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Does Board Connectedness Contribute to Firms Performance During A Financial Crisis?

Rajendra Prasad Gangavarapu

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Does Board Connectedness Contribute to Firms Performance During A Financial Crisis?

by

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ACCEPTANCE

This dissertation was prepared under the direction of the *Rajendra Prasad Gangavarapu* Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Business Administration in the J. Mack Robinson College of Business of Georgia State University.

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DEDICATION

I dedicate this dissertation to my father Krishna Murthy Gangavarapu who lost his life due to COVID 19.

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Special thanks to my advisor and committee members for their dissertation guidance. I also thank the supportive faculty, staff, and alumni of GSU for their feedback. I am extremely grateful to my wife, Lakshmi Gangavarapu, and my sons, Siddharth and Bharat, for their understanding and support throughout the program and in particular when I was undertaking this research.

TABLE OF CONTENTS

ABSTRACT

Does board connectedness contribute to firm performance during a financial crisis?

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This study examines the relationship between board connectedness and future firm performance during the crisis period, and whether performance varies with the firm's age and growth opportunities. This study distinguishes between the effect of various board centrality measures on firm performance during a crisis. We find that board connectedness does help future firm performance during a financial crisis. For all firms, future performance for the highest quintile of connected firms outperforms the lowest quintile by approximately 1% per year on average in the 2008–09 crisis period. The impact of connectedness on firms' future performance during the crisis period is more pronounced for young and high growth firms. Overall, board connectedness appears to effectively manage uncertainty, provide access to valuable resources, shrink the information gap, and help future firm performance during a financial crisis.

INDEX WORDS: Centrality; Board connectedness; Financial crisis; Firm's age; Growth; Uncertainty

I INTRODUCTION

The board of directors has a fiduciary responsibility to protect and represent the interest of shareholders. Boards play an important role in providing strategic direction for companies to maneuver effectively during uncertain times. But the question arises: Are all boards equally effective in impacting firm performance? On one hand, highly connected directors can offer better advice and help firms make efficient decisions, including dealing with macroeconomic shocks. Boards that are better connected may be more proficient at obtaining novel and private information or expertise on regulatory changes, industry trends, and market conditions (Larcker, So, and Wang, 2013). Managing external uncertainty can be extremely critical during an environment of macroeconomic stress, making the board connections even more valuable during the crisis. Anecdotal evidence supports this conjecture. For instance, Ford Motor Co. leveraged John Thornton, a longtime board member with deep connections in the banking industry and multiple board seats, to overcome its liquidity crisis in 2008 (*Wall Street Journal. March 20, 2020*[1]).[2] He was the chairman and board member of HSBC North America Holdings Inc (HNAH), and a director on the board of Intel, 21st Century FOX, China Netcom Group (Hong Kong) Ltd., Industrial and Commercial Bank of China (ICBC) at that time. 3 On the other hand, some studies claim that board interlocks would reduce monitoring effectiveness (Fich and Shivdasani, 2006) and propagate poor corporate practices (Bizjak, Lemmon, and Whitby, 2009) and that firms with such interlocks are more likely to perform poorly compared to industry standards (Pfeffer, 1972).

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[1] https://www.wsj.com/articles/corporate-boards-suffer-experience-gap-as-coronavirus-upends-business-11584716400.

[2] In an another anecdotal evidence, Steve Miller, who served on several boards, said he tapped his connections and expertise in the bankruptcy and restructuring fields, acquired from his 17-year tenure as a United Airlines board member when he joined the board of American International Group Inc (AIG). He joined the AIG board in 2009 as it began a major overhaul after the financial crisis.

[3] Source: BoardEx.

Thus, the net economic impact of a board's connectedness during the crisis period is ambiguous and is, therefore, an open empirical question.

Previous studies have examined the theoretical and empirical net economic impact of board connections on future firm performance. However, the importance of relationships in times of uncertainty has been overlooked in the literature. This paper fills this gap by examining the empirical relation between a board's connectedness (in terms of current professional relations of board members) and future firm performance during a financial crisis. Moreover, it examines how this relationship varies with a firm's age and growth opportunities.

Theoretically and empirically, there is an ambiguity regarding the effect of board connectedness on firms' financial performance. Fich and Shivdasani (2006) find that multiple directorships hurt firms' financial performance because busy and overcommitted directors are unable to discharge their duties effectively. In contrast, Larcker et al. (2013) show that board connectedness would improve the firms' performance. Fich and Shivdasani (2006) study only captures the busyness of directors. On the other hand, Larcker et al. (2013) leverage network theory holistically, capturing the network centrality and various dimensions of connectedness. Busyness captures the board interlocks, whereas connectedness captures how well the directors are connected in the network.

Stronger firm performance is observed among companies with board interlocks to family and state-owned firms during the financial crisis (Carney, Child, & Li, 2020). Our paper complements the findings of Larcker et al. (2013) and Carney et al. (2020) but differs along several dimensions. This study differentiates the relationship between board connectedness and future firm performance during crisis and non-crisis periods, and how that may vary with a firm's age and growth opportunities. Carney et al.'s (2020) study is about political and family connections in southeast Asian countries. In contrast, our study doesn't look at political or family connections but considers the professional relationships of directors in the United States. Carney et al. (2020) show that board interlocks to family and state-owned firms add value when the institutional framework is weak. Our research shows that board connectedness helps future firm performance in the United States, where the institutional framework is stronger relative to southeast Asian countries.

Existing literature uses resource dependence and network theories to explain the board connectedness and firm performance. Resource dependence theory (Pfeffer & Salancik, 1978) argues that boards play a crucial role in linking the firm to the external environment to provide needed outside resources and guidance. Connected firms can raise debt capital at a lower cost (Chuluun, Prevost, and Puthenpurackal, 2014). A board provides advice and expertise in the formulation of a firm's strategy and vital decisions (Hillman and Dalziel, 2003). It has been shown that directors with better connectedness play a critical role in bridging the firm's information gap and the external market. A well-connected director has better access to information, which helps the firm in strategic decision-making (Mizruchi, 1996), and reduces information asymmetry between the firm and the external market (Schoorman et al. 1981). Network theory provides network centrality measures that capture various dimensions of connectedness. These include degree, betweenness, closeness, and eigenvector centrality, introduced in Bonacich (1972) and Freeman (1977) and used in the more recent Larcker et al. study (2013). The measures in network theory are widely used to study informal and professional relations. Prior academic research studies conducted by Larcker et al. (2013), Intintoli et al. (2018) used these measures to study professional board connections. Our analysis uses standard tools developed by network theory to explain the effectiveness of board connectedness on future firm performance during a financial crisis.

Our study contributes to the existing literature as follows. First, we assess the impact of board connectedness on future firm performance during a period of crisis. Second, we evaluate if and how the effect of board connectedness on future firm performance during a crisis period varies with the firm's age and growth opportunities. Third, this study distinguishes between the effect of various board centrality measures on firm performance during a crisis.

In this paper, Section II presents hypothesis development. Section III explains the dataset construction, the relevant variables employed, model specification, and summary statistics of the key variables. Section IV documents the empirical results and discussion. Section V concludes.

II HYPOTHESIS DEVELOPMENT

We examine the relationship between board connectedness and firm future performance during the crisis period. This study also differentiates the impact of board connectedness on firm performance in a crisis vs. a normal period.

- Research Question 1: Does board connectedness help future firm performance during a financial crisis?
- Research Question 2: Is the impact of board connectedness on future firm performance more pronounced for younger and growth firms during a crisis?

Board connections serve as a link to share knowledge and resources and as channels of information transfer. Through these links, the board members can access valuable resources, information, and networks to protect the firm from adversity and reduce uncertainty (Hillman, Canella, and Paetzold, 2000). Board connectedness enables managers to achieve an optimal "business scan" of the latest business practices and overall business environment (Useem, 1984). Connectedness helps reduce the information gaps faced by firms. Highly connected board members have close relations with business partners, influence the modification of the terms of contracts, and receive lower financing costs (Uzzi, 1999). As tension in the economic environment rises during a financial crisis, the value of information increases and the need for timely access to credit, thereby amplifying board networks' benefits, which leads to our first hypothesis.

Hypothesis 1: During a financial crisis, corporate board connectedness positively impacts future firm performance.

Young firms experienced slower growth in revenues and faced tighter financing conditions during the financial crisis. Firms are more likely to survive if they are larger in terms of revenues and assets. Young and growth firms faced tight credit constraints, and they were severely affected by the financial crisis in 2008 - 2009.[4] Younger firms can have more significant information uncertainty with limited cash flows than older firms (Zhang, 2006). Older firms with a long history have more information available. Board connectedness may help to shrink the information gaps faced by such firms. Further, board connectedness can result in higher trade credit, whereas poorly connected firms are more likely to underperform during a crisis (Carney et al. 2020). Intuitively, the difference in future firm performance between highly and poorly networked firms is more significant among young and growth firms during the crisis. This leads to our second hypothesis.

Hypothesis 2: During a financial crisis, the impact of board connectedness on future firm performance does vary with the firm's age and growth opportunities.

[4] The Fed - How Did Young Firms Fare During the Great Recession? Evidence from the Kauffman Firm Survey (federalreserve.gov).

III DATA SOURCES AND VARIABLE CONSTRUCTION

III.1 Data Sources

The study's data draws from multiple sources such as BoardEx, Compustat, and CRSP. The period of study ranges from 2000 to 2017. This research study explicitly separates the sample period (January 2000 to December 2017) into the normal period (2000 to 2007 and 2010 to 2017) and the crisis period (December 2007 to June 2009).

BoardEx is widely used in academic studies and industry research and is known for accuracy and completeness. BoardEx collects data from various public sources, including regulatory filings, annual reports, proxy statements, company websites, press, and regulatory news wires and provides professional relationships among directors of private and listed firms in the United States. BoardEx data undergoes rigorous checks by 350+ skilled analysts, completing 547,000 staff hours of research a year. Larcker et al. (2013) study covers the listed and private companies with annual sales exceeding $1 billion using Boardmag data. BoardEx and Boardmag have similar coverage of the variables used for this study. Boardmag is proprietary and not available to the public. We excluded private companies for this study. Use of BoardEx makes it easier for others to replicate this study. Each director's unique identifier is used to determine whether boards share common directors. We then compute the boardroom centrality on a firm-year basis. The financial accounting data comes from Compustat, and stock return data is from the CRSP database. We merge the Compustat, CRSP, and BoardEx data on a firm-year basis.

The database contains the company board name represented by ticker, debt ratio, total assets, sales, alpha, book to market ratio, and return on assets. Network centrality measures (degree, closeness, betweenness, and eigenvector) are computed using the Python package (NetworkX).

The database used in this research study is sufficiently representative of the BoardEx population by sector, as shown in the Figure 1 below. The aggregated database has a match rate of around 60% with the BoardEx data.

<Insert Figure 1 here>

III.2 Variable Construction

Independent Variables:

Following the literature, the study employs four centrality measures of network theory, namely degree, closeness, betweenness, and eigenvector centrality (Larcker et al. 2013), which are explained below:

Degree captures the number of direct professional network connections between the given firm and other firms through shared directors.

$$DEGREE_i = \sum_{j \neq i} \delta(i, j) \quad (1)$$

δ(i,j) denotes an indicator that boards *i* and *j* share at least one director.

Closeness measures how quickly directors can access other directors in the network. It is defined as the inverse of the average distance. Boards with a high closeness score have the shortest distances from all other boards in the sample.

$$CLOSENESS_i = \frac{n-1}{\sum_{j \neq i} l(i,j)} \quad (2)$$

$l(i, j)$ denotes the number of steps in the shortest path through which firms *i* and *j* can be connected by sharing directors, and *n* is the number of nodes.

Betweenness centrality is a way of detecting the influence a node has over information flow in a graph. It represents the importance of an individual board member serving as the shortest information bridge with other members. Betweenness centrality is a way of detecting the influence a board member has over information flow in a network.

$$BETWEENNESS_i = \sum_{j \neq i: i \notin \{k.j\}} \frac{P_i(k,j)/P(k,j)}{(n-1)(n-2)/2} \qquad (3)$$

Where *n*= (*n*-1)(*n*-2)/2 measures the number of pairs in each year in the sample, P(*k*,*j*) denotes the total number of shortest paths between firms *k* and *j*, and $P_i(k,j)$ represents the total number of quickest ways through which boards *k* and *j* are connected through the board *i*.

Eigenvector centrality assumes that not all individuals connected to a given person are equally important. This is a weighted degree measure, with the weights based on how well connected each direct link is. The eigenvector centrality score is proportional to the sum of the scores of shared directorates.

$$Eigenvector\ of\ Centralities = A\ \frac{r}{\lambda} \qquad (4)$$

Where λ represents the largest eigenvalues of the adjacency matrix *A*, *A* is an *n*×*n* symmetric matrix, and *n* is the number of firms in the network.

N-Score is a composite network centrality measure that denotes the average value of the quintile values for the four centrality indices. Higher N-Score values indicate higher board room centrality. They range from 1 to 5. A higher value indicates a higher degree of centrality.

$$N - Score\ = Quint\ \left(\frac{1}{4}\ \{Quint(DEGREE_i)\ +\ Quint(CLOSENESS_i)\ + Quint(BETWEENNESS_i)\ +\ Quint(EIGENVECTOR_i)\}\right) \qquad (5)$$

III.3 Model Specification

We regress ΔROA ($ROA_{t+2} - ROA_{t0}$) on quintiles of the five centrality measures, as well as the lag of ΔROA [*lag (ΔROA)*], debt ratio, measured as the total book value of liabilities divided by the total book value of equity; total assets, $log(Total\ Assets)$, measured as the natural logarithm of the firm's total assets; LBM, [*log(1+ Book-to-Market ratio)*], measured as the natural logarithm of 1 plus the firm's book-to-market ratio; alpha, measured as the excess return of stock over the index; Sales, [*log*(*Sales*)], measured as the natural logarithm of total sales. We include industry x year fixed effects to absorb time-varying industry factors. The use of quintile ranks instead of continuous variables for different centrality measures reduces the influence of outliers.

The regression specification we use in examining the relation between ROA and network centrality measure is:

One-year ahead firm performance

- $$ROA_{it+1} - ROA_{it} = \beta_0 + \beta_1 Quintile(Board\ Connectedness)_{it} + \beta_2 Debt\ Ratio + \beta_3 \log(Total\ Assets) + \beta_4 LBM + \beta_5 Alpha + \beta_6 \log(Sales) + \beta_7 lagROA_{it+1} - ROA_{it} + Industry\ x\ Year\ Fixed\ Effects + \varepsilon_{it} \quad (6)$$

Two-year ahead firm performance

- $$ROA_{it+2} - ROA_{it} = \beta_0 + \beta_1 Quintile(Board\ Connectedness)_{it} + \beta_2 Debt\ Ratio + \beta_3 \log(Total\ Assets) + \beta_4 LBM + \beta_5 Alpha + \beta_6 \log(Sales) + \beta_7 lagROA_{it+1} - ROA_{it} + Industry\ x\ Year\ Fixed\ Effects + \varepsilon_{it} \quad (7)$$

We use degree, closeness, betweenness, eigenvector, and N-Score as a proxy for board connectedness, capturing various dimensions of Board Connectedness in this study.

The dependent variable, i.e. firm future financial performance, is measured as the firm's ROA FY1 minus ROA FY0 or ROA FY2 minus ROA FY0.

We assess the relationship between board-connectedness and future firm performance in the case of all firms, young and growth firms, high growth firms, low growth firms, young firms, and old firms. Book-to-market ratio measures the growth of firms. If this ratio is below the median, the firm is considered to be high growth, while above-median is regarded as low growth. Larcker et al. (2013) defined age as the log of the number of prior months that the firm appears in CRSP. We refine their approach to determine the age of the firm. Specifically, we consider the current date minus the IPO date. If the IPO date is missing, the first year available in CRSP is taken. If the age is below the median, we assign it to the group of young firms while above-median age firms are considered as old firms.

Control variables: Following previous studies, we control for variables that may affect firms' performance. Our control variables are debt ratio, measured as the total book value of liabilities divided by the total book value of equity; total assets, $\log(Total\ Assets)$, measured as the natural logarithm of the firm's total assets; LBM, measured as the natural logarithm of 1 plus the firm's book-to-market ratio; Alpha, measured as the excess return of stock over the index; and Sales, log(*Sales*), measured as the natural logarithm of total sales.

We control for industry x year fixed effects in all estimated regressions. We include the lagged dependent variable as a control variable and estimate the panel regression with the Arellano and Bond (1991) correction. The t-statistics are reported in parentheses and are based on two-way (firm and year) cluster robust standard errors to account for cross-sectional and time-series dependence in the residuals (Gow et al. 2010).

III.4 Summary Statistics

<Insert Table 1 here>

Panel A in Table 1 provides the sample distribution of the number of observations, mean, and median of network centrality measures such as degree, closeness, betweenness, eigenvector, and N-Score. Our sample covers 44,779 firm-year observations associated with 5,123 unique firms. On average, each firm in our sample is linked to 5.88 other firms by directly sharing directors. The median degree centrality is 5, consistently below the mean during the sample period, suggesting there are some firms with very high levels of degree centrality. Network centrality is persistent during the crisis. Board interlocks remained mostly intact during the crisis (Heemskerk et al, 2016). Firms can consider hiring well-connected directors as part of their long-term strategy. However, hiring well-connected directors during the crisis may not be a feasible approach due to the time it takes to hire the director and transition into the role.

Panel B in Table 1 provides the sample distribution of the number of observations and network centrality measures by industry, using two-digit GIC industry codes. The lowest N-Score is observed for the retail sector, whereas the highest value is observed for the materials industry. Connectedness can vary by the industry, demand, and supply of the director's skills. The material industry is a business-to-business (B2B), whereas retail is business-to-consumer (B2C). Intuitively, connectedness can play an important role in B2B compared to B2C. Customers in the boards of B2B firms can improve a more in-depth understanding of the customer business and firm performance. Dass et al. (2013) observe that directors from related upstream or downstream industries have a positive effect on firm performance. Clayton Act prohibits board interlocks between competitors. The exemptions in this act may also cause variation across sectors.

Panel C in Table 1 presents pooled descriptive statistics of firms' characteristics and network centrality measures. Closeness and betweenness have significant skewness, indicating that certain firms can quickly access the boardroom network in a shorter path than others.

Panel D in Table 1 presents the firm characteristics across quintiles of N-Score, which is the composite centrality measure. We find that high-centrality firms tend to have a lower book-to-market ratio, younger in age, higher ROA, and sales. Since these differences in firm characteristics can potentially help explain the differences in future performance between high- and low-centrality firms, we include controls for these characteristics in our multivariate analyses later on.

Panel E in Table 1 presents the correlation matrix among the independent and control variables in the study. The degree measure of centrality is moderately correlated with betweenness

(0.671) and eigenvector (0.663). Therefore, to avoid multicollinearity issues, we estimate separate regressions for each centrality measure.

IV DISCUSSION

Prior research examined the relation between board connectedness and future firm performance. Board connectedness negatively impacts monitoring effectiveness (Fich and Shivdasani, 2006). Subsequent research demonstrated that firms with well-connected boards have higher returns (Larcker et al. 2013). Our paper complements the findings of Larcker et al. (2013) and Carney et al. (2020) by focusing on how the relation between board connectedness and future firm performance during the crisis and the non-crisis periods, and how this relation may vary with firms' age and growth opportunities.

We regress the change in ROA on board connectedness and firms' characteristics to test the relation between board connectedness and future firm performance through the economic cycle for the entire study period from 2000 to 2017. Then we run the sub-sample regression for young & growth, young, old, high growth, and low growth firms during the normal period (2000 to 2007, 2010 to 2017) and the crisis period (2008 to 2009). N-Score is a composite network measure, which takes the equal-weighted average quintile rank in each of the four centrality measures (degree, closeness, betweenness, and eigenvector). We will be focusing on the N-Score in the discussion.

Table 2 presents the relationship between board centrality measures and future firm performance for the entire sample period. We find that board connectedness has a positive relationship with future firm performance, and results are statistically significant at 1% for only change in two-year ahead ROA. Intuitively, ROA is an accounting measure. It takes time to reflect the impact of the board's connectedness on ROA. Hence, the subsequent analysis uses the change in two-year ahead ROA as the primary measure of firm performance in our study. N-Score is statistically significant, supporting our hypothesis that board connectedness helps all firms. The coefficient on quintile (N-Score) is 0.0030, indicating that the highest quintile of connected firms

(N-Score) outperforms the lowest quintile of connected firms in future firm performance by approximately 1.2% (i.e., (5-1) × 0.0030 × 100%) per year, on an average for all firms in the entire sample period. These results are consistent with the findings of Larcker et al. (2013).

<Insert Table 2 here>

Table 3 presents that board connectedness helps all firms in the normal as well as during the crisis period. Centrality-return relation is pervasive across time and persistent across different types of firms (Larcker et al. 2013). This indicates that firms in the study have rich networks, the shortest distance to other firms, and speedy access to crucial information, which would help firms in making better and quicker decisions (Harjoto & Wang, 2020). N-Score is statistically significant for all firms in the normal period (coefficient = 0.0030; *p*-value <.01) and the crisis period (coefficient = 0.0026; *p*-value <.1). The coefficient of 0.0030 on N-Score in the normal period, indicating that the highest (fifth) quintile of connected firms outperforms the firms in the lowest (first) quintile by approximately 1.2% (i.e., (5-1) × 0.0030 × 100%) per year, on average. The coefficient of 0.0026 on N-Score in the crisis period, indicating that the highest quintile of connected firms outperforms the firms in the lowest quintile by approximately 1% (i.e., (5-1) × 0.0026 × 100%) per year, on average. Degree, closeness, betweenness and eigenvector are statistically significant for all firms in the normal period (degree: coefficient = 0.0023; *p*-value <.01; closeness: coefficient = 0.0032; *p*-value <.01; betweenness: coefficient = 0.0017; *p*-value <.01; eigenvector: coefficient = 0.0014; *p*-value <.05). Degree and betweenness are significant at 5% (degree: coefficient = 0.0033; *p*-value <.05; betweenness: coefficient = 0.0028; *p*-value <.05) during the crisis. Closeness and eigenvector have no statistical significance during the crisis. Degree represents how information can be accessed efficiently through the network whereas betweenness shows the influence of connectedness. Well-connected directors' direct network connections, influence over the information flow help the firms to deal with uncertainty and obtain financing during the crisis.

<Insert Table 3 here>

We further assess the network centrality and future firm performance relationship for various types of firms during the normal and crisis periods. The idea is to determine whether the relationship holds during the changing economic conditions for young, high growth, low growth, and old firms during the normal period, the crisis period, and the entire sample period.

Table 4 presents the results of young and high growth firms during the normal and crisis periods. It is observed that the N-Score is statistically significant for young and growth firms in the normal period (coefficient = 0.0037; *p*-value <.05) and crisis period (coefficient = 0.0061; *p*-value <.05), indicating that board connectedness helps in both normal and crisis times. The coefficient of 0.0037 on N-Score in the normal period, indicating that the highest quintile of connected young and high growth firms outperforms the lowest quintile in future firm performance by approximately 1.4% (i.e., (5-1) × 0.0037 × 100%) per year, on average. The coefficient of 0.0061 on N-Score in the crisis period, indicating that the highest quintile of connected young and high growth firms outperforms the lowest quintile by approximately 2.4% (i.e., (5-1) × 0.0061 × 100%) per year, on average. Degree and betweenness are significant at 1% and 5%, respectively, during the crisis, representing the directors' influence to control the network's information flow. Directors with a high quintile of degree and betweenness improve the information flow and influence, which is valuable during the crisis for young and high growth firms.

<Insert Table 4 here>

Similar results are observed in case of young firms during the normal and crisis period shown in Table 5. It is observed that the N-Score is statistically significant for young firms in the normal period (coefficient = 0.0030; *p*-value <.01) and crisis period (coefficient = 0.0037; *p*-value <.05), indicating that board connectedness helps in both normal and crisis times. The coefficient of 0.0030 on N-Score in the normal period, indicating that the highest quintile of connected young firms outperforms the lowest quintile in future firm performance by approximately 1.2% (i.e., (5-1) × 0.0030 × 100%) per year, on average. The coefficient of 0.0037 on N-Score in the crisis period, indicates that the highest quintile of connected young firms outperforms the lowest quintile by approximately 1.4% (i.e., (5-1) × 0.0037 × 100%) per year, on average. This indicate that there exists a positive and stronger relation between board centrality and firm performance in case of young firms during adverse economic conditions (Larcker, So, & Wang, 2013).

Table 7 presents the regression results for the overall sample period of young and growth firms (Panel A), young firms (Panel B), old firms (Panel C), high growth firms (Panel D), and low growth firms (Panel E). We observe that the N-Score is significant at 1% for all types of firms in Table 7.

<Insert Table 7 here>

Table 8 presents the regression results for the normal period. N-Score is significant and shows a positive relationship with future firm performance during the normal period. This represents that all firms benefit from board connectedness in a normal period. Panel A presents the regression results for the normal period of all firms. Board connectedness has a positive and statistically significant impact on future firms' performance (coefficient = 0.0030; *p*-value <.01). The coefficient of 0.0030 on N-Score in the normal period for all firms, indicating that the highest quintile of connected firms outperforms the lowest quintile in future firm performance by approximately 1.2% (i.e., (5-1) × 0.0030 × 100%) per year, on average.

<Insert Table 8 Panel A here>

Panel B presents the results of young and high growth firms during the normal period. It is observed that the N-Score is statistically significant for young and growth firms in the normal period (coefficient = 0.0037; *p*-value $<.05$), indicating that board connectedness helps in the normal times. The coefficient of 0.0037 on N-Score for young and high growth firms, indicating that the highest quintile of connected firms outperforms the lowest quintile by approximately 1.4% (i.e., (5-1) × 0.0037 × 100%) per year, on average.

<Insert Table 8 Panel B here>

Panel A in Table 9 presents the regression results for the crisis period. Consistent with our first hypothesis, board connectedness has a positive and statistically significant impact on firms' future performance (coefficient = 0.0026; *p*-value $<.1$) during the financial crisis. These results are consistent with the findings of Carney et al. (2020) that companies with board connections to state-owned firms and family business groups had greater crisis-period accounting performance. The coefficient of 0.0026 on N-Score for all firms in the crisis period, indicating that the highest quintile of connected firms outperforms the lowest quintile by approximately 1% (i.e., (5-1) × 0.0026 × 100%) per year, on average.

<Insert Table 9 Panel A here >

Consistent with our second hypothesis, board connectedness has a positive and statistically significant impact on the young and growth firms' future performance (coefficient = 0.0061; *p*-value $<.05$), as shown in Panel B (Table 9). Thus, the results suggest that board connectedness allows young and growth firms to better handle the financial crisis. This suggests that young and growth firms with high connectedness better manage information uncertainty and get timely information when the crisis unfolds. The coefficient of 0.0061 on N-Score for young and growth firms in the crisis period, indicating that the highest quintile of connected firms outperforms the lowest quintile by approximately 2.4% (i.e., (5-1) × 0.0061 × 100%) per year, on average. There is no statistical significance observed for old and value firms during crisis. In sum, board connectedness matters more for young and high growth firms compared to old and value firms during the crisis.

<Insert Table 9 Panel B here >

In order to assess the impact of board connectedness on firms' performance, our study leverages resource dependence theory, which explains how organizations reduce environmental interdependence and uncertainty (Hillman, Withers, Collins, 2009). Our results show that board connectedness helps future firm performance and supports the resource dependence theory, which emphasizes sharing the required resources, skills, knowledge, information flow and ability to influence the contract terms or financing by directors on multiple boards that help the firms face uncertainties during the crisis.

V CONCLUSION

Board connectedness provides access to valuable resources, shrinks the information gap, and helps future firms' performance during uncertain times. The resource dependence theory explains the boards' role in engaging with the external environment to access critical resources and protect from adversity. A board can be considered a visible link to the firm's external environment to effectively obtain valuable information (Pfeffer and Salancik, 1978). It helps to bring first-hand information on how other companies react to a given crisis caused by exogenous shocks, including the recent pandemic (COVID-19).

We examine whether board connectedness helps future firm performance during a financial crisis and whether this differs with the firm's age and growth opportunities. Our results demonstrate that board connectedness helps future firm performance during a financial crisis. Most connected firms outperform least connected firms by approximately 1% per year, on average in the crisis period. The impact of connectedness on future firm performance is more pronounced for young and high growth firms. The highest quintile of connected young and high growth firms outperforms the lowest quintile by approximately 2.4% per year, on average in the crisis period.

This study makes several contributions to the corporate governance literature. First, this study differentiates the impact of board connectedness on firm performance in a crisis versus a normal period. Second, firms lacking board connectedness are more vulnerable to crisis. Third, this study distinguishes various centrality measures during the crisis. Degree and betweenness matter during a crisis, which improves future firm performance, especially for the young and high growth firms.

Our results are consistent with the hypothesis that well-connected firms allow for better access to information, capital, and other resources during a financial crisis. The economics of board connectedness vary with the economic environment. Well-connected boards help firms to achieve better future performance than those with less connected boards during a crisis. This paper addresses the gap and examines the empirical relationship between board connectedness and future firm performance during a financial crisis. Our work can be extended to study the cost implications of having connected directors, the demand/supply gap, and regulatory implications. Future research can test if these results hold for private and nonprofit companies in the United States as well as for firms in other countries.

APPENDICES: TABLES AND FIGURES

Figure 1: Distribution between Aggregated data versus BoardEx by Sector

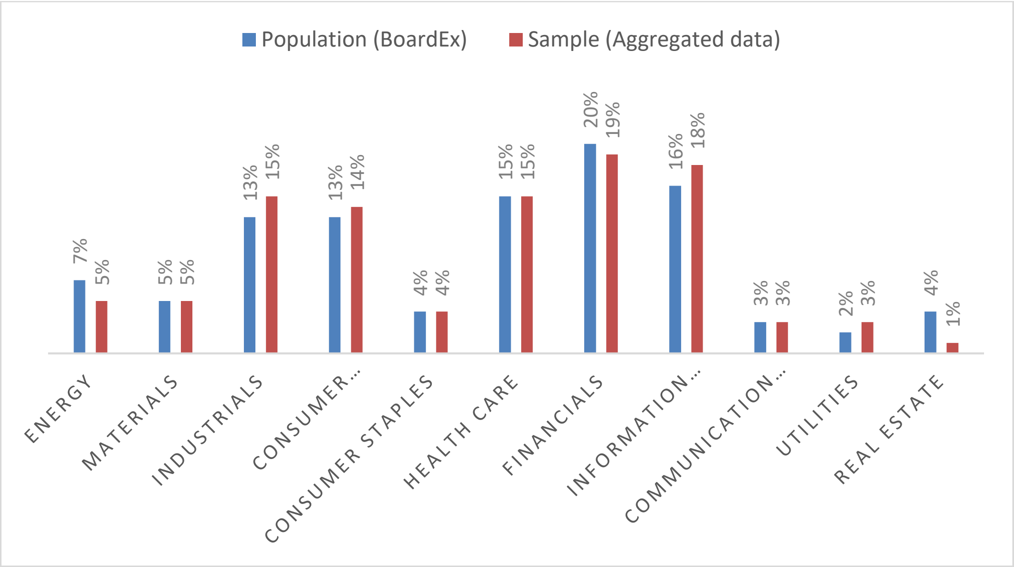

Table 1: Summary Statistics

Panel A: Firm Counts and Sample Averages by Year

Panel A provides the number of firms and sample averages and medians (shown in parentheses) for each year of the 2000–2017 sample. All centrality measures (Degree, Closeness, Betweenness, Eigenvector, and N-Score) are detailed in Section Variable Construction.

	Observations	Connected	Connected %	Degree		Closeness		Betweenness		Eigenvector		N-Score	
				Average	Median	Average	Median	Average	Median	Average	Median	Average	Median
2000	2,065	726	35%	5.544	4	0.122	0.127	0.435	0.008	0.018	0.014	3.868	4
2001	2,130	892	42%	6.155	4	0.099	0.102	0.288	0.007	0.017	0.011	3.948	4
2002	2,234	960	43%	6.334	5	0.256	0.272	0.295	0.004	0.017	0.011	3.973	4
2003	2,302	1,691	74%	5.965	4	0.051	0.053	0.165	0.001	0.012	0.008	3.478	4
2004	2,472	2,123	86%	6.077	5	0.041	0.043	0.134	0.002	0.011	0.007	3.119	3
2005	2,599	2,285	88%	6.314	5	0.02	0.02	0.124	0.002	0.011	0.007	2.151	2
2006	2,675	2,310	86%	6.343	5	0.037	0.038	0.112	0.004	0.009	0.006	3.01	3
2007	2,684	2,288	85%	6.192	5	0.023	0.024	0.121	0.005	0.009	0.006	2.429	2
2008	2,638	2,157	82%	5.715	4	0.031	0.032	0.136	0.008	0.009	0.007	2.911	3
2009	2,555	2,135	84%	5.709	4	0.032	0.033	0.137	0.005	0.009	0.006	3.007	3
2010	2,492	2,099	84%	5.508	4	0.026	0.027	0.142	0.004	0.009	0.004	2.735	3
2011	2,464	2,084	85%	5.584	4	0.022	0.023	0.138	0.004	0.009	0.004	2.377	2
2012	2,468	2,098	85%	5.62	4	0.022	0.023	0.143	0.004	0.009	0.008	2.407	2
2013	2,489	2,126	85%	5.795	5	0.025	0.026	0.136	0.005	0.01	0.008	2.721	3
2014	2,601	2,231	86%	5.78	5	0.022	0.023	0.131	0.004	0.01	0.008	2.372	2
2015	2,674	2,360	88%	5.856	5	0.013	0.013	0.136	0.005	0.01	0.008	2.112	2
2016	2,637	2,295	87%	5.793	5	0.057	0.06	0.136	0.006	0.011	0.008	3.447	4
2017	2,600	2,263	87%	5.592	4	0.025	0.026	0.133	0.002	0.011	0.009	2.905	3
All	44,779	5,123	77%	5.874	4.5	0.039	0.026	0.149	0.004	0.01	0.007	2.943	3

Panel B: Firm Counts and Sample Averages by Industry

Panel B provides the pooled sample averages by industry, where industries are grouped by two-digit GIC industry codes.

	Observations	Degree	Closeness	Betweenness	Eigenvector	N-Score
Energy	2,059	5.927	0.040	0.142	0.011	2.979
Materials	2,133	7.222	0.042	0.194	0.014	3.221
Industrials	6,539	6.653	0.040	0.168	0.012	3.032
Consumer Discretionary	6,054	6.093	0.040	0.160	0.011	2.899
Consumer Staples	1,815	6.680	0.042	0.205	0.012	2.989
Health Care	6,684	5.852	0.038	0.138	0.010	2.838
Financials	8,357	4.535	0.037	0.111	0.008	2.335
Information Technology	8,153	5.265	0.040	0.125	0.009	2.729
Communication Services	1,216	7.143	0.039	0.236	0.013	3.046
Utilities	1,255	7.581	0.043	0.197	0.013	3.189
Real Estate	434	5.201	0.037	0.114	0.009	2.673

Panel C: Descriptive Statistics of Firm Characteristics

Panel C presents pooled descriptive statistics. Assets is the natural logarithm of the firm's total assets; Debt ratio is total book value of liabilities divided by the total book value of equity; LBM is the natural logarithm of 1 plus the firm's book-to-market ratio; Alpha, is the excess return of stock over the index; Age is the number of months from IPO date, and Sales is the natural logarithm of total sales.

	Average	STDEV	P25	Median	P75	Skew
Degree	5.874	4.790	2.000	5.000	8.000	1.837
Closeness	0.039	0.042	0.023	0.026	0.038	4.180
Betweenness	0.149	0.332	0.000	0.004	0.135	4.952
Eigenvector	0.010	0.013	0.002	0.007	0.015	2.716
N-Score	2.820	1.415	2.000	3.000	4.000	0.118
ROA	0.054	0.399	0.021	0.090	0.156	77.000
Size	13.105	2.042	11.763	13.116	14.430	-0.006
Assets	6.495	2.069	5.068	6.472	7.836	0.146
Debt Ratio	0.560	0.530	0.330	0.543	0.768	70.060
LBM	0.468	0.288	0.268	0.429	0.616	2.909
Alpha	0.004	0.015	0.000	0.008	0.011	-1.356
Age	8.563	6.572	3.000	8.000	13.000	0.870
Sales	5.876	2.186	4.416	5.880	7.358	-0.242

Panel D: Firm Characteristics Across Quintiles of Centrality

Panel D presents the descriptive statistics of firm characteristics across quintiles of N-Score.

	N-Score					
	1 (Low)	2	3	4	5 (high)	High - Low
ROA	0.036	0.048	0.057	0.130	0.099	0.063
Size	12.370	13.009	13.509	14.092	14.819	2.449
Assets	5.887	6.279	6.730	7.271	8.096	2.209
Debt Ratio	0.542	0.531	0.544	0.573	0.600	0.057
LBM	0.489	0.452	0.436	0.421	0.425	-0.064
Alpha	0.005	0.006	0.006	0.005	0.004	-0.001
Age	9.710	9.335	9.217	8.696	7.761	-1.949
Sales	5.064	5.689	6.222	6.822	7.680	2.616

Panel E: Correlation Matrix

Panel E contains the annual cross-sectional correlations of the raw network measures, SIZE, and LBM, where Pearson (Spearman) correlations are shown above (below) the diagonal.

	Quintile_ Degree	Quintile_ Closeness	Quintile_ Betweenness	Quintile_ Eigenvector	Debt Ratio	Assets	L.B.M .	Alpha	Sales	ROA_1_0 _delta_lag	N-Score
Quintile_ Degree	1	0.207	0.671	0.663	0.105	0.456	-0.106	-0.054	0.511	-0.005	0.876
Quintile_ Closeness	0.207	1	0.049	0.214	0.002	0.037	0.014	-0.079	0.056	-0.006	0.434
Quintile_ Betweenness	**0.671**	0.049	1	0.372	0.083	0.329	-0.087	0.000	0.361	-0.010	0.731
Quintile_ Eigenvector	**0.663**	0.214	0.372	1	0.046	0.305	-0.091	-0.026	0.369	-0.005	0.759
Debt Ratio	0.105	0.002	0.083	0.046	1	0.481	0.138	0.001	0.262	0.009	0.088
Assets	0.456	0.037	0.329	0.305	0.481	1	0.083	-0.024	0.823	0.002	0.390
LBM	-0.106	0.014	-0.087	-0.091	0.138	0.083	1	0.071	-0.009	0.003	-0.091
Alpha	-0.054	-0.079	0.000	-0.026	0.001	-0.024	0.071	1	-0.039	-0.003	-0.051
Sales	0.511	0.056	0.361	0.369	0.262	0.823	-0.009	-0.039	1	0.003	0.445
ROA_1_0_delta_lag	-0.005	-0.006	-0.010	-0.005	0.009	0.002	0.003	-0.003	0.003	1	-0.011
N-Score	**0.876**	0.434	0.731	0.759	0.088	0.390	-0.091	-0.051	0.445	-0.011	1

Table 2. Overall sample period

Panel A: Regression Results for All Firms

Panel A presents the results from regressing future firm performance ($ROA_{t+1} - ROA_{t0}$ and $ROA_{t+2} - ROA_{t0}$) on the quintiles of centrality measures (board connectedness) all firms for the entire sample period. Descriptions of Degree, Closeness, Betweenness, Eigenvector, and N-Score are detailed in Section Variable Construction. N-Score equals the average quintile rank of the four centrality measures. Debt ratio is the total book value of liabilities divided by the total book value of equity; Assets is the natural logarithm of the firm's total assets; LBM is the natural logarithm of 1 plus the firm's book-to-market ratio; Alpha is the excess return of stock over the index; and Sales is the natural logarithm of total sales. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	ROA (t+1) - ROA (t)	ROA (t+1) - ROA (t)	ROA (t+1) - ROA (t)	ROA (t+1) - ROA (t)	ROA (t+1) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)

Model	1	2	3	4	5	6	7	8	9	10
Q_Degree	0.0004					0.0025***				
	(0.00)					(0.00)				
Q_Closeness		0.0004					0.0031***			
		(0.00)					(0.00)			
Q_Betweenness			0.0003					0.0017***		
			(0.00)					(0.00)		
Q_Eigenvector				-0.0002					0.0012**	
				(0.00)					(0.00)	
N-Score					0.0005					0.0030***
					(0.00)					(0.00)
Debt Ratio	0.0593***	0.0593***	0.0592***	0.0591***	0.0593***	0.0791***	0.0794***	0.0790***	0.0790***	0.0791***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Assets	-0.0045***	-0.0044***	-0.0044***	-0.0043***	-0.0045***	-0.0035*	-0.0028	-0.0031	-0.0028	-0.0035*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LBM	-0.0006	-0.0007	-0.0006	-0.001	-0.0005	0.0200***	0.0191***	0.0195***	0.0192***	0.0201***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
alpha	0.3243***	0.3229***	0.3236***	0.3286***	0.3231***	0.1588***	0.1525***	0.1592***	0.1649***	0.1557***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Lag of ROA	0.0013	0.0013	0.0013	0.0013	0.0013	0.0011	0.0011	0.0011	0.0011	0.0011
(t+1) - ROA (t)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Sales	0.0015	0.0015	0.0015	0.0015	0.0015	-0.0025	-0.0025	-0.0023	-0.0023	-0.0025
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Intercept	-0.0207***	-0.0214***	-0.0209***	-0.0208***	-0.0208***	-0.0421***	-0.0473***	-0.0433***	-0.0437***	-0.0427***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Industry Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	34,701	34,701	34,701	34,701	34,701	30,833	30,833	30,833	30,833	30,833
R-square	0.0211	0.0211	0.0211	0.021	0.0211	0.0244	0.0251	0.024	0.0238	0.0247

Table 3: All Firms

Table 3 presents the results from regressing firm-specific ΔROA ($ROA_{t+2} – ROA_{t0}$) on the quintiles of centrality measures (board connectedness) of all firms during the normal and crisis period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	Normal period					Crisis period				
	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$
Model ID	1	2	3	4	5	6	7	8	9	10
Q_Degree	0.0023^{***}					0.0033^{**}				
	(0.00)					(0.00)				
Q_Closeness		0.0032^{***}					0.0022			
		(0.00)					(0.00)			
Q_Betweenness			0.0017^{***}					0.0028^{**}		
			(0.00)					(0.00)		
Q_Eigenvector				0.0014^{**}					0.0011	
				(0.00)					(0.00)	
N-Score					0.0030^{***}					0.0026^{*}
					(0.00)					(0.00)
Intercept	-0.0409^{***}	-0.0459^{***}	-0.0420^{***}	-0.0425^{***}	-0.0414^{***}	-0.0166	-0.0225	-0.0181	-0.0179	-0.0175
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Industry X Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	26,583	26,583	26,583	26,583	26,583	4,250	4,250	4,250	4,250	4,250
R-square	0.0249	0.0249	0.0238	0.0237	0.0245	0.0565	0.057	0.0562	0.0567	0.0567

Table 4: Young and Growth Firms

Table 4 presents the results from regressing firm-specific ΔROA (ROA_{t+2} – ROA_{t0}) on the quintiles of centrality measures (board connectedness) of young and high growth firms during the normal and crisis period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	Normal period					Crisis period				
	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$
Model ID	1	2	3	4	5	6	7	8	9	10
Q_Degree	0.0033**					0.0090***				
	(0.00)					(0.00)				
Q_Closeness		0.0039***					0.0051			
		(0.00)					(0.00)			
Q_Betweenness			0.0044**					0.0073**		
			(0.00)					(0.00)		
Q_Eigenvector				0.0013					0.0024	
				(0.00)					(0.00)	
N-Score					0.0037**					0.0061**
					(0.00)					(0.00)
Intercept	-0.0274	-0.0328*	-0.0288	-0.0284	-0.0276	-0.0676*	-0.0773**	-0.0681*	-0.0662*	-0.0672*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Industry Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	6,329	6,329	6,329	6,329	6,329	1,090	1,090	1,090	1,090	1,090
R-square	0.139	0.1392	0.14	0.1382	0.1391	0.1601	0.1575	0.1593	0.157	0.1584

Table 5: Young Firms

Table 5 presents the results from regressing firm-specific ΔROA (ROA_{t+2} – ROA_{t0}) on the quintiles of centrality measures (board connectedness) of young firms during the normal and crisis period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	Normal period					Crisis period				
	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$
Model ID	1	2	3	4	5	6	7	8	9	10
Q_Degree	0.0029***					0.0053***				
	(0.00)					(0.00)				
Q_Closeness		0.0033***					0.0040**			
		(0.00)					(0.00)			
Q_Betweenness			0.0027***					0.0034**		
			(0.00)					(0.00)		
Q_Eigenvector				0.0014*					0.0022	
				(0.00)					(0.00)	
N-Score					0.0030***					0.0037**
					(0.00)					(0.00)
Intercept	-0.0532***	-0.0587***	-0.0545***	-0.0553***	-0.0538***	-0.0394**	-0.0488***	-0.0408**	-0.0412**	-0.0403**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Industry Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	13,125	13,125	13,125	13,125	13,125	3,047	3,047	3,047	3,047	3,047
R-square	0.1091	0.1093	0.1092	0.1082	0.109	0.0864	0.0851	0.0852	0.0844	0.0852

Table 6: High Growth Firms

Table 6 presents the results from regressing firm-specific ΔROA (ROA_{t+2} – ROA_{t0}) on the quintiles of centrality measures (board connectedness) of high growth firms during the normal and crisis period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	Normal period					Crisis period				
	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$
Model ID	1	2	3	4	5	6	7	8	9	10
Q_Degree	0.0020*					0.0042				
	(0.00)					(0.00)				
Q_Closeness		0.0033***					0.0004			
		(0.00)					(0.00)			
Q_Betweenness			0.0017					0.0039		
			(0.00)					(0.00)		
Q_Eigenvector				0.001					0.0004	
				(0.00)					(0.00)	
N-Score					0.0029***					0.0031
					(0.00)					(0.00)
Intercept	-0.0452**	-0.0498***	-0.0459**	-0.0459**	-0.0457***	-0.0345	-0.0347	-0.0366	-0.0339	-0.0354
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Industry Year Fixed Effects	Y	Y	Y		Y	Y	Y	Y		Y
Observations	13,265	13,265	13,265	13,265	13,265	1,589	1,589	1,589	1,589	1,589
R-square	0.0467	0.0475	0.0466	0.0465	0.047	0.0893	0.0901	0.0893	0.0893	0.0897

Table 7: Overall sample period

Panel A: Regression Results for Young and Growth Firms

Panel A presents the results from regressing firm-specific ΔROA ($ROA_{t+2} – ROA_{t0}$) on the quintiles of centrality measures (board connectedness) of young and growth firms during the overall sample period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$
Model	1	2	3	4	5
Q_Degree	0.0041***				
	(0.00)				
Q_Closeness		0.0041***			
		(0.00)			
Q_Betweenness			0.0045***		
			(0.00)		
Q_Eigenvector				0.0015	
				(0.00)	
N-Score					0.0041***
					(0.00)
Intercept	-0.0522**	-0.0590**	-0.0540**	-0.0532**	-0.0528**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Industry Year Fixed Effects	Y	Y	Y	Y	Y
Observations	7,419	7,419	7,419	7,419	7,419
R-square	0.0912	0.0913	0.0918	0.0902	0.0913

Table 7: Overall sample period

Panel B: Regression Results for Young Firms

Panel B presents the results from regressing firm-specific ΔROA (ROA_{t+2} – ROA_{t0}) on the quintiles of centrality measures (board connectedness) of young firms during the overall sample period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$
Model	1	2	3	4	5
Q_Degree	0.0015***				
	(0.00)				
Q_Closeness		0.0027***			
		(0.00)			
Q_Betweenness			0.0005		
			(0.00)		
Q_Eigenvector				0.0008	
				(0.00)	
N-Score					0.0019***
					(0.00)
Intercept	-0.0403***	-0.0440***	-0.0415***	-0.0417***	-0.0405***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Industry Year Fixed Effects	Y	Y	Y	Y	Y
Observations	16,172	16,172	16,172	16,172	16,172
R-square	0.0743	0.0747	0.0742	0.0733	0.0743

Table 7: Overall sample period

Panel C: Regression Results for Old Firms

Panel C presents the results from regressing firm-specific ΔROA ($ROA_{t+2} – ROA_{t0}$) on the quintiles of centrality measures (board connectedness) of old firms during the overall sample period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$
Model	6	7	8	9	10
Q_Degree	0.0017*				
	(0.00)				
Q_Closeness		0.0030***			
		(0.00)			
Q_Betweenness			0.0007		
			(0.00)		
Q_Eigenvector				0.001	
				(0.00)	
N-Score					0.0028***
					(0.00)
Intercept	-0.0208	-0.0245*	-0.0217*	-0.0219*	-0.021
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Industry Year Fixed Effects	Y	Y	Y	Y	Y
Observations	14,661	14,661	14,661	14,661	14,661
R-square	0.0121	0.013	0.0118	0.0119	0.0126

Table 7: Overall sample period

Panel D: Regression Results for High Growth Firms

Panel D presents the results from regressing firm-specific ΔROA (ROA$_{t+2}$ – ROA$_{t0}$) on the quintiles of centrality measures (board connectedness) of high growth firms during the overall sample period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$
Model	6	7	8	9	10
Q_Degree	0.0022**				
	(0.00)				
Q_Closeness		0.0033***			
		(0.00)			
Q_Betweenness			0.0019*		
			(0.00)		
Q_Eigenvector				0.0008	
				(0.00)	
N-Score					0.0030***
					(0.00)
Intercept	-0.0484***	0.0537***	-0.0493***	-0.0489**	-0.0491***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Industry Year Fixed Effects	Y	Y	Y	Y	Y
Observations	14,854	14,854	14,854	14,854	14,854
R-square	0.0457	0.0463	0.0456	0.0453	0.046

Table 7: Overall sample period

Panel E: Regression Results for Low Growth Firms

Panel A presents the results from regressing firm-specific ΔROA ($ROA_{t+2} – ROA_{t0}$) on the quintiles of centrality measures (board connectedness) of low growth firms during the overall sample period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$
Model	6	7	8	9	10
Q_Degree	0.0015***				
	(0.00)				
Q_Closeness		0.0027***			
		(0.00)			
Q_Betweenness			0.0005		
			(0.00)		
Q_Eigenvector				0.0008	
				(0.00)	
N-Score					0.0019***
					(0.00)
Intercept	-0.0403***	-0.0440***	-0.0415***	-0.0417***	-0.0405***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Industry Year Fixed Effects	Y	Y	Y	Y	Y
Observations	15,979	15,979	15,979	15,979	15,979
R-square	0.1742	0.1756	0.1739	0.1739	0.1745

Table 8. Normal period

Panel A: Regression Results of All Firms

Panel A presents the results from regressing firm-specific ΔROA ($ROA_{t+2} – ROA_{t0}$) on the quintiles of centrality measures (board connectedness) of all firms during the normal period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$
Model ID	1	2	3	4	5
Q_Degree	0.0023***				
	(0.00)				
Q_Closeness		0.0032***			
		(0.00)			
Q_Betweenness			0.0017***		
			(0.00)		
Q_Eigenvector				0.0014**	
				(0.00)	
N-Score					0.0030***
					(0.00)
Intercept	-0.0409***	-0.0459***	-0.0420***	-0.0425***	-0.0414***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Industry Year Fixed Effects	Y	Y	Y	Y	Y
Observations	26,583	26,583	26,583	26,583	26,583
R-square	0.0249	0.0249	0.0238	0.0237	0.0245

Table 8. Normal period

Panel B: Regression Results for young and growth firms

Panel B presents the results from regressing firm-specific ΔROA ($ROA_{t+2} – ROA_{t0}$) on the quintiles of centrality measures (board connectedness) of young and growth firms during the normal period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	High Growth Firms				
	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$
Model ID	1	2	3	4	5
Q_Degree	0.0033**				
	(0.00)				
Q_Closeness		0.0039***			
		(0.00)			
Q_Betweenness			0.0044**		
			(0.00)		
Q_Eigenvector				0.0013	
				(0.00)	
N-Score					0.0037**
					(0.00)
Intercept	-0.0274	-0.0328*	-0.0288	-0.0284	-0.0276
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Industry Year Fixed Effects	Y	Y	Y	Y	Y
Observations	6,329	6,329	6,329	6,329	6,329
R-square	0.139	0.1392	0.14	0.1382	0.1391

Table 8. Normal period

Panel C: Regression Results for Young vs. old firms

Panel C presents the results from regressing firm-specific ΔROA (ROA_{t+2} – ROA_{t0}) on the quintiles of centrality measures (board connectedness) of young vs. old firms during the normal period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	Young Firms					Old Firms				
	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)
Model ID	1	2	3	4	5	6	7	8	9	10
Q_Degree	0.0029***					0.0020**				
	(0.00)					(0.00)				
Q_Closeness		0.0033***					0.0034***			
		(0.00)					(0.00)			
Q_Betweenness			0.0027***					0.0009		
			(0.00)					(0.00)		
Q_Eigenvector				0.0014*					0.0015*	
				(0.00)					(0.00)	
N-Score					0.0030***					0.0032***
					(0.00)					(0.00)
Intercept	-0.0532***	-0.0587***	-0.0545***	-0.0553***	-0.0538***	-0.0243*	-0.0279**	-0.0253*	-0.0256*	-0.0244*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Industry Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	13,125	13,125	13,125	13,125	13,125	13,458	13,458	13,458	13,458	13,458
R-square	0.1091	0.1093	0.1092	0.1082	0.109	0.0121	0.0133	0.0118	0.012	0.0127

Table 8. Normal period

Panel D: Regression Results for High vs. Low growth firms

Panel D presents the results from regressing firm-specific ΔROA ($ROA_{t+2} – ROA_{t0}$) on the quintiles of centrality measures (board connectedness) of High vs. Low growth firms during the normal period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	High Growth Firms					Low Growth Firms				
	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)	ROA (t+2) - ROA (t)
Model ID	1	2	3	4	5	6	7	8	9	10
Q_Degree	0.0020*					0.0015**				
	(0.00)					(0.00)				
Q_Closeness		0.0033***					0.0031***			
		(0.00)					(0.00)			
Q_Betweenness			0.0017					0.0007		
			(0.00)					(0.00)		
Q_Eigenvector				0.001					0.0011**	
				(0.00)					(0.00)	
N-Score					0.0029***					0.0023***
					(0.00)					(0.00)
Intercept	-0.0452**	-0.0498***	-0.0459**	-0.0459**	-0.0457***	-0.0437***	-0.0478***	-0.0449***	-0.0450***	-0.0437***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Industry Year Fixed Effects	Y	Y	Y		Y	Y	Y	Y	Y	Y
Observations	13,265	13,265	13,265	13,265	13,265	13,318	13,318	13,318	13,318	13,318
R-square	0.0467	0.0475	0.0466	0.0465	0.047	0.199	0.2008	0.1987	0.1988	0.1995

Table 9 Crisis period

Panel A: Regression Results of All Firms

Panel A presents the results from regressing firm-specific ΔROA ($ROA_{t+2} – ROA_{t0}$) on the quintiles of centrality measures (board connectedness) of all firms during the crisis period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$
Model ID	1	2	3	4	5
Q_Degree	0.0033**				
	(0.00)				
Q_Closeness		0.0022			
		(0.00)			
Q_Betweenness			0.0028**		
			(0.00)		
Q_Eigenvector				0.0011	
				(0.00)	
N-Score					0.0026*
					(0.00)
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Intercept	-0.0166	-0.0225	-0.0181	-0.0179	-0.0175
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Industry Year Fixed Effects	Y	Y	Y	Y	Y
Observations	4,250	4,250	4,250	4,250	4,250
R-square	0.0565	0.057	0.0562	0.0567	0.0567

Table 9 Crisis period; Panel B: Regression Results for young and growth firms versus old and value firms

Results from regressing firm-specific ΔROA on the quintiles of centrality measures of Young and growth firms versus old and value firms during the crisis period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile. YG represents Young & High Growth; OV represents Old & Value Firms.

	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$	$ROA_{(t+2)}$ - $ROA_{(t)}$
Model ID	1	2	3	4	5
Q_Degree_OV	0.0090***				
Q_Degree_OV	0.0015				
Q_Closeness_YG		0.0051			
Q_Closeness_OV		0.0007			
Q_Betweenness_YG			0.0073**		
Q_Betweenness_OV			0.0018		
Q_Eigenvector_YG				0.0024	
Q_Eigenvector_OV				0.0004	
N-Score_YG					0.0061**
N-Score_OV					0.0011
Intercept_YG	-0.0676*	-0.0773**	-0.0681*	-0.0662*	-0.0672*
Intercept_OV	-0.0209	-0.0236	-0.0215	-0.0221	-0.0215
Industry Year Fixed Effects	Y	Y	Y	Y	Y
Observations_YG	1,090	1,090	1,090	1,090	1,090
Observations_OV	704	704	704	704	704
R-square_YG	0.1601	0.1575	0.1593	0.157	0.1584
R-square_OV	0.1679	0.1676	0.1683	0.1683	0.1685

Table 9 Crisis period

Panel C: Regression Results for Young vs. Old firms

Panel C presents the results from regressing firm-specific ΔROA (ROA_{t+2} – ROA_{t0}) on the quintiles of centrality measures (board connectedness) of young vs. old firms during the crisis period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	Young Firms					Old Firms				
	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$	$ROA_{(t+2)} - ROA_{(t)}$
Model ID	1	2	3	4	5	6	7	8	9	10
Q_Degree	0.0053***					-0.0001				
	(0.00)					(0.00)				
Q_Closeness		0.0040**					-0.0017			
		(0.00)					(0.00)			
Q_Betweenness			0.0034**					0.002		
			(0.00)					(0.00)		
Q_Eigenvector				0.0022					-0.0016	
				(0.00)					(0.00)	
N-Score					0.0037**					0.0009
					(0.00)					(0.00)
Intercept	-0.0394**	-0.0488***	-0.0408**	-0.0412**	-0.0403**	0.0287	0.0332	0.0282	0.0298	0.0287
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Industry Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	3,047	3,047	3,047	3,047	3,047	1,203	1,203	1,203	1,203	1,203
R-square	0.0864	0.0851	0.0852	0.0844	0.0852	0.0898	0.09	0.0902	0.09	0.0898

Table 9 Crisis period

Panel D: Regression Results for High vs. Low growth firms

Panel C presents the results from regressing firm-specific ΔROA ($ROA_{t+2} – ROA_{t0}$) on the quintiles of centrality measures (board connectedness) of high vs. Low growth firms during the crisis period. Standard control variables specified in the model specification section are used. The t-statistics based on two-way (firm and year) cluster robust standard errors are shown in parentheses. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively; Q represents quintile.

	High Growth Firms					Low Growth Firms				
	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$	ROA $_{(t+2)}$ - ROA $_{(t)}$
Model ID	1	2	3	4	5	6	7	8	9	10
Q_Degree	0.0042					0.0012				
	(0.00)					(0.00)				
Q_Closeness		0.0004					0.0013			
		(0.00)					(0.00)			
Q_Betweenness			0.0039					0.0008		
			(0.00)					(0.00)		
Q_Eigenvector				0.0004					0.0003	
				(0.00)					(0.00)	
N-Score					0.0031					0.0007
					(0.00)					(0.00)
Intercept	-0.0345	-0.0347	-0.0366	-0.0339	-0.0354	-0.0183	-0.0214	-0.019	-0.019	-0.0187
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Industry Year Fixed Effects	Y	Y	Y		Y	Y	Y	Y	Y	Y
Observations	1,589	1,589	1,589		1,589	2,661	2,661	2,661	2,661	2,661
R-square	0.0893	0.0901	0.0893		0.0897	0.1359	0.1359	0.1357	0.1355	0.1356

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