Executive Networks and Global Stock Liquidity

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Abstract

We examine whether executive networks affect the information environment around stocks in an international setting. We find that firms whose executives are more connected enjoy lower stock liquidity costs, as executive networks lower information asymmetries for market participants. However, the positive effects of executive networks on stock liquidity are subsumed in countries where investor protections are weaker. These results suggest that the detrimental effects of network connections (e.g., managerial entrenchment, extraction of private benefits, propensity to commit fraud, etc.) documented in prior studies create space for asymmetric information in the information environment around stocks when formal institutions are weak.

JEL Classification: F3, D85, G10, G14, L14

Keywords: international, equity liquidity, networks, network centrality, information asymmetry

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Abstract

We examine whether executive networks affect the information environment around stocks in an international setting. We find that firms whose executives are more connected enjoy lower stock liquidity costs, as executive networks lower information asymmetries for market participants. However, the positive effects of executive networks on stock liquidity are subsumed in countries where investor protections are weaker. These results suggest that the detrimental effects of network connections (e.g., managerial entrenchment, extraction of private benefits, propensity to commit fraud, etc.) documented in prior studies create space for asymmetric information in the information environment around stocks when formal institutions are weak.

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1. Introduction

A growing literature investigates the importance of connections between managers, market participants, and/or investors with regard to firm and market outcomes. Connections between people, or social networks, have been shown to improve the information environment for market participants, lowering the cost of equity (Ferris, Javakhadze, and Rajkovic, 2017), debt (Engelberg, Gao, and Parsons, 2012; Fogel, Jandik, and McCumber, 2018), and improving stock liquidity (Egginton and McCumber, 2018). In each case, the authors argue that direct and indirect connections between market participants lower information asymmetries and improves firm and market outcomes, and that these effects are greater when markets are more opaque. Conversely, connections have also been shown to be detrimental when managers are able to leverage their networks to extract rents or insulate themselves from discipline. Executive connections are associated with the increased likelihood of corporate fraud (Khanna, Kim, and Lu, 2015), higher leverage, greater likelihood of bailouts, poor firm performance (Faccio, Marsulis, and McConnell, 2007; Faccio, 2010) and lower executive turnover following poor performance or fraudulent activity (El-Khatib, Fogel, and Jandik, 2015; Khanna et.al., 2015). These detrimental effects are more pronounced where financial development is weaker and corruption more prevalent (Faccio, 2006).

In this study, we examine whether executive networks affect stock liquidity taking into account the financial development and strength of investor protections in a firm's host country. Stock liquidity is important to firms in that it lowers the direct and indirect costs of raising equity capital in follow-up offerings (Butler, Grulton, and Weston, 2005; Corwin, 2003) and lowers the risk premium required of equity investors. Since direct and indirect costs of equity issuance are higher where markets are less developed, executive networks may be more important where markets are less developed. Executive network effects may ameliorate or exacerbate liquidity costs.

To examine the relationship between executive networks and stock liquidity we calculate four measures of global network centrality for chief executive officers (CEOs) and chief financial officers (CFOs) using current board appointments. These measures of degree, eigenvector, closeness, and betweenness centralities capture the size and importance of executives' networks as well as their spatial position relative to all other executives in the network. In support of Egginton and McCumber (2018), we find that, *ceteris paribus*, firms whose executives are more connected enjoy lower liquidity costs, as networks afford more efficient information flows around more connected managers. At the mean, a one standard deviation increase in executive centrality lowers bid-asked spreads by 9.91%. However, in countries with weaker investor protections, the benefits of executive centrality on liquidity costs are partially or wholly subsumed. These findings strongly suggest that the detrimental effects of network connections (e.g., managerial entrenchment, extraction of private benefits, propensity to commit fraud, etc.) create space for asymmetric information in the information environment around stocks in the absence of strong formal institutions.

This paper contributes to the growing literature on investor networks by confirming the findings of Egginton and McCumber that executive networks affect the informational environments around stocks in an international setting. This study also contributes to the literature on the deleterious effects of managerial connections when formal institutions are weaker.

The remaining sections of this paper are organized as follows. Section 2 discusses the related literature and motivates this study. Section 3 discusses the data and methodology. Section 4 discusses the primary results and considers changes in executive centrality around CEO replacements. Section 5 concludes.

2. Related Literature and Concept Development

Several studies have proffered how information diffusion through the network of market participants may affect investor profits and stock liquidity. Ozsoylev et al. (2014) consider two traders to be connected if they exhibit similar trading patterns and find that traders more central in the network trade earlier and enjoy greater profits than traders who are less central. Walden (2018) introduces a dynamic network model wherein more central agents are more profitable. Importantly, the author hypothesizes and empirically tests that information diffuses more rapidly through denser networks; volatility post information shock is more persistent in less central networks. Akbas et al. (2016) argue that sophisticated traders are able to collect and aggregate "bits and pieces" of information dropped by more connected board members and that these tidbits provide traders with actionable and profitable trades. Egginton and McCumber (2018) find that firms whose executives are more central in the network have narrower bid-asked spreads. The authors argue that more central managers have greater ability and incentive to disclose meaningful information to markets, and further, that such managers are more visible to market participants such that even small details or manager opinions more quickly diffuse to the market.

To date, these studies consider network effects on equity markets in countries with highly developed, transparent financial markets and strong investor protections. Eleswarapu and Venkataraman (2006) find that equity trading costs are higher in countries with weaker accounting standards, judicial efficiency, and political stability. Faccio et al. (2007) and Faccio

(2010) find that firms with more political connections are disproportionately more likely to receive bailouts from the International Monetary Fund or the World Bank and deliver poorer performance. Further, the authors find that these effects are greater in countries with higher levels of corruption. If, as in Khanna et al. (2015), executive connections lowers both the probability of detection of fraudulent or other self-serving activity and the cost of engaging in such activities, especially in less transparent financial environments, then network centrality may decrease stock liquidity and increase trading costs in such regimes. Further, greater opacity may make "bits and pieces" of information, per Akbas et al. (2016), more valuable to sophisticated traders, again decreasing stock liquidity. On the other hand, if network effects primarily enable more efficient information flows around more central agents, then executive network centrality may be of even greater importance in opaque markets and/or when investor protections and disclosure requirements are lower.[1] Using a measure of CEO network centrality to proxy for managerial social capital, Ferris et al. (2017) find that social capital lowers the cost of equity and is more valuable where investor protections are weaker and financial markets less developed. The authors argue that social capital may substitute for legal protections and market mechanisms that foster efficient contracting. However, as in studies of the cost of equity and debt in North American markets, Ferris et al. (2017) are concerned with institutional shareholders and firms, e.g. banks, investment companies, and other suppliers of capital to firms. We are interested in secondary markets, where executive network effects are unclear, specifically, in ex-North American markets.

[1] Even if managers would prefer to utilize their network positions to reap private benefits and/or obfuscate direct disclosures to market participants, the increased visibility of central agents may enable efficient, e.g. truthful, information flows.

The effects of global executive networks on stock liquidity are therefore an empirical matter. While we expect that, *ceteris paribus*, executive networks improve stock liquidity per Egginton and McCumber (2018), it is an open question as to whether networks mitigate information asymmetries for market participants where investor protections and financial sophistication are lower. If executive networks improve the efficiency of information production, we expect that higher network centrality will be of even greater importance in the absence of strong investor protections and financial development. If executive networks afford managers greater ability to extract private benefits from their firms and/or escape disciplinary action, we expect to find that executive network centrality is associated with higher bid-asked spreads and greater stock liquidity costs as the potential for information asymmetry increases in the absence of strong institutions.

3. Data and Methodology

BoardEx provides data on executives and their professional profiles, including executive and non-executive board appointments. From BoardEx we extract executive identities, their professional appointments, and identifying information on the entities they serve, from 2007 through 2017. The data include 707,771 unique executives serving on the boards of 580,286 unique corporate, non-profit, or government entities. There are millions of connections between executives, wherein we define a connection present if two executives serve on the board of the same entity at the same time.

Each year we construct a global network of executive boards. Networks are dynamic, as board appointments change over time. Each year we construct four measures of executive network centrality to capture the size and influence of an executive's immediate network as well as her spatial representation relative to other executives: degree, eigenvector, closeness, and betweenness, resultant of all executive appointments at all entities in the network. We focus on "current" networks, that is, we only consider two people linked if they currently sit on the same board. When one of the executives leaves the board, the two are no longer linked.[2]

Measures of the size and scope of one's network include degree and eigenvector centralities. Degree centrality is the number of direct links an executive has to others in the network; it is simply the size of one's immediate network. Weighting one's connections by degree centrality results in eigenvector centrality, a measure of how connected one's connections are. An executive with higher eigenvector centrality is connected to people who in turn have larger networks.

Spatial representations of one's network position include betweenness and closeness centralities. Betweenness centrality is a measure of the number of times a node lies between other nodes, and is closely related to the concept of brokerage. Consider information flows – a node that is between two other nodes may choose to pass along, block, or alter information passing through the central node. Relatedly, closeness centrality is the inverse of the number of steps it takes for one node to reach all other nodes in the network. Higher closeness centrality implies that an executive's network is close and dense, potentially affording more efficient information flows around and through the executive's position.

[2] We consider contemporaneous connections because, intuitively, these are more likely to afford information flows around firm executives to market participants. Though direct past connections, e.g. past employment or education, may be beneficial in mitigating information asymmetries between contracting parties (Engelberg et al., 2012; Fogel et al., 2018), we are interested in the overall informational environment amongst market participants. Further, Khanna et al. (2015) find past connections to be insignificant in their study of connections and corporate malfeasance.

While degree centrality is intuitive, e.g. one can imagine that someone with 150 direct connections may have informational and other advantages compared to someone with 5 connections, raw measures of eigenvector, betweenness, and closeness centralities are less so. We therefore normalize each centrality variable such that an equal number of executives are placed in percentile "buckets". An executive in the 78th percentile of closeness is more central – her network is denser than - 77% of all other executives that year. Centrality is computed for all executives in the global network each year. Our sample executives include 4,809 CEOs and 4,694 CFOs. At the means, CEOs have a degree centrality of 178 direct connections, placing the average CEO in the 54th percentile of all global executives in degree. Finally, though each centrality variable captures a different dimension of network influence and visibility, we average each executive's annual centrality percentages to create a *Central Index* to capture the executive's overall network position.

[Figure 1 about here]

Figure 1 is a visualization of a subsample of the global network of all executives in 2013 consisting of 3,259 German executives, 1,845 Malaysian executives, 65,236 other executives, and the 363,344 connections between them that year. The algorithm renders the visualization to maximize both the density among closer nodes and the distance between nodes that are further away. A core-periphery structure is clearly visible, with the large German cluster of connections taking center stage. The black dots are executives, and the size of the dots is scaled by degree centrality; larger nodes have more connections. Lines between nodes are shared board appointments, the colors of which represent the country in which the firm or other entity is headquartered. By construction, German and Malaysian companies are well represented, though the executives are serving more companies headquartered in the United States than in Malaysia. German boards are in red, representing 49.01% of all observations. United States boards are in blue, and Malaysian in green, representing 22.85% and 12.81% of observations, respectively.

[Figure 2 about here]

Figure 2 is a close up of the eastern edge of the German cluster in figure 1. One may easily observe individual executives and the tight clusters of people within the larger German cluster. A highly central node is also visible, with many connections to German and United States firms and executives. Figures 1 and 2 are meant to build intuition with regard to how networks may affect information flows and/or allow more central figures to reap benefits from the size of their respective networks and their positions within the network.

We use Compustat Global daily price data to measure equity liquidity. We compute a measure of equity liquidity following Corwin and Schultz (2012) by estimating the daily bid-ask spread by firm using daily stock price transaction data over the period January 1, 2007 through December 31, 2017. We then compute the yearly average annual quoted spread by firm, *Spread*, to measure equity liquidity. Additionally, we gather data on various factors identified in McInish and Wood (1992) as determinants of equity liquidity. For each firm in the sample, we collect data on stock price (*Price*), trading volume (*Volume*), and return volatility $\sigma(Return)$. We measure *Price* as the annual average of the daily closing price by firm in U.S. dollars. *Volume* is the natural log of the annual average daily trading volume by firm. $\sigma(Return)$ is the standard deviation of daily closing price returns by firm.

In addition to firm-level data, we collect data on the countries covered in our sample from the World Bank. For each country-year, we use World Bank data to measure intra-country competitiveness (*Competitiveness*) and intra-country strength of investor protections (*Investor Protections*). *Competitiveness* is the value of the Global Competitiveness Index (GCI) for each country in each year as reported by the World Bank, and is an index comprised of over 150 measures intended to measure the contributing factors to economic growth and prosperity.[3] *Investor Protections* is a value measuring the strength of investor protections, inclusive of financial disclosure requirements, accounting transparency, minority shareholder protections, and ownership disclosures, for each country in each year as reported by the World Bank, and ranges from 1 (worst) to 10 (best). To simply sort the countries in our sample into stronger or weaker protections, we construct an indicator variable, *Bottom Investor Protections*, which takes a value of 1 if a country's value of *Investor Protections* is below the yearly median value, and 0 otherwise. The result of our sample identification procedure and data limitations yields a final sample of 14,187 firm-year observations covering 3,128 firms in 40 countries.

[Insert Table 1 here]

Descriptive statistics of the sample are presented in Table 1. Mean values for the measures used in the analysis are presented by country. Additionally, mean and median values are reported for the entire sample at the bottom of the table. Over the sample period, the mean value of *Spread* is 0.018 with a high of 0.246 in the Hong Kong and a low of 0.005 in Turkey. *Central Index* is highest in Turkey (0.74), lowest in Saudi Arabia (0.40), and 0.48 over the entire sample. The mean value of *Investor Protections* is 6.22 for the full sample with a high of 8.95 in New

[3] According to the World Bank, the Global Competitiveness Index (GCI) covers 140 countries on 12 pillars of competitiveness comprised of over 150 measures shown in theoretical and empirical literature to contribute to economic progress and GDP growth. Contributing factors to the index include measures of the efficacy of formal institutions, infrastructure, financial market development, labor and goods market efficiency, business sophistication, and more. The descriptive material may be found at http://reports.weforum.org/global-competitiveness-index-2017-2018/introduction/.

Zealand and a low of 4.02 in Switzerland. *Competitiveness* is highest in Switzerland (5.72) and lowest in Argentina (3.84). The sample mean *Competitiveness* is 5.08. Finally, the highest average *Volume* occurs in China (16.62) and the highest average *σ(Return)* occurs in Ireland (0.063). The lowest average *Volume* and *σ(Return)* occur in Switzerland and the Philippines, respectively.

4. Analysis of Empirical Results

Executive Network Centrality and International Liquidity: Univariate Results

Table 2 provides summary statistics for the sample. The left-third of the table presents results for the entire sample, and the right two-thirds report the results of a subsample analysis where the subsamples are determined by the centrality of the CEO. To construct the subsamples, we divided the sample into two groups, 'Low Centrality Index' and 'High Centrality Index'. Firms are classified as being in the 'Low Centrality Index' ('High Centrality Index') subsample if the value *Central Index* for their CEO is below (above) the yearly median value. For the subsample analysis, descriptive statistics are reported, as well as differences in means and medians. Statistical results for differences in means (medians) are from t-tests (k-sample tests). The full sample results are presented for comparative purposes as most of these results can be found at the bottom of Table 1. Formal variable definitions are provided in Appendix A.

[Insert Table 2 here]

The subsample analysis highlights distinct differences between the high and low centrality subsamples. The firm-year observations in the high centrality subsample exhibit statistically lower values of *Spread* at both the mean and median. Mean (median) values of *Spread* are 3 basis points (2 basis points) lower in the high centrality subsample relative to the low centrality subsample. In economic terms, the difference in *Spread* evaluates to a 16.58% reduction at the mean and a 15.37% reduction at the median. *Central Index*, and its four components, are statistically higher in the high subsample. Although this result is somewhat expected based on the construction of the subsamples, the statistically significant difference does suggest measurable variation in the values of centrality across the subsamples. Additionally, firm-year observations in the high centrality subsample are characterized by statistically significant lower values of *Competitiveness* and *σ(Return)*, and statistically significant higher values of *Volume*.

Executive Network Centrality and International Liquidity: Multivariate Results

Our univariate results indicate significant within sample heterogeneity. To control for the in-sample variation, we investigate the relationship between centrality and liquidity in the cross section. We estimate the following model

$$Spread_{i,j,t} = \beta_0 + \beta_1 Central_{i,j,t} + \beta_2 Competitiveness_{j,t} + \boldsymbol{\gamma Controls_{i.j,t}} + \varepsilon_{i.j,t} \qquad (1)$$

where $Spread_{i,j,t}$ is the annual average of the Corwin and Schultz (2010) estimation of bid-ask spread measured daily for firm *i* in country *j* at time *t*. $Central_{i,j,t}$ is one of the five measures of centrality described previously. $GCI_{j,t}$ is the value of the Global Competitiveness Index for country *j* in time *t*. $\boldsymbol{Controls_{i,j,t}}$ is a vector of control variables which includes *Price*, *Volume*, and *σ(Return)* (McInish and Wood, 1992). To control for cross-correlations in *Spread*, we include fixed effects for year, industry, and country and compute robust standard errors clustered by country (White, 1980).

Table 3 reports the regression results for equation (1) with *t*-statistics reported in the parentheses below the coefficient estimates. The coefficient estimates on all five measures of CEO network centrality are negative and statistically significant at better than the 5% level. The negative coefficients present evidence that CEO centrality is negatively related to bid-ask spreads. This result is consistent with the findings of Egginton and McCumber (2018) that firms with central CEOs enjoy lower equity liquidity costs. In economic terms, a one standard deviation increase in *Central Index* is associated with a 9.91% reduction in the mean value of *Spread* (i.e., $-0.008 * 0.223/0.018$) and a 19.82% reduction in the median value of *Spread* (i.e., $-0.008 * 0.223/0.009$). For *Degree*, *Eigen*, *Between*, and *Close* the same one standard-deviation increase is associated with a reduction in the mean value of *Spread* of 12.39%, 8.67%, 4.98%, and 11.20%, respectively.

[Insert Table 3 here]

The coefficient estimates on *Volume* and *Volatility* have signs consistent with the results in McInish and Wood (1992). Greater trading volume and reduced volatility lead to reductions in liquidity-related trading costs.

The full sample results presented in Table 3 support prior literature in arguing for the beneficial, information-channel effects resultant of robust executive networks. We next examine whether centrality is more or less beneficial in markets where investor protections are stronger or weaker. If centrality is a substitute for investor protections in that it affords more efficient information flows around central actors, centrality should be more important in markets where protections are weaker. If centrality enables obfuscation or sub-optimal behaviors where protections are weaker, we expect to see an increase in trading costs for firms with more central managers. We thus extend the previous study by conditioning the sample on country-specific investor protections. Specifically, we augment our regression specification presented in equation (1) to include the strength of investor protections data provided by the World Bank as follows:

$$\begin{aligned} Spread_{i,j,t} = \beta_0 + \beta_1 Central_{i,j,t} + \beta_2 Bottom\ Investor\ Protections_{j,t} \\ + \beta_3 Central_{i,j,t} x Bottom\ Investor\ Protections_{j,t} \\ + \beta_4 Competitiveness_{j,t} + \boldsymbol{\gamma Controls_{i.j,t}} + \varepsilon_{i.j,t} \end{aligned} \tag{2}$$

where $Bottom\ Investor\ Protections_{j,t}$ is an indicator variable which takes a value of 1 if a country's value of *Investor Protections* is below the yearly median value, and 0 otherwise. $Central_{i,j,t} x Bottom\ Investor\ Protections_{j,t}$ is the interaction between *Bottom Investor Protections* and one of the five measures of CEO centrality described previously. The remainder of the variable definitions follow that of equation (1). Finally, we include fixed effects for year, industry, and country and compute robust standard errors clustered by country (White, 1980). The regression results for equation (2) are presented in Table 4 with *t*-statistics reported in the parentheses below the coefficient estimates.

Coefficient estimates on the measures of centrality are again negative and statistically significant at better than the 1% level for all five specifications. This result is consistent with the findings presented in Table 3 and provides further evidence supporting the beneficial information-channel effects of executive centrality. Coefficient estimates *Bottom Investor Protections* are not statistically different from zero. Importantly, however, the coefficients on the interaction terms exemplify the dual nature of network effects. All of the five coefficient estimates on the centrality measures interacted with *Bottom Investor Protections* terms are positive and four of the five are statistically significant. The positive estimates suggest that firms in countries with weaker investor protections suffer in terms of higher liquidity costs as the centrality of the firm's CEO increases. This finding supports the detrimental effects of executive centrality suggested by prior studies (e.g. Khanna, Kim, and Lu, 2015; Faccio, 2010, and El-Khatib, Fogel, and Jandik, 2015). When shareholder protections are weak, firms with highly central CEOs face higher trading costs. Unreported F-tests on the summation of the coefficient estimates on the centrality measures and on estimates for the interaction terms are statistically indistinguishable from zero for all five specifications. The beneficial effects of executive centrality seem to be offset in countries where investor protections are weak.

Executive Network Centrality and International Liquidity: Additional Analysis

In this section, we explore two areas of additional analysis into the relation between executive centrality and equity liquidity costs. Namely, we first perform testing where we define the measure of executive centrality as the centrality of the CFO. We then examine the association around CEO turnover events.

We explore the effect of CFO centrality on equity liquidity by re-estimating a version of equations (1) and (2) where the measures of centrality are replaced with the values for a firm's CFO. Results of this testing are presented in Table 5 where panel A reports the results from equation (1) and panel B for equation (2).

[Insert Table 5 here]

Across both panels, the coefficient estimates on the five measures of CFO centrality are negative across all of the specifications and are statistically significant in nine of the ten. The negative coefficients indicate that the effect of centrality extends to the CFO, suggesting that firms with central CFOs enjoy lower equity liquidity costs. The effect, however, is relatively smaller than that for CEOs. For example, a one standard deviation increase in the value of *Central Index* for the CFO is associated with a 6.69% reduction in the mean value of *Spread* (i.e., $-0.005 * 0.214/0.016$) when evaluated using the regression results in column (1).[4] The 6.69% reduction in *Spread* from a one standard-deviation increase in the average CFO's *Central Index* is just over half of the magnitude of the effect from a similar increase in the average CEO's value of *Central Index*. The coefficient estimates on the interaction between CFO *Central Index* and *Bottom Investor Protections* in panel B tell a similar story. The reductions in *Spread* occurring for firms with central CFOs is somewhat offset then when the firm resides in a country with relatively weaker investor protections. The coefficient estimates on the interaction terms are all positive, though they are statistically weaker than those in the CEO specifications and are smaller in magnitude. Similar to the findings on CEO centrality, when shareholder protections are weak, firms with highly central CFOs face higher trading costs.

Executive centrality measures exhibit some degree of persistence. If the within-firm variation on centrality is not adequate to allow for the regression specifications to detect the association, the measure has the potential to act as a pseudo firm-fixed effect. Our firm-specific covariates attempt to address this issue in our cross-sectional, time-series regression specifications. However, we attempt to address the persistence issue directly by examining the effect of exogenous shocks to executive network centrality on firm liquidity. Specifically, we explore the association around CEO turnover events. We identify turnover events occurring in our sample and calculate the changes in CEO centrality as the difference between the values of centrality for the new CEO less the values for the outgoing CEO. To calculate the changes in centrality, and all

[4] In unreported results, the standard deviation of *Central Index* for the CFOs in our sample is 0.214. The mean value of *Spread* in the CFO subsample is 0.016.

other variables, we use the first full year an executive is in service less the last full year the previous executive was in office, thereby excluding the 'transition year'. Our change measures exclude the transition year as executive turnover for three reasons: 1) we often do not have exact appointment dates; 2) centrality measures are computed from annual data thus restricting the frequency of computation; and, 3) the turnover event has the potential to induce noise in our measures, e.g., increased media coverage surrounding the turnover event may affect liquidity during the transition period.

We identify 942 CEO turnover events in our sample with sufficient data pre- and post-turnover to compute changes in our measures. We examine the effect CEO turnover on equity liquidity by estimating a dynamic version of the regression specification presented in equation (1):

$$\Delta Spread_{i,j,t} = \beta_0 + \beta_1 \Delta Central_{i,j,t} + \beta_2 \Delta Competitiveness_{j,t} + \boldsymbol{\gamma} \Delta \boldsymbol{Controls_{i.j,t}} + \varepsilon_{i.j,t} \quad (3)$$

where the symbol Δ represents the difference in the value of a measure from the first full year an executive is in service less the last full year the previous executive was in office. The regression results for equation (3) are presented in Table 6 with *t*-statistics reported in the parentheses below the coefficient estimates. The coefficient estimates on the changes in our centrality measures are negative for all five specifications, are statistically significant for four of the five. CEO turnover events that result in the appointment of a CEO with increased network centrality lead to increases in equity liquidity and reductions in liquidity costs.

5. Conclusion

In this study, we examine the extent to which executive networks affect stock liquidity in a global, ex-North American, setting accounting for the development and strength of investor protections in a firm's host country. Social connections, or networks, have been shown to reduce information asymmetry and improve the information environment for market participants (Engelberg, Gao, and Parsons, 2012; Ferris, Javakhadze, and Rajkovic, 2017; Fogel, Jandik, and McCumber, 2018), thus improving stock liquidity (Egginton and McCumber, 2018). Conversely, connections have also been found to be detrimental when managers are able to leverage their networks to extract rents or insulate themselves from discipline (Faccio, Marsulis, and McConnell, 2007; Faccio, 2010; El-Khatib, Fogel, and Jandik, 2015; Khanna et.al., 2015; Khanna, Kim, and Lu, 2015).

We examine whether executive networks affect stock liquidity taking into account the financial development and strength of investor protections in a firm's host country. We find that firms whose executives are more connected enjoy lower bid-ask spreads. This outcome indicates that social networks afford firms with more connected executives more efficient information flows. In economic terms, a one standard deviation increase in executive centrality is associated with a reduction in bid-asked spreads by 9.91%. However, in countries with weaker investor protections, the benefits of executive centrality on liquidity costs are partially or wholly subsumed.

Our results suggest that firms whose executives are more connected enjoy lower stock liquidity costs, as executive networks act to reduce information asymmetries for market participants. However, the informational effects of social networks are not unidirectional. The positive effects of executive networks on stock liquidity are subsumed in countries where investor protections are weaker. This result suggests that the detrimental effects of network connections documented in prior studies (e.g., managerial entrenchment, extraction of private benefits, propensity to commit fraud, etc.) create space for asymmetric information around stocks in the absence of strong formal institutions.

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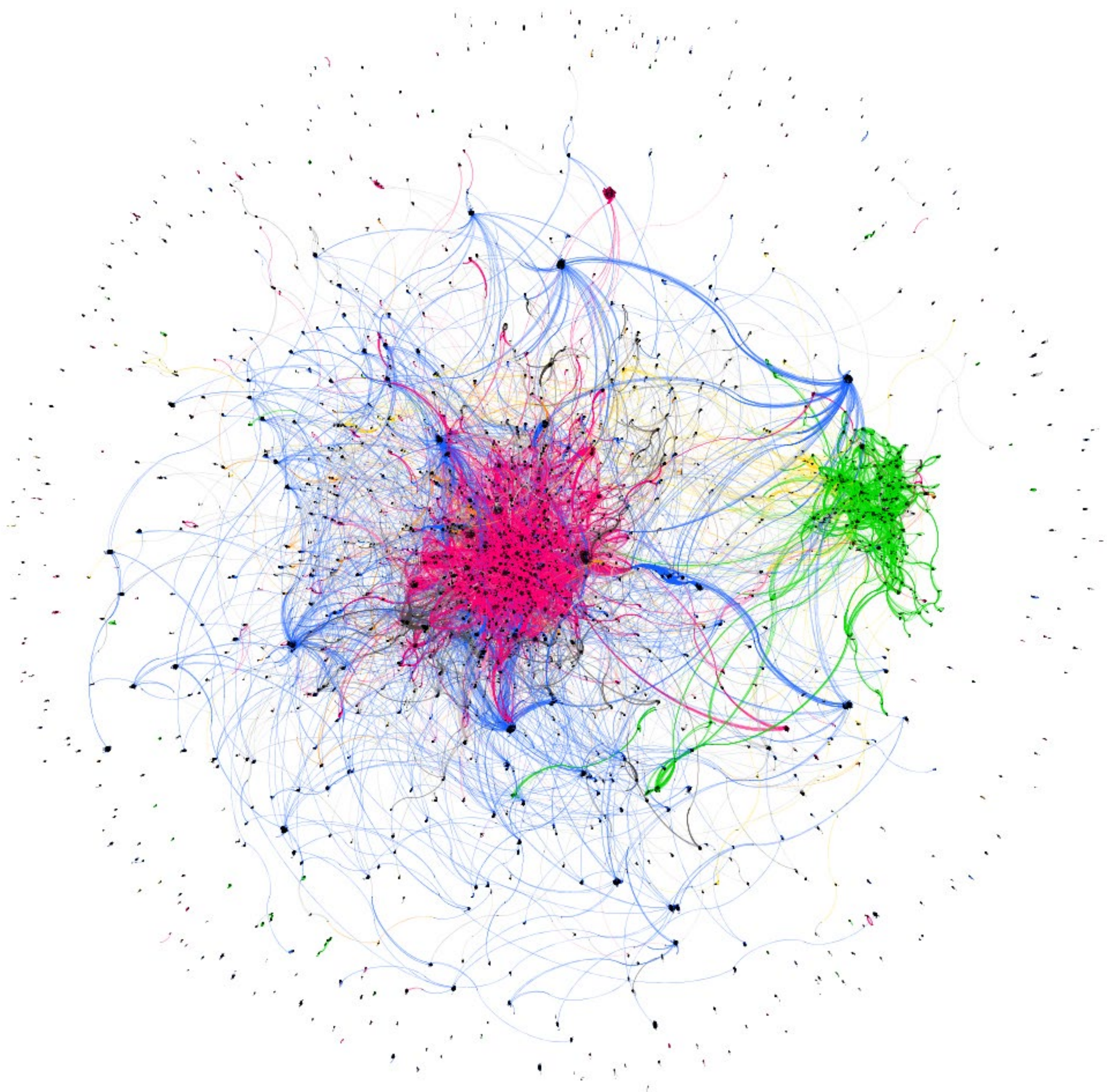
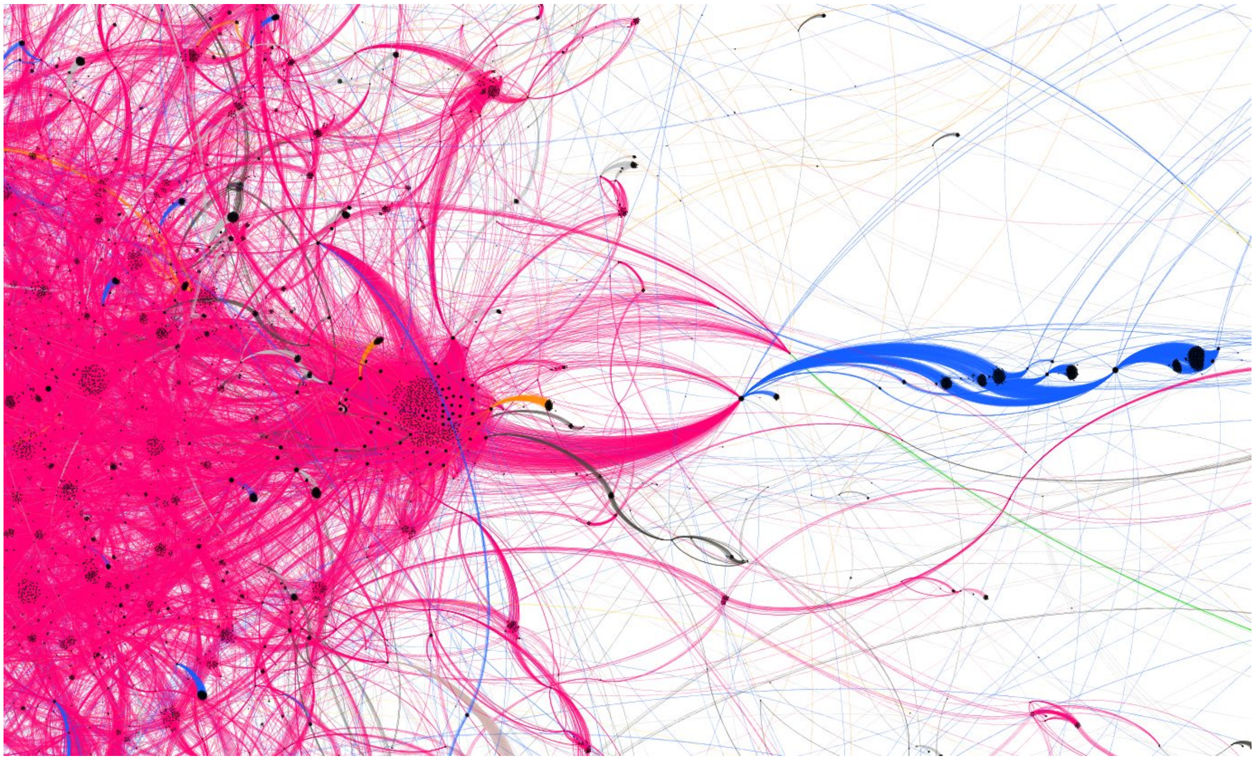
Figure 1: Subnetwork of German and Malaysian executives, 2013



This figure is a visualization of global subnetwork consisting of 3,259 German, 1,845 Malaysian, and 65,236 other executives sitting on boards of for-profit, non-profit, and governmental institutions in 2013. There are 363,344 connections between these executives. People (nodes) are represented by dots, whose size reflects the number of current direct connections (degree centrality) each has with other executives. Lines (edges) between people represent board relationships. Colors represent the country in which the entity is headquartered; German entities are red, Malaysian are green, United States are blue. Other colors include Switzerland (3.84% of observations), France (1.48%), Netherlands (1.21%), Singapore (0.88%), and Luxembourg (0.72%), with grey lines representing other countries.

Figure 2: Close up of German and Malaysian executives subnetwork, 2013



This figure is a close up of the eastern edge of the German cluster of the global subnetwork consisting of 3,259 German, 1,845 Malaysian, and 65,236 other executives sitting on boards of for-profit, non-profit, and governmental institutions in 2013. There are 363,344 connections between these executives. People (nodes) are represented by dots, whose size reflects the number of current direct connections (degree centrality) each has with other executives. Lines (edges) between people represent board relationships. Colors represent the country in which the entity is headquartered. Visible colors in the close up include German entities (red), United States (blue), France (orange), Switzerland (dark grey), and Malaysian (green). Light grey lines represent other countries.

Table 1: Descriptive Statistics by Country

Country	# of Obs.	# of Firms	Spread	Central Index	Degree	Eigen	Between	Close	SIP	GCI	Price	Volume	σ(Return)
Argentina	4	1	0.011	0.54	0.62	0.53	0.59	0.43	5.75	3.84	21.84	10.81	4.66%
Australia	2182	527	0.024	0.49	0.54	0.42	0.57	0.45	5.71	5.15	3.85	13.19	4.50%
Austria	203	37	0.010	0.49	0.58	0.37	0.64	0.39	5.12	5.17	52.47	10.62	2.33%
Belgium	322	68	0.010	0.50	0.55	0.40	0.61	0.42	6.54	5.16	93.22	9.48	2.37%
Brazil	261	63	0.013	0.46	0.54	0.34	0.62	0.35	5.90	4.15	18.68	13.31	3.20%
Chile	130	22	0.010	0.47	0.57	0.39	0.57	0.36	6.15	4.67	55.81	13.82	1.82%
China	60	13	0.027	0.50	0.58	0.36	0.65	0.39	4.63	4.90	7.32	16.62	2.77%
Denmark	166	31	0.021	0.55	0.62	0.41	0.73	0.46	6.53	5.41	90.27	11.11	2.67%
Finland	255	45	0.012	0.54	0.63	0.40	0.71	0.43	5.69	5.46	17.90	11.74	2.50%
France	1477	320	0.013	0.42	0.50	0.33	0.53	0.34	5.88	5.15	58.03	9.58	2.95%
Germany	1282	261	0.014	0.42	0.47	0.32	0.54	0.33	5.39	5.50	55.89	10.48	3.24%
Greece	107	23	0.012	0.50	0.61	0.37	0.61	0.40	4.57	4.03	11.30	12.03	3.35%
Hong Kong	31	5	0.246	0.61	0.63	0.53	0.69	0.59	8.60	5.42	20.18	15.39	5.52%
India	975	233	0.015	0.54	0.61	0.44	0.61	0.50	6.71	4.39	9.30	12.97	2.81%
Indonesia	83	16	0.014	0.54	0.65	0.39	0.66	0.45	5.78	4.49	32.92	15.67	4.30%
Ireland	191	41	0.047	0.46	0.49	0.40	0.53	0.42	7.96	4.99	8.29	12.00	6.28%
Israel	321	74	0.015	0.46	0.53	0.41	0.52	0.38	7.90	5.04	14.68	11.27	3.38%
Italy	443	98	0.016	0.50	0.56	0.39	0.63	0.41	6.01	4.43	12.26	12.71	2.86%
Japan	440	117	0.008	0.45	0.59	0.31	0.59	0.31	6.78	5.42	270.42	13.91	2.53%
Korea, Rep.	192	48	0.011	0.42	0.46	0.33	0.54	0.34	6.28	5.04	5445.24	12.84	2.61%
Luxembourg	46	13	0.028	0.57	0.61	0.45	0.69	0.51	4.43	5.11	18.97	11.28	5.01%
Malaysia	287	66	0.010	0.46	0.54	0.35	0.57	0.39	8.26	5.09	1.33	13.62	2.18%
Mexico	191	36	0.026	0.58	0.65	0.51	0.66	0.49	5.89	4.30	18.76	13.17	3.81%

This table presents descriptive statistics on the mean values of CEO network centrality, equity liquidity, and firm characteristics by country for the observations in our sample. The sample consists of all firms with non-missing values covered by Compustat Global daily price data, BoardEx, and the World Bank Global Competitiveness Index data over the period January 1, 2007 through December 31, 2017. Formal variable definitions are provided in Appendix A.

Table 1: Descriptive Statistics by Country (Cont.)

Country	# of Obs.	# of Firms	Spread	Central Index	Degree	Eigen	Between	Close	SIP	GCI	Price	Volume	σ(Return)
Netherlands	430	91	0.022	0.47	0.52	0.38	0.57	0.42	5.03	5.46	25.95	11.55	3.23%
New Zealand	158	37	0.015	0.45	0.53	0.35	0.56	0.38	8.95	5.18	2.75	12.48	2.25%
Norway	367	75	0.014	0.44	0.55	0.28	0.63	0.30	6.89	5.29	12.14	11.88	3.23%
Philippines	73	3	0.007	0.69	0.77	0.61	0.76	0.62	4.10	4.29	2.79	13.59	1.73%
Poland	67	17	0.014	0.52	0.60	0.40	0.67	0.42	6.08	4.46	20.05	13.00	2.81%
Portugal	85	16	0.012	0.51	0.59	0.38	0.70	0.36	5.92	4.47	6.13	11.65	3.21%
Russian Federation	62	14	0.102	0.59	0.69	0.45	0.73	0.48	5.26	4.40	72.18	13.49	5.54%
Saudi Arabia	106	20	0.009	0.40	0.46	0.29	0.53	0.31	5.94	4.87	10.68	13.95	2.17%
Singapore	683	142	0.025	0.49	0.53	0.41	0.56	0.46	8.85	5.60	1.50	13.54	3.72%
South Africa	581	121	0.022	0.46	0.56	0.37	0.53	0.40	7.60	4.37	10.71	12.44	3.76%
Spain	401	91	0.013	0.50	0.60	0.39	0.60	0.42	5.63	4.62	18.77	13.03	2.66%
Sweden	488	107	0.010	0.48	0.57	0.33	0.66	0.36	6.27	5.50	14.21	11.70	2.63%
Switzerland	635	137	0.014	0.47	0.51	0.41	0.57	0.40	4.01	5.72	919.80	8.98	2.77%
Thailand	82	19	0.013	0.53	0.67	0.33	0.71	0.41	6.88	4.64	13.55	15.52	6.25%
Turkey	1	1	0.005	0.74	0.75	0.66	0.82	0.74	7.00	4.42	25.87	12.17	6.03%
United Arab Emirates	97	26	0.023	0.50	0.56	0.39	0.60	0.44	5.60	5.11	1.23	14.58	3.55%
United Kingdom	222	53	0.050	0.46	0.48	0.38	0.56	0.43	7.94	5.36	4.56	12.20	4.86%
Sample Mean	14187	3128	0.018	0.48	0.55	0.38	0.58	0.40	6.22	5.08	145.56	12.02	3.32%
Sample Median	14187	3128	0.009	0.45	0.53	0.34	0.65	0.36	6.00	5.18	6.26	12.41	2.27%

Table 2: Descriptive Statistics by CEO Network Centrality

	Full Sample				Low Centrality Index			High Centrality Index			Difference	
	N	Mean	Median	Std. Dev.	N	Mean	Median	N	Mean	Median	Mean	Median
Spread	14187	0.018	0.009	0.048	7126	0.020	0.010	7061	0.017	0.009	-0.003***	-0.002***
Central Index	14187	0.477	0.450	0.223	7126	0.292	0.300	7061	0.664	0.645	0.373***	0.345***
Degree	14187	0.545	0.530	0.211	7126	0.387	0.380	7061	0.704	0.710	0.317***	0.330***
Eigen	14187	0.378	0.340	0.231	7126	0.211	0.190	7061	0.547	0.530	0.336***	0.340***
Between	14187	0.583	0.650	0.301	7126	0.358	0.310	7061	0.810	0.850	0.452***	0.540***
Close	14187	0.402	0.360	0.254	7126	0.210	0.200	7061	0.596	0.590	0.386***	0.390***
SIP	14187	6.220	6.000	1.257	7126	6.243	6.000	7061	6.196	6.000	-0.047**	0.000
GCI	14187	5.080	5.177	0.445	7126	5.114	5.181	7061	5.046	5.165	-0.068***	-0.016***
Price	14187	145.561	6.395	6536.889	7126	80.675	5.162	7061	211.045	7.975	130.370	2.813***
Volume	14187	12.016	12.326	2.635	7126	11.303	11.589	7061	12.736	12.997	1.433***	1.409***
σ(Return)	14187	0.033	0.024	0.051	7126	0.037	0.026	7061	0.030	0.022	-0.007***	-0.004***

Table 2 reports descriptive statistics on CEO network centrality, equity liquidity, and firm characteristics for the observations in the sample. The sample consists of all firms with non-missing values covered by Compustat Global daily price data, BoardEx, and the World Bank Global Competitiveness Index data over the period January 1, 2007 through December 31, 2017. The right-hand portion of the table reports the results of differences in means/medians analysis where the sample is divided into two subsamples based on CEO centrality. Specifically, we divide the sample into two groups based on the CEO's value of *Central Index* in a given year, observations where the CEO exhibits a value of *Central Index* above (below) the median are classified as being in the "High Centrality Index" ("Low Centrality Index") subsample. Variable definitions are provided in Appendix A. Statistical significance on differences in means and medians is computed using t-tests for mean estimates and k-sample tests for median estimates. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 3: CEO Network Centrality and Equity Liquidity

Dependent Variable = Spread	(1)	(2)	(3)	(4)	(5)
Central Index	-0.008***				
	(-3.425)				
Degree		-0.010***			
		(-2.791)			
Eigen			-0.007***		
			(-2.940)		
Between				-0.003**	
				(-2.478)	
Close					-0.008***
					(-3.206)
GCI	-0.020	-0.020	-0.019	-0.020	-0.020
	(-1.554)	(-1.567)	(-1.535)	(-1.569)	(-1.555)
Price	-0.000	-0.000	-0.000*	-0.000*	-0.000
	(-1.682)	(-1.516)	(-1.740)	(-1.907)	(-1.468)
Volume	-0.001*	-0.000*	-0.001**	-0.001**	-0.001*
	(-1.971)	(-1.869)	(-2.205)	(-2.413)	(-1.901)
σ(Return)	0.272***	0.270***	0.272***	0.273***	0.272***
	(4.077)	(4.041)	(4.097)	(4.106)	(4.084)
Constant	0.121*	0.123*	0.119*	0.121*	0.120*
	(1.774)	(1.796)	(1.746)	(1.793)	(1.758)
Observations	14,187	14,187	14,187	14,187	14,187
Adj. R^2	0.165	0.165	0.165	0.164	0.165

This table reports coefficient estimates from ordinary-least-squares regression testing on the association between *Spread*, CEO network centrality, and a vector of control variables. *Spread* is computed following the Corwin and Schultz (2012) method using Compustat Global daily price data. All specifications include fixed effects for year, industry, and country as identified by the World Bank and compute robust standard errors clustered by country. *t*-statistics are presented in parentheses below the coefficient estimates. The remaining variable definitions are provided in Appendix A. [*], [**], and [***] indicate statistical significance at the 10%, 5%, and 1%, respectively.

Table 4: CEO Network Centrality, Equity Liquidity, and Shareholder Protections

Dependent Variable = Spread	(1)	(2)	(3)	(4)	(5)
Central Index	-0.013***				
	(-4.794)				
Central Index x Bottom Investor Protections	0.010***				
	(3.464)				
Degree		-0.015***			
		(-3.267)			
Degree x Bottom Investor Protections		0.011**			
		(2.226)			
Eigen			-0.012***		
			(-3.916)		
Eigen x Bottom Investor Protections			0.012***		
			(3.607)		
Between				-0.004***	
				(-2.866)	
Between x Bottom Investor Protections				0.002	
				(1.169)	
Close					-0.013***
					(-4.131)
Close x Bottom Investor Protections					0.010***
					(3.412)
Bottom Investor Protections	-0.003	-0.004	-0.002	0.001	-0.002
	(-1.232)	(-1.208)	(-1.111)	(0.329)	(-0.960)
GCI	-0.019	-0.019	-0.019	-0.020	-0.019
	(-1.546)	(-1.566)	(-1.519)	(-1.578)	(-1.537)
Price	-0.000	-0.000	-0.000*	-0.000*	-0.000
	(-1.560)	(-1.254)	(-1.694)	(-1.852)	(-1.294)
Volume	-0.001**	-0.001*	-0.001**	-0.001**	-0.001**
	(-2.118)	(-2.020)	(-2.357)	(-2.470)	(-2.090)
σ(Return)	0.271***	0.270***	0.272***	0.273***	0.271***
	(4.079)	(4.045)	(4.096)	(4.105)	(4.087)
Constant	0.121*	0.123*	0.118*	0.121*	0.119*
	(1.801)	(1.834)	(1.761)	(1.816)	(1.773)
Observations	14,187	14,187	14,187	14,187	14,187
Adj. R^2	0.166	0.166	0.166	0.164	0.166

Table 4 reports coefficient estimates from ordinary-least-squares regression testing on the association between *Spread*, CEO network centrality, country-level investor protections, and a vector of control variables. *Spread* is computed following the Corwin and Schultz (2012) method using Compustat Global daily price data. *Bottom Investor Protections* indicator variable which takes a value of 1 if a country's strength of investor protections value, as reported by the World Bank, is below the median value of all countries in a given year, and 0 otherwise. All specifications include fixed effects for year, industry, and country as identified by the World Bank and compute robust standard errors clustered by country. *t*-statistics are presented in parentheses below the coefficient estimates. The remaining variable definitions are provided in Appendix A. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Table 5: CFO Network Centrality, Equity Liquidity, and Shareholder Protections

Panel A **Dependent Variable = Spread**	(1)	(2)	(3)	(4)	(5)
Central Index	-0.004*				
	(-2.107)				
Degree		-0.006**			
		(-2.650)			
Eigen			-0.004*		
			(-2.184)		
Between				-0.002	
				(-1.289)	
Close					-0.003
					(-1.578)
GCI	-0.002	-0.002	-0.002	-0.002	-0.002
	(-0.568)	(-0.532)	(-0.551)	(-0.607)	(-0.599)
Price	-0.000	-0.000	-0.000	-0.000	-0.000
	(-1.519)	(-1.477)	(-1.716)	(-1.416)	(-1.651)
Volume	-0.000	-0.000	-0.000	-0.000	-0.000
	(-0.818)	(-0.701)	(-1.015)	(-1.158)	(-0.945)
σ(Return)	0.334***	0.333***	0.334***	0.335***	0.334***
	(3.940)	(3.945)	(3.943)	(3.943)	(3.933)
Constant	0.019	0.019	0.019	0.020	0.019
	(0.982)	(0.975)	(0.955)	(1.015)	(0.993)
Observations	12,788	12,788	12,788	12,788	12,788
Adj. R^2	0.110	0.110	0.109	0.109	0.109

This table reports coefficient estimates from ordinary-least-squares regression testing on the association between *Spread*, CFO network centrality, and a vector of control variables. *Spread* is computed following the Corwin and Schultz (2012) method using Compustat Global daily price data. *Bottom Investor Protections* indicator variable which takes a value of 1 if a country's strength of investor protections value, as reported by the World Bank, is below the median value of all countries in a given year, and 0 otherwise. All specifications include fixed effects for year, industry, and country as identified by the World Bank and compute robust standard errors clustered by country. *t*-statistics are presented in parentheses below the coefficient estimates. The remaining variable definitions are provided in Appendix A. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Table 5: CFO Network Centrality, Equity Liquidity, and Shareholder Protections (Cont.)

Panel B **Dependent Variable = Spread**	(6)	(7)	(8)	(9)	(10)
Central Index	-0.008**				
	(-2.595)				
Central Index x Bottom Investor Protections	0.008**				
	(2.812)				
Degree		-0.009***			
		(-3.429)			
Degree x Bottom Investor Protections		0.008***			
		(3.174)			
Eigen			-0.006*		
			(-2.156)		
Eigen x Bottom Investor Protections			0.004		
			(1.161)		
Between				-0.005**	
				(-2.519)	
Between x Bottom Investor Protections				0.007***	
				(4.238)	
Close					-0.005*
					(-1.822)
Close x Bottom Investor Protections					0.005
					(1.592)
Bottom Investor Protections	-0.002	-0.003	0.000	-0.002	-0.000
	(-1.045)	(-1.415)	(0.166)	(-1.130)	(-0.053)
GCI	-0.001	-0.001	-0.001	-0.001	-0.001
	(-0.311)	(-0.337)	(-0.402)	(-0.351)	(-0.410)
Price	-0.000	-0.000	-0.000	-0.000	-0.000
	(-1.513)	(-1.430)	(-1.738)	(-1.352)	(-1.720)
Volume	-0.000	-0.000	-0.000	-0.000	-0.000
	(-0.908)	(-0.793)	(-1.062)	(-1.248)	(-1.013)
σ(Return)	0.334***	0.332***	0.334***	0.335***	0.334***
	(3.934)	(3.934)	(3.941)	(3.943)	(3.926)
Constant	0.015	0.017	0.016	0.016	0.016
	(0.824)	(0.887)	(0.849)	(0.845)	(0.863)
Observations	12,788	12,788	12,788	12,788	12,788
Adj. R^2	0.110	0.110	0.110	0.110	0.110

Table 6: CEO Turnover and Changes in Equity Liquidity

Dependent Variable = ΔSpread	(1)	(2)	(3)	(4)	(5)
ΔCentral Index	-0.013*				
	(-1.912)				
ΔDegree		-0.019*			
		(-2.481)			
ΔEigen			-0.011*		
			(-2.058)		
ΔBetween				-0.004	
				(-0.714)	
ΔClose					-0.013**
					(-2.822)
ΔGCI	-0.007	-0.008	-0.006	-0.008	-0.006
	(-0.348)	(-0.380)	(-0.300)	(-0.382)	(-0.302)
ΔPrice	0.000	0.000	0.000	0.000	0.000
	(1.632)	(1.588)	(1.827)	(1.598)	(1.593)
ΔVolume	-0.001	-0.001	-0.001	-0.000	-0.001
	(-0.269)	(-0.280)	(-0.295)	(-0.218)	(-0.304)
Δσ(Return)	0.296*	0.293*	0.296*	0.297*	0.295*
	(2.384)	(2.385)	(2.374)	(2.373)	(2.389)
Constant	0.022	0.022	0.022	0.022	0.022
	(1.318)	(1.332)	(1.325)	(1.291)	(1.325)
Observations	942	942	942	942	942
Adj. R^2	0.067	0.069	0.067	0.066	0.068

This table reports coefficient estimates from ordinary-least-squares regression analyses of the changes in CEO centrality measures, the changes in *Spread*, and the changes in a vector of control variables surrounding a CEO turnover. The dependent and independent variables are measured as the year-over-year change in value around a CEO turnover. Each measure is computed as the change from the new CEO's first full year of service less the outgoing CEO's last year in office. All specifications include fixed effects for year, industry, and country as identified by the World Bank and compute robust standard errors clustered by country. *t*-statistics are presented in parentheses below the coefficient estimates. The remaining variable definitions are provided in Appendix A. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, respectively.

Appendix A: Variable Definitions

Variable	Definition
Spread	The annual average of the estimated daily bid-ask spread computed using the daily high and low prices following Corwin and Schultz (2012).
Central Index	The average of four percentile-rank measures of executive centrality: Degree, Eigen, Between, and Close.
Degree	Degree is the percentile rank of the number of direct connections an executive has with others in the network.
Eigen	A percentile rank measure of the visibility of one's connections. Holding degree constant, for example, one is advantageously positioned if his connections are also well positioned and thus would have a higher value of eigen vector centrality.
Between	Betweeness centrality is a percentile rank measure capturing the frequency with which a node (executive) is "between" two other nodes.
Close	A percentile rank measure of the inverse of the mean distance between an executive and all other executives in the network.
SIP	Strength of Investor Protections is one measure computed by the World Bank in their construction of the Global Competitiveness Index. Higher index values reflect stronger investor protections. For more information, see the following: www.worldbank.org
Bottom Investor Protections	An indicator variable which takes a value of 1 if a country's SIP value is below the median value of all countries in a given year, and 0 otherwise.
GCI	Global Competitiveness Index as computed and distributed by The World Bank. The index measures the set of institutions, policies, and factors that determine the level of productivity of a country. For more information, see the following: www.worldbank.org
Price	The annual average of the daily closing price for a security in USD.
Volume	The natural log of the annual average daily trading volume for a given security.
σ(Return)	The standard deviation of the daily closing price returns over a given year.