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Impact of audit committee social capital on the adoption of COSO 2013

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ABSTRACT

This study aims to examine the effect of audit committee social capital, measured using network centrality from social network theory, on the adoption of the COSO 2013 updated internal control framework (COSO 2013). Drawing on social capital literature, we argue that well-connected audit committees have informational advantages and reputational concerns which prompt them to learn more about best industry practices and adopt those practices in their own organizations. As predicted, we find organizations that have well-connected audit committees are more likely to adopt COSO 2013 and do so in a timely manner. Additional analysis indicates that our findings are driven by overall audit committee connectedness and not by the connectedness of committee chairs, committee financial experts, or committee members, and hold only for accelerated filers. Further, we find, contrary to conventional wisdom, that audit committee connectedness prompts KPMG client organizations to adopt COSO 2013. The results hold even after controlling for CEO and CFO connectedness and are robust to endogeneity concerns. By linking audit committee connectedness with COSO 2013 adoption, we add to the literature investigating the effect of audit committee characteristics on firm compliance with internal control framework updates.

1. Introduction

> "Corporate safeguards to prevent financial errors and fraud are like armor: unpolished they rust, and by then it's too late."
> — Maxwell Murphy (2015).

This research aims to study the effect of audit committee social capital,[1] measured using network centrality from social network theory, on the adoption of the Committee of Sponsoring Organizations of the Treadway Commission's updated 2013 internal control framework (Committee of Sponsoring Organizations of the Treadway Commission (COSO), 2013). Oversight of internal control systems is one of the three key responsibilities of the audit committee (Ashraf, Michas, & Russomanno, 2020; DeZoort, Hermanson, Archambeault, & Reed, 2002). The Sarbanes-Oxley Act (SOX) changed the landscape of audit committee responsibilities regarding internal controls (U.S. House of Representatives, Committee on Financial Services, 2002). Prior research documents that audit committees play a critical role in effective internal control systems. For example, audit committee characteristics such as quality, expertise, and independence enhance the quality of internal controls in organizations (Chalmers, Hay, & Khlif, 2019; Goh, 2009; Krishnan, 2005). Audit committee oversight and diligence positively affect internal audit budget allocated to internal-control-based activities (Abbott, Parker, & Peters, 2010; Barua, Rama, & Sharma, 2010).

When designing and maintaining internal controls, organizations need to select a recognized framework to conceptualize the entity's risk and systematically develop controls commensurate with the organization's objectives. Shaw (2006) documents that most organizations in the U.S. use the Internal Control—Integrated Framework, first introduced by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) in 1992. In 2013, COSO released an updated framework with an enhanced focus on internal controls. COSO 2013 supersedes the 1992 COSO framework effective December 15, 2014. The update of the COSO framework was triggered by changes that occurred in operating

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[1] Studies also use the terms "network centrality" or "connectedness" for social capital (Intintoli et al., 2018; Larcker et al., 2013). Therefore, we use the terms interchangeably.

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and reporting environments since the release of the original framework in 1992 (Addy & Berglund, 2020). Specifically, the update of the framework focuses on information technology controls over business processes (Addy & Berglund, 2020). Both practitioners and academics consider the updated framework an improvement and an effective tool to respond to the dramatic changes in the business environment (Janvrin, Payne, Byrnes, Schneider, & Curtis, 2012; Lawson, Muriel, & Sanders, 2017). Addy and Berglund (2020) note that not adopting COSO 2013 is dangerous for two reasons – first, using the old framework increases the risk of financial reporting failure, and second, the use of the previous framework increases the risk of SEC scrutiny because the SEC has indicated that it will scrutinize organizations that are late or fail to update to COSO 2013 (Securities and Exchange Commission (SEC), 2015a, Securities and Exchange Commission (SEC), 2015b). Audit committees should care about updating to the new 2013 framework for the effective discharge of their oversight responsibilities over internal controls, which are considered critical for financial reporting quality (Doyle, Ge, & McVay, 2007). Prior research suggests that investors consider audit committee responsible for financial reporting failure, and audit committee members are more likely to be named as defendants in litigation (Brochet & Srinivasan, 2014; Srinivasan, 2005). Further, organizations that fail to transition to COSO 2013 face negative market consequences as investors perceive the quarterly earnings surprises of these organizations as less credible (Park, Qin, Seidel, & Zhou, 2021).

We hypothesize that audit committees with greater social capital will be both *able* and *motivated* to recommend that management adopt COSO 2013. This ability results from information that can be accessed from other experts and organizations that are part of the network. Greater social capital affords informational advantages to more connected executives (Omer, Shelley, & Tice, 2020), as information flows through the network more efficiently to those with advantageous network positions. These informational advantages help audit committee members learn about industry best practices and, if necessary, adopt those practices in their own organizations. Social networks are useful for gathering hard-to-quantify information about the advantages and disadvantages of adopting new business practices. COSO 2013 adoption involved risks and costs, and the benefits were not well known. Simply put, well-connected audit committees have access to more and better information enabling them to assess the costs and benefits of COSO 2013 adoption. Their connectedness mitigates information asymmetry surrounding prioritizing COSO 2013 adoption. Moreover, since audit committees are tasked with overseeing the internal controls of the organization, not adopting the COSO 2013 signals a negative tone at the top (Murphy, 2015) that can impact investors' perception of audit committee performance. Further, not updating to COSO 2013 poses risks of financial reporting failures. Audit committees are considered responsible for financial and audit failures, which affect their reputation and career prospects (Murphy, 2015; Srinivasan, 2005). Financial and audit failures negatively impact audit committee members' professional prospects as failures result in fewer subsequent board appointments (Intintoli, Kahle, & Zhao, 2018). Therefore, audit committees should be motivated to transition to the new internal control framework. Finally, adopting COSO 2013 requires greater commitment of time, resources, and coordination among parties within the organization (Lawson et al., 2017). Well-connected audit committee members are better positioned to make such commitments as they have greater ability to communicate and greater incentives to comply with expectations (Egginton & McCumber, 2019). There is, however, no regulatory mandate to adopt COSO 2013. Audit committees may consider COSO 2013 to be an optional update and decide to forego adoption if they believe that their current internal controls are adequate, especially if greater social capital protects audit committees from the repercussions of negative signals or failures. Therefore, it is an empirical question whether audit committee social capital is associated with the adoption of COSO 2013.

To test our hypothesis, we utilize data from *BoardEx*, *SeekEdgar*, *Audit Analytics*, and *Compustat* to identify and compile a final sample of 4293 firm-year observations for the period 2014–2017. We identify adopters of COSO 2013 using 10-K filings. We measure audit committee social capital by constructing network centrality measures common in studies of social network analysis (Bonacich, 1972; Borgatti, 2005; Freeman, 1978) from raw BoardEx data. Specifically, we use four standard computations of network centrality— *DEGREE*, *EIGENVECTOR*, *BETWEENNESS*, and *CLOSENESS*, that measure the size and importance of each node's network as well as the spatial position of each node in the network of actors, where nodes are represented by individual audit committee members. In addition to these four network centrality measures, we use a comprehensive *CENTRALITY* measure to examine the overall effect of connectedness on the adoption of COSO 2013.

Consistent with our predictions, we find that organizations with well-connected audit committees are more likely to adopt COSO 2013 and do so in a timely manner. We also find that our initial results remain unchanged when controlling for CEO and CFO connectedness. Our results further indicate that the effect of audit committee connectedness on COSO 2013 adoption holds only for accelerated filers. In support of prior research, we find that KPMG client organizations are less likely to adopt COSO 2013, but audit committee connectedness may prompt them to adopt COSO 2013. Additional analyses indicate that the results are driven by the overall centrality of the audit committee and not by the centrality of committee chairs, committee financial experts, or individual committee members. Endogeneity tests using entropy balancing and matched samples provide robust support to our findings.

Our study makes several contributions. First, we extend Addy and Berglund (2020), who do not find strong evidence that timely COSO 2013 adoption is diffused through an audit committee-specific director network. Addy and Berglund (2020) measure audit committee networks via interlocks, which focus on isolated firms and are limited to the local transfer of information through direct links. Network centrality measures are not localized and allow for novel information flows via indirect links following Granovetter (1973) "strength of weak ties" logic. Therefore, our expanded measures of audit committee connectedness using network centrality metrics enhance our understanding of the effect of audit committee connectedness on internal controls. Second, we contribute to the auditing literature examining the effect of audit committee characteristics on financial reporting. As audit committees play a critical role in maintaining and improving an effective internal control system, our results add to the literature studying the effect of different characteristics of audit committees on internal controls (Ashraf et al., 2020; Krishnan, 2005). Third, we add to the burgeoning social network literature that articulates the impact of executive/director network connections on accounting and auditing outcomes (Egginton & McCumber, 2019; El-Khatib, Fogel, & Jandik, 2015; Fogel, Jandik, & McCumber, 2018; Intintoli et al., 2018; Omer et al., 2020; Rossi, Blake, Timmermann, Tonks, & Wermers, 2018) by expanding our understanding of the effect of audit committee connectedness on internal control systems, specifically with respect to the firm's compliance with an internal control framework update. Practitioners, regulators, and investors may find our results useful as we lend empirical support to the supposition that audit committees play an important role for COSO 2013 adoption and other enterprise-wide governance efforts.

The remainder of the paper is organized as follows: section two discusses the background literature and develops the main hypotheses. Section three introduces the research design and describes the variables used in our analyses. Section four discusses the sample and reports empirical results. Section five presents additional analyses and robustness tests, respectively. Section six concludes.

Similarities

1. The core definition of internal control.
2. The cube: three objectives that an organization is trying to achieve (operations, reporting, and compliance); five components of internal control (control environment, risk assessment, control activities, information and communication, and monitoring activities) that are necessary to achieve the objectives; four levels of the organization where the components operate (entity, division, operating unit, and function).
3. The exercise of judgment when evaluating the effectiveness of internal controls.

Differences

1. The 17 core principles associated with the five components, implicit in the old framework, are explicit in the new one. The new framework also provides "points of focus" that represent characteristics associated with the principles. The points of focus map directly to the 17 principles, which map directly to the five components.
2. In the new framework, the role of objective-setting in internal control is clarified. Specifically, having objectives is a prerequisite for internal controls, not a part of internal controls.
3. The new framework reflects the increased relevance of technology.
4. An enhanced discussion of governance concepts.
5. The reporting objective is expanded beyond financial reporting. Four types of reporting are addressed: internal financial, internal non-financial, external financial, and external non-financial.
6. Consideration of anti-fraud expectations is enhanced.
7. A greater focus on non-financial reporting objectives.

Fig. 1. COSO 1992 vs COSO 2013.
Notes: The figure compares COSO 1992 and COSO 2013. The source of the figures is Protiviti (2014); available at http://www.protiviti.com/en-US/Documents/Surveys/2014-SOX-Compliance-Survey-Protiviti.pdf

2. Background and hypothesis development

2.1. Internal control systems and the importance of adopting the COSO 2013 framework

Effective systems of internal controls are considered critical for the integrity of the financial reporting process (Doyle et al., 2007). Managers design and maintain effective internal control processes that aim to ensure efficient and effective operations, better quality of reporting, and compliance with laws and regulations (Committee of Sponsoring Organizations of the Treadway Commission (COSO), 2013). Specifically, internal controls help to understand and mitigate risks, safeguard assets, prevent and detect fraud, and prevent misstatements in financial statements (Asare et al., 2013; Schneider, Gramling, Hermanson, & Ye, 2009). The passage of SOX in 2002 had a special focus on the reporting and assessment of the effectiveness of internal controls and required CEOs and CFOs to periodically report on the changes in and the effectiveness of internal controls (U.S. House of Representatives, Committee on Financial Services, 2002). Prior research documents that ineffective internal controls lead to poor financial reporting quality (Doyle et al., 2007; Nagy, 2010). Weak internal controls are associated with a host of other negative outcomes such as higher cost of financing (Kim, Song, & Zhang, 2011; Ogneva, Subramanyam, & Raghunandan, 2007), audit fees (Raghunandan & Rama, 2006), and poor analyst forecasts (Xu & Tang, 2012). Together, these findings call attention to the importance of effective internal control systems in organizations.

When designing and maintaining internal controls, management needs to use a best practice framework as guidance to achieve an effective system of internal controls. Similarly, auditors utilize a control framework when evaluating the internal controls of an organization because a widely recognized internal control framework can be used in an audit to aid in the evaluation of the organization's internal control performance. Although the COSO Internal Control—Integrated Framework, originally developed in 1992, was widely used by organizations in the U.S. (Shaw, 2006), there is no regulatory requirement mandating its use or an update to COSO 2013 (i.e., organizations may use other frameworks in lieu of COSO). However, COSO's integrated internal control framework has gained widespread support from regulators (SEC, 2003). Moreover, COSO's framework has become an acceptable framework for the SOX 404 requirement (U.S. House of Representatives, Committee on Financial Services, 2002). The widespread use and regulatory support for COSO's internal control framework highlights the importance of the framework in designing, implementing, maintaining, and evaluating internal controls in organizations.

In 2013, COSO released an updated framework, which superseded the 1992 framework, addressing changes to an increasingly complex and global business environment, including changes in technology (McNally, 2013; Vandervelde, Brazel, Jones, & Walker, 2012). The updated framework emphasizes the increased reliance on technology for financial reporting as data breaches, cybersecurity, and privacy have become critical issues for effective internal controls (Addy & Berglund, 2020). COSO 2013 retains the definition, objectives, and five components of controls noted in COSO 1992 and introduces 17 principles that facilitate the implementation of the new updated framework (Lawson et al., 2017; Vandervelde et al., 2012). Fig. 1 compares the COSO 1992 and COSO 2013 frameworks. Surveys indicate that, compared to the older framework, the principles of the new framework act as a guide to map existing controls to the updated framework, helping to identify gaps in controls (Lawson et al., 2017; Salierno, 2014). Both practitioners and academics believe the updated framework strengthens the internal controls of organizations (Janvrin et al., 2012; Lawson et al., 2017). Although the SEC does not require adoption of COSO 2013, it encourages organizations to update to the new framework (Addy & Berglund, 2020). SEC comment letters voice concerns regarding firms who chose not to update their controls (Securities and Exchange Commission (SEC),

Table 1
Network centrality measures.

DIRECTOR	DEGREE	EIGENVECTOR	BETWEENNESS	CLOSENESS
Gina	5.00	0.92	1.17	0.08
Mary	6.00	1.00	4.17	0.06
Mike	4.00	0.80	0.33	0.03
Luci	3.00	0.63	0.00	0.03
Gary	4.00	0.73	1.00	0.03
Noel	4.00	0.78	0.33	0.02
Ann	2.00	0.40	0.00	0.07

Notes: This table represents the social capital (network centrality) metrics of the network in Fig. 2. In network theory, a node or vertex is the individual, and a link or edge is a relation between nodes. In this study, nodes are audit committee members and edges are links where two members serve on the same board. Here we have seven audit committee members who are connected. Four network centrality measures—*DEGREE*, *EIGENVECTOR*, *BETWEENNESS*, and *CLOSENESS*—capture the connectedness (social capital) of the members. Please see section 3.1 for the detailed discussions of these four network centrality metrics.

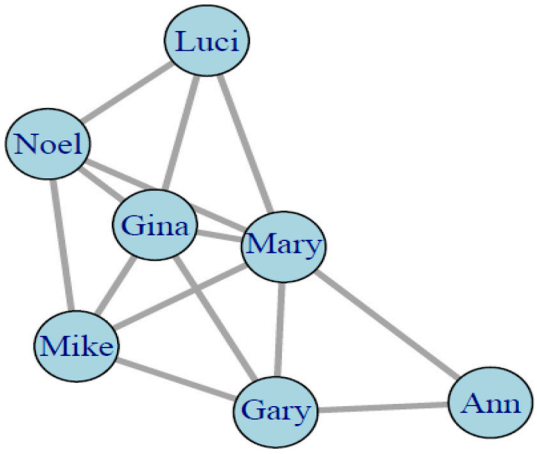

Fig. 2. An Example of a Network.
Notes: The figure is an example of a network consisting of seven audit committee members who are connected to each other through board memberships. Each node represents an audit committee member and edges are links where two members serve on the same board.

2015a, Securities and Exchange Commission (SEC), 2015b), as not updating to the new framework increases the risk of financial reporting failures and sends a negative signal to the market that such firms do not put proper emphasis on internal controls (Murphy, 2015).

2.2. Role of audit committee in internal control systems

Audit committees play a critical role in ensuring effective internal controls by overseeing organizations' internal control processes (Ashraf et al., 2020). Prior research on the association between audit committees and internal controls provides ample evidence that positive audit committee characteristics such as quality, expertise, and independence enhance the quality of internal controls at the firms they serve (Chalmers et al., 2019; Goh, 2009). DeZoort (1997, p. 210) documents that "audit committee members perceive internal control evaluation as the most important audit committee oversight area." Carcello, Hermanson, and Neal (2002) and Krishnan (2005) document that audit committee members do review and evaluate internal controls. Effective audit committees demand relevant, timely, and accurate information about internal controls from management and the internal and external auditors and ask direct and challenging questions (KPMG, 2019). When performing an audit of internal control over financial reporting (ICFR) as required by SOX, external auditors need to communicate their audit strategy regarding internal controls to audit committees (Public Company Accounting Oversight Board (PCAOB), 2012). They are also required to notify audit committees about significant deficiencies and material weaknesses of internal controls identified during the audit (Public Company Accounting Oversight Board (PCAOB), 2003). Further, research confirms that audit committees influence the effectiveness of internal controls (Krishnan, 2005; Zhang, Zhou, & Zhou, 2007), reduce control risks, and increase external auditors' reliance on the work performed by internal audit functions (Pizzini, Lin, & Ziegenfuss, 2015). Thus, extant literature documents that audit committees are actively involved in shaping internal control systems.

2.3. Social capital theory & prior research about the social capital of directors/executives

Social capital is the value that individuals or groups derive from their networks and the norms of reciprocity and trust that exist in those networks (Burt, 2007). Social capital facilitates cooperation and coordination between people that leads to the creation of social and economic benefits. Social capital is an intangible asset that individuals or groups may leverage to gain access to information, opportunities, or resources they would be unable to obtain on their own. Social capital is

Table 2
Measurement of variables.

Variables	Definitions
ADOPT	Dummy variable set equal to 1 if firm adopts COSO 2013, 0 otherwise. (Source: SeekEdgar)
DEGREE	Percentile ranks of raw scores of degree centrality, where degree centrality is total number of audit committee member connections that an audit committee member node has. (Source: BoardEx)
EIGENVECTOR	Percentile ranks of raw scores of eigenvector centrality, where eigenvector centrality is the extent to which and an audit committee member node is connected to other board member nodes. (Source: BoardEx)
BETWEENNESS	Percentile ranks of raw scores of betweenness centrality, where betweenness centrality is the extent to which an audit committee member node lies between two other board member nodes. (Source: BoardEx)
CLOSENESS	Percentile ranks of raw scores of closeness centrality, where closeness centrality is the ease and speed within which an audit committee member node can reach out to other board member nodes within the network. (Source: BoardEx)
CENTRALITY	Percentile ranks of raw scores of the principal component factor of DEGREE, EIGENVECTOR, BETWEENESS, and CLOSENESS. (Source: BoardEx)
LNASSETS	Natural logarithm of total assets. (Source: Compustat)
INVREC	Inventory plus total receivables scaled by total assets. (Source: Compustat)
FOREIGN	Dummy variable set equal to 1 if the firm reported foreign pretax income in period t, 0 otherwise. (Source: Compustat)
MERGER	Dummy variable set equal to 1 if the firm reported a merger or acquisition in period t, 0 otherwise. (Source: Compustat)
ROA	Pre-tax income divided by total assets. (Source: Compustat)
LOSS	Dummy variable set equal to 1 if net income is negative in period t, 0 otherwise. (Source: Compustat)
SALESGROWTH	Percentage change in sales from period t-1 to t. (Source: Compustat)
RESTRUCTURE	Pre-tax restructuring charges divided by total assets. If the variable is missing, it is set equal to 0. (Source: Compustat)
SEGMENT	Square root of the number of business segments. (Source: Compustat Segment Disclosure)
ICWEAKNESS	Dummy variable set equal to 1 if the firm has a reported material internal control weakness, 0 otherwise. (Source: Audit Analytics)
LEVERAGE	Total liabilities scaled by total assets. (Source: Compustat)
LITIGATE	Dummy variable set equal to 1 if the firm operates in a litigious industry (SIC codes 2833:2836, 3570:3577, 3600:3674, 5200:5961, or 7370:7374), 0 otherwise. (Source: Compustat)
RESTATEMENT	Dummy variable set equal to 1 if the firm has restated its earnings in period t, 0 otherwise. (Source: Audit Analytics)
PWC	Dummy variable set equal to 1 if the firm is audited by PricewaterhouseCoopers. (Source: Audit Analytics)
DELOITTE	Dummy variable set equal to 1 if the firm is audited by Deloitte. (Source: Audit Analytics)
EY	Dummy variable set equal to 1 if the firm is audited by Ernst and Young. (Source: Audit Analytics)
KPMG	Dummy variable set equal to 1 if the firm is audited by KPMG. (Source: Audit Analytics)
AGE	Number of years the firm has been in existence since its Initial Public Offering (IPO). (Source: Compustat Names Database)
AUDTURNOVER	Dummy variable set equal to 1if the firm experienced an auditor turnover in period t, 0 otherwise. (Source: Audit Analytics)
AUDTENURE	Number of years the auditor has been retained by the firm. (Source: Audit Analytics)

Notes: This table defines the variables and their measurements.

Table 3
Sample selection and distribution by industry and year.

Panel A: Selection of Sample

Description	Data Source	Firm-years
Total Observations for Audit Committee Network Centrality Measures (2014–2017)	*BoardEx*	14,043
Less: Observation Lost When Merged with COSO 2013 Adoption Dataset	*SeekEdgar*	(3181)
Less: Observations Lost for Control Variables	*Compustat/Audit Analytics*	(6569)
Final Sample (2014–2017)		4293

Panel B: Sample Distribution by Industry

Industry (2 Digit SIC)	Total	Percent
Agriculture, Forestry, and Fishing (01–09)	11	0.26%
Mining (10–14)	179	4.17%
Construction (15–17)	63	1.47%
Manufacturing - Part 1(20–29)	690	16.07%
Manufacturing - Part 2(30–39)	1056	24.60%
Transportation and Communication (40–48)	216	5.03%
Utilities (49)	136	3.17%
Wholesale Trade (50–51)	161	3.75%
Retail Trade (52–59)	275	6.41%
Financial (60–69)	807	18.80%
Services (70–89)	685	15.96%
Public Administration (91–99)	14	0.33%
Total	4293	100.00%

Panel C: Sample Distribution by Year

Year	Total	Percent
2014	1632	38.02%
2015	1707	39.76%
2016	554	12.90%
2017	400	9.32%
Total	4293	100.00%

Notes: This table represents the sample and the distribution of the sample by industry and year. Section 3.3 elaborates on the sample selection process.

captured by network centrality measures that represent the size, importance, and spatial position of one's network. The network acts as a conduit between actors through which information and knowledge are exchanged, existing relationships are enhanced, and new relationships are built. Individuals who are higher in the social network hierarchy (i.e., better connected individuals) can more efficiently gather and process discrete and soft information which leads to positive outcomes. Social capital helps to determine the amount, timeliness, and likelihood of exchanging information based on how central an individual is in his or her network.

Extant research measures the social capital of the board of directors and C-suite executives either via interlocks or network centrality. Interlocks, by construction, are limited to the local information transfer among directly connected executives. Because network centrality measures are derived from the entire network of connections, information flows are modeled both directly and indirectly among multiple dimensions. Thus, centrality measures offer a more comprehensive view of networks and a more complete picture of information flows (Omer et al., 2020).

Studies of information transfer via social networks in economics, finance, and accounting point to both positive and negative outcomes. Specifically, social capital is shown to be associated with positive governance policy transfers, the spread of disclosure policies (Cai, Dhaliwal, Kim, & Pan, 2014), the diffusion of tax-related information (Brown & Drake, 2014), improved stock liquidity (Egginton & McCumber, 2019), and lower costs of debt (Fogel et al., 2018). On the other hand, social capital may also hinder information flows, enable suboptimal behavior, and weaken governance. Social capital is shown to be associated with earnings management contagion, increased incidence and slower detection of fraudulent activity, firm underperformance, and lower probability of executive dismissal (Chiu, Teoh, & Tian, 2013;

Table 4
Summary statistics of variables.

Statistic	N	Mean	St. Dev.	Q1	Median	Q3
DEGREE	4293	75.22	12.48	68.00	77.25	84.25
EIGENVECTOR	4293	69.55	16.19	61.5	73.4	81.2
BETWEENNESS	4293	81.57	15.39	74.5	86.3	92.6
CLOSENESS	4293	71.02	18.48	61.7	74.7	84.6
CENTRALITY	4293	83.34	9.48	78	84.2	90
ADOPT	4293	0.35	0.48	0	0	1
LNASSETS	4293	6.78	2.21	5.23	6.89	8.32
INVREC	4293	0.23	0.20	0.06	0.18	0.33
FOREIGN	4293	0.49	0.50	0	0	1
MERGER	4293	0.38	0.49	0	0	1
ROA	4293	−0.03	0.40	−0.01	0.04	0.10
LOSS	4293	0.28	0.45	0	0	1
SALESGROWTH	4293	0.68	23.67	−0.02	0.06	0.18
RESTRUCTURE	4293	−0.002	0.04	−0.001	0	0
SEGMENT	4293	2.04	0.80	1.41	2.00	2.45
ICWEAKNESS	4293	0.05	0.22	0	0	0
LEVERAGE	4293	0.57	1.52	0.35	0.52	0.69
LITIGATE	4293	0.28	0.45	0	0	1
RESTATEMENT	4293	0.11	0.31	0	0	0
PWC	4293	0.17	0.38	0	0	0
DELOITTE	4293	0.14	0.35	0	0	0
EY	4293	0.24	0.43	0	0	0
KPMG	4293	0.17	0.38	0	0	0
AGE	4293	2.88	0.82	2.40	2.94	3.47
AUDTURNOVER	4293	0.06	0.24	0	0	0
AUDTENURE	4293	8.62	4.81	4	9	13

Notes: This table represents the summary statistics of the variables. All continuous variables are winsorized at 1 and 99 percentiles. Q1 and Q3 correspond to the 25th and 75th percentile respectively. All variables are defined in Table 2.

Table 5
Correlation of variables.

Panel A: Pearson Correlations for Columns (1)–(12)

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12
1.DEGREE												
2.EIGENVECTOR	**0.8**											
3.BETWEENNESS	**0.81**	**0.65**										
4.CLOSENESS	**0.92**	**0.9**	**0.77**									
5.CENTRALITY	**0.81**	**0.66**	**0.76**	**0.77**								
6.ADOPT	**0.15**	**0.12**	**0.1**	**0.14**	**0.15**							
7.LNASSETS	**0.57**	**0.44**	**0.37**	**0.49**	**0.4**	**0.21**						
8.INVREC	**−0.13**	**−0.14**	**−0.11**	**−0.15**	**−0.09**	**−0.04**	**−0.09**					
9.FOREIGN	**0.25**	**0.12**	**0.22**	**0.2**	**0.2**	**0.1**	**0.23**	**0.13**				
10.MERGER	**0.18**	**0.11**	**0.15**	**0.15**	**0.14**	**0.07**	**0.25**	**0.05**	**0.3**			
11.ROA	**0.09**	**0.06**	0.02	**0.05**	0.02	**0.08**	**0.36**	**0.11**	**0.1**	**0.11**		
12.LOSS	**−0.14**	**−0.1**	**−0.04**	**−0.1**	**−0.05**	**−0.1**	**−0.43**	**−0.12**	**−0.06**	**−0.12**	**−0.47**	
13.SALESGROWTH	−0.01	−0.01	0.00	0.00	−0.01	0.02	**−0.03**	−0.01	0.02	0.02	**−0.03**	**0.03**
14.RESTRUCTURE	−0.02	−0.02	**−0.05**	**−0.03**	0.00	0.00	**0.03**	−0.02	**−0.03**	−0.01	**0.08**	**−0.05**
15.SEGMENT	**0.21**	**0.14**	**0.14**	**0.17**	**0.15**	**0.08**	**0.35**	**0.17**	**0.5**	**0.29**	**0.17**	**−0.16**
16.ICWEAKNESS	**−0.09**	**−0.07**	**−0.05**	**−0.09**	**−0.03**	**−0.04**	**−0.14**	**0.03**	0.02	**−0.03**	**−0.14**	**0.13**
17.LEVERAGE	**0.05**	**0.06**	**0.04**	**0.05**	**0.04**	0.00	**−0.03**	0.01	−0.02	0.00	**−0.38**	**0.03**
18.LITIGATE	−0.01	**−0.05**	**0.03**	−0.01	0.02	−0.02	**−0.23**	**−0.07**	**0.08**	−0.02	**−0.17**	**0.22**
19.RESTATEMENT	**−0.06**	**−0.07**	**−0.05**	**−0.07**	**−0.04**	−0.02	**−0.04**	−0.02	**−0.03**	0.00	**−0.03**	−0.01
20.PWC	**0.18**	**0.13**	**0.14**	**0.16**	**0.13**	**0.06**	**0.21**	**−0.07**	0.12	**0.07**	**0.05**	**−0.07**
21.DELOITTE	**0.14**	**0.1**	**0.1**	**0.12**	**0.08**	**0.06**	**0.18**	0.02	**0.08**	**0.06**	**0.07**	**−0.09**
22.EY	**0.19**	**0.13**	**0.14**	**0.17**	**0.11**	**0.08**	**0.16**	**−0.08**	**0.05**	**0.04**	0.02	−0.02
23.KPMG	**0.09**	**0.08**	**0.07**	**0.07**	**0.07**	0	**0.14**	0.01	**0.09**	0.02	**0.05**	**−0.08**
24.AGE	**0.06**	**0.04**	**−0.04**	**0.04**	**−0.03**	**0.08**	**0.24**	**0.15**	**0.13**	**0.06**	**0.19**	**−0.26**
25.AUDTURNOVER	**−0.11**	**−0.08**	**−0.07**	**−0.1**	**−0.08**	**−0.03**	**−0.15**	0.00	**−0.07**	**−0.04**	−0.01	**0.06**
26.AUDTENURE	**0.22**	**0.19**	**0.12**	**0.2**	**0.11**	**0.17**	**0.38**	0.00	**0.17**	**0.09**	**0.15**	**−0.23**

Panel B: Pearson Correlations for Columns (13)–(25), continued from Panel A.

VARIABLES	13	14	15	16	17	18	19	20	21	22	23	24	25
14.RESTRUCTURE	**−0.03**												
15.SEGMENT	**−0.03**	−0.02											
16.ICWEAKNESS	0.00	0.02	−0.02										
17.LEVERAGE	0.00	0.00	−0.01	**0.1**									
18.LITIGATE	**0.03**	**−0.03**	**−0.15**	**0.05**	0.01								
19.RESTATEMENT	0.00	0.01	−0.01	**0.05**	0.02	**−0.03**							
20.PWC	**0.03**	**0.03**	**0.13**	**−0.04**	0.00	−0.03	0.02						
21.DELOITTE	−0.01	−0.01	**0.09**	**−0.03**	0.00	−0.01	**−0.03**	**−0.19**					
22.EY	−0.01	−0.01	−0.01	**−0.04**	−0.01	0.01	0	**−0.26**	**−0.23**				
23.KPMG	−0.01	0.01	**0.03**	−0.01	0.00	−0.01	**−0.05**	**−0.21**	**−0.19**	**−0.26**			
24.AGE	−0.01	−0.01	**0.37**	**−0.1**	−0.02	**−0.14**	0.02	**0.04**	**0.04**	**−0.06**	**0.06**		
25.AUDTURNOVER	0.01	−0.01	**−0.08**	**0.08**	−0.02	0.01	**0.05**	**−0.08**	**−0.03**	**−0.08**	**−0.04**	**−0.04**	
26.AUDTENURE	0.01	0.01	**0.29**	**−0.13**	−0.01	**−0.11**	**−0.03**	**0.17**	**0.08**	**0.11**	**0.13**	**0.5**	**−0.33**

Notes: This table represents the correlation between variables. All continuous variables are winsorized at 1 and 99 percentiles. Please see Table 2 for variable descriptions. Bold values represent significance at 10% level or lower.

Table 6
T-Test of Variables (Means) Between ADOPT = 0 and ADOPT = 1 Firms.

Variables	Mean (ADOPT = 0)	Mean (ADOPT = 1)	t-stat	p
DEGREE	73.85	77.73	−10.37	0.00
EIGENVECTOR	68.05	72.28	−8.76	0.00
BETWEENNESS	80.40	83.72	−7.20	0.00
CLOSENESS	69.13	74.48	−9.65	0.00
CENTRALITY	82.28	85.30	−10.76	0.00
LNASSETS	6.43	7.41	−14.82	0.00
INVREC	0.23	0.22	2.53	0.01
FOREIGN	0.45	0.55	−6.51	0.00
MERGER	0.35	0.42	−4.48	0.00
ROA	−0.05	0.02	−5.62	0.00
LOSS	0.31	0.22	6.48	0.00
SALESGROWTH	0.31	1.36	−1.02	0.31
RESTRUCTURE	0.00	0.00	0.07	0.94
ICWEAKNESS	0.06	0.04	2.88	0.00
LEVERAGE	0.57	0.56	0.33	0.74
LITIGATE	0.28	0.27	1.33	0.18
RESTATEMENT	0.12	0.10	1.67	0.10
PWC	0.15	0.20	−3.95	0.00
DELOITTE	0.13	0.17	−3.59	0.00
EY	0.21	0.29	−5.38	0.00
KPMG	0.17	0.17	−0.20	0.84
AGE	2.83	2.97	−5.62	0.00
AUDTURNOVER	0.07	0.05	2.35	0.02
AUDTENURE	8.03	9.70	−11.01	0.00

Notes: This table presents the univariate results, comparing the means of variables between firms that did not adopt (ADOPT = 0) COSO 2013 ($n = 2777$) and firms who adopted (ADOPT = 1) COSO 2013 ($n = 1516$). All continuous variables are winsorized at 1 and 99 percentiles. Please see Table 2 for variable descriptions. Level of significance is indicated by $^{*}p < 0.10$; $^{**}p < 0.05$; and $^{***}p < 0.01$.

Faccio, 2010; Khanna, Kim, & Lu, 2015). It is possible that social capital better enables the adoption of COSO 2013 by mitigating information asymmetries surrounding the risks and benefits of doing so. It is also possible that more connected executives who do not wish to adopt the updated framework or who are not diligent with internal controls are protected from any negative consequences from a failure to adopt COSO 2013.

2.4. Why would audit committees with greater social capital be more likely to adopt COSO 2013?

We argue that audit committees with greater social capital will be both *able* – because of informational advantages arising from the network – and motivated – because of reputation and career concerns – to recommend that their organizations adopt the COSO 2013 framework. Information flows more efficiently to more connected executives, lending a greater ability to access information. Connected audit committee members can access information about corporate policies, accounting practices, and business strategies via both direct and indirect connections (Omer et al., 2020). Informational advantages of highly central audit committees allow them to learn about effective corporate governance practices of other firms and, if appropriate, recommend that their organizations adopt such practices (Intintoli et al., 2018). Social networks are useful for gathering hard-to-quantify information about the advantages and disadvantages of adopting new business practices. COSO 2013 adoption involved risks and costs, and the benefits were not well known. Given their informational advantages, well-connected audit committees had more information enabling them to assess the costs and benefits of COSO 2013 adoption. Thus, their connectedness should have mitigated uncertainty surrounding the prioritization of COSO 2013 adoption.

Failure to update to the new COSO framework sends a negative signal to stakeholders concerning the oversight and implementation of effective internal controls (Murphy, 2015). The COSO 2013 framework emphasizes the importance of a positive and responsible tone from top executives about the control environment component of internal controls. Moreover, a transition to the new COSO framework relies upon effective communication between executives, internal auditors, and outside stakeholders. Surveys on COSO 2013 indicate that implementation of the new framework required a commitment of significant time and resource (Addy & Berglund, 2020; Lawson et al., 2017). Well-connected audit committees should be better positioned to effectively implement change because they have greater ability to communicate and higher incentives to comply with expectations (Egginton & McCumber, 2019). Additionally, well-connected audit committees should be keen to promote a culture of accountability and transparency, which enables them to garner trust, resolve conflict, and mitigate opportunistic behavior (Fan, 2015; PricewaterhouseCoopers, 2015).

Financial reporting failures significantly and negatively affect audit committee members' reputation and careers (Srinivasan, 2005). Failure to update to the new COSO framework increases the risk of financial reporting failures (Addy & Berglund, 2020; Murphy, 2015). Investors consider audit committees responsible for financial reporting and audit failures, and thus they face relatively higher reputational penalties (Srinivasan, 2005). Moreover, audit committee members are more likely to be named as defendants in litigation (Brochet & Srinivasan, 2014). Well-connected audit committee members are disproportionally more likely to suffer reputational and career losses when the firms they lead report financial misconduct; they are more likely to be replaced and less likely to be appointed to future boards (Intintoli et al., 2018). Thus, audit committees with greater social capital should have greater motivation to recommend that their firms adopt COSO 2013. We therefore hypothesize -

Ha. Companies having audit committees with greater social capital are more likely to adopt COSO 2013 framework.

3. Research method

3.1. Measures of social capital

We proxy for audit committee social capital via network centrality measures common to studies of social capital and networks (Egginton & McCumber, 2019; Fogel et al., 2018; Larcker, So, & Wang, 2013). The network of audit committee members is formed when they sit on multiple boards of different organizations. We map the entire network of all board members, drawing a new network each year, then identify board members who serve on audit committees. We utilize four distinct network centrality variables that measure the size and importance of each board member's network as well as the spatial position of each board member in the complete network of all board members. Centrality variables include *degree*, *eigenvector*, *closeness*, and *betweenness* centralities. Fig. 2 presents a simplified network of audit committee members; the circles are individuals and the lines between circles represent direct connections between them. These direct connections are shared board appointments (e.g., Mary and Luci are connected because they serve on the same board at the same time). Table 1 presents the four network centrality measures resultant of the small example network.

Degree centrality (*DEGREE*) is the number of direct connections an actor has with other actors.[2] For example, Ann in Fig. 2 is connected to Mary and Gary; therefore, her degree centrality is 2. The degree centrality represents an actor's influence, reach, and visibility in the

[2] Our degree centrality measure is different from the interlock measure defined in Addy and Berglund (2020). Addy and Berglund (2020) measure interlocks using a dummy variable equal to one when any of the firm's directors holds a second directorship in another company that adopts the 2013 COSO framework. In contrast, *DEGREE* measures the total number of connections each director on the board has with other actors in the network, allowing the reach of an individual director's social network to influence the firm-level measure we use in analyses.

network (Egginton & McCumber, 2019). Degree centrality is measured as follows—

$$DEGREE = \sum_{j \neq i} x_{ij} \quad (1)$$

Here $x_{ij} = 1$ if board members i and j serve or served on a common board. In this example, Mary in Fig. 2 has the highest degree centrality as she is connected to all other members in the network.While higher degree centrality indicates that one has many connections, degree by itself does not necessarily indicate the importance of one's network; it may be that an actor has many connections to relatively isolated actors. Eigenvector centrality (*EIGENVECTOR*) better captures the importance of one's network as it weighs degree centrality by the degree centralities of one's connections. In other words, higher eigenvector centrality means that the actor is connected to people who are also well-connected. Eigenvector centrality is measured as follows—

$$EIGENVECTOR = K_1^{-1} \sum A_{ij} x_j \quad (2)$$

Here, A is the adjacency matrix and K_1 is the largest eigenvalue of the adjacency matrix A. Eigenvector is proportional to the sum of the centralities of one's neighbors. Though Mike, Gary, and Noel have the same degree centrality, their eigenvector centralities are not the same; Gary has the lowest eigenvector because he is connected to Ann, who is not well-connected.

Betweenness centrality (*BETWEENNESS*) measures the frequency with which an actor lies between two otherwise disconnected actors. Betweenness is related to the notion of information brokerage, since if a node lies between two disconnected nodes it can control the frequency and quality of information flows between the otherwise disconnected nodes. Betweenness is measured as —

$$BETWEENNESS = \sum_{ac} \frac{P_{ac}^{i} / g_{ac}}{(n-1)(n-2)/2} \quad (3)$$

$P_{ac}^{i} = 1$ if a node i lies on the geodesic path between a and c, and 0 otherwise; g_{ac} indicates the total number of possible paths between a and c. Luci and Ann have betweenness scores of 0 because they do not lie between any other two actors.

Closeness centrality (*CLOSENESS*) is a measure of the relative density of the network surrounding each node, capturing the ease and speed with which a node can gather and disseminate information through the network to other nodes. The greater the distance between two actors, the higher the cost of information acquisition and dissemination. Closeness is measured as follows—

$$CLOSENESS = L_i^{-1} = \frac{n-1}{\sum_j d_{ij}} \quad (4)$$

Here, L is the average distance between node i and all other nodes. Gina has the highest closeness centrality because the average distance to all other nodes is lower than for the other actors in the sample network.

While degree centrality is intuitive, assuming a larger network is more advantageous than a smaller network, raw scores for other centrality measures are difficult to interpret. We therefore transform the raw scores into a normalized ranking system, placing an equal number of board members into percentiles each year based upon the raw scores. If an audit committee member is in the 63rd percentile in closeness centrality in 2013, her closeness ranking is 63, as her network position is more advantageous than 62% of all other executives in the network that year.

We measure audit committee centrality at the firm level by simply averaging the percentile ranks of all audit committee members for each centrality measure each firm-year. Finally, as by construction centrality measures are highly correlated (e.g., high degree centrality actors are also more likely to be connected to other connected actors, resulting in higher eigenvector centrality), we calculate the first principal component of the four measures to create an overall measure of centrality (*CENTRALITY*).

3.2. Empirical model

To investigate whether audit committee social capital impacts the decision to adopt COSO 2013, we estimate the following cross-sectional logistic regression model[3]:

$$\begin{aligned} ADOPT = {} & \alpha_0 + \alpha_1 \ \text{CENTRALITY} + \alpha_2 \ \text{AUDTENURE} + \alpha_3 \ \text{LNASSETS} + \alpha_4 \ \text{INVREC} + \alpha_5 \\ & FOREIGN + \alpha_6 \ \text{MERGER} + \alpha_7 \ \text{ROA} + \alpha_8 \ \text{LOSS} + \alpha_9 \ \text{SALESGROWTH} + \alpha_{10} \\ & SEGMENT + \alpha_{11} \ \text{RESTRUCTURE} + \alpha_{12} \ \text{LEVERAGE} + \alpha_{13} \ \text{LITIGATE} + \alpha_{14} \\ & RESTATEMENT + \alpha_{15} \ \text{PWC} + \alpha_{16} \ \text{DELOITTE} + \alpha_{17} \ \text{EY} + \alpha_{18} \ \text{KPMG} + \alpha_{19} \\ & AGE + \alpha_{20} \ \text{AUDTURNOVER} + \alpha_{21} \ \text{ICWEAKNESS} + \varepsilon \end{aligned} \quad (5)$$

where the dependent variable *ADOPT*[4] is an indicator variable equal to 1 if a firm adopts the COSO 2013 framework and 0 otherwise. Our variable of interest is audit committee *CENTRALITY*, captured at the firm-level based on the underlying five centrality measures described above. Following prior accounting studies that *t*-test the diffusion and adoption of various practices (Brown, 2011; Chiu et al., 2013), we use a discrete-time logistic model[5] where we drop firms from the sample in years following COSO 2013 adoption, as in a survivor model. The discrete-time logistic model is appropriate for time-to-event settings such as our research question; the event of interest (Committee of Sponsoring Organizations of the Treadway Commission (COSO), 2013 adoption)

[3] Our research design differs from that of Addy and Berglund (2020) in that their sample period is only one year, whereas ours is four years. Unlike Addy and Berglund (2020), since we have more than one period in our sample, we utilize a method that allows for the prediction of discrete one-time events in multi-period samples where subsequent years of data need to be dropped after the occurrence of the one-time discrete event such as adoption of COSO 2013. In addition, their research focus was on different determinants of COSO 2013 adoption whereas ours focuses on the role of the social capital of audit committees.

[4] For our sample period, we keep the treatment firms (*ADOPT = 1*) only once. For example, if a firm adopts COSO 2013 in 2015, that firm is assigned in treatment group (*ADOPT = 1*) only in 2015; in subsequent years (2016 and 2017), this firm is dropped from the sample. In prior years, i.e., in 2014, the firm is treated as a control (*ADOPT = 0*).

[5] Event history analysis was developed in the biological sciences and later introduced in the social sciences to study social changes. The core elements of event history analysis are the survivor function, the event function, and the hazard rate. The survivor function is the probability that the event of interest will not occur during the given period; the event function specifies the variables that influence event occurrence, and the hazard rate is the probability that the event will occur within the period. The event study analysis can be modeled using either a continuous or discrete time function. In our setting, a discrete time function model is appropriate because the adoption of COSO 2013 is a discrete event in a given period and there is no change within-year timing.

Table 7
Impact of audit committee connectedness on COSO 2013 adoption.

		Dependent Variable				
				ADOPT		
		(1)	(2)	(3)	(4)	(5)
DEGREE	+	0.010**				
		(0.005)				
EIGENVECTOR	+		0.006*			
			(0.003)			
BETWEENNESS	+			0.006*		
				(0.004)		
CLOSENESS	+				0.006*	
					(0.003)	
CENTRALITY	+					0.012*
						(0.007)
LNASSETS	+	0.272***	0.252***	0.257***	0.278***	0.253***
		(0.042)	(0.036)	(0.035)	(0.041)	(0.036)
INVREC	?	−0.462	−0.398	−0.418*	−0.457	−0.420*
		(0.328)	(0.246)	(0.244)	(0.330)	(0.244)
FOREIGN	?	0.449***	0.412***	0.389***	0.456***	0.394***
		(0.133)	(0.118)	(0.119)	(0.133)	(0.119)
MERGER	?	−0.163	−0.139	−0.144	−0.163	−0.143
		(0.117)	(0.110)	(0.110)	(0.117)	(0.110)
ROA	?	−0.004	0.032	0.032	−0.001	0.031
		(0.173)	(0.172)	(0.174)	(0.173)	(0.173)
LOSS	?	−0.074	−0.128	−0.129	−0.074	−0.124
		(0.127)	(0.123)	(0.123)	(0.127)	(0.123)
SALESGROWTH	?	0.002	0.003	0.003	0.002	0.003
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
RESTRUCTURE	?	−0.423	−0.232	−0.245	−0.390	−0.263
		(1.934)	(1.685)	(1.765)	(1.902)	(1.674)
SEGMENT	?	−0.093	−0.089	−0.090	−0.092	−0.093
		(0.087)	(0.081)	(0.081)	(0.087)	(0.081)
ICWEAKNESS	−	−0.178	−0.194	−0.191	−0.177	−0.187
		(0.232)	(0.232)	(0.233)	(0.232)	(0.233)
LEVERAGE	?	−0.015	−0.022	−0.016	−0.015	−0.017
		(0.035)	(0.044)	(0.038)	(0.035)	(0.039)
LITIGATE	?	0.141	0.156	0.147	0.148	0.146
		(0.210)	(0.112)	(0.112)	(0.210)	(0.112)
RESTATEMENT	?	0.084	0.129	0.118	0.088	0.117
		(0.170)	(0.167)	(0.167)	(0.170)	(0.167)
PWC	+	0.653***	0.788***	0.774***	0.670***	0.779***
		(0.207)	(0.199)	(0.200)	(0.207)	(0.199)
DELOITTE	+	0.662***	0.812***	0.798***	0.677***	0.809***
		(0.196)	(0.189)	(0.189)	(0.196)	(0.189)
EY	+	0.708***	0.842***	0.826***	0.724***	0.833***
		(0.175)	(0.165)	(0.166)	(0.174)	(0.166)
KPMG	−	−0.190	−0.160	−0.171	−0.174	−0.161
		(0.161)	(0.154)	(0.155)	(0.160)	(0.155)
AGE	+	0.227***	0.216***	0.222***	0.227***	0.219***
		(0.081)	(0.077)	(0.077)	(0.081)	(0.077)
AUDTURNOVER	?	0.079	0.089	0.091	0.078	0.095
		(0.212)	(0.209)	(0.210)	(0.212)	(0.210)
AUDTENURE	?	0.037***	0.033***	0.034***	0.036***	0.034***
		(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Industry FE		Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes
Observations		4293	4293	4293	4293	4293
Pseudo R^2		0.55	0.54	0.54	0.55	0.54

Notes: This table reports the results of regressing COSO 2013 adoption (*ADOPT*) on the five measures of connectedness (*DEGREE*, *EIGENVECTOR*, *BETWEENNESS*, *CLOSENESS*, and *CENTRALITY*). Section 3.1 details the description of the network centrality measures. Please see Table 2 for variable descriptions. All continuous variables are winsorized at 1 and 99 percentiles. All regression models include industry (based on two-digit SIC codes) and year fixed effects. Standard errors (SE) are clustered by firm and given in parentheses. Level of significance is indicated by *p < 0.10; **p < 0.05; and ***p < 0.01.

Table 8
Impact of audit committee connectedness on COSO 2013 adoption After controlling for CEO and CFO connectedness.

Panel A: Controlling for CEO Connectedness						
		Dependent Variable				
		ADOPT				
		(1)	(2)	(3)	(4)	(5)
DEGREE	+	0.010*				
		(0.006)				
DEGREECEO	?	−0.005				
		(0.004)				
EIGENVECTOR	+		0.009**			
			(0.004)			
EIGENVECTORCEO	?		−0.002			
			(0.003)			
BETWEENNESS	+			0.007*		
				(0.004)		
BETWEENNESSCEO	?			−0.002		
				(0.002)		
CLOSENESS	+				0.009**	
					(0.004)	
CLOSENESSCEO	?				−0.005	
					(0.003)	
CENTRALITY	+					0.013*
						(0.007)
CENTRALITYCEO	?					−0.008
						(0.005)
Observations		3780	3780	3780	3780	3780
Pseudo R^2		0.56	0.55	0.55	0.56	0.55
Panel B: Controlling for CFO Connectedness						
DEGREE	+	0.011**				
		(0.005)				
DEGREECFO	?	−0.001				
		(0.004)				
EIGENVECTOR	+		0.008*			
			(0.004)			
EIGENVECTORCFO	?		−0.002			
			(0.004)			
BETWEENNESS	+			0.006		
				(0.004)		
BETWEENNESSCFO	?			0.001		
				(0.002)		
CLOSENESS	+				0.007**	
					(0.004)	
CLOSENESSCFO	?				−0.001	
					(0.003)	
CENTRALITY	+					0.012*
						(0.007)
CENTRALITYCFO	?					−0.003
						(0.006)
Observations		3860	3860	3860	3860	3860
Pseudo R^2		0.56	0.56	0.56	0.56	0.56
Controls Included		Yes	Yes	Yes	Yes	Yes
Industry FE		Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes

Notes: Table 8 reports the results of regressing COSO 2013 adoption (*ADOPT*) on the five measures of connectedness (*DEGREE*, *EIGENVECTOR*, *BETWEENNESS*, *CLOSENESS*, and *CENTRALITY*), after controlling for the CEO (Panel A) and CFO (Panel B) centrality measures. The variables *DEGREECEO, EIGENVECTORCEO, BETWEENNESSCEO, CLOSENESSCEO, and CENTRALITYCEO* refer to the centrality measures of CEO. The variables *DEGREECFO, EIGENVECTORCFO, BETWEENNESSCFO, CLOSENESSCFO, and CENTRALITYCFO* refer to the centrality measures of CFO. Section 3.1 provides a detailed description of the network centrality measures. All other variables are defined in Table 2. All continuous variables are winsorized at 1 and 99 percentiles. All regression models include industry (based on two-digit SIC codes) and year fixed effects. Robust standard errors (SE) given in parentheses are adjusted for heteroscedasticity and clustered by firms. Level of significance is indicated by $^*p < 0.10$; $^{**}p < 0.05$; and $^{***}p < 0.01$.

occurs at a discrete point in time and the outcome variable is a conditional probability that the event happens given that it did not occur before (Allison, 1982).

Following prior research (Addy & Berglund, 2020; Tadesse, Rosa, & Parker, 2022) we include several control variables that are likely associated with adoption of COSO 2013. We include firm size (*LNASSETS*), performance (*ROA*), and firm age (*AGE*) as large, mature, and profitable firms have more resources and thus are more likely to adopt COSO 2013. We also add dummy variables for auditing firms (*PWC, DELOITTE, EY, KPMG*) as auditing firms have been found to impact timely adoption decisions. We include auditor tenure (*AUDTENURE*) because auditors that have longer working relationships with their clients are more familiar with client operations and existing internal controls and are better equipped to provide guidance and assistance in the transition to COSO 2013. We also control other financial characteristics (*LOSS, SALESGROWTH, LEVERAGE*) that have been found to be associated with

Table 9
Impact of audit committee connectedness on timely adoption of COSO 2013 framework.

		Dependent Variable				
		$ADOPT_{TIMELY}$				
		(1)	(2)	(3)	(4)	(5)
DEGREE	+	0.015**				
		(0.007)				
EIGENVECTOR	+		0.008*			
			(0.004)			
BETWEENNESS	+			0.009*		
				(0.005)		
CLOSENESS	+				0.011***	
					(0.004)	
CENTRALITY	+					0.015*
						(0.008)
LNASSETS	+	0.318***	0.338***	0.339***	0.323***	0.334***
		(0.056)	(0.054)	(0.054)	(0.055)	(0.055)
INVREC	?	−0.665	−0.654	−0.669	−0.636	−0.696
		(0.439)	(0.440)	(0.438)	(0.440)	(0.438)
FOREIGN	?	0.486***	0.512***	0.488***	0.498***	0.496***
		(0.170)	(0.170)	(0.171)	(0.170)	(0.170)
MERGER	?	−0.344**	−0.343**	−0.346**	−0.349**	−0.344**
		(0.149)	(0.149)	(0.149)	(0.149)	(0.149)
ROA	?	0.082	0.076	0.078	0.093	0.066
		(0.246)	(0.245)	(0.245)	(0.246)	(0.244)
LOSS	?	−0.138	−0.146	−0.133	−0.148	−0.132
		(0.177)	(0.178)	(0.177)	(0.177)	(0.177)
SALESGROWTH	?	0.003	0.004	0.004	0.003	0.003
		(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
RESTRUCTURE	?	−3.173	−3.156	−3.152	−3.140	−3.161
		(2.675)	(2.707)	(2.687)	(2.681)	(2.699)
SEGMENT	?	−0.097	−0.096	−0.095	−0.098	−0.099
		(0.108)	(0.108)	(0.107)	(0.108)	(0.107)
ICWEAKNESS	−	−0.363	−0.370	−0.369	−0.364	−0.368
		(0.289)	(0.289)	(0.289)	(0.290)	(0.289)
LEVERAGE	?	−0.139	−0.151	−0.120	−0.158	−0.133
		(0.254)	(0.254)	(0.253)	(0.254)	(0.253)
LITIGATE	?	0.223	0.242	0.226	0.235	0.211
		(0.266)	(0.266)	(0.266)	(0.266)	(0.267)
RESTATEMENT	?	0.078	0.088	0.081	0.090	0.074
		(0.220)	(0.220)	(0.220)	(0.220)	(0.219)
PWC	+	1.155***	1.208***	1.181***	1.169***	1.194***
		(0.261)	(0.259)	(0.260)	(0.260)	(0.259)
DELOITTE	+	0.816***	0.867***	0.842***	0.823***	0.867***
		(0.253)	(0.251)	(0.252)	(0.252)	(0.251)
EY	+	0.673***	0.727***	0.703***	0.682***	0.717***
		(0.218)	(0.215)	(0.217)	(0.217)	(0.216)
KPMG	−	−1.333***	−1.292***	−1.316***	−1.326***	−1.297***
		(0.226)	(0.223)	(0.225)	(0.225)	(0.224)
AGE	+	0.055	0.049	0.062	0.057	0.054
		(0.103)	(0.103)	(0.104)	(0.103)	(0.103)
AUDTURNOVER	?	−0.061	−0.057	−0.056	−0.060	−0.051
		(0.274)	(0.273)	(0.274)	(0.274)	(0.274)
AUDTENURE	?	0.021	0.019	0.021	0.020	0.021
		(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Industry FE		Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes
Observations		4293	4293	4293	4293	4293
Pseudo R^2		0.68	0.68	0.68	0.68	0.67

Notes: This table reports the logistic regression results of audit committee network centrality measures (*DEGREE*, *EIGENVECTOR*, *BETWEENNESS*, *CLOSENESS*, and *CENTRALITY*) on timely adoption of COSO 2013 framework ($ADOPT_{TIMELY}$). Here, $ADOPT_{TIMELY}$ equals 1 if the firm has adopted the updated 2013 framework on or before December 15, 2014 or else 0. Section 3.1 provides a detailed description of the network centrality measures and all other variables are defined in Table 2. All continuous variables are winsorized at 1 and 99 percentiles. All regression models include industry (based on two-digit SIC codes) and year fixed effects. Standard errors (SE) are clustered by firm and given in parentheses. Level of significance is indicated by *p < 0.10; **p < 0.05; and ***p < 0.01.

internal control issues. Finally, we include several variables (*ICWEAKNESS, RESTATEMENT, LITIGATION, SEGEMNT, RESTRUCTURE, FOREIGN*) to control for the firm's internal control environment and the complexity of business operations. All variables are defined in Table 2.

3.3. Sample

To calculate our network centrality measures, we first obtain board of director (executive and non-executive) appointments data from the *BoardEx* database. Audit committee members are connected to others in the network when they serve on the same board in a given year. We calculate audit committee network centrality scores for the years 2014–2017, resulting in 14,043 firm-year observations. Next, we utilize *SeekEdgar* to examine 10-K filings to identify the adopters of the COSO 2013 framework. This process results in 10,862 firm-year observations. We use the *Audit Analytics* and *Compustat* databases to collect audit and client organization-related control variables. The resulting final sample includes 4293 observations for 2014–2017. Table 3 describes the sample

Table 10
Impact of Audit Committee Connectedness on COSO 2013 Adoption in KPMG and Non-KPMG Firms.

Panel A: Non-KPMG Firms						
		Dependent Variable				
		ADOPT				
		(1)	(2)	(3)	(4)	(5)
DEGREE	+	0.015** (0.006)				
EIGENVECTOR	+		0.007* (0.004)			
BETWEENNESS	+			0.007* (0.004)		
CLOSENESS	+				0.008** (0.004)	
CENTRALITY	+					0.016* (0.008)
Observations		3555	3555	3555	3555	3555
Pseudo R^2		0.61	0.61	0.61	0.61	0.61
Panel B: KPMG Firms						
DEGREE	−	0.014 (0.017)				
EIGENVECTOR	−		0.017 (0.012)			
BETWEENNESS	−			0.022* (0.013)		
CLOSENESS	−				0.015 (0.011)	
CENTRALITY	−					0.018 (0.022)
Observations		738	738	738	738	738
Pseudo R^2		0.55	0.55	0.55	0.55	0.55
Controls Included		Yes	Yes	Yes	Yes	Yes
Industry FE		Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes

Notes: This table reports the logistic regression results of audit committee network centrality measures (*DEGREE*, *EIGENVECTOR*, *BETWEENNESS*, *CLOSENESS*, and *CENTRALITY*) on COSO 2013 adoption (*ADOPT*) in KPMG and Non-KPMG firms. Please see Section 3.1 and Table 2 for variable descriptions and measurements. All continuous variables are winsorized at 1 and 99 percentiles. All regression models include industry (based on two-digit SIC codes) and year fixed effects. Standard errors (SE) are clustered by firm and given in parentheses. Level of significance is indicated by *p < 0.10; **p < 0.05; and ***p < 0.01.

Table 11
Impact of Audit Committee Connectedness on Accelerated and Non-Accelerated Filers.

Panel A: Accelerated Filers						
		Dependent Variable				
		ADOPT				
		(1)	(2)	(3)	(4)	(5)
DEGREE	+	0.017* (0.009)				
EIGENVECTOR	+		0.013* (0.007)			
BETWEENNESS	+			0.016** (0.007)		
CLOSENESS	+				0.013** (0.006)	
CENTRALITY	+					0.030** (0.012)
Observations		2447	2447	2447	2447	2447
Pseudo R^2		0.64	0.64	0.64	0.64	0.64
Panel B: Non-Accelerated Filers						
DEGREE	?	0.005 (0.007)				
EIGENVECTOR	?		−0.001 (0.004)			
BETWEENNESS	?			0.0004 (0.005)		
CLOSENESS	?				0.002 (0.004)	
CENTRALITY	?					0.0004 (0.008)
Observations		1713	1713	1713	1713	1713
Pseudo R^2		0.44	0.44	0.44	0.44	0.44
Controls Included		Yes	Yes	Yes	Yes	Yes
Industry FE		Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes

Notes: This table reports the logistic regression results of audit committee network centrality measures (*DEGREE*, *EIGENVECTOR*, *BETWEENNESS*, *CLOSENESS*, and *CENTRALITY*) on the likelihood of COSO 2013 adoption (*ADOPT*) in accelerated and non-accelerated filers. We separate accelerated and non-accelerated filers based on firms' 10-K filing deadlines. Please see Section 3.1 and Table 2 for variable descriptions and measurements. All continuous variables are winsorized at 1 and 99 percentiles. All regression models include industry (based on two-digit SIC codes) and year fixed effects. Standard errors (SE) are clustered by firm and given in parentheses. Level of significance is indicated by *$p < 0.10$; **$p < 0.05$; and ***$p < 0.01$.

selection process (Panel A) along with the distribution of the sample by industry (2-digit SIC code) and year (Panels B & C). It is evident that the observations come from multiple industries, with manufacturing representing the largest percentage of total observations (1746/4293, or 40%). Other industries with large representations include financials (18.80%), services (15.96%), retail trade (6.41%), and mining (4.17%).

4. Results

4.1. Descriptive statistics

Table 4 reports descriptive statistics for the variables used in our analyses. The mean (median) percentile rankings for *DEGREE*, *EIGENVECTOR*, *BETWEENESS*, and *CLOSENESS* are 75.22% (77.25%), 69.55% (73.4%), 81.57% (86.3%) and 71.02% (74.7%), respectively. The mean (median) of overall audit committee *CENTRALITY* (ranking of the first principal component of the centrality measures) is 83.34 (84.2) and ranges from 78 to 90 from the 25th to the 75th percentile. This indicates that audit committee members, on average, are more influential than the average director. The mean *ADOPT* is 0.35, suggesting that on average 35% of the sample firms have adopted the COSO 2013 framework in a given year. The mean *AUDTENURE* is 8.62 years. The mean *ROA* is - 3% and 28% of the sample firms reported losses. 5% of the sample firms have reported material weakness in internal controls, 11% reported restatements, and 72% of the firms are audited by Big 4 firms. The breakdown of auditing firms is: *PWC* 17%, *DELOITTE* 14%, *EY* 24% and *KPMG* 17%.

4.2. Correlation matrix

Table 5 reports the correlations between the independent variables, dependent variables, and control variables. As expected, audit committee network centrality measures are highly correlated. As predicted in H_a, all audit committee centrality measures are significantly and positively correlated with *ADOPT* ($p < 0.01$). Correlations also suggest that well-connected audit committees are positively correlated with firm size (*LNASSETS*) and negatively correlated with material internal control weaknesses (*ICWEAKNESS*). Overall, these correlations suggest that audit committee connectedness is positively and significantly correlated with the adoption of COSO 2013.

Table 12
Connectedness of Audit Committee's Composition and Adoption of COSO 2013 Framework.

Dependent Variable:						
		ADOPT				
		(1)	(2)	(3)	(4)	(5)
Panel A: Audit Committee - Chair						
DEGREE	+	0.006*				
		(0.003)				
EIGENVECTOR	+		0.004			
			(0.003)			
BETWEENNESS	+			0.005**		
				(0.002)		
CLOSENESS	+				0.004*	
					(0.002)	
OVERALLCENTRALITY	+					0.005
						(0.004)
Observations		4163	4163	4163	4163	4163
Pseudo R^2		0.54	0.54	0.54	0.54	0.54
Panel B: Audit Committee - Financial Expert						
DEGREE	+	0.006				
		(0.004)				
EIGENVECTOR	+		0.005*			
			(0.003)			
BETWEENNESS	+			0.005*		
				(0.003)		
CLOSENESS	+				0.005**	
					(0.003)	
OVERALLCENTRALITY	+					0.004
						(0.005)
Observations		4211	4211	4211	4211	4211
Pseudo R^2		0.54	0.54	0.54	0.54	0.54
Panel C: Audit Committee - Members						
DEGREE	+	0.007*				
		(0.004)				
EIGENVECTOR	+		0.002			
			(0.003)			
BETWEENNESS	+			0.002		
				(0.003)		
CLOSENESS	+				0.006**	
					(0.003)	
OVERALLCENTRALITY	+					0.006
						(0.006)
Observations		3430	3430	3430	3430	3430
Pseudo R^2		0.53	0.53	0.53	0.53	0.53
Controls Included		Yes	Yes	Yes	Yes	Yes
Industry FE		Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes

Notes: Table 12 shows the logistic regression results of connectedness (*DEGREE*, *EIGENVECTOR*, *BETWEENNESS*, *CLOSENESS*, and *CENTRALITY*) of Audit Committee - Chair, Financial Expert, and Members - on the likelihood of adopting the COSO 2013 framework (*ADOPT*). Please see Section 3.1 and Table 2 for variable descriptions and measurements. All continuous variables are winsorized at 1 and 99 percentiles. All regression models include industry (based on two-digit SIC codes) and year fixed effects. Standard errors (SE) are clustered by firm and given in parentheses. Level of significance is indicated by *p < 0.10; **p < 0.05; and ***p < 0.01.

4.3. Univariate and multivariate results

To investigate the impact of audit committee connectedness on the adoption of the COSO 2013, we first utilize a univariate approach. Table 6 reports the univariate results. According to H_a, audit committee centrality scores should differ between adopters and non-adopters. As evident in Table 6, adopters have higher audit committee centrality scores (*DEGREE*, *EIGENVECTOR*, *BETWEENESS*, *CLOSENESS,* and *CENTRALITY* scores are 77.73, 72.28, 83.72, 74.48, and 85.30, respectively) compared to non-adopters (*DEGREE*, *EIGENVECTOR*, *BETWEENESS*, *CLOSENESS,* and *CENTRALITY* scores are 73.85, 68.05, 80.40, 69.13, and 82.28, respectively). The mean differences are significant (p = 0.0000) for the adopters relative to the non-adopters of the COSO 2013 framework. Overall, these univariate results suggest that well-connected audit committees are associated with the adoption of COSO 2013.

Table 7 reports results of regressions of COSO 2013 adoption on audit committee centrality measures (*DEGREE*, *EIGENVECTOR*, *BETWEENESS*, *CLOSENESS* and *CENTRALITY*). In all models, the coefficients of audit committee centrality measures are positive and statistically significant, providing support for H_a that firms with well-connected audit committees are more likely to adopt the COSO 2013 framework. In terms of economic significance, these results suggest that an increase in one standard deviation in *DEGREE* centrality is associated with a 13% increase in the probability of COSO 2013 adoption. For *EIGENVECTOR, BETWEENNESS, CLOSENESS,* and *CENTRALITY* network measures, the increase in the probability of COSO 2013 adoption is 11%, 10%, 12%, and 12% respectively. Overall, the results suggest that the social capital of audit committees increases the probability

Table 13
Impact of Audit Committee Connectedness on COSO 2013 Adoption (Entropy Balancing).

PANEL A: Differences in Covariates (Variables)

Variables	High Connected AC	Less Connected AC	Difference
LNASSETS	7.87	7.83	0.05
INVREC	0.21	0.21	0.00
FOREIGN	0.59	0.59	0.00
MERGER	0.45	0.45	0.00
ROA	0.01	0.01	0.00
LOSS	0.22	0.22	0.00
SALESGROWTH	0.34	0.34	0.00
RESTRUCTURE	0.00	0.00	0.00
ZSCORE	8.72	8.67	0.05
SEGMENT	2.19	2.18	0.01
ICWEAKNESS	0.03	0.03	0.00
LEVERAGE	0.65	0.64	0.00
LITIGATE	0.27	0.26	0.00
RESTATEMENT	0.09	0.09	0.00
PWC	0.24	0.23	0.00
DELOITTE	0.19	0.18	0.00
EY	0.31	0.30	0.00
KPMG	0.19	0.19	0.00
AGE	2.96	2.94	0.02
AUDTURNOVER	0.04	0.04	0.00
AUDTENURE	9.66	9.60	0.06

PANEL B: Regression of Adoption of COSO 2013 Framework on Audit Committee Connectedness

Dependent Variable:

ADOPT

		(1)	(2)	(3)	(4)	(5)
DEGREE	+	0.832***				
		(0.100)				
EIGENVECTOR	+		0.546***			
			(0.100)			
BETWEENNESS	+			0.499***		
				(0.099)		
CLOSENESS	+				0.676***	
					(0.099)	
CENTRALITY	+					0.714***
						(0.102)
LNASSETS	+	−0.044	−0.021	−0.022	−0.014	−0.047*
		(0.027)	(0.026)	(0.029)	(0.025)	(0.025)
INVREC	?	−0.536	−0.411	−0.592	−0.041	−0.621
		(0.365)	(0.361)	(0.365)	(0.311)	(0.401)
FOREIGN	?	0.178	0.381***	0.282**	0.290**	0.360***
		(0.116)	(0.121)	(0.119)	(0.113)	(0.116)
MERGER	?	−0.063	−0.029	−0.108	−0.207**	−0.095
		(0.086)	(0.102)	(0.102)	(0.088)	(0.097)
ROA	?	−0.061	−0.034	−0.050	0.040	−0.079
		(0.086)	(0.097)	(0.054)	(0.072)	(0.049)
LOSS	?	−0.230***	−0.354***	−0.434***	−0.254***	−0.318***
		(0.084)	(0.104)	(0.106)	(0.098)	(0.101)
SALESGROWTH	?	0.006*	0.004*	0.003	0.006*	0.005
		(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
RESTRUCTURE	?	1.252	0.032	1.556	0.261	1.861
		(1.776)	(1.956)	(1.569)	(2.071)	(1.417)
SEGMENT	?	−0.010	−0.058	−0.018	−0.053	−0.032
		(0.070)	(0.066)	(0.074)	(0.065)	(0.069)
ICWEAKNESS	−	−0.283	−0.271	−0.232	−0.162	−0.365*
		(0.268)	(0.227)	(0.229)	(0.264)	(0.216)
LEVERAGE	?	−0.160	−0.129	−0.136**	−0.273*	−0.194***
		(0.115)	(0.133)	(0.066)	(0.144)	(0.064)
LITIGATE	?	−0.082	0.005	−0.250*	0.018	−0.192
		(0.113)	(0.143)	(0.133)	(0.122)	(0.143)
RESTATEMENT	?	0.110	−0.124	0.035	−0.078	−0.018
		(0.148)	(0.138)	(0.144)	(0.157)	(0.148)
PWC	+	0.542**	0.769***	0.609***	0.595***	0.696***
		(0.216)	(0.180)	(0.185)	(0.203)	(0.182)
DELOITTE	+	0.592***	0.674***	0.710***	0.574***	0.607***
		(0.210)	(0.189)	(0.194)	(0.212)	(0.188)
EY	+	0.607***	0.801***	0.715***	0.600***	0.730***
		(0.214)	(0.181)	(0.189)	(0.201)	(0.184)

(continued on next page)

Table 13 (*continued*)

PANEL B: Regression of Adoption of COSO 2013 Framework on Audit Committee Connectedness						
Dependent Variable:						
ADOPT						
		(1)	(2)	(3)	(4)	(5)
KPMG	–	0.187	0.291	0.049	0.163	0.080
		(0.230)	(0.188)	(0.196)	(0.207)	(0.186)
AGE	?	0.036	0.017	0.079	0.005	0.101
		(0.058)	(0.068)	(0.073)	(0.060)	(0.072)
AUDTURNOVER	?	−0.282	−0.307	−0.216	−0.264	−0.049
		(0.248)	(0.222)	(0.224)	(0.237)	(0.225)
AUDTENURE	?	0.038***	0.020*	0.054***	0.033***	0.047***
		(0.010)	(0.011)	(0.013)	(0.012)	(0.012)
Industry FE		Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes
Observations		4293	4293	4293	4293	4293
Pseudo R^2		0.52	0.52	0.53	0.52	0.53

Notes: This table reports the regression results of audit committee network centrality measures (*DEGREE*, *EIGENVECTOR*, *BETWEENNESS*, *CLOSENESS*, and *CENTRALITY*) on the likelihood of COSO 2013 adoption (*ADOPT*) using entropy balancing. Panel A presents the matched covariates between treatment and control groups for *DEGREE* centrality as an example. Panel B presents the regression results of audit committee network centrality measures and *ADOPT*, but uses the post-weighting treatment and control observations. All centrality variables are dummy variables. Please see Section 3.1 and Table 2 for variable descriptions and measurements. All continuous variables are winsorized at 1 and 99 percentiles. All regression models include industry (based on two-digit SIC codes) and year fixed effects. Standard errors (SE) are clustered by firm and given in parentheses. Level of significance is indicated by *p < 0.10; **p < 0.05; and ***p < 0.01.

of COSO 2013 adoption by at least 10%.

With regard to control variables, we find that large (*LNASSETS*) and mature (*AGE*) firms with foreign pre-tax income (*FOREIGN*) have a higher likelihood of adopting COSO 2013. Regression results also show that auditing firms play a key role concerning the decision to adopt. Specifically, the coefficients of *PWC*, *DELOITTE*, and *EY* in all models are positive and statistically significant, suggesting that the clients of these audit firms are more likely to adopt COSO 2013. Further, we find that the coefficients on *AUDTENURE* in all models are positive and statistically significant. This suggests that longer audit tenure is associated with a higher likelihood of a client firm's adoption of COSO 2013.

5. Additional analyses & robustness tests

5.1. CEO and CFO connectedness

While we investigate the impact of audit committee connectedness on COSO 2013 adoption, executives' network connections might also affect the adoption decision because executives influence internal control weakness disclosures, improvements, and compliance (Hoitash, Hoitash, & Johnstone, 2012; McConnell Jr & Banks, 2003). Executives may also exercise significant and independent influence on audit committee effectiveness (Lisic, Neal, Zhang, & Zhang, 2016). Given that CEOs and CFOs are responsible for establishing, maintaining, and evaluating internal control effectiveness, their network connections may impact COSO 2013 adoption. Therefore, we control for CEO and CFO network centrality measures and re-run the models using Eq. (5). These results are presented in Table 8.

Table 8 (Panel A) indicates that firms with well-connected audit committees are more likely to adopt COSO 2013, even after controlling for CEO network centrality measures. Interestingly, the results also suggest that CEO connectedness has no significant impact on the adoption of the COSO 2013. Panel B reports that our findings are also robust to the inclusion of CFO connectedness, and that like CEOs, CFO social capital is not relevant to COSO 2013 adoption. We conjecture that audit committee effectiveness lessens the importance of CEO and CFO connectedness. While previous studies document that audit committee monitoring effectiveness is influenced by CEO and CFO power (Lisic et al., 2016), we find that with regard to COSO 2013 adoption, CEO and CFO power does not positively or negatively affect the decision.

5.2. Audit committee connectedness and the timely adoption of COSO 2013

The COSO 2013 framework superseded the 1992 framework as of December 15, 2014. However, transitioning to the updated framework was challenging and costly, and many firms were either slow to adopt or continued to use the 1992 framework even after the deadline (Addy & Berglund, 2020; Salierno, 2014). As timely adoption of the updated framework was necessary to minimize the risk of internal control failures and data breaches, we examine the impact of audit committee connectedness on the speed to adoption of COSO 2013. To investigate whether audit committee connectedness impacts the timely adoption of COSO 2013 framework, we create a variable, $ADOPT_{TIMELY}$ which equals 1 if the firm adopted the updated 2013 framework on or before December 15, 2014, and 0 otherwise. Results are presented in Table 9.

Table 9 indicates that in all models, the coefficients of audit committee centrality measures are positive and statistically significant, suggesting that firms with well-connected audit committees were more likely to adopt COSO 2013 in a timely manner.

5.3. KPMG and non-KPMG firms

Prior literature suggests that audit firms played a key role in the adoption of COSO 2013 (Addy & Berglund, 2020; Tadesse et al., 2022). Consistent with prior studies, we find that clients of *PWC*, *DELOITTE*, and *EY* are more likely to adopt the COSO 2013 framework, whereas being a *KPMG* client has no significant effect on COSO 2013 adoption. Prior studies also find that *KPMG* clients tended to adopt relatively late, though it is not clear why KPMG, unlike other big N auditors, did not prioritize the adoption of COSO 2013. Whitehouse (2014) documents that KPMG's position was that "companies shouldn't rush to transition" and " perhaps next year might be a better transition date." To examine if audit committee social capital may counteract *KPMG*'s stance on adoption of COSO 2013, we split the sample into *KPMG* and non-*KPMG* firms and re-run our regressions. The results are presented in Table 10.

Table 10 Panel A shows the impact of audit committee social capital on COSO 2013 adoption in client firms of *PWC*, *DELOITTE*, and *EY*. As expected, client firms of *PWC*, *DELOITTE*, and *EY* with well-connected audit committees are more likely to adopt the COSO 2013 framework. Panel B of Table 10 highlights the impact of KPMG advice on COSO 2013 adoption. While the coefficients on *DEGREE*, *EIGENVECTOR*, *CLOSENESS* and *CENTRALITY* are not significant, the coefficient on

Table 14
Impact of Audit Committee Connectedness on Adoption of COSO 2013 Framework (Matched Sample).

		Dependent Variable:				
				ADOPT		
		(1)	(2)	(3)	(4)	(5)
DEGREE	+	0.012**				
		(0.005)				
EIGENVECTOR	+		0.007**			
			(0.003)			
BETWEENNESS	+			0.006*		
				(0.004)		
CLOSENESS	+				0.007**	
					(0.003)	
CENTRALITY	+					0.012*
						(0.007)
LNASSETS	+	0.262***	0.254***	0.262***	0.267***	0.272***
		(0.046)	(0.038)	(0.038)	(0.045)	(0.045)
INVREC	?	−0.557	−0.309	−0.331	−0.549	−0.593*
		(0.350)	(0.264)	(0.273)	(0.351)	(0.349)
FOREIGN	?	0.481***	0.409***	0.386***	0.489***	0.488***
		(0.143)	(0.125)	(0.126)	(0.143)	(0.143)
MERGER	?	−0.158	−0.128	−0.131	−0.160	−0.159
		(0.123)	(0.115)	(0.116)	(0.124)	(0.123)
ROA	?	0.038	0.103	0.102	0.043	0.024
		(0.201)	(0.207)	(0.214)	(0.200)	(0.198)
LOSS	?	−0.084	−0.166	−0.158	−0.086	−0.079
		(0.138)	(0.135)	(0.139)	(0.138)	(0.138)
SALESGROWTH	?	0.002	0.003	0.003	0.002	0.002
		(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
RESTRUCTURE	?	−0.738	−0.497	−0.547	−0.695	−0.718
		(2.437)	(2.584)	(2.620)	(2.421)	(2.466)
SEGMENT	?	−0.099	−0.082	−0.084	−0.098	−0.101
		(0.092)	(0.086)	(0.081)	(0.093)	(0.092)
ICWEAKNESS	−	−0.152	−0.181	−0.173	−0.149	−0.159
		(0.238)	(0.238)	(0.236)	(0.237)	(0.237)
LEVERAGE	?	−0.017	−0.015	−0.008	−0.018	−0.015
		(0.043)	(0.049)	(0.042)	(0.047)	(0.043)
LITIGATE	?	0.071	0.096	0.090	0.081	0.062
		(0.224)	(0.119)	(0.123)	(0.224)	(0.224)
RESTATEMENT	?	0.032	0.077	0.064	0.037	0.020
		(0.177)	(0.174)	(0.166)	(0.177)	(0.176)
PWC	+	0.750***	0.852***	0.848***	0.766***	0.782***
		(0.226)	(0.217)	(0.196)	(0.226)	(0.226)
DELOITTE	+	0.661***	0.825***	0.820***	0.672***	0.699***
		(0.207)	(0.197)	(0.194)	(0.207)	(0.206)
EY	+	0.712***	0.839***	0.830***	0.728***	0.746***
		(0.184)	(0.173)	(0.172)	(0.183)	(0.183)
KPMG	−	−0.271	−0.179	−0.181	−0.256	−0.241
		(0.168)	(0.158)	(0.180)	(0.167)	(0.167)
AGE	+	0.252***	0.255***	0.260***	0.253***	0.253***
		(0.086)	(0.082)	(0.082)	(0.086)	(0.086)
AUDTURNOVER	?	0.097	0.119	0.123	0.094	0.104
		(0.218)	(0.212)	(0.221)	(0.218)	(0.219)
AUDTENURE	?	0.038***	0.031**	0.032**	0.037***	0.037***
		(0.014)	(0.014)	(0.015)	(0.014)	(0.014)
Industry FE		Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes
Observations		2380	2380	2380	2380	2380
Pseudo R^2		0.28	0.26	0.26	0.28	0.28

Notes: This table reports the regression results of audit committee network centrality measures (*DEGREE*, *EIGENVECTOR*, BETWEENNESS, *CLOSENESS*, and *CENTRALITY*) on the likelihood of COSO 2013 adoption (*ADOPT*) using a matched sample. Please see Section 3.1 and Table 2 for variable descriptions and measurements. All continuous variables are winsorized at 1 and 99 percentiles. All regression models include industry (based on two-digit SIC codes) and year fixed effects. Standard errors (SE) are clustered by firm and given in parentheses. Level of significance is indicated by *p < 0.10; **p < 0.05; and ***p < 0.01.

BETWEENNESS is significant, thus providing some limited evidence that *KPMG* client firms with well-connected audit committees were more likely to adopt COSO 2013. These findings shed new light on the conventional wisdom that KPMG clients were unlikely (or late) to adopt COSO 2013.

5.4. Accelerated vs non-accelerated filers

Section 404(a) of SOX requires companies to include management's assessment (management report) on internal controls in the 10-K, whereas Section 404(b) requires companies to have auditors evaluate the effectiveness of internal controls. However, the Dodd-Frank Wall

Street Reform and Consumer Protection Act (2010) exempts non-accelerated filers[6] from Section 404(b) of SOX (Holder, Karim, & Robin, 2013). This exemption came for non-accelerated filers as Congress aimed to reduce the costly SOX compliance burden smaller filers had to bear and meant that attestation by the auditors was no longer mandated for internal control over financial reporting. Because audit committees of non-accelerated filers may not be as motivated as those of accelerated filers to adopt COSO 2013, we rerun our models splitting the sample into accelerated and non-accelerated filing firms. The results are presented in Table 11.

Unsurprisingly, Table 11 indicates that the effect of audit committee connectedness on COSO 2013 adoption is significant only for accelerated filers.[7] Non-accelerated filers have less regulatory burden and are therefore less likely to voluntarily adopt COSO 2013.

5.5. Connectedness of the audit committee chair, financial experts, and members

We measure audit committees' connectedness for the full committee. However, audit committees are comprised of a chair, financial experts, and other members. Differential compositions of the audit committee may differently affect COSO adoption, since prior studies document that different expertise and the composition of audit committees have implications for financial reporting quality and investors (Abernathy, Beyer, Masli, & Stefaniak, 2014; Krishnan & Lee, 2009; Krishnan, Wen, & Zhao, 2011). We therefore re-run regression models for audit committee chairs, financial experts, and members. The results are reported in Table 12.

The results indicate that the connectedness of each group of audit committees, i.e., chair, members, financial experts, impacts the likelihood of COSO 2013 adoption. Together, these results suggest that our initial results, that is well-connected audit committees are more likely to adopt the COSO 2013 framework, are not dominated by the effect of any particular group within the audit committees. Rather the positive effect of audit committee connectedness on COSO 2013 adoption is due to the overall social capital of the audit committee.

5.6. Endogeneity tests

5.6.1. Entropy balancing

The significant correlation between audit committee centrality measures and other firm- and audit-related variables might raise a concern that certain firms are more likely to have well-connected directors serving on their boards. Larger, mature, and more profitable firms are more likely to have well-connected board members. Also, well-connected board members are less likely to serve at firms with material internal controls weaknesses, restatements, and going concern opinions. To mitigate endogeneity concerns resulting from omitted firm characteristics that may also be correlated with centrality, we employ a multivariate matching approach, entropy balancing (Hainmueller, 2012; McMullin & Schonberger, 2020), to reweight our observations such that the distributional characteristics of treatment and control groups are similar post-weighting. Entropy balancing ensures a better covariate balance between treatment (well-connected audit committee members) and control groups (less connected audit committee members). Firms are placed in the treatment group if audit committee centrality ranking is greater than the median centrality value. Table 13 reports the regression results of audit committee connectedness and adoption of COSO 2013 framework after entropy balancing.

Table 13 Panel A presents the means and their differences between the treatment and control groups after re-weighting of observations for *DEGREE* centrality, as an example. The means of covariates for both groups are almost the same, thus suggesting that entropy balancing is properly achieved. Panel B of Table 13 reports the regression results, using post-weighted treatment and control observations. In all models, the coefficients of audit committee centrality measures are positive and statistically significant, validating our initial support for H_a that firms with well-connected audit committees are more likely to adopt the COSO 2013 framework.

5.6.2. Matched sample

To further alleviate endogeneity concerns, we re-run our regressions on a matched sample. To generate the sample, we match firms that did not adopt COSO 2013 with firms that did. We first match both groups of firms using year and industry (two-digit SIC code). Then using firm size and profitability, we create quartiles for each year and industry. For a given year and industry, we consider a non-adopting firm ($ADOPT = 0$) as matched with an adopting firm ($ADOPT = 1$) if non-adopting firms are in the same quartile with adopting firms. We use firm size and profitability when matching firms because larger and more profitable firms in an industry are more likely to have similar practices and take similar approaches to comply with regulatory expectations (Filbien & Kooli, 2011; Uhlenbruck, Hughes-Morgan, Hitt, Ferrier, & Brymer, 2017). This matching process helps to address endogeneity arising from sample selection bias.[8] Table 14 reports the regression results of audit committee connectedness and adoption of COSO 2013 for this matched sample.[9] In all models, the coefficients on the audit committee centrality measures are positive and statistically significant, providing further support for H_a that firms with well-connected audit committees are more likely to adopt the COSO 2013 framework.

6. Discussion and conclusion

As audit committees are integral in maintaining and improving effective internal controls systems in firms, we investigate the effect of audit committees' social capital, proxied by the average network centrality of audit committee members, on the likelihood of adopting COSO 2013. Using a sample of 4293 firm-year observations over 2014–2017, we find that organizations with well-connected audit committees are more likely to adopt the updated COSO 2013 framework, even after controlling for a myriad of organization- and audit- related factors. We also find that organizations with well-connected audit committees tend to adopt COSO 2013 in a timely manner. Our results do not appear to be driven by the differential expertise or composition of audit committees, but by the overall connectedness of the audit committee. Our findings remain unchanged even after controlling for executive (CEO and CFO) connectedness. We also show that the positive effect of audit committee connectedness on COSO 2013 adoption is significant only for accelerated filers. Overall, our results suggest that audit committee characteristics in terms of network connections impact compliance with internal

[6] Large accelerated filers are those whose public float is more than $700 million and accelerated filers are those whose public float is $75 million or more as of the last business day of second fiscal quarter. A reporting company that does not meet the requirements to be an accelerated filer or a large accelerated filer is non-accelerated filer.

[7] In this study, we use the term accelerated filer to indicate firms that are larger than non-accelerated filers and include firms with both the large accelerated and accelerated filing status.

[8] For example, one sample selection concern might be that *KPMG* variable is not significant in the models because KPMG audits more non-accelerated filers than other BIG N firms in the sample and the result may be driven by the fact that non-accelerated filers are not required to have their internal control report audited; if so, audit committees in these firms would be less likely to encourage switching to COSO 2013. However, the matching process we use alleviates this concern and shows that the *KPMG* variable is still not significant in the matched sample results.

[9] We also used propensity score matched sample using nearest neighbor matching and the results remain qualitatively the same.

control framework updates.

Our study contributes to both theory and practice. With respect to theory, using alternative metrics of audit committee connectedness, we extend Addy and Berglund (2020) to show that audit committee connectedness positively impacts the adoption of COSO 2013. We also add to the burgeoning social network literature that articulates the impact of executive/director network connections on different accounting and auditing outcomes. Our results should be of interest to practitioners as well. We show that having a well-connected audit committee has beneficial effects on internal controls through firm compliance and adoption decisions. Regulators such as the Public Accounting Oversight Board as well as the SEC should consider seeking input and buy-in from directors serving on the audit committee for future initiatives related to internal control and auditing, as audit committees appear to communicate endorsements through their networks. Our study opens new avenues for research by showing a need for more scholarly investigation on the effects of network connections and audit committee related factors on firm outcomes and decisions.

Declaration of Competing Interest

The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript.

Data availability

Data are available from the sources identified in the manuscript.

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