholders when privileged information is transferred through social networks. An important result from our work is the finding that the potential flow of information through social networks is incorporated into the cost of trading. Although it is logical that information flow varies with the strength and character of social ties, these different dimensions and their variation over time can be rather subtle. It is an empirical issue whether social ties affect bid–ask spreads and whether such subtle variation as local versus

and Nimalendran (2003), the market makers need not be explicitly aware of the deaths to sense a shift in informed trading.

[4]For example, after a public firm selects a mutual fund to administer its 401(k) plan, the chief executive officer (CEO) of the public firm and the mutual fund manager may become social friends and start to play golf together. The death of the fund manager, however, severs only his or her personal social tie to the CEO but not the business relationship between his or her fund and the public firm. Therefore, the effect of social ties on trading costs is unlikely to be driven by a firm's business relationship with investment firms.

[5]A number of recent studies examine the potential information transfer via an investment banking relationship. See, for example, Massa and Rehman (2008), Bodnaruk, Massa, and Simonov (2009), Jegadeesh and Tang (2010), Kedia and Zhou (2014), Ivashina and Sun (2011), and Griffin, Shu, and Topaloglu (2012), among others. We, however, exclude all investment banks from the investment firms. Our results therefore are unlikely to be driven by information transfer via banking relationship.

long-distance ties, short- versus long-duration ties, and ties related to trading firms versus those unrelated are reflected in spreads. Our results find that these effects are indeed present in trading costs and that the magnitude of these costs can be quite large.

The remainder of our paper is organized as follows: Section II reviews the related literature. Section III presents our sample and research design. Results are presented in Section IV. Section V concludes.

II. Literature Review

A. Social Ties and the Transfer of Information

Executive suites and corporate boardrooms are continually devising and implementing strategies that alter the level and riskiness of cash flows to their businesses. At the same time, executives and traders at investment firms are continuously assessing the values of these same firms in an attempt to recognize trading opportunities. In essence, one team of executives operates inside the corporate box; multiple teams operate outside the corporate box. Teams both inside and outside the box are trying to estimate value. All parties are constrained by the laws regulating the flow of insider information. Much of the information flow about a company is heavily restricted by Regulation Fair Disclosure (FD) and the laws governing insider trading.[6] Corporate insiders are warned to carefully monitor their communications and take actions to avoid unintentional leakage of privileged information.

To the extent that social connections link those within and external to the corporate box, they provide the possibility of (perhaps inadvertent) information transfer. It is not surprising that information is transferred through social networks. Even a casual comment between social contacts can result in the inadvertent transfer (or creation) of new information. In addition, we are trained from birth to detect information from the nonverbal and social cues that surround us. The social psychology literature has long argued that human beings' ability to communicate nonverbally is at the core of social perception, cognition, and interaction (Ambady and Weisbuch (2010)). Nonverbal influence theories suggest that nonverbal expressions, whether through facial expressions, body language, or even tone of voice, are signals that influence perceivers' actions. Indeed, nonverbal expressions that do not influence the behavior of others would not survive the evolutionary forces (Fridlund (1994), Owren, Rendall, and Bachorowski (2005)). There is a nearly infinite number of intentional or unintentional nonverbal cues that can transfer information between acquaintances. Obvious examples include a person's tone of voice, a smile, or other visual cues. We may notice that a contact seems stressed or engages in more (or less) conspicuous consumption. We may even infer information by the presence or absence of an acquaintance at social gatherings. The list of social cues that permit the transfer of information is as large and varied as the extent and range of human interaction.

[6]Regulation FD became effective at the beginning of our sample period on Oct. 23, 2000.

B. The Importance of Social Ties in Finance

A growing literature recognizes the importance of social ties in business. Cohen et al. (2008) find that social networks often serve as channels for the flow of inside information. Their analysis indicates that mutual fund managers tend to outperform on stocks of firms where they have social ties and that the superior performance is concentrated around the release of corporate news (e.g., earnings announcements). In return, the connected fund managers are more likely to vote against shareholder proposals aimed to limit executive compensation at the connected firms, resulting in higher CEO compensation for these firms (Butler and Gurun (2012)). The importance of social ties is also documented in other financial contexts. Gray and Kern (2011) find that fund managers often share price-relevant information in their social networks. Cohen, Frazzini, and Malloy (2010) report that analysts outperform on their stock recommendations when they have school ties with the company's senior officers, although the accuracy of analyst earnings forecasts is not related to social ties. Social networks are also found to influence the trading behavior of mutual fund managers (Hong, Kubik, and Stein (2005)) and households (Hong, Kubik, and Stein (2004)).

Social ties can be beneficial to firms if they facilitate (legitimate) information flow and monitoring. Engelberg, Gao, and Parson (2012) find that firms that have social ties with their banks obtain loans with lower interest rates and fewer covenants. These firms also have better performance ex post. They conclude that social connections between firms and banks help to improve information flow ex ante or monitoring ex post. Huang, Jiang, Lie, and Yang (2014) find that bidders whose directors have ties to investment banks earn higher merger announcement returns. Cai and Sevilir (2012) find that social ties between directors of target and acquirer firms improve merger performance. Hochberg, Ljungqvist, and Lu (2007) find that an expanded network for venture capital firms is associated with improved fund performance. Larcker, So, and Wang (2013) find that companies with boards at a more central location in the interlocking network tend to have better stock and operating performance. Faccio (2006) finds that a firm's stock price reacts positively to events that potentially expand a firm's social network, for example, when a firm's officer or large shareholder enters politics or when a politician joins a firm's board. In a related study, Faccio and Parsley (2009) document that sudden deaths of politicians result in a 1.7% decline, on average, in firm value for companies headquartered in the politician's hometown. Social ties can also directly benefit individuals in the network. For example, Engelberg, Gao, and Parson (2013) find that CEOs with more social connections to outsiders receive higher compensation, in particular when other executives have fewer social ties or when their companies are located in geographically isolated locations. Barnea and Guedj (2009) find that boards more centrally located in director networks pay their CEOs higher compensation.

Social ties can also be detrimental if they result in agency conflicts. For example, a growing literature in finance documents that social ties between management and the board of directors of a firm are often associated with governance failures, such as weak board monitoring (Fracassi and Tate (2012)), higher CEO compensation and lower pay–performance sensitivity (Larcker, Richardson, Seary, and Tuna (2005), Hwang and Kim (2009)), lower turnover-to-performance sensitivity (Nguyen (2012)), earnings management (Hwang and Kim (2012)),

insider trading by independent directors (Cao, Dhaliwal, Li, and Yang (2014)), a higher probability of financial frauds (Chidambaran, Kedia, and Prabhala (2012)), and a lower quality of financial reporting (Dey and Liu (2011)). Ishii and Xuan (2014) find that social ties between target and acquirer firms result in higher retention rates of target CEOs and directors by the combined firm and lower abnormal returns to the acquirer and combined equity. El-Khatib, Fogel, and Jandik (2015) document that merger and acquisition (M&A) deals initiated by CEOs associated with higher social network centrality are more likely to be value destructing.

Several recent studies find that the same social ties can be beneficial if they facilitate information transfer but can be detrimental if they exacerbate favoritism. For example, Kuhnen (2009) finds that both effects exist in the social connections between mutual fund advisors and boards. Schmidt (2015) finds that friendly boards, as measured by social ties between CEOs and directors, are associated with superior (poor) merger announcement returns when advising (monitoring) needs are high. Duchin and Sosyura (2013) document that the social ties between CEOs and divisional managers increase (decrease) investment efficiency and firm value when information asymmetry is high (corporate governance is weak).

In summary, the current literature documents that social ties transfer information that can provide benefits to companies but also to traders exploiting that information. We extend this analysis by recognizing that the potential information transfer via social ties and consequently the increased probability of informed trading may lead to larger bid–ask spreads. The extent to which this happens to companies with social ties is an empirical issue; if it does, social ties also produce costs to a firm's shareholders.

III. Sample and Research Design

A. Sample Selection

Our sample consists of data from a number of sources. We construct the social connections between a U.S. public firm's executives and directors and those of investment firms based on the director profile information provided by the BoardEx database of Management Diagnostic Limited. BoardEx provides the social network data of senior executives and board members of over 14,000 U.S. and European public and private companies since 1999.[7] From these profiles, we collect information on current employment, past employment, educational background, and affiliation with professional associations, not-for-profit associations, and club memberships.[8]

We then match the BoardEx data with data from the Center for Research in Security Prices (CRSP) and Compustat databases to obtain the financial and

[7]Social ties formed before 1999 are also captured because BoardEx records career, education, and activity history of the covered executives and directors for as long as data are available.

[8]Most of the employment, education, and leisure activities information is self-reported. We are more likely to capture experiences or affiliations with reputable institutions, such as Ivy League schools or Fortune 500 firms, than those affiliated with less reputable ones, such as imprisonment. As a result, we may miss some social ties the directors and executives have through less reputable companies or institutions. Such bias increases the noise in the data and works against our finding significant results.

accounting variables used in our analysis. After excluding all financial and insurance firms, we obtain our main sample of 18,482 firm-year observations during the period of 2000–2008.

B. Measuring the Social Connection

We measure the social connection between a public firm executive and director and an investment firm executive and director by their current and past overlap in employment, education, and activities.[9] Investment firms include those classified by BoardEx as "investment companies," "private equity," or "specialty and other finance," except the major investment banks and firms identified as market makers by Nasdaq Trade and Quote (NASTRAQ) database. Most of the investment firms in our sample, therefore, are asset management firms, mutual funds, private equity firms, and other trading companies.[10] We exclude market makers because informed market makers may trade strategically on their informational advantage and narrow the spreads.[11] We exclude investment banks because they may have other business relationships with a public firm.[12] We exclude all financial services firms from the public firm sample because these firms are often closely intertwined with the investment firms (e.g., joint venture, cross-ownership, close business relationship, etc.).

We define two individuals as connected via employment if their careers overlap at the same employer in the past or at present. It is possible that the two individuals may not know each other even if they both work at the same employer. Such misclassification increases the noise in the data and works against our finding significant results.[13]

We define two individuals as connected via education if they attend the same university or college and obtain the same degree within 1 year of each other. Individuals receiving more specialized degrees, such as a master of business administration (MBA) or a juris doctor (JD), are likely to know others in the same class or the class immediately before or after. Individuals receiving more general degrees, such as a bachelor of science (BS), are less likely to know all others receiving the same degree because there are a larger number of people receiving such degrees.

[9] In a sensitivity test, we separate social ties by whether the employment or activity overlap is current or past. Education-based ties, by definition, are all past ties. In unreported tests, we find that both current and past ties have a significant effect on trading costs, and there is no statistically significant difference between the effects of past ties and those of current ties.

[10] Individuals outside the investment community can also take advantage of privileged information they receive via social ties. Investment professionals, however, are likely to be more sensitive to information (from either verbal or nonverbal cues) related to stock value. They are also more likely to have access to a large amount of capital to take advantage of the privileged information. Therefore, we focus on the social ties between public firms and the investment community.

[11] The NASTRAQ database provides a list of market makers but does not detail the specific stocks for which a market maker makes market. It is possible that a market maker does not make market for its socially connected public firms. We exclude the market makers as a precaution, although our results are similar if we include them in the sample of investment firms.

[12] Results are similar if we include investment banks in the sample of investment firms.

[13] BoardEx regards the U.S. government and military as employers. However, two individuals who are in the U.S. Navy, for example, at the same time are unlikely to know each other. We therefore do not include such connections in the analysis.

Again, misclassification increases noise in the data and works against our finding significant results.

We define two individuals as connected via activities if they both serve as officers of the same professional associations, nonprofit associations, or leisure clubs. Many individuals listed in the activities section of the BoardEx data are members (but not officers) of such associations and clubs. These individuals are unlikely to know each other in organizations that often have thousands of members (e.g., American Bar Association, CPA Association of California, etc.). We therefore exclude individuals whose role is "member" or "unknown" when defining social ties via activities.[14]

We next aggregate the number of executives and directors in a public firm who are connected to an executive or director of an investment firm. Panel A of Table 1 shows that for the average firm, BoardEx reports 14 executives and directors, among whom 7 are socially connected to investment firms.[15] On average, six of the socially connected directors and executives are connected through

TABLE 1

Summary Statistics

The sample consists of 18,482 firm-year observations available from CRSP, Compustat, and BoardEx during the period of 2000–2008. We exclude all financial and insurance firms from the analysis. Panel A of Table 1 reports the number of connected directors and executives (D&E) a company has via employment, education, or leisure activities. A public firm executive or director is connected to the investment firms if he or she has or once had employment, education, or leisure activity overlap with an executive or director of an investment firm. The social connection does not include same-person connections, that is, individuals who themselves are also directors or executives of an investment firm. Investment firms include all firms classified by BoardEx as "private equity," "investment companies," or "specialty and other finance," except for the market makers identified by NASDAQ and the major investment banks. Panel B presents the summary statistics of the firm characteristics. Market capitalization is the product of average number of shares outstanding and the average share price over a firm's fiscal year. We follow Stoll (2000) and define a stock's proportional quoted bid–ask spread as (ask price – bid price)/average quoted price. We also follow Stoll (2000) in taking the average of each underlying variable over a firm's fiscal year in calculating the annual bid–ask spread. Volume is the average daily dollar volume of trading over the firms' fiscal year. Price is the average closing share price over the fiscal year. The NASDAQ dummy equals 1 if the stock is listed on NASDAQ, and 0 otherwise. Average daily trades are the average number of trades per day over the firm's fiscal year. (This variable is available for NASDAQ firms only.) Return variance is the variance of the stock's daily return over the fiscal year. Panel C reports the distribution of the BoardEx industry classifications of the sample.

Variables	*N*	Mean	Median	Std. Dev.
Panel A. Social Tie				
No. of reported D&E	18,482	14.31	13.00	5.18
No. of connected D&E	18,482	7.44	6.00	5.71
via employment	18,482	6.04	4.00	5.76
via education	18,482	1.13	1.00	1.40
via activities	18,482	3.11	2.00	3.16
No. of same-person connections	18,482	0.12	0.00	0.46
Panel B. Other Firm Characteristics				
Market capitalization ($billions)	18,482	2.81	0.46	13.52
Annual bid–ask spread (%)	18,482	0.80	0.39	1.12
Volume ($millions)	18,482	24.39	3.17	116.90
Price	18,482	22.31	16.65	34.67
NASDAQ dummy	18,482	0.57	—	—
Average daily trades (in thousands) × NASDAQ dummy	18,482	1,105.46	46.97	4,827.24
Return variance	18,482	0.001	0.001	0.002

(continued on next page)

[14] In an unreported sensitivity test, we assume members of an association have a social tie with each other if fewer than 100 individuals are listed in this association by BoardEx. Our results are robust to this alternate specification.

[15] In most of our tests we use the number of connected directors, rather than the number of ties, because each connected individual represents a potential source of information transfer. We explore alternate measures in sensitivity tests, including the number of ties, and find similar results.

TABLE 1 (continued)
Summary Statistics

Industry	No. of Firm-Year Obs.	No. of Connected D&E	
		Mean	Median
Panel C. Industry Distribution			
Aerospace & Defense	149	7.3	6.0
Automobiles & Parts	274	8.2	7.0
Beverages	67	10.5	7.0
Blank Check/Shell Companies	2	7.5	7.5
Business Services	1,084	7.5	6.0
Chemicals	518	8.6	7.0
Clothing, Leisure and Personal Products	355	7.1	5.0
Construction & Building Materials	493	7.4	6.0
Consumer Services	111	7.8	6.0
Containers & Packaging	94	7.9	6.0
Diversified Industrials	142	7.6	5.0
Education	103	8.3	8.0
Electricity	81	12.1	10.0
Electronic & Electrical Equipment	2,307	6.2	5.0
Engineering & Machinery	943	7.0	6.0
Food & Drug Retailers	127	7.7	5.0
Food Producers & Processors	490	7.8	5.0
Forestry & Paper	174	9.3	8.0
General Retailers	977	8.2	6.0
Health	1,091	6.1	5.0
Household Products	247	7.5	6.0
Information Technology Hardware	743	6.8	5.0
Leisure & Hotels	535	7.6	6.0
Media & Entertainment	391	7.5	5.0
Mining	179	7.4	6.0
Oil & Gas	796	6.6	5.0
Pharmaceuticals and Biotechnology	1,377	7.1	6.0
Publishing	226	11.3	10.0
Real Estate	787	8.1	7.0
Software & Computer Services	1,447	7.4	6.0
Steel & Other Metals	186	7.7	7.0
Telecommunication Services	537	7.9	7.0
Tobacco	31	7.6	8.0
Transport	605	7.6	6.0
Utilities (Other)	543	10.9	9.0
Wholesale Trade	270	6.6	5.0

employment-based ties, one is connected through education, and three are connected through activities. Note that one executive or director may be connected through more than one type of connection. For example, he or she may have attended the same school as mutual fund manager A and may have once worked for the same company as hedge fund manager B.[16]

Finally, some public firm directors or executives could also be an executive or director at an investment firm themselves. For example, a public firm's independent director may be a private equity manager. Some of these overlapping directors and executives have been studied in the interlocking director literature.[17]

[16]Two individuals may be connected via multiple channels. For example, they may have gone to the same college and have worked for the same company. Such ties through multiple social experiences are arguably stronger than the other ties. We show that the presence of public firm directors with these stronger ties to investment firms is associated with larger bid–ask spreads.

[17]For example, Fama and Jensen (1983) suggest that reputable directors are rewarded with additional outside directorships for greater monitoring expertise. Consistent with the reputation hypothesis, Kaplan and Reishus (1990) find that top executives of dividend-reducing companies are less likely to receive additional outside directorships. In addition to the incentive from the labor market, outside

Overlaps between boards or management teams clearly constitute a connection (henceforth "same-person connection") between the public firm and the investment firm, and privileged information may transfer through such a tie. However, because we are interested in the social ties between *two different individuals*, we exclude ties between a public firm and investment firms via a shared director or executive from the calculation of the social tie variables. Nevertheless, we control for the number of such same-person connections a public firm has with investment firms in all our regression analyses. These same-person connections are not common in our data. The average public firm has 0.12 executives and directors who are also directors or executives of an investment firm.

C. Measuring the Trading Costs

Our research question tests whether the social connections of a firm's executives and directors with investment firms have a material influence on the firm's trading costs. Following Stoll (2000), we use the stock's proportional quoted spread as our measure of trading costs.[18] Panel B of Table 1 reports summary statistics of the annual bid–ask spread used in our main sample. An average firm's annual bid–ask spread is 0.8%, which is similar to that reported in prior literature. For example, Stoll (2000) defines the proportional quoted half spread as 0.5 × (ask price – bid price)/closing price. He reports a sample average of 0.389%. This translates into a sample mean of 0.778% using our proportional quoted spread.

Finally, Panel C in Table 1 reports the industry distribution of our main sample, which covers 37 out of the 43 BoardEx industries. Six financial industries are excluded from the sample of public firms in our analysis. Columns 2 and 3 of Panel C indicate that the number of connected executives and directors in an average firm is similar across most industries, with Health and Electronic & Electrical Equipment being the least connected industries and Publishing and Electricity being the most connected industries.

IV. Empirical Results

A. Social Ties and Trading Costs

We first examine the empirical relation between social ties and trading costs as measured with the bid–ask spread. Stoll (2000) lists five important determinants of the cross-sectional variation of bid–ask spreads: trading volume, volatility, stock price, market capitalization, and the number of trades per day.

directors also receive monetary incentives from performance-sensitive compensation packages (Yermack (2004)). Furthermore, the reputation of the outside directors has a direct wealth impact on the shareholders. Fich and Shivdasani (2007) find that interlocked firms that share directors with firms sued for financial fraud experience value reduction at the lawsuit filing. Bizjak, Lemmon, and Whitby (2009) argue that interlocking directors help to spread the practice of option backdating.

[18] Another traditional measure of informed trading in a stock is the probability of information-based trading (PIN) developed by Easley, Kiefer, and O'Hara (1996). However, the Lee–Ready (1991) algorithm widely used in PIN estimates becomes less reliable for our sample because short sales represent a significant fraction of the trading volume during this period, which makes the estimates prone to systematic misclassification of short sales (Asquith, Oman, and Safaya (2010)).

We control for these firm characteristics in all regression models and find similar result for these control variables as those of Stoll (2000). We also include a dummy variable for listing on the NASDAQ exchange, BoardEx industry dummies, and calendar-year dummies to control for any secular trend in bid–ask spread.[19] Thus, all of our models examine the relation between social ties and bid–ask spread while abstracting from variables known to affect bid–ask spread.

Table 2 presents the regression results. The dependent variable is the annual percentage bid–ask spread, and the key independent variable is the number of directors or executives of a public firm who are connected to investment firms. In all models we obtain an adjusted R^2 of about 0.58. This result suggests that our model captures over half of the cross-sectional variation of bid–ask spread in a

TABLE 2

Social Connections to Investment Firms and Trading Costs

The sample used in Table 2 is described in Table 1. The dependent variable is a firm's annual bid–ask spread as defined in Table 1. All the control variables are as defined in Table 1. In Table 2, the *t*-statistics (reported below in parentheses) are based on standard errors robust to clustering at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: Annual Bid–Ask Spread (%)				
Independent Variables	1	2	3	4	5
Intercept	1.80 (7.39)***	1.77 (7.30)***	1.72 (7.03)***	1.87 (7.42)***	1.90 (7.56)***
No. of connected D&E ($\times 10^{-2}$)	1.09 (5.02)***				
No. of connected D&E via employment ($\times 10^{-2}$)		1.10 (5.48)***			0.73 (3.69)***
No. of connected D&E via education ($\times 10^{-2}$)			2.78 (5.04)***		1.43 (2.59)***
No. of connected D&E via activities ($\times 10^{-2}$)				1.77 (5.49)***	0.94 (2.89)***
No. of same-person connections ($\times 10^{-2}$)	−4.43 (−3.79)***	−5.46 (−4.38)***	−0.79 (−0.70)	−1.01 (−0.92)	−4.58 (−3.69)***
ln(Volume)	−0.32 (−13.59)***	−0.32 (−13.61)***	−0.32 (−13.54)***	−0.32 (−13.53)***	−0.32 (−13.59)***
ln(Market cap)	0.17 (6.47)***	0.18 (6.63)***	0.18 (6.74)***	0.17 (6.17)***	0.16 (5.96)***
ln(Price)	−0.24 (−12.11)***	−0.24 (−12.24)***	−0.24 (−12.58)***	−0.24 (−12.42)***	−0.23 (−12.03)***
NASDAQ dummy	0.69 (6.07)***	0.69 (6.09)***	0.69 (6.09)***	0.68 (5.93)***	0.67 (5.88)***
ln(Average daily trades) × NASDAQ dummy	−0.14 (−8.37)***	−0.14 (−8.45)***	−0.14 (−8.51)***	−0.14 (−8.11)***	−0.14 (−8.05)***
Return variance	96.28 (4.40)***	96.22 (4.41)***	95.88 (4.39)***	95.81 (4.39)***	95.77 (4.39)***
Year and industry dummies	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.58	0.58	0.58	0.58	0.58
N	18,482	18,482	18,482	18,482	18,482

[19]In a sensitivity test, we also include institutional holdings and its Herfindahl index as control variables. Our results are robust, although the sample size is reduced by about 10%. In another robustness test, we use the natural logarithms of the social tie variables as the main independent variables and find similar results. For interpretation convenience, we report the results using the raw social tie variables in the main text.

sample of over 18,000 firm-year observations.[20] Because the measures of social connections are annual variables, we use the average daily bid–ask spread over a firm's fiscal year in this analysis. Model 1 reports a coefficient of 0.0109 for the main independent variable (the number of connected executives and directors); this figure is statistically significant at the 1% level, with a *t*-statistic of 5.02.

In models 2–4 of Table 2, we separate the types of social ties by how a public firm executive or director is connected to an investment firm executive or director, that is, whether they have overlap with each other from current or past employment, education, or leisure activities. The results in models 2–4 show that all three types of social ties have a positive association with trading costs, with the coefficients for employment-, education-, and activity-based ties equal to 0.0110, 0.0278, and 0.0177, respectively.[21] All three coefficients are statistically significant at the 1% level. Interestingly, the ties via education and leisure activities have a substantially stronger association with trading costs than the ties via employment. The coefficient of the educational ties variable is more than 2.5 times higher than the coefficient of employment ties. Because two individuals may share more than one type of social connection, we include all three types of social ties in model 5 and find that all three coefficients are positive and statistically significant at the 1% level. Again, the ties via education have the highest coefficient, nearly twice as high as that of the ties via employment. It appears that people connected through casual nonprofessional ties are more likely to convey potentially privileged information.[22] This result is consistent with both network theory suggesting that social ties formed through nonbusiness venues tend to foster more trust, empathy, and sympathy, whereas social ties formed through prior common employment also have a competitive element (Ingram and Zou (2008), Zou and Ingram (2007), and Kang, Liu, Low, and Zhang (2013)), and recent empirical evidence that education and nonbusiness ties are more likely to be associated with financial frauds than are professional ties (Chidambaran et al. (2012)). In contrast, the number of same-person ties connecting public firms and investment firms has a negative and significant coefficient in three of the five regressions. One explanation for this result is that executives and directors who also work at investment firms are likely to be more mindful of insider trading restrictions. This variable, however, is insignificant in the other two regressions.[23]

The coefficient on the number of connected executives and directors in model 1 of Table 2 suggests that one additional connected executive or director increases

[20] Because the social tie variables are fairly stable over time, we estimate the Fama–MacBeth (1973) type regression as a robustness test. Even though we have a short time series of only 9 years, our results in Table 2 are largely similar.

[21] The coefficients of the employment-, education-, and activity-based ties are all higher than the coefficient of the overall ties in model 1 of Table 2 because one connected director or executive may have more than one type of tie.

[22] Results regarding the relative impact of the types of social connection on trading costs must be interpreted with some caution because, by their nature, the way social ties are measured differs across education, employment and leisure connections. For example, ties identified via education and leisure activities are typically based on information disclosed voluntarily while disclosure of employment information is often mandatory.

[23] In a robustness test, we drop the same-person connection variable; our main results are similar. In addition, our results are also similar when we include these ties in the main social tie variables.

his or her firm's bid–ask spread by 0.0109% of the stock price. This coefficient is also economically significant given that the average annual bid–ask spread is 0.80% of stock price and the average firm has 7.44 connected executives and directors. To further understand the magnitude of the association between social ties and trading costs, we calculate for each firm the incremental trading cost associated with social ties to investment firms. For a median public firm in our sample, the annual additional cost associated with its social ties to investment firms is $459,000. Using the average risk-free rate (3.07%) during our sample period as the discount rate, we estimate the median present value of the costs to be $15 million, which represents 3.2% of the median market capitalization of $460 million of our sample firms. We return to the discussion of economic significance with greater details in Section IV.D.[24]

Of course, these connections to the investment community may also provide benefits to the firm and its shareholders. An analysis of the existence and magnitude of any benefits is beyond the scope of the current study. Nevertheless, our results provide a benchmark against which any benefits can be compared.

B. Local Social Ties and Trading Costs

When two individuals with prior acquaintance live in close proximity, it is easier for them to exchange information. For example, they are more likely to have face-to-face social interactions, which enhances social bonding and allows information to pass through nonverbal channels such as a gesture, a smile, or other cues. Theories in social psychology literature suggest that nonverbal communication is fundamental to social interaction and directly affects perceivers' actions (Ambady and Weisbuch (2010), Fridlund (1994), and Owren et al. (2005)). In contrast, information exchanged between individuals connected through long-distance ties is likely to be limited to verbal communication (via phone, e-mail, or letter). In addition, information transfer in a face-to-face situation is less likely to leave a detectable trace than communication over a long distance. Therefore, we conjecture that local social ties to investment firms have a stronger effect on a firm's trading costs.

To determine whether a social tie between a public firm executive or director and his or her counterparts at investment firms is local, we need the residential locations of both parties. Unfortunately, we do not have such residence data and instead rely on firm locations. For executive directors or senior managers of a company, we use the company headquarters as the executive's location. For outside directors of a company, we attempt to identify their primary job location (i.e., where they serve as an executive or senior manager). We are able to obtain the primary job location for about one-third of the outside directors in our sample.[25]

[24] In a robustness test, we examine the nonlinear relation between a public firm's social connections to investment firms and its trading costs by including squared terms of the social tie measures. However, the estimated coefficients of the squared terms are insignificant in all five models of Table 2.

[25] We cannot use a public firm's headquarters location as the residential location of its outside directors because many live far away. For those outside directors with available data on primary job

Using the zip codes of the primary job locations of these public and investment firm directors, we are able to calculate the distance between two connected directors or executives for about half of the ties. We define a tie as local if the distance between the two connected individuals is less than 100 miles. We next calculate for each public firm the number of directors and executives who have at least one local tie with investment firms. Similarly, we count the number of connected directors/executives who are connected but have no known local ties with investment firms.[26] Panel A of Table 3 reveals that almost one-quarter (1.72 out 7.44) of the connected public firm directors and executives have local ties to investment firms' directors and executives. Education-based ties are the least likely to be local. This is expected because people often work in different geographical areas after finishing college.

Panel B of Table 3 reports the regression results where the dependent variable is again the firm's average bid–ask spread over a fiscal year. Model 1 reveals that one additional public firm executive or director with local ties increases his or her firm's bid–ask spread by 0.016%, whereas one additional connected executive or director with no known local ties increases the spread by only 0.009%. Both figures are statistically significant at the 1% level. More importantly, the difference between the two coefficients is statistically significant at the 5% level. This result suggests that important private information is more likely to pass through local social ties than long-distance ties. In models 2–4, we separate the social ties by whether they are based on employment, education, or leisure activities. In all three regressions, both local ties and nonlocal ties are statistically significant

TABLE 3

Local Social Ties and Trading Costs

The sample used in Table 3 is described in Table 1. Panel A of Table 3 reports the summary statistics of the number of D&E a firm has who are connected to investment firms and grouped by the geographic distance between the connected individuals. We define social ties as local if the two connected executives' or directors' primary job locations are within 100 miles of each other. Panel B presents the regression results where the dependent variable is a firm's annual bid–ask spread as defined in Table 1. All the other control variables are as defined in Table 1. *t*-statistics (reported below in parentheses) are based on standard errors robust to clustering at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	*N*	Mean	Median	Std. Dev
Panel A. Summary Statistics				
No. of connected D&E with at least one local tie to investment firms	18,482	1.72	1.00	2.97
via employment	18,482	1.29	0.00	2.76
via education	18,482	0.13	0.00	0.42
via activities	18,482	0.67	0.00	1.29
No. of connected D&E with no known local ties to investment firms	18,482	5.71	5.00	4.39
via employment	18,482	4.75	3.00	4.60
via education	18,482	1.00	1.00	1.26
via activities	18,482	2.44	2.00	2.40

(continued on next page)

locations, we find that 65% of public firm outside directors and 55% of the investment firm outside directors' primary job locations are over 100 miles away.

[26]We do not know the distance of many ties. For example, because we do not have the location data for foreign firms, the distance of ties with individuals whose primary employer is a foreign firm is unknown. Therefore, the directors/executives whom we classify as having no known local ties with investment firms may actually have such a tie. This data imperfection introduces a bias that works against us in finding significant difference between local and distant ties.

TABLE 3 (continued)
Local Social Ties and Trading Costs

	Dependent Variable: Annual Bid–Ask Spread (%)				
Independent Variables	1	2	3	4	5
Panel B. Regression Analysis					
Intercept	1.82 (7.43)***	1.78 (7.31)***	1.73 (7.03)***	1.88 (7.42)***	1.91 (7.57)***
No. of connected D&E with at least one local tie to investment companies ($\times 10^{-2}$)	1.55 (5.85)***				
No. of connected D&E with at least one local tie to investment companies via employment ($\times 10^{-2}$)		1.38 (5.51)***			0.75 (2.97)***
No. of connected D&E with at least one local tie to investment companies via education ($\times 10^{-2}$)			3.94 (2.66)***		1.70 (1.10)
No. of connected D&E with at least one local tie to investment companies via activities ($\times 10^{-2}$)				3.03 (4.97)***	1.96 (2.98)***
No. of connected D&E with no known local ties to investment companies ($\times 10^{-2}$)	0.89 (3.71)***				
No. of connected D&E with no known local ties to investment companies via employment ($\times 10^{-2}$)		1.01 (4.51)***			0.72 (3.25)***
No. of connected D&E with no known local ties to investment companies via education ($\times 10^{-2}$)			2.59 (4.44)***		1.24 (2.11)**
No. of connected D&E with no known local ties to investment companies via activities ($\times 10^{-2}$)				1.25 (3.34)***	0.56 (1.56)
No. of same-person connections ($\times 10^{-2}$)	−5.03 (−4.29)***	−5.81 (−4.66)***	−0.84 (−0.76)	−1.24 (−1.15)	−4.74 (−3.82)***
ln(Volume)	−0.32 (−13.56)***	−0.32 (−13.59)***	−0.32 (−13.54)***	−0.32 (−13.51)***	−0.32 (−13.56)***
ln(Market cap)	0.17 (6.41)***	0.18 (6.61)***	0.18 (6.74)***	0.17 (6.11)***	0.16 (5.92)***
ln(Price)	−0.24 (−12.13)***	−0.24 (−12.24)***	−0.24 (−12.58)***	−0.24 (−12.46)***	−0.23 (−12.05)***
NASDAQ dummy	0.69 (6.05)***	0.69 (6.09)***	0.69 (6.10)***	0.67 (5.91)***	0.67 (5.87)***
ln(Average daily trades) × NASDAQ dummy	−0.14 (−8.34)***	−0.14 (−8.44)***	−0.14 (−8.51)***	−0.14 (−8.09)***	−0.14 (−8.04)***
Return variance	96.08 (4.40)***	96.15 (4.40)***	95.87 (4.39)***	95.59 (4.39)***	95.60 (4.39)***
Difference between coefficients of local ties and nonlocal ties					
All ties	0.66 (2.49)**				
Employment-based ties		0.38 (1.46)			0.03 (0.13)
Education-based ties			1.35 (0.86)		0.45 (0.28)
Activity-based ties				1.79 (2.52)**	1.40 (1.91)*
Year and industry dummies	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.58	0.58	0.58	0.58	0.58
N	18,482	18,482	18,482	18,482	18,482

at the 1% level, and local ties consistently have a more positive coefficient than the nonlocal ties. The difference in coefficients is statistically significant at the 5% level for activities-based ties, but insignificant for employment-based and education-based ties. In model 5, we include all six categories of social ties in the same regression, and the inference is similar. Overall, the results in Table 3 suggest that a firm's local social ties with investment firms are more related to its trading costs than are the nonlocal ties.

C. Social Tie Strength and Trading Costs

The evidence documented in previous sections suggests that a public firm's trading costs increase with the number of directors or executives connected to investment firms. However, the strength of ties to investment firms may vary across these connected directors and executives. In this section, we further investigate whether the quality and the quantity of a public firm's connections to investment firms affect its trading costs (i.e., whether the stronger ties are associated with larger bid–ask spreads). Specifically, we examine four aspects of social tie strength: multiple ties, long-lasting ties, social ties with investment firms or individuals directly responsible for trading, and social ties via multiple channels.

First, public firm executives and directors connected to multiple individuals at investment firms may have more chances to channel information through the social network than individuals with a single tie to investment firms. We separately count the number of directors or executives with multiple ties to investment firms and those with only a single connection and include both variables in the regressions. Panel A of Table 4 reports that, on average, nearly three-quarters (5.10 out of 7.44) of the connected public firm directors and executives have more than one tie to investment firms. The proportion is similar for social ties via employment and activities but substantially lower for school ties (0.39 out of 1.13).

Regression results are shown in Panel B of Table 4. Model 1 reveals that one additional public firm executive or director with multiple ties to investment firms increases his or her firm's bid–ask spread by 0.015%, whereas one additional connected executive or director with a single tie increases the spread by only 0.003%. The difference between the two coefficients is statistically significant at the 1% level. This result suggests that the strength of connections to investment firms plays an important role in transferring private information. In models 2–4, we separate the social ties by whether they are based on employment, education, or leisure activities. The difference in coefficients, although always positive, is statistically significant at the 1% level for employment- and activities-based ties, but insignificant for education-based ties. Finally, in model 5 we include all six

TABLE 4

Multiple Social Ties and Trading Costs

The sample used in Table 4 is described in Table 1. Panel A of Table 4 presents the summary statistics of the number of D&E at the public firms who are connected to investment firms grouped by whether there are multiple connections between the individual and the investment firms. We define a public firm executive or director as having multiple ties to investment firms if she is connected to more than one investment professional. Panel B presents the regression results where the dependent variable is a firm's annual bid–ask spread as defined in Table 1. All the other control variables are as defined in Table 1. *t*-statistics (reported below in parentheses) are based on standard errors robust to clustering at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	*N*	Mean	Median	Std. Dev
Panel A. Summary Statistics				
No. of connected D&E with multiple ties to investment companies	18,482	5.10	4.00	4.71
via employment	18,482	3.57	2.00	4.25
via education	18,482	0.39	0.00	0.78
via activities	18,482	2.24	1.00	2.65
No. of connected D&E with a single tie to investment companies	18,482	2.33	2.00	2.41
via employment	18,482	2.47	2.00	3.00
via education	18,482	0.74	0.00	0.99
via activities	18,482	0.87	1.00	1.08

(continued on next page)

TABLE 4 (continued)
Multiple Social Ties and Trading Costs

	Dependent Variable: Annual Bid–Ask Spread (%)				
Independent Variables	1	2	3	4	5
Panel B. Regression Analysis					
Intercept	1.84 (7.51)***	1.79 (7.37)***	1.73 (7.04)***	1.87 (7.44)***	1.91 (7.58)***
No. of connected D&E with multiple ties to investment companies ($\times 10^{-2}$)	1.51 (6.24)***				
No. of connected D&E with multiple ties to investment companies via employment ($\times 10^{-2}$)		1.61 (6.94)***			1.13 (4.92)***
No. of connected D&E with multiple ties to investment companies via education ($\times 10^{-2}$)			2.83 (3.21)***		0.67 (0.75)
No. of connected D&E with multiple ties to investment companies via activities ($\times 10^{-2}$)				2.19 (6.18)***	1.18 (3.29)***
No. of connected D&E with a single tie to investment companies ($\times 10^{-2}$)	0.30 (1.02)				
No. of connected D&E with a single tie to investment companies via employment ($\times 10^{-2}$)		0.52 (2.06)**			0.36 (1.43)
No. of connected D&E with a single tie to investment companies via education ($\times 10^{-2}$)			2.75 (4.09)***		1.35 (2.02)**
No. of connected D&E with a single tie to investment companies via activities ($\times 10^{-2}$)				0.21 (0.36)	−0.20 (−0.35)
No. of same-person connections ($\times 10^{-2}$)	−5.01 (−4.20)***	−6.46 (−5.05)***	−0.79 (−0.71)	−1.00 (−0.90)	−5.26 (−4.19)***
ln(Volume)	−0.32 (−13.63)***	−0.33 (−13.68)***	−0.32 (−13.54)***	−0.32 (−13.55)***	−0.32 (−13.65)***
ln(Market cap)	0.17 (6.28)***	0.17 (6.52)***	0.18 (6.74)***	0.17 (6.14)***	0.16 (5.95)***
ln(Price)	−0.23 (−12.02)***	−0.23 (−12.17)***	−0.24 (−12.57)***	−0.24 (−12.44)***	−0.23 (−12.02)***
NASDAQ dummy	0.68 (5.97)***	0.68 (6.01)***	0.69 (6.09)***	0.67 (5.88)***	0.66 (5.82)***
ln(Average daily trades) × NASDAQ dummy	−0.14 (−8.20)***	−0.14 (−8.31)***	−0.14 (−8.50)***	−0.14 (−8.07)***	−0.14 (−7.98)***
Return variance	96.17 (4.40)***	96.20 (4.41)***	95.88 (4.39)***	95.58 (4.39)***	95.68 (4.39)***
Difference between coefficients of multiple ties and single ties					
All ties	1.22 (4.06)***				
Employment-based ties		1.10 (4.10)***			0.77 (2.87)***
Education-based ties			0.09 (0.08)		−0.68 (−0.64)
Activity-based ties				1.99 (3.08)***	1.38 (2.15)**
Year and industry dummies	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.58	0.58	0.58	0.58	0.58
N	18,482	18,482	18,482	18,482	18,482

categories of social ties in the same regression and find similar results. Overall, our results suggest that individuals with multiple ties to investment firms are associated with a larger increase in their firms' trading costs.

Second, the strength of a social tie may also be related to its duration. Individuals who have a long-term relationship may share a stronger tie, and consequently build up more trust for each other, than individuals who are only briefly acquainted. We therefore estimate the duration of each social tie from the start of

two individuals' overlap in a company, a school, or a social club until the end of such overlap, or the end of the current fiscal year if the overlap is still current.[27] We next count for each public company the number of directors and executives who have at least one social tie to investment firms that has lasted 10 years or longer, as well as the number of directors and executives without such long-lasting ties (but nevertheless socially connected to the investment firms). Panel A of Table 5 reports that, on average, nearly one-third (2.43 out of 7.44) of the connected public firm directors and executives have long-lasting ties to investment firms' directors and executives. The proportion is similar for ties based on employment and leisure activities, but it is significantly lower for education-based ties because few education experiences last over 10 years.

Panel B of Table 5 reports the results of bid–ask spread regressions where both the number of directors and executives with long-lasting social ties to investment firms and the number of those without are included as independent variables. Model 1 reveals that one additional public firm director or executive with long-lasting ties to investment firms is associated with an increase in his or her firm's bid–ask spread of 0.018%, whereas one additional connected director or executive with short ties is associated with a bid–ask spread increase of 0.007%. Both figures are statistically significant at the 1% level. More importantly, the difference between the two figures is also significant at the 1% level. This evidence suggests that the quality of social ties may play an important role in the transfer of private information. In models 2–4, we separate social ties by whether they

TABLE 5

Social Tie Duration and Trading Costs

The sample used in Table 5 is described in Table 1. Panel A of Table 5 presents the summary statistics of the number of D&E at the public firms who are connected to investment firms grouped by whether they have ties that have lasted for over 10 years. We measure the duration of a social tie from the start of two individuals' overlap in a company, a school, or a social club until the end of such overlap, or the end of the current fiscal year if the overlap is still current. Panel B presents the regression results where the dependent variable is a firm's annual bid–ask spread as defined in Table 1. All the other control variables are as defined in Table 1. *t*-statistics (reported below in parentheses) are based on standard errors robust to clustering at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	*N*	Mean	Median	Std. Dev
Panel A. Summary Statistics				
No. of connected D&E with ties that have lasted for over 10 years	18,482	2.43	2.00	2.98
via employment	18,482	1.78	1.00	2.57
via education	18,482	0.06	0.00	0.28
via activities	18,482	0.86	0.00	1.37
No. of connected D&E with ties that have lasted for less than 10 years	18,482	5.01	4.00	3.91
via employment	18,482	4.26	3.00	4.29
via education	18,482	1.07	1.00	1.31
via activities	18,482	2.25	2.00	2.29

(continued on next page)

[27]The start and end dates of an employment record in BoardEx are usually clearly defined. For education, we use the degree award date as the end date and estimate the start date as 4 years before the award date of a bachelor's degree, 2 years before a master's degree, or 5 years before a doctorate degree. Leisure activity records often do not have clearly defined start and end dates. As a result, we are unable to estimate the duration for a substantial fraction of leisure ties. In addition, one may argue that once two individuals are acquainted, they cannot be unacquainted even after the end of their overlap at a company, a school, or a club. We therefore also have an alternate measure of social tie duration that ends at the current fiscal year regardless of whether the overlap has ended. Our results are similar when using this definition of social tie duration.

TABLE 5 (continued)
Social Tie Duration and Trading Costs

	Dependent Variable: Annual Bid–Ask Spread (%)				
Independent Variables	1	2	3	4	5
Panel B. Regression Analysis					
Intercept	1.84 (7.47)***	1.79 (7.32)***	1.73 (7.04)***	1.87 (7.41)***	1.91 (7.57)***
No. of connected D&E with ties that have lasted for over 10 years ($\times 10^{-2}$)	1.79 (6.41)***				
No. of connected D&E with employment ties that have lasted for over 10 years ($\times 10^{-2}$)		1.57 (5.64)***			0.96 (3.30)***
No. of connected D&E with education ties that have lasted for over 10 years ($\times 10^{-2}$)			5.31 (2.28)**		2.07 (0.88)
No. of connected D&E with activity ties that have lasted for over 10 years ($\times 10^{-2}$)				2.93 (5.27)***	1.86 (3.40)***
No. of connected D&E without ties that have lasted for over 10 years ($\times 10^{-2}$)	0.73 (2.80)***				
No. of connected D&E without employment ties that have lasted for over 10 years ($\times 10^{-2}$)		0.92 (3.77)***			0.64 (2.71)***
No. of connected D&E without education ties that have lasted for over 10 years ($\times 10^{-2}$)			2.58 (4.50)***		1.26 (2.16)**
No. of connected D&E without activity ties that have lasted for over 10 years ($\times 10^{-2}$)				1.21 (3.25)***	0.47 (1.24)
No. of same-person connections ($\times 10^{-2}$)	−4.75 (−4.12)***	−5.69 (−4.67)***	−0.81 (−0.73)	−1.01 (−0.93)	−4.65 (−3.90)***
ln(Volume)	−0.32 (−13.61)***	−0.32 (−13.62)***	−0.32 (−13.53)***	−0.32 (−13.55)***	−0.32 (−13.61)***
ln(Market cap)	0.17 (6.32)***	0.18 (6.56)***	0.18 (6.70)***	0.17 (6.16)***	0.16 (5.94)***
ln(Price)	−0.23 (−12.11)***	−0.24 (−12.24)***	−0.24 (−12.58)***	−0.24 (−12.45)***	−0.23 (−12.06)***
NASDAQ dummy	0.68 (5.94)***	0.68 (6.03)***	0.69 (6.08)***	0.67 (5.89)***	0.67 (5.82)***
ln(Average daily trades) × NASDAQ dummy	−0.14 (−8.20)***	−0.14 (−8.36)***	−0.14 (−8.48)***	−0.14 (−8.07)***	−0.14 (−7.98)***
Return variance	95.99 (4.40)***	96.11 (4.40)***	95.85 (4.39)***	95.61 (4.39)***	95.57 (4.39)***
Difference between coefficients of long-lasting ties and short-lasting ties					
All ties	1.06 (3.28)***				
Employment-based ties		0.65 (1.87)*			0.32 (0.89)
Education-based ties			2.73 (1.13)		0.81 (0.33)
Activity-based ties				1.72 (2.68)***	1.40 (2.17)**
Year and industry dummies	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.58	0.58	0.58	0.58	0.58
N	18,482	18,482	18,482	18,482	18,482

are based on employment, education, or leisure activities. In all three cases, the longer-lasting ties have a higher coefficient than the shorter ties. The difference in coefficients is statistically significant for employment- and activities-based ties, but insignificant for education-based ties. This is not surprising because there are very few education experiences that last over 10 years. In model 5, we include all six categories of social ties in the same regression and find similar results. Overall, our results suggest that directors and executives with longer relationships

with investment firms are associated with larger increases in their firms' bid–ask spreads.

In an unreported test, we also aggregate the social tie duration of all the directors and executives of a public company. This aggregate social tie duration variable gives more weight to social ties with longer duration. We find similar results using this variable as the main independent variable in our baseline regressions in Table 2.

Third, we separate directors or executives of investment firms who are directly involved in making trading decisions from those responsible for other functions of their firms. For example, a hedge fund manager routinely buys and sells stocks, whereas the head of the insurance arm of a specialty finance firm rarely does so. If informed trading is the link between social ties and trading costs, we expect a public firm's social ties to individuals directly responsible for trading to have a stronger impact on the firm's bid–ask spread. Information passed to these individuals is more likely to result in informed trades in the marketplace. These individuals also have direct access to larger amounts of capital and (because they are regularly evaluating trade-related information) may be more sensitive to nonverbal cues that could influence their trades.

To test this hypothesis, we manually identify an investment firm as directly involved in trading if the firm is a hedge fund, a mutual fund, an investment advisor, or a private equity firm. Directors and executives of such firms are likely to be directly involved in trading. For other investment firms, we identify individuals whose positions may be directly related to trading, such as working on the trading desk, portfolio management, private wealth management and asset management, and so forth. We next calculate for each public firm the number of directors and executives who have at least one social tie to these trading firms or individuals. We also count the number of connected directors/executives who have no social tie to the trading firms or individual but have ties to other investment firms or individuals. Panel A of Table 6 reveals that about 70% (5.15 out of 7.44) of the public firms' connected directors or executives have at least one connection to an individual or a firm directly involved in trading.

TABLE 6

Social Connections to Trading Firm/Individual and Trading Costs

The sample used in Table 6 is described in Table 1. Panel A of Table 6 presents the summary statistics of public firms' social ties to investment firms/individuals directly involved in trading activities. A public firm executive or director is defined as connected to a trading firm/individual if the connected investment firm is identified as a trading company or the connected individual at an investment firm holds a position with direct oversight of trading activities. Panel B presents the regression results where the dependent variable is a firm's annual bid–ask spread as defined in Table 1. All the other control variables are as defined in Table 1. *t*-statistics (reported below in parentheses) are based on standard errors robust to clustering at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	*N*	Mean	Median	Std. Dev
Panel A. Summary Statistics				
No. of connected D&E with connection to trading firm/individual	18,482	5.15	4.00	5.09
via employment	18,482	3.84	2.00	4.90
via education	18,482	0.62	0.00	1.02
via activities	18,482	2.16	1.00	2.57
No. of connected D&E without connection to trading firm/individual	18,482	2.29	2.00	2.70
via employment	18,482	2.20	1.00	3.13
via education	18,482	0.51	0.00	0.79
via activities	18,482	0.96	1.00	1.24

(continued on next page)

TABLE 6 (continued)

Social Connections to Trading Firm/Individual and Trading Costs

	Dependent Variable: Annual Bid–Ask Spread (%)				
Independent Variables	1	2	3	4	5
Panel B. Regression Analysis					
Intercept	1.81 (7.43)***	1.77 (7.29)***	1.73 (7.05)***	1.87 (7.42)***	1.89 (7.54)***
No. of connected D&E with connection to trading firm/individual ($\times 10^{-2}$)	1.41 (5.90)***				
No. of connected D&E with connection to trading firm/individual via employment ($\times 10^{-2}$)		1.36 (6.01)***			0.85 (3.73)***
No. of connected D&E with connection to trading firm/individual via education ($\times 10^{-2}$)			3.57 (4.54)***		1.62 (2.15)**
No. of connected D&E with connection to trading firm/individual via activities ($\times 10^{-2}$)				2.70 (7.39)***	1.76 (4.67)***
No. of connected D&E without connection to trading firm/individual ($\times 10^{-2}$)	0.26 (1.03)				
No. of connected D&E without connection to trading firm/individual via employment ($\times 10^{-2}$)		0.61 (2.79)***			0.37 (1.70)*
No. of connected D&E without connection to trading firm/individual via education ($\times 10^{-2}$)			1.68 (2.10)**		0.40 (0.48)
No. of connected D&E without connection to trading firm/individual via activities ($\times 10^{-2}$)				−0.95 (−1.93)*	−1.22 (−2.46)**
No. of same-person connections ($\times 10^{-2}$)	−4.45 (−3.80)***	−5.55 (−4.47)***	−0.83 (−0.75)	−1.19 (−1.11)	−4.50 (−3.61)***
ln(Volume)	−0.32 (−13.58)***	−0.32 (−13.61)***	−0.32 (−13.54)***	−0.32 (−13.57)***	−0.32 (−13.62)***
ln(Market cap)	0.17 (6.37)***	0.18 (6.59)***	0.18 (6.73)***	0.17 (6.13)***	0.16 (5.95)***
ln(Price)	−0.23 (−12.10)***	−0.24 (−12.24)***	−0.24 (−12.53)***	−0.24 (−12.41)***	−0.23 (−12.03)***
NASDAQ dummy	0.68 (6.01)***	0.69 (6.06)***	0.69 (6.08)***	0.66 (5.82)***	0.66 (5.78)***
ln(Average daily trades) × NASDAQ dummy	−0.14 (−8.31)***	−0.14 (−8.42)***	−0.14 (−8.48)***	−0.14 (−8.02)***	−0.14 (−7.96)***
Return variance	96.20 (4.41)***	96.20 (4.41)***	95.87 (4.39)***	95.56 (4.40)***	95.59 (4.39)***
Difference between coefficients of ties to trading firm/individual and of ties to nontrading firm/individuals					
All ties	1.16 (4.79)***				
Employment-based ties		0.75 (3.61)***			0.47 (2.24)**
Education-based ties			1.89 (1.65)*		1.22 (1.08)
Activity-based ties				3.65 (6.56)***	2.98 (5.24)***
Year and industry dummies	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.58	0.58	0.58	0.58	0.58
N	18,482	18,482	18,482	18,482	18,482

Panel B of Table 6 reports regression results where the dependent variable is the firm's average bid–ask spread over a fiscal year. Model 1 details that one additional public firm executive or director with social ties to the trading firm/individuals increases his or her firm's bid–ask spread by 0.014%, whereas one additional connected executive or director without such ties increases the spread by only 0.003%. The first figure is statistically significant at the 1% level,

whereas the second figure is insignificant. More importantly, the difference between the two coefficients is statistically significant at the 1% level. This result provides additional evidence that informed trading is likely to be the channel from social ties to increased bid–ask spreads.

In models 2–4 of Table 6, we separate the social ties by whether they are based on employment, education, or leisure activities. In all three cases, social ties directly related to trading have a significantly stronger association with the bid–ask spread than do ties to investment firms' individuals not directly related to trading. The coefficients of ties to trading firms or individuals equal 0.014%, 0.036%, and 0.027%, respectively. All three figures are statistically significant at the 1% level. In contrast, social ties to investment firm/individuals not directly related to trading have coefficients of 0.006%, 0.017%, and −0.009%, which are statistically significant at the 1%, 5%, and 10% levels, respectively. Furthermore, the differences between the coefficients of social ties to trading firms or individuals and those of ties to other investment firms are statistically significant at the 1% level in two cases, and at the 10% level in one case. In model 5, we include all six categories of social ties in the same regression and find similar results. The overall evidence of Table 6 is consistent with our conjecture that public firms connected to trading firms/individuals via social ties are associated with significantly higher trading costs for their own stock.

Fourth, two individuals may be connected through multiple channels. For example, they may have gone to the same college and have worked for the same company. Such ties are arguably stronger than the other ties. We separately count the number of public firm directors and executives who have such connections to the investment firms and those who do not. Although these ties average only 0.35 directors or executives per public firm, a multivariate regression similar to those in Table 2 shows that the presence of one such director or executive is associated with an average increase of 0.038% in the bid–ask spread, as opposed to an increase of 0.009% associated with the presence of one director or executive without such strong ties (but nevertheless socially connected to the investment firms). Both figures are statistically significant at the 1% level, and the difference between them is also significant at the 1% level.

The evidence reported in this section suggests that stronger ties are associated with a more pronounced increase in trading costs. These results help to validate our main finding that a public firm's social ties with investment firms are associated with additional trading costs for shareholders. Taken together, our overall evidence is most consistent with the argument that privileged information is transferred via social networks, and the resulting informed trading leads to higher trading costs.

D. The Economic Impact of Social Ties

Tables 2–6 show that social ties to investment firms impose significant costs to shareholders. Table 7 reveals that the economic costs can also be substantial. The first four columns show the additional annual trading costs associated with one additional connected executive or director calculated as the regression coefficient from the appropriate table times a firm's annual dollar trading volume.

TABLE 7

The Economic Impact of Social Ties to Investment Firm on Trading Costs

Table 7 reports a calibration of the dollar-value impact on the sample firms' trading costs that are associated with social ties to investment firms. We perform our calculations using the regression coefficients of the social tie measures reported in Tables 2, 3, 4, 5, and 6, respectively. We estimate the additional annual trading costs associated with one connected executive or director as the regression coefficient multiplied by a firm's annual dollar trading volume. To calculate the additional annual transaction cost associated with all connected executives and directors, we multiply the additional annual trading costs per connected executive or director with the number of such connected executives and directors for each firm.

	Additional Annual Trading Costs Associated with ONE Connected Director or Executive ($millions)				Additional Annual Transaction Cost Associated with ALL Connected Directors and Executives ($millions)			
Variables	Mean	Q1	Median	Q3	Mean	Q1	Median	Q3
Connected directors and executives (CD&Es)	0.670	0.014	0.087	0.364	9.482	0.056	0.459	2.816
CD&Es with at least one local tie vs.	0.953	0.020	0.124	0.518	4.214	0.000	0.022	0.562
CD&Es with no known local ties	0.547	0.012	0.071	0.297	5.322	0.035	0.291	1.748
CD&Es with multiple ties vs.	0.928	0.020	0.121	0.505	9.954	0.036	0.378	2.540
CD&Es with a single tie	0.184	0.004	0.024	0.100	0.632	0.001	0.027	0.187
CD&Es with ties that have lasted for over 10 years vs.	1.100	0.023	0.143	0.598	6.222	0.002	0.141	1.240
CD&Es with ties that have lasted for less than 10 years	0.449	0.009	0.058	0.244	3.813	0.023	0.206	1.243
CD&E with connection to trading firm/individual vs.	0.867	0.018	0.113	0.471	9.189	0.031	0.334	2.344
CD&E without connection to trading firm/individual	0.160	0.003	0.021	0.087	0.567	0.000	0.017	0.144

For the median firm, the annual cost of one connection is $87,000. In addition, the trading costs of social ties vary substantially depending on the strength of the ties. For example, a long-lasting connection to an investment director or executive is associated with median incremental trading costs of $143,000. In contrast, a connection to an investment firm director or executive who is not directly responsible for trading is associated with an additional $21,000 median trading costs.

To calculate the total annual cost to a firm, we multiply the additional annual trading costs per connected executive or director by the number of such connected executives and directors and report these figures in the next four columns of Table 7. For the median firm, the value across all executives is $459,000. If we capitalize this at the risk-free rate prevailing during our sample period (3.07%), we find that the total capitalized value is about 15 million dollars, or 3.2% of the median market capitalization of $460 million. Table 7 reveals that the average yearly costs of social ties vary greatly. In all cases the median cost of stronger ties for a particular executive or director exceed the cost of weaker ties. There are two cases where this is reversed at the firm level, not because weaker ties cost more but because such connections (i.e., our multiplier) are more prevalent across executives and directors.[28]

In equilibrium, the public cost of social ties (manifested in increased spreads) equals the private gains informed traders extract directly from the market makers.

[28] For example, on average, firms have more nonlocal ties than local ties. As a result, the overall cost of the nonlocal ties is higher than that of the local ties. A similar situation exists for the long-lasting connections.

That is, market makers price the bid–ask spread competitively given their assessment of losses to informed traders. Informed traders, nevertheless, may profit more when they trade directly with uninformed traders or when market makers pass the exposure to uninformed traders before news revelation. Thus, the results of Table 7 represent lower bounds on the gains to trading on private information. The actual informed trading gains are likely to be dramatically higher. As an example, a market maker may not be involved in every trade and may have an average holding time less than the duration of the insider's information advantage. If a market maker bears a loss 20% of the time an informed trader trades, for example, then the private benefit would be five times the increased spread.[29] Moreover, uninformed investors may demand higher expected returns to compensate for the increased risk of informed trading of firms with more social ties, which may result in higher cost of capital for these firms (Easley and O'Hara (2004)). We return to this issue at the end of the paper.

E. What Happens When a Connection Is Severed by Exogenous Shocks? An Event Study of Director and Executive Deaths

To this point, our results indicate a significant association between a public firm's connections to investment firms and the trading costs of its common stock. We have argued that important information can be transferred through social connections, either purposefully or inadvertently, and that market makers adjust bid–ask spreads for the increased probability of trading against informed traders. Nevertheless, a firm's connections to investment firms and its trading costs may be endogenously determined. To address the endogeneity issue, we examine a sample of social connections severed by exogenous shocks: the deaths of the connected directors and executives at investment firms. If information transfer through social ties results in higher trading costs, we expect to observe a reduction in trading costs after a (public firm's) connected director or executive at an investment firm dies. This test also addresses the potential concern for any omitted firm characteristics correlated with social ties and bid–ask spreads.

During our sample period, there are 885 events in which a public firm's connected investment firm director or executive dies. Because we exclude same-person connections from all social tie variables throughout the paper, we also exclude those cases where the deceased investment firm director or executive also serves as a director or executive of the public firm. Therefore, these deaths do not cause any change to the public firms' boards or executive teams except in their social ties to investment firms. The change in bid–ask spread is calculated from 1 year before the death event (year $t-1$) to 1 year after (year $t+1$). This specification allows the market makers, who are unlikely to be aware of the deaths, more than 1 year of time to detect the potential changes in trading patterns and adjust bid–ask spreads. To account for industry and secular trends in bid–ask spreads, we compare the sample firms' bid–ask spread change with the median bid–ask spread change of a group of matching firms during the same time period in a

[29] We thank the editor for this example and his general thoughts on the magnitude of private gains and total costs of social ties.

difference-in-differences test. The matching firms belong to the same BoardEx industry and have market capitalization between 50% and 200% of that of the sample firm.

Panel A of Table 8 presents the univariate results. On average, the death of an investment firm director or executive represents a social tie loss of 13.19% to its connected public firm. The average industry-adjusted change in the bid–ask spread from year $t - 1$ to year $t + 1$ is -0.09%, which is statistically significant at the 1% level.[30] Thus, the loss of connections is associated with a significant reduction in the bid–ask spread over the 3-year period surrounding the death. Furthermore, the average reduction in the industry-adjusted bid–ask spread is significantly larger when the severed social ties are local or the deceased investment firm director (or his or her firm) is directly involved with trading. For example, the average change in the industry-adjusted bid–ask spread is -0.23% for the subsample where at least one of the severed social ties between the public firm

TABLE 8

Change in Bid–Ask Spread around the Death of Connected Investment Executives and Directors

The sample in Panels A and B of Table 8 includes 885 public firms whose connected investment firm director or executive dies. We exclude those cases where the deceased director or executive is also a director or executive of the public firm. Therefore, the death events do not affect the public firms' boards or executive teams. The change in the bid–ask spread is calculated from 1 year before the death event (year $t - 1$) to 1 year after (year $t + 1$). To adjust for industry and secular trends in bid–ask spreads, we adjust the sample firms' bid–ask spread change with the median bid–ask spread change of a group of matching firms. The matching firms belong to the same BoardEx industry and have market capitalization between 50% and 200% of that of the sample firm. We define the percentage of social ties lost as the number of public firm directors and executives who lost connections to investment firms divided by the total number of connected directors and executives before the death event. Other control variables are as defined in Table 1. Panel C presents the change in the connected investment firms' trading volume in these public firm stocks before and after the death events. Specifically, we manually match the BoardEx investment firms with the mutual funds and financial institutions in the Thomson Financial Mutual Fund Holdings and Institutional Holdings databases. We identify 134 events where the connected investment firm holds shares of the connected public firm both before and after the death of the investment firm director/executive. We then calculate the investment firm's interquarter trading volume as the absolute value of the quarter-to-quarter change in its stock holdings of its connected public firm, normalized by the number of outstanding shares. The change in annual trading volume is calculated as the aggregate trading volume over the four quarters after the death event minus that before the event. To control for any industry and secular trends or change in the investment firms' general trading strategy attributable to the executive/director death, we further construct two adjusted measures of the change in annual trading volume. First, we adjust the change in annual trading volume of the public firm with the mean change in annual trading volume of a group of industry-matched public firms by the same investment firm in question over the event window. The matching firms belong to the same BoardEx industry but do not lose any social connections (including unconnected firms) to the investment firm as a result of the executive or director death. Second, we adjust the change in annual trading volume with the mean change in annual trading volume of the same public firm by other investment firms (i.e., nonevent investment firms) with nonmissing information on stock holdings over the event window. For Panel B, *t*-statistics are reported below in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	*N*	Mean	Median	*t*-Stat.
Panel A. Univariate Results				
Social ties lost (%)	885	13.19	10.00	34.16***
Industry-adjusted change in bid–ask spread (%)				
Full sample	885	−0.087	−0.005	−6.11***
At least one of the severed ties is local	32	−0.231	−0.111	−4.16***
None of the severed ties is local	853	−0.081	−0.005	−5.59***
p-value of difference		(0.0132)	(0.0375)	
The deceased director is directly involved in trading	593	−0.119	−0.013	−6.09***
The deceased director is not directly involved in trading	292	−0.022	0.003	−1.34
p-value of difference		(0.0001)	(0.0002)	

(continued on next page)

[30] Although the median is quite different from the mean, the difference is not driven by a few outliers. When we winsorize the industry-adjusted change in the bid–ask spread at the 1% and 99% levels, the mean value equals -0.091%.

TABLE 8 (continued)

Change in Bid–Ask Spread around the Death of Connected Investment Executives and Directors

Independent Variables	Dependent Variable: Industry-Adjusted Change in Bid–Ask Spread (%) 1	2	3
Panel B. Regression Analysis			
Intercept	−0.02 (−0.80)	0.07 (0.92)	0.10 (1.46)
Percentage of social ties lost	−0.53 (−4.32)***	−0.43 (−3.78)***	−0.42 (−3.72)***
At least one of the severed ties is local (1/0)			−0.13 (−2.05)**
Deceased individual is directly involved in trading (1/0)			−0.06 (−2.66)***
Δln(Volume)		−0.004 (−0.57)	−0.003 (−0.45)
Δln(Market cap)		−0.11 (−2.33)**	−0.11 (−2.42)**
Δln(Price)		−0.12 (−2.50)**	−0.12 (−2.39)**
ΔNASDAQ dummy		1.36 (7.21)***	1.36 (7.25)***
Δln(Average daily trades) × NASDAQ dummy		−0.21 (−9.08)***	−0.21 (−9.19)***
ΔReturn variance (%)		0.01 (11.14)***	0.01 (11.11)***
N	885	885	885
Adj. R^2	0.020	0.350	0.358

Variables	*N*	Mean	Median	*t*-Stat.
Panel C. Change in Trading Activities				
ΔAnnual trading volume by connected investment firms (%)	134	−0.829	−0.003	−3.47***
Adjusted by matching public firm portfolio (%)	128	−0.776	−0.001	−3.16***
Adjusted by nonevent investment firms' trading activities (%)	116	−0.967	−0.009	−3.53***

and investment firms are local, compared with an average −0.08% change in the bid–ask spread when none of the severed ties is local. The difference is statistically significant at the 5% level. Similarly, the industry-adjusted bid–ask spread is reduced by 0.12% when the deceased director (or his or her firm) is directly involved in trading, whereas the corresponding reduction is 0.02% when the deceased director is not directly involved in trading. The difference between these two figures is statistically significant at the 1% level.

The loss of one connected investment firm director or executive may affect public firms' social networks differently, depending on how many other social ties the firm has. For a well-connected firm, such loss may sever only 5% of its ties to investment firms, whereas the effect may be much larger for other firms where the death represents a more significant loss of connections. We therefore examine whether the reduction in the bid–ask spread is related to the extent of network loss as result of the death. In Panel B of Table 8, we estimate regressions of the change in industry-adjusted bid–ask spread on the percentage of ties the firm lost as a result of the death. Model 1 in Table 8 reports a negative coefficient of −0.53, which is statistically significant at the 1% level. This result shows that the magnitude of reduction in transaction costs is related to the magnitude of network

damage by the death. In model 2, we further control for the changes of other determinants of bid–ask spreads. The coefficient of the percentage of ties lost equals −0.43, which is again statistically significant at the 1% level. This figure suggests that, on average, a 10% reduction in social ties to investment firms results in a 4-bp reduction in a firm's bid–ask spread. Furthermore, our previous analyses suggest that when the social ties between the public firm and investment firms are local or involve individuals directly associated with trading activities, the impact of such social ties on the public firm's trading costs is larger. We therefore add two more dichotomous variables in model 3 indicating whether the loss of social ties is local or whether the deceased individual is directly involved in trading activities. Coefficients on both indicator variables are negative (i.e., −0.13 and −0.06, respectively) and statistically significant, suggesting that severing social ties with more impact is associated with more substantially reduced trading costs. These results provide further support to the argument that social ties influence the cost of trading.

In view of the reduction in the firm's trading costs, a natural question arises as to whether the death of an investment firm executive or director affects his or her firm's trading activities in the connected public firm's stock. If private information transferred through social ties gives an informational advantage to the investment firm in trading the connected public firm's stock, one would expect a reduction in the investment firm's trading activity in the public firm after the death severs ties. To test this prediction, we adopt a difference-in-differences analysis. First, we manually match the BoardEx investment firms with the mutual funds and financial institutions in the Thomson Financial Mutual Fund Holdings and Institutional Holdings databases. Among the 885 pairs of investment firms and public firms where their social connections are severed due to death events, we are able to identify a subsample of 134 cases where the investment firms have nonmissing information on stock holdings during the period from 1 year before to 1 year after the event. We then infer the investment firm's interquarter trading volume as the absolute value of the quarter-to-quarter change in its stock holdings of the socially connected public firm, normalized by the number of outstanding shares. The change in annual trading volume is then calculated as the aggregate trading volume over the four quarters after the death event minus the corresponding measure before the death. To account for any industry and secular trends or potential changes in the investment firm's general trading strategy due to the death of its executive or director, we further construct two adjusted measures of the change in annual trading volume. First, we adjust the change in interquarter annual trading volume described previously with the mean change in corresponding trading volume by the same investment firm in a group of industry-matched public firms over the event window. The matching public firms belong to the same BoardEx industry as the sample public firm but do not experience any change in their social connections to the investment firm whose executive or director dies. Second, we adjust the change in annual trading volume with the average change in annual trading volume in the same (formerly connected) public firm by other investment firms.

The results are presented in Panel C of Table 8. On average, the investment firm reduces its annual trading volume in the connected public firms by 0.83%

of outstanding shares after the social connection between the pair is severed, and this figure is statistically significant at the 1% level. Adjusting the change in trading volume by subtracting that of a matching firm portfolio is associated with a reduction of trading of 0.78% of outstanding shares from year $t-1$ to year $t+1$; this figure is statistically significant at the 1% level. Relative to other investment firms whose social connections to the public firm are not affected, the one with severed ties reduces its annual trading volume in the same public firm by 0.97% of outstanding shares, and this figure is again statistically significant at the 1% level. This evidence suggests that a firm's loss of connections to investment firms is associated with reduced trading costs, likely due to the tempered informed trading activities. The overall evidence in Table 8 suggests that a public firm's social ties with investment firms lead to more informed trading and, consequently, higher trading costs for all shareholders.

F. Omitted Variables

In all of our tests we explicitly control for all variables identified in the literature as related to bid–ask spreads. Of course, as in all research, we must keep in mind the possibility of an unidentified omitted variable correlated with both our dependent and key independent variables, in this case, bid–ask spreads and social ties. Although the analysis on the director death events addresses the omitted-variable problem, we nevertheless conduct the following four additional tests.

1. Change-Regression Results

First, we adopt a change-regression specification by estimating regressions of the change in the annual bid–ask spread on the changes of social ties and of other firm characteristics. This specification captures the within-firm time-series variation of bid–ask spreads associated with social ties. Therefore, it addresses the concern of cross-firm correlation between potentially omitted variables, social ties, and bid–ask spreads, although admittedly not fully precluding the effects of within-firm time-series correlations between these variables. Table 9 reports the results of this test for the main regressions in Table 2. Model 1 reveals that a year-to-year increase in a firm's social connection to investment firms is associated with a significant increase in the firm's bid–ask spread. On average, when a firm adds (loses) an executive or director who is connected to investment firms, the bid–ask spread of the firm increases (decreases) by 0.0048%. In models 2–4, we examine ties based on employment, education, and leisure activities, respectively, and find that, similar to earlier results, gain or loss of education- or activity-based ties is associated with a larger change in bid–ask spreads than that of the employment-based ties. In model 5, we include all three types of ties in the same regression and find similar results.

2. Placebo Test

Another way to check for the impact of omitted variables is to conduct a falsification test.[31] If omitted variables related to investment firm connections are

[31] We thank the referee for this suggestion.

TABLE 9

Changes in Social Connections to Investment Firms and Changes in Trading Costs

The sample used in Table 9 is described in Table 1. In Table 9, the dependent variable is a firm's change in average yearly bid–ask spread from year $t-1$ to year t. The independent variables are the corresponding changes from year $t-1$ to year t of the independent variables in Table 1. t-statistics (reported below in parentheses) are based on standard errors robust to clustering at the firm level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Dependent Variable: ΔAnnual Bid–Ask Spread (%)				
Independent Variables	1	2	3	4	5
Intercept	0.27 (4.87)***	0.27 (4.88)***	0.27 (4.90)***	0.27 (4.93)***	0.27 (4.85)***
ΔNo. of connected D&E ($\times 10^{-2}$)	0.48 (3.19)***				
ΔNo. of connected D&E via employment ($\times 10^{-2}$)		0.39 (3.26)***			0.32 (2.59)***
ΔNo. of connected D&E via education ($\times 10^{-2}$)			1.33 (2.62)***		1.10 (2.15)**
ΔNo. of connected D&E via activities ($\times 10^{-2}$)				0.71 (1.80)*	0.44 (1.10)
ΔNo. of same-person connections ($\times 10^{-2}$)	0.41 (0.48)	0.33 (0.39)	1.96 (2.30)**	1.90 (2.19)**	0.41 (0.48)
Δln(Volume)	−0.25 (−13.00)***	−0.25 (−13.00)***	−0.25 (−13.00)***	−0.25 (−12.99)***	−0.25 (−13.01)***
Δln(Market cap)	0.16 (3.38)***	0.16 (3.39)***	0.16 (3.38)***	0.16 (3.38)***	0.16 (3.36)***
Δln(Price)	−0.39 (−8.95)***	−0.39 (−8.95)***	−0.39 (−8.93)***	−0.39 (−8.96)***	−0.39 (−8.93)***
ΔNASDAQ dummy	0.44 (3.14)***	0.44 (3.14)***	0.44 (3.14)***	0.44 (3.14)***	0.44 (3.11)***
Δln(Average daily trades) × ΔNASDAQ dummy	−0.09 (−4.14)***	−0.09 (−4.14)***	−0.09 (−4.15)***	−0.09 (−4.14)***	−0.09 (−4.11)***
ΔReturn variance	39.11 (3.65)***	39.10 (3.65)***	39.08 (3.65)***	39.03 (3.64)***	39.10 (3.65)***
Year and industry dummies	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.31	0.31	0.31	0.31	0.31
N	14,542	14,542	14,542	14,542	14,542

also related to the noninvestment firm connections, and if these omitted variables are driving our results, we would again obtain significant results in our estimates using ties to noninvestment firms. Consequently, we calculate the social ties between a firm and a random set of noninvestment firms and then use these social tie variables in our tests. Results are shown in Table 10. Replications of Table 2, using the connections to random noninvestment, are never associated with significant coefficients.

3. Firm Fixed Effects and Determinants of Social Ties

Next, we include firm fixed effects in our main regressions and find similar results. The firm fixed effects should capture any (unobservable) firm characteristics that could be correlated with both the firm's social ties with the investment community and its bid–ask spread.

Finally, we study the determinants of a firm's social ties. Untabulated analysis reveals that firm size, Q, leverage, volatility, industry, return on assets (ROA), return on equity (ROE), and a New York headquarters indicator explain over 45% of the cross-sectional variation of investment firms' connections.

TABLE 10

Placebo Tests

In Table 10, we estimate a public firm's social ties with a random sample of 475 noninvestment companies because we have 475 investment companies in the main analysis. We then repeat the regression analysis in Table 2 using these social tie variables. As in the main test, we exclude all financial firms from the analysis. All other variables are as defined in Table 1.

Variables	*N*	Mean	Median	Std. Dev.
Panel A. Social Ties with Random Noninvestment Firms				
No. of connected D&E	18,482	9.68	8.00	6.95
via employment	18,482	8.54	6.00	7.18
via education	18,482	1.21	1.00	1.49
via activities	18,482	3.99	3.00	3.89

	Dependent Variable: Annual Bid–Ask Spread (%)				
Independent Variables	1	2	3	4	5
Panel B. Multivariate Regressions					
Intercept	1.46 (6.64)***	1.46 (6.66)***	1.47 (6.68)***	1.47 (6.69)***	1.46 (6.66)***
No. of connected D&E ($\times 10^{-2}$)	0.12 (1.10)				
No. of connected D&E via employment ($\times 10^{-2}$)		0.10 (0.98)			0.12 (0.83)
No. of connected D&E via education ($\times 10^{-2}$)			0.42 (0.96)		0.35 (0.57)
No. of connected D&E via activities ($\times 10^{-2}$)				0.08 (0.37)	−0.17 (−0.55)
ln(Volume)	−0.31 (−14.05)***	−0.31 (−14.05)***	−0.31 (−14.02)***	−0.31 (−14.04)***	−0.31 (−14.03)***
ln(Market cap)	0.18 (7.19)***	0.18 (7.19)***	0.18 (7.18)***	0.18 (7.19)***	0.18 (7.19)***
ln(Price)	−0.24 (−13.41)***	−0.24 (−13.41)***	−0.24 (−13.41)***	−0.24 (−13.38)***	−0.24 (−13.40)***
NASDAQ dummy	0.75 (7.27)***	0.75 (7.27)***	0.76 (7.27)***	0.76 (7.28)***	0.75 (7.28)***
ln(Average daily trades) × NASDAQ dummy	−0.15 (−10.12)***	−0.15 (−10.13)***	−0.15 (−10.12)***	−0.15 (−10.13)***	−0.15 (−10.13)***
Return variance	94.90 (4.41)***	94.92 (4.41)***	94.90 (4.41)***	94.92 (4.41)***	94.93 (4.41)***
Year and industry dummies	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.57	0.57	0.57	0.57	0.57
N	18,482	18,482	18,482	18,482	18,482

More importantly, when we use the unexplained portion of the social tie variables as the key independent variables in our analyses, the main results are similar. The evidence of these four tests and the findings of the tests involving death events suggest that our results are unlikely to be driven by omitted variables.

G. Additional Tests

1. Alternate Measure of Trading Costs

Following Stoll (2000), we use a stock's proportional quoted spread as our measure of trading cost. An alternative way to measure trading cost is the effective bid–ask spread. Following Stoll (2000) and Brockman, Chung, and Yan (2009), we estimate a stock's effective bid–ask spread as two times the absolute value of the difference between the trade price and the quoted midpoint, scaled by the

quoted midpoint. Our results are similar when using this alternative measure of trading costs.

Previous research shows that information transfer via private channels increases the probability of informed trading; as a result, market makers widen the bid–ask spread to protect themselves from the potential losses of trading against informed parties. This part of the bid–ask spread is often referred to as the adverse-selection component of the spread (Copeland and Galai (1983), Glosten and Milgrom (1985)). To further test the proclivity for the privileged information to transfer through social networks between public firms and investment firms, we follow Lin, Sanger, and Booth (1995) and estimate the adverse-selection component of the bid–ask spread. We then replace the bid–ask spread in our main tests with this estimated adverse-selection component and find similar results.

2. Do Social Connections Have a Stronger Impact among Firms with Severe Information Asymmetry?

Our main regressions in Table 2 suggest that one additional connected executive or director increases his or her firm's bid–ask spread by 0.0109% of the stock price. One may expect the impact of the connection to investment firms to be stronger among firms associated with higher information asymmetry. To test this conjecture, we bifurcate the sample using an ex ante proxy of information asymmetry, the number of analysts following the firm at the beginning of each year. We then repeat the regressions presented in Table 2 separately for the two subsamples and compare the coefficients of our social connection measures. Our results are consistent with the conjecture that the impact of connections to investment firms is stronger among firms with more severe information asymmetry. For example, the difference in the coefficients of the number of connected directors and executives in model 1 is 0.0087%, which is statistically significant at 10% level, between the subsamples with high and low information asymmetry.

3. Do Social Connections Have a Stronger Impact When Informed Trading Is More Likely?

If the documented association between a firm's social ties with investment firms and its trading costs is attributable to informed trading, we expect a stronger association when informed trading is more likely to exist in the marketplace. To test this hypothesis, we separate time periods likely to have a higher probability of informed trading from those with lower probability. We define the pre–earnings announcement period of $(-10, 0)$ as the high-risk period because during this period corporate insiders and their social contacts may already know something about the yet-to-be-reported quarterly earnings. We define the post–earnings announcement period of $(+3, +12)$ as the low-risk period.[32] We then estimate regressions similar to those in Table 2 using the average bid–ask spreads from these two separate time periods. In untabulated tests, we find that in all five pairs of regressions the coefficients of social ties are higher during the pre–earnings announcement period than during the post–earnings announcement period. The differences

[32] Bettis, Coles, and Lemmon (2000) document that the most common corporate policy on insider trading allows insiders to trade during a 10-day window from the 3rd to the 12th trading days after quarterly earnings announcements. This period, therefore, has relatively low risk of adverse selection.

are statistically significant in four out of the five regressions. This result is also consistent with informed trading being the link between a firm's social ties with investment firms and its trading costs.

4. Alternate Measure of Social Connections

We measure a public firm's social connections with investment firms by the number of the firm's directors and executives who are tied to investment firms. A director or executive, however, may have multiple ties to the investment firms. To test the robustness of our social connection measures, we also define a public firm's social connections with investment firms by the number of specific ties the firm has with investment firms. That is, we use the sum of all connections of a public firm's executives and directors rather than using the number of connected executives and directors. Our results are similar when using this alternate measure of social ties.

5. Do Social Ties Affect Expected Returns?

Easley and O'Hara (2004) argue that uninformed investors protect themselves from the increased possibility of losses to informed trading by demanding higher expected returns on the associated stocks. To test this, we form an equal-weighted long–short portfolio at the end of each calendar year based on the number of social ties of our sample firms, where the long (short) leg consists of firms with above-median (below-median) social ties. To control for the correlation between the number of social ties a firm has and its size, we orthogonalize the social tie measure with respect to the market value of equity. We then track the returns of this portfolio for the following calendar year and rebalance annually. Table 11

TABLE 11

Social Ties and Expected Returns

We form an equal-weighted long-short portfolio at the end of each calendar year based on the number of social ties of our sample firms, where the long (short) leg consists of firms with above-median (below-median) social ties. To control for the correlation between the number of social ties a firm has and its size, we orthogonalize the social tie measure with respect to the market value of equity. We then track the returns of this portfolio for the following calendar year and rebalance annually. Table 11 reports the Fama–French (1993) 3-factor and Carhart (1997) 4-factor monthly regressions results. Small-minus-big (SMB) is the size factor. High-minus-low (HML) is the book-to-market factor. Up-minus-down (UMD) is the momentum factor.

	Dependent Variable: Return of High-Social-Tie Portfolio − Return of Low-Social-Tie Portfolio	
Variables	1	2
Intercept	0.00384 (2.50)**	0.00374 (2.48)**
Market return – Risk-free rate	−0.132 (−4.04)***	−0.140 (−3.52)***
SMB	−0.042 (−0.77)	−0.044 (−0.79)
HML	0.371 (7.92)***	0.373 (7.87)***
UMD		−0.0001 (−0.36)
N	108	108
Adj. R^2	0.438	0.438

reports the Fama–French (1993) 3-factor and Carhart (1997) 4-factor regressions results. The intercept is significantly positive in each case, indicating higher expected returns for firms with more social ties. The long–short portfolio on average earns 37 bps per month, or about 4.5% per year. Our result is consistent with that of Choi, Jin, and Yan (2013), who use a sample of daily trades by institutional investors of the Shanghai Stock Exchange and find that the informed trading in a stock is associated with higher expected returns. The evidence of higher expected returns suggests additional private gains by the informed parties, which is another reason the estimates implied by the bid–ask spread in Table 7 represents a lower bound on the costs of social ties to shareholders. In addition, the higher expected ROE for firms with more social ties also increases the cost of capital for these firms, resulting in fewer projects with positive net present value (NPV) and lower valuation of equity.

V. Summary and Conclusions

A growing literature in finance examines the consequences of the flow of information through social networks and the resulting effect on financial markets. Several influential studies document the transfer of private information via social ties and the resulting benefits to information recipients such as mutual fund managers and financial analysts. In this study, we examine the consequences of such information transfer to shareholders. Quite simply, the selective flows of information from corporate insiders to connected investment firms increase the probability of informed trading. If bid–ask spreads rise because of this increased probability, it imposes costs on the firm's shareholders.

The extent to which social networks actually influence trading costs is an empirical issue. To explore this topic, we test several hypotheses using a network of connections linking executives and directors of public firms with their social ties at investment firms. Our sample includes over 18,000 firm-year observations. Our results indicate that the social connections between a public firm's executives and directors and investment firms are associated with statistically significant and economically meaningful increases in the firm's trading costs. Furthermore, this relation is significantly stronger for local ties, multiple ties, and long-lasting ties; when the connected parties are directly involved in trading; and during time periods when informed trading is more likely. When the social connection is severed by exogenous shocks, trading costs and trading activities by once-connected investment firms are reduced.

We estimate that at the median level, social ties account for approximately 15% of a firm's bid–ask spread and impose additional trading costs of about 3% of its market value of equity. In addition to the absolute magnitude of the increased trading costs, our work provides additional evidence of the importance of social networks in the transfer of privileged information.

Our work contributes to the growing literature on social networks. The results are consistent with information flows through social networks and the adjustment for these flows in trading costs. These adjustments significantly alter trading costs to a firm's shareholders.

Appendix. Summary of Empirical Tests

Our paper tests the broad proposition that information transferred via social ties between a public firm and investment firms likely leads to informed trading, which results in higher trading costs of the connected firm's shares. We test this proposition directly. However, we also test a number of other implications associated with the transfer of information through social ties. This Appendix documents the testable implications surrounding our proposition:

1. Firms with more social ties have wider bid–ask spreads (Table 2).
2. Local social ties are associated with wider bid–ask spreads than distant ties (Table 3).
3. Directors or executives with multiple ties to investment firms are associated with wider bid–ask spreads than those with only one tie (Table 4).
4. Directors or executives with long-lasting ties to investment firms are associated with wider bid–ask spreads than those with ties of short duration (Table 5).
5. Social ties with individuals more directly involved in trading are associated with wider bid–ask spreads (Table 6).
6. When social ties are severed, spreads narrow (Table 8).
7. When social ties are severed, trading by once-connected parties subsides (Table 8).
8. Change regressions address the concern of cross-firm correlation between potentially omitted variables, social ties, and bid–ask spreads (Table 9).
9. Placebo tests show that social ties to a random set of noninvestment firms are not associated with significant increases in bid–ask spreads (Table 10).
10. Fama–French (1993) and Carhart (1997) tests show that expected rates of return are higher for firms with more social ties (Table 11).

Untabulated Robustness Tests

11. Variables logically associated with social ties (size, industry, location, etc.) do not drive the results documented (Table A11 of the Internet Appendix, available at www.jfqa.org).
12. Alternate measures of trading costs produce similar results (Tables A12.1–A12.2 of the Internet Appendix).
13. Alternate measures of social connections produce similar results (Table A13 of the Internet Appendix).
14. Social ties have a stronger effect for firms with less analyst coverage (Table A14 of the Internet Appendix).
15. Social ties have a stronger effect when the informed trading is more likely (Table A15 of the Internet Appendix).
16. Results are robust with the inclusion of institutional holdings and its Herfindahl index as control variables (Table A16 of the Internet Appendix).
17. Results are robust with estimates from Fama–MacBeth (1973) type regressions rather than panel regressions (Table A17 of the Internet Appendix).

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