Social Networks and Managerial Rent Seeking: Evidence from Insider Trading

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Abstract

This study examines whether board social networks are associated with insider trading profitability. Using a sample of U.S. public firms with the history of insider trading from the years 2000 to 2015, we find robust evidence that the profitability of insider trading is significantly lower in firms with higher level of board social networks. The evidence is consistent with our view that board social networks effectively curb insiders' private information advantage over outsiders, thus leading to a lower level of managerial rent seeking. We further explore two potential explanations for our findings, namely the *Monitoring Spillover Channel* and the *Information Dissemination Channel*. Our empirical cross-sectional analyses offer strong support to the former and weak to the latter. Collectively, our research has important policy implications for regulators concerned about the role of corporate board in affecting the functioning of capital market.

JEL Classification: G14; G34

Keywords: social networks; managerial rent seeking; insider trading

1. Introduction

Jensen and Meckling (1976) maintain that, due to the separation of ownership and control, managers are incentivized to engage in activities in order to extract private benefits from shareholders' wealth. Studies suggest that insider trading is one of the mechanisms through which corporate insiders, including executives, leverage information advantage over outside parties and thus enjoy personal benefits (e.g., Seyhun 1986; Fishman and Hagerty 1992; Baiman and Verrecchia 1996; Cheng and Lo 2006; Kraft, Lee, and Lopatta 2014). It is well known that corporate governance matters in curbing managerial rent extraction. Specifically, prior empirical literature has focused on the impact of formal governance/information mechanisms, including regulatory constraints, analyst following, corporate insider trade policies, financial reporting and internal control systems, board structure and institutional ownership, and other governance provisions, on restricting the profitability of insider trading (e.g., Bettis, Coles and Lemmon 2000; Frankel and Li 2004; Brochet 2010; Jagolinzer, Larcker and Taylor 2011; Skaife, Veenman and Wangerin 2013; Dai, Fu, Kang and Lee 2016). However, there exists scant evidence on whether and how informal mechanisms play a role in affecting the profitability of insider trading, a commonly regarded self-serving action. In the recent years, informal mechanisms like social network have received increased attention from regulators, investors and other corporate stakeholders (e.g., Lawrence, Witzel and Johnson 2011; Akbas, Meschke and Wintoki 2016). In this study, we seek to fill the gap of the literature by investigating the impact of board social networks on executive trading profitability.

We center on board of directors given their responsibility for alleviating agency conflicts due to managers' informational advantage (Armstrong, Guay, and Weber 2010). We measure board social networks at the aggregate level based on all the social ties between directors of the

firm and executives, officers, and directors of other firms. We conjecture that, as one of the important informal mechanisms, board social network may affect the profitability of executive trading in the following manners. First, board social networks capture director connections through professional experience, educational background, and civic activities, reflecting directors' access to information sources beyond boardrooms. Prior literature suggests that social networks speed up information transfer and improve information quality, especially for actors with better connections (e.g., Haythornthwaite 1996; Jackson, Rogersy and Zenou, 2016). Thus, well-social-connected boards have broad access to information resources (Haythornthwaite 1996), which facilitates their monitoring over corporate executives. In addition, labor market incentives motivate board members to improve their reputations as strict monitors (Fama 1980; Fama and Jensen 1983; Jiang, Wan and Zhao 2016). Considering that a board's reputation is closely tied to social networks of its directors, it follows that reputation and legal liability concerns incentivize a well-social-connected board to implement stringent oversight over managerial opportunistic behavior.

Specifically, due to the fact that economic information can transmit from social networks to directors, boards with broader social networks would have access to more comprehensive and timelier private information, including "the launch of a new product by peer firms that potentially accelerates obsolescence of the firm's existing products, whether major customers are suffering financial distress, whether major lenders are imposing tight credit rationing, the pending acquisition of an important supplier, potential strategic alliances among competitors, upcoming regulatory restrictions, loss of major customer contracts" (Fang, Pittman, and Zhao 2021). Such knowledge advantage places a board in a better position to assess a firm's business operation by supplementing information provided to the board by managers, and thus makes

managers more difficult to hoard information for personal benefits. In fact, directors can leverage their information privilege to enforce policies against executives' hoarding of private information in fulfilling their monitoring duty (Fama and Jensen 1983). Moreover, social networks can aid directors, via in-depth consultations with connections in their network, in assimilating firm-level information in order to better evaluate its implications and focus on their monitoring role. Consequently, managers are more forthcoming in revealing corporate information in the presence of a well-connected and better-informed board, as a result leading to a weakened position of managerial advantage in private information. Given that insider trading profitability stems from private information insiders possess (i.e., not transferred through public channels), information flowing through informal mechanisms, including board social networks, could lessen the executives' monopoly over private information and curtail their trading profitability. As a result, we anticipate a lower level of insider trading profitability for firms with better social networked board. We regard this mechanism as the monitoring spillover channel of the network-insider trading link.

The alternative view of information dissemination also suggests that board social networks may constrain the profitability of insider trading. Under this view, firm-specific private information travels from a board to external market participants via board social networks, despite of government regulation and corporate policies prohibiting exploiting such information for trading purpose. In studying abnormal returns of social networks, Cohen, Frazzini and Malloy (2008) and Akbas, Meschke and Wintoki (2016) suggest that private information transmits from board directors to various external market players, including mutual fund managers, short sellers, option traders, and institutional investors, who subsequently trade on it. Especially, Akbas et al. (2016) document that sophisticated investors tend to better forecast upcoming

earnings surprises for firms with more highly social-connected boards, and that a larger portion of news concerning such firms is already impounded in stock prices even prior to the public announcement. Given that such information dissemination via board social networks speeds up the incorporation of private information into equity prices, it should mitigate information advantage for managers and dampen the profitability of insider trading. We consider this mechanism of information flowing through the chain from directors to social-network connected parties as the information dissemination channel of the network-insider trading link. Collectively, we conjecture that, under both the monitoring spillover and information dissemination views, insider trading profitability will be lower when board social networks are larger. Nevertheless, if private information transmitted via board social networks is not reliable or firm-specific, it might weaken the relation between board social networks and insider trading profitability.

Using a large sample of U.S. public firms for the years 2000–2015, we examine the empirical link between board social networks and insider trading profitability. Controlling inter alia for a series of firm-level factors that potentially affect insider trading profitability, we find compelling evidence that firms with well-connected board social networks exhibit lower level of insider trading profitability relative to firms with poorly-connected board social networks. These findings are consistent with our perspective that board social networks effectively curb insider trading profitability. To evaluate the economic importance according to the coefficient estimates, we compare insider trading profitability across the inter-quartile range in the distribution of board social networks metrics, holding all other variables at their mean values. Reflecting the first-order economic materiality of our results, insider trading profitability falls, on average, by 14.12 percent of the sample mean with a shift from the 25th to the 75th percentile in the distribution of board social networks metrics. The effect is economically as well as statistically significant.

Importantly, we continue to observe a robust and inverse relation between board social networks and insider trading profitability in extensive sensitivity analyses, including controlling for public financial information quality in alternative ways, decomposing profitability into sales-based and purchase-based transactions, employing trading-volume-based measure of insider trading, and disaggregating CEO versus non-CEO executives' trading profitability, respectively.

Next, we conduct cross-sectional analyses that exploit settings where the inverse relation between board social networks and insider trading profitability is predictably stronger. Specifically, we attempt to disentangle the two channels (*Monitoring Spillover* versus *Information Dissemination*) linking the relation between board social networks and insider trading profitability by identify settings where each channel (but not both) matters the most. The premise underlying the *Monitoring Spillover Channel* is that corporate board is well-motivated to fulfill their monitoring roles by enforcing policies against executives' hoarding of private information for private benefits. We expect that, if the *Monitoring Spillover Channel* has empirical validity, the importance of board social networks on curbing insider trading profitability is more pronounced (more negative) for firms with more severe agency conflict and/or weaker external monitoring, because in these firms managerial privilege of private information is greater and board social networks, as an informal information mechanism, is likely to play a more important role in exerting monitoring functions. Supporting the *Monitoring Spillover Channel* effect, our empirical results show that the negative association between board social networks and insider trading profitability is more pronounced for firms with greater CEO centrality, externally hired CEOs, greater shareholders' litigation threat, and higher level of transient institutional ownership. These cross-sectional findings further buttress and enrich our understanding of the relation between board social networks and insider trading profitability, as well as shed light on how board social

networks interact with agency conflicts and external monitoring mechanisms to affect insider trading profitability.

To gauge the extent of the *Information Dissemination Channel* effect, we evaluate circumstances where it is more likely that board social networks play a role in affecting insider trading profitability. We expect that, if board social networks effectively facilitate the transmission of private information to external market participants, it can diminish insider trading profitability. Thus, the inverse relation between board social networks and insider trading profitability is based on the participation of externally informed traders. In other words, if the information dissemination channel functions, then the relation between board social networks and insider trading profitability should be more pronounced for firms with high level of informed external trading. Using multiple measures of externally informed trading, we find weak evidence supporting the *Information Dissemination Channel* effect.

Finally, we investigate whether the impact of board social networks on insider trading profitability had capital market consequence on cost of equity capital. Asset pricing theory suggests that enhanced information supply reduces information asymmetries between managers and outsiders, thus resulting in lower costs of capital (e.g., Akerlof 1970; Glosten and Milgrom 1985; Amihud and Mendelson 1986). Thus, we conjecture that large board social networks would have an impact on the cost of capital through curtailing managerial rent seeking based on private information advantage. Our path analysis shows that board social networks have significant impact on reducing cost of equity capital through the mediation of insider trading profitability. This evidence helps to corroborate that insider trading profitability is an important outcome of board social networks.

Our study provides several important contributions to the literature. First, our paper builds on the growing literature linking board social networks with economic behavior. Recent studies document a significant impact of board social networks on a variety of corporate decision-making activities, including firm performance, financial reporting quality, and corporate bad news disclosure (e.g., Larcker, So, and Wang 2013; Intintoli, Kahle, and Zhao 2018; Fang, Pittman, and Zhao 2021). To our knowledge, this is the first study to assess the direct linkage between board social networks and executive rent seeking. In particular, emphasizing a unique perspective, insider trading profitability, we provide new and direct evidence concerning the economic consequence of board social networks, as an informal information mechanism, on managerial exploitation of private benefits. Our study extends the literature on board social networks by documenting an important benefit that board social networks bring to firms and their shareholders in protecting investors' welfare through informal mechanism.

In addition, our findings help regulators identify gaps in current regulation of corporate board and thereby take actions to limit insider trading based on information advantage correspondingly. Huddart and Ke (2007, p.197) point out that "[i]dentifying the characteristics of firms where insiders' trades are most profitable may prove useful to regulators who design enhanced disclosures or other remedies to limit insiders' trading advantage." Our study supports recent efforts of "Exchange Act Rule 14a-11" by the Securities and Exchange Commission (SEC) to increase shareholders' ability to nominate qualified directors to corporate board. Our evidence is in line with the viewpoint of PricewaterhouseCoopers (2015) regarding the role of board of directors in ensuring better compliance about insider trading.

Further, we seek to identify and understand the underlying economic factors that lead to cross-sectional differences in the economic consequences of board social networks to insider

trading profitability. Beyond indicating that board social networks matter in affecting executive trading profitability, the contextual findings in our study corroborate the agency perspective of our main finding; that is, the negative relation between board social networks and executive trading profitability is driven by severe agency conflicts and weak monitoring mechanisms. The cross-sectional evidence contributes to our understanding of the settings where shareholders' wealth is most at risk via insider trading.

Last, we extend the insider trading literature on factors that contribute to insider trading profitability (e.g., Aboody and Lev 2000; Beneish and Vargus 2002; Jagolinzer et al. 2011; Skaife et al. 2013; Dai, Fu, Kang and Lee 2016). Prior studies highlight the importance of formal mechanisms of corporate governance and information reporting on reducing insider trading profitability. For example, Bettis, Coles, and Lemmon (2000) document that corporate policies and procedures in place restrict trading by insiders. Specifically, the blackout periods successfully curtail insider trading for both buy and sale transactions, and the associated trading profitability is significantly lower during the periods. Frankel and Li (2004) find that increased analyst following is associated with muted profitability of insider trading, implying that information collection by capital market intermediaries reduces insiders' information advantage over outsiders and thus compromises insiders' ability to trade profitably based on non-public information. Brochet (2010) presents evidence indicating a negative association between stock returns around filings of insider sales and the Sarbanes-Oxley Act (SOX) of 2002. His findings suggest that timely disclosures about insider transactions introduced by Section 403 of SOX reduces insiders' incentives to sell based on private negative information. Jagolinzer, Larcker, and Taylor (2011) find that corporate general counsel limits insiders' trading profits and the predictive ability of insider trades for future operating performance, thus effectively hindering insiders' rent

extraction. Skaife, Veenman and Wangerin (2013) investigate the relation between effectiveness of internal control over financial reporting and the profitability of insider trading. They find that the profitability of insider trading is negatively associated with effectiveness of internal control, and the association disappears after remediation of the internal control problems. They further show even greater profitability of insider trading when insiders tend to behave in their own best interest as evidenced by auditors' weak ''tone at the top'' adverse internal control opinions. More recently, Dai, Fu, Kang and Lee (2016) utilize the data from corporate board and institutional holdings to proxy for the quality of corporate governance at the firm level and show that well-governed firms restrict the profitability of insider trading, mainly insider sales, for the purpose of reducing legal risk. They also find that, to lessen the insider trading profitability, better-governed firms tend to implement ex-ante preventive policies (e.g., voluntary insider trading restriction) more effectively and fulfill ex-post disciplinary actions more actively. Overall, the literature has shown the mitigating effect of formal corporate mechanisms on insider trading. Distinct from the aforementioned studies, our study considers whether informal mechanisms, e.g., board social networks, play a role in curtailing insider trading profitability. We empirically show that, after controlling for various formal mechanisms of corporate governance (i.e., board size, analysts following, various types of institutional ownership, and auditor characteristics), board social networks remain as one of the most important determinants of insider trading profitability in both the statistical and economic significances. We help fill a void in the extant literature. In this regard, our paper also contributes to the broad extant literature on the relation between corporate governance and managerial misconduct. Our findings suggest that, as an important informal information mechanism, board social networks play an important disciplinary role against executive' self-serving misbehavior.

The paper proceeds as follows. Section 2 describes the sample, variable measurement, and research design. Section 3 presents the empirical results. Section 4 concludes.

2. Sample, variables, and descriptive Statistics

2.1. The sample

The initial sample comprises firm-year observations for which board network information is available on the BoardEx database. We obtain insider trading transactions from Thomson Reuters' Insiders Data Feed and collect open market purchases and sales by officers. Following Skaife et al. (2013) and Tang and Xin (2021), our study focuses on the insider trading transactions of the C-suite officers, including CEOs and other major officers (i.e., Chief Finance Officer (CFO), Chief Operating Officer (COO), Chief Investment Officer (CIO), and Chief Technology Officer (CTO)). Compared with other insiders, the C-suite officers are more likely to have access to private information and thus trade on it. In addition, we collect: 1) stock return data from CRSP daily stock files; 2) accounting data from *Compustat* annual files; 3) analyst coverage data from *I/B/E/S*; 4) institutional ownership data from the Thomson Reuters' Institutional Holdings database; and 5) audit related data from Audit Analytics. We further exclude observations with non-positive total assets and equity book values, observations with year-end share prices less than one dollar, and observations with fewer than six months of *CRSP* return data available. Our final sample consists of 32,286 firm-year observations for the years 2000 to 2015 inclusive.

2.2. Measure of director external social networks

Following Akbas et al. (2016), we utilize board external social networks to reflect a variety of director links through current and former employers, schools attended, military services and

civic activities. First, we use the natural logarithm of the aggregate board level of each director's social connections with executives, officers, and directors of other firms, extracted from BoardEx, as a raw measure of social networks for each firm-year (*Raw SOCIALNETWORKS*). Second, we regress this raw measure on the natural logarithms of firm size, board size, firm age, number of analysts, and institutional ownership. We employ the residual values from the regressions as a second proxy for board social networks (*Residual SOCIALNETWORKS*). This approach helps ensure that our measure of board social networks is not contaminated by potentially correlated firm characteristics, and therefore mitigates potential bias on the coefficient of social networks arising from omitted correlated variables.

2.3. Measuring insider trading

Following prior literature (e.g., Skaife et al., 2013; Tang and Xin 2021; Huddart and Ke 2007), our insider trading measure is insider trading profitability, i.e., the (unrealized) capital gains after insider purchases and the capital losses avoided by insider sales. If insiders trade only on the information already embedded in stock prices, insider trading profitability would, on average, be zero. Our measure of insider trading profitability is determined by three factors documented in the literature: (1) the difference between the market price of the stock and its value based on insiders' private information; (2) the number of shares traded; and (3) the frequency of insider trading. Focusing only on any single factor as a proxy for insider trading profitability might mismeasure the pecuniary value of private information insiders trade on. Thus, we follow prior studies to take into account all of the three factors in developing one aggregate measure, that is insider trading profitability, at the firm-year level to capture private monetary benefits of insider trading.

Specifically, we construct the empirical measure of insider trading profitability in the following way. First, when multiple insider trades of the same firm occur on the same day, we aggregate these trades at the firm-day level. And, duplicate firm-days are removed. Next, using daily stock returns from CRSP, we compute the one-year buy-and-hold abnormal (size-adjusted) return following each individual trade to impute the value of private information for insider trades over the market price. We then multiply the abnormal return by the dollar value traded to determine insider trading profitability. For share purchases, the product represents the potential gain from purchases to insiders for one-year holding period. For share sales, we use the negative of the product of abnormal return and value traded to determine the amount of potential losses avoided when selling shares. Finally, we aggregate individual transactions at the firm-year level:

$$PROFIT\%_{it} = \frac{\sum_{j=1}^{n} ABRET_{itj} * VALUE\_BOUGHT_{itj} - ABRET_{itj} * VALUE\_SOLD_{itj}}{MV_{it-1}}, \qquad (1)$$

where $ABRET_{itj}$ is the buy-and-hold abnormal return computed for the one-year period starting one day after transaction date j in year t for firm i; $VALUE\_BOUGHT_{itj}$ and $VALUE\_SOLD_{itj}$ are the total dollar value of shares bought and sold by all insiders on day j, respectively; n is the total number of firm-days with insider trading activity during firm-year it; MV_{it-1} is the market value of equity at the end of fiscal year t-1. We multiply the value of Eq. (1) by 100 to denote $PROFIT\%$ as a percentage of market value at the beginning of the year. Finally, Frankel and Li (2004) point out that insiders will not trade on their private information when doing so would be unprofitable. Thus, we follow prior research (i.e., Huddart and Ke 2007; Skaife et al. 2013) by including firm-years for which there are no reported insider trades and set *PROFIT%* equal to zero. We employ each firm-year $PROFIT\%$ as the dependent variables in our empirical tests.

2.4. Control variables

Following prior literature on insider trading (e.g., Skaife et al. 2013; Gao, Lisic, and Zhang, 2014; Ryan et al. 2016; Tang and Xin 2021), we control for the following variables: *RET, LAG_RET*, and *LEAD_RET* defined as annual firm-specific return for the current year, the lagged year, and the lead year, respectively, where firm-specific return is estimated based on Hutton, Marcus, and Tehranian (2009)'s expanded market and industry index regression; *SIGMA* defined as the standard deviation of firm-specific returns over the current year; *MB* defined as the market-to-book ratio at the end of the fiscal year; *LEV* defined as the book value of all long-term liabilities divided by the total assets at the end of the fiscal year; *FIRMSIZE* defined as the log of market value of equity at the end of the fiscal year; *BOARDSIZE* defined as the log of the number of directors serving the board; *ROE* defined as net income excluding discontinued operations and extraordinary items, divided by the book value of total shareholders' equity at the end of the fiscal year; *FR_OPAQUE* defined as the three-year moving sum of the absolute value of annual performance-adjusted discretionary accruals-as developed by Kothari, Leone, and Wasley (2005)—for the current year; *RM* defined as the value of the overall measure of real earnings management developed by Roychowdhury (2006); *AGE* defined as the natural logarithm of the number of years that the firm has been listed on *Compustat* since 1950; *RD* measured as the research and development expense divided by the lagged value of total assets; *TURNOVER* defined as the average monthly share turnover over the fiscal year, where monthly share turnover is calculated as the monthly share trading volume divided by the number of shares outstanding over the month; *AUD_TEN* defined as the number of consecutive years in the fiscal year that the auditor has been employed by the firm; *BIGN* equal to one if the firm is audited by Big N auditor; *ANA* defined as the natural logarithm of one plus the number of analyst forecast estimates for the

firm; *TRA, QIX*, and *DED* defined as the percentage of a firm's shares held by transient, quasi-indexer, and dedicated institutional investors, respectively[1];

The appendix summarizes the variable definitions used in this study.

-------Insert Appendix ------

2.5. Descriptive statistics

Table 1 Panel A provides descriptive statistics for the key variables used in our regression models. The mean (median) values of *PROFIT%* are 0.0406 (0.0000), comparable to the statistics reported in prior studies (e.g., Skaife et al. 2013; Tang and Xin 2021). The mean values (standard deviations) of *Raw SOCIALNETWORKS* and *Residual SOCIALNETWORKS* are 8.5548 (0.8926) and 0.0007 (0.5754), which are similar to that obtained in Akbas et al. (2016) and Fang et al. (2021).

Panel B of Table 1 provides a Pearson correlation matrix for the key variables under study. Our measures of board social networks, *Raw SOCIALNETWORKS* and *Residual SOCIALNETWORKS* are significantly negatively correlated with *PROFIT%* at the 1% level (two-tailed), offering some preliminary support to our prediction of the relation between board social networks and insider trading profitability. In line with prior research, insider trading profitability is significantly related with a set of firm-characteristics variables as evidenced in Panel B.

-------Insert Table 1 ------

2.6. Portfolio Analysis

To further unravel the relation between board social networks and insider trading, we implement a portfolio analysis. Specifically, we first separate the sample firms into three

[1]We use Bushee's website: https://accounting-faculty.wharton.upenn.edu/bushee/ to obtain information about institutional investor types.

portfolios (i.e., terciles) based on the raw and residual values of board social networks. Here, we focus on the top and bottom terciles, i.e., portfolios with high versus low board social networks. Then, for each tercile, we calculate the mean values of insider trading profitability. Table 2 provides the mean values of insider trading profitability between portfolios with high and low level of board social networks. Panel A of Table 2 shows that the mean value of *PROFIT%* (i.e., 0.0254) for firms with high *Raw SOCIALNETWORKS* are much lower than those (i.e., 0.0510) for firms with low *Raw SOCIALNETWORKS*. The *t*-tests indicate that the difference of the mean values between the two portfolios is significant at the 1% level (*t*-statistic=12.05). In a similar vein, Panel B of Table 2 provides evidence of two-group comparison for *PROFIT%* when we split the sample using alternative measure of board social networks, *Residual SOCIALNETWORKS*. The results remain similar. Overall, Table 2 provides preliminary evidence consistent with our prediction that managers are less inclined to seek rents via inside trading in firms engaging high level of board social networks.

-------Insert Table 2 ------

4. Empirical Analyses

4.1. Primary Evidence

To test the empirical prediction between board social networks and insider trading profitability, we estimate the following regression:

$$PROFIT\%_{j,T} = \alpha_0 + \alpha_1 Raw\ (Resudial)SOCIALNETWORKS_{j,T} + \sum_k \alpha_k Controls_{j,T}^k +$$

$$IndustryDummies + YearDummies\ + \varepsilon_{j,T+1} \quad (2)$$

In regression equation (2), we controls for year and industry (i.e., Fama-French 48 industry classifications) fixed-effects. The regression equation is estimated using pooled Ordinary Least

Squares with White standard errors corrected for firm clustering. We focus on the role that *Raw (Residual) SOCIALNETWORKS* plays in affecting insider trading profitability. That is, we are interested in the coefficient estimate, α_1. We also conduct more tests in order to make stronger inferences as described in the later sections of the paper below.

We report the least-squares estimation results for Equation (2) in Table 3. Sample sizes and adjusted R^2 values for the regressions are reported in the last two rows. Models (1) - (2) present the regression results for each of *Raw* and *Residual SOCIALNETWORKS*, respectively. The coefficients for *Raw* and *Residual SOCIALNETWORKS* are consistently and significantly negative at less than a 1% significance level (*t*-statistics= -3.32 and -3.21). These findings are consistent with our view that board social networks effectively curtail insider trading activities. The adjusted R^2 are comparable to those documented in the prior literature.[2]

To further examine the economic significance of the results, we set *Raw* and *Residual SOCIALNETWORKS* at the 25th and 75th percentile values, respectively, and then compare *PROFIT%* at these two percentile values in the regression model while holding all other variables at their mean values. The economic magnitudes are significant. On average, we find that a shift from the 25th to the 75th percentile of the distribution of *Raw* and *Residual SOCIALNETWORKS* is associated with an estimated 16.90% and 11.34% decrease in *PROFIT%* related to its sample mean, respectively. Untabulated evidence indicates that the estimated impact of board social networks on insider trading is, in economic significance, similar to the impact of other factors on insider trading. For example, the shift in *PROFIT%* amounts to 9.12% and 14.76% of the sample mean moving across the interquartile range in the *FIRM SIZE* distributions, respectively.

[2] The adjusted R^2s in Table 3 are 6.17% comparable to the results of prior studies on insider trading. For example, the adjusted R^2 values in Skaife et al. 2013) and Tang and Xin (2021) are about 2% and 12%, respectively.

Turning to control variables, we find that a number of the estimated coefficients are highly significant and take on the signs hypothesized by the literature. For example, the coefficient on *SIGMA* is significantly positive, implying that volatile stocks are more likely to provide insiders high trading profitability. Also, the coefficients on *LEV*, *FIRMSIZE*, *AGE*, and *BOARDSIZE* are significantly negative. These are consistent with the conjecture that highly-leveraged firm, large firm, old firm or firm with large boards are more likely to be subject to stringent external monitoring from debt holders or equity holders and thus have a low profitability of insider trading. Moreover, we observe the positive coefficients on *RET*, *ROE*, *FR*_OPAQUE, and *TRA*, suggesting that insider trading profits are greater for firms with better performance, worse financial reporting quality, and more transient institutional ownership.

In short, the findings in Table 3 uniformly support our conjecture that board social networks are negatively related to insider trading profitability. These findings are consistent with the view of board social networks that board social networks effectively curb insider trading profitability. The results are robust to the use of both proxies for board social networks, after controlling for a variety of determinants of insider trading and board social networks (e.g., firm size, board size, investor disagreement, analysts following, financial reporting opacity, and various institutional holdings).

-------Insert Table 3 ------

4.2. Economic Mechanisms: *Monitoring Spillover* versus *Information Dissemination Channels*

In this section, we attempt to disentangle the two channels (*monitoring spillover* versus *information dissemination*) linking the relation between board social networks and insider trading. Methodologically, we identify settings where each channel (but not both) matters the most.

4.2.1. Monitoring Spillover Channel

The *Monitoring Spillover Channel* is based on the presumption that board of directors is well-motivated to fulfill their monitoring role by enforcing policies against executives' hoarding of private information for private benefits. Thus, when a firm's agency conflicts are more severe or formal monitoring mechanisms weaker, managerial advantage of private information is more appealing and thus board social networks, as an informal information mechanism, should play a more prominent role in exerting monitoring efforts and implementing governance oversight. In other words, for a firm with either little agency conflict or strong formal monitoring mechanism, the role of board social networks in mitigating managerial rent seeking would be minimal. Based on this reasoning, if the *Monitoring Spillover Channel* has empirical validity, we expect to find that the impact of board social networks on insider trading is more pronounced (more negative) for large networks when a firm's formal monitoring mechanism is weak or agency conflict is severer, as compared to small networks.

To test for the *Monitoring Spillover Channel* view, we deepen our analysis by exploring the following factors that identify cross-sectional differences in the economic consequences of board networks to insider trading: (i) the severity of agency conflicts evident in CEO and firm characteristics; and (ii) the strength of external monitoring by institutional investors.

We begin by considering whether the relation between board social networks and insider trading profitability is sensitive to CEO characteristics, including CEO centrality and hiring status. Prior research suggests that board social networks will have a larger impact on constraining insider trading profitability when CEO centrality is higher. Bebchuk, Cremers, and Peyer (2011) indicate that CEO centrality reflects the relative importance of the CEO within the executive team along with her capacity to deprive investors by extracting rents. When the CEO has low centrality,

she/he will attempt to develop more centrality in order to better extract rents. In the high centrality condition, the powerful CEO is in a better position to consume private benefits (Bebchuk et al. 2011; Chen, Huang, and Wei 2013).[3] [4] In fact, developing a reputation for competence is a valuable asset that enables CEOs to enjoy more managerial autonomy (e.g., Fama, 1980; Hermalin and Weisbach, 1988). Thus, we expect that the relation between board social networks and insider trading profitability is more pronounced for CEOs with higher centrality. We follow Bebchuk et al. (2011) and use the CEO pay slice (*CPS*), i.e., the total CEO pay divided by the sum of the total pay of the top 5 executives, to capture CEO centrality. We require the CEO to serve the company for an entire year. We compute *CPS* using data from the *Compustat ExecuComp* database. We re-estimate Equation (2) after interacting *Raw* and *Residual SOCIALNETWORKS* with *CPS,* separately.

Next, we evaluate whether CEO hiring status (i.e., internally versus externally hired CEO) shapes the importance of board social networks to insider trading profitability. Reflecting that shareholders are concerned about moral-hazard and adverse-selection problems of hiring due to the asymmetric information about external CEO candidates, shareholders tend to grant some extra informational rent to an externally hired CEO in order to motivate she/he to exert the same level effort as an internal CEO (Ors, Palomino, and Peyrache 2013). As a result, externally hired CEOs get a higher fraction of their compensation that is equity based than internally hired ones. Gillan, Hartzell, and Parrino (2009) and Palomino and Peyrache (2013) provide empirical evidence supporting this theoretical prediction. Here, we conjecture that board social networks

[3] Bebchuk et al. (2011) report that firms are more likely to grant opportunistically timed options to CEOs with higher centrality. Similarly, their evidence implies that CEOs with higher centrality are more apt to enjoy a lucky option grant that has an exercise price at the lowest price of the grant month.

[4] Likewise Lisic, Neal, Zhang and Zhang (2016) argue that a powerful CEO is more apt to provide the board with low-quality information or less information. Friedman (2014) develops an agency model showing that a powerful CEO can seek information rents by biasing financial reporting measures.

play a more salient role in constraining insider trading profitability for externally hired CEOs than for internally hired ones because externally hired CEOs are more prone to engage in insider trading due to higher equity ownership. We define an externally hired CEO (*CEO_EXTERNAL*) as one if s/he joined the firm when appointed to the position of CEO, and zero otherwise. We re-estimate Equation (2) after adding the interaction terms *Raw SOCIALNETWORKS*CEO_EXTERNAL* and *Residual SOCIALNETWORKS*CEO_EXTERNAL*, separately.

Further, we consider whether shareholder litigation risk matters to the link between board social networks and insider trading profitability. Shleifer and Vishny (1997) stress that legal protection grants investors power against expropriation by managers for private benefits. In the United States, court matters in protecting shareholders' rights by enforcing corporate charters against managerial self-dealing and interfering in management theft and asset diversion. Correspondingly, shareholder lawsuit threat is one of the important and effective mechanisms in constraining managerial exploitation of private benefits. Academic studies have shown that managers are incentivized to disclose more information in a timely manner to mitigate the risks of future shareholder litigation (e.g., Skinner 1994 and 1997; Francis, Philbrick and Schipper 1994; Kasznik and Lev 1995; and Baginski, Hassell, and Kimbrough 2002; Watts 2003).[5] Two recent studies, Cheng, Huang, and Li (2016) and Adhikari, Agrawal, and Sharma (2021) provide evidence suggesting that shareholder litigation threat pre-empts insiders from engaging in

[5] Another literature suggests the otherwise. For example, Rogers and Van Buskirk (2009) report that the amount of information that firms divulge falls in post-litigation periods, which reconciles with managerial perceptions that plaintiff attorneys tend to exploit corporate disclosures to justify allegations of managerial misconduct, even when such disclosures were made in good faith. Similarly, Johnson, Kasznik, and Nelson (2001) and Rogers and Stocken (2005) argue that accounting transparency may attract future litigation against the firm and its managers, with the marginal cost of corporate disclosure subsiding with litigation risk. Since firms are typically sued for withholding bad news (Francis, Philbrick, and Schipper 1994 and Rogers and Van Buskirk 2009), fear of civil litigation could further induce managers to hide bad news in order to avoid becoming embroiled in costly lawsuits.

profitable trading based on private information. Thus, we conjecture that the importance of board social networks to restricting insider trading profitability will be more pronounced among firms facing lower risk of shareholder litigation, since managers in these firms are more likely to engage in insider trading activities. We measure shareholder litigation risk based on the approach developed by Kim and Skinner (2012). Kim and Skinner (2012) provide compelling evidence that supplementing industry measure of litigation risk with firm-level characteristics, e.g., firm size, growth, and equity volatility, significantly enhances the predictive power of future litigations. Thus, we follow Kim and Skinner (2012)'s estimation model to quantify a firm-specific litigation probability (*LITIG*). We re-estimate Equation (2) after adding the interaction terms *Raw SOCIALNETWORKS*LITIG* and *Residual SOCIALNETWORKS*LITIG*, separately.

Last, we employ *TRA*, *QIX*, and *DED* to proxy for the strength of external monitoring by institutions. Bushee (1998, 2001) provides supporting evidence that transient institutions effectively induce managerial opportunism due to their short-term orientation and that dedicated institutions serve a monitoring role in effectively curtailing short-term myopic behavior by management. Similarly, Gaspar, Massa, and Matos (2005) argue that inadequate monitoring due to the presence of short-term investors gives managers the opportunity to engage in activities for their private benefit while sacrificing the interests of shareholders. Consistently, their empirical evidence shows that firms with a high level of *TRA* exhibit weak market performance with respect to mergers and acquisitions. Further, Chen, Harford, and Lia (2007) find that monitoring of acquisitions is facilitated by independent long-term institutions with concentrated holdings. Thus, a larger percentage of *TRA* (*DED*) suggests weak (strong) investor oversight and corporate governance. Here, we expect that the impact of board social networks on curtailing insider trading profitability will play a larger role for firms with weak institutional monitoring. However,

the view on *QIX* is mixed. Porter (1992) states that the passive and fragmented ownership of quasi-indexers barely offers them incentives to gather information to monitor management. Bushee (1998) further argues that quasi-indexers *de facto* abandon their influence over managers to other institutions, thereby enticing managers for short-term oriented actions. In contrast, Monks and Minow (1995) argue that because indexing strategies do not encourage selling, quasi-indexers are motivated to monitor management to ensure their long-term interests in the firm. We re-estimate Equation (2) after interacting *Raw* (*Residual*) *SOCIALNETWORKS* with *TRA, QIX*, and *DED*.

In successive regressions, we analyze whether the role that board social networks play in affecting insider trading profitability hinges on CEO centrality and hiring status, shareholder litigation risk, and various institutional monitoring. In Table 4, we report in Panel A the estimation results with board social networks measured by *Raw SOCIALNETWORKS*. In Models 1 and 2, we find that the coefficient estimates on the interaction terms between *Raw SOCIALNETWORKS* and CEO characteristics variables, including *CPS* and *CEO_EXTERNAL*, are negative and significant at the ten and five percent levels, respectively (*t*-statistics = -1.69 and -2.09, respectively). In Models 3 and 4, the coefficient estimates on the interaction terms between *Raw SOCIALNETWORKS* and *LITIG* and *TRA*, load positively and negatively at the one percent levels, respectively (*t*-statistics = 3.04 and -3.61, respectively). In a similar vein, Panel B of Table 4 shows the estimation results with board social networks measured by *Residual SOCIALNETWORKS*. We find consistent evidence on the interactions between *Residual SOCIALNETWORKS* and *CPS*, *CEO_EXTERNAL*, *LITIG*, and *TRA*, respectively (*t*-statistics = -1.86, -2.45, 1.96, and -1.82, respectively).

Altogether, the results in Tables 4 suggest that better informed boards are more capable of constraining insider trading profitability in the presence of more intensive agency conflicts stemming from managerial centrality and CEO hiring status, greater shareholders litigation threat, and weaker monitoring by institutional investors, supporting the monitoring spillover view as a rationale for our main findings.

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4.2.2. Information Dissemination Channel

We next test for the presence of the *Information Dissemination Channel*. We expect that if private information can successfully travel from a board to external market participants via large board social networks compared to small ones, managers' information advantage would be weakened, thus dampening insider trading profitability. In other words, the relation between board social networks and insider trading is based on how successfully information is disseminated from a board to external market participants. Given that the level of informed external trading reflects how successfully information is disseminated from directors to outsiders (Akbas et al. 2016), we expect that the relation between board social networks and insider trading profitability is more pronounced for firms with high level of informed external trading. Alternatively, if the level of informed external trading is low, the impact of large social networks relative to small ones in curtailing insider trading profitability would be diminished. We next implement additional empirical analyses to examine whether the documented negative relation between board social networks and insider trading profitability reflects the channel of information dissemination from directors to outsiders.

To test this channel, we follow prior research (e.g., Brown and Hillegeist 2007; Akbas et al. 2016) and measure informed external trading with these four variables: (i) the short interest ratio (*SIR*); (ii) the ratio of total monthly put and call trading volume to stock trading volume (*OPTION/STOCK VOL*); (iii) the probability of informed trading (*PIN*);[6] and (iv) insider trades (*INS_TRADE*), which is the dollar value of net insider trading, scaled by firm size. We re-estimate Equation (2) after interacting *Raw* and *Residual SOCIALNETWORKS* with each of the four informed external trading measures in successive regressions. Here, we expect the interaction terms between board social networks and each of these measures of informed external trading to be negative and significant.

In Table 5, Panel A, we find that none of the coefficient estimates on the interaction terms between board social networks and the measures of informed external trading except *SIR* and *INST_TRADE* is, as predicted, significantly negative. In Panel B of Table 5, we do not find significant evidence to support our prediction, implying that the information dissemination channel appears to work through the informed trading only by short sellers or institutional trading at most. Collectively, our analyses provide strong support for the monitoring spillover view and weak support for the information dissemination view.

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4.3. Public Financial Information Quality

Prior studies find that social networks of corporate board's audit committee exert a positive effect on financial reporting quality measured by discretionary accrual (Intintoli, Kahle,

[6] We obtain the PIN data from http://scholar.rhsmith.umd.edu/sbrown/pin-data. In another specification, we include the interaction between *CONNECTEDNESS* and institutional ownership. In both regressions, the coefficient estimate on the interaction term is also insignificant.

and Zhao 2018) and internal control over financial reporting and earning quality are highly inversely related to insider trading profitability (Aboody, Hughes, and Liu 2005; Skaife, Veenman and Wangerin 2013). In our main analysis, we explicitly control for *FR_OPAQUE* to make sure that the relation between board social networks and insider trading profitability is not simply driven through opaqueness of public financial information but rather reflects a direct impact of board social networks on managerial privilege in private information.

Next, we extensively examine whether our core results remain robust to no longer controlling for *FR_OPAQUE* and to re-estimating the regressions with several alternative specifications of financial reporting opacity. We first re-estimate regression Equation (2) without controlling for *FR_OPAQUE*. In Models (1) of Table 8, we find that the coefficients on *Raw* and *Residual SOCIALNETWORKS* remain very similar, suggesting that *FR_OPAQUE* is highly unlikely to affect the relation between social networks and insider trading. Additionally, we replace *FR_OPAQUE* with alternative measures of public financial information opacity: (i) absolute value of discretionary accruals estimated based on the modified Jones model (Dechow, Sloan, and Sweeney, 1995); (ii) Dechow and Dichev (2002)'s accrual quality measure; (iii) Dechow, Ge, Larson, and Sloan (2011)'s *F*-score; (iv) Chen, Miao, and Shevlin (2015)'s disclosure quality measure; (v) financial misstatements retrieved from the *Audit Analytics* database; (vi) analyst forecast accuracy; and (vii) analyst forecast dispersion. Table 6 Models (1)-(7) show that, after controlling for these alternative proxies in successive regressions, the coefficients on *Raw* and *Residual SOCIALNETWORK* remain highly significant at the five and one percent levels with a similar magnitude. Collectively, our core evidence is materially insensitive to no longer controlling for *FR_OPAQUE* or controlling for a series of financial reporting opacity, reflecting

the direct link between board social networks and insider trading, rather than the intermediate effect spuriously coming through public financial information opacity.

Alternatively, we examine whether the importance of board social networks to insider trading profitability holds for firms with low levels of opacity by partitioning the sample based on the median values of *FR_OPAQUE* and re-estimating the main equation. In Models 8 and 9 of Table 6, we observe that the effect is much stronger for firms with low level of financial reporting opacity at one percent significance level, reinforcing the view that we document a pervasive and direct economic phenomenon regarding the impact of board social networks on insider trading profitability.

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4.4. Type of Trades: Sales versus Purchase Profitability

A natural question to ask is whether the impact of board social networks on insider trading varies with the transaction type: sales versus purchase. A series of recent theoretical and empirical studies maintain that managers withhold unfavorable information from investors because of career and short-term compensation concerns, and that they tend not to give up until a sufficiently long-run of unfavorable information accumulates and reaches a critical threshold level (Jin and Myers 2006; Hutton, Marcus, and Tehranian 2009). Consistent with this idea, Graham, Harvey, and Rajgopal's (2005) survey documents that managers tend to delay unfavorable news disclosures more than favorable news disclosures. In the same vein, Kothari, Shu, and Wysocki (2009) argue that as long as the accumulated unfavorable information has not reached the threshold level, managers will withhold the accumulated unfavorable information and try to "bury" the accumulated unfavorable information with any favorable information that

might arrive later. And Kothari et al. (2009) provide strong evidence consistent with the view that managers, on average, delay the release of unfavorable information to investors. To some extent, the studies discussed above suggest that information asymmetry regarding unfavorable versus favorable information between insiders and outsiders brings about higher profitability of insider sales than insider purchase.

In addition, some studies show that insiders exploit unfavorable private information by earning abnormal profits from insider sales versus purchase (e.g., Jagolinzer 2009; Jagolinzer et al. 2011; Muller et al. 2012). We conjecture that board social networks might play a bigger role in curtailing insider sales, relative to insider purchase, based on the advantage of unfavorable information. Correspondingly, the relation between board social networks and insider trading is more likely to be salient for the transactions of insider sales than for those of insider purchase. To address this question, we disaggregate insider trading by sales versus purchase and implement our analyses on each of the two-subsamples, i.e., purchase and sales subsamples, respectively. Specifically, we re-estimate regression equation (2) using the sales-transactions-based profitability measure (*SALE_PROFIT%*) as the dependent variable. Similarly, we redo the estimation using the purchase-transactions-based profitability measure (*BUY_PROFIT%*) as the dependent variable. For some firm-year observations without reported information of insider sales (or purchase), we set these variables equal to zero.

Table 7 provides the estimation results. In Models 1 and 2 when we use *SALE_PROFIT%* as the dependent variable, the coefficients on *Raw* and *Residual SOCIALNETWORKS* are significant and negative at one percent level (*t*-statistics= -3.91 and -3.80, respectively). Turning to insider purchases profitability, we find that, in Models 3 and 4, the coefficients on *Raw* and *Residual SOCIALNETWORKS* are significant at the one and five percent levels (*t*-statistics= -2.84

and -2.46, respectively). Further, in terms of economic magnitude, the coefficients on *Raw* and *Residual SOCIALNETWORKS* are much larger in Models 1 and 2 than those in Models 3 and 4. Overall, our evidence indicates that, although board social networks have a statistically significant impact on both insider sales and purchase profitability, the relation we observed between board social networks and insider trading profitability is, economically more pronounced for sales-based than purchase-based transactions, which implies that board social networks play a more prominent role in curbing insider sales relative to purchases due to managerial advantage of unfavorable information.

-------Insert Table 7------

4.5. Trading-volume-based Measure

In our main analysis, we use insider trading profitability as the main measure of insider trading. While Cziraki and Gider (2021) suggest that dollar profits are a precise measure for corporate governance applications of insider trading for private benefits, we follow prior research to check whether our results are robust to insider trading volume at the firm-year level. Based on Piotroski and Roulstone (2004) and Ryan, Tucker, and Zhou (2016), we use the absolute dollar amount of sale transactions minus purchases transaction by all of the firm's insiders during the year (multiplied by 100 for presentation purposes), scaled by beginning-of-year market value of equity. We denote this measure as *NETTRADE%*. It is less likely to be affected by trading volatility (i.e., equal changes in insider sales and purchases for a firm during a specific year), and thus we regard such a volatility as having offsetting implications on our measure of insider trading. Next, we re-estimate regression equation (2) using the *NETTRADE%* as the dependent variable.

Table 8 Models 1 and 2 presents the estimation results. We find that *NETTRADE%* is negatively and significantly related to *Raw* and *Residual SOCIALNETWORKS*, respectively (*t*-statistics= -6.05 and -5.77). These results are align with those reported in the main results, lending further support to the view of board social networks that firms with large board social networks are less prone to have insider trading activities. The economic magnitudes are also significant. On average, holding all other variables at their mean values, a shift from the 25th to the 75th percentile of the distribution of *Raw* and *Residual SOCIALNETWORKS* is associated with an estimated 18.80% and 12.32% decrease in insider trading activities as measured by *NETTRADE%*.

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4.6. CEOs versus Non-CEO executives

We investigate whether the role that board social networks play in shaping insider trading activities is sensitive to the role of insiders, i.e., CEOs versus non-CEO executives. On one hand, CEOs have the most and highest executive power in the firm, and they have full access to a variety of private information. On the other hand, non-CEO executives like CFOs, COOs and CIOs have direct access to information along their own operational functions, thereby inducing them to engage in insider trading based on private information. Here, we conjecture that the role board social networks play in constraining insider trading might apply to both CEOs and non-CEO executives.

To test our conjecture, we recalculate insider trading profitability for CEOs and non-CEO executives based on Equation (1), respectively. We denote the insider trading profitability for CEOs (non-CEO executives) as *CEO_PROFIT%* (*NONCEO_PROFIT%*). Then we re-estimate the

regression equation (2) using *CEO_PROFIT%* and *NONCEO_PROFIT%* as dependent variables, respectively. Here, we focus on the coefficients of *Raw* and *Residual SOCIALNETWORKS*.

Table 9 presents the estimation results. In Models 1 and 2 when we use CEO trading profitability as the dependent variable, both the coefficients on *Raw* and *Residual SOCIALNETWORKS* are significantly negative at one percent level (*t*-statistics =-3.53 and -3.39, respectively), suggesting that board social networks have a significant impact on reducing CEOs' trading profitability. Similarly, in Models 3 and 4 with non-CEO trading profitability as a dependent variable, we observe that both the coefficients on *Raw* and *Residual SOCIALNETWORKS* remain negative and significant at one percent level (*t*-statistics =-3.08 and -2.84, respectively), implying that board social networks have a material effect on lowering non-CEOs' trading profitability. Overall, our findings indicate that the role board social networks play in constraining insider trading profitability is pervasive, which affects the insider trading behaviors of both CEOs and non-CEO executives.

-------Insert Table 9------

4.7. Capital Market Consequences

Economic theory suggests that increased information supply reduces information asymmetries between managers and outsiders, leading to reduced costs of capital (e.g., Akerlof 1970; Glosten and Milgrom 1985; Amihud and Mendelson 1986; Merton 1987; Diamond and Verrecchia 1991; Easley, Hvidkjaer, and O'Hara 2002; Easley and O'Hara 2004). Specifically, a series of theoretical studies (i.e., Amihud and Mendelson 1986; Admati 1985; Dow and Gorton 1995; Easley and O'Hara 2004) provide support for the exploitation of private information by insiders as the rationale for a cost of capital effect of asymmetric information.

Since our findings suggest that the large social networks of corporate board lead to a low level of managerial rent seeking based on private information (i.e., insider trading profitability), we conjecture that board social networks have capital market consequences through its impact on managerial insider trading. To test this conjecture, we conduct a path analysis to examine and better understand the mechanisms by which board social networks influences capital market outcome variables. Specifically, we estimate a structural equation model (SEM) that decomposes the relation between board social networks and capital market outcome (i.e., cost of equity capital) into a direct effect, and an indirect effect through the mediation of insider trading profitability (Baron and Kenny 1986).

Our cost of equity capital variable includes two measures: 1) one based on Claus and Thomas (2001) (*R_CT*); 2) the other based on Gebhardt, Lee, and Swaminathan (2001) (*R_GLS*). We calculate R_CT as follows:

$$P_0 = B_0 + \sum_{i=1}^{5} \frac{feps_i - r_{CT} B_{i-1}}{(1+r_{CT})^i} + \frac{(feps_5 - r_{CT} B_4)*(1+g)}{(1+r_{CT})^5 (r_{CT} - g)} \quad (3)$$

Where B_0 is current book value of equity per share at the end of each year, B_t is future book value of equity per share at period *t* estimated using a clean surplus assumption, P_0 is current price per share at the end of each year, $feps_t$ is a *t*-period-ahead consensus analyst forecast of accounting earnings per share (*t=1, 2, 3, 4* and *5*) at the end of each year, *g* is the growth rate of residual earnings in perpetuity equal to the expected inflation rate (10-year risk-free rate minus 3 percent) at the end of each year, and r_{CT} is implied cost of equity capital at the end of each years.[7] We use

[7] Explicit accounting earnings per share forecasts for years 4 and 5 are often unavailable and if so, are generated by projecting earnings per share for years 4 and 5 using analysts' consensus long-term growth forecast. If the long-term growth forecast is also unavailable, we assume that earnings grow at the rate of inflation beyond year 3.

a numerical approximation program to identify r_{CT} within a .005 difference between the actual and fitted value of P_0.

R_GLS is calculated as follows: (we omit firm subscript)

$$P_0 = B_0 + \frac{feps_1 - r_{GLS}B_0}{1+r_{GLS}} + \frac{feps_2 - r_{GLS}B_1}{(1+r_{GLS})^2} + ... + \frac{feps_{12} - r_{GLS}B_{11}}{(1+r_{GLS})^{12}} + \frac{feps_{13} - r_{GLS}B_{12}}{r_{GLS}(1+r_{GLS})^{12}}, \quad (4)$$

where B_0, B_t, P_0 and $feps_t$ are as previously defined, and r_{GLS} is the implied cost of equity capital at the end of each year. The *R_GLS* approach uses actual book values per share and forecasted earnings per share up to three years ahead to derive future expected residual income for the first three-year period. Dividends are set equal to a constant fraction of forecasted earnings. After the first three years, we forecast $feps_4$ to $feps_{12}$ such that *ROE* linearly converges to industry *ROE* in the 12th year. Industry *ROE* is estimated as the five-year moving average median of past *ROE*s of all firms in the same industry. We use a numerical approximation program to identify r_{GLS} within a 0.005 difference between the actual and fitted value of P_0.

Following prior literature using path analysis (e.g., Pevzner, Xie, and Xin 2015; DeFond, Lim, and Zang 2016; Bentley-Goode, Omer, and Twedt 2017), we regress each measure of the cost of equity capital on board social networks and on the mediating variable of insider trading profitability. In addition, we regress the mediating variable of insider trading profitability on board social networks. All regression equations include the control variables from Section 2.4 above. Figure 1 shows the structural equations model and the detailed paths with cost of equity capital as the capital-market-related outcome.

Table 10, Panel A, presents the results from the path analysis with board social networks measured by *Raw SOCIALNETWORKS*.[8] In Column (1), the direct path coefficient between board social networks and *R_CT*, controlling for insider trading profitability, [*p*(*Raw SOCIALNETWORKS*, *R_CT*)], is significant (*t*-statistic = -2.08). The indirect path coefficient between board social networks and insider trading profitability [*p*(*Raw SOCIALNETWORKS*, *PROFIT%*)] is significantly negative at the five percent level (*t*-statistic =2.23), reinforcing our main finding that board social networks curtail insider trading profitability. The path coefficient between insider trading profitability and the cost of equity capital [*p*(*PROFIT%*, *R_CT*)] is significantly positive at the one percent level (*t*-statistic = 7.30), consistent with exploitation of private information by insiders leading to increased cost of equity capital. The total mediated path (i.e., indirect path) for insider trading profitability [*p*(*Raw SOCIALNETWORKS*, *PROFIT%*)* *p*(*PROFIT%*, *R_CT*)] is significantly negative at the five percent level (*t*-statistic =-2.13), indicating that increased board social networks result in a reduction in the cost of equity capital via insider trading profitability.[9] The results in Column (2), Panel A using *R_GLS* to measure the cost of equity capital are similar. The total mediated path for insider trading profitability [*p*(*Raw SOCIALNETWORKS*, *PROFIT%*)**p*(*PROFIT%*, *R_GLS*)] is significantly negative at the one percent level (*t*-statistic = -3.59), though the direct path between board social networks and *R_GLS* is insignificant. These findings indicate that increased board social networks consistently significantly influence the cost of equity capital through its impact on insider trading profitability. Similarly, Table 10, Panel B, provides the estimation from the path analysis with board social networks measured by *Residual SOCIALNETWORKS*. The results are similar. Collectively, the

[8] To facilitate comparison of the coefficients, path analysis standardizes all variables in the model with a zero mean and a standard deviation of one.

[9] The significance of the indirect effect is estimated using the Sobel (1982) test statistic.

evidence from the path analysis shows that board social networks have significant consequences on the capital market through the channel of insider trading, including reduced cost of equity capital.

-------Insert Table 10------

5. CONCLUSION

In this study, we investigate whether board social networks are negatively associated with insider trading. Using a sample of U.S. public firms for the period 2000-2015, we find strong evidence that firms with larger board social networks exhibit lower levels of insider trading profitability. Our findings are consistent with the view that board social networks effectively compromise the information advantage of the manager and thus curb insider trading. We further explore two channels, the *Monitoring Spillover Channel* and the *Information Dissemination Channel*, as explanations for our main findings, and find empirical strong support for the former and weak for the later channel. These additional findings help reinforce our understanding of the influence of social networks on reducing agency costs in public firms by mitigating managerial rent-seeking activity in the form of insider trading.

This study complements the existing literature on social networks and insider trading. Our study supports extant evidence that board social networks, as an informal mechanism, have a direct and positive spillover effect on the wealth of shareholders. In addition, our results are consistent with the broad view that social networks matter for influencing economic activities in the society (e.g.,Coleman, Katz and Menzel 1957; Kapferer, 1969; Laumann, Marsden, and Galaskiewicz 1977). We expect that other social-related factors besides board social networks also affect managerial behavior and have similar economic implications. These factors are worth

researching further, especially if they help to reduce the incidences of managerial rent seeking in the capital markets that have a material impact on the welfare of investors.

APPENDIX

Variables	Definition and measurement
PROFIT%	Insider trading profitability, estimated using equation (1).
Raw SOCIALNETWORKS	The natural logarithm of the aggregate board level of each director's social connections with executives, officers, and directors of other firms.
Residual SOCIALNETWORKS	Regression residual obtained from regressing the natural logarithm of aggregate connections on the natural logarithms of firm size, board size, firm age, number of analysts, and institutional ownership.
LAG_RET	Annual firm-specific return for the lagged year, where firm-specific return is estimated based on expanded market and industry index regression (Hutton et al. 2009).
LEAD_RET	Annual firm-specific return for the lead year, where firm-specific return is estimated based on expanded market and industry index regression (Hutton et al. 2009).
SIGMA	Standard deviation of firm-specific returns over the current year.
RET	Annual firm-specific return for the current year, where firm-specific return is estimated based on expanded market and industry index regression (Hutton et al. 2009).
MB	Market-to-book ratio at the end of the fiscal year.
LEV	Leverage, measured as the ratio of total long-term liabilities to total assets at the end of the fiscal year.
FIRMSIZE	Firm size, measured as the log of market value of equity at the end of the fiscal year.
BOARDSIZE	Board size, measured as the log of number of directors serving on the board of the company.
ROE	Net income excluding discontinued operations and extraordinary items, divided by the book value of total shareholders' equity at the end of the fiscal year.
FR_OPAQUE	The three-year moving sum of the absolute value of annual performance-adjusted discretionary accruals (Kothari et al. 2005).
RM	Value of the overall measure of real earnings management (Roychowdhury 2006).
AGE	Firm age, measured as the natural logarithm of the number of years the company has been listed on *Compustat* since 1950.
RD	Previous year-end ratio of research and development expenses to total assets. Missing research and development expenses are set to be 0.
TURNOVER	The average monthly share turnover over the fiscal year, where monthly share turnover is calculated as the monthly share trading volume divided by the number of shares outstanding over the month.
AUD_TEN	The number of consecutive years in the fiscal year that the auditor has been employed by the firm.
BIGN	Set to one if the firm is audited by Big N auditor, and zero otherwise.
ANA	The natural logarithm of one plus the number of analysts forecast estimates for the firm.
TRA	The percentage of a firm's shares held by transient investors.
QIX	The percentage of a firm's shares held by quasi-indexer investors.
DED	The percentage of a firm's shares held by dedicated institutional investors.
CPS	The CEO pay slice, measured as the total CEO pay divided by the sum of the total pay of the top 5 executives.
CEO_EXTERNAL	Set to one if the CEO joined the firm when appointed to the position of CEO, and zero otherwise.

LITIG	The firm-specific litigation probability estimated based on Kim and Skinner (2002).
SIR	Total shares shorted divided by total shares outstanding.
OPTION/STOCK VOL	The ratio of total monthly put and call trading volume to stock trading volume.
PIN	The probability of informed trading.
INS_TRADE	The dollar value of net insider trading, scaled by firm size.
SALE_PROFIT%	The sale-transactions-based profitability estimated using equation (1).
BUY_PROFIT%	The purchase-transactions-based profitability estimated using equation (1).
NETTRADE%	The absolute dollar amount of sale transactions minus purchase transactions by firm's insiders during the year (multiplied by 100 for presentation purposes), scaled by beginning-of-year market value of equity.
CEO_PROFIT%	Insider trading profitability for CEOs estimated using equation (1).
NONCEO_PROFIT%	Insider trading profitability for Non-CEOs estimated using equation (1).
R_CT	Cost of equity measure estimated based on Claus and Thomas (2001).
R_GLS	Cost of equity measure estimated based on Gebhardt, Lee, and Swaminathan (2001).

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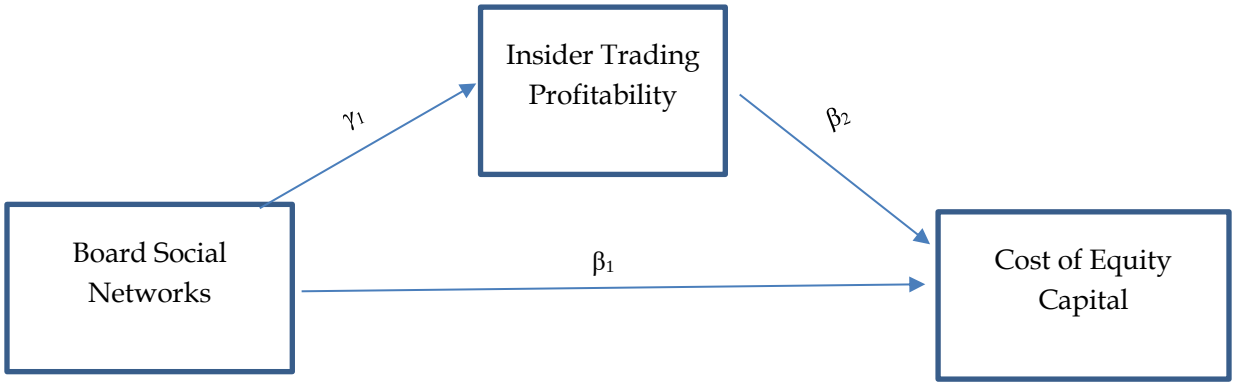
Figure 1

Paths between Board Social Networks and Cost of Equity Capital



This figure describes both the direct and indirect paths by which board social networks potentially affects cost of equity capital. The path analysis is conducted by utilizing a structural equation model (SEM) to estimate the system of two equations shown below. The path coefficient between board social networks and cost of equity capital (β_1) is the direct effect of board social networks on cost of equity capital, controlling for insider trading profitability. The path coefficients between board social networks and insider trading profitability (γ_1) and between insider trading profitability and cost of equity capital (β_2) represent the indirect mediating effect of insider trading profitability on the relation between board social networks and cost of equity capital. The composite coefficient γ_{1*} β_2 measures this indirect effect. A significant negative composite coefficient implies that board social networks negatively affect cost of equity capital via the mediation of insider trading profitability. All path coefficients are standardized.

The path analysis is based on the following system of equations, where cost of equity capital is measured by R_CT and R_GLS, respectively:

Cost of Equity Capital = β_0 + β_1 *Raw (Residual) SOCIALNETWORKS* + β_2 *PROFIT%* + β_3 Controls + IndustryDummies + YearDummies + ε;

PROFIT% = γ_0 +γ_1 *Raw (Residual) SOCIALNETWORKS* +γ_2 Controls + IndustryDummies + YearDummies + ε;

Table 1
Summary Statistics

This table presents summary statistics of key variables of interest for the sample of firms included in our study. The sample covers firm-year observations with non-missing values for all variables for the period 2000 to 2015. Panel A presents descriptive statistics; Panel B presents a Pearson correlation matrix. Bold values indicate statistical significance at the 1 percent level. All variables are defined in Appendix A.

Panel A. Descriptive Statistics

	N	Mean	Standard Deviation	Q1	Median	Q3
PROFIT%	32,286	0.0406	0.1574	0.0000	0.0000	0.0155
Raw SOCIALNETWORKS	32,286	8.5548	0.8926	8.0605	8.6360	9.1459
Residual SOCIALNETWORKS	32,286	0.0007	0.5754	-0.3329	0.0514	0.3857
LAG_RET	32,286	-0.0005	0.0009	-0.0006	-0.0003	-0.0002
LEAD_RET	32,286	-0.0005	0.0010	-0.0005	-0.0003	-0.0001
SIGMA	32,286	0.0274	0.0152	0.0170	0.0239	0.0340
RET	32,286	-0.0005	0.0010	-0.0006	-0.0003	-0.0001
MB	32,286	3.3721	4.3506	1.3923	2.2132	3.6902
LEV	32,286	0.1550	0.1694	0.0000	0.1099	0.2587
FIRMSIZE	32,286	20.2526	1.9122	18.9475	20.2359	21.5481
BOARDSIZE	32,286	2.0669	0.2758	1.9459	2.0794	2.1972
ROE	32,286	-0.0052	0.6038	-0.0202	0.0834	0.1571
FR_OPAQUE	32,286	0.1715	0.1476	0.0804	0.1308	0.2107
RM	32,286	-0.0222	0.4677	-0.2343	-0.0023	0.2127
AGE	32,286	2.7872	0.6166	2.3026	2.8332	3.3322
RD	32,286	0.0049	0.0285	0.0000	0.0000	0.0000
TURNOVER	32,286	0.0038	0.0998	-0.0293	0.0012	0.0351
AUD_TEN	32,286	2.0611	0.9280	1.3863	2.1972	2.7726
BIGN	32,286	0.7868	0.4096	1.0000	1.0000	1.0000
ANA	32,286	1.6393	0.9887	0.6931	1.7918	2.3979
TRA	32,286	0.1393	0.1139	0.0421	0.1239	0.2133
QIX	32,286	0.3444	0.2222	0.1451	0.3760	0.5283
DED	32,286	0.0616	0.0746	0.0000	0.0345	0.1006

Panel B. Pearson Correlation Matrix

		1	2	3	4	5	6	7	8	9	10	11
1	*PROFIT%*											
2	*Raw SOCIALNETWORKS*	**-0.07**										
3	*Residual SOCIALNETWORKS*	**-0.03**	**0.65**									
4	*LAG_RET*	**-0.05**	**0.18**	**-0.06**								
5	*LEAD_RET*	**-0.02**	**0.15**	**-0.04**	**0.22**							
6	*SIGMA*	**0.11**	**-0.29**	**0.07**	**-0.51**	**-0.4**						
7	*RET*	**-0.06**	**0.15**	**-0.05**	**0.36**	**0.28**	**-0.75**					
8	*MB*	0.01	**0.10**	0.00	**-0.03**	0.01	**-0.02**	0.00				
9	*LEV*	**-0.07**	**0.14**	0.00	**0.09**	**0.04**	**-0.13**	**0.06**	**0.13**			
10	*FIRMSIZE*	**-0.07**	**0.61**	**-0.02**	**0.34**	**0.31**	**-0.56**	**0.30**	**0.18**	**0.21**		
11	*BOARDSIZE*	**-0.10**	**0.63**	0.01	**0.23**	**0.17**	**-0.35**	**0.18**	**0.02**	**0.23**	**0.57**	
12	*ROE*	0.02	**0.07**	**-0.08**	**0.19**	**0.22**	**-0.33**	**0.21**	**-0.03**	0.00	**0.25**	**0.12**
13	*FR_OPAQUE*	**0.09**	**-0.17**	-0.01	**-0.24**	**-0.17**	**0.30**	**-0.16**	**0.12**	**-0.13**	**-0.23**	**-0.21**
14	*RM*	**-0.06**	**-0.04**	**-0.04**	**0.03**	0.00	**-0.05**	**0.03**	**-0.20**	**0.12**	**-0.05**	**0.05**
15	*AGE*	**-0.12**	**0.09**	0.01	**0.19**	**0.12**	**-0.28**	**0.14**	**-0.10**	**0.04**	**0.17**	**0.25**
16	*RD*	**0.04**	**0.02**	**0.03**	**-0.06**	**-0.04**	**0.09**	**-0.06**	**0.06**	**-0.07**	-0.02	**-0.04**
17	*TURNOVER*	**0.13**	-0.01	-0.01	**0.07**	**-0.02**	**0.17**	**-0.12**	**0.05**	**0.03**	**0.02**	0.00
18	*AUD_TEN*	**-0.06**	**0.23**	0.01	**0.17**	**0.13**	**-0.25**	**0.13**	0.00	**0.07**	**0.33**	**0.28**
19	*BIGN*	**-0.02**	**0.40**	**0.07**	**0.17**	**0.18**	**-0.26**	**0.16**	**0.04**	**0.16**	**0.51**	**0.35**
20	*ANA*	0.00	**0.52**	**-0.03**	**0.25**	**0.21**	**-0.37**	**0.21**	**0.11**	**0.16**	**0.75**	**0.41**
21	*TRA*	**0.08**	**0.20**	**-0.03**	**0.11**	**0.13**	**-0.14**	**0.11**	**0.07**	**0.07**	**0.28**	**0.09**
22	*QIX*	0.00	**0.32**	**-0.04**	**0.30**	**0.23**	**-0.42**	**0.24**	**-0.02**	**0.10**	**0.48**	**0.28**
23	*DED*	-0.01	**0.16**	-0.01	**0.12**	**0.09**	**-0.16**	**0.10**	**0.03**	**0.12**	**0.22**	**0.13**

		12	13	14	15	16	17	18	19	20	21	22
13	*FR_OPAQUE*	**-0.16**										
14	*RM*	**-0.03**	**-0.07**									
15	*AGE*	**0.13**	**-0.24**	**0.12**								
16	*RD*	**-0.06**	**0.06**	**-0.11**	**-0.05**							
17	*TURNOVER*	**0.03**	0.02	**-0.05**	-0.01	**0.01**						
18	*AUD_TEN*	**0.11**	**-0.17**	**0.02**	**0.37**	-0.01	-0.01					
19	*BIGN*	**0.09**	**-0.17**	**-0.02**	**-0.02**	0.01	0.01	**0.34**				
20	*ANA*	**0.15**	**-0.17**	**-0.08**	**0.02**	0.00	-0.01	**0.24**	**0.44**			
21	*TRA*	**0.09**	**-0.05**	**-0.10**	**-0.07**	0.00	**0.06**	**0.05**	**0.24**	**0.43**		
22	*QIX*	**0.18**	**-0.24**	0.01	**0.21**	**-0.04**	-0.02	**0.24**	**0.34**	**0.55**	**0.52**	
23	*DED*	**0.06**	**-0.10**	-0.01	0.01	**-0.02**	-0.01	**0.06**	**0.17**	**0.26**	**0.23**	**0.29**

Table 2
Portfolio Analysis

This table compares mean values of *PROFIT%* for a sample of firms with large board social networks (i.e., top tercile) versus firms with small board social networks (i.e., bottom tercile). Panels A and B present the results based on the raw-value and residual-value measures of board social networks, respectively. *t*-Tests are used to test differences in means. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Raw-value Measure of Board Social Networks

		PROFIT%
	N	MEAN
Firms with high *Raw SOCIALNETWORKS*	10,760	0.0254
Firms with low *Raw SOCIALNETWORKS*	10,771	0.0510
Test statistic for difference		*12.05***

Panel B. Residual-value Measure of Board Social Networks

		PROFIT%
	N	MEAN
Firms with high *Raw SOCIALNETWORKS*	10,762	0.0373
Firms with low *Raw SOCIALNETWORKS*	10,762	0.0447
Test statistic for difference		*3.42***

Table 3
Impact of Board Social Networks on Insider Trading Profitability

This table estimates the pooled cross-sectional regression of insider trading profitability on board social networks. The sample covers firm-year observations with non-missing values for all variables for the period 2000 to 2015. *t*-statistics reported in parentheses are based on White standard errors corrected for firm clustering. Year and industry fixed-effects are included. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. All variables are defined in Appendix A.

	PROFIT%			
	Model 1		**Model 2**	
	Coeff.	t-stat.	Coeff.	t-stat.
TEST VARIABLE				
Raw SOCIALNETWORKS	-0.0063***	(-3.32)		
Residual SOCIALNETWORKS			-0.0064***	(-3.21)
CONTROL VARIABLES				
LAG_RET	-1.3815	(-1.21)	-1.3890	(-1.21)
LEAD_RET	1.5704	(0.98)	1.5701	(0.98)
SIGMA	0.8910***	(5.04)	0.8891***	(5.03)
RET	3.8451*	(1.78)	3.8310*	(1.78)
MB	-0.0003	(-1.46)	-0.0003	(-1.47)
LEV	-0.0326***	(-4.62)	-0.0323***	(-4.59)
FIRMSIZE	-0.0028**	(-2.57)	-0.0036***	(-3.57)
BOARDSIZE	-0.0147**	(-2.57)	-0.0238***	(-4.89)
ROE	0.0110***	(6.91)	0.0110***	(6.92)
FR_OPAQUE	0.0404***	(4.55)	0.0405***	(4.55)
RM	-0.0115***	(-4.14)	-0.0115***	(-4.14)
AGE	-0.0163***	(-7.93)	-0.0157***	(-7.61)
RD	0.0723*	(1.67)	0.0721*	(1.67)
TURNOVER	0.1740***	(14.82)	0.1739***	(14.81)
AUD_TEN	0.0005	(0.42)	0.0005	(0.42)
BIGN	-0.0038	(-1.06)	-0.0038	(-1.06)
ANA	0.0078***	(4.85)	0.0071***	(4.36)
TRA	0.0955***	(7.39)	0.0949***	(7.34)
QIX	0.0207***	(3.24)	0.0204***	(3.20)
DED	-0.0199	(-1.50)	-0.0207	(-1.57)
Year fixed effects	YES		YES	
Industry fixed effects	YES		YES	
INTERCEPT	0.1764***	(8.36)	0.1592***	(7.47)
N	32,286		32,286	
Adjusted R^2	0.0617		0.0617	

Table 4

Differential Impact of Board Social Networks on Insider Trading Profitability: Monitoring Spillover Channel

This table estimates the pooled cross-sectional regression of insider trading profitability on board social networks, interacted with the severity of agency conflicts and the strength of external monitoring, respectively. The sample covers firm-year observations with non-missing values for all variables for the period 2000 to 2015. Panels A and B present the results based on the raw-value and residual-value measures of board social networks, respectively. To economize on space, all the control variables (see Table 3) are suppressed. *t*-statistics reported in parentheses are based on White standard errors corrected for firm clustering. Year and industry fixed effects are included. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. All variables are defined in Appendix A.

Panel A. Raw-value Measure of Board Social Networks

	PROFIT%							
	Model 1		**Model 2**		**Model 3**		**Model 4**	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
TEST VARIABLE								
Raw SOCIALNETWORKS	0.0025	(0.48)	-0.0034	(-1.29)	-0.0084***	(-3.60)	0.0033	(1.35)
*Raw SOCIALNETWORKS*CPS*	-0.0202*	(-1.69)						
CPS	0.1922*	(1.74)						
*Raw SOCIALNETWORKS*CEO_EXTERNAL*			-0.0112**	(-2.09)				
CEO_EXTERNAL			0.1056**	(2.15)				
*Raw SOCIALNETWORKS*LITIG*					0.1836***	(3.04)		
LITIG					-2.1140***	(-3.66)		
*Raw SOCIALNETWORKS*TRA*							-0.0595***	(-3.61)
*Raw SOCIALNETWORKS*QIX*							-0.0031	(-0.45)
*Raw SOCIALNETWORKS*DED*							-0.0394**	(-2.14)
TRA							0.6043***	(4.13)
QIX							0.0472	(0.77)
DED							0.3216**	(1.96)
Controls	YES		YES		YES		YES	
Year fixed effects	YES		YES		YES		YES	
Industry fixed effects	YES		YES		YES		YES	
N	15,058		16,098		30,882		32,286	
Adjusted R^2	0.0626		0.0685		0.0607		0.0635	

Panel B. Residual-value Measure of Board Social Networks

	PROFIT%							
	Model 1		**Model 2**		**Model 3**		**Model 4**	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
TEST VARIABLE								
Residual SOCIALNETWORKS	0.0089	(1.09)	-0.0008	(-0.29)	-0.0081***	(-2.84)	-0.0061*	(-1.86)
*Residual SOCIALNETWORKS*CPS*	-0.0362*	(-1.86)						
CPS	0.0128	(1.23)						
*Residual SOCIALNETWORKS*CEO_EXTERNAL*			-0.0219**	(-2.45)				
CEO_EXTERNAL			0.0074	(1.84)				
*Residual SOCIALNETWORKS*LITIG*					0.1666**	(1.96)		
LITIG					-0.4346***	(-7.19)		
*Residual SOCIALNETWORKS*TRA*							-0.0232*	(-1.82)
*Residual SOCIALNETWORKS*QIX*							0.0118	(1.19)
*Residual SOCIALNETWORKS*DED*							-0.0204	(-0.80)
TRA							0.0946***	(7.33)
QIX							0.0206***	(3.23)
DED							-0.0205	(-1.54)
Controls	YES		YES		YES		YES	
Year fixed effects	YES		YES		YES		YES	
Industry fixed effects	YES		YES		YES		YES	
N	15,058		16,098		30,882		32,286	
Adjusted R^2	0.0626		0.0690		0.0604		0.0617	

Table 5

Differential Impact of Board Social Networks on Insider Trading Profitability: Information Dissemination Channel

This table estimates the pooled cross-sectional regression of insider trading profitability on board social networks, interacted with external informed trading. The sample covers firm-year observations with non-missing values for all variables for the period 2000 to 2015. Panels A and B present the results based on the raw-value and residual-value measures of board social networks, respectively. To economize on space, all the control variables (see Table 3) are suppressed. *t*-statistics reported in parentheses are based on White standard errors corrected for firm clustering. Year and industry fixed effects are included. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. All variables are defined in Appendix A.

Panel A. Raw-value Measure of Board Social Networks

	PROFIT%							
	Model 1		**Model 2**		**Model 3**		**Model 4**	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
TEST VARIABLE								
Raw SOCIALNETWORKS	-0.0013	(-0.61)	-0.0072***	(-2.63)	-0.0140***	(-4.28)	-0.0052***	(-2.74)
*Raw SOCIALNETWORKS*SHORT*	-0.1416***	(-4.92)						
SHORT	1.2760***	(5.01)						
*Raw SOCIALNETWORKS*OPTION_VOL*			-0.3217	(-0.23)				
OPTION_VOL			7.7717	(0.58)				
*Raw SOCIALNETWORKS*PIN*					0.0380***	(3.27)		
PIN					-0.4922***	(-5.17)		
*Raw SOCIALNETWORKS*INST_TRADE*							-0.0486***	(-4.71)
INST_TRADE							0.4736***	(5.12)
Controls	YES		YES		YES		YES	
Year fixed effects	YES		YES		YES		YES	
Industry fixed effects	YES		YES		YES		YES	
N	32,286		21,656		22,343		32,259	
Adjusted R^2	0.0635		0.0876		0.0718		0.0646	

Panel B. Residual-value Measure of Board Social Networks

	PROFIT%							
	Model 1		**Model 2**		**Model 3**		**Model 4**	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
TEST VARIABLE								
Residual SOCIALNETWORKS	-0.0053**	(-2.22)	-0.0105***	(-3.36)	-0.0063	(-1.52)	-0.0063***	(-3.24)
*Residual SOCIALNETWORKS*SHORT_RAT*	-0.0277	(-0.75)						
SHORT_RAT	0.0558**	(2.54)						
*Residual SOCIALNETWORKS*OPTION_VOL*			4.7792**	(2.01)				
OPTION_VOL			4.8688***	(3.22)				
*Residual SOCIALNETWORKS*PIN*					-0.0042	(-0.24)		
PIN					-0.1917***	(-9.51)		
*Residual SOCIALNETWORKS*INST_TRADE*							-0.0025	(-0.17)
INST_TRADE							0.0517***	(6.42)
Controls	YES		YES		YES		YES	
Year fixed effects	YES		YES		YES		YES	
Industry fixed effects	YES		YES		YES		YES	
N	32,286		21,656		22,343		32,259	
Adjusted R^2	0.0620		0.0877		0.0713		0.0634	

Table 6
Public Financial Information Quality

This table estimates the pooled cross-sectional regression of insider trading profitability on board social networks after controlling for a series of alternative measures of public financial information quality and partitioning the sample based on the mean of FR_OPAQUE, respectively. The sample covers firm-year observations with non-missing values for all variables for the period 2000 to 2015. To economize on space, all the control variables (see Table 3) are suppressed. *t*-statistics reported in parentheses are based on White standard errors corrected for firm clustering. Year and industry fixed effects are included. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. All variables are defined in Appendix A.

Dep. Variable:		*PROFIT%*			
		Raw SOCIALNETWORKS		*Residual SOCIALNETWORKS*	
	Model	Coeff.	t-stat.	Coeff.	t-stat.
Alternative Financial Information Quality					
Modified Jones Model	**(1)**	-0.0061***	(-3.21)	-0.0061***	(-3.06)
Dechow and Dichev AQ	**(2)**	-0.0067***	(-3.52)	-0.0069***	(-3.44)
Dechow, Ge, Larson, and Sloan's F-score	**(3)**	-0.0050**	(-2.55)	-0.0051**	(-2.48)
Chen, Miao, and Shevlin's DQ Measure	**(4)**	-0.0066***	(-3.46)	-0.0066***	(-3.31)
Restatement	**(5)**	-0.0057***	(-3.42)	-0.0061***	(-3.53)
Analyst Forecast Accuracy	**(6)**	-0.0066***	(-3.25)	-0.0069***	(-3.31)
Analyst Forecast Dispersion	**(7)**	-0.0052**	(-2.44)	-0.0053**	(-2.37)
Subsample					
High FR_OPAQUE Group	**(8)**	-0.0043	(-1.63)	-0.0048*	(-1.73)
Low FR_OPAQUE Group	**(9)**	-0.0086***	(-3.44)	-0.0085***	(-3.27)

Table 7
Insider Trading Profitability: Type of Trades

This table estimates the pooled cross-sectional regression of insider trading profitability on board social networks for sales transactions by insiders and purchase transactions by insiders, respectively. The sample covers firm-year observations with non-missing values for all variables for the period 2000 to 2015. To economize on space, all the control variables (see Table 3) are suppressed. *t*-statistics reported in parentheses are based on White standard errors corrected for firm clustering. Year and industry fixed effects are included. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. All variables are defined in Appendix A.

	SALE_PROFIT%				*BUY_PROFIT%*			
	Model 1		**Model 2**		**Model 3**		**Model 4**	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
TEST VARIABLE								
Raw SOCIALNETWORKS	-0.0070***	(-3.91)			-0.0008***	(-2.84)		
Residual SOCIALNETWORKS			-0.0071***	(-3.80)			-0.0007**	(-2.46)
Controls	YES		YES		YES		YES	
Year fixed effects	YES		YES		YES		YES	
Industry fixed effects	YES		YES		YES		YES	
N	32,286		32,286		32,286		32,286	
Adjusted R^2	0.0881		0.0880		0.0595		0.0594	

Table 8
Trading-volume-based Measure

This table estimates the pooled cross-sectional regression of insider trading volume on board social networks. The sample covers firm-year observations with non-missing values for all variables for the period 2000 to 2015. To economize on space, all the control variables (see Table 3) are suppressed. *t*-statistics reported in parentheses are based on White standard errors corrected for firm clustering. Year and industry fixed effects are included. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. All variables are defined in Appendix A.

	NETTRADE%			
	Model 1		**Model 2**	
	Coeff.	t-stat.	Coeff.	t-stat.
TEST VARIABLE				
Raw SOCIALNETWORKS	-0.0375***	(-6.05)		
Residual SOCIALNETWORKS			-0.0372***	(-5.77)
Controls	YES		YES	
Year fixed effects	YES		YES	
Industry fixed effects	YES		YES	
N	32,286		32,286	
Adjusted R^2	0.1316		0.1313	

Table 9
Insider Trading Profitability: CEOs versus Non-CEO Executives

This table estimates the pooled cross-sectional regression of insider trading profitability on board social networks for CEOs versus non-CEO executives. The sample covers firm-year observations with non-missing values for all variables for the period 2000 to 2015. To economize on space, all the control variables (see Table 3) are suppressed. *t*-statistics reported in parentheses are based on White standard errors corrected for firm clustering. Year and industry fixed effects are included. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. All variables are defined in Appendix A.

	CEO_PROFIT%				*NONCEO_PROFIT%*			
	Model 1		**Model 2**		**Model 3**		**Model 4**	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
TEST VARIABLE								
Raw SOCIALNETWORKS	-0.0045***	(-3.53)			-0.0016***	(-3.08)		
Residual SOCIALNETWORKS			-0.0046***	(-3.39)			-0.0016***	(-2.84)
Controls	YES		YES		YES		YES	
Year fixed effects	YES		YES		YES		YES	
Industry fixed effects	YES		YES		YES		YES	
N	32286		32286		32286		32286	
Adjusted R^2	0.0485		0.0484		0.0610		0.0609	

Table 10
Path Analysis

This table reports the results from a path analysis that examines the effect of board social networks on the capital market through insider trading profitability. These capital-market-related outcome variables include the cost of equity capital using the Claus and Thomas (2001) measure (R_CT) and the cost of equity capital using the Gebhardt, Lee, and Swaminathan (2001) measure (R_GLS), respectively. Each p(X1,X2) represents a standardized path coefficient. The sample covers firm-year observations with non-missing values for all variables for the period 2000 to 2015. Panels A and B present the results based on the raw-value and residual-value measures of board social networks, respectively. The significance of the indirect effect is estimated using the Sobel (1982) test statistics. The table reports the path coefficients of interest. All models include year and industry fixed effects. *, **, and *** indicate statistical significance in two-tailed tests at the 10 percent, 5 percent, and 1 percent levels, respectively. All variables are defined in Appendix B.

Panel A. Raw-value Measure of Board Social Networks

DEPVAR	*R_CT* **Model 1**		*R_GLS* **Model 2**	
Direct Path	Coeff.	t-stat.	Coeff.	t-stat.
p(Raw SOCIALNETWORKS, DEPAR)	-0.0193**	(-2.08)	-0.0066	(-1.33)
Mediated Path for Insider Trading				
p(Raw SOCIALNETWORKS, PROFIT%)	-0.0229**	(-2.23)	-0.0400***	(-4.37)
p(PROFIT%, DEPVAR)	0.0575***	(7.30)	0.0231***	(6.32)
Total Mediated Path for Insider Trading				
p(Raw SOCIALNETWORKS, *PROFIT%)** *p*(PROFIT%, DEPVAR)	-0.0013**	(-2.13)	-0.0009***	(-3.59)
Controls	YES		YES	
n	19,731		24,145	

Panel B. Residual-value Measure of Board Social Networks

DEPVAR	*R_CT*		*R_GLS*	
	Model 1		**Model 2**	
Direct Path	Coeff.	t-stat.	Coeff.	t-stat.
p(Residual SOCIALNETWORKS, DEPAR)	-0.0136**	(-2.14)	-0.0013	(-0.36)
Mediated Path for Insider Trading				
p(Residual SOCIALNETWORKS, PROFIT%)	-0.0144**	(-2.04)	-0.0263***	(-4.10)
p(PROFIT%, DEPVAR)	0.0575***	(7.29)	0.0232***	(6.35)
Total Mediated Path for Insider Trading				
p(Residual SOCIALNETWORKS, PROFIT%)* *p*(PROFIT%, DEPVAR)	-0.0008**	(-1.97)	-0.0006***	(-3.44)
Controls	YES		YES	
n	19,731		24,145	