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RESEARCH ARTICLE

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The Chief Information Officer: Impact on Organizational Forecasting Outcomes

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Abstract

Management earnings forecasts are essential sources of information for organizational shareholders. However, many companies remain in a quandary about how to develop an appropriate governance structure within top management to produce high-quality forecasts. This study investigates how firms with chief information officers (CIOs) impact organizational outcomes in terms of both the frequency and the bias of management earnings forecasts. We integrate the following theories to formulate our hypotheses: upper echelons theory, agency theory, and information processing theory (in conjunction with strategic management literature). Using a sample of firm-years (2000 to 2010), we find robust support for the proposition that firms with CIOs are associated with reduced opportunistic bias in earnings forecasts. In addition, we find that, as information uncertainty increases, firms with CIOs generate management forecasts less frequently and exhibit a reduction in optimistic forecasting bias. Collectively, these findings provide a theory-based understanding of how firms with CIOs can influence forecasting outcomes.

Keywords: Chief Information Officer (CIO), Upper Echelons Theory, Agency Theory, Information Processing Theory, IS Leadership, Strategic Management, Top Management, Management Earnings Forecasts

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1 Introduction

Management earnings forecasts are a fundamental mechanism that firms use to voluntarily disclose insight into their future performance and reduce information asymmetry between investors and firm management (Hsieh et al., 2019). Management earnings forecasts represent one of the most important information sources for investors, capturing 55% of firms' accounting-based information (Beyer et al., 2010). Prior research has documented that management earnings forecasts provide a key source of information to capital markets and can significantly affect a multitude of organizational outcomes: firm's market valuation (Patell, 1976; Penman, 1980; Pownall et al., 1993; Yang, 2012), financial analyst forecasts (Ajinkya & Gift, 1984), executive turnover (Lee et al., 2012), future analyst response (Williams, 1996), and corporate investment efficiency (Goodman, et al., 2014). However, few studies have examined how top management members impact earnings forecasting (Bamber et al., 2010; Ke et al., 2019). This paper responds to calls for research examining the influence of top managers, beyond financial executives, on management earnings forecasts (Xing, 2019). Despite the vital importance of earnings forecasting quality, organizations still face great challenges in developing sound information governance structures from which forecasts can be developed free of bias. According to upper echelons theory (UET), senior executives are essential for developing and leading strategic

initiatives for organizations (Finkelstein & Hambrick, 1990; 1996). In this study, we specifically focus on how the top management role of the chief information officer (CIO) impacts an organization's management earnings forecasts.

The CIO is the highest-ranking information executive within a company, a role that is becoming ever more prominent, as indicated by the increasing number of firms that have adopted a CIO position in recent years (Banker et al., 2011, Yayla & Hu, 2014). Previously CIOs primarily held technical roles with limited strategic impact. However, many CIOs now report directly to the CEO and are often held accountable for a wide array of organizational-level and strategic responsibilities, such as aligning IS with business strategy, redesigning management processes, and ultimately creating business value for the organization as a whole (Banker et al., 2011; Karahanna & Preston, 2013; Luo, 2013). The rising prominence of CIOs has been attributed to the growing focus that organizations are placing on information as a strategic asset (Preston & Karahanna, 2009). Many companies are currently undergoing a digitalization transformation, and information and IT are becoming more deeply embedded in a multitude of business processes and practices (Kettinger et al., 2011). Firms are increasingly motivated to exploit their information resources to achieve competitive advantages by gradually shifting their strategic emphasis from technology to information (Peppard et al., 2011).

Some speculation in the practitioner literature suggests that the importance of the CIO could be diminished to some degree by, for example, the increasing prevalence of cloud computing and IT outsourcing, higher levels of IT competency among other executives (CEO, CFO, chief marketing officer, etc.), and the potential emergence of new C-level technology positions (e.g., chief data scientist; chief technology officer, chief digitization officer, chief analytics officer, etc.) (Drewry & Weiss, 2011). However, the majority of recent evidence suggests that the diminishment of the CIO role is unlikely. Because routine and perfunctory IT tasks are now being outsourced or handled at the functional/managerial level of the organization, the executive-level CIO in the age of digitization has become even more focused on delivering strategic initiatives, enabling transformation, and driving revenue for the organization (Abramovich, 2019; Stackploe, 2019). In addition, it has been observed that IT awareness among top management members facilitates (rather than hinders) the CIO's effectiveness (Yayla & Hu, 2014). Furthermore, the CIO role remains critical to spearheading new technological information-related innovation, and the CIO is generally responsible for managing analytics and digitization efforts (Nott, 2018) as well as any newly created technology responsibilities (Paredes, 2018). Specifically, the strategic role of the CIO is to essentially oversee all aspects of a firm's internal and external information flows (Spitze & Lee, 2012). As such, in the digital economy, the CIO is expected to play a critical role in shaping a company's information processes and is likely to have a significant effect on a firm's capacity to effectively utilize information (Feng & Wang, 2019; Kettinger et al., 2011).[1]

Information systems (IS) researchers have emphasized the need to further examine the complex relationships between information capabilities, governance structures, and firm performance (Dawson et al., 2016; Karahanna & Preston, 2013). In this study, we specifically focus on how the inclusion of the CIO within the firm potentially impacts corporate information outcomes, as reflected in both the frequency and bias of management earnings forecasts. Managerial earnings forecasts can establish or alter market expectations of a company and represent an important constituent of the information capacity of the firm (Beyer et al., 2010; Hirst et al., 2008).

We integrate UET in conjunction with agency theory, information processing theory (IPT), and the strategic management literature to investigate an underdeveloped research domain—i.e., whether firms with CIOs can better address the frequency and bias of management earnings forecasts. IS researchers have called for research that applies organizational and strategic management theories in order to examine idiosyncratic leadership concerns that emanate from the unique aspects of the CIO position within the organization (Karahanna & Watson, 2006; Preston et al., 2008). In this study, we also address calls from the upper echelons and IS leadership literature to examine top executives' (i.e., specifically CIOs') impact beyond designated functional areas within the organization (Carpenter et al., 2004; Menz & Scheef, 2014; Preston & Karahanna, 2009) into a more expansive strategic role for the CIO. Furthermore, this study complements prior management earnings

[1] The CIO and CTO (i.e., chief technology officer) are terms that have, at times, been used interchangeably; however, there are clear distinctions between the two positions in large companies. Chief technology officer (CTO) is an executive-level position whose responsibility is focused on scientific and technological issues within an organization. The "technology" focus of the CTO may be IT related but can also be non-information-focused technology (e.g., biotech, engineering, etc.). (see http://www.cio.com/article/2440655/cio-role/whatever-happened-to-the-cto-role-.html) In this study, we focus on the CIO instead of the CTO regarding forecasts, because the CIO's primary responsibility is information related, while the CTO's is more technology focused. However, we also conducted additional tests by including the CTO position in our analyses, discussed below.

forecast research that relates forecast frequency and bias to IS control issues, specifically focusing on information governance by highlighting the CIO's importance in this process (Dorantes et al., 2013; Li et al., 2012). The remainder of the paper is organized as follows: Section 2 presents the theoretical development and research model, Section 3 details the research method and results, and Section 4 discusses the limitations of our study, the theoretical and practical implications of our findings, and future research avenues.

2 Research Model and Theoretical Development

2.1 Theoretical Overview

Below, we discuss the three primary theories (upper echelons theory, agency theory, and information processing theory) that serve as the theoretical foundation for examining the current phenomenon of interest. Collectively, we use UET, agency theory, and IPT to demonstrate the pivotal role that CIOs can play in enhancing an organization's information processing capacity without overloading hierarchical channels. We then integrate these theoretical foundations to clarify the influence of the CIO on strategic initiatives and, more specifically, on management earnings forecasting.

Upper echelons theory (UET) proposes that the top management team (TMT) collectively integrates the various perspectives of its individual members into specific strategic actions that determine organizational outcomes (Finkelstein & Hambrick 1990, 1996). Although there may be individual executive perceptions, it is the TMT as a cohesive unit that defines organizational interpretations, recognizes valuable opportunities, and makes strategic decisions impacting organizational outcomes (Armstrong & Sambamurthy, 1999). Top executives with strong backgrounds and functional expertise can supplement and complement the collective knowledge base of the TMT and thus facilitate the TMT's decision-making processes through filtering and interpreting information (Menz, 2012). The presence of a CIO within a TMT not only legitimizes this role as a strategic position but can provide unique perspectives on complex situations involved in information gathering and synthesis processes (Preston & Karahanna, 2009). TMT knowledge exchange and integration is paramount for organizational action and for making sense of data generated from internal information systems (Armstrong & Sambamurthy, 1999; Chatterjee et al., 2001).

Agency theory presumes that management (agents) act rationally in their own interest even at the potential expense of organizational shareholders (principals) (Jensen & Meckling, 1976). A number of studies focusing on corporate governance have used classical agency theory as their theoretical basis (Lan & Heracleous, 2010) to show how organizations seek to manage opportunistic behaviors from agents through the design of governance structures (Dawson et al., 2016). We contend that the CIO, as part of the top management team, is positioned to develop and ensure information processing capabilities and is an essential element of the organizational governance structure. Nevertheless, CIOs, like other senior executives, often have their own objectives and agendas (Shrivastava & Mitroff, 1984; Daft & Lengel, 1986) that may conflict with organizational goals. Therefore, CIOs may be biased if they narrowly focus on their individual agendas without assimilating the company's overall objectives (Walsh, 1988).

The information processing theory of organizations is based on the premise that coping with data from the environment is often the most critical contingency faced by the modern organization (Atuahene-Gima & Li, 2004; Daft & Weick, 1984). Specifically, according to IPT, organizations are open social systems that interface with both internal and external sources of complexity; therefore, they must develop mechanisms to acquire, process, filter, and act on relevant information (Olson et al., 2007; Sanders & Carpenter, 1998; Tushman & Nadler, 1978). IPT contends that an effective organizational design seeks to develop a fit between the organization's information processing requirements and capacities, which can be developed via the following managerially led mechanisms: (1) reducing the need for information (via the creation of slack resources and self-contained tasks), and (2) increasing the firm's information processing capability (via the investment in vertical information channels and creation of lateral relations) (Galbraith, 1973; Galbraith, 1977; Song et al., 2005). Prior IPT research proposes that organizations should seek to develop an executive role within the hierarchical power structure to lead the acquisition and dissemination of information and manage the fit between information requirements and capacities (Galbraith, 1973; Galbraith, 1977; Song et al., 2005). However, different executives hold different levels of functional knowledge pertaining to the organization (Ke et al., 2019).[2]

[2] The various executives have access to different/specialized operational and business information. For example, chief sales officers would have immediate access to customers and a better understanding of market demand and trend while production executives would be more knowledgeable about equipment and inventory conditions than other executives. Such information constitutes necessary input for making

2.2 The Influence of the CIO on Strategic Initiatives

As noted above, a number of studies in the extant literature that have examined the strategic role of the CIO; we summarize the most relevant empirical research in Appendix A1. A number of studies have examined the strategic role and/or strategic impact of the CIO within the organization. The primary strategic organizational outcomes derived from the CIO's influence include strong CIO/TMT relationships, IS/business strategy formulation/orientation, shared understating with the TMT regarding the strategic role of IS within the organization, IS strategic alignment, and various elements of organizational performance (R&D productivity, hospital financial performance, positive reactions in the marketplace, etc.). The IS leadership and IS strategic alignment literatures have been widely used to support theoretical assertions in the CIO studies outlined in Appendix A1. In addition, these studies have employed UET, social capital theory, and knowledge and resource-based views of the firm, among other theories.

The principal responsibility of the CIO is to ensure that rapidly evolving informational opportunities are understood, initiated, and strategically exploited for the benefit of the organization (Grover et al., 1993; Karahanna & Preston, 2013; Khallaf & Skantz, 2015). However, the IS leadership literature has drawn a clear distinction between the role of an organizational CIO and that of the IS manager (as well as the outlined differences between the CIO and CTO). Currently, the role of the CIO generally emphasizes information (rather than technology) to focus on strategic level initiatives and add value to the organization, whereas IS managers focus on technical/tactical specialties within their functional group in the organization (Peppard et al., 2011; Schobel & Denford, 2013).[3] The CIO constitutes the crucial link between the organization's informational orientation and the day-to-day information-oriented operations of the firm, whereas IS managers provide insight from their area of specialty to advise the CIO on technical/tactical matters (Grover et al., 1993; Peppard, 2010). However, this approach may be easier said than done because it takes an information leader in the organization to align information capabilities with organizational needs (Paredes, 2018).

The use of information provides the base of understanding for the actions of organizational actors (Huber & Daft, 1987; Forbes, 2007). The organization faces both horizontal and vertical boundaries with the environment; therefore, the complexity the firm faces in its competitive environment requires top managers to process vast amounts of diverse, ambiguous, and conflicting information (Gomez et al., 2016; Sanders & Carpenter, 1998). Although many actors may channel information into the organization, the tenets of UET contend that the organization's top management synthesizes and interprets information for organizational actions, based on their perceptions of the environment, (Daft & Weick, 1984; Hambrick & Mason, 1984). However, top managers are constrained by bounded rationality and their decisions are based on their perceptions of the environment rather than on the actual environment itself, which can introduce various levels of inaccuracy (Chari et al., 2014).

Although top managers and organizational board members might be relatively informed on the latest information-related trends and technology concepts, they often lack an in-depth understanding of the full range of principles that need to be considered and applied in order to timely and effectively meet the information needs of the organization (Atkins & Stacey, 2018). Prior research has emphasized that governance structures must give top managers the appropriate capacity to process critical information (Finkelstein & Hambrick, 1996; Haleblian & Finkelstein, 1993; Preston & Karahanna, 2009). Specifically, we contend that the CIO (as the executive directly responsible for managing information) is well positioned to influence the perceptions of the top management. The extant research argues that the CIO has organization-wide leadership responsibilities. As such, rather than chief information officer, CIO might also be taken to mean "chief influencing officer" (Banker et al., 2011). For example, the practitioner literature has noted that effective CIOs function as evangelists for information-related initiatives throughout the organization that may allow for cultural change (Baig, 2018). The strategic management literature has noted that the appointment of an executive with specific functional expertise ensures that the organizational function/domain will receive sufficient attention and resources (Menz & Scheef, 2014). As the top IS executive within the organization, the CIO position leads the development and refinement of information policies applicable across functional groups and manages the acquisition, interpretation, and dissemination of information within the organization.[4]

revenue and expenses forecasts. (Schilit & Perler, 2010; Kieso et al., 2013).

[3] Recently, new organizational positions associated with the rise of technology and digitization of firms have emerged (e.g., titled chief digital officer, chief data officer, etc.). In some cases, these positions may supplant the CIO position. However, such cases are rare and may simply involve a change in title for the same position as the prior CIO. The CIO position is relatively entrenched within the senior ranks of management, despite volatile expectations and demands on the particular individuals holding that position. The digitization of firms requires greater strategic capabilities of CIOs who tend to leave operational and specialized tasks to subordinates (Banker & Feng, 2019; Gerth & Peppard, 2016).

[4] We refer to "information systems" in general within the organization rather than a specific set of idiosyncratic technologies.

2.3 CIO Influence on Management Earnings Forecasting

A series of studies have also examined the influence of top managers on earnings forecasts. We summarize the most relevant extant empirical research in this domain in Appendix A2. The majority of these studies examine the characteristics of members of the upper echelon or relationships among the CEO, CFO, or top management in general as potential influencers on management earnings forecasts. Only one study in this domain (Liu et al., 2018) examines the CIO's role in aligning IT changes to accounting reporting requirements. The supporting theoretical bases are generally supported by the management forecast, literature, and disclosure literatures. Although the accounting literature is the predominant basis for theoretical support, this literature base also applies theories from the management literature including UET, agency theory, IPT, and social ties, among others (see Appendix A2). To date, there is a dearth of empirical research examining the CIO's potential influence on management earnings forecasts.

Management earnings forecasts are important information outcomes generated by a company's collective information capacity, which allows the firm to communicate its financial prospects to stock market participants (Hirst et al., 2008; Kwak et al., 2012), preempt litigation concerns, and build firm reputation for transparent reporting (Ajinkya et al., 2005; Hirst et al., 2008; Skinner, 1997). The upper echelon's perception of the external environment shapes the sociopolitical process within top management and the framing of the issues facing their firm (Heavey & Simsek, 2013). Prior accounting research proposes that corporate governance and senior executives' characteristics can affect both the frequency and bias of management earnings forecasts (Baik et al., 2011; Feng et al., 2009; Karamanou & Vafeas, 2005; Kwak et al., 2012). For example, it has been documented that management forecast frequency increases with institutional ownership and board independence (Ajinkya et al., 2005; Kwak et al., 2012). Furthermore, prior research has demonstrated that management earnings forecasts are more accurate for firms with higher institutional ownership (Ajinkya et al., 2005). Earlier studies have also investigated the role of IS governance and IS implementation in enhancing/compromising the quality of such forecasts. Li et al., (2012) show that management earnings forecasts are less accurate for firms with IS material weaknesses. Dorantes et al., (2013) found that management forecasts are more accurate after firms implement needed enterprise systems. Interestingly, the influence of the CIO, whose primary responsibility is information, has not been examined.

Forecasting earnings involve senior executives from different functional areas who are privy to varying levels of domain-specific information (Schilit & Perler, 2010; Kieso et al., 2013; Ke et al., 2019) because earnings forecasts require communication and consolidation of functional, operational, and financial information provided by various executives (Dorantes et al., 2013; Hutton et al., 2012; Li et al., 2012). To effectively assess the environment the organization faces, top management needs to be receptive to guidance by individual members with knowledge or expertise in particular situations or contexts, particularly executives with responsibilities that span various boundaries (Agle et al., 2006; Cannella et al., 2008). As discussed earlier, the CIO (as the senior IS executive in charge of linking and integrating information across the organization) can improve top management access to and understanding of information, thus reducing information asymmetry. UET contends that the background and experience of top managers build their cognitive framing and, in turn, their potential to influence the decision-making of other members within the firm's upper echelon (Finkelstein & Hambrick, 1990, 1996). In accordance with UET, we expect that the background and expertise of the CIO (i.e., whose role in the organization is to bridge strategic IS capabilities with the business) is fundamental in shaping how fellow top managers engage in information collection and processing to address organizational needs (Preston & Karahanna, 2009). Although the CFO is directly responsible for financial reporting within the organization, the CIO plays an essential role in channeling, consolidating, and interpreting information for the top management team (e.g., Cusimano, 2013). For example, Ke et al., (2019) contend that information sharing among top executives within the organization is essential for forecasting earnings and goes beyond contributions of the CEO and CFO. Interestingly, the CFO position came into prominence in the 1960s when it became necessary to have an executive with specialized domain knowledge to address persistent financial challenges faced by an organization (Schobel & Denford, 2013). Although CFOs are now ubiquitous across almost all publicly traded organizations (e.g., 97% of US firms have a CFO present in the C-suite) (Datta & Iskandar-Datta, 2014), the responsibilities of the CFO generally consist of narrow financially centric functional skills and are typically consistent and homogeneous across firms (Datta & Iskandar-Datta, 2014). Furthermore, since the CEO and other top management members are generally receptive to the financial mindset of the CFO, the nature of the CFO's management of financial reporting can be readily assessed by other top management members (Ke et al., 2019; Stevens et al., 2005). Liu et al., (2018) contend that accounting regulatory changes mandate the need for the CIO to take the lead in aligning organizational information capacity with reporting requirements. We note that most firms have a senior IT executive with the title of "CIO"; however, unlike the

CFO, the CIO still may not necessarily be a formal member of the TMT (Denford & Schobel, 2021). In the digital age, organizations need to ensure that the CIO works in unison with the CEO, CFO, and executive team as a whole to address informational issues and risks that are fundamental to the firm's financial management and reporting (Lanz, 2017; Schobel & Denford, 2013).

With regard to management earnings forecasting, agency issues may exist not only between the firm's top management and organizational shareholders but also between the corporate top management team and leaders within any of the business units. The CIO is positioned to serve as the lynchpin that links information dispersed across functional groups and channels information from the lower tiers of the organizations upward through the hierarchy to the centralized top management for ultimate strategic decision-making. For instance, the CEO can, at times, be the last to know about critical issues within an organization (Auriemma, 2014). As such, a fundamental role of the CIO is to ensure that information dispersed throughout various layers and functional groups within the organization are properly channeled to the senior executive level in the organization and that information planning objectives are readily passed throughout the organization and aligned with the overall objectives of the firm (Grover et al., 1993; Peppard, 2010). Such reduction in information asymmetry can ensure that more accurate and transparent performance information is created and disseminated in the form of management earnings forecasts.

We contend that the CIO can help activate the information capacity of the firm and can thus increase management earnings forecast frequency and also reduce forecast bias. The CIO can facilitate consolidating and interpreting operational and financial information dispersed among functional departments and segments, which in turn can be particularly instrumental for providing earnings forecasts. As such, because of their IS expertise, their ability to span boundaries across functional areas, and their cross-functional knowledge, CIOs play a critical role in instituting the organization's information capacity and reducing levels of information asymmetry. Through developing and executing informational strategies, the CIO can facilitate information flows across business functions and organizational units and counsel CEOs, CFOs, and other senior executives accordingly (Carter et al., 2011; Lim et al., 2013). With improved access to and interpretation of information, firms should be able to more easily generate management earnings forecasts.

Furthermore, the CIO can also provide accountability for forecasting quality since biased earnings forecasts can lead to lawsuits against the company and its executives (Karamanou & Vafeas, 2005; Kwak et al., 2012). For firms lacking a true CIO, opportunities to capitalize on the influence of CIOs in terms of management forecast earnings will likely be lost since IT directors/managers (who are not top managers) rarely have the capacity to influence organizational decision-making above functional/departmental levels within the organization (Peppard, 2010; Preston & Karahanna, 2009). Hence, we predict that firms with CIOs are positioned to better mitigate management forecast biases and that management forecasts will be less likely to be optimistically biased. Thus, we posit:

H1a: Management forecast frequency will be higher for CIO firms than for non-CIO firms.

H1b: Optimistic management forecast biases will be smaller for CIO firms than for non-CIO firms.

2.4 The Context of Information Uncertainty

We next argue that the influence of the presence of CIOs on management forecast frequency and optimistic bias is contingent upon the information uncertainty surrounding a company. "Uncertainty" implies that organizational decision makers know the probabilities associated with a set of possible outcomes, even though they do not know exactly which outcome will occur (Forbes, 2007). The need to address information uncertainty is one of the most critical tasks that organizations face. Senior executives (i.e., including the CIO) will likely be held accountable for shareholder loss because of biases in management earnings forecasts (Burton et al., 2013), and information uncertainty increases the difficulty and cost of providing accurate earnings forecasts (e.g., Feng et al., 2009). Policy makers, practitioners, and academics all recognize that heightened organizational/litigation risk can reduce a firm's tendency to provide forward-looking earnings disclosures since actual earnings are likely to fall short of the forecast in the presence of high uncertainty (American Institute of Certified Public Accountants, 1994; Breeden, 1995). Baginski et al. (2002) found that US-based companies produce less frequent earnings forecasts than Canadian companies and argue that US managers experience greater legal risks when forecasting earnings. In the current study, we consider the impacts of information uncertainty on the organizational forecasting activities of firms with CIOs. Specifically, we contend that information uncertainty has differential moderating effects on forecasting frequency and biases.

Information uncertainty places a greater burden on an organization's information-processing capacity (e.g., strategic processes and communication/control systems) and hinders the ability of the top management team to execute effectively (Atuahene-Gima & Li, 2004; Galbraith, 1973; Tushman & Nadler, 1978). In conditions of heightened information uncertainty, senior managers need to quickly assess decision

situations and execute actions accordingly (Cannella et al., 2008). The processing of information at the executive level, especially under dynamic conditions, requires knowledge integration across various functional areas for effective decision-making (Melone, 1994). When facing uncertainty, firms need to invest greater efforts and resources to collect, analyze, and comprehend environmental information in order to make effective choices (Daft & Weick, 1984; Forbes, 2007; Qian et al., 2013). Information uncertainty can diminish the confidence of top managers' decision-making when there is a high level of information asymmetry that leads to heightened ambiguity between relevant and irrelevant data (Chari et al., 2014; Milliken, 1987). Thus, the CIO's influence as an information leader within the firm may become more prominent in uncertain environments. The CIO can help the firm assess the nature of the information encountered by the organization and can empower the top management team to execute actions, which is particularly important in unpredictable environments.

However, as an executive, the CIO is accountable for forecasting biases (e.g., Kwak et al., 2012), and the managerial accountability for information outcomes is more salient under high levels of information uncertainty (e.g., Ajinkya et al., 2005; Li et al., 2012). We contend that institutional factors, in conjunction with legal and professional concerns, may discourage CIOs from endorsing more frequent earnings forecasts in uncertain environments (vis-à-vis more stable conditions) and that heightened information uncertainty motivates CIOs to further reduce optimistic forecast biases. Litigation or career risks are likely to be of great concern for the CIO since the CIO executive positions remain precarious. Nearly one in four CIOs are fired for perceived poor performance and have an involuntary turnover rate that is approximately 23% higher than that of other executives (Earl, 2018; Gerth & Peppard, 2014; Nash, 2009). Often, fired CIOs have an excellent prior record of success within the organization and are blindsided by their dismissal (Earl, 2018).

Although the CEO and CFO may also be accountable for information issues, the CIO is often a readily accessible scapegoat when discrepancies or issues of poor information control arise (Earl, 2018; Seijts, 2015). Because of such agency issues, information uncertainty may propel firms with CIOs to be more conservative with their earnings forecasts, which should reduce optimistic forecast bias. Furthermore, information uncertainty may foster institutionally driven inertia along with legal/professional concerns that reduce earnings forecast frequency to a greater extent for firms with CIOs (versus those without a CIO). Thus, information uncertainty may increase the earnings forecast frequency of firms with CIOs (relative to non-CIO firms) because of the CIO's information integrator role, or it may decrease the forecast frequency of firms with CIOs because of heightened agency issues associated with CIOs' reputational and legal concerns. Reputational and legal concerns are likely to dominate the CIO's information integrator role since those concerns arise not only for CIOs but also for other senior executives; thus, the top management team as a whole is more likely to decide to reduce earnings forecast frequency. Therefore, we posit that the forecast frequency of CIO firms decreases more than it does for non-CIO firms when information uncertainty increases.

H2a: Information uncertainty reduces the frequency with which CIO firms release management earnings forecasts to a greater extent than it does in non-CIO firms.

In terms of forecasting biases, information uncertainty not only motivates CIOs to be more conservative, but firms with CIOs are also motivated to offer less optimistically biased earnings forecasts. Therefore, we posit:

H2b: Information uncertainty reduces the optimistic bias in management earnings forecasts in CIO firms to a greater extent than it does in non-CIO firms.

3 Research Method and Results

3.1 Research Models

We estimate the following ordinary least square (OLS) models to test whether management earnings forecast frequency (*MFREQ*) is higher for CIO firms than for non-CIO firms (H1a).

$$MFREQ = \beta_0 + \beta_1 CIO(HCIO) + \beta_2 HCFO + \beta_3 CTO + \beta_4 ITD + \beta_5 COO + \beta_6 LNAT + \beta_7 BETA + \beta_8 ABSCHGROA + \beta_9 INST + \beta_{10} BIG + \beta_{11} NUMANAL + \beta_{12} GROWTH + \beta_{13} LEVERAGE + \beta_{14} LOSS + \beta_{15} SPI + \beta_{16} FOREIGN + \beta_{17} VOL\_SALE + \beta_{18} BINDEP + \beta_{19} DISPFOR + FIRM \& YEAR\ DUMMIES + \varepsilon \quad (1)$$

MFREQ is the frequency of management earnings forecasts (Ajinkya et al., 2005; Kwak et al., 2012) and is obtained from the First Call Database of Company Issued Guidance (CIG). Our variable of interest is *CIO*, which is defined as 1 if a CIO is present in a company. CIO presence is determined using the BoardEx database, which collects and reports profile information of senior executives (discussed in detail in Section 3.2), and 0 otherwise. CIOs vary in accountability and status across companies. A high-status CIO is likely held accountable for more operational processes and is also presumably more resourceful, thus exerting a stronger influence on earnings forecast processes and outcomes. We capture CIO internal accountability and status by using an alternative variable of interest—*HCIO*. *HCIO* is defined as 1 if a CIO is present and has two or more executive titles, and 0 otherwise. Executive titles in this

case are vice president (VP), senior VP, executive VP, etc. Using *HCIO*, we examine whether high-status CIOs, i.e., those with two or more executive titles, more strongly influence forecast outcomes than CIOs with only one title (CIO) and firms without CIOs. Appendix B provides variable definitions used in the analysis.

To control the confounding effect of other senior executives, we include a few other senior executives that may have overlapping functions with CIOs—i.e., CTO, IT director (ITD), and chief operating officer (COO). Specifically, *CTO* is coded as 1 if the firm has a CTO, ITD, or COO, and 0 otherwise. If these executives and managers similarly contribute to forecasting earnings, then *MFREQ* would be positively associated with the presence of these executives ($\beta_2 > 0$, $\beta_3 > 0$, $\beta_4 > 0$). Additionally, we measure the influence of CFOs are directly responsible for making earnings forecasts. While every company has a CFO, CFOs differ in their accountability and status across firms. We include *HCFO* to capture CFO accountability/status. *HCFO* is defined as 1 if a CFO has three or more executive titles (e.g., executive VP, senior VP, treasurer), and 0 otherwise.[5]

We follow prior literature (e.g., Ajinkya et al., 2005; Feng et al., 2009; Li et al., 2012) and control for a range of variables that may be correlated with *MFREQ*. We include economic determinants, such as size (*LNAT*), firm growth (*GROWTH*), change in return on assets (*ABSCHGROA*), leverage (*LEVERAGE*), loss (*LOSS*), and special item events (*SPI*). We expect size (*LNAT*) to be positively related to forecast frequency ($\beta_5 > 0$), since larger firms have a greater demand for management earnings guidance (Kasznik & Lev 1995). *BETA* captures the equity market risk, and *VOL_SALE* is our proxy for sales volatility, both of which increase the difficulty of earnings forecast ($\beta_6 < 0$, $\beta_{16} < 0$). Firms with higher growth (*GROWTH*) or earnings changes (*ABSCHGROA*) are also likely to issue more forecasts ($\beta_7 > 0$, $\beta_{11} > 0$) since these organizational changes necessitate disclosure to aid the market in forming earnings expectations (Kwak et al., 2012, Dorantes et al., 2013). We predict that firms experiencing losses (*LOSS*) make fewer earnings forecasts ($\beta_{13} < 0$), as they likely have greater difficulty forecasting future earnings (Ajinkya et al., 2005; Baik et al., 2011). Firms with special item events (*SPI*) events (e.g., restructuring, mergers, and acquisitions) and foreign operations (*FOREIGN*) have greater operating complexity, placing greater information processing burden on forecasting earnings (Feng et al., 2009; Dorantes et al., 2013). Accordingly, we expect such firms to provide fewer management earnings forecasts ($\beta_{14} < 0$, $\beta_{15} < 0$).

Analyst forecast dispersion (*DISPFOR*) measures the degree of consensus among analysts regarding a firm's *future* earnings and is often used as a proxy for information uncertainty (e.g., Barron et al., 1998; Cheng et al., 2011; Imhoff & Lobo, 1992; Yeung, 2009). We predict forecast frequency to be negatively associated with information uncertainty (*DISPFOR*) ($\beta_{18} < 0$). We also control for corporate governance variables such as institutional ownership (*INST*), audit quality (*BIG*), the number of analysts following (*NUMANAL*), and board independence (*BINDEP*). We predict that earnings forecast frequency is positively associated with institutional ownership ($\beta_5 > 0$), audit quality ($\beta_6 > 0$), analyst following ($\beta_7 > 0$), and board independence ($\beta_{14} > 0$) because stronger corporate governance tends to compel firms to be more transparent and forthcoming (Ajinkya et al., 2005; Baik et al., 2011; Kwak et al., 2012). Finally, we include firm- and year-fixed effects to control for (time-invariant) firm-specific characteristics and time trends, respectively.[6] We report *t*-statistics based upon firm-clustering adjusted standard errors to account for the potential serial correlations between observations across years of the same firm (Petersen, 2009).

We estimate the following ordinary least square (OLS) models to test H1b, which predicts that firms with CIOs are less optimistically biased in their earnings forecast bias than non-CIO firms.

$$MFBIAS = \lambda_0 + \lambda_1 CIO(HCIO) + \lambda_2 HCFO + \lambda_3 CTO + \lambda_4 ITD + \lambda_5 COO + \lambda_6 LNAT + \lambda_7 BETA + \lambda_8 ABSCHGROA + \lambda_9 INST + \lambda_{10} BIG + \lambda_{11} NUMANAL + \lambda_{12} GROWTH + \lambda_{13} LEVERAGE + \lambda_{14} LOSS + \lambda_{15} SPI + \lambda_{16} FOREIGN + \lambda_{17} VOL\_SALE + \lambda_{18} BINDEP + \lambda_{19} DISPFOR + \lambda_{20} HORIZON + \lambda_{21} SURPRISE + FIRM \& YEAR\ DUMMIES + \varepsilon \quad (2)$$

[5] Our descriptive statistics (untabulated) show that over 85% of CFOs have at least two executive titles besides the title of CFO, and over 30% of CFOs have three to four executive titles.

[6] Our panel data is amenable to either random-effect or fixed-effect estimation models. We conducted Hausman tests to identify the most appropriate estimation approach for our sample data. Specifically, we estimated the random-effect model for both the management forecast frequency analysis (i.e., the dependent variable is *MFREQ*) and the forecast bias analysis (i.e., the dependent variable is *MFBIAS*). We then performed the Hausman test for each analysis. Under the null hypothesis, the appropriate model is assumed to be the random-effect model. The alternative hypothesis is that the fixed-effect model is more appropriate. We obtained a test statistic of 429.21 and 47.90 for the forecast frequency regression analysis and the forecast bias regression analysis, respectively. These test statistics strongly reject the null hypothesis that the random-effect model is appropriate for our sample. Therefore, we employed the fixed-effect model for our hypotheses tests.

MFBIAS is thus defined as the difference between earnings per share (EPS) forecast minus actual EPS deflated by the price at the beginning of a year (Dorantes et al., 2013; Kwak et al., 2012). Forecasted and actual EPS were both obtained from the CIG dataset. Median annual forecasts are used if a firm issued multiple forecasts in a given year. For range estimates, the midpoint was used for management forecasts. We included control variables similar to those included in Model (1). If CTOs, ITDs, or COOs contribute to mitigating optimistic forecast biases, then *MFBIAS* would be negatively associated with the presence of these executives ($\lambda_3 < 0$, $\lambda_4 < 0$, $\lambda_5 < 0$). CFOs are directly responsible for making earnings forecasts, and CFO status or accountability (*HCFO*) is likely to be negatively associated with forecast optimistic biases ($\lambda_2 < 0$). Firms with greater operating complexity and volatility are motivated to issue optimistic forecasts to attract and increase market interests. Accordingly, we predict positive signs on *BETA* ($\lambda_6 > 0$), *ABSCHGROA* ($\lambda_7 > 0$), and *VOL_SALE* ($\lambda_{16} > 0$) (Ajinkya et al., 2005; Baik et al., 2011; Feng et al., 2009). Similarly, poorly performing firms often have incentives to provide more optimistic forecasts to inflate market expectations (Rogers & Stocken 2005), and thus we expect *LOSS* firms to have greater optimistic biases ($\lambda_{13} > 0$). Corporate governance mechanisms are expected to mitigate optimistic management forecast biases (Ajinkya et al., 2005; Karamanou & Vafeas, 2005; Kwak et al., 2012). Hence, we expect *MFBIAS* to be negatively associated with corporate governance effectiveness measures such as *INST* ($\lambda_8 < 0$), *BIG* ($\lambda_9 < 0$), *NUMANAL* ($\lambda_{10} < 0$), and *BINDEP* ($\lambda_{18} < 0$).

DISPFOR is defined as the standard deviation of the most recent analysts' forecasts before the management forecasts scaled by the median analyst forecast. [7] *DISPFOR* captures information uncertainty (Abarbanell et al., 1995; Lang & Lundholm, 1996) and is expected to increase management forecast bias ($\lambda_{18} > 0$). In addition, we follow extant voluntary disclosure literature (Ajinkya et al., 2005; Karamanou & Vafeas, 2005) and include forecast characteristics such as forecast horizon (*HORIZON*) and forecast surprise (*SURPRISE*). *HORIZON* is defined as the number of days between the forecast date and the earnings announcement date scaled by 360. We predict that the coefficient on *HORIZON* to be positive ($\lambda_{19} > 0$), as management's earnings forecast optimism increases with the forecast horizon (Baginski et al., 2002). *SURPRISE* measures the discrepancy between management forecast and prevailing consensus analyst forecast and is expected to increase forecast biases ($\lambda_{20} > 0$) (Ajinkya et al., 2005; Kwak et al., 2012). Firm- and year-fixed effects are included in the model as well.

3.2 Sample Selection and Descriptive Statistics

We obtained our data from BoardEx (the CIO and corporate governance variables), CIG (management forecast variables), Compustat (financial statement variables), Thomason Reuters—Institutional (13f) Holdings (institutional ownership variable), Center for Research in Security Prices (i.e., CRSP—stock returns to generate beta), and IBES (analyst forecast variables).[8] Our sample period begins in 2000, since BoardEx provides limited coverage of top management (e.g., CIOs) before 2000. Our sample period ends in 2010, since First Call ceased updating management guidance (i.e., management forecasts) soon after 2010.

We refer to "firms with CIOs" as firms having a senior manager titled either "Chief Information Officer" or "CIO" in Boardex, and "non-CIO firms" are those without a senior manager having any of these titles. Accordingly, we defined an indicator variable (*CIO*), whose value equals 1 for firms with CIOs and 0 for non-CIO firms. We began with 48,645 firm-year observations with available data to construct the CIO indicator from 2000 to 2010. We then removed observations without necessary financial statement variables from Compustat and observations without institutional ownership data from Thomason Reuters, resulting in 27,595 firm-years. Next, we deleted 1,892 firm observations that did not have necessary CRSP data and firm-years with a share price of less than $1.00 at the beginning of the fiscal year. We required the share price to be greater than $1.00, since we used the price as a deflator of management forecast bias and a very low price could result in extreme values of management forecast biases (e.g., Kama & Weiss, 2013). We next

[7] *DISPFOR* is defined using *initial* analyst forecast dispersion in the forecast frequency (*MFREQ*) model because initial forecasting uncertainty influences a firm's tendency to initiate earnings forecasts (Ajinkya et al., 2005; Dorantes et al., 2013). Given higher initial forecast uncertainty, some firms may make no or fewer forecasts. For the forecast bias (*MBIAS*) model, *DISPFOR* is defined using the analyst forecast dispersion immediately before each management forecast. This definition (versus initial analyst forecast dispersion) captures the most recent information uncertainty, and thus will likely have the most direct and significant effect on forecast bias.

[8] Boardex identifies senior managers of publicly listed companies from public sources such as proxy statements, annual reports, US stock exchange websites, corporate websites, etc., and provides biographical data (e.g., age, gender, employment, education, and nationality) on these managers of US publicly traded firms. Following Chemmanur et al., (2018), we define senior managers as managers with a title of VP or higher. This dataset allows researchers to investigate issues related to executive characteristics (e.g., CFO expertise) and social connections (Bruynseels & Cardinaels, 2014; Kostovetsky, 2015; Kuang et al., in press). We obtained BoardEx offline data, which was archived in 2014.

deleted firm-years without necessary analyst forecast data or with fewer than three analysts following the firm, which left us with 16,155 firm-years to test our hypotheses related to management forecast frequency (H1a and H2a).[9] For this sample, CIOs were present in 3,755 firm-years and 3,109 CIOs had additional titles including senior VP and executive VP, etc. (*HCIO* = 1).

To test forecast bias hypotheses (i.e., H1b and H2b), we required sample firms to have either point or range management forecasts. After dropping firm-years without management earnings forecasts (i.e., *MFREQ* = 0), our sample for testing the forecast bias hypotheses comprised 6,310 observations that had the necessary forecast data to construct the management forecast bias variable. For this sample, CIOs were present in 1,771 firm-years, and 1,525 CIOs had executive titles beyond the CIO title alone (*HCIO* = 1). Table 1 provides a summary of our sample selection process. In comparison to the overall Compustat population in the comparable period (untabulated), our sample firms on average were larger in size, had less debt, were more profitable, and had lower growth. The systematic differences in these characteristics suggest that our sample is more biased towards larger, more profitable, less leveraged, and mature firms; therefore, the inferences of our findings should be interpreted in consideration of this bias.

Table 2 presents the descriptive statistics for the full sample, firms with CIOs, and non-CIO firms. Table 2a provides descriptive statistics for control variables. To mitigate the influence of outliers, we winsorized the top and bottom 1% of each of the continuous variables. In general, firms with CIOs in our sample tend to be larger (*LNAT*), more likely to be audited by the Big Four (*BIG*), and less likely to be a loss firm (*LOSS*). Compared to non-CIO firms, firms in our sample with CIOs exhibit less market risk (*BETA*), fewer changes in earnings (*ABSCHGROA*), slower sales growth (*GROWTH*), lower sales volatility (*VOL_SALE*), higher leverage (*LEVERAGE*), greater analyst forecast dispersion (*DISPFOR*), more institutional shareholders (*INST*), greater analyst following (*NUMANAL*), and more independent directors on their boards (*BINDEP*). For the forecast bias sample, univariate tests indicate that firms in our sample with CIOs have smaller preexisting analyst forecast dispersion (*DISPFOR*), issue earnings forecasts sooner (*HORIZON*), and have smaller revisions (*SURPRISE*) than non-CIO firms. In sum, firms with CIOs and non-CIO firms in our sample differ in terms of an array of observable characteristics.

Table 2b presents the descriptive statistics for our dependent variables. On average, our sample firms issued 1.7210 earnings forecasts each year. The average forecast bias (*MFBIAS*) is 0.0098 as a percentage of the stock price at the start of a fiscal year, indicating that the firms are, on average, optimistically biased. These descriptive statistics are similar in magnitude to those from prior studies (Bamber et al., 2010; Baik et al., 2011; Kwak et al., 2012). The univariate tests suggest that firms with CIOs, compared to non-CIO firms, have more frequent management forecasts (2.3241 versus 1.5383, t = 14.70) and greater optimistic biases (0.0066 versus 0.0110, t = -5.36). Table 2c provides the average forecast frequencies and biases for both firms with CIOs and non-CIO firms over the years. Firms with CIOs consistently had higher forecast frequencies and lower optimistic forecast biases than non-CIO firms across our sample years. In summary, these descriptive results provide preliminary support for both H1a and H1b.

Table 1: Sample Selection

Sample	Firm-year observations
Firm-years with BoardEx data from 2000 to 2010	48,645
Less: Firm-years without financial data from COMPUSTAT	(8,005)
Firm-year with both BoardEx and COMPUSTAT data	40,640
Less: Firm-years without institutional ownership data from Thomson Reuters	(13,045)
Firm-year with BoardEx, COMPUSTAT, and institutional ownership data	27,595
Less: Firm-years missing CRSP data or having an initial annual stock price < $1.00	(1,892)
Firm-years with CRSP data	25,703
Less: Firm-years missing analyst forecast or with less than three analysts following the firm	(9,548)
The final sample used for management forecast frequency tests	**16,155**
Less: Firm-years with missing management forecast biases	(9,845)
The final sample used for management forecast bias tests	**6,310**

[9] Chuk et al. (2013) document that CIG data does not have complete management forecast data, especially prior to 1998, and recommend that researchers consider performing analysis on samples where analyst following is greater. Since our sample period starts in 2000, the concern of sampling biases is less of an issue for this study. To further address the potential sampling bias of CIG data, we followed Ajinkya et al.'s (2005) recommendations and deleted observations with less than three analysts. This sampling requirement is also necessary because one of the primary control variables is the standard deviation of analysts' forecasts. Nevertheless, our results and inference remain qualitatively similar without this requirement.

Table 2a. Descriptive Statistics—Control Variables

Variable	Total			CIO = 0			CIO = 1			Difference	
	# obs.	Mean	(Median)	# obs.	Mean	(Median)	# obs.	Mean	(Median)	*t*-stat	(*z*-stat)
LNAT	16,155	7.3699	(7.2930)	12,400	7.1186	(7.0461)	3,755	8.200	(8.1107)	34.04 ***	(23.21)
BETA	16,155	1.1445	(1.0836)	12,400	1.1509	(1.0887)	3,755	1.1234	(1.0645)	-2.77 ***	(-1.90)
ABSCHGROA	16,155	0.0629	(0.0227)	12,400	0.0680	(0.0245)	3,755	0.0461	(0.0181)	-12.84 ***	(-9.37)
INST	16,155	0.6943	(0.7283)	12,400	0.6784	(0.7109)	3,755	0.7465	(0.7778)	16.76 ***	(11.57)
BIG	16,155	0.8714	(1)	12,400	0.8515	(1)	3,755	0.9369	(1)	13.77 ***	(13.68)
NUMANAL	16,155	12.8424	(10)	12,400	11.9322	(10)	3,755	15.8482	(14)	26.36 ***	(20.90)
GROWTH	16,155	0.1512	(0.0916)	12,400	0.1649	(0.0990)	3,755	0.1068	(0.0742)	-10.61 ***	(-8.26)
LEVERAGE	16,155	0.6241	(0.6005)	12,400	0.6133	(0.5848)	3,755	0.6596	(0.6448)	7.67 ***	(9.52)
LOSS	16,155	0.2095	(0)	12,400	0.2280	(0)	3,755	0.1486	(0)	-10.51 ***	(-10.47)
SPI	16,155	-0.0132	(-0.0001)	12,400	-0.0134	(0)	3,755	-0.0124	(-0.0009)	1.31	(-6.88)
FOREIGN	16,155	0.3129	(0)	12,400	0.3152	(0)	3,755	0.3052	(0)	-1.16	(-1.17)
VOL_SALE	16,155	0.0625	(0.0383)	12,400	0.0645	(0.0402)	3,755	0.0559	(0.0335)	-5.74 ***	(-7.48)
BINDEP	16,155	0.7337	(0.7500)	12,400	0.7213	(0.7500)	3,755	0.7747	(0.8000)	19.51 ***	(16.17)
DISPFOR	16,155	0.1116	(0.0600)	12,400	0.1078	(0.0600)	3,755	0.1241	(0.0700)	5.87 ***	(5.18)
HORIZON	6,310	0.4234	(0.4313)	4,539	0.4185	(0.4296)	1,771	0.4359	(0.4361)	4.30 ***	(3.47)
SURPRISE	6,310	0.0086	(0.0004)	4,539	0.0091	(0.0005)	1,771	0.0075	(0.0003)	-2.84 ***	(-1.74)

Note: *** denotes *t*-statistic significance at level 0.01.

Table 2b. Descriptive Statistics—Dependent Variables

Variable	Total			CIO = 0			CIO = 1			Difference	
	# obs.	Mean	(Median)	# obs.	Mean	(Median)	# obs.	Mean	(Median)	*t*-stat	(*z*-stat)
MFREQ	16,155	1.7210	(0)	12,400	1.5383	(0)	3,755	2.3241	(1)	14.70 ***	(11.55)
MFBIAS	6,310	0.0098	(0.0003)	4,539	0.0110	(0.0005)	1,771	0.0066	(-0.0002)	-5.36 ***	(-5.10)

Note: *** denotes *t*-statistic significance at level 0.01.

Table 2c. Descriptive Statistics: Forecast Frequency and Bias across Sample Years

Year	Forecast Frequency			Forecast Bias		
	CIO = 0	CIO = 1	All firms	CIO = 0	CIO = 1	All firms
2000	0.6544	1.0000	0.6968	0.0205	0.0205	0.0205
2001	1.3471	1.4000	1.3547	0.0193	0.0166	0.0189
2002	1.7488	2.4438	1.8652	0.0143	0.0128	0.0140
2003	1.7516	2.4815	1.8697	0.0133	0.0116	0.0130
2004	1.8418	2.4419	1.9487	0.0095	0.0091	0.0094
2005	1.6766	2.3464	1.8208	0.0089	0.0059	0.0081
2006	1.7515	2.4664	1.9271	0.0042	0.0036	0.0040
2007	1.6818	2.4280	1.8823	0.0064	0.0051	0.0060
2008	1.5710	2.7307	1.9080	0.0177	0.0091	0.0145
2009	1.3938	2.2926	1.6603	0.0110	0.0053	0.0090
2010	1.0986	2.0463	1.3915	0.0060	-0.0006	0.0033
Total	1.5383	2.3241	1.7210	0.0110	0.0066	0.0098

Moreover, our results indicate that optimistic biases have been decreasing over time for both non-CIO and firms with CIOs, suggesting that firms have become increasingly conservative over time. Table C1a and C1b in the Appendix present Pearson correlations of the main variables for the forecast frequency sample and the forecast bias sample, respectively. Most of the correlations are relatively small in magnitude.[10] Table C1a shows that the *CIO* is positively correlated with *MFREQ* (0.130, $p < 0.001$) and Table C1b shows that the CIO is negatively correlated with *MFBIAS* (-0.056, $p < 0.001$). In comparison, the correlations of *MFREQ* and *MFBIAS* with other executives are either smaller in magnitude (e.g., *CTO* and *ITD*) or nonsignificant (*COO*). These preliminary statistics are largely consistent with our contention that the presence of a CIO in the top management team is associated with increased forecast frequency (H1a) and decreased optimistic biases (H1b).

To visualize our hypothetical relations, we present the bar charts of management forecast frequency (*MFREQ*) and forecast bias (*MFBIAS*) over quantiles of analyst forecast dispersion (*DISPFOR*) for CIO firms and non-CIO firms, respectively. Figure 1, Panel A and B present the CIO effect on management forecast frequency and management forecast bias, respectively.

As shown in Panel A, forecast frequency decreases with forecast uncertainty (i.e., analyst forecast dispersion), which is consistent with prior literature (e.g., Ajinkya et al., 2005; Karamanou & Vafeas, 2005; Dorantes et al., 2013). Across all quantiles of forecast dispersion, CIO firms provide more earnings forecasts than non-CIO firms, although the difference in forecast frequency appears to decrease as forecast dispersion increases. Therefore, the visual inspection of Panel A is consistent H1a, which posits that the CIO firms provide more frequent earnings forecasts than non-CIO firms, and also with H2a, which predicts the moderating role of forecast uncertainty. Panel B shows that CIO firms generally have smaller forecast biases across all quantiles of forecast uncertainty (i.e., analyst forecast dispersion), which is consistent with H1b. Moreover, the difference in forecast bias appears to be more pronounced in the top quantile of analyst forecast dispersion than in the first three quantiles, which is consistent with H2b, which posits that the CIO's role in mitigating optimistic forecast biases is more instrumental in highly uncertain forecasting environments.

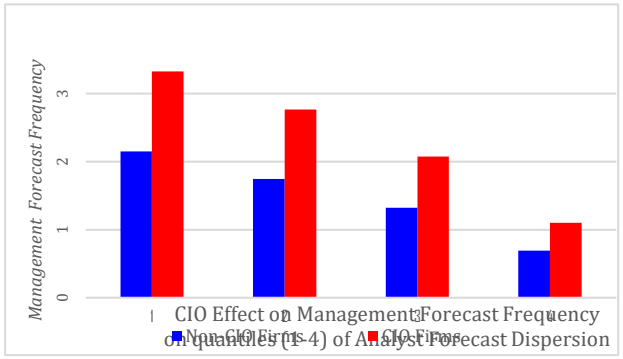
3.3 Regression Results

3.3.1 Regression Results for Management Forecast Frequency: H1a and H2a.

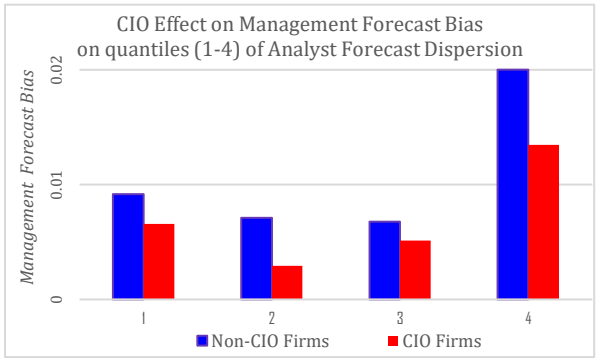
H1a hypothesizes that management forecast frequency is higher for CIO firms than for non-CIO firms, and H2a predicts that information uncertainty negatively moderates this relationship because of the heightened litigation and career concerns of CIOs. Table 3 provides testing results for H1a and H2a using the management forecast frequency sample (n = 16,155). Columns (1) and (2) present the OLS regression results for Model (1) of testing H1a after controlling for firm- and year-fixed effects, and Columns (3) and (4) provide estimation results of the H2a tests. Columns (1) and (3) focus on the simple effect of CIO as a member of the senior executive team (*CIO*) and Columns (2) and (4) focus on the effect of higher-status CIOs (i.e., those with multiple executive titles). Columns (1) and (2) show that the coefficient estimates on *CIO* (-0.0167, t = -0.21) and *HCIO* (0.0520, t = 0.60) are not significant. These results do not support H1a's prediction that firms with CIOs issue more frequent earnings forecasts. Estimation results of control variables from Columns (1) to (4) are similar. We focus our discussion of the estimation results of the control variables reported in Column (1).

As shown, we did not find forecast frequency (*MFREQ*) to be associated with *CTO*, *ITD* and *COO*. High CFO accountability/status (*HCFO*) is also not associated with forecast frequency (-0.1094, t = -1.54). We found that *MFREQ* is positively associated with firm size (*LNAT*), earnings change (*ABSCHGROA*), and analyst coverage (*NUMANAL*). These results suggest that larger firms, firms experiencing greater earnings changes, and firms with more analysts following make more frequent earnings forecasts (e.g., Baik et al., 2011; Kwak et al., 2012; Dorantes et al., 2013). We also found that *MFREQ* decreases with financial loss (*LOSS*) and earnings uncertainty (*DISPFOR*). These findings suggest that firms experiencing losses and firms with greater earnings uncertainty find it more difficult to make earnings forecasts (Ajinkya et al., 2005; Karamanou & Vafeas 2005; Dorantes et al., 2013).

[10] We also examined multicollinearity among independent variables for both forecast frequency and forecast bias analyses. For the forecast frequency analyses, we found that independent variables such as *LNAT*, *BINDEP*, and *INST* have variance inflation factors (VIF) values of greater than 10. For the forecast bias analyses, we found that *LNAT*, *BINDEP*, *INST*, *BIG*, and *HORIZON* have VIFs of greater than 10. Corporate governance characteristics (e.g., *BINDEP*) and some firm-specific characteristics (e.g., *LNAT*) are often sticky over time and are thus highly correlated with firm dummies. In contrast, the VIF values of our variable of interest (e.g., *CIO*, *HCIO*, *CIO*DISPFOR*, *HCIO*DISPFOR*) have VIFs below 3. We conducted sensitivity tests by removing control variables with VIFs above 10, and our inferences remain the same. Therefore, we conclude that multicollinearity is not a serious concern for our study.



Panel A: CIO Effect on Forecast Frequency



Panel B: CIO Effect on Forecast Bias

Figure 1: CIO Effect on Management Forecast Frequency and Bias over the Quantiles of Forecast Dispersion

Table 3: Regression Results for Management Forecast Frequencies (N = 16,155)

	Column (1): H1a		Column (2): H1a		Column (3): H2a		Column (4): H2a	
	Coeff.	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***t*-stat.**
CIO	-0.0167	-0.20			0.1258	1.24		
HCIO			0.0520	0.60			**0.2047**	**1.93****
CIO*DISPFOR					**-1.2881**	**-3.10****		
HCIO*DISPFOR							**-1.3843**	**-2.92*****
HCFO	-0.1091	-1.54	-0.1097	-1.54	-0.1054	-1.48	-0.1084	-1.53
CTO	-0.0143	-0.14	-0.0159	-0.15	-0.0112	-0.11	-0.0137	-0.13
ITD	0.0057	0.03	0.0133	0.08	-0.0048	-0.03	0.0038	0.02
COO	0.1288	1.52	0.1277	1.51	0.1257	1.49	0.1289	1.53
LNAT	0.4396	4.70***	0.4401	4.71***	0.4318	4.61***	0.4324	4.62***
BETA	0.0424	0.99	0.0423	0.98	0.0486	1.13	0.0492	1.15
ABSCHGROA	0.3050	1.86*	0.3037	1.85*	0.2914	1.78*	0.2913	1.78*
INST	-0.1134	-0.63	-0.1126	-0.63	-0.1030	-0.58	-0.1057	-0.59
BIG	-0.3174	-3.19***	-0.3180	-3.20	-0.3122	-3.14***	-0.3131	-3.15***
NUMANAL	0.0139	2.21**	0.0139	2.20	0.0143	2.27**	0.0142	2.26**
GROWTH	0.0553	1.33	0.0545	1.31	0.0570	1.37	0.0559	1.35
LEVERAGE	-0.0945	-1.05	-0.0936	-1.05	-0.0982	-1.10	-0.0955	-1.07
LOSS	-0.3627	-6.76***	-0.3629	-6.76***	-0.3611	-6.75***	-0.3594	-6.72***
SPI	-0.6430	-1.62	-0.6470	-1.63	-0.6418	-1.61	-0.6411	-1.61
FOREIGN	0.0098	0.12	0.0099	0.12	0.0117	0.14	0.0116	0.14
VOL_SALE	0.2949	0.53	0.2778	0.50	0.3164	0.57	0.3006	0.54
BINDEP	-0.2379	-0.92	-0.2460	-0.96	-0.2382	-0.93	-0.2506	-0.98
DISPFOR	-2.3314	-13.96***	-2.3317	-13.97***	-2.0631	-11.79***	-2.1066	-12.06***
INTERCEPT	-2.2770	-3.56***	-2.2766	-3.56***	-2.2689	-3.54***	-2.3000	-2.92***
Firm Fixed Effect	Yes		Yes		Yes		Yes	
Year Fixed Effect	Yes		Yes		Yes		Yes	
Adjusted R^2 (%)	8.41%		8.52%		8.66%		8.78%	

Note: This table presents coefficients and the *t*-statistics for the following OLS regression model:

$$MFREQ = \beta_0 + \beta_1 CIO(HCIO) + \beta_2 HCFO + \beta_3 CTO + \beta_4 ITD + \beta_5 COO + \beta_6 LNAT + \beta_7 BETA + \beta_8 ABSCHGROA + \beta_9 INST + \beta_{10} BIG + \beta_{11} NUMANAL + \beta_{12} GROWTH + \beta_{13} LEVERAGE + \beta_{14} LOSS + \beta_{15} SPI + \beta_{16} FOREIGN + \beta_{17} VOL\_SALE + \beta_{18} BINDEP + \beta_{19} DISPFOR + FIRM \& YEAR\ DUMMIES + \varepsilon \quad (1)$$

*, **, and *** denote significance at levels of 0.1, 0.05, and 0.01, respectively (one-tailed test for the hypothesized effect, and two-tailed otherwise).

To test H2a, we included in Model (1) an interaction term between earnings forecast uncertainty (*DISPFOR*) and *CIO* (Column 3) and *HCIO* (Column 4). *DISPFOR* measures the interanalyst disagreement over a firm's *future* earnings and captures information uncertainty at the beginning of the fiscal year (e.g., Barron et al., 1998; Cheng et al., 2011; Imhoff & Lobo, 1992; Yeung, 2009).H2a predicts that the coefficients on the interaction terms are negative. As shown in Column (2), the coefficient on the interaction term *CIO*DISPFOR* is significant and negative (-1.2881, t = -3.10), which suggests that firms with CIOs issue fewer earnings forecasts when information uncertainty rises. In terms of economic significance, a one-standard-deviation (i.e., 0.1486) increase in *DISPFOR* is associated with a decrease in forecast frequency by 0.3066 (i.e., the coefficient estimate of *DISPFOR*, i.e., -2.0631, multiplied by the standard deviation of *DISPFOR*, i.e., 0.1486) for non-CIO firms. In comparison, CIO firms reduced their forecast frequency by an incremental fraction of 0.1914 (i.e., the coefficient of *CIO*DISPFOR* multiplied by the standard deviation of *DISPFOR*, i.e., 0.1486), which amounts to a total decrease in frequency of 0.4980 (i.e., 0.3066 plus 0.1914).

The decrease in the earnings forecast frequency of CIO firms (i.e., 0. 4980) amounts to a 162% decrease in forecast frequency of non-CIO firms (i.e., 0.3066). Column (4) shows that the coefficient on the interaction term *HCIO*DISPFOR* is also significant and negative (-1.3843, t = -2.92). This finding suggests that firms with CIOs issue fewer earnings forecasts when information uncertainty increases. Moreover, we also found that the coefficient estimate on *HCIO* is positive and significant (0.2047, t = 1.93) in the presence of the interaction effect of *HCIO*DISPFOR*. Combined, our findings provide limited support for H1a, suggesting that firms with CIOs issue more frequent forecasts. However, our findings provide consistent support for H2a, indicating that CIO firms reduce earnings forecast frequency to a greater extent than non-CIO firms when earnings forecast uncertainty increases.

3.3.2 Regression Results for Management Forecast Bias: H1b and H2b.

H1b hypothesizes that optimistic forecast biases are lower for CIO firms than for non-CIO firms, whereas H2b predicts that the firms with CIOs are even less optimistically biased when information uncertainty increases. Table 4 provides testing results for hypotheses related to forecast biases (*MFBIAS*) using the forecast bias sample (n = 6,310). Columns (1) and (2) present the fixed effects OLS regression results of Model (2) for testing H1b, and Columns (3) and (4) provide estimation results for testing H2b.Columns (1) and (3) focus on the effect of CIO presence (*CIO*) and Columns (2) and (4) focus on the effect of higher-status CIOs (*HCIO*). Columns (1) and (2) show that the coefficient estimates on *CIO* (-0.0023, t = -1.97) and *HCIO* (-0.0029, t = -2.40) are both significantly negative, and thus support H1b and indicate that firms with CIOs are less optimistically biased than non-CIO firms. Column (1) results suggest that optimistic biases for firms with CIOs are 34.85% (coefficient estimate of -0.0023 divided by the average non-CIO firms' forecast bias of 0.0066 from Table 2b) less than the average non-CIO firm. We did not find *CTO*, *ITD*, *COO*, or *HCFO* to be associated with optimistic earnings forecast biases.

The coefficient estimates on control variables are generally consistent with prior literature and across model specifications from Column (1) to (4). For brevity, we discuss coefficient estimates as reported in Column (1). We found that forecast bias (*MFBIAS*) is positively associated with *BETA*, *ABSCHGROA*, *NUMANAL*, and *LOSS*. These results suggest that firms with higher equity market risk, greater performance change, more analyst following, and financial loss are more optimistic in signaling their enthusiasm about the future (Feng et al., 2009; Baik et al., 2011; Li et al., 2012). We also found that *MFBIAS* is negatively associated with *GROWTH* and *LEVERAGE*, suggesting that growth firms and highly leveraged firms are more conservative in their management earnings forecasts (Li et al., 2012). The negative coefficient on *SPI* suggests that firms experiencing special item events such as asset write-offs and restructuring are less optimistic in forecasts. In addition, we found that *MFBIAS* is positively related to *HORIZON* (i.e., earlier earnings forecasts are more optimistic than more recent forecasts) and *SURPRISE* (i.e., management forecasts tend to be more optimistic when there is a greater difference between management forecasts and analyst forecasts).

To test H2b, we included in Model (1) an interaction term between information uncertainty (*DISPFOR*) and *CIO* (Column 3) and *HCIO* (Column 4). H2b predicts the coefficient estimate on the interaction term to be negative. Column (3) shows that the coefficient on *CIO*DISPFOR* is negative (-0.0548) and significant (t = -1.68, p = 0.046, one-tailed), thus supporting H2b. In terms of economic significance, a one-standard-deviation (i.e., 0.1063) increase in *DISPFOR* is associated with a decrease in forecast bias by 0.0058 (i.e., the coefficient estimate of *DISPFOR*, i.e., -0.0548, multiplied by the standard deviation of *DISPFOR*, i.e., 0.1063) for CIO firms. Given that the average forecast bias is only 0.0098, the economic significance of the reduction of the optimistic bias is large (e.g., Li et al., 2012). Analogously, Column (4) shows that the coefficient on *HCIO*DISPFOR* is significantly negative (-0.0472, t = -2.17). Consistent with H2b, this finding suggests that higher-status CIOs are associated with less optimistic forecast biases when forecast uncertainty increases. Combined, our findings provide robust support of H2b and indicate that CIO firms decrease their optimistic forecast bias to a greater extent than non-CIO firms when information uncertainty increases.

Table 4: Regression Results for Management Forecast Biases (N = 6,310)

	Column (1): H1b		Column (2): H1b		Column (3): H2b		Column (4): H2b	
	Coeff.	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***t*-stat.**
‘	**-0.0023**	**-1.97****			-0.0003	-0.25		
HCIO			**-0.0029**	**-2.40****			-0.0009	-0.69
CIO*DISPFOR					**-0.0548**	**-1.68****		
HCIO*DISPFOR							**-0.0472**	**-2.17****
HCFO	-0.0002	-0.20	-0.0002	-0.18	-0.0002	-0.13	-0.0002	-0.00
CTO	-0.0006	-0.33	-0.0006	-0.32	-0.0006	-0.37	-0.0006	-0.32
ITD	0.0037	1.42	0.0037	1.41	0.0037	1.43	0.0037	1.41
COO	0.0002	0.08	0.0002	0.07	0.0001	0.05	-0.0002	0.07
LNAT	0.0013	0.77	0.0013	0.73	0.0011	0.66	0.0013	0.73
BETA	0.0023	1.67*	0.0023	1.67*	0.0025	1.81*	0.0023	1.77*
ABSCHGROA	0.0271	2.42**	0.0272	2.43**	0.0273	2.43**	0.0272	2.43**
INST	-0.0080	-1.12	-0.0079	-1.12	-0.0079	-1.11	-0.0080	-1.13
BIG	0.0007	0.20	0.0007	0.20	0.0007	0.22	0.0007	0.20
NUMANAL	0.0002	1.77	0.0002	1.83*	0.0002	1.79*	0.0002	1.83*
GROWTH	-0.0148	-5.12***	-0.0147	-5.12***	-0.0149	-5.19***	-0.0145	-5.23***
LEVERAGE	-0.0055	-2.84***	-0.0055	-2.84***	-0.0055	-2.86***	-0.0057	-2.94***
LOSS	0.0196	5.89***	0.0196	5.89	0.0198	5.98***	0.0198	5.98***
SPI	-0.0649	-1.68	-0.0646	-1.68*	-0.0646	-1.67*	-0.0637	-1.65*
FOREIGN	-0.0004	-0.25	-0.0004	-0.24	-0.0004	-0.20	-0.0005	-0.26
VOL_SALE	-0.0082	-0.90	-0.0078	-0.86	-0.0090	-0.96	-0.0083	-0.91
BINDEP	0.0035	0.68	0.0035	0.68	0.0033	0.64	0.0036	0.69
DISPFOR	0.0130	1.22	0.0130	1.22	0.0166	1.49	0.0216	1.83
HORIZON	0.0164	4.26***	0.0164	4.27***	0.0165	4.27***	0.0163	4.25***
SURPRISE	0.9328	11.25***	0.9319	11.25***	0.9314	11.21***	0.9313	11.25***
INTERCEPT	-0.0069	-0.49	-0.0067	-0.47	-0.0058	-0.41	-0.0054	-0.39
Firm-fixed effect	Yes		Yes		Yes		Yes	
Year-fixed effect	Yes		Yes		Yes		Yes	
Adjusted R^2 (%)	33.22%		33.28%		33.36%		33.56%	

Note: This table presents coefficients and the *t*-statistics for the following regression model:

$$MFBIAS = \lambda_0 + \lambda_1 CIO(HCIO) + \lambda_2 HCFO + \lambda_3 CTO + \lambda_4 ITD + \lambda_5 COO + \lambda_6 LNAT + \lambda_7 BETA + \lambda_8 ABSCHGROA + \lambda_9 INST + \lambda_{10} BIG + \lambda_{11} NUMANAL + \lambda_{12} GROWTH + \lambda_{13} LEVERAGE + \lambda_{14} LOSS + \lambda_{15} SPI + \lambda_{16} FOREIGN + \lambda_{17} VOL\_SALE + \lambda_{18} BINDEP + \lambda_{19} DISPFOR + \lambda_{20} HORIZON + \lambda_{21} SURPRISE + FIRM \& YEAR\ DUMMIES + \varepsilon \quad (2)$$

*, **, and *** denote significance at levels of 0.1, 0.05, and 0.01, respectively (one-tailed test for the hypothesized effect, and two-tailed otherwise).

3.3.3 Propensity Score Matching Analyses

Above, we employ OLS regressions to test our hypotheses, which assumes a linear relationship between outcome and explanatory variables. If the regression model is misspecified, then the regression model may suffer functional-form misspecification (FFM) bias and can produce biased estimates (Shipman et al., 2017). Furthermore, this potential bias may be aggravated when the treatment groups (e.g., CIO versus non-CIO firms) are dissimilar. Table 2a shows significant differences between CIO and non-CIO firms along multiple dimensions that are predictive of forecast outcomes, indicating that FFM bias may be of concern. To alleviate this concern, we employed a propensity score matching (PSM) technique to test our hypotheses. First, we modeled the likelihood of having a CIO by including observable variables correlated with both management forecast properties *and* the presence of a CIO (Garrido, 2014). Consistent with prior research (e.g., Hope et al., 2013; Lawrence et al., 2011), we estimated the following logit model:

$$CIO = \alpha_0 + \alpha_1 LNAT + \alpha_2 BETA + \alpha_3 ABSCHGROA + \alpha_4 INST + \alpha_5 BIG + \alpha_6 NUMANAL + \alpha_7 GROWTH + \alpha_8 LEVERAGE + \alpha_9 LOSS + \alpha_{10} SPI + \alpha_{11} FOREIGN + \alpha_{12} VOL\_SALE + \alpha_{13} BINDEP + INDUSTRY \& YEAR\ DUMMIES + \varepsilon, \quad (3)$$

where all variables are previously defined. We include industry dummies instead of firm dummies because firm and year dummies together can perfectly predict the presence of a CIO (Garrido, 2014). We estimated the above logit model for the forecast frequency sample (n = 16,155) and the forecast bias sample (n = 6,310), respectively, and report the estimation results in Table D1 in the Appendix.

We applied a kernel matching algorithm to match firms with CIOs to non-CIO firms, which assigns greater weight to non-CIO firms with propensity scores closer to firms with CIOs. In addition, we imposed a caliper distance (i.e., the maximum allowable distance between propensity scores for a match) of 1% to "decrease the likelihood of 'poor' matches and to improve covariate balance" (Shipman et al., 2017 (p. 218)). In so doing, we ensured the identification of close matches for firms with CIOs and retained most sample firms (both CIO firms and non-CIO firms) for comparison purposes. Three (five) out of 16,555 (6,310) firms for the forecast frequency (bias) sample fell outside the common support range (i.e., overlapping range of propensity scores) and were thus dropped. All the other observations had common support and were retained in the additional analyses. As discussed in detail in Appendix D, the matching procedure allowed us to achieve a covariate balance between CIO and non-CIO firms.

A univariate comparison between CIO firms and matched non-CIO firms reveals that CIO firms issue significantly more forecasts than non-CIO firms (2.3212 versus 2.0902, t = 3.97). The average CIO-firm issued 11.05% (=(2.3212-2.0902)/2.0902) more earnings forecasts than the average non-CIO firm, which is consistent with H1a. In terms of management earnings forecast bias (*MBIAS*), earnings forecasts for CIO firms were, on average, less optimistically biased than non-CIO firms (0.0066 versus 0.0083, t = 1.69). This average CIO-firm's earnings forecast is 20.48% (=(0.0083-0.0066)/0.0084) less optimistically biased than this average non-CIO firm's earnings forecast, which supports H1b.[11]

The above univariate comparisons do not control for the variation in control variables because they relate to forecast frequencies and forecast biases. Using the PSM samples, we then conducted second-stage regression analyses to assess the CIO effect on forecast outcomes (i.e., *MFREQ* and *MFBIAS*). In the second-stage regression analyses, we assigned greater weights for non-CIO observations with propensity scores closer to the matched CIO firms, which are produced by the kernel PSM procedure. We utilized firm-level clustering to produce robust standard errors to control for potential serial correlation across years of the same firm in the second-stage regression analyses. Table 5 tabulates the second-stage regression results.

For brevity, we only included estimation results for the key variables of interest such as *CIO*, *HCIO*, and their respective interactions with forecast uncertainty. Table 5a provides the second-stage regression results of the matched sample for the management forecast frequencies (H1a and H2a). Columns (1) and (2) report estimation results for H1a (i.e., the main effect of CIO on forecast frequencies), and Columns (3) and (4) provide estimation results for H2a (i.e., the moderating effect of forecast uncertainty).

Column (1) reports a positive coefficient on CIO (0.2123, t =1.64) and Column (2) reveals an even stronger effect for high-status CIOs (0.3457, t = 3.08). Column (3) also reports a positive CIO main effect (0.4258, t = 3.19) and a significantly negative moderation effect of forecast uncertainty (-1.9046, t = -3.41). Analogous to Column (3), Column (4) provides inferentially similar findings for the high-status CIOs. Combined, these results support both H1a and H2a and suggest that although CIO firms tend to provide more frequent earnings forecasts, this tendency is significantly mitigated under heightened forecasting environments.[12]

Table 5b provides the second-stage regression estimation results for the management forecast biases (H1b and H2b). Columns (1) and (2) tabulate results for H1b (i.e., the main effect of CIO presence on management forecast biases), and Columns (3) and (4) provide estimation results for H1b (i.e., the moderating effect of forecast uncertainty). Columns (1) and (2) report a negative coefficient on *CIO* (-0.0017, t = -2.51) and *HCIO* (-0.0017, t = -2.60), respectively, and lend support for H1b, indicating that CIO firms are less optimistically biased. Columns (3) and (4) show that optimistic biases are reduced to a larger degree for CIO firms (-0.0556, t = -2.08) and firms with high-status CIOs (-0.0769, t = -2.15) under heightened forecasting uncertainty. Taken together, the second stage PSM regression results are consistent with those reported in Table 4 and provide additional support for both H1b and H2b.

[11] We also used the PSM sample to assess the effect of high-status CIOs (*HCIO*) on forecast frequency and bias. We found that firms with a high-status CIO (*HCIO* = 1) issue more earnings forecasts (2.4773 versus 2.1227, t = -5.55) and are less optimistically biased (0.0062 versus 0.0081, t = -1.92) than firms without a high-status CIO (*HCIO* = 0).

[12] Even though the PSM analyses provide support for H1a (i.e., CIO firms provide more frequent forecasts), these results are at odds with Table 4, which reveals that the CIO effect is often insignificant. Hence, we caution readers against making conclusive inferences for H1a.

Table 5a. Second-Stage Regression Results using Propensity Score Matched Samples: Management Forecast Frequencies (N = 16,152)

	Column (1): H1a		Column (2): H1a		Column (3): H2a		Column (4): H2a	
	Coeff.	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***t*-stat.**
CIO	0.2123	2.01**			0.4258	3.19***		
HCIO			0.3243	2.83***			0.5950	4.07***
CIO*DISPFOR					-1.9046	-3.41***		
HCIO*DISPFOR							-2.4507	-3.79***
Control Variables	Included		Included		Included		Included	
Firm-fixed effect	Yes		Yes		Yes		Yes	
Year-fixed effect	Yes		Yes		Yes		Yes	
Adjusted R^2 (%)	23.22%		23.80%		23.39%		24.05%	

Note: Table 5a presents coefficients and the *t*-statistics for the following OLS regression model: $MFREQ = \beta_0 + \beta_1 CIO(HCIO) + \beta_2 HCFO + \beta_3 CTO + \beta_4 ITD + \beta_5 COO + \beta_6 LNAT + \beta_7 BETA + \beta_8 ABSCHGROA + \beta_9 INST + \beta_{10} BIG + \beta_{11} NUMANAL + \beta_{12} GROWTH + \beta_{13} LEVERAGE + \beta_{14} LOSS + \beta_{15} SPI + \beta_{16} FOREIGN + \beta_{17} VOL\_SALE + \beta_{18} BINDEP + \beta_{19} DISPFOR + FIRM \& YEAR\ DUMMIES + \varepsilon$ (1)

*, **, and *** denote significance at levels of 0.1, 0.05, and 0.01, respectively (one-tailed test for the hypothesized effect, and two-tailed otherwise).

Table 5b. Second-Stage Regression Results using Propensity Score Matched Samples: Management Forecast Biases (N = 6,305)

	Column (1): H1a		Column (2): H1a		Column (3): H2a		Column (4): H2a	
	Coeff.	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***t*-stat.**
CIO	-0.0017	2.51**			0.0003	0.42		
HCIO			-0.0019	-2.79***			0.0007	0.54
CIO*DISPFOR					-0.0556	-2.08**		
HCIO*DISPFOR							-0.0717	-2.15**
Control variables	Included		Included		Included		Included	
Firm-fixed effect	Yes		Yes		Yes		Yes	
Year-fixed effect	Yes		Yes		Yes		Yes	
Adjusted R^2 (%)	37.52%		36.87%		37.73%		37.11%	

Note: Table 5b presents coefficients and the *t*-statistics for the following regression model:

$MFBIAS = \lambda_0 + \lambda_1 CIO(HCIO) + \lambda_2 HCFO + \lambda_3 CTO + \lambda_4 ITD + \lambda_5 COO + \lambda_6 LNAT + \lambda_7 BETA + \lambda_8 ABSCHGROA + \lambda_9 INST + \lambda_{10} BIG + \lambda_{11} NUMANAL + \lambda_{12} GROWTH + \lambda_{13} LEVERAGE + \lambda_{14} LOSS + \lambda_{15} SPI + \lambda_{16} FOREIGN + \lambda_{17} VOL\_SALE + \lambda_{18} BINDEP + \lambda_{19} DISPFOR + \lambda_{20} HORIZON + \lambda_{21} SURPRISE + FIRM \& YEAR\ DUMMIES + \varepsilon$ (2)

*, **, and *** denote significance at levels of 0.1, 0.05, and 0.01, respectively (one-tailed test for the hypothesized effect, and two-tailed otherwise).

3.3.4 Alternative Dependent Variable of Interest: Management Forecast Precision

In our primary analyses, we focused primarily on two key management forecast characteristics—frequencies and biases. The extant voluntary disclosure literature has also investigated management forecast precision (e.g., Baginski et al., 2002; Cheng et al., 2015). For quantitative forecasts, management forecasts can be provided in the form of point forecasts or range (i.e., closed interval) forecasts. Different forms of earnings forecasts capture different degrees of management forecast precision. Analogous to our primary analyses, we used additional analyses to investigate whether CIO presence is associated with forecast precision and how this association varies with forecast uncertainties. Our expectation of the relationship between CIO presence and forecast precision is largely in line with those arguments provided for forecast frequencies. That is, CIO presence likely improves information acquisition, exchange, and interpretation, which likely increases the precision of management earnings forecasts. Nevertheless, litigation and professional considerations that arise from heightened forecasting uncertainties will likely discourage CIOs from supporting more precise forecasts. That is, information uncertainty likely erodes the CIO's information integrator role. Therefore, whereas CIOs may enable firms to provide more precise earnings forecasts, they are likely to reduce their forecast precision when forecasting uncertainty increases.

Forecast precision could only be computed for quantitative earnings forecasts. Following Cheng et al., (2013), we focused on point forecasts and range forecasts, and defined forecast precision (*PRECISION*) as the average annual forecast width multiplied by negative 100. The forecast width is calculated as the difference between the upper- and lower-end estimates, scaled by the absolute value of the midpoint of the forecast estimate, and zero for point forecasts.

We then estimated the effect of CIO presence and the moderating role of forecasting uncertainty by using forecast precision (*PRECISION*) as the dependent variable of interest in Model (2). Table 6 provides the estimation results using the full sample (n = 6,309). We also used a propensity-score matched sample and (untabulated) results are inferentially similar to those presented in Table 6.

Columns (1) and (2) show that *CIO* and *HCIO* are not significantly associated with management forecast precision. As reported in Columns (3) and (4), both *CIO* and *HCIO* are significant and positive in the presence of the moderating effect of forecasting uncertainty, whereas the interaction effect of *CIO*DISPFOR* (-0.4333, *t* = -2.95) and *HCIO*DISPFOR* (-0.4763, *t* = -3.10) are significantly negative. Combined, these results suggest that CIO presence is associated with increased forecast precision under conditions of low forecasting uncertainty, and CIO-firms decrease their forecast precision to a greater degree than non-CIO firms when forecasting uncertainty rises. These results are generally consistent with previous findings for management forecast frequency and forecast biases.

3.3.5 CIO Demographic Characteristics

The findings reported in Table 7 suggest that the negative association between CIOs and management forecast bias, as tabulated in Table 4, Column (1), is primarily driven by CIOs with an MBA degree and that business education experience empowers CIOs to alleviate optimistic biases in management forecasts. These findings are also consistent with the tenets of UET as well as the CIO literature. For example, Bamber et al. (2010) document that executives with an MBA degree make more accurate earnings forecasts. As noted above, while a sizable proportion of CIOs may be technically savvy or even have some level of functional business knowledge, many CIOs may lack a deep level of strategic business knowledge (i.e., distinct from operational and tactical knowledge). Specifically, The CIO's level of strategic business knowledge will allow the CIO to understand how to communicate in business terms and to converse in shared language with the TMT and ultimately determine the degree to which the CIO can act as a strategic decision maker within the organization (Karahanna & Preston, 2013). As such, this finding provides further support that the CIO's level of strategic business knowledge is a key factor that enables the CIO to build and maintain a relationship with other members of top management and consequently influence the strategic choices for the organization (Preston et al., 2008; Preston & Karahanna, 2009). of the organization and thus influence the other top management members in the process of effectively reducing forecasting bias.

In this post hoc analysis, we found that CIOs who hold MBA degrees are able to reduce forecasting bias, which we posit is related to the ability of the CIO to understand the strategic needs and plans. In our discussion for future research below, we expand on how the background of the CIO can be further explored to assess forecasting and other strategic outcomes of the organization. With the above lone exception, none of the other CIOs' demographic characteristics are associated with either management forecast frequency or management forecast bias. Taken together, our findings highlight that the CIO presence per se, rather than any specific CIO characteristics, is an important determinant of management earnings forecast characteristics.

3.3.6 Industry Average CIO Ratio

Our primary inferences are based on the firm-fixed effects regressions as tabulated in Tables 3 and 4. Firm-level fixed effects help to control for time-invariant unobservable firm-level factors. To further control for industry-level time trends, we conducted an additional robustness test by including an annual industry average CIO ratio in Models (1) - (4). Our findings are inferentially similar, albeit weaker (Table 8). We chose not to include the industry average CIO ratio in our primary testing models because its inclusion would have resulted in large VIF values. Untabulated statistics show that the VIF value on the annual industry CIO ratio ranges from 15.37 to 15.89 across all model specifications, which are well above the rule-of-thumb threshold value of 10. That is, the inclusion of this ratio would have introduced high multicollinearity, which would have likely inflate estimation errors and reduced testing power, likely because both firm- and year-fixed effects were already been included in the testing models.

3.3.7 Reverse Causality

According to UET, senior executives (e.g., CIOs) likely influence corporate processes and outcomes (e.g., management forecasts). Reverse causality, however, may be of concern in that the provision of less optimistically biased earnings forecasts may lead firms to institute CIO positions. We consider reverse causality to be less plausible in our setting because the CIO's primary responsibility within an organization is not to provide less biased earnings forecasts but to lead IS initiatives for both the operational and strategic goals of the organization. Nevertheless, we conducted additional sensitivity tests to alleviate the reverse causality concern. For the reverse causality tests, we focused on the association between CIO presence and forecast biases (versus forecast frequencies), since we only found this association to be statistically significant (See Table 3 and 4), making it therefore subject to the reverse causality concern.

Table 6: Analyses of Management Forecast Precision

	Column (1): Main effect of CIO		Column (2): Main effect of HCIO		Column (3): Moderating effect		Column (4): Moderating effect	
	Coeff.	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***t*-stat.**
CIO	-0.0019	-0.61			0.0137	2.80***		
HCIO			-0.0029	-1.00			0.0128	2.71***
CIO*DISPFOR					-0.4333	-2.95***		
HCIO*DISPFOR							-0.4763	-3.10***
Control variables	Included		Included		Included		Included	
Firm-fixed effect	Yes		Yes		Yes		Yes	
Year-fixed effect	Yes		Yes		Yes		Yes	
Adjusted R^2 (%)	25.60%		26.73%		25.61%		26.44%	

Note: Table 6 presents coefficients and the *t*-statistics for the following OLS regression model:

$$PRECISION = \beta_0 + \beta_1 CIO(HCIO) + \beta_2 HCFO + \beta_3 CTO + \beta_4 ITD + \beta_5 COO + \beta_6 LNAT + \beta_7 BETA + \beta_8 ABSCHGROA + \beta_9 INST + \beta_{10} BIG + \beta_{11} NUMANAL + \beta_{12} GROWTH + \beta_{13} LEVERAGE + \beta_{14} LOSS + \beta_{15} SPI + \beta_{16} FOREIGN + \beta_{17} VOL\_SALE + \beta_{18} BINDEP + \beta_{19} DISPFOR + FIRM \& YEAR\ DUMMIES + \varepsilon \quad (3)$$

*, **, and *** denote significance at levels of 0.1, 0.05, and 0.01, respectively (one-tailed test for the hypothesized effect, and two-tailed otherwise).

Table 7: CIOs with an MBA Degree and Management Forecast Biases (N = 6,024)

	Column (1): H1b		Column (2): H1b	
	Coeff.	***t*-stat.**	**Coeff.**	***t*-stat.**
CIO			-0.0010	-0.64
MBA_CIO	**-0.0045**	**-2.58****	**-0.0038**	**-1.80***
Control Variables	Included		Included	
Firm Fixed Effect	Yes		Yes	
Year Fixed Effect	Yes		Yes	
Adjusted R^2 (%)	24.90%		24.90%	

Note: This table presents coefficients and the t-statistics for the following regression model:

$$MFBIAS = \lambda_0 + \lambda_1 CIO + \lambda_1 \text{'}MBA\_CIO + \lambda_2 HCFO + \lambda_3 CTO + \lambda_4 ITD + \lambda_5 COO + \lambda_6 LNAT + \lambda_7 BETA + \lambda_8 ABSCHGROA + \lambda_9 INST + \lambda_{10} BIG + \lambda_{11} NUMANAL + \lambda_{12} GROWTH + \lambda_{13} LEVERAGE + \lambda_{14} LOSS + \lambda_{15} SPI + \lambda_{16} FOREIGN + \lambda_{17} VOL\_SALE + \lambda_{18} BINDEP + + \lambda_{19} DISPFOR + \lambda_{20} HORIZON + \lambda_{21} SURPRISE + FIRM \& YEAR\ DUMMIES + \varepsilon \quad (2)$$

*, **, and *** denote significance at levels of 0.1, 0.05, and 0.01, respectively (one-tailed test for the hypothesized effect, and two-tailed otherwise).

Table 8a. Regression Results Including the Annual Industry Average CIO Presence: Management Forecast Frequencies (N = 16,155)

	Column (1): H1a		Column (2): H1a		Column (3): H2a		Column (4): H2a	
	Coeff.	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***t*-stat.**
CIO	-0.0329	-0.39			0.1093	1.06		
HCIO			0.0360	0.41			0.1882	1.76*
CIO*DISPFOR					-1.2844	-3.09***		
HCIO*DISPFOR							-1.3798	-2.91***
MIND_CIO	1.3867	2.02**	1.3269	1.94*	1.3798	2.02**	1.3180	1.93*
Control Var.	Included		Included		Included		Included	
Firm FE	Included		Included		Included		Included	
Year FE	Included		Included		Included		Included	
Adj. R^2	8.46%		8.56%		8.71%		8.80 %	

Note: Table 8a presents coefficients and the *t*-statistics for the following OLS regression model:

$$MFREQ = \beta_0 + \beta_1 CIO(HCIO) + \beta_2 HCFO + \beta_3 CTO + \beta_4 ITD + \beta_5 COO + \beta_6 LNAT + \beta_7 BETA + \beta_8 ABSCHGROA + \beta_9 INST + \beta_{10} BIG + \beta_{11} NUMANAL + \beta_{12} GROWTH + \beta_{13} LEVERAGE + \beta_{14} LOSS + \beta_{15} SPI + \beta_{16} FOREIGN + \beta_{17} VOL\_SALE + \beta_{18} BINDEP + \beta_{19} DISPFOR + \beta_{20} MIND\_CIO + FIRM \& YEAR\ DUMMIES + \varepsilon \quad (1)$$

*, **, and *** denote significance at levels of 0.1, 0.05, and 0.01, respectively (one-tailed test for the hypothesized effect, and two-tailed otherwise).

Table 8b. Regression Results Including the Annual Industry Average CIO Presence: Management Forecast Bias (N = 6,310)

	Column (1): H1b		Column (2): H2b		Column (3): H1b		Column (4): H2b	
	Coeff.	*t*-stat.	Coeff.	*t*-stat.	Coeff.	*t*-stat.	Coeff.	*t*-stat.
CIO	-0.0023	-1.85*			-0.0003	-0.19		
HCIO			-0.0029	-2.26**			-0.0002	-0.11
CIO*DISPFOR					-0.0549	-1.68*		
HCIO*DISPFOR							-0.0808	-2.06*
MIND_CIO	-0.0015	-0.17	-0.0012	-0.13	-0.0020	-0.22	-0.0017	-0.19*
Control Var.	Included		Included		Included		Included	
Firm FE	Included		Included		Included		Included	
Year FE	Included		Included		Included		Included	
Adj. R^2	33.21%		33.25%		33.34%		33.39%	

Note: Table 8b presents coefficients and the *t*-statistics for the following regression model: $MFBIAS = \lambda_0 + \lambda_1 CIO(HCIO) + \lambda_2 HCFO + \lambda_3 CTO + \lambda_4 ITD + \lambda_5 COO + \lambda_6 LNAT + \lambda_7 BETA + \lambda_8 ABSCHGROA + \lambda_9 INST + \lambda_{10} BIG + \lambda_{11} NUMANAL + \lambda_{12} GROWTH + \lambda_{13} LEVERAGE + \lambda_{14} LOSS + \lambda_{15} SPI + \lambda_{16} FOREIGN + \lambda_{17} VOL\_SALE + \lambda_{18} BINDEP + \lambda_{19} DISPFOR + \lambda_{20} HORIZON + \lambda_{21} SURPRISE + \beta_{22} MIND\_CIO + FIRM \& YEAR DUMMIES + \varepsilon$ (2)

*, **, and *** denote significance at levels of 0.1, 0.05, and 0.01, respectively (one-tailed test for the hypothesized effect, and two-tailed otherwise).

This finding suggests that the reverse causality does not drive the association between CIO presence and forecast bias. We considered it more appropriate to use the contemporaneous measure of CIO presence for our hypotheses testing. The use of a lagged measure of CIO presence captures the CIO's legacy influence for the current-period earnings forecasts, and it is unclear how this legacy effect would vary with the forecasting uncertainty. In contrast, the contemporaneous measure provides a direct test of the CIO influence on the contemporaneous earnings forecast processes and outcomes. The contemporaneous measures of CIO presence also allowed us to investigate how forecasting uncertainty moderates the CIOs' influence on the earnings forecast outcomes in the same fiscal period (e.g., H2b). Finally, the use of the lagged presence variable for the forecast bias analyses would have resulted in a sample attrition of 1,803 (28.57%) observations, which limits the generalizability of our inferences.

4 Limitations, Implications, and Recommendations for Future Research

This study has some potential limitations that suggest avenues for future research. We acknowledge that our use of secondary data limits the ability to develop specific constructs designed for the highest level of content validity. In addition, the nature of the secondary data may not allow for the research design to fully capture the strategic knowledge base or other attributes of the CIO and the level of information intensity/quality within the organization, both of which could potentially influence the informational phenomenon. Nevertheless, secondary data is highly objective and is thus avoids various methodological issues with using primary data (i.e., surveys, experiments, etc.) such as response bias, common method bias, hypothesis guessing, and respondent validity. Future studies should seek to use primary data analysis in conjunction with secondary data to examine this CIO-related phenomenon. In addition, our testing sample consisted of publicly traded organizations, which constrains the generalizability of the findings to some extent; therefore, further work examining an extension of this phenomenon using a broader pool of organizations would be beneficial (e.g., private companies, not-for-profit organizations, etc.).

Our finding that firms with CIOs are associated with improved management and integration of corporate information is also contingent on the level of uncertainty faced by the firm. Specifically, we found empirical support indicating that: (1) firms with CIOs have reduced optimistic bias in management earnings forecasts (relative to firms without CIOs), (2) information uncertainty weakens the degree to which CIO firms influence forecasting frequency (compared to non-CIO firms), and (3) information uncertainty strengthens the degree to which optimistic forecasting biases are reduced in CIO firms (compared to non-CIO firms).

This study provides key implications for several streams of literature. We contribute to CIO literature seeking to understand how the CIO creates business value. Prior CIO research has documented positive market reactions to announcements of newly created CIO positions (Chatterjee et al., 2001), and the importance of the CIO role in developing IS strategic alignment and consequent levels of organizational performance (Karahanna & Preston, 2013; Preston & Karahanna, 2009; Reich & Benbasat, 1996, 2000).

Table 9: Reverse Causality Tests

	MFBias Column (1)		*MFBias* Column (2)		*CIO* Column (3)		*HCIO* Column (4)	
	Coeff.	***t*-stat.**	**Coeff.**	***t*-stat.**	**Coeff.**	***z*-stat.**	**Coeff.**	***z*-stat.**
LAG_CIO	-0.0330	-1.98**						
LAG_HCIO			-0.0040	-2.52**				
LAG_MFBIAS					0.8262	0.21	-2.2588	-0.48
Control Var.	Included		Included		Included		Included	
Firm FE	Included		Included		Included		Included	
Year FE	Included		Included		Included		Included	
Number of Observations	4,507		4,507		1,451[a]		1,451[a]	

Note: Column (1) and (2) present coefficients and the *t*-statistics for the following OLS regression model:

$$MFBIAS = \lambda_0 + \lambda_1 LAG\_CIO/LAG\_HCIO + \lambda_2 HCFO + \lambda_3 CTO + \lambda_4 ITD + \lambda_5 COO + \lambda_6 LNAT + \lambda_7 BETA + \lambda_8 ABSCHGROA + \lambda_9 INST + \lambda_{10} BIG + \lambda_{11} NUMANAL + \lambda_{12} GROWTH + \lambda_{13} LEVERAGE + \lambda_{14} LOSS + \lambda_{15} SPI + \lambda_{16} FOREIGN + \lambda_{17} VOL\_SALE + \lambda_{18} BINDEP + \lambda_{19} DISPFOR + \lambda_{20} HORIZON + \lambda_{21} SURPRISE + FIRM \& YEAR\ DUMMIES + \varepsilon \quad (4)$$

Column (3) and (4) present coefficients and the *t*-statistics for the following OLS regression model:

$$CIO/\ HCIO = \lambda_0 + \lambda_1 LAG\_\ MFBIAS + \lambda_2 HCFO + \lambda_3 CTO + \lambda_4 ITD + \lambda_5 COO + \lambda_6 LNAT + \lambda_7 BETA + \lambda_8 ABSCHGROA + \lambda_9 INST + \lambda_{10} BIG + \lambda_{11} NUMANAL + \lambda_{12}\ GROWTH + \lambda_{13} LEVERAGE + \lambda_{14} LOSS + \lambda_{15} SPI + \lambda_{16} FOREIGN + \lambda_{17} VOL\_SALE + \lambda_{18} BINDEP + \lambda_{19} DISPFOR + \lambda_{20} HORIZON + \lambda_{21} SURPRISE + FIRM \& YEAR\ DUMMIES + \varepsilon \quad (5)$$

*, **, and *** denote significance at levels of 0.1, 0.05, and 0.01, respectively (one-tailed test for the hypothesized effect, and two-tailed otherwise).

876 groups (3,201 observations) are dropped because of all positive or all negative outcomes.

The findings of the current study examining the CIO influence on management forecasting extend the current body of knowledge on the impact that the CIO can have on corporate outcomes. Furthermore, we found that the CIO has a greater impact on forecasting accuracy in uncertain environments. This enriches the CIO research since it highlights the organizational context under which the CIO and top management can best influence organizational outcomes (Menz, 2012). The findings also extend the upper echelons literature that has called for research to examine various outcomes of top managers outside the executive's primary functional area (Carpenter et al., 2004).

The finding that the CIO plays an essential role in shaping the earnings forecasting environment suggests that the CIO's influence can cut across functional areas that may not be immediately considered to be the traditional functional domain of the CIO (i.e., IT management). In accordance with agency theory, our findings indicate that the CIO is essential to facilitating knowledge creation and transfer, thus reducing information asymmetry, which is conducive to improved forecasting accuracy. Furthermore, this finding further extends this literature base by documenting how the CIO's influence on information quality is moderated by ambiguity and how information asymmetry is thus imposed by uncertain information environments. This study extends theory by demonstrating how top managers can influence the organization's information processing to thus develop greater fit between information processing requirements and capabilities. Specifically, this study advances theory by showing that CIOs can act across organizational domains to influence the earnings forecasting function through their leadership role in terms of the firm's information processing, integration, and interpretation. Furthermore, this study advances the management forecast literature by investigating the influence of various members of top management on forecasting through highlighting the CIO's role in facilitating strategic initiatives (Karamanou & Vafeas, 2005; Ke et al., 2019; Kwak et al., 2012). We also complement and extend the management forecast literature by showing how informational governance affects the management forecast bias (Dorantes et al., 2013; Li et al., 2012).

While the current study focuses on the CIO's activation of information-processing capacity for earnings forecasting, future research could expand this application to include the assessment information requirements, and thus the fit with capacity. Further work could also investigate additional information outcomes that may be of relevance, such as financial reporting quality, cost of capital, and market crash risk. Given that middle management is becoming more influential in determining corporate action and outcomes (Raes et al., 2011), future research could also explore whether the CIO can facilitate knowledge dissemination at lower levels of the organization and whether such knowledge dissemination can impact intermediate outcomes within different functional

units. In addition, researchers could further examine the mechanisms through which the CIO is able to influence forecasting outcomes (e.g., overall organizational information quality), such as informational and accounting governance structures, IS experience of accounting employees, etc. In accordance with UET, future research would benefit from a greater depth of understanding in terms of how the CIO's demographics and background (age, strategic IS and business knowledge, functional experience, accounting knowledge, etc.) influence the managerial forecasting process. It would also be interesting to examine the CIO's relationship with specific top managers (i.e., CEO, CFO, CMO, and other top executives) for bridging potential CIO limitations with the specialized knowledge of other specific functional groups. In addition, future research should seek to examine how CIOs' relationships with emerging technologists (e.g., chief digital officer, chief data officer, chief innovation officer, data scientists at various levels within the organizational hierarchy, etc.) influence information-based outcomes for the organization. Future research could also conduct a more granular examination of the relational factors between the CIO and top management (e.g., managerial characteristics / diversity, formal top management team membership, etc.).

The results of this study have several important implications for managerial practice. First, we demonstrate that firms with CIOs can indeed influence the management forecasting process. As such, firms need to understand that the CIO is fundamental to this strategic disclosure of information. As discussed above, management forecasting is typically considered to be in the domain of the CEO and CFO. However, the findings of this study provide evidence that the CIO can influence strategic level outcomes outside of the traditional responsibilities of the top IS executive. As such, firms need to ensure that the CIO is involved in the consolidation and dissemination of information of various functional groups. Furthermore, when selecting and promoting the CIO, firms with greater strategic demand for information and knowledge should ensure that the CIO is positioned to engage with other senior managers. In addition, the inclusion of the CIO within the organization is particularly relevant when firms make information-sensitive decisions (e.g., forecasting) that may involve knowledge consolidation and integration across different segments. Hence, firms should leverage the CIOs' ability to act as an integrator of knowledge and establish governance structures to ensure that diverse knowledge bases can be pooled to synergistically achieve desirable information outcomes. Organizations may also wish to further consider the roles of other top management executives. Other executives (e.g., CFO, CMO, etc.) may feel somewhat constrained to focus on their primary functional domain, even though the expansion of their roles into cross-functional disciplines as well as collaboration with other top management may enable better decision-making within the upper echelon. For external investors and stakeholders, our findings may provide reassurance that firms with CIOs are better enabled to channel information as needed to provide earnings guidance with less bias, thus allowing for a sounder and more reputable firm from a forecasting standpoint. As such, the evaluation of a firm's governance structure may provide greater insight into investment opportunities.

In conclusion, our empirical results offer theoretical and practical implications for the widely unexplored domain of CIO impact on forecasting, which is influenced by information uncertainty. Collectively, the findings provide a theory-based understanding of how CIOs can affect strategic outcomes in the form of managerial forecasts. Furthermore, our study is of practical relevance for organizations in that it provides guidance on how governance structures can be manipulated to influence managerial forecasts and other strategic outcomes.

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Appendix A: Literature Summary: Strategic Role/Impact of the CIO

Table A1: Literature Summary: Strategic Role/Impact of the CIO

Study	Journal	Research context	Theoretical foundation	Summary of findings
Grover et al. (1993)	*Journal of Management Information Systems*	Conceptual. Framework development	Mintzberg's classic managerial role model	This study examines the strategic role of the CIO based on Mintzberg's classic managerial role model. As the IS management matures within an organization, the CIO's role as spokesman and liaison becomes more important; however, the CIO's strategic responsibilities in the monitor and entrepreneur roles do not become more important. Also, more centralized IS resources leads to a more pronounced CIO role in acting as a spokesman, environmental monitor, and resource allocator.
Armstrong & Sambamurthy (1999)	*Information Systems Research*	Empirical. Survey data collected from 169 CIO-TMT matched-pairs in US-based hospitals	Knowledge-based view, Resource-based view	This study found that three key factors influence IT assimilation: (a) quality of senior leadership, (b) sophistication of IT infrastructures, and (c) organizational size. This study finds that the CIOs' membership in the TMT and informal interactions with TMT members enhance the CIO's strategic IT and business knowledge. These relationships are most pronounced in firms that articulate a transformational IT vision. The sophistication of IT infrastructures was also found to be significant factor to impact IT assimilation, while IT knowledge of senior business executives was not.
Chatterjee et al. (2001)	*MIS Quarterly*	Empirical. Event study. 137 press releases from 1987-1998 time period	IS leadership literature	Findings provide strong support that announcements of newly created CIO positions induce positive reactions from the marketplace, especially for firms that compete within in industries undergoing IT-driven transformation.
Smaltz et al. (2006)	*IEEE TEM*	Empirical. Survey data collected from 100 CIO-TMT matched pairs from US hospitals	IS leadership literature	This study develops six key roles of an effective CIO role (business strategist, integrator, relationship architect, utility provider, information steward, and educator). The findings of this study reveal that high levels of CIO-TMT engagement do not directly influence CIO's role effectiveness but are mediated by the effects of CIO capabilities (IS and business knowledge, political savvy, communication skills).
Preston et al. (2006)	*IEEE TEM*	Empirical. Survey data collected from 163 US CIOs and 44 French CIOs	Upper echelons theory, Hofstede's cultural dimensions, IS strategy literature, shared mental model literature	This cross-cultural study examines the mechanisms (guided by cultural factors) that facilitate the development of a shared CIO-TMT understanding of the strategic role of IS in US and French organizations. CIO educational mechanisms are found to influence the development of a shared understanding in both samples. However, differences are also noted across the two samples. Social systems of knowing are key mechanisms to shared IS understanding in the French sample while structural systems of knowing and relational similarity are key mechanisms in the US sample.
Enns et al. (2007)	*MIS Quarterly*	Empirical. Structured Interviews. Survey data from 69 CIO-TMT matched-pairs in North American firms	Influence behaviors	The CIO's use of influence behaviors of rational persuasion and personal appeal exhibited significant relationships with TMT peer commitment, while exchange and pressure were significantly related to peer resistance.

Preston et al. (2008)	*Decision Sciences*	Empirical. Survey data collected from 174 matched-pair CIOs and business executives in US firms.	Upper echelons theory, theory of managerial discretion, power and politics literature, IS leadership literature	CIO strategic decision-making authority (in conjunction with CIO strategic effectiveness) is the key direct antecedent to IT's contribution to firm performance. This decision-making authority mediates the organizational (climate and support for IT) and executive-level characteristics (CIO structural power and CIO-TMT partnership).
Preston et al. (2008)	*MIS Quarterly Executive*	Empirical. Survey data collected from 174 matched-pair CIOs and business executives in US firms	Upper echelons theory, theory of managerial discretion, power and politics literature, IS leadership literature	This study developed four CIO leadership profiles based on the CIO's strategic decision-making authority and the CIO's level of strategic effectiveness. Each profile had differential levels on influence on the degree to which IT contributed to firm performance. CIOs who were strategically effective and were granted strategic decision-making authority were found to have the greatest firm performance impacts.
Preston & Karahanna (2009)	*Information Systems Research*	Empirical. Survey data collected from 243 CIO-TMT matched-pairs in US firms	Upper echelons theory, IS strategic alignment and leadership literature, shared mental model literature	A shared understanding between the CIO and TMT regarding the strategic role of IS within the organization is the key proximal antecedent to IS-business strategic alignment at an organizational level. CIO-TMT understanding mediates the influence of other organizational factors (structural/social systems of knowing); CIO educational mechanisms employed; and the CIO-TMT relationship (relational similarity, shared domain knowledge, shared business language).
Preston & Karahanna (2009)	*MIS Quarterly Executive*	Empirical. Survey data collected from 243 CIO-TMT matched-pairs in US firms	Upper echelons theory, IS strategic alignment and leadership literature, shared mental model literature	This paper provides a framework for creating a shared IT vision between the CIO and TMT, which is key to aligning the IS strategy with its business strategy. This paper shows how this shared IT vision is facilitated by six visioning mechanisms and identifies five distinct configurations of visioning mechanisms used by firms. These configuration profiles are used by CIOs and TMT members to assess which visioning mechanisms best for a shared CIO-TMT vision for IS strategic alignment based on the CIOs' characteristics and the organizational context
Chen et al. (2010)	*Journal of Management Information Systems*	Empirical. Survey data collected from 174 matched-pair CIOs and business executives in US firms	Supply-side and demand-side leadership literature	This paper develops a staged maturity model that is supported by the findings in that: (1) both CIO supply-side and demand-side leadership directly influence short-term effects of IT's contribution to firm efficiency; (2) CIO demand-side leadership mediates the influence of CIO supply-side leadership on the longer-term effects of IT's contribution to strategic growth. Differential effects on the antecedent variables (CIO human capital, CIO structural power, and organizational support for IT) on CIO supply-side and demand-side leadership are also observed.
Banker et al. (2011)	*MIS Quarterly*	Empirical. Secondary longitudinal data from two periods (1990-1993 and 2006)	Strategy-structure paradigm	The findings of this study support the contention that the firm's strategic positioning (differentiation vs. cost leadership) is the key factor that determines the firm's CIO reporting structure. The results indicate that a CIO-CEO reporting structure is only superior for firms that seek to be differentiators while a CIO-CFO reporting structure is superior only for firms that are cost leaders.
Carter et al. (2011)	*MIS Quarterly Executive*	Empirical. Field study of 45 CIOs	IS leadership literature	This study finds that the role of business technology strategist is most strongly related to the CIO's formal power and to his or her skills in absorbing and disseminating relevant information (the informational role).
Peppard et al. (2011)	*MIS Quarterly Executive*	Interviews	IS leadership literature	The findings of this study indicate that there are five distinct roles of the CIO: utility IT director, evangelist CIO, innovator CIO, facilitator CIO, and

				agility IT director/CIO. The appropriate role for the CIO within a particular organization at a certain point in time is contingent upon the degree to which IS critical for competitive differentiation, the maturity of the firm's IS leadership capabilities, and the digital literacy of the TMT.
Lim et al. (2013)	*Journal of Management Information Systems*	Empirical. Econometric analysis based on panel data for 1,326 large cross-industry US firms (1997-2009)	IS leadership literature	IT executives with greater structural power (e.g., higher job titles) or IT-related expert power (e.g., IT-related education or experience) are more likely to attract public recognition for their firm's IT capability. Organizations that develop an IT capability reputation are more likely to promote their IT executives, who in turn have longer organizational tenure with their firm. This further leads to the ability of a firm to sustain its IT capability reputation.
Schobel & Denford (2013)	*Journal of Information Systems*	Case studies	IS leadership literature	The perceptions of the CIO and CFO regarding the other's strategic role within the organization is a key differentiator that can facilitate or hinder this executive relationship and consequently impact firm-level outcomes.
Karahanna & Preston (2013)	*Journal of Management Information Systems*	Empirical. Survey data collected from 81 CIO-TMT matched-pairs in US-based hospitals.	Upper echelons theory, social capital theory, IS strategic alignment, and leadership literature	The findings indicate that the alignment between the IS strategy and business strategy is the key proximal antecedent to a hospital's financial performance. IS strategic alignment mediates the influence of CIO-TTM social capital on performance. The results also show that cognitive and relational CIO-TMT social capital directly influence IS information systems strategic alignment, but that CIO-TMT structural social capital only has indirect influence on IS alignment through its effects on cognitive social capital.
Chen et al. (2015)	*Database for Advances in Information Systems*	Empirical. Survey data from senior IS executives in 165 US and Indian firms	IS strategic management and leadership literature	The strategic leadership role of the CIO positively moderates the influence of an innovative IS strategy of an organization on the derived innovative business orientation (which in turn leads to customer value).
Khallaf & Skantz (2015)	*International Journal of Accounting Information Systems*	Empirical. Secondary longitudinal data from two periods (1997-1998 and 1999-2007).	Knowledge-based view	This study finds that new appointments of CIOs lead to greater organizational R&D productivity in one time frame (1997-1998) but not for appointments in later years (1999-2007). The study also finds that organizations with superior IT capabilities also lead to productivity improvements over the entire phase (1997-2007). The findings indicate that newly appointed CIOs are able to improve both the firm's IT and overall knowledge management.
Feng & Wang (2019)	*International Journal of Accounting Information Systems*	Empirical. Compustat data from 2003 to 2015	IS leadership literature	The findings of this study shows that a CIO's level of risk aversion is associated with fewer incidents of security breaches. In addition, this associated is amplified when the firm's CEO is also risk averse and is also moderated by the CIO's power within the organization.

Table A2. Literature Summary: Role Top Management's Characteristics on Earnings Forecasts

Study	Journal	Research context	Theoretical foundation	Summary of findings
Ajinkya et al. (2005)	*Journal of Accounting Research*	Empirical	Accounting management literature	The findings of this study indicate that firms with more outside directors and greater institutional ownership are more likely to issue a forecast and are inclined to forecast more frequently. Furthermore, these forecasts were observed to tend to be more accurate and less optimistically biased.
Karamanou & Vafeas (2005)	*Journal of Accounting Research*	Empirical	Accounting management literature, financial disclosure literature	This study examines how corporate boards and audit committees are associated with voluntary financial disclosure practices (proxied by management earnings forecasts). This study found that firms with more effective board and audit committee structures have managers that are more likely to create and update earnings forecasts. Furthermore, for such firms, forecasts are more likely to be less precise, more accurate, and to elicit a more favorable market response.
Bamber et al. (2010)	*The Accounting Review*	Empirical	Strategic management literature	This study finds that top executives provide both unique and economically significant influence on their firms' voluntary disclosures. The demographic and background characteristics of these top managers were found to influence their unique disclosure style.
Baik et al. (2011)	*Contemporary Accounting Research*	Empirical	Voluntary disclosure literature	This study posits that CEOs voluntarily issue earnings forecasts to signal their ability. The findings indicate that the CIO's ability will lead to an increased frequency of management earnings forecast issuances. High-ability CEOs also issue more accurate forecasts with the market being more responsive to the news in forecasts associated with these higher-ability CEOs.
Kwak et al. (2012)	*Journal of Accounting and Economics*	Empirical	Voluntary disclosure literature	This study finds that firms with a general counsel (GC) in top management are more likely to issue forecasts, particularly when such forecasts provide bad news. Furthermore, the forecasts for such firms are less optimistic and more accurate than those issued by firms with a stronger stock price reaction to their forecast news. Also, such effects are more pronounced when the GC has a higher level of managerial status within the organization.
Lee et al. (2012)	*The Accounting Review*	Empirical	Management forecast literature	This study finds that the probability of CEO turnover is positively related to the magnitude of absolute forecast errors when poor firm performance is observed. This relationship holds for both positive and negative forecast errors. Also, this study finds that the positive link between forecast errors and CEO turnover is concentrated in the sample of less entrenched CEOs. Furthermore, the findings indicate that boards of directors use management forecast accuracy as a signal for the managerial ability of the CEO who is responsible for issuing accurate forecasts.

Yang (2012)	*Journal of Accounting and Economics*	Empirical	Neoclassical view of the firm, management forecast literature	This paper examines how the forecasting style of top managers (e.g., CEOs and CFOs) affect their perceived credibility. This research posits that if this is the case, then the stock price reaction to forecast news should increase with managers' prior forecasting accuracy. The observations are consistent with this prediction with the findings supporting that the stock price reaction to management forecast news is stronger when information uncertainty is high and when the manager has a history of issuing more accurate forecasts, which indicates that individual managers benefit from establishing a personal disclosure reputation.
Liu et al. (2018)	*Information & Management*	Empirical	IS leadership literature, Information processing literature, reporting literature	This study posits that because of accounting regulatory changes that affect IT infrastructure, CIOs are required to lead in aligning IT changes with new accounting reporting requirements. The findings of this study indicate that there is a significant increase in CIO compensation associated with periods following the mandatory adoption of more rigid mandated reporting requirements.
Ke et al. (2019)	*Management Science*	Empirical	Economic and sociological literature	This study examines social connections within the TMT to capture the team's interaction, cooperation, and teamwork, which are found to be associated with greater levels of accuracy for management forecasts. Such findings are consistent with the economic and sociological literature that information is dispersed within a firm and that social connections facilitate information sharing. Further analyses provide support that the association between social connections and forecast accuracy is stronger in the initial phases of team development. Such conditions are indicative of times when firms generally face greater levels of uncertainty/adversity and also when the CEOs generally exert less power within the group.

Appendix B: Variable Definitions

Table B 1: Variable Definitions

CIO	1 if a CIO can be identified for a given firm in a fiscal year from Boardex and 0 otherwise
HCIO	1 if a CIO has two or more executive titles including chief information officer (CIO) and 0 otherwise
HCFO	1 if a CFO has three or more executive titles including chief financial officer (CFO) and 0 otherwise
CTO	1 if a firm appoints a CTO; and 0 otherwise
ITD	1 if a firm appoints an IT director; and 0 otherwise
COO	1 if a firm appoints a COO; and 0 otherwise
MFREQ	The number of management earnings forecasts a firm issued during the year
MFBIAS	Management EPS forecast minus actual EPS scaled by the stock price at the beginning of the year, i.e., (management earnings forecast - actual earnings per share)/lagged price
LNAT	The natural log of total assets
BETA	The market model beta, estimated with daily returns over the past fiscal year
ABSCHGROA	The absolute value of change in return on assets from year *t*-1 to *t*
INST	The percentage of institutional ownership
BIG	1 if a firm hires a Big Four auditor in year t; and 0 otherwise
NUMANAL	The number of financial analysts following the company
GROWTH	The sales growth from year *t*-1 to *t*
LEVERAGE	Total liabilities / total assets
LOSS	1 if the income before extraordinary items is negative; and 0 otherwise
SPI	Absolute value of special items scaled by the total assets at the beginning of the year
FOREIGN	1 if the firm has foreign transactions in year *t* and 0 otherwise
VOL_SALE	The standard deviation of quarterly sales over the prior 7 years
BINDEP	The percentage of independent directors sitting on the board
DISPFOR	The standard deviation of analysts' forecasts at the beginning of a fiscal year (*MFREQ* model) / The standard deviation of the most recent analysts' forecasts before the management forecasts scaled by the absolute value of median analyst forecast (*MFBIAS* model)
HORIZON	The number of days between the earnings announcement date and the management earnings forecast date
SURPRISE	The price-deflated management forecast surprise, i.e. (management forecast - most recent analyst consensus EPS forecast before management forecast)/stock price at the beginning of the year
MIND_CIO	The average value of *CIO* by Fama-French 12 industry each year

Appendix C: Pearson Correlations

Table C1a. Forecast Frequency Sample (N = 16,115)

	FREQ	*CIO*	*CTO*	*ITD*	*COO*	*HCFO*	*LNAT*	*BETA*	*ABSCHGRO*
CIO	**0.130**								
CTO	**0.022**	0.012							
ITD	**0.025**	**-0.060**	**0.534**						
COO	-0.015	-0.015	**0.074**	**0.030**					
HCFO	**-0.036**	**-0.052**	**0.021**	**0.017**	**-0.039**				
LNAT	**0.187**	**0.259**	**-0.026**	0.006	**-0.058**	**-0.174**			
BETA	**-0.148**	**-0.022**	**0.046**	0.001	**0.027**	**0.024**	**-0.111**		
ABSCHGROA	**-0.132**	**-0.084**	**0.041**	**-0.023**	**0.033**	**0.032**	**-0.320**	**0.187**	
INST	**0.175**	**0.123**	**0.052**	**0.016**	**-0.020**	**0.031**	**0.040**	**0.148**	**-0.039**
BIG4	**0.121**	**0.108**	**0.043**	**0.019**	**-0.027**	**-0.034**	**0.092**	**0.077**	**0.027**
NUMANAL	**0.108**	**0.203**	**0.072**	-0.013	0.014	**-0.123**	**0.520**	**0.022**	**-0.036**
GROWTH	**-0.049**	**-0.070**	-0.012	**-0.023**	**0.043**	0.005	**-0.129**	**0.035**	**0.215**
LEVERAGE	**0.022**	**0.060**	**-0.082**	-0.002	**-0.025**	**-0.083**	**0.426**	**-0.120**	**-0.122**
LOSS	**-0.194**	**-0.082**	0.011	**-0.027**	**0.040**	0.002	**-0.276**	**0.218**	**0.355**
SPI	**0.022**	0.010	**-0.028**	**0.023**	-0.005	0.007	**0.112**	**-0.086**	**-0.338**
FOREIGN	**-0.074**	-0.009	**0.041**	**-0.024**	**-0.023**	**-0.029**	**0.054**	**0.057**	**-0.029**
VOL_SALE	-0.007	**-0.045**	0.011	-0.002	**0.047**	**0.019**	**-0.306**	0.014	**0.180**
BINDEP	**0.141**	**0.152**	**0.062**	**0.027**	-0.003	**0.016**	**0.108**	**0.075**	**-0.045**
DISPFOR	**-0.206**	**0.046**	**-0.027**	0.008	0.007	**-0.023**	**0.150**	**0.166**	**0.121**

	INST	*BIG4*	*NUMANAL*	*GROWTH*	*LEVERAGE*	*LOSS*	*SPI*	*FOREIGN*	*VOL_SALE*	*BINDEP*
BIG4	**0.263**									
NUMANAL	**0.179**	**0.170**								
GROWTH	**-0.035**	-0.001	0.005							
LEVERAGE	**-0.116**	**-0.105**	0.007	**0.147**						
LOSS	**-0.099**	-0.008	**-0.103**	-0.005	**-0.103**					
SPI	**-0.026**	**-0.049**	-0.013	0.005	**0.062**	**-0.413**				
FOREIGN	**-0.025**	**-0.121**	0.012	**-0.028**	**0.036**	-0.009	**-0.016**			
VOL_SALE	**-0.037**	**0.040**	**-0.084**	**0.061**	**-0.132**	**0.049**	**-0.063**	**-0.103**		
BINDEP	**0.258**	**0.039**	**0.076**	**-0.074**	0.014	**-0.020**	0.014	**0.111**	**-0.139**	
DISPFOR	**0.067**	**0.057**	**0.076**	-0.015	**0.069**	**0.201**	-0.002	0.001	**-0.032**	**0.076**

Note: Bolded correlations indicate significance at the 5% level.

Table C1b. Forecast Bias Sample (N = 6,310)

	MFBIAS	*CIO*	*CTO*	*ITD*	*COO*	*HCFO*	*LNAT*	*BETA*	*ABSCHGROA*	*INST*
CIO	**-0.056**									
CTO	**-0.038**	0.002								
ITD	**0.030**	**-0.092**	**0.558**							
COO	-0.009	-0.015	**0.092**	**0.044**						
HCFO	**0.064**	**-0.032**	0.020	0.016	-0.023					
LNAT	0.014	**0.237**	**-0.037**	-0.018	**-0.064**	**-0.155**				
BETA	**0.062**	**-0.034**	**0.061**	**0.050**	0.011	**0.051**	**-0.157**			
ABSCHGR	**0.046**	**-0.058**	**0.036**	**-0.025**	0.017	0.008	**-0.318**	**0.142**		
INST	-0.018	**0.058**	**0.031**	0.003	0.014	**0.076**	**-0.088**	**0.186**	-0.007	
BIG4	-0.009	**0.101**	0.012	0.012	**-0.030**	-0.002	**0.115**	0.015	-0.014	**0.147**
NUMANAL	**-0.086**	**0.179**	**0.054**	**-0.035**	0.020	**-0.105**	**0.520**	**-0.079**	**-0.025**	**0.036**
GROWTH	**-0.073**	**-0.066**	0.010	-0.021	**0.033**	**0.018**	**-0.181**	**0.048**	**0.172**	**0.030**
LEVERAGE	**0.031**	**0.067**	**-0.079**	**-0.033**	**-0.068**	**-0.064**	**0.421**	**-0.106**	**-0.134**	**-0.093**
LOSS	**0.214**	**-0.050**	0.021	0.011	**0.030**	0.020	**-0.144**	**0.159**	**0.325**	-0.021
SPI	**-0.111**	0.012	0.005	**0.035**	0.004	0.000	**0.073**	**-0.038**	**-0.371**	**-0.033**
FOREIGN	**-0.060**	-0.017	**0.044**	**-0.027**	0.013	**-0.062**	-0.018	**0.058**	**0.058**	0.021
VOL_SALE	**-0.034**	**-0.043**	**-0.031**	-0.024	**0.058**	0.017	**-0.322**	0.006	**0.215**	**-0.025**
BINDEP	**-0.069**	**0.178**	**0.080**	**0.048**	**-0.027**	0.008	**0.142**	**0.066**	**-0.054**	**0.228**
DISPFOR	**0.208**	**-0.049**	**0.028**	**0.034**	**0.030**	**0.037**	**-0.128**	**0.179**	**0.158**	0.006
HORIZON	**0.048**	**0.054**	**0.048**	0.015	0.004	-0.001	**0.097**	**0.052**	0.004	**0.039**
SURPRISE	**0.503**	**-0.036**	**-0.071**	**0.033**	0.015	**0.069**	**0.051**	**0.026**	**-0.120**	**0.061**

	BIG4	*NUMANAL*	*GROWTH*	*LEVERAGE*	*LOSS*	*SPI*	*FOREIGN*	*VOL_SALE*	*BINDEP*	*DISPFOR*	*HORIZON*
NUMANAL	**0.094**										
GROWTH	-0.024	0.016									
LEVERAGE	-0.016	**0.036**	**0.110**								
LOSS	0.003	**-0.043**	**-0.048**	**-0.055**							
SPI	**-0.035**	**-0.035**	**0.025**	**0.038**	**-0.504**						
FOREIGN	**-0.070**	**0.059**	-0.001	**-0.065**	**0.036**	**-0.082**					
VOL_SALE	0.020	**-0.073**	**0.143**	**-0.121**	**0.037**	**-0.036**	**-0.056**				
BINDEP	**0.093**	**0.051**	**-0.087**	0.013	-0.019	-0.004	**0.083**	**-0.136**			
DISPFOR	**-0.033**	**-0.124**	**-0.055**	**-0.059**	**0.336**	**-0.080**	-0.022	0.017	-0.016		
HORIZON	**0.028**	**0.128**	**-0.066**	-0.010	**0.056**	**-0.045**	**0.044**	**-0.031**	**0.092**	0.029	
SURPRISE	**0.036**	**-0.105**	**0.049**	**0.071**	**-0.059**	**0.116**	**-0.086**	**-0.078**	**-0.087**	**0.137**	-0.031

Note: Bolded correlations indicate significance at the 5% level.

Appendix D: Propensity Score Matching

We estimate the likelihood of a CIO (or high-status) present in top management using Model (3). Table D1 presents logistic regression results for both the forecast frequency sample (n = 16,155) and the forecast bias sample (n = 6,310), respectively. For brevity, the logistic regression results for the high-status CIO (*HCIO*) are not tabulated. The untabulated regression results are inferentially similar to the logistic regression results for the CIO presence (i.e., *CIO*) as the dependent variable. Estimation results for the frequency sample and bias sample are mostly consistent with each other with a few exceptions. Common to both samples, we find that the likelihood of having a CIO increases with firm size (*LNAT*), audit quality (*BIG*), analyst following (*NUMANAL*), sales volatility (*VOL_SALE*), and board independence (*BINDEP*), whereas it decreases with market risk (*BETA*) and foreign operations (*FOREIGN*). Unique to the frequency sample, we found that the likelihood of having a CIO increases with institutional ownership (*INST*), whereas it decreases with growth (*GROWTH*) and special items events (*SPI*). Unique to the bias sample, the likelihood of having a CIO increases with earnings change (*ABSCHGROA*).

Table D1. Logit Model to Estimate the Propensity of the Presence of a CIO in Top Management (*CIO*)

Dependent variable: CIO	**Disclosure frequency sample**		**Forecast bias sample**	
	Coeff.	***t*-stat**	**Coeff.**	***t*-stat**
LNAT	0.3279	17.01***	0.3355	11.22***
BETA	-0.1076	-2.33**	-0.2034	-2.45**
ABSCHGROA	-0.2971	-1.11	0.9600	1.75*
INST	0.4512	4.31**	-0.1441	-0.84
BIG	0.4788	6.04***	0.6786	4.76***
NUMANAL	0.0246	7.54***	0.0151	2.93***
GROWTH	-0.1952	-2.50**	-0.1161	-0.67
LEVERAGE	-0.0115	-0.14	0.0662	0.49
LOSS	-0.1472	-2.23**	-0.2140	-1.62
SPI	-1.2689	-2.06*	0.6767	0.55
FOREIGN	-0.1020	-2.21**	-0.1563	-2.10**
VOL_SALE	0.7669	2.68***	0.7293	1.71*
BINDEP	1.5977	9.50***	2.2904	8.23***
INTERCEPT	-6.2248	-27.38***	-6.6627	-17.83***
Industry Fixed Effect	Yes		Yes	
Year Fixed Effect	Yes		Yes	
N	16,155		6,310	
Pseudo R^2 (%)	12.96%		12.04%	

Note: Table D1 presents coefficients and the *z*-statistics for the following clustered logistic regression model:

$$CIO\ (HCIO) = \alpha_0 + \alpha_1 LNAT + \alpha_2 BETA + \alpha_3 ABSCHGROA + \alpha_4 INST + \alpha_5 BIG + \alpha_6 NUMANAL + \alpha_7 GROWTH + \alpha_8 LEVERAGE + \alpha_9 LOSS + \alpha_{10} SPI + \alpha_{11} FOREIGN + \alpha_{12} VOL\_SALE + \alpha_{13} BINDEP + INDUSTRY\ \&\ YEAR\ DUMMIES + \varepsilon \quad (3)$$

*, **, and *** denote significance at levels of 0.1, 0.05, and 0.01, respectively.

We verify that matching helps to reduce or eliminate the observable differences between CIO firms and non-CIO firms. Table D1 presents the univariate differences between CIO firms and non-CIO firms for the two samples. Unlike Table 2 showing significant differences between CIO firms and non-CIO firms along almost all dimensions, Table D2 indicates that none of the covariates are significantly different between CIO firms and matched non-CIO firms in both the forecast frequency sample and the forecast bias sample. Hence, propensity score matching allows us to achieve covariate balance (i.e., resemblance of covariate characteristics) between CIO firms and non-CIO firms.

Table D2. Univariate Tests for the Independent Variables used in Model (3)

Variable	Forecast frequency			Forecast bias		
	CIO firms	Non-CIO firms	Difference *t*-statistics	CIO firms	Non-CIO firms	Difference *t*-statistics
LNAT	8.1976	8.1735	0.59	8.2775	8.264	0.23
BETA	1.1238	1.1180	0.53	1.0119	1.0060	0.43
ABSCHGROA	0.0461	0.0467	-0.32	0.0348	0.0350	-0.10
INST	0.7465	0.7435	0.63	0.7695	0.7667	0.43
BIG	0.9368	0.9342	0.47	0.9609	0.9588	0.32
NUMANAL	15.8390	15.7740	0.31	15.5970	15.6450	-0.17
GROWTH	0.1069	0.1074	-0.08	0.1046	0.1053	-0.11
LEVERAGE	0.6598	0.6577	0.31	0.6548	0.6540	0.10
LOSS	0.1487	0.1473	0.17	0.0759	0.0711	0.54
SPI	-0.0124	-0.0125	0.10	-0.0105	-0.0101	-0.35
FOREIGN	0.3054	0.3049	0.05	0.2588	0.2528	0.41
VOL_SALE	0.0559	0.0570	-0.66	0.0576	0.0595	-0.69
BINDEP	0.7746	0.7713	1.11	0.7921	0.7892	0.71

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