CEO Social Connection and Bank Systemic Risk*

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Abstract

We find that banks governed by CEOs with more social connections with executives of other banks are exposed more to systemic risk than banks governed by CEOs with fewer social connections. Using connected-CEO death as an exogenous shock to social network, we employ a difference-in-differences model to identify the causal relation between CEO social connection and bank systemic risk. We further document the two mechanisms attributed to this causality. First, we find that banks governed by socially-connected CEOs are more active in inter-bank transactions. Second, a bank-pair with connected CEOs share a higher degree of asset similarity and have a higher correlation in their stock returns than a bank-pair without connected CEOs. Our findings provide new insights into the relation between the social network of bank executives and the financial interconnectedness of the banking sector.

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1 Introduction

Since the financial crisis of 2007 - 2009, the relationship between financial networks and systemic risk has drawn tremendous attentions among academics, policy makers, and practitioners. The crisis has triggered a debate on the role of the financial sector since the widespread failures and losses of financial institutions could impose huge negative externalities on the rest of the economy. The investigation of systemic risk is therefore critical, since the distress of the financial system will affect the capacity of banks to make enough credit available for business activities. In view of this, researchers have devoted substantial effort to measuring the distress of the financial system and develop variety of systemic risk proxies that can give early signals of market failures (e.g., Billio, Getmansky, Lo, and Pelizzon 2012; Adrian and Brunnermeier 2016; Acharya, Pedersen, Philippon, and Richardson 2017; Brownlees and Engle 2017).[1]

The network of the financial system can have a positive effect of diversifying banks' systemic risk exposure, but it can also serve as an important element in the transmission of shocks. Early works by Allen and Gale (2000) and Freixas, Parigi, and Rochet (2000) reveal that network connections enhance the resilience of the financial system to withstand contagion of shocks due to co-insurance mechanism. Hence, systemic stability is achieved in a highly interconnected banking sector. Conversely, Acemoglu, Ozdaglar, and Tahbaz-Salehi (2015) show that in the event of larger shocks, dense interconnections may serve as a mechanism for the propagation of such shocks, leading to a fragile financial system. It is well known that financial institutions are mostly linked to each other either through common asset holdings or balance sheet connections (e.g., Allen and Gale 2000; Acemoglu et al. 2015; Billio et al. 2012; Braverman and Minca 2018). Despite a large amount of research devoted to understanding how bank interconnnectedness contributes to systemic risk, studies on what factors determine this bank interconnectedness is in paucity.

In this paper, rather than emphasizing the financial interconnection of the banking system, we focus on the social connection of bank executives. In particular, we posit that the social connection of bank executives is one of key factors shaping the interconnectedness of the banking system, and attribute to banking sectors' systemic risk. Top executives of large financial insti-

[1] According to Billio, Getmansky, Lo, and Pelizzon (2012), systemic risk involves the financial system, a collection of interconnected institutions that have mutually beneficial business relationships through which illiquidity, insolvency, and losses can quickly propagate during periods of financial distress.

tutions are highly connected with each other through their personal and professional network and occupy central positions in social networks of the corporate elite. Social connection among bank executives enhance information sharing between the connected banks and enable banks to engage in a variety of inter-bank transactions (e.g. Houston, Lee, and Suntheim 2018). Social network plays key role in economic activities by improving information sharing, facilitating resource flow and enhancing inter-firm linkages. For instance, well connected banks will make better decisions and gain more contracts through their social networks. In line with a large amount of sociology literature (e.g., Coleman 1988; Ellison and Fudenberg 1995) and growing empirical evidence documenting the importance of social network in business (Hochberg, Ljungqvist, and Lu 2007; Cohen, Frazzini, and Malloy 2008; Engelberg, Gao, and Parsons 2012; Fracassi and Tate 2012; Faleye, Kovacs, and Venkateswaran 2014), we propose two channels through which social ties attribute to bank systemic risk.

First, the social network among banks' executives enables them to engage in a wide range of inter-bank transactions. The interbank market serves as a platform where liquidity flows from banks with excess liquidity to banks that need liquidity (Acharya, Gromb, and Yorulmazer 2012b). One of the concerns in the interbank market is that the efficient flow of liquidity among banks can be hindered due to certain frictions such as information asymmetry (e.g. Flannery 1996; Freixas and Jorge 2008). Since interbank deposits and loans are not insured and often uncollateralized in the interbank market, banks have a strong incentive to monitor each other (Furfine 2001). The social connections among executives can alleviate the information asymmetry and enhance business transactions (El-Khatib, Fogel, and Jandik 2015). On one hand, well-connected banks that engage in interbank transactions may help provide liquidity, which support other banks in their operations and hence enhance systemic stability. Davydov (2021) reveals that increasing liquidity creation may strengthen the systemic linkage of banks to severe shocks in the financial system. We hypothesize that CEO social connections enhances interbank activities by providing liquidity and hence reduces bank systemic risk. On the other hand, the interbank lending position held by the highly socially connected banks could lead to larger risk concentration among the set of banks that are well-connected to other banks within the banking system. We therefore hypothesize that a stronger CEO social network is positively associated with inter-bank transactions and hence systemic risk.

Second, social connections among executives may result in common asset holdings. One key function of social connections is to facilitate information sharing, which affects decision-making. The information sharing among socially connected CEOs are likely to increase the similarity of their decision-making, leading to a high degree of asset similarity across banks. In his study, Fracassi (2017) shows that the more connections two firms share with each other, the more similar their capital investments are. When socially connected bank pairs have similar asset policies, these paired banks may be exposed to common shocks, which may trigger joint liquidation (e.g., Chu, Deng, and Xia 2019).

Examining the causal relation between CEOs social connection and bank systemic risk is a big challenge because CEOs social network and banks business network interact with each other. For instance, a CEO of a systemically important bank is more easily to extend her social network through business activities. Banks with higher systemic risk may prefer to hire a more connected CEO, since a more connected CEO help the bank to reduce it capital shortfall risk. We take multi-prong methods to overcome this identification challenge. First, we use the historically-determined CEOs social connection as explanatory variable. Specifically, we include the one-year lags of the explanatory variables in all regressions. This allows us to alleviate the reserve causality concern. Second, we include a large amount of control variables to address the omitted variable concern. We control for CEO characteristics such as age and tenure, bank factors such as size and leverage, and include bank fixed effects to control for unobservable time-invariant bank characteristics.

To further sharpen our identification, we use CEO death as an exogenous shocks to the social network within the banking sector and conduct difference-in-differences test (e.g. Bennedsen, Pérez-González, and Wolfenzon 2020; Fracassi and Tate 2012; Fracassi 2017; Salas 2010). In this experiment, we exclude banks with CEO death because these banks are affected by CEO changes. For banks without CEO changes, we classify them into treated banks, whose CEOs were connected with a deceased CEO, and control banks whose CEOs were not connected with any deceased CEO. Since the death of CEO is unpredictable, the treated and control groups are arguably randomly assigned. This diff-in-diff model allows us to estimate the incremental effect of reduced social connection on bank systemic risk. Finally, we estimate instrumental variable two-stage least squares (2SLS) regressions to pin down causal relation between CEO social connection and bank systemic risk. We use three instruments: a two-year lag of CEO social connections, an MBA dummy variable and the death of a connected CEO (e.g., Faleye et al. 2014; Bhandari, Mammadov, Shelton, and Thevenot 2018).

We ensemble a sample of 1,049 unique CEOs at 606 unique U.S. publicly traded banks over the period 2000 to 2018. We use the BoardEx database to measure CEO social connections and network centrality. Using the biographical information of CEOs, we measure CEO employment connections as the total number of other banks' CEOs with whom the CEO shares a common employment history in BoardEx.[2] Following Acharya, Engle, and Richardson (2012a) and Brownlees and Engle (2017), we construct SRISK as our main measure of systemic risk. SRISK measures how much capital a bank needs at the time of a crisis to maintain a given capital adequacy ratio. As an alternative measure of systemic risk, we follow Adrian and Brunnermeier (2016) and construct the change in the conditional value at risk ($\Delta CoVaR$). $\Delta CoVaR$, computed as the difference between the Value at Risk (VaR) of the banking sector conditional on an individual bank being in distress and the VaR of the banking sector conditional on this bank operating in its median state.

Our baseline model show that CEO social connections and network centrality lead to higher systemic risk measured by both SRISK and $\Delta CoVaR$. More specifically, the coefficient of CEO employment connections suggests that a one more increase in CEO employment connections increases SRISK and $\Delta CoVaR$ by 12 and 1.9 percent, respectively. In terms of economic magnitude, a one standard deviation increase in CEO employment connections results in an increase in SRISK by 8.38% of its standard deviation, and an increase in $\Delta CoVaR$ by 2.50% of its standard deviation, respectively. [3]

Using a diff-in-diff model, we further confirm the above findings. We find that banks CEOs affected by the death of a connected CEO reduces their SRISK by 25.5%. In a dynamic diff-in-diff model, we confirm that banks' SRISK begin to reduce period after the death of a connected CEO. Our 2SLS model further provide affirmation to the baseline findings. We find that an increase in CEO employment connections lead to an increase in SRISK and $\Delta CoVaR$ by 11

[2]We employ CEO total connections (connections established through employment, education and social activities) and CEO network centrality as robustness checks. Fracassi (2017) find that current employment and education connections are the most effective in influencing capital expenditure decisions.

[3]Given the standard deviation of CEO Employment connections is 0.812, the standard deviation of SRISK is 1.172, and the coefficient of CEO Employment connections is 0.121, the economic magnitude is computed as 0.121×0.812/0.172= 8.38%. Again, given the standard deviation of $\Delta CoVaR$ is 0.227, and the coefficient of CEO Employment connections is 0.007, the economic magnitude is computed as 0.007×0.812/0.227= 2.50%.

and 1.8 percent, respectively. The results remain similar and valid with several robustness checks including the use of CEO total connections or CEO network centrality, the exclusion of Systemically Important Financial Institutions (SIFI), and a subsample excluding banks which were acquired or bankrupted during sample period.

After establishing the causal relation between the CEO social network and systemic risk, we evaluate the potential channels. As discussed earlier, the first mechanism explored is the inter-bank transaction channel. Ideally, we should collect pair-wised inter-bank transactions and explore the relation between CEO connection and inter-bank transaction. However, data on direct interbank lending between pair of US banks is not publicly available. We hence rely on the bank-reported inter-bank transactions on balance sheet to examine the validation of this conjecture. We focus on three inter-bank transaction activities: interbank loans, interbank deposits and net of interbank loans and deposits. We find that CEO employment connections increases with Interbank loans. Our results further show that banks CEOs with more employment connections have lower deposits from other banks. The net of interbank loans and deposits, which we refer to as Interbank transactions, is defined as the ratio of interbank loans and deposits placed with other financial institutions, net of impairment allowances to total assets. We show that CEO connections is positively related to interbank transactions. This suggests that banks with more-connected CEOs tend to lend more to other banks relative to banks with less-connected CEOs. Using the instrumental variable 2SLS regression, we obtain similar results.

As we discussed earlier, the interbank market can serve as a source of liquidity creation, which may enhance the systemic linkage of banks to severe shocks in the financial system (e.g. Davydov 2021). However, this market could be a potential source of systemic risk in the event of a larger shocks. Previous studies show that in the event of larger shocks densely interconnected financial system may serve as a mechanism for the propagation of shocks. Hence, CEO social network in the interbank market may enhance bank interconnections which can serve as a channel for the propagation of such shocks resulting in systemic risk. In view of this contrasting argument, we examine the effect of interbank transactions on systemic risk. Our results show that interbank transactions is positively and significantly related to both measures of systemic risk.

In order to test the asset similarity channel, we first measure bank-pair CEO connectedness, which is a dummy variable equal to one (1) if a pair of banks is connected and zero (0) otherwise. We use net lending policy (defined as the ratio of net loans to total assets) as a proxy for a bank's asset policy, since lending decisions are crucial to banks and top executives are likely to approve such decisions. We follow the two-stage paired econometric model procedure used in Shue (2013) and Fracassi (2017) to estimate the role of the social network on bank lending similarity. In the first stage, we estimate the excess net lending of each bank. In the second stage, for each pair of banks, we measure the similarity in the excess net lending of the two banks. We then examine the relationship between similarity in net lending and the social network. Our findings show that CEOs that share employment connections have more similar lending policies. Furthermore, we find that socially connected banks have a positive equity return correlation.

This paper relates to two strands of economics and finance literature. First, our paper contributes to the literature on the determinants of systemic risk (Allen and Gale 2000; Freixas et al. 2000; Dasgupta 2004; Billio et al. 2012; Braverman and Minca 2018; Acemoglu et al. 2015; Adrian and Brunnermeier 2016; Laeven, Ratnovski, and Tong 2016; Brownlees and Engle 2017). To the best of our knowledge, this paper is the first to use CEO social network to explore bank systemic risk. We argue that CEO social network shapes bank interconnection which further affect systemic risk. Elliott, Golub, and Jackson (2014) reveal that a financial network generates systemic risk by interacting with a propagation mechanism such as bankruptcy. We add to this literature by showing that the CEO social network plays significant role in explaining banks' systemic risk. We examine this determinant through its effect on interbank transactions and asset similarity. Close to our paper is Houston, Lee, and Suntheim (2018), who find that banks with shared social connections among their board members are more likely to form partnerships in the global syndicated loan market. Our study is also related to Fang, Hasan, Liu, and Wang (2016), who examine how bank CEO connection with top executives and board members of other banks and non-banks firms affect bank risk-taking. Our study differs from Fang et al. (2016) in several ways. First, our measure of CEO connections captures the social connections existing between only CEOs of the connected banks. Using the social connections between the CEOs of the two banks allow us to track the intensity of the connectedness of the CEOs in the

U.S. banking sector. Again, the outcome variables (SRISK and $\Delta CoVaR$) capture both banks' exposure and contribution to systemic risk instead of individual bank risk-taking.

Second, this paper adds to the literature on social networks in finance. Previous studies emphasize how an executive's social network established over time is vital for their employment and can be important in the labor market (Faleye et al. 2014; Liu 2014). Other studies focus on the economic consequences of social networks. For instance, Engelberg, Gao, and Parsons (2013) show that CEOs with more connections earn more than those with fewer connections; Engelberg, Gao, and Parsons (2012) find that the social network between board members of borrowers and banks affect the pricing of bank loan agreements; Cohen, Frazzini, and Malloy (2008) reveal that mutual fund managers undertake larger investment in firms in which they share some form of social connections and perform relatively better on these holdings relative to their non-connected holdings. Other strand of literature focuses on the risk-taking behavior emanating from a social network. In this study, we demonstrate how the social networks among bank CEOs matters for bank policy decisions.

The rest of the paper proceeds as follows. Section 2 presents the sample and data used, Sections 3 presents the methodology and main results, Section 4 presents potential channels through which CEO social connections leads to systemic risk, and Section 5 presents results of additional robustness tests. Section 6 concludes.

2 Sample and Data

We construct a sample of U.S. publicly traded banks and bank holding companies using the Federal Reserve's CRSP-PERMCO linked table that contains 1,410 banks and bank holding companies.[4] We focus on commercial banks and bank holding companies, and this procedure reduces our sample banks to 939. We obtain data on these banks and other variables from several sources. We use the BoardEx database to construct the various measures of CEO connections. The database provides extensive biographical and relationship information of board members and top managers in notable private and public global companies including banks. We obtain accounting information from Bankfocus, Compustat and market information

[4]The New York Fed data set documents historical linkages between regulatory entity codes and Center for Research in Security Prices (CRSP) PERMCOs for publicly traded banks and bank holding companies. Useful for researchers conducting academic research involving commercial banks. For more details on the CRSP-FRB link "Federal Reserve Bank of New York. 2017.CRSP-FRB Link."

from CRSP. We supplement the above-mentioned data with other data from Bloomberg, Federal Reserve Bank, and World Development Indicators (WDI). The BoardEx database has a unique company ID, ticker, ISIN, CIK for all listed firms. We use the bank PERMCOs to obtain their ticker from CRSP and merged these data using ticker. We also confirm the merging with the CIK and manual matching using the bank names. Our final sample consists of 6,957 firm-year observations for 1,049 unique CEOs at 606 unique banks over the period 2000 to 2018.

2.1 Variable Definition

2.1.1 CEO Social Network

Using the biographical information of CEOs of publicly traded banks in U.S., we measure the connections among CEOs of the various banks as the total number of other banks' CEOs with whom a CEO shares common employment, educational or social history in BoardEx. We define three (3) forms of social network that represent the connections among CEOs as follows; CEO Employment Connections, CEO Education Connections, and CEO Social connections. Two CEOs are socially connected through employment networks if they both worked in the same company (private or public) or sit together either in the top management team or on board of directors before or during that year. Two CEOs are socially connected through education if both CEOs attended the same school and graduated within two years of each other. Two CEOs are connected through their social activities if they share same membership in clubs, charities, and non-for-profit organizations. In our main regressions, we focus on CEO employment connections and use the CEO total connections (thus employment, education, and social connections) as robustness check in our additional analysis.

2.1.2 CEO Network Centrality

We also construct series of network centrality measures which includes degree, betweenness, closeness and eigenvector centrality. The centrality measures are such that, they can capture how each CEO is positioned in the whole network and how much information flows through each CEO. We use the CEO employment connections to construct the centrality measures. Considering the CEO employment connections, each year we construct $n * n$ unweighted adjacency matrix (where n is the total number of CEOs in the network) which takes a dummy value one if CEO_i and CEO_j are connected and zero otherwise. Following Hochberg, Ljungqvist, and Lu (2007), Larcker, So, and Wang (2013) and Houston, Lee, and Suntheim (2018), we construct the following four measures of CEO network centrality.

Degree: The degree centrality computes the number of other CEOs in which a CEO_i shares a first-degree connection. Let $D_{i,j}$ denotes that CEO_i and CEO_j are connected. We normalize the degree centrality by dividing it by $n-1$, where n is the total number of CEOs in the network. Formally, degree centrality of CEO_i is defined as

$$Degree_i = \frac{1}{n-1} \sum_{i \neq j} D_{i,j}$$

Closeness: The closeness centrality computes the inverse of the average length of shortest path that two CEOs lies on. Let $L_{i,j}$ indicates the number of steps in the shortest path between CEO_i and CEO_j. Formally, closeness centrality of CEO_i is defined as

$$Closeness_i = \frac{n-1}{\sum_{i \neq j} L_{i,j}}$$

Betweenness: Betweenness centrality captures the frequency in which a given CEO lies on the shortest path between all sets of possible CEO pairs within the sample of networks. This centrality measure determines the extent of the importance of a given node in a whole network. Let $T_{i,j}$ indicates the total number of shortest paths from CEO_i to CEO_j and $T_{i,j}(k)$ is the number of those paths that pass through CEO_k. We use normalized values of the betweenness centrality. Formally, betweenness centrality of CEO_k is defined as

$$Betweenness_k = \sum_{i,j:i \neq j, k \notin i,j} \frac{T_{i,j}(k)/T_{i,j}}{((n-1)*(n-2)/2)}$$

Eigenvector: Eigenvector centrality assigns high values to those CEOs that have many links to other important CEOs that are central within the network system. The eigenvector centrality of a given CEO depends on the centrality of other important CEOs in the network. The computation of eigenvector centrality involves more mathematics and require computation of eigen values. For more details on the computation refer to Bonacich (1987).

2.1.3 Measures of Systemic Risk

We adopt SRISK proposed by Acharya, Engle, and Richardson (2012a) and Brownlees and Engle (2017) and $\Delta CoVaR$ proposed by Adrian and Brunnermeier (2016) as proxies for systemic risk. These measures are used in the literature and are recognized measures of systemic risk (Laeven et al. 2016; Cai, Eidam, Saunders, and Steffen 2018; Houston et al. 2018). The SRISK captures banks' exposure to systemic risk and we focus on this measure as our main measure of systemic risk. SRISK measures how much capital a bank needs at the time of crisis to maintain a given capital adequacy ratio. According to Acharya, Engle, and Richardson (2012a) and Brownlees and Engle (2017), SRISK estimates the capital shortfall of a financial institution conditional on a systemic event. More specifically, SRISK\$ (in terms of dollar value) is defined as

$$\begin{aligned} SRISK\$_{i,t} &= kD_{i,t} - (1-k)\,W_{i,t}\,(1 - LRMES_{i,t}) \\ &= W_{i,t}\,[kLVG_{i,t} + (1-k)\,LRMES_{i,t} - 1] \end{aligned} \tag{1}$$

where $SRISK\$_{i,t}$ is the systemic risk of bank i at time t, k is the prudential capital fraction, $D_{i,t}$ is the book value of debt, $W_{i,t}$ is the market value of equity, $LVG_{i,t}$ denotes the quasi-leverage ratio $(D_{i,t} + W_{i,t})/W_{i,t}$ and $LRMES_{i,t}$ is long run marginal expected shortfall of the firm equity multi-period arithmetic return conditional on the systemic event, that is

$$LRMES_{i,t} = -E_t\left(R_{i,t+1:t+h} | R_{m,t+1:t+h} < C\right) \tag{2}$$

where $R_{i,t+1:t+h}$ is the multi period arithmetic bank return between period $t+1$ and $t+h$, $R_{m,t+1:t+h}$ is the multi period arithmetic market return between period $t+1$ and $t+h$, C is the threshold of the decline in market index. We denote systemic event as $R_{m,t+1:t+h} < C$. Following Acharya, Engle, and Richardson (2012a), we set prudential capital fraction k to 8%, threshold C to -40% and horizon h to six months (that is 180 days). In all of our analysis, SRISK is one plus natural logarithm of $SRISK\$$ (in billions). For banks with negative $SRISK\$$, we change the negative values to zero since negative $SRISK\$$ means the bank is functioning properly with no capital shortfall.

As an alternative measure of systemic risk, we consider $\Delta CoVaR$ which captures banks' contribution to systemic risk. The measure of $\Delta CoVaR$ follows Adrian and Brunnermeier

(2016). $\Delta CoVaR$ as defined earlier is the difference between the VaR of the banking sector conditional on an individual bank being in distress and the VaR of the banking sector conditional on this bank operating in its median state. Formally, the VaR of the banking system conditional upon *bank i* performing at its worst $q\%$ quantile ($CoVaR_q^{system|i}$) is defined as

$$Pr(X^{system} \leq \; CoVaR_q^{system|i} | X^i = VaR_q^i) = q \tag{3}$$

where X^{system} is the asset-level return of the banking system, X^i is the asset-level return of *bank-i* and VaR_q^i is the Value at Risk of *bank-i* at the $q\%$ quantile. Similarly, the VaR of the banking system conditional upon *bank-i* performing at its median state ($CoVaR_q^{system|i,median}$) is defined as

$$Pr(X^{system} \leq \; CoVaR_q^{system|i,median} | X^i = VaR_{median}^i) = q \tag{4}$$

Therefore, *bank-i*'s contribution to systemic risk is defined as

$$\Delta CoVaR_q^i = CoVaR_q^{system|i} - CoVaR_q^{system|i,median} \tag{5}$$

In order to compute $\Delta CoVaR$ over time and capture the variations in the $\Delta CoVaR$, we follow Adrian and Brunnermeier (2016) and control for a number of state variables. The state variables include interest rate risk (proxy for change in the three-month Treasury bill rate), term spread change (measured as yield spread between ten-year Treasury rate and three-month Treasury bill rate), liquidity risk (measured as the difference between the three-month LIBOR rate and the three-month bill rate), default risk (measured as change in the credit spread between Baa-rated corporate bonds and the ten-year Treasury rate), weekly market return computed from the S&P 500 and equity volatility (computed as the 60-day rolling standard deviation of the daily CRSP market value-weighted index return).[5]

Specifically, we use the approach in Adrian and Brunnermeier (2016) and define banking system to be our sample of banks. We then transform book value of total assets into market value using its market-to-book equity ratio. The weekly asset-level returns is computed using

[5] Three-month Treasury bill rate, ten-year Treasury rate is from Federal Reserve Board's H.15 release, three-month LIBOR rate is obtained from Bloomberg, Baa-rated corporate bonds is from Moody's, Moody's Seasoned Baa Corporate Bond Yield [DBAA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DBAA.

estimates of the market-valued total assets. The asset-level return of the banking system is defined as the weighted average of the banks' weekly asset-level returns using their 1-week lagged market-valued total assets as weights. We estimate $\Delta CoVaR$ at the 5% level by running quantile regressions on weekly data for each bank. We predict each bank's VaR at 5% level and at the 50% (median) level using a vector of lagged state variables. The time varying $VaR^i_{5\%}$ and $VaR^i_{50\%}$ are calculated as the fitted values from the quantile regressions. We then estimate the VaR of the banking sector conditional on the same lagged state variables and contemporaneous performance of each individual bank. We use varying $VaR^i_{5\%}$ and $VaR^i_{50\%}$ to calculate $CoVaR^{system|i}_{5\%}$ and $CoVaR^{system|i,median}_{5\%}$. The $\Delta CoVaR^i_{5\%}$ of the individual *bank-i* is the difference between the two $CoVaR$ values. In our empirical analysis, we take the negative value of $\Delta CoVaR$ to translate it into increasing measure of systemic risk.

2.2 Variables and Descriptive Statistics

2.2.1 CEO Connections and CEO-level control variables

Table 1 presents the summary statistics of the variables employed in the study. Specifically, Panel A provides summary statistics of the CEOs, banks, macroeconomic and bank-pair level variables. On average, a CEO has six total connections. Of these, three are from employment, one connection through shared educational histories and two from social clubs or non-for-profit organizations. In addition to the CEO connection measures, we employ the measures of CEO network centrality which include degree, closeness, betweenness, and eigenvector centrality. The degree, closeness, betweenness, and eigenvector centralities have mean values of 0.003, 0.002, 0.003, and 0.024 respectively. The pairwise correlation matrix shows that the correlation among CEO connections and network centrality is positive and significant. The pairwise correlation matrix is reported in Table A1 (refer to Appendix).

[Insert Table 1 about here]

To control for CEO characteristics, our regressions include CEO age, CEO tenure, Chair-CEO and Founder-CEO. We measure CEO age as the chief executive officer's age measured in years, CEO tenure is the number of years for which the CEO has been in office, Chair-CEO is a dummy variable which is equal to 1 if the CEO serves as board chair during his position as

CEO of the bank or 0 otherwise, Founder-CEO is a dummy variable which is equal to 1 if the CEO was a founder or co-founder of the bank or 0 otherwise, and the average CEO age is 57 years and a CEO can serve his or her tenure for an average of 6 years. Previous studies examine CEOs of large public companies and find that on average a CEO's tenure and age are 7 years and 57 years, respectively (Engelberg et al. 2013; Cain and McKeon 2016). On average 42.6% of the CEOs also served as the board's chair and only 9.5% were CEOs and at the same time founders (or co-founder). Faleye, Kovacs, and Venkateswaran (2014) analyze CEOs of firms in S&P 1500 indexes and show that on average 66% of the CEO also serve as board chair while 10% of the CEOs were also founders (or co-founder) of the companies.

2.2.2 Systemic risk, Bank-level, Macroeconomic and State variables

The Panel A of Table 1 reports summary statistics of the two measures of systemic risk. SRISK which measures banks' exposure to systemic risk is one plus natural logarithm of $SRISK\$$. The average value of SRISK is 0.58 and a 75^{th} percentile of 0.68. Higher values of SRISK indicates higher bank exposure to systemic risk. The average $\Delta CoVaR$ for our sample banks is 0.77% which is a little lower than the value 1.17% as reported by Adrian and Brunnermeier (2016). The differences in the mean of $\Delta CoVaR$ may be due to the fact that Adrian and Brunnermeier (2016) employ different sample size and study period (1986Q1 – 2010Q4). Higher values of $\Delta CoVaR$ indicate higher systemic risk contribution. The Value at Risk of a bank, VaR, is obtained by running 5 percent quantile regression of asset level returns on the one-week lag of the state variables and by computing the predicted value of the regression. The VaR is the individual bank risk measure with an average value of -7.13% and standard deviation of 2.23%.

Laeven, Ratnovski, and Tong (2016) argue that larger financial institutions contribute more to systemic risk since they are likely to enjoy Too-big-to-fail subsidies in the event of failure. Adrian and Brunnermeier (2016) reveal that higher leverage, larger size, and higher asset valuation predict higher $\Delta CoVaR$. Therefore, we control for bank characteristics such as bank size, growth opportunities, deposit-to-asset ratio, and leverage. The average bank size which we proxy by total asset for the sample is $US\$34.25$ billion. Market-to-book ratio, which represents growth opportunities, is ratio of market value to book value of equity and has a mean value of 1.46 and standard deviation of 1.13. The deposit-to-asset ratio is the ratio of deposit to total asset and has a mean value of 74.8%. Leverage, which is the ratio of the book value of total asset to the book value of total equity, has a mean value of 10.58. This finding is close to Houston, Lee, and Suntheim (2018) who report average market-to-book ratio and leverage of 1.99 and 21.15 respectively for a sample of 99 largest banks in BoardEx.

In addition, we control for stock return and volatility. Volatility, which is the annualized daily standard deviation of bank equity returns over trading days in the year window has an average value of 2.49% and standard deviation of 1.87%. Return is the annual equity returns with an average value of -0.79%. Interbank transactions, which is the ratio of the ratio of interbank loans and deposits placed with other financial institutions, net of impairment allowances to total assets., has an average value of 2.73% and standard deviation of 4.92%. Interbank loans is the ratio of loans and advances to banks to total assets. Interbank loans has mean value of 4.02% and a 75^{th} percentile of 4.52%. Interbank deposits, which is the ratio of Deposits from banks including funds due/owed to credit institutions to total assets, has average of 3.50% and a 75^{th} percentile of 4.89%. Net lending policy is proxied by the ratio of net loan to total asset ratio. This ratio measures the percentage of bank total assets that is tied up to loans. The higher the ratio the less liquid the bank will be. On the average, the percentage of this ratio is 64.93%. This indicates that a significant proportion of banks asset goes into lending. Loan loss reserves ratio is the ratio of loan loss reserve to total asset and has a mean of 0.95%. Liquidity is proxied by the ratio of liquid assets to deposit and short term funding. Liquidity measures what percentage of customer and short term funds could be met if they were withdrawn suddenly. The higher this percentage the more liquid the bank is and less vulnerable to a classic run on the bank. The mean value of liquidity is 71.06% and a median value of 4.79%. We also provide summary statistics of the macroeconomic variables employed. GDP growth rate has an average value of 2.07%.

Furthermore, investigating the asset similarity channel requires that we employ socially connected bank pairs. This allows us to examine the effect of social neighbouring banks on similar asset structures. Given that there are 606 sample banks, there should be 183,314 unique bank pairs and 3,005,838 pair year observations. However, this sample is reduced after merging since not all banks survived the sample period. After dropping missing observations we have a final observation of 731,249. We report the summary statistics of the bank pair variables. Following the social network index of Fracassi (2017), we constructed a measure of CEO connectedness, which is the connection between two bank pairs, established through common employment history of their CEOs. CEO connectedness measures the social connectivity of two bank pairs through the CEO employment history. The CEO connectedness is a dummy variable which is equal to one if the two banks are connected through common employment history of their CEOs and zero otherwise. CEO connectedness has average of 0.003. The pairwise equity return correlation of two bank pairs has a mean of 0.23 and a 25^{th} percentile of -0.01. Net Lending Dissimilarity is the measure of bank asset policy similarity. The average of net lending dissimilarity is 2.37% and a median of 2.47%.

In the bank pair estimation, we also control for the absolute differences between the bank pairs variables. Specifically, the average of Abs. Diff. Market-to-book, which is the absolute difference between market-to-book ratio of bank pairs has average of 0.63. The Abs. Diff. Bank size is the absolute difference between total assets in natural logarithm of bank pairs and has a mean value of 1.77. The Abs. Diff. Deposit-to-asset is the absolute difference between deposit-to-asset ratio of the pair of banks and has average 12%. The Abs. Diff. leverage is the absolute difference between ratio of the book value of total asset to the book value of total equity of the pair of banks and has an average value of 4.30. We control for stock return and volatility. The mean of absolute difference between volatility and that of stock return are 0.01% and 29.18% respectively.

In Panel B, we present the summary statistics of state variables as described in Adrian and Brunnermeier (2016). The mean of market return is -0.006%. We find that on average equity volatility is 1.05% with standard deviation of 0.44%. The mean of interest rate risk 3.28%. The mean of term spread change is 1.90%. Liquidity risk has an average of 0.44%. The mean of default risk is 0.06% with a standard deviation of 0.75%.

3 Methodology and Main Results

The interconnection of banks within the financial system makes it possible for small shocks to transmit from one bank to the other banks, generating financial fragility. Gai and Kapadia (2010) demonstrate that network can generate systemic risk by facilitating the spread of larger shocks. This study examines how social connections that exist among the CEOs in the banking sector affect systemic risk. To test this hypothesis, we estimate the following baseline model, controlling for lagged value of CEO- and bank- specific characteristics, macroeconomic and state variables.

$$\begin{aligned} SR_{i,t} = \alpha + \beta_0 CEO\ Connections_{i,t-1} + \beta_1 X_{i,t-1} \\ + \beta_2 Y_{i,t-1} + \beta_3 Z_{t-1} + \lambda_i + \delta_t + \varepsilon_{i,t} \end{aligned} \tag{6}$$

where $SR_{i,t}$ is the proxy for systemic risk measure of bank i at year t. We employ SRISK and $\Delta CoVaR$ as measures of systemic risk. CEO connections is one of our CEO social connectiion measures discussed in Section 2.1.1. $X_{i,t-1}$ is a set of CEO level controls. $Y_{i,t-1}$ is a set of bank level controls. Z_{t-1} is the set of macroeconomic and state variables. We include bank fixed effects λ_i and year fixed effects δ_t to control for time-invariant bank level heterogeneity and macroeconomic shocks that affect all banks each year. In all regressions, we cluster the standard errors at the CEO level.

3.1 Endogeneity Issues

A primary concern is whether the regression result is attributable to reverse causality and omitted variable. For example, a bank with higher systemic risk may be more likely to hire a CEO with large network because a well-connected CEO helps the bank reduce the risk of bankruptcy. In this case, the main regression may show a positive relation between systemic risk and CEO connections, even though the later has no causal effect on the former. The type of reverse causality problem has been mitigated in prior studies by regressing the dependent variable on lagged values of the explanatory variables (Faleye 2007; Cheng 2008). In all our regression estimation, we use one-year lagged of the explanatory variables. We further include bank fixed effect in the main model to control for unobservable time-invariant characteristics that may affect systemic risk. Endogeniety issues can also arise from omitted variable problem in which there is unobserved bank characteristics that affect both CEO hiring and the bank's systemic risk. In order to mitigate this concerns, we adopt both instrument variable regressions and a difference-in-differences methods.

3.1.1 Instrumental Variable Regression

We estimate instrumental variable 2SLS regressions to address potential endogeneity arising from unobservable heterogeneity. Our first instrument is two-year lagged of the main independent variable, CEO connections. We use this instrument because our results maybe be influenced by the current position of the CEO rather than the CEO personal connections. The second instrument we identify is the death of a connected CEO and this instrument is also employed in Fracassi and Tate (2012). The death dummy takes a value equal one if CEO is affected by the death of other CEO and zero otherwise. Here, we focus on banks-year when the CEO did not change but her social networks were affected by death of her connected CEOs in other banks. We exclude bank-year observations when the banks' CEOs passed on because these observations are affected by changes of CEO and we aim to catch up the effect of change of CEO connection. Our last instrumental variable is binary variable indicating whether the CEO earned the MBA degree in addition to a degree obtained. Similar instrument is employed in Faleye, Kovacs, and Venkateswaran (2014). For our instrument to be valid, it should satisfy both the relevance and exclusion condition. The basic rule concerning the validity of the instrument chosen here is that the instrument can influence the dependent variables through its effect on the variable that we believe may be endogenous. In the first stage regression, each of the instruments is statistically significant in predicting CEO connections measures. This suggest that the instruments satisfy the relevance requirement and explain CEO social connections measures.

3.1.2 Difference-in-Differences Analysis

We employ a difference-in-differences estimation to further explore the causal relationship between CEO employment connections and systemic risk. The death of a CEO serves as exogenous shock to the social network within the banking sector and this setting allows us to conduct a difference-in-differences analysis. Consider that CEO of bank A has connection with CEO of bank B, then the death of bank B's CEO will affect the social connections of CEO of bank A. However, this death should have no direct impact on the operation of bank A. Again, we exclude banks with passed on CEOs from this analysis because the change of CEOs would have direct impact on banks operation but our purpose is to examine the CEO's connection instead of the change of CEOs. Our analysis compares CEOs whose network were affected by the death of a connected CEO with those unaffected CEOs. There were 52 CEO death recorded over our sample period. We define our treatment group as the bank with CEOs affected by the death of a connected CEO (in other words CEOs who were connected to other CEOs who passed on) and the control group as the CEOs who were not connected to CEOs who passed on. Post is a dummy variable which is equal to one after the death of a connected CEO and zero otherwise. Since the control group has no connection with a CEO that passed on, then the Post for control is zero for all. Hence the interaction of Treatment and Post is the same as Post in our estimation. In our difference-in-differences estimation, we consider 5-year windows before and after the CEO passed on. The number of bank CEOs affected by the death of other CEOs (Treatment group) were 76 (383 bank-year observations) and a control group of 977 CEOs (6314 bank-year observations). The number of control observation is large as compared to that of the treatment group.

Before we estimate the difference-in-differences estimation, we employ the propensity score-matching (PSM). We use propensity score-matching algorithm with 3-nearest neighbor matching based on the banks' total asset and leverage to define the control group of banks with a caliper parameter to be 0.25 standard deviation of the estimated propensity scores(example Rosenbaum and Rubin (1985)). This procedure reduces our observation to 1,336. Using the matching algorithm, we employ in the regression 75 treated CEOs (with 381 bank-year observations) and 492 control CEOs (with 955 bank-year observations).

3.2 CEO Employment Connections and Systemic Risk - Main Results

Table 2 reports the regression results on the effect of CEO Employment connections on banks' systemic risk. In all columns of Panel A, we examine the effect of CEO Employment connections on SRISK, controlling for the set of control variables. All explanatory variables are lagged one year. CEO Employment connections is the natural logarithm of 1 plus the number of other banks' CEO with whom a CEO shares common employment history. Finally, we correct robust standard errors for CEO-level clustering. In column 1, we report the baseline regression that includes CEO connections, CEO characteristics, and year fixed effect to control for common fluctuations in banks' exposure to systemic risk over time effects. Column 1 therefore reports pooled time series cross-section specification (basically, Equation 6 without bank fixed effects). We find a positive and statistically significant relation between CEO Employment connection and SRISK. We provide evidence that CEO Employment connections increases with banks' exposure to systemic risk. The coefficient of CEO-age and tenure is not significant. The coefficient of chair-CEO is positive and statistically significant. The coefficient of Founder-CEO is positive and not significant. In column 2, we include bank fixed effects to control for bank differences in the level of systemic risk. The coefficient of CEO employment connections remains positive and statistically significant. Other findings remain similar.

In column 3 of Panel A, we include other determinants of SRISK as indicated in the literature. The coefficient of CEO employment connections remains positive and significant. The coefficient of CEO age is positive and significant at 10% level. This shows that older CEO reduces bank's exposure to systemic risk. The coefficient of Founder-CEO is positive and significant at 10% level. The coefficient for market-to-book ratio is negative and significant at 10% level. This shows that banks with higher market-to-book value of equity significantly reduces SRISK. We again find that bank size is strongly associated with SRISK with estimated coefficient of 0.495 at 1% statistically significance level. The coefficient of Bank size suggests that an increase in total asset by one percent may increase SRISK by 49.5 percent. This result is consistent with Laeven, Ratnovski, and Tong (2016) who find that bank size is significantly and positively associated with SRISK. The coefficient of deposit-to-asset ratio is positive and insignificant. The coefficient of leverage is negative and not significant.

In column 4 of Panel A, we further control for volatility, returns and GDP growth. The coefficient of CEO employment connections here is 0.12, which is significant at the 5% level. The coefficient of CEO employment connections suggests that a one more increase in CEO employment connections may lead to an increase in SRISK by 12 percent. In terms of economic magnitude, a one standard deviation increase in CEO employment connections results in an increase in SRISK by 8.38% of its standard deviation.Our results reveal that volatility, which is also a measure of bank individual risk, is positively and significantly associated with SRISK. Returns has negative coefficient but not significant. We also find that GDP growth is positively associated with SRISK and statistically significant at 10% level.

[Insert Table 2 about here]

In Panel B of Table 2, we employ the alternative measure of systemic risk, $\Delta CoVaR$. $\Delta CoVaR$ captures banks' contribution to systemic risk. According to Brownlees and Engle (2017), Adrian and Brunnermeier (2016)'s $CoVaR$ links systemic risk contribution of a bank with the increase in VaR of the entire financial system associated with that financial entity being under distressed. Following Adrian and Brunnermeier (2016), who suggest that the variation in $\Delta CoVaR$ is from both the tail dependence and the time variation of the state variables, we include state variables in the regression of $\Delta CoVaR$. All explanatory variables are lagged one year. In column 1 of Panel B, we examine the effect of CEO Employment connections on $\Delta CoVaR$, controlling for the CEO-level control variables, and state variables. In column 1, we do not include bank fixed effects and this allows us to test the cross-sectional effect of CEO Employment connections. We find a positive and statistically significant relation between CEO Employment connection and $\Delta CoVaR$.

In column 2, we include bank fixed effects to control for bank differences in the level of systemic risk. The coefficient of CEO Employment connections in column 2 is 0.019, which is significant at the 1% level. The coefficient of CEO employment connections suggests that one more increase in CEO employment connections may increase $\Delta CoVaR$ by 1.9 percent (approximately 2 percent). In terms of economic magnitude, a one standard deviation increase in CEO employment connections results in an increase in $\Delta CoVaR$ by 2.50% of its standard deviation. The coefficient of CEO-age is negative and statistically significant at 1% level. This shows that as CEO age increases, the bank's contribution to systemic risk is reduced. The coefficient of CEO tenure is positive and statistically significant at 1% level. This suggests that CEOs who have longer years of tenure contribute more to systemic risk. The coefficient of CEO-chair is negative and statistically significant at 1% level. The result shows that CEOs who were board chair reduce $\Delta CoVaR$. The coefficient of Founder-CEO is positive and not significant.

As expected and consistent with previous studies, the coefficient of the VaR is positive and statistically significant at 1% level. VaR measures individual bank risk. This result suggests that higher individual bank risk is associated with higher bank's contribution to systemic risk. The result is consistent with Adrian and Brunnermeier (2016), who find that VaR is positively associated with $\Delta CoVaR$. The coefficient of the state variables is all statistically significant at 1% level. Specifically, market return, market volatility, term spread change, liquidity risk and default risk are significantly and positively associated with $\Delta CoVaR$. The coefficient of Interest rate risk is negative and statistically significant. Banks with higher return significantly reduces $\Delta CoVaR$. In column 3 we control for leverage, deposit-to-asset ratio and market-to-book ratio. We find that leverage is negatively associated with $\Delta CoVaR$ and significant at 1% level. Our findings for leverage is similar with Houston, Lee, and Suntheim (2018). The coefficient of market-to-book ratio is negative and significant at 1% level indicating that banks with higher market-to-book value of equity significantly reduces $\Delta CoVaR$. Our results indicate that market-to-book ratio is a significant determinant of systemic risk. In column 4 of Panel B, we examine other determinants of $\Delta CoVaR$. We find that bank size is strongly associated with $\Delta CoVaR$. The coefficient of Bank size is 0.03, which is significant at the 1% level. Hence large size banks contribute more to systemic risk. This finding is consistent with Adrian and Brunnermeier (2016) who find that financial institution's size is significantly associated with $\Delta CoVaR$. Our result also reveals that volatility is positively and significantly associated with $\Delta CoVaR$.

3.3 CEO Employment Connections and Systemic Risk - 2SLS Results

Panel A of Table 3 reports the 2SLS regression results on the effect of predicted CEO Employment connections (from the first stage of 2SLS) on SRISK. The first stage results on estimating the effect of CEO Employment Connections on SRISK is reported in Panel A of Table A2 (refer to Appendix). The first stage of the 2SLS include the set of controls. The coefficients of the instruments, two-year lagged CEO Employment connections and MBA dummy are positive and statistically significant at 1% and 5% level, respectively. After death dummy is a dummy variable equal to 1 a year after the death of a connected CEO and 0 otherwise. The coefficient of After death dummy is negative and statistically significant. This suggest that the instruments satisfy the relevance condition and predicts CEO Employment connections. In Panel A of Table 3, we examine the effect of predicted CEO Employment connections on SRISK. All explanatory variables are lagged one year. In Column 4 of Panel A, the coefficient of predicted CEO employment connections is 0.11, which is significant at the 5% level. The coefficient of predicted CEO employment connections suggests that one more increase in CEO employment connections may lead to an increase in SRISK by 11 percent. The results are consistent with the regression results in Panel A of Table 2. We perform the under-identification and weak identification tests to check the validity of our instruments. Taking the SRISK model as an example, the results in column 4 of Panel A indicate that these instruments pass both the under-identification test with Kleibergen-Paap rk LM statistic of 160.27 (p-value$<$ 1%) and the weak identification test with Kleibergen-Paap rk Wald F statistic of 546.79. Using the Cragg-Donald Wald F statistic (not reported) in the weak identification test also gives a value much greater than the critical value of 22.30 for the 10% maximal IV size based on Stock and Yogo (2005).

[Insert Table 3 about here]

Panel B of Table 3 reports the 2SLS regression results on the effect of predicted CEO Employment connections (from the first stage of 2SLS) on $\Delta CoVaR$. The first stage results on estimating the effect of CEO Employment Connections on $\Delta CoVaR$ is reported in Panel B of Table A2 (refer to Appendix). The first stage of the 2SLS include the set of controls. The coefficients of the instruments are all positive and statistically significant at 1% level except MBA dummy which is significant at 10% level. In Panel B of Table 3, we examined the effect of predicted CEO Employment connections on $\Delta CoVaR$. All explanatory variables are lagged one year. In column 2 of Panel B, the coefficient of predicted CEO employment connections is 0.018, which is significant at the 1% level. However, the effect of CEO Employment connections on $\Delta CoVaR$ is positive and not significant in columns 3 and 4. The reason may be the effect of bank size, market-to-book ratio and volatility, which are important determinants of systemic risk. Again, we check the validity of the instruments in the $\Delta CoVaR$ model, the results in column 2 of Panel B indicate that these instruments passes both the underidentification test with Kleibergen-Paap rk LM statistic of 162.29 (p-value$<$ 1%) and the weak identification test with Kleibergen-Paap rk Wald F statistic of 561.03. Similarly, Cragg-Donald Wald F statistic (not reported) in the weak identification test gives a value much greater than the critical value of 22.30 for the 10% maximal IV size.

3.4 Difference-in-Differences Estimation - Empirical Results

In Panel A of Table 4, we present the results on difference-in-differences analysis. We examine the effect of the Post (which is the same as interaction of Treatment and Post) on systemic risk using the matched sample. Treatment is a dummy variable which is equal to 1 if a CEO is connected to another CEO who passed on over the sample period and 0 otherwise. Post is a dummy variable which is equal to one after the death of a connected CEO and zero otherwise. Since all the control group has post of zero (0), then the interaction of Treatment and Post is same as Post. All explanatory variables are lagged one year. In all columns, the coefficient of Post is negative and significant at 5% level. The results show that, SRISK is reduced for banks with CEOs affected by the death of a connected CEO. In other words, banks affected by the death of a connected CEO are exposed less to systemic risk. We include the set of all controls and the results remain robust.

[**Insert Table 4 about here**]

An underlying assumption of difference-in-differences estimation is the parallel trend assumption. To test for this, we use the 5-year windows of before and after to estimate Post dummies. We expect that during the pretreatment period, there should be no significant differences between the control and treatment. However, in periods after the death of a connected CEO, we expect a significant effect of the Post on the outcome variable, SRISK. We exclude the bank-year observations when the CEO passed (*i.e.*, Post t=0). In Panel B of Table 4, we estimate the dynamic treatment effects. We provides evidence that, there is no significant differences in trends during the before treatment period. However, SRISK begins to reduce significantly in the first 3-year window after the death of a connected CEO.

4 Potential Channels

We evaluate two potential channels through which CEO connections affect systemic risk. The first channel we examine is the interbank lending channel. As already discussed, the interbank market serves as a platform where liquidity flows from banks with excess liquidity to liquidity needy banks (Acharya et al. 2012b). We expect that personal connections can mitigate the information asymmetry and hence improve lending relationship. To test this hypothesis, we estimate the following model, controlling for lagged values of CEO- and bank-specific characteristics and macroeconomic variable.

$$Interbank\ transactions_{i,t} = \alpha + \beta_0 CEO\ Connections_{i,t-1} + \beta_1 X_{i,t-1} + \beta_2 Y_{i,t-1} + \beta_3 Z_{t-1} + \lambda_i + \varepsilon_{i,t} \quad (7)$$

where $CEO\ Connections_{i,t-1}$ is one of our CEO social connection measures discussed in Section 2.1.1. $Interbank\ transactions_{i,t}$ is the ratio of interbank loans and deposits placed with other financial institutions, net of impairment allowances to total assets. $X_{i,t-1}$ is a set of CEO level control variables. $Y_{i,t-1}$ is a set of bank level control variables. Z_{t-1} is the set of macroeconomic variable. We include bank fixed effects λ_i to control for bank level heterogeneity.

The second channel we investigate is the asset policy similarity channel. We examine if socially connected banks have similarity in lending policy. We follow the two-stage pair model procedure used in Shue (2013) and Fracassi (2017) to estimate the role of social network on bank lending policy.

We begin with the first-stage model, regressing bank i's lending policy decision, Net lending Policy, on the control variables, $X_{i,t}$.

$$Net\ lending\ Policy_{i,t} = \alpha_0 + \alpha_1 X_{i,t} + \delta_t + \gamma_i + \varepsilon_{i,t} \quad (8)$$

$Net\ lending\ Policy_{i,t}$ is proxied by the ratio of net loan to total asset ratio. This measure can be explained as the percentage of bank assets which are tied up to loan. The residual $\varepsilon_{i,t}$ in Equation 8 represents the excess or idiosyncratic component of the policy of bank i at time t, relative to the expected policy according to the standard model. For each pair of bank i and bank j, we define the net lending policy dissimilarity as the absolute value of the difference in their residual:

$$Net\ Lending\ Dissimilarity = |\varepsilon_{i,j,t}| = abs(\varepsilon_{i,t} - \varepsilon_{j,t}) \quad (9)$$

The variable is a proxy for the difference in the loan finance policy decisions of the two banks. The smaller the variable, the more similar the policies of the two banks are with each other.

In the second stage, a gravity model tests how CEO social connectedness affect similarity in lending policy. Gravity models are used when outcomes are affected by the distance between objects, like gravity.

$$\ln(1 + |\varepsilon_{i,j,t}|) = \beta_0 + \beta_1 CEO\ connectedness_{i,j,t-1} + \beta_2 X_{i,j,t-1} + \beta_3 Y_{t-1} + \delta_t + \gamma_{i,j} + \mu_{i,j,t} \tag{10}$$

CEO connectedness is a dummy variable equal to 1 if the two banks are connected through the common employment history of their CEOs and 0 otherwise. $X_{i,j,t-1}$ is the set of bank pairs controls. Y_{t-1} is the macroeconomic variable. We include both year and bank-pair fixed effects. Although in theory, the second stage specification should not need further controls since the determinants of bank policy are controlled in the first stage specification. However, Fracassi (2017) indicates that including additional controls in the second stage is relevant to control for any possible heteroskedasticity in the second moments of the net lending variables across the set of controls that can affect and bias the second stage results.

Furthermore, we expect that having similar asset policies may translate into return correlation. We examine the relationship between CEO connectedness and pairwise return correlation. We test if socially connected banks show higher pairwise correlation in their equity performance. The following model is employed

$$Pair\ ret.\ corr_{i,j,t} = \alpha + \beta_c CEO\ connectedness_{i,j,t-1} + \sum_{k=1}^{n} \beta_k Controls_{i,j,t-1} + \delta_t + \varepsilon_{i,j,t} \tag{11}$$

We follow Houston, Lee, and Suntheim (2018) and compute banks' pairwise equity return correlation, $Pair\ ret.\ corr_{i,j,t}$. CEO connectedness is a dummy variable equal to one if the two banks are connected through the common employment history of their CEOs and zero otherwise. $Controls_{i,j,t-1}$ is the set of bank pairs controls. Following similar estimation in Houston, Lee, and Suntheim (2018), we include year fixed effects δ_t.

4.1 CEO Connections and Interbank Lending results

We examine the effect of CEO Employment connection on a set of Interbank lending activities. Panel A of Table 5 reports the regression results on the effect of CEO Employment connections on measures of Interbank lending activities. All explanatory variables are lagged one year. In columns 1 of Panel A, we examine the effect of CEO Employment connections on Interbank loans. Interbank loans is the ratio of loans and advances to banks to total assets. The coefficient of CEO employment connections is positive and significant. We provide evidence that CEO employment connections increases with Interbank loans. Our findings is consistent with Houston, Lee, and Suntheim (2018), who find that banks with central position in the global banking network lend more to their peer banks. We find that CEO age is positively and significantly related with interbank loan. The coefficient of market-book ratio is negative and significant at 5% level. Our findings reveal that banks with higher deposit-asset ratio increase interbank loans. Higher volatility is associated with interbank loans. We find that the relation between returns and interbank loan is negative and statistically significant. Higher GDP growth leads to lower interbank loans.

In columns 2 of Panel A, we examine the effect of CEO Employment connections on Interbank deposits. Interbank deposits is the ratio of Deposits from banks including funds due/owed to credit institutions to total assets. The coefficient of CEO employment connections is negative and significant. Our results suggest that Banks CEOs with more employment connections have lower deposits from other banks. In other words, banks with fewer employment connections tend to receive more deposit from other banks. Houston, Lee, and Suntheim (2018) find that banks at more peripheral positions in the networks tend to receive deposits from other banks in the global banking system. In columns 3 of Panel A, we examine the effect of CEO Employment connections on Interbank transactions. Interbank transactions is the ratio of interbank loans and deposits placed with other financial institutions, net of impairment allowances to total assets. Here, The coefficient of CEO employment connections is positive but not significant.

In columns 4, 5 and 6, we examine the effect of CEO total connections on measures of Interbank lending activities. The results remains similar and significant. Specifically, in column 6 we find a positive and significant relation between CEO total connections and interbank transaction. The coefficient of CEO Total connections is 0.35 and statistically significant at

1% level. This shows that employment, education, and social connections on average affect Interbank transactions. The coefficient of CEO total connections suggests that one more increase in CEO total connections may lead to an increase Interbank transactions by 0.35 percent. This result implies that banks with CEOs who have more employment, education and social connections with other banks' CEOs lend more to their peer banks relative to banks with CEOs who have few connections. The coefficients of CEO age and CEO tenure are positive and statistically significant. Banks with CEOs who were founder significantly reduce Interbank transactions. The coefficient for market-to-book ratio is negative and significant. The coefficient of deposit-to-asset ratio is positive, which is statistically significant at the 1% level suggesting that banks with higher deposit lend more in the interbank market. Leverage is positively and significantly related to Interbank transactions. We find volatility to be positively associated with Interbank transactions, but returns is not significant. The coefficient of GDP growth is negative and statistically significant.

[**Insert Table 5 about here**]

Our results from the regression in Panel A of Table 5 show a correlation exist between Interbank lending activities and CEO connections. However, these results could be biased due to omitted variables and other endogeneity issues. In addition to this regression, we estimate the instrumental variable 2SLS regression to mitigate possible endogeneity arising from unobservable heterogeneity. The instruments are significant in the first-stage in predicting CEO Employment connections suggesting that the instrument satisfy the relevance condition and explains CEO Employment connections well.

In Panel B of Table 5, we examine the effect of predicted CEO connections (from the first stage of 2SLS regression) on measures of Interbank lending activities. In column 1, the coefficient of predicted CEO employment connections is 0.74 and significant at the 5% level. This result is highly significant relative to the result in the same column of Panel A of Table 5. The result suggests that banks with CEOs who have more employment connections with other banks' CEOs lend more to their peer banks relative to banks with CEOs who have few employment connections. The findings for predicted CEO total connection is significant and consistent. Other control variables remain similar and statistically significant. We conduct the under-identification and weak identification tests to check the validity of our instruments. The results in column 6 of Panel B indicate that this instrument passes both the under-identification test with Kleibergen-Paap rk LM statistic of 120.53 (p-value$<$ 1%) and the weak identification test with Kleibergen-Paap rk Wald F statistic of 386.20.

Interbank market can serve as a source of liquidity for banks. However, this market could be a potential source of systemic risk in the event of counterparties default. In this section, we examine the effect of Interbank transactions on systemic risk. We anticipate that in the event of counterparties default, Interbank transactions may be associated with systemic risk. Panel A of Table A3 (reported in Appendix) presents the regression results on the effect of Interbank transactions on SRISK. All explanatory variables are lagged one year. In all columns, the coefficient of Interbank transactions is positive and statistically significant at 5% level. The coefficient of Interbank transactions suggests that a one-percent increase in Interbank transactions may increase SRISK by 1.4 percent. Panel B of Table A3 (reported in Appendix) presents the regression results on the effect of Interbank transactions on $\Delta CoVaR$. All explanatory variables are lagged one year. In column 1, the coefficient of Interbank transactions is positive and statistically significant at 1% level.

4.2 CEO social Network and Net Lending Similarity results

As discussed earlier, the two-stage pair model procedure is used to estimate the role of social network on bank lending policy. Panel A of Table 6 reports the results of the first-stage of the model. In this stage, we control for several control variables which includes loan loss reserve ratio, deposit-to-asset ratio, bank size, leverage, market-to-book ratio. All explanatory variables are lagged one year. We also include year fixed effects to control for common fluctuations in net loan over time, bank fixed effects to control for bank differences in the level of net lending. Finally, we correct robust standard errors for bank-level clustering. Our results show that banks loan loss reserve ratio is positively related to net lending. The coefficient of loan loss reserve ratio is 1.85, which is significant at 5% level. Our results show that market-to-book ratio and Bank size are not significantly associated with Net lending. We also find that the higher the deposit-to-asset ratio of a bank, the higher the net lending. The coefficient of bank leverage is -0.36, which is significant at 1% level. The coefficient of leverage show banks with higher leverage reduces their lending. The coefficient of liquidity is not significant.

[Insert Table 6 about here]

Next, we examine whether social ties between bank-pairs affect similarity of net lending. Panel B of Table 6 shows the results of the second stage of the pair model. The main explanatory variable here is CEO connectedness which measure the social ties between two banks. All explanatory variables are lagged one year. We also include year fixed effects to control for common fluctuations in similarities in net lending over time, bank pair fixed effects to control for bank differences in the level of net lending similarity. Finally, we correct robust standard errors for bank pairs level clustering. In column 1 of Panel B, the coefficient of CEO connectedness is -0.09, which is significant at 5% level. The coefficient of CEO connectedness indicates that two banks connected through their CEO social tie have similar net lending policy. The results remain similar after controlling for bank size, volatility, returns and GDP growth. The set of controls are significantly associated with similarity in net lending.

4.3 CEO connectedness and pairwise return correlation results

We estimate the relation between CEO connectednes and pairwise equity return correlation. Using a pooled OLS specification with time fixed effects, we estimate the effect of CEO connectedness. Table 7 reports the regression of the effect of CEO connectedness on equity return correlation. CEO connectedness is a dummy variable equal to 1 if the two banks are connected through the common employment history of their CEOs and 0 otherwise. In all columns of Table 7, we examine the effect of social connections on equity return correlation. All explanatory variables are one year lagged. We also include year fixed effects to control for common fluctuations in similarities in equity return correlation over time. Finally, we correct robust standard errors for bank pair level clustering. We show that socially connected banks have higher equity return correlation. In column 1 of Table 7, the coefficient of CEO connectedness is 0.08 and significant at 1% level. In column 2 and 3 of Table 7, we control for several controls and the results remain similar and statistically significant. The coefficients of the controls are statistically significant. Specifically, the higher the absolute difference in bank size of bank pairs the lower the equity return correlation.

[Insert Table 7 about here]

5 Additional Robustness Checks

5.1 CEO Total Connections and Systemic risk: Non-SIFI, Survived Banks

We conduct an additional robustness check using CEO total connections. CEO total connections is the natural logarithm of 1 plus the number of other banks' CEOs with whom the CEO shares common education, employment history and social activity in BoardEx.

[Insert Table 8 about here]

Table 8 reports the regression results on the effect of CEO total connections on banks' systemic risk. In column 1 of Panel A, we examine the effect of CEO total connections on SRISK, controlling for the set of control variables. All control variables are lagged one year. We also include year fixed effects to control for common fluctuations in banks' contribution to systemic risk over time, bank fixed effects to control for bank differences in the level of systemic risk contribution. Finally, we correct robust standard errors for CEO-level clustering. Our results reveal that CEO Total connections increases with SRISK. In column 1 of Panel A, the coefficient of CEO total connections is positive and significant at the 10% level. In column 1, the coefficient of CEO total connections suggests that one more increase in CEO total connections may lead to an increase in SRISK by 6 percent, which is statistically similar to the baseline results in Panel A of Table 2. We also examine other determinants of systemic risk and the results remain robust.

Our main result is likely to be influenced by large banks within the sample. These banks because of their size and complexity are systemically important in the financial system. According to the Financial Stability Board (FSB), systemically important financial institutions (SIFI) are financial institutions whose distress, because of their size, complexity, and systemic interconnectedness would cause disruption to the financial system. Due to the complexity and size of such banks, we exclude them from our sample and re-estimate the baseline regression. These banks include JP Morgan Chase, Citigroup, Bank of America, Goldman Sachs, Wells Fargo, Bank of New York Mellon, Morgan Stanley and State Street. In column 2 of Panel A, we examine the effect of CEO employment connections on SRISK for non-SIFI banks. Our finding remains similar and statistically significant. We thus provide evidence that CEO Employment connections is positively associated with bank's systemic risk.

Our main result is again likely to be influenced by banks with different sample period in our data. We obtain a balanced panel by using all the banks that survived during the whole sample period. We conduct additional test using these banks over the sample period. The number of banks that survived within the whole sample period (2000 to 2018) were 127. In column 3 of Panel A, we examine the effect of CEO employment connections on SRISK. Our finding remains similar and statistically significant.

In Panel B of Table 8, we examine the effect of CEO total connections on $\Delta CoVaR$, controlling for the set of control variables. In column 1 of Panel B, the coefficient of CEO total connections is positive but not significant. The control variable remains similar and statistically significant. In column 2 of Panel B, we exclude SIFI and examine the effect of CEO employment connections on $\Delta CoVaR$. We find significant and positive relationship between CEO employment connections and $\Delta CoVaR$. In column 3 of Panel B, we employ banks that survived over the whole sample period. We find that CEO Employment connection is positively and significantly related to $\Delta CoVaR$.

5.2 CEO Network Centrality and Systemic Risk

In this section, we introduce the series of CEO network centrality measures which include degree, betweenness, eigenvector, closeness, and principal component score. The centrality measures capture how each CEO is positioned in the banking network, and how much information flows through each CEO. Each of these centrality measures is captured using the employment connections.

Panels A and B of Table 9 reports the regression results on the effect of CEO network centrality on banks' systemic risk. In Panel A of Table 9, we examine the effect of CEO network centrality on SRISK. CEO network centrality is measured by degree in column 1, closeness in column 2, betweenness in column 3, eigenvector in column 4, and first principal component score in column 5. All explanatory variables are lagged one year. We also include year fixed effects to control for common fluctuations in banks' systemic risk over time, bank fixed effects to control for bank differences in the level of systemic risk. Finally, we correct robust standard errors for CEO-level clustering. Our results show that CEO centrality is positive and statistically significant in all columns except closeness and eigenvector in columns 2 and 4. Our results reveal that CEO centrality is positively associated with SRISK. Thus, more central banks have high exposure to systemic risk. For instance, the coefficient of first principal component of centralities is 0.064, which is significant at the 5% level. The coefficient of the first principal component of centralities suggests that a one-percent increase in CEO centrality may increase SRISK by 6.4 percent. In addition, the positive and statistically significant coefficient of the first principal component of centralities in column 5 suggest that the four centrality dimensions plays a substantial joint common effect on banks' exposure to systemic risk. The set of the control variables are similar and consistent but not reported.

[**Insert Table 9 about here**]

In Panel B of Table 9, we examine the effect of CEO network centrality on $\Delta CoVaR$. Our results show that CEO centrality is positive and statistically significant in all columns except for degree and eigenvector in columns 1 and 4. Our result confirms that CEO centrality is positively associated with banks' contribution systemic risk. The coefficient of the first principal component of centralities is 0.005, which is significant at the 1% level. The coefficient of the first principal component of centralities suggests that a one-percent increase in CEO centrality may increase $\Delta CoVaR$ by 0.5 percent. Again, the positive and statistically significant coefficient of the first principal component of centralities in column 5 suggest that the four centrality dimensions plays a substantial joint common effect on banks' contribution to systemic risk. The set of the control variables are similar and consistent but not reported.

5.3 CEO Network Centrality and Systemic Risk - 2SLS Results

Using the same instruments as discussed above we report the 2SLS regression results on the effect of predicted CEO network centrality measures (from the first stage regression) on systemic risk. Panel C of Table 9 reports the 2SLS regression results on the effect of predicted CEO network centrality measures on SRISK. Our results show that the coefficients of predicted CEO network centralities are positive and statistically significant for all measures of CEO network centrality except eigenvector. GDP growth is omitted because of high collinearity with year fixed effects. The results remain similar after including GDP growth and excluding year fixed effects, but not reported. Panel D of Table 9 reports the 2SLS regression results on the effect of predicted CEO network centrality measures on $\Delta CoVaR$. Our results show that CEO network centrality measures are positive and statistically significant except for the coefficient of predicted degree and eigenvector.

6 Conclusion

The social network among banks' top management and executives plays key role in business transactions and other economic activities. CEOs establish social network mostly through their employment, social activities, and educational background. In this study, we examine the effect of CEO social network on banks' systemic risk. Specifically, we examine whether the CEO employment connections in the U.S. banking sector affect banks' exposure and contribution to systemic risk. We conduct analysis using a sample of sample of 1,049 unique CEOs at 606 unique U.S. publicly traded banks over the period 2000 to 2018. Our results suggest that CEO employment connections in the banking sector is an important determining factor of banks' systemic risk. Our study provide evidence that banks' exposure and contribution to systemic risk increases with CEO social network. We further show that CEO network centrality measures are significantly and positively associated with systemic risk.

Furthermore, we examine the channels through which CEO social network affect banks' systemic risk. The first channel identified is the interbank lending channel. We examine how social network among CEOs in the banking sector serve as important tool in the interbank market. The interbank market is an informal market that enables banks to borrow funds from and/or lend funds to other banks and so serve as a platform for financial intermediation. We provide evidence that banks whose CEOs have more connections lend more in the interbank market. In some instance, CEO social network is a valuable tool in the interbank market by alleviating the information asymmetry and enhancing lending relationship. This same social network connections can lead to spread of shock to the banking system in the event of financial crisis. This is evident in the positive relationship between interbank lending and banks' systemic risk. Moreover, we show that banks that are socially connected through their CEOs have similarity in lending policy and positive equity return correlation. Therefore, social network facilitates information sharing among connected CEOs and in turn leads to asset similarity across connected banks. This similarity of asset holding across banks is a channel raising systemic risk of bank sectors.

From a policy perspective, our findings provide important additional information on the driving forces of systemic risk to policy makers who are in charged with the regulation of the U.S. banking sector. Based on our findings, policy makers may want to have concrete understanding of the social networks across the U.S. banks formed through the key executives and decision makers. Regulators may also focus on banks whose CEOs have large network since these banks are exposed and contribute largely to systemic risk.

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Table 1. Summary Statistics

This Table reports the summary statistics of the variables. CEO Employment connections is the number of other banks' CEOs with whom a CEO shares common employment history. CEO Education connections is the number of other banks' CEOs with whom a CEO attended the same school and graduated within two years of each other. CEO Social connections is the number of other banks' CEOs with who a CEO shares membership in clubs, charities and other non-for-profit organizations. CEO Total connections is the sum of the CEO Employment connections, CEO Education connections, and CEO social connections. Degree, Closeness, Betweeness, and Eigenvector are the measures of CEO network centrality and are defined in Section 2.1.2. Panel A provide the summary statistics of CEO, bank, macroeconomic and bank-pair variables and Panel B provides that of state variables. SRISK and $\Delta CoVaR$ are proxies for systemic risk of a bank and are defined in Section 2.1.3. All variables are defined in Table A4 (reported in Appendix).

Panel A: CEO, Bank, macroeconomic and Bank-pair variables

Variables	N	Mean	STD	25^{th} Pctl.	50^{th} Pctl.	75^{th} Pctl.
CEO						
CEO Employment Connections	6,957	2.990	3.770	1	2	4
CEO Education Connections	6,957	0.414	0.894	0	0	0
CEO Social Connections	6,957	1.813	5.528	0	0	1
CEO Total Connections	6,957	5.217	7.536	1	3	6
Degree	6,957	0.003	0.004	0.001	0.002	0.004
Closeness	6,957	0.002	0.001	0.001	0.001	0.003
Betweenness	6,957	0.003	0.006	0	0	0.002
Eigenvector	6,957	0.024	0.101	0	0	0.004
CEO age	6,902	56.83	7.164	52	57	61
CEO tenure	6,957	6.227	4.151	3	5	9
Chair-CEO	6,957	0.426	0.495	0	0	1
Founder-CEO	6,957	0.095	0.294	0	0	0
Bank						
SRISK	6,957	0.583	1.172	0	0	0.680
$\Delta CoVaR$	6,947	0.770	0.227	0.625	0.691	0.845
VaR	6,947	-7.132	2.229	-7.837	-6.317	-5.662
Bank size	6,942	34.246	191.692	0.756	1.694	5.499
Market-book ratio	6,941	1.457	1.134	0.982	1.335	1.821
Deposit-asset ratio	6,941	0.748	0.133	0.708	0.779	0.825
Leverage	6,942	10.579	37.484	8.708	10.369	12.310
Volatility	6,957	2.485	1.868	1.480	1.887	2.760
Returns	6,920	-0.786	40.720	-14.775	3.172	19.946
Interbank transactions	4,028	2.731	4.921	0.098	0.786	3.130
Interbank loans	3,755	4.022	6.910	0.403	1.558	4.523
Interbank deposits	3720	3.507	4.995	0.286	2.042	4.893
Net Lending policy	4,277	64.927	14.659	59.490	67.490	74.390
Loan loss reserve ratio	4,277	0.945	0.535	0.653	0.854	1.098
Liquidity	4,259	71.064	3279.23	2.970	4.790	8.620
Macroeconomic						
GDP growth	19	2.067	1.495	1.567	2.25	2.861

Table 1. continued

Variables	N	Mean	STD	25^{th} Pctl.	50^{th} Pctl.	75^{th} Pctl.
Bank- Pair level						
CEO connectedness	731,249	0.003	0.053	0	0	0
Pairwise return correlation	731,249	0.229	0.342	-0.013	0.245	0.492
Net Lending Dissimilarity	402,866	2.374	0.904	1.792	2.471	3.029
Abs. Diff Market-to-book	730,433	0.633	1.440	0.193	0.423	0.78
Abs. Diff Bank Size	731,249	1.771	1.636	0.572	1.274	2.441
Abs. Diff Deposit-to-asset	731,249	0.121	0.147	0.036	0.078	0.145
Abs. Diff Leverage	731,249	4.301	30.035	1.105	2.374	4.243
Abs. Diff Volatility	731,249	0.010	0.016	0.002	0.005	0.011
Abs. Diff return	703,422	29.184	34.378	8.792	19.332	36.549

Panel B: Summary Statistics of state variables

Variables	N	Mean	STD	25^{th} Pctl.	50^{th} Pctl.	75^{th} Pctl.
Market return	19	-0.006	0.195	-0.067	0.033	0.129
Equity volatility	19	1.048	0.443	0.710	0.872	1.416
Interest rate risk	19	3.276	5.439	0.221	1.692	3.571
Term spread change	19	1.895	1.010	1.141	2.091	2.896
Liquidity risk	19	0.437	0.322	0.209	0.343	0.476
Default risk	19	0.061	0.754	-0.422	-0.022	0.511

Table 2. CEO Employment Connections and Systemic Risks

This table reports the effect of CEO Employment connections on banks' systemic risk. The dependent variables are SRISK and $\Delta CoVaR$. The main explanatory variable is CEO Employment connections. CEO Employment connections is the natural logarithm of 1 plus the number of other banks' CEOs with whom the CEO shares common employment history. All other explanatory variables are defined in Table A4 (reported in Appendix). All explanatory variables are lagged one year. Robust standard errors clustered at CEO level and are shown in brackets. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

Panel A: CEO Employment Connections and SRISK

	SRISK			
Variables	(1)	(2)	(3)	(4)
CEO Employment Connections	0.250***	0.211***	0.126**	0.121**
	(0.060)	(0.071)	(0.054)	(0.054)
CEO age	0.101	-0.296	-0.434*	-0.469**
	(0.242)	(0.259)	(0.224)	(0.228)
CEO tenure	-0.001	-0.014	-0.017	-0.006
	(0.036)	(0.038)	(0.035)	(0.036)
Chair-CEO	0.103**	0.017	0.020	0.016
	(0.048)	(0.053)	(0.047)	(0.046)
Founder-CEO	0.183	0.262	0.268*	0.292*
	(0.134)	(0.167)	(0.161)	(0.163)
Market-book ratio			-0.122*	-0.116*
			(0.064)	(0.065)
Bank size			0.495***	0.496***
			(0.073)	(0.073)
Deposit-asset ratio			0.348	0.298
			(0.355)	(0.359)
Leverage			-0.000	-0.003
			(0.003)	(0.002)
Volatility				0.041***
				(0.009)
Returns				-0.000
				(0.000)
GDP growth				0.154*
				(0.079)
Number of CEOs	909	909	909	907
Bank FE	NO	YES	YES	YES
Year FE	YES	YES	YES	YES
N	5,841	5,841	5,841	5,820
R^2/Within - R^2	0.256	0.261	0.306	0.313

Panel B: CEO Employment Connections and $\Delta CoVaR$

	$\Delta CoVaR$			
Variables	(1)	(2)	(3)	(4)
CEO Employment Connections	0.010***	0.019***	0.007**	0.004
	(0.001)	(0.004)	(0.003)	(0.003)
CEO age	0.005	-0.128***	-0.124***	-0.125***
	(0.011)	(0.022)	(0.020)	(0.020)
CEO tenure	0.036***	0.061***	0.048***	0.045***
	(0.002)	(0.004)	(0.003)	(0.003)
Chair-CEO	-0.015***	-0.026***	-0.017***	-0.015***
	(0.003)	(0.006)	(0.005)	(0.005)
Founder-CEO	-0.001	0.004	0.009	0.010
	(0.004)	(0.010)	(0.008)	(0.008)
VaR	1.568***	1.577***	1.685***	1.702***
	(0.047)	(0.047)	(0.046)	(0.046)
Market return	0.507***	0.471***	0.456***	0.453***
	(0.008)	(0.009)	(0.009)	(0.009)
Market volatility	4.209***	4.253***	4.496***	4.540***
	(0.124)	(0.123)	(0.119)	(0.120)
Interest rate risk	-0.022***	-0.025***	-0.025***	-0.026***
	(0.000)	(0.000)	(0.000)	(0.000)
Term spread change	1.260***	1.265***	1.354***	1.367***
	(0.036)	(0.036)	(0.036)	(0.036)
Liquidity risk	6.396***	6.413***	6.843***	6.901***
	(0.175)	(0.174)	(0.172)	(0.173)
Default risk	0.152***	0.159***	0.151***	0.154***
	(0.003)	(0.004)	(0.004)	(0.004)
Returns	-0.000***	-0.000***	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Leverage			-0.000	-0.000
			(0.000)	(0.000)
Deposit-asset ratio			-0.013	-0.019
			(0.030)	(0.028)
Market-book ratio			-0.056***	-0.054***
			(0.005)	(0.005)
Bank size				0.016***
				(0.004)
Volatility				0.003***
				(0.001)
Number of CEOs	905	905	905	905
Bank FE	NO	YES	YES	YES
N	5810	5,810	5,810	5,810
R^2/Within - R^2	0.794	0.801	0.812	0.812

Table 3. CEO Employment Connections and Systemic Risk: 2SLS Results

This table reports the second stage results from the 2SLS regression on how CEO employment connections affect systemic risk. The dependent variables are SRISK and $\Delta CoVaR$ in Panel A and B, respectively. In Panel A and B, the main explanatory variable is predicted CEO Employment connections obtained from the first stage results (as reported in Panel A and B of Appendix Table A2) of the 2SLS regression using the instruments; two-year lagged CEO Employment connections, MBA dummy, and after death dummy. All other explanatory variables are defined in Table A4 (reported in Appendix). All explanatory variables are lagged one year. GDP growth is highly collinear with year fixed effects so we do not include year fixed effects in column 3 of Panel A. The results remain the same if GDP growth is omitted and year fixed effects is controlled, but not reported. Robust standard errors clustered at CEO level and are shown in brackets. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

Panel A: CEO Employment Connection and SRISK - 2SLS results

	SRISK			
Variables	(1)	(2)	(3)	(4)
Predicted CEO Employ Con	0.317***	0.185***	0.113**	0.106**
	(0.066)	(0.064)	(0.053)	(0.053)
CEO age	-0.114	-0.478*	-0.323	-0.309
	(0.228)	(0.274)	(0.247)	(0.246)
CEO tenure	-0.165**	-0.016	-0.064	-0.059
	(0.069)	(0.045)	(0.043)	(0.043)
Chair-CEO	0.532***	0.075	0.064	0.067
	(0.086)	(0.057)	(0.052)	(0.051)
Founder-CEO	0.175	0.079	0.066	0.030
	(0.165)	(0.231)	(0.184)	(0.183)
Market-book ratio			-0.145*	-0.138
			(0.086)	(0.087)
Bank size			0.582***	0.600***
			(0.080)	(0.081)
Deposit-asset ratio			0.579	0.533
			(0.369)	(0.375)
Leverage			0.001	-0.004
			(0.003)	(0.003)
Volatility				0.058***
				(0.011)
Returns				0.000
				(0.000)
Kleibergen-Paap rk LM statistic	255.59	152.17	160.3	160.27
Kleibergen-Paap rk Wald F statistic	8430.37	580.23	549.95	546.79
Number of CEOs	730	730	730	730
Bank FE	NO	YES	YES	YES
Year FE	YES	YES	YES	YES
N	4722	4722	4722	4722

Panel B: CEO Employment Connection and $\Delta CoVaR$: 2SLS results

	$\Delta CoVaR$			
Variables	(1)	(2)	(3)	(4)
Predicted CEO Employment Con.	0.007***	0.018***	0.004	0.001
	(0.001)	(0.004)	(0.004)	(0.004)
CEO age	0.017*	-0.050**	-0.029	-0.022
	(0.009)	(0.022)	(0.021)	(0.020)
CEO tenure	0.024***	0.040***	0.022***	0.018***
	(0.002)	(0.004)	(0.004)	(0.004)
Chair-CEO	-0.011***	-0.028***	-0.017***	-0.015***
	(0.002)	(0.005)	(0.005)	(0.005)
Founder-CEO	0.001	0.013	0.014*	0.011
	(0.003)	(0.010)	(0.008)	(0.007)
VaR	0.521***	0.614***	0.781***	0.787***
	(0.051)	(0.056)	(0.054)	(0.054)
Market return	0.448***	0.421***	0.412***	0.410***
	(0.005)	(0.005)	(0.005)	(0.005)
Market volatility	1.581***	1.828***	2.219***	2.234***
	(0.134)	(0.147)	(0.140)	(0.141)
Interest rate risk	-0.027***	-0.029***	-0.029***	-0.030***
	(0.000)	(0.000)	(0.000)	(0.000)
Term spread change	0.407***	0.481***	0.618***	0.623***
	(0.039)	(0.043)	(0.042)	(0.042)
Liquidity risk	2.416***	2.755***	3.416***	3.435***
	(0.190)	(0.210)	(0.203)	(0.205)
Default risk	0.219***	0.219***	0.207***	0.209***
	(0.004)	(0.004)	(0.004)	(0.004)
Returns	0.000	-0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Leverage			-0.000	-0.000
			(0.000)	(0.001)
Deposit-asset ratio			0.036	0.029
			(0.027)	(0.026)
Market-book ratio			-0.056***	-0.053***
			(0.004)	(0.004)
Bank size				0.015***
				(0.004)
Volatility				0.003**
				(0.001)
Kleibergen-Paap rk LM statistic	264.4	145.37	152.42	162.29
Kleibergen-Paap rk Wald F statistic	8940.2	674.09	646.5	561.03
Number of CEOs	730	730	730	730
Bank FE	NO	YES	YES	YES
N	4715	4715	4715	4715

Table 4. Difference-in-Differences Analysis

This table reports the regression results of the difference-in-differences estimation and the dynamic treatment effect. The dependent variable is SRISK. Panel A reports the results on difference-in-differences estimation. Treatment is banks' CEOs who are connected to another CEO who passed on and control group are those without connection. Post is a dummy variable which is equal to one for years after the death of a connected CEO and zero otherwise. We consider 5-year window before and after the death of a connected CEO. Here the interaction of Treatment and Post is the same as Post. In Panel B, we test for dynamic treatment effects using the post dummies. All other explanatory variables are defined in Table A4 (reported in Appendix). All explanatory variables are lagged one year. Robust standard errors clustered at CEO level and are shown in brackets. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

Panel A: Difference-in-Differences estimation results

	SRISK	
Variables	(1)	(2)
Post	-0.262**	-0.255**
	(0.121)	(0.123)
CEO age	-0.419	-0.413
	(1.036)	(1.036)
CEO tenure	0.163	0.172
	(0.174)	(0.174)
Chair-CEO	-0.264	-0.267
	(0.201)	(0.197)
Founder-CEO	0.320	0.336
	(0.504)	(0.518)
Market-book ratio	-0.398	-0.442
	(0.324)	(0.370)
Bank size	0.062	0.080
	(0.513)	(0.504)
Deposit-asset ratio	1.631	1.538
	(1.081)	(1.096)
Leverage	-0.036	-0.039
	(0.039)	(0.037)
Volatility		0.025
		(0.067)
Returns		0.002
		(0.002)
GDP growth		-0.185
		(0.475)
Number of CEOs	189	189
Bank FE	YES	YES
Year FE	YES	YES
N	514	514
Within - R^2	0.299	0.306

Panel B: SRISK: Dynamic treatment effects

Variables	(1)	(2)
Post(t-5)	-0.256	-0.258
	(0.241)	(0.248)
Post(t-4)	0.074	0.086
	(0.230)	(0.229)
Post(t-3)	0.033	0.040
	(0.212)	(0.211)
Post(t-2)	-0.238	-0.228
	(0.238)	(0.234)
Post(t-1)	-0.142	-0.128
	(0.190)	(0.188)
Post(t+1)	-0.381*	-0.365*
	(0.202)	(0.201)
Post(t+2)	-0.322*	-0.306*
	(0.175)	(0.173)
Post(t+3)	-0.345**	-0.337**
	(0.167)	(0.157)
Post(t+4)	-0.080	-0.065
	(0.185)	(0.185)
Post(t+5)	0.032	0.032
	(0.198)	(0.196)
CEO age	-0.394	-0.382
	(1.087)	(1.087)
CEO tenure	0.222	0.228
	(0.185)	(0.185)
Chair-CEO	-0.296	-0.299
	(0.200)	(0.198)
Founder-CEO	0.307	0.320
	(0.506)	(0.520)
Market-book ratio	-0.437	-0.475
	(0.337)	(0.382)
Bank size	0.083	0.098
	(0.507)	(0.501)
Deposit-asset ratio	1.526	1.454
	(0.998)	(1.004)
Leverage	-0.026	-0.030
	(0.037)	(0.036)
Volatility		0.022
		(0.064)
Returns		0.002
		(0.002)
GDP growth		-0.080
		(0.473)
Number of CEOs	189	189
Bank FE	YES	YES
Year FE	YES	YES
N	514	514
Within - R^2	0.327	0.333

Table 5. CEO Connections and Interbank Lending

This table reports the regression results of the effect of CEO employment connections on Interbank transactions. In Panel A, the dependent variable is Interbank transactions. The main explanatory variable is CEO Employment connections. CEO Employment connections is the natural logarithm of 1 plus the number of other banks' CEOs with whom the CEO shares common employment history in BoardEx. Panel B reports the second stage from 2SLS regression on how CEO employment connections affect Interbank transactions. All other explanatory variables are defined in Table A4 (reported in Appendix). All explanatory variables are lagged one year. Robust standard errors clustered at CEO level and are shown in brackets. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

Panel A: CEO Employment and Total Connections and Interbank Transactions

	Interbank Loans	Interbank Deposits	Interbank transactions	Interbank Loans	Interbank Deposits	Interbank transactions
Variables	(1)	(2)	(3)	(4)	(5)	(6)
CEO Employment Connections	0.434*	-0.625***	0.285			
	(0.240)	(0.219)	(0.177)			
CEO Total connections				0.363***	-0.310***	0.354***
				(0.119)	(0.097)	(0.109)
CEO age	3.497**	1.178	2.100*	3.364**	1.228	1.941*
	(1.457)	(1.634)	(1.165)	(1.465)	(1.621)	(1.151)
CEO tenure	0.146	-0.136	0.598***	0.079	-0.088	0.525***
	(0.185)	(0.182)	(0.149)	(0.184)	(0.183)	(0.148)
Chair-CEO	-0.265	-0.338	-0.454*	-0.148	-0.425	-0.339
	(0.281)	(0.420)	(0.240)	(0.276)	(0.419)	(0.236)
Founder-CEO	0.721	-0.264	-1.128*	0.756	-0.296	-1.092*
	(1.473)	(0.583)	(0.585)	(1.486)	(0.563)	(0.581)
Market-book ratio	-0.600**	0.292	-0.848**	-0.579**	0.280	-0.826**
	(0.293)	(0.236)	(0.357)	(0.285)	(0.233)	(0.348)
Bank size	0.014	-0.405	0.521**	-0.115	-0.376	0.348
	(0.315)	(0.301)	(0.248)	(0.293)	(0.281)	(0.245)
Deposit-asset ratio	7.754***	-22.075***	7.918***	7.073***	-21.688***	7.114***
	(1.932)	(5.799)	(1.815)	(1.976)	(5.918)	(1.810)
Leverage	0.060	0.198**	0.083**	0.065	0.195**	0.089**
	(0.064)	(0.077)	(0.038)	(0.064)	(0.078)	(0.038)
Volatility	0.247***	0.002	0.216***	0.251***	-0.006	0.217***
	(0.063)	(0.044)	(0.054)	(0.064)	(0.045)	(0.054)
Returns	-0.006**	-0.001	-0.002	-0.006**	-0.001	-0.003
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
GDP growth	-0.122**	-0.007	-0.179***	-0.126**	-0.006	-0.185***
	(0.056)	(0.038)	(0.058)	(0.056)	(0.037)	(0.058)
Number of CEOs	479	473	515	479	473	515
Bank FE	YES	YES	YES	YES	YES	YES
N	3,196	3,162	3,408	3,196	3,162	3,408
Within - R2	0.103	0.247	0.183	0.107	0.246	0.190

Panel B: CEO Employment Connection and Interbank Transactions: 2SLS results

	Interbank Loans	Interbank Deposits	Interbank transactions	Interbank Loans	Interbank Deposits	Interbank transactions
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Predicted CEO Employment Con.	0.743**	-0.820***	0.498**			
	(0.327)	(0.261)	(0.244)			
Predicted CEO Total Con.				0.504***	-0.393***	0.487***
				(0.166)	(0.131)	(0.156)
CEO age	2.109	1.358	-0.109	2.287	1.167	-0.058
	(1.930)	(2.340)	(1.316)	(1.978)	(2.311)	(1.325)
CEO tenure	0.746**	-0.324	1.388***	0.588*	-0.216	1.225***
	(0.316)	(0.335)	(0.251)	(0.317)	(0.339)	(0.248)
Chair-CEO	-0.174	-0.343	-0.424*	0.039	-0.498	-0.208
	(0.295)	(0.452)	(0.256)	(0.294)	(0.449)	(0.255)
Founder-CEO	1.614	0.180	-1.140	1.676	0.091	-1.116
	(2.280)	(0.717)	(0.842)	(2.340)	(0.658)	(0.857)
Market-book ratio	-0.665*	0.119	-0.774**	-0.653*	0.117	-0.756**
	(0.352)	(0.220)	(0.390)	(0.344)	(0.217)	(0.379)
Bank size	-0.419	-0.245	0.109	-0.583	-0.195	-0.126
	(0.402)	(0.413)	(0.291)	(0.380)	(0.386)	(0.303)
Deposit-asset ratio	6.956***	-22.153***	7.255***	6.051***	-21.672***	6.140***
	(2.090)	(6.722)	(1.929)	(2.165)	(6.934)	(1.960)
Leverage	0.059	0.256**	0.098**	0.065	0.252**	0.106**
	(0.067)	(0.107)	(0.047)	(0.067)	(0.108)	(0.047)
Volatility	0.175**	-0.026	0.139**	0.192**	-0.045	0.149**
	(0.073)	(0.055)	(0.069)	(0.075)	(0.058)	(0.069)
Returns	-0.004	-0.001	-0.001	-0.004	-0.001	-0.002
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
GDP growth	-0.155**	-0.020	-0.232***	-0.137**	-0.039	-0.217***
	(0.068)	(0.042)	(0.068)	(0.067)	(0.042)	(0.067)
Kleibergen-Paap rk LM statistic	106.95	106.93	114.82	114.34	113.22	120.53
Kleibergen-Paap rk Wald F statistic	581.26	580.6	568.05	398.18	397.88	386.2
Number of CEOs	408	403	435	408	403	435
Bank FE	YES	YES	YES	YES	YES	YES
N	2,699	2,668	2,869	2,699	2,668	2,869

Table 6. CEO Connectedness and Net Lending Dissimilarity

Panel A of this table reports the results of the determinants of net lending policy. In the first stage, the dependent variable is net lending policy. Net lending policy is proxied by the net loan to total asset ratio. All other explanatory variables are defined in Table A4 (reported in Appendix). All explanatory variables are lagged one year. Robust standard errors clustered at bank level and are shown in brackets. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

Panel A First Stage Regression – Determinants of Net lending

Variables	Net Lending policy
Loan loss reserve ratio	1.852**
	(0.842)
Market-book ratio	0.253
	(0.401)
Bank size	0.659
	(0.963)
Deposit-asset ratio	12.885*
	(7.304)
Leverage	-0.357***
	(0.119)
Liquidity	-0.012
	(0.033)
Bank FE	YES
Year FE	YES
N	3,868
Within - R^2	0.162

Panel B of this table reports the second stage model. The dependent variable is net lending dissimilarity. The main explanatory variable is CEO connectedness which is a dummy variable equal to 1 if the two banks are connected through common employment history of their CEOs and zero otherwise. All other explanatory variables are defined in Table A4 (reported in Appendix). All explanatory variables are lagged one year. Robust standard errors clustered at bank-pairs level and are shown in brackets. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

Panel B: CEO Connectedness and Net Lending Dissimilarity

	Net Lending Dissimilarity		
Variables	(1)	(2)	(3)
CEO connectedness	-0.093**	-0.093**	-0.093**
	(0.042)	(0.042)	(0.042)
Abs. Diff Bank Size		-0.018**	-0.018**
		(0.007)	(0.007)
Abs. Diff Volatility		-0.222*	-0.222*
		(0.113)	(0.113)
Abs. Diff return		0.000**	0.000**
		(0.000)	(0.000)
GDP growth			-0.094***
			(0.008)
Pair FE	YES	YES	YES
Year FE	YES	YES	YES
N	350,396	350,396	350,396
Within - R^2	0.004	0.004	0.004

Table 7. CEO Connectedness and Pairwise Return Correlation

This table reports the regression results of the effect of CEO connectedness on equity return correlation. The dependent variable is pairwise equity return correlation. The main explanatory variable is CEO connectedness which is a dummy variable equal to 1 if the two banks are connected through common employment history of their CEOs. All other explanatory variables are defined in Table A4 (reported in Appendix). All explanatory variables are lagged one year. Robust standard errors clustered at bank-pairs level and are shown in brackets. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively.

	Pairwise Equity Return Correlation		
Variables	(1)	(2)	(3)
CEO connectedness	0.088***	0.088***	0.089***
	(0.018)	(0.018)	(0.018)
Abs. Diff Market-to-book		-0.008***	-0.001
		(0.001)	(0.002)
Abs. Diff Bank Size		-0.004**	-0.007***
		(0.002)	(0.002)
Abs. Diff Deposit-to-asset			0.065***
			(0.024)
Abs. Diff Leverage			-0.001***
			(0.000)
Abs. Diff Volatility			-0.919***
			(0.187)
Abs. Diff return			-0.000**
			(0.000)
Year FE	YES	YES	YES
N	610,762	610,247	585,702
R^2	0.133	0.135	0.137

Table 8. CEO Total Connections and Systemic Risk

This table reports the results of additional robustness tests for CEO connections and systemic risk. Panel A reports the results on the effect of CEO Total connections on SRISK, CEO Employment connection and SRISK by excluding SIFI banks and CEO Employment connections and SRISK for survived banks in full sample period. CEO Total connections is the natural logarithm of 1 plus the number of other banks' CEOs with whom the CEO shares common education, employment, and social activity in BoardEx. Panel B report similar results using $\Delta CoVaR$ as dependent variable. All other explanatory variables are defined in Table A4 (reported in Appendix). All explanatory variables are lagged one year. Robust standard errors clustered at CEO level and are shown in brackets. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively.

Panel A: CEO Total Connections and SRISK

Variables	All Banks (1)	No SIFI (2)	Survived Banks (3)
CEO Total Connections	0.057*		
	(0.034)		
CEO Employment Connections		0.103**	0.143*
		(0.047)	(0.081)
CEO controls	YES	YES	YES
Bank controls	YES	YES	YES
Macroeconomic controls	YES	YES	YES
Number of CEOs	907	883	249
Bank FE	YES	YES	YES
Year FE	YES	YES	YES
N	5,820	5,692	2,117
Within - R2	0.312	0.320	0.366

Panel B: CEO Total Connections and $\Delta CoVaR$

Variables	All Banks (1)	No SIFI (2)	Survived Banks (3)
CEO Total Connections	0.000		
	(0.002)		
CEO Employment Connections		0.009**	0.009**
		(0.004)	(0.004)
CEO controls	YES	YES	YES
State controls	YES	YES	YES
Bank controls	YES	YES	YES
Number of CEOs	905	881	881
Bank FE	YES	YES	YES
N	5810	5682	5682
Within - R2	0.801	0.802	0.802

Table 9. CEO Network Centrality and Systemic Risk

This table reports the results of the effect of CEO network centralities on systemic risk. Panel A reports the results on the effect of CEO network centrality measures on SRISK. The main independent variables are Degree in Column 1, Closeness in Column 2, Betweeness in Column 3, Eigenvector in Column 4, Principal Component, which is the first principal component score, in Column 5. Panel B reports the results on the effect of CEO network centrality measures on $\Delta CoVaR$. Panel C and D reports the second stage results from 2SLS regression on how CEO employment connections affect SRISK and $\Delta CoVaR$. All other explanatory variables are defined in Table A4 (reported in Appendix). All explanatory variables are lagged one year. Robust standard errors clustered at CEO level and are shown in brackets. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.

Panel A: CEO Network Centrality and SRISK

	SRISK				
Variables	(1)	(2)	(3)	(4)	(5)
Degree	30.775**				
	(13.276)				
Closeness		24.866			
		(30.379)			
Betweenness			11.911**		
			(5.190)		
Eigenvector				0.459	
				(0.415)	
Principal Component					0.064**
					(0.027)
CEO controls	YES	YES	YES	YES	YES
State controls	YES	YES	YES	YES	YES
Bank controls	YES	YES	YES	YES	YES
Number of CEOs	907	907	907	907	907
Bank FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
N	5,820	5,820	5,820	5,820	5,820
Within - R^2	0.314	0.310	0.312	0.311	0.313

Panel B: CEO Network Centrality and $\Delta CoVaR$

Variables	$\Delta CoVaR$ (1)	(2)	(3)	(4)	(5)
Degree	0.220				
	(0.707)				
Closeness		22.068***			
		(2.709)			
Betweenness			1.048***		
			(0.324)		
Eigenvector				-0.011	
				(0.020)	
Principal Component					0.005***
					(0.002)
CEO controls	YES	YES	YES	YES	YES
State controls	YES	YES	YES	YES	YES
Bank controls	YES	YES	YES	YES	YES
Number of CEOs	905	905	905	905	905
Bank FE	YES	YES	YES	YES	YES
N	5,810	5,810	5,810	5,810	5,810
Within - R^2	0.801	0.803	0.801	0.801	0.801

Panel C: CEO Network Centrality and SRISK: 2SLS results

	SRISK				
Variables	(1)	(2)	(3)	(4)	(5)
Pred. Degree	31.065***				
	(11.294)				
Pred. Closeness		102.269**			
		(45.790)			
Pred. Betweenness			23.323***		
			(7.737)		
Pred. Eigenvector				1.187	
				(0.768)	
Pred. Principal Component					0.095***
					(0.032)
CEO controls	YES	YES	YES	YES	YES
Bank controls	YES	YES	YES	YES	YES
Kleibergen-Paap rk LM statistic	66.12	166.54	38.31	19.58	53.36
Kleibergen-Paap rk Wald F statistic	575.05	140.16	73.14	18.32	184.08
Number of CEOs	730	730	730	730	730
Bank FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
N	4722	4722	4722	4722	4722

Panel D: CEO Network Centrality and $\Delta CoVaR$: 2SLS results

	$\Delta CoVaR$				
Variables	(1)	(2)	(3)	(4)	(5)
Pred. Degree	0.018				
	(0.677)				
Pred. Closeness		31.028***			
		(3.975)			
Pred. Betweenness			1.603***		
			(0.462)		
Pred. Eigenvector				0.059	
				(0.042)	
Pred. Principal Component					0.007***
					(0.002)
CEO controls	YES	YES	YES	YES	YES
State controls	YES	YES	YES	YES	YES
Bank controls	YES	YES	YES	YES	YES
Kleibergen-Paap rk LM statistic	62.78	209.33	37.72	19.94	52.39
Kleibergen-Paap rk Wald F statistic	572.00	254.15	74.16	18.22	199.52
Number of CEOs	730	730	730	730	730
Bank FE	YES	YES	YES	YES	YES
N	4,715	4,715	4,715	4,715	4,715

Figure 1. CEO Employment Connections in 2005 and 2015

Figures 1a. and 1b. were drawn using the Pajek software for large social networks. We used the kamada-kawai free energy algorithm with random starting positions to draw the network. The network shows all the connections between banks CEOs based on employment history in 2005 and 2015.

Figure 1a. CEO Employment Connections in 2005

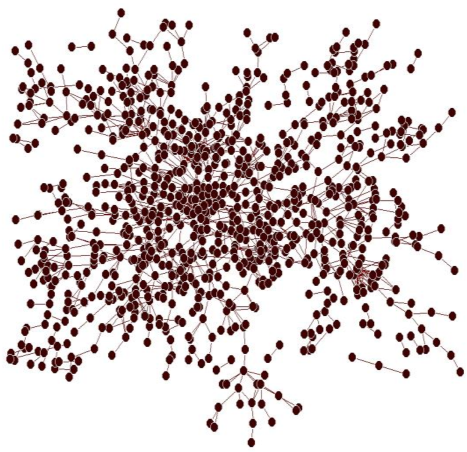
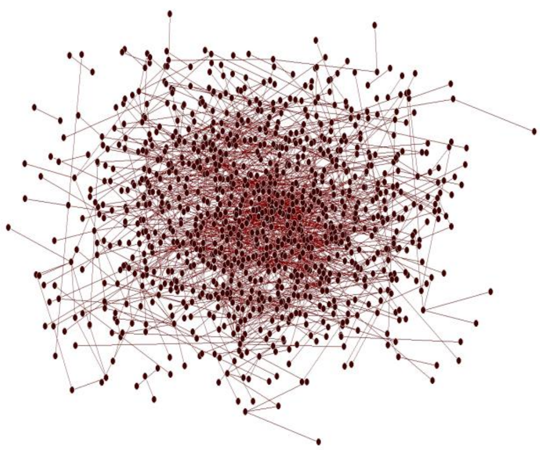


Figure 1b. CEO Employment Connections in 2015



Appendix

Table A1. Pairwise Correlation across Different CEO Centrality and Employment Connections

This table reports the pairwise correlation across different network centralities and CEO Employment connections. Degree, Closeness, Betweeness and Eigenvector are the measures of CEO network centrality and are defined in Table A4. * indicates significance at the 1% level.

Variables	1	2	3	4	5
1. Degree	1.0000				
2. Closeness	0.5645*	1.0000			
3. Betweenness	0.8112*	0.3881*	1.0000		
4. Eigenvector	0.6677*	0.2113*	0.5472*	1.0000	
5. CEO Employment connections	0.9924*	0.5607*	0.8016*	0.6437*	1.0000

Table A2. Systemic Risk and CEO Employment Connections: First-stage Results

This table reports the results of the first stage results from the 2SLS regression of CEO Employment connections and systemic risk using the instruments; two-year lagged CEO Employment connections, MBA dummy, and After Death dummy. MBA dummy is a dummy variable equal to 1 if the CEO has MBA degree and 0 otherwise After death dummy is a dummy variable equal to 1 a year after the death of a connected CEO and 0 otherwise. Panel A and B of Table A2 provides first stage results for Panel A and B of Table 3, respectively. All explanatory variables are lagged one year. All other explanatory variables are defined in Table A4. Robust standard errors clustered at bank level and are shown in brackets. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively.

Panel A: First-stage 2SLS results

	CEO Employment Connections			
Variables	(1)	(2)	(3)	(4)
CEO Employment Connection(L2)	0.976***	0.833***	0.826***	0.826***
	(0.006)	(0.020)	(0.021)	(0.021)
MBA dummy	0.028**	0.040*	0.047**	0.047**
	(0.012)	(0.022)	(0.022)	(0.022)
After Death dummy	-0.008	-0.048**	-0.047**	-0.047**
	(0.026)	(0.022)	(0.022)	(0.022)
CEO age	0.009	0.113	0.122	0.122
	(0.042)	(0.076)	(0.076)	(0.076)
CEO tenure	0.003	0.005	-0.000	-0.000
	(0.013)	(0.016)	(0.016)	(0.016)
Chair-CEO	0.015	0.012	0.012	0.012
	(0.010)	(0.017)	(0.017)	(0.017)
Founder-CEO	-0.013	0.034	0.029	0.026
	(0.015)	(0.040)	(0.042)	(0.042)
Market-book ratio			-0.000	0.002
			(0.007)	(0.008)
Bank size			0.060***	0.059***
			(0.022)	(0.022)
Deposit-asset ratio			0.272**	0.264**
			(0.112)	(0.113)
Leverage			-0.001	-0.002
			(0.001)	(0.001)
Volatility				0.006
				(0.005)
Returns				-0.000
				(0.000)
GDP growth				
Number of CEOs	730	730	730	730
Bank FE	NO	YES	YES	YES
Year FE	YES	YES	YES	YES
N	4,722	4,722	4,722	4,722
R2/Within - R2	0.922	0.678	0.680	0.681

Panel B: First-stage 2SLS results

Variables	CEO Employment Connections (1)	(2)	(3)	(4)
CEO Employment Connection(L2)	0.978***	0.846***	0.839***	0.827***
	(0.006)	(0.019)	(0.019)	(0.020)
MBA dummy	0.029**	0.048**	0.048**	0.050**
	(0.012)	(0.021)	(0.021)	(0.022)
After Death dummy	-0.011	-0.052**	-0.055**	-0.050**
	(0.025)	(0.024)	(0.023)	(0.022)
CEO age	0.014	0.077	0.075	0.102
	(0.043)	(0.073)	(0.072)	(0.073)
CEO tenure	0.012	0.039***	0.030**	0.010
	(0.011)	(0.012)	(0.013)	(0.014)
Chair-CEO	0.011	-0.007	0.001	0.008
	(0.010)	(0.017)	(0.017)	(0.017)
Founder-CEO	-0.012	0.037	0.033	0.026
	(0.015)	(0.037)	(0.039)	(0.042)
VaR	-0.222*	-0.219	-0.192	-0.191
	(0.128)	(0.134)	(0.134)	(0.133)
Market return	-0.030	-0.026	-0.029	-0.040
	(0.027)	(0.027)	(0.027)	(0.028)
Market volatility	-0.602*	-0.603*	-0.545	-0.537
	(0.336)	(0.353)	(0.352)	(0.349)
Interest rate risk	0.001	0.003***	0.002**	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Term spread change	-0.169*	-0.170	-0.144	-0.143
	(0.100)	(0.105)	(0.105)	(0.105)
Liquidity risk	-0.851*	-0.856*	-0.725	-0.731
	(0.476)	(0.496)	(0.496)	(0.492)
Default risk	0.001	-0.003	-0.004	0.004
	(0.007)	(0.007)	(0.007)	(0.008)
Returns	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Leverage			-0.001	-0.001
			(0.002)	(0.002)
Deposit-asset ratio			0.313**	0.286***
			(0.122)	(0.107)
Market-book ratio			-0.012	-0.002
			(0.011)	(0.011)
Bank size				0.063***
				(0.017)
Volatility				0.006
				(0.005)
Number of CEOs	730	730	730	730
Bank FE	NO	YES	YES	YES
N	4,715	4,715	4,715	4,715
R^2/Within - R^2	0.922	0.741	0.743	0.745

Table A3. Interbank Lending and Systemic Risk

This table reports the results of the effect of Interbank transactions on SRISK and $\Delta CoVaR$. All explanatory variables are lagged one year. All other explanatory variables are defined in Table A4. Robust standard errors clustered at bank level and are shown in brackets. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively.

Panel A: Interbank transactions and SRISK

		SRISK	
Variables	(1)	(2)	(3)
Interbank transactions	0.014**	0.015**	0.014**
	(0.006)	(0.006)	(0.006)
CEO Employment Connections	0.276***	0.193***	0.185***
	(0.089)	(0.068)	(0.069)
CEO age	-0.188	-0.406	-0.436
	(0.446)	(0.402)	(0.411)
CEO tenure	-0.041	-0.042	-0.035
	(0.059)	(0.055)	(0.056)
Chair-CEO	-0.065	-0.036	-0.042
	(0.062)	(0.055)	(0.055)
Founder-CEO	0.398*	0.410*	0.397*
	(0.225)	(0.214)	(0.205)
Market-book ratio		-0.068	-0.065
		(0.062)	(0.062)
Bank size		0.598***	0.599***
		(0.098)	(0.099)
Deposit-asset ratio		0.697	0.680
		(0.449)	(0.443)
Leverage		-0.002	-0.008
		(0.007)	(0.008)
Volatility			0.070***
			(0.016)
Returns			-0.000
			(0.000)
GDP growth			0.218**
			(0.109)
Bank FE	YES	YES	YES
Year FE	YES	YES	YES
N	3,472	3,472	3,464
Within - R^2	0.297	0.336	0.347

Panel B: Interbank transactions and $\Delta CoVaR$

	$\Delta CoVaR$		
Variables	(1)	(2)	(3)
Interbank transactions	0.003***	0.000	0.000
	(0.001)	(0.001)	(0.001)
CEO Employment Connections	0.009*	-0.000	-0.001
	(0.005)	(0.005)	(0.005)
CEO age	-0.202***	-0.168***	-0.168***
	(0.035)	(0.033)	(0.032)
CEO tenure	0.059***	0.046***	0.045***
	(0.004)	(0.004)	(0.004)
Chair-CEO	-0.013	-0.004	-0.004
	(0.008)	(0.007)	(0.007)
Founder-CEO	0.006	0.005	0.004
	(0.011)	(0.018)	(0.018)
VaR	1.359***	1.487***	1.496***
	(0.056)	(0.054)	(0.055)
Market return	0.473***	0.456***	0.456***
	(0.009)	(0.008)	(0.009)
Market volatility	3.673***	3.976***	3.998***
	(0.146)	(0.139)	(0.141)
Interest rate risk	-0.025***	-0.025***	-0.025***
	(0.000)	(0.000)	(0.000)
Term spread change	1.101***	1.203***	1.211***
	(0.043)	(0.042)	(0.042)
Liquidity risk	5.597***	6.093***	6.125***
	(0.207)	(0.200)	(0.203)
Default risk	0.175***	0.166***	0.167***
	(0.004)	(0.004)	(0.004)
Returns	-0.000***	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Leverage		0.001	0.001
		(0.001)	(0.001)
Deposit-asset ratio		-0.042	-0.042
		(0.042)	(0.042)
Market-book ratio		-0.063***	-0.062***
		(0.006)	(0.006)
Bank size			0.003
			(0.006)
Volatility			0.002
			(0.002)
Bank FE	YES	YES	YES
N	3,458	3,458	3,458
Within - R^2	0.786	0.802	0.802

Table A4. Variable Definitions

Variables	Definition
CEO Employment Connections	CEO Employment connections is the natural logarithm of 1 plus the number of other banks' CEOs with whom the CEO shares common employment history.
CEO Total Connections	CEO Total connections is the natural logarithm of 1 plus the number of other banks' CEOs with whom the CEO shares common education, employment and social activity.
CEO network centrality	Degree, Closeness, betweenness and eigenvector are the measures of CEO network centrality and are defined in Section 2.1.2.
CEO age	CEO age is the natural log of CEO's age.
CEO tenure	CEO tenure is the natural log of the number of years for which the CEO has been in office.
Chair-CEO	Chair-CEO is a dummy variable which is equal to 1 if a CEO also serves as board chairman during his position as CEO of the bank or zero otherwise.
Founder-CEO	Founder-CEO is a dummy variable which is equal to 1 if the CEO was a founder or co-founder of the bank or 0 otherwise.
SRISK	SRISK estimates the capital shortfall of a financial institution conditional on a systemic event. SRISK is the proxy for systemic risk. Refer to Section 2.1.3 for details.
$\Delta CoVaR$	$\Delta CoVaR$ is the difference between the value at risk of the financial system conditional on an institution being under distress and the value at risk of the financial system conditional on an institution operating in its median state. $\Delta CoVaR$ is the second proxy for systemic risk. Refer to Section 2.1.3 for details.
VaR	Value at Risk (VaR) is obtained by running 5-% quantile regression of asset level returns on the one-week lag of the state variables and by computing the predicted value of the regression.
Bank size	Bank size is the natural logarithm of total asset in millions of U.S. dollars.
Market-to-book ratio	Market-book ratio is the ratio of market value to book value of equity.
Deposit-to-asset ratio	Deposit-Asset ratio is the ratio of deposit to total asset of the bank.
Leverage	Leverage is the ratio of the book value of total asset to the book value of total equity.

Table A4. continued

Variables	Definition
Volatility	Volatility is the annualized daily standard deviation of bank equity returns over trading days in the year window expressed in percent.
Returns	Return is the annual equity returns expressed in percent.
Interbank transactions	Interbank transactions is the ratio of interbank loans and deposits placed with other financial institutions, net of impairment allowances to total assets.
Interbank loans	Interbank loans is the ratio of loans and advances to banks to total assets.
Interbank deposits	Interbank deposits is the ratio of Deposits from banks including funds due/owed to credit institutions to total assets.
Net lending policy	Net lending policy is proxied by the ration of net loan to total asset.
Loan loss reserve ratio	Loan loss reserves ratio is the ratio of loan loss reserves to total asset.
Liquidity	Liquidity is proxied by the ratio of liquid assets of the bank to deposit and short-term funding.
GDP growth	GDP growth is the annual percentage growth rate of GDP.
CEO connectedness	CEO connectedness measures the social connectivity of two bank pairs through the CEO employment history. CEO connectednes is a dummy variable equal to 1 if two banks are connected through employment history of their CEO and 0 otherwise.
Pairwise return correlation	Pairwise return correlation is the equity return correlation between the bank pairs.
Net Lending Dissimilarity	Net Lending Dissimilarity measures the similarity in the bank pairs lending policy.
Market return	Market return is the market return computed from the weekly S&P 500.
Equity volatility	Equity volatility is the 60-day rolling standard deviation of the daily CRSP market value-weighted index return.
Interest rate risk	Interest rate risk is the change in the three-month Treasury bill rate.
Term spread change	Term spread change is measured as spread between ten-year Treasury rate and three-month Treasury bill rate.
Liquidity risk	Liquidity risk is measured as the difference between the three-month LIBOR rate and the three-month bill rate.
Default risk	Default risk is measured as the change in the credit spread between Baa-rated corporate bonds and the 10-year Treasury rate.