A STUDY OF CIOS' SELECTION, COMPENSATION, AND TURNOVER

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ABSTRACT

Implementation of the Sarbanes-Oxley Act and recovery in IT spending after the dot-com bust in 2002 have enhanced the Chief Information Officer's (CIO's) role and needed skills. The CIO significantly influences strategy implementation and firm performance through the management of IT resmyces. I posit that firms must appoint a CIO with an appropriate background (technical versus business) that is aligned with their strategic positioning (differentiation versus cost leadership) for IT resmyces to support the firm's strategy. I find that differentiators (cost leaders) are more likely to appoint a CIO with a technical (business) background. Notably, firms announcing aligned CIO appointments (technical CIOs for differentiators and business CIOs for cost leaders) have superior investor reactions. Second, I take the first step to understand the impact of CIO's education on determining their compensation. I find that CIO education characteristics are significant determinants of CIO compensation, addressing the ongoing debate regarding the desired CIO education. Furthermore, drawing on Agency theory, I separately examine salary and bonus due to their divergent roles in rewarding and incentivizing ability and effort. My findings suggest that CIO education characteristics strongly determine CIO salary whereas firm financial performance measures strongly determine CIO bonus, consistent with salary rewarding CIO ability and bonus incentivizing CIO effort. Third, I investigate the relationship between data breaches and Chief Information Officer (CIO) turnover. Executive turnover literature finds that CEOs and CFOs turnover when they fail to meet financial performance expectations. Unlike CEOs and CFOs, CIOs are directly responsible for IT performance and I argue that CIOs are more likely to turnover when they fail to meet their performance expectation as reflected by data breaches. Following previous work, I classify system breaches into system glitch, criminal attack, human error and other. I document system glitches increase the likelihood of CIO turnover by two-fold. Furthermore, I find that the impact of system glitches on CIO turnover lasts for two years.

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CHAPTER 1

MOTIVATION

The Chief Information Officer (CIO) is responsible for managing a firm's Information Technology (IT) resmyces and plays a strategic role in improving the firm's operational efficiency and agility, supporting business decisions by providing timely and accurate information, and shaping the future of business strategy using IT (Richardson et al. 2014; Ernst & Young 2012). Over the past decade, a stricter regulatory environment due to Sarbanes-Oxley Act of 2002 and IT advances sparked by increased IT spending recovery following the early 2000 dot.com bust have increased the importance of IT for firms. Thus, there is a steep rise in new CIO appointments after 2002 as a response to the increased importance of IT; for example, 75 CIOs are appointed annually by Fortune 500 companies (Gariano 2010).

As the importance for CIOs rises, "What makes a good CIO, technical skills or business acumen?" has become a hot topic in the popular press recently (CIO Insight, January 2012) after a public debate between Bill Gates and Steve Jobs1 on the implications of technical vs. non-technical education on IT-related job performance. Education has been recognized by both academia and practitioners as an important indicator of CIO's ability and can significantly affect their future executive and firm performance (ExecRank2 2013; Sobol and Klein 2009; Khallaf and Skantz 2007; Ang et al 2002). The first chapter of this

[1] In a speech before the National Governors Association on Feb 28, 2011, Gates implied that technical disciplines, such as science, technology, engineering and mathematics, are needed for firms who strive for innovation in the future. However, this argument provoked many responses from defenders of non-technical disciples, for example, 3 days later, on March 2, 2011, at the end of the launch event of iPad2, Steve Jobs wrapped up that Apple would never invent products as elegant as the iPad without employees from fields of liberal arts and business.

[2] ExecRank is a leading and patent-pending proprietary executive ranking system in the US.

dissertation is to address this issue by positing that CIO's educational background must be aligned with firm's strategic positioning and examines how the stock market reacts towards aligned CIO appointment announcements.

CIO compensation has been rising steadily at 16% annually on average since 20023 in response to the dramatically increased demand for CIOs due to the changes introduced by Sarbanes-Oxley Act of 2002 and the technological advances from the IT spending recovery (Sutton and Arnold 2005; World Bank4; InformationWeek 2013; Agarwal and Beath 2007). Despite the importance of CIOs and their rapidly growing compensation, majority of extant executive compensation studies have mainly focused on CEOs and CFOs (Banker et al. 2013; Balsam et al. 2011; Lambert and Larcker 1987). In the second chapter, I address this gap in the literature by investigating CIO compensation and this study is particularly interested in the question "Why do some CIOs get paid more than others". I examine how CIO education determines their compensation. Furthermore, drawing on Agency theory, I separately examine salary and bonus due to their divergent roles in rewarding and incentivizing ability and effort.

The average Chief Information Officer (CIO) tenure is typically less than three years (Strassmann 2004), which is much shorter than that of CEOs (8.4 years) and CFOs (well over 10 years) (SpencerStuart 2013). However, "…a new CIO needs at least five years to get things on track" (June Drewry, global CIO at the Chubb Corp5), which far

[3] 14% increase in CIO compensation is calculated based on my sample data during 2002-11
[4] IT spending has increased annually at a rate of approximately 5% since the recovery in 2002 from the Dot.com bubble bust (World Bank data item: Information and communication technology expenditure (current US$) in United States during 2002-09)
[5] http://www.computerweekly.com/news/1280096301/Short-CIO-tenures-paralyze-IT.

exceeds the average CIO tenure. Such a high rate of CIO turnover makes information technology (IT) less effective and leads to negative firm consequences (Strassmann 2004). Furthermore, it imposes a significant amount of repeated adjustment costs on the firm to replace the incumbent CIO and also incentivizes CIOs to focus on short-term goals that may conflict with the firm's long-term strategic plans (McGillicuddy 2007). In spite of the rising importance of IT and the evolving role of a CIO, the literature has yet to address questions about the determinants of CIO turnover. Grounded in executive turnover literature and computer security literature, I study the association between data breaches and CIO turnover.

This dissertation is constructed in the three aforementioned sections to investigate the whole life cycle of the recruitment of CIOs including (1) appointing, (2) compensating and (3) dismissing of CIOs. In summary, Chapter 3 posits that CIO's educational background must be aligned with firm's strategic positioning and examines how the stock market reacts towards aligned CIO appointment announcements. Chapter 4 takes the first step to understand the impact of CIO's education on determining their compensation. Chapter 5 examines the consequence of data breach incidents on CIO turnover. Chapter 6 discusses contributions and future research directions.

CHAPTER 2

LITERATURE REVIEW

The CIO's Position

The position of CIO has been created in the early 1980s' as a consequence of the pervasive use of information technology in firms and the emergence of the information economy (e.g., Benjamin et al. 1985; Rockart et al. 1982). The desired type of CIOs has been evolving over time. As IT started to play a more important role in business process and firm strategy, the CIO position gradually became more influential (Applegate and Elam 1992) and a IT-focused CIO with business acumen was preferred to deliver IT value into a firm's business in a strategic orientation (Enns et al 2003). The passage of the Sarbanes-Oxley Act of 2002 in the United States (U.S.) promises to once again radically alter the CIO's position and, accordingly, the necessary knowledge base with a re-focus of IT (Boritz and Lim 2011; Kaarst-Brown and Kelly 2005). There has been a heated debate among practitioners and academia on "which background makes a desired CIO" in the post SOX era (CIO Insight 2012). However, few studies have answered this question.

Impact of Sarbanes-Oley Act on CIOs

An important objective of SOX is to strengthen internal controls over financial reporting[6] among US public firms and enhance investor and stakeholder confidence in published financial reports. Although SOX doesn't directly regulate a firm's IT

[6] A process designed by, or under the supervision of, the registrant's principal executive and principal financial officers, or persons performing similar functions, and effected by the registrant's board of directors, management and other personnel, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles…" (SEC 2003)

department, IT is the backbone of internal controls and financial reporting processes that the law directly regulates. Therefore, the passage of SOX Act of 2002 has significantly influenced the role of CIOs and consequently the desired competency of CIOs (Sutton and Arnold 2005).

- Section 302 requires CEO, CFO and the audit firm certify the accuracy of financial statements and that those statements fairly represent the financial condition of the firm. And Section 404 requires internal controls that generate financial statements to be accurate by mandating a management assessment report on internal controls over financial reporting. A CEO or CFO is subject to criminal penalty if he/she knowingly or willing issue inaccurate financials or internal controls. Although CEOs and CFOs are directly facing the responsibility of understanding and reporting the effectiveness of financial reporting and internal controls, CIOs are also bearing the burden and are expected to sign off the adequacy of data and internals (Koch 2004), given the important of IT in supporting related activities.

- Section 409 requires companies to disclose any material changes in financial condition or operations in real time to protect investors from delayed information. A firm's IT system must be capable of identifying material changes in financial condition or operations and reporting such changes on a rapid basis.

- Section 802 requires companies and their auditors to retain records (including electronic records such as emails, instant messages and Excel spreadsheets) that impact financial performance. Those records are kept for a period of five years from the end of fiscal year in which the audit was concluded. A firm's IT department

must properly record electronic documents by appropriate media so that such documents can be easily reviewed and securely stored.

All of the aforementioned sections make it crucial for firms to have a CIO who can facilitate the automation of documentation and establish business processes to ensure the effectiveness of internal controls within the IT system.

Impact of IT Spending Recovery on CIOs

Annual IT spending increased from $2 trillion to $3 trillion in the years after 2002 (Flom 2011). The recovery from the dot.com bust sparked a new stream of technologies that motivated firms to increase their IT spending to remain competitive and ensure future growth. With the emergence of new technologies including innovative new platforms and social networks, "increasing numbers of corporate IT managers plan to replace aging equipment, apply new technologies …, and pursue new opportunities created by advances in open-smyce software and wireless communications" and pursue "new options to improve the flexibility … and profitability." (Gartner Symposium/ITxpo 2003), creating a greater demand for CIOs who could "understand and acquire the capabilities surrounding these technologies" (Gartner Symposium/ITxpo 2003). As a result, forward-thinking firms are focused on increasing IT spending for new technologies and IT initiatives supporting their core business strategies, and CIOs who have upgraded their knowledge around these new technologies and understand how their skills can play into a firm's business strategy will be in high demand and will be rewarded accordingly (Richardson et al. 2014; Armstrong and Sambamurthy 1999).

CHAPTER 3

CIO SELECTION

Motivation

A heated discussion on Linkedin has drawn attention from over 100 CIOs who have provided their opinions regarding this question "What makes a good CIO" (Linkedin, CIO Network). Many respondents contend that "the CIO is the outward facing role of the IT department, being the coordinator of business needs and IT capabilities towards satisfying business strategy" (Kirk Rheinlander, CIO at KPJ Squared, Inc.). However, the choice between a technical CIO versus a business CIO "depends on the firm's strategy" (Jeff O'Hare, Executive Partner at Gartner), and it is of great importance that the CIO is able to ensure "that the agreed strategy with his peers is correctly translated in IT strategic initiatives" (Safwan El Jazouli, former IS Global Project Leader at Atlas Copco). This debate shows that in order to optimize a firm's strategy and actualize its strategic initiatives, the firm must hire the right CIO with the necessary skills and appropriate background to align IT initiatives with the firm's strategic positioning, facilitating the effective implementation of its overall strategy and firm performance.

In this chapter, I focus on the CIO's educational background (technical or business) as inspired by a debate between Bill Gates and late Steve Jobs regarding the role of different educational backgrounds on job performance.[7] Specifically, I categorize CIOs into either

[7] In a speech before the National Governors Association on Feb 28, 2011, Gates suggested that technical disciplines, such as science, technology, engineering and mathematics, are needed for firms that strive for innovation. However, this argument provoked many responses from defenders of non-technical disciplines, for example, 3 days later, on March 2, 2011, at the end of the launch event of iPad2, Steve Jobs stated that Apple would never produce such elegant products without employees from fields of business and liberal arts.

technical or business based on their educational background, following the academic literature (Cash et al. 2004; Armstrong and Sambamurthy 1999) and practitioners' insights (CIO Insight 2012). Generally speaking, a technical educational background refers to education specific to the IT field, including but not limited to knowledge and competencies associated with hardware, systems and application software, and telecommunications, whereas a business educational background refers to a non-technical education related to business skills and business administration (Cash et al. 2004; Goles et al. 2008).

Firms may select two generic strategies --- differentiation and cost leadership (Porter, 1980; Porter, 1996). Differentiators distinguish their products by providing unique and innovative features that are attractive to customers. Cost leaders are primarily interested in leading their industry by keeping their cost low and pursuing a low-price/high-volume sales strategy. "Nearly every strategic issue I address is now triggered by IT." (Earl and Feeny 2000). An effective CIO should ensure that IT supports the firm's chosen strategy, which requires an effective IT leadership from the CIO (Li and Tan 2013).

CIOs influence firm strategy in two key ways. First, CIOs impact internal controls through their influence on IT. They can facilitate an effective internal control system that supports the firm's business processes with low waste and maximum efficiency. Such support successfully allows a strategy characterized by operational excellence. Second, CIOs can also lead IT resmyces to support R&D and innovation, essential for firms whose strategy depends on differentiation, product innovation, and new product development.

Since a CIO can affect the firm's strategy in different ways, it is important for firms to hire a CIO with the appropriate background in order to best carry out the firm's intended strategy. I discuss my hypotheses as following.

Hypotheses

Integrating the literature on CIO appointment announcements (Chaterjee et al. 1999) with the alignment literature between the CIO's characteristics and the firm's strategy, I propose a set of hypotheses linking the firm's strategic positioning (differentiation and cost leadership) with the CIO's type (CIOs having technical or business background).

Differentiators Hiring CIOs with Technical Background

I hypothesize that firms with a differentiation strategy tend to hire CIOs with technical background. Achieving effective differentiation requires a perception of exclusivity that can be created by leading scientific research and advanced product/service development (Govidarajan, 1989), which requires a substantial amount of R&D investments (Greve, 1998). After the Dotcom Bubble, a stream of new technologies emerged and those renewed technology will be embraced by firms "to support a renewed corporate emphasis on innovation to support business growth" and CIOs who have a solid base of knowledge in technology are favored (Gartner Symposium/ITxpo 2003). Prior research has suggested that managers/executives with education in technical areas, such as engineering, science, and math, will be more likely to favor high levels of R&D spending. For example, by explicitly arguing that science, engineering, and math education creates managers that have a more comprehensive understanding of technology and innovation, Tyler and Steensma (1998) found evidence that, compared to executives without a

technical education, executives with technical education are more likely to display an attitude towards advanced R&D and superior innovation that comes with technical education. They also argued that executives who have received formal technical training tend to position the company in a way that its competitive advantage is relaying on its leading technology. In a more recent study, Barker and Mueller (2002) documented that CEOs who have extensive science and engineering education tend to spend more in R&D than CEOs who have no R&D or engineering education. Following this line of reasoning, I predict that technical CIOs will be more likely to spend on R&D and scientific research that provides the indispensible foundation for product development and innovation (Makri and Scandura, 2010), thus serving as the core of implementing and sustaining a differentiation strategy. Thus, I hypothesize:

H1-a: Differentiators are more likely to hire a CIO with a technical background.

Cost Leaders Hiring CIOs with Business Background

I hypothesize that firms with cost leadership strategy tend to hire CIOs with a business background. Past studies have shown that business education tends to attract people who are more risk-averse and conservative (Baker and Mueller 2002; Finkelstein and Hambrick 1996; Hambrick and Mason 1984). Given this reasoning, a business CIO is less likely to allocate the firm's limited IT budget to R&D spending that requires a risk-taking attitude. Besides, business CIOs usually lack technical capabilities and knowledge are required to perform well in certain IS areas (Khan and Kukalis 1990). Thus, they tend to work up through organizational hierarchy to their current executive level by their outstanding managerial skills, such as more attention on issues including tight cost control,

close supervision of labor, operation excellence that are obtained through business-related training.

H1-b: Cost leaders are more likely to hire a CIO with a business background.

Alignment of CIO Educational Background with Strategic Positioning and Firm Value

Recent trends in the intensity of global competition have changed the market landscape, and firms face new competitive challenges that have forced them to use IT resmyces and require new skills from their IT leaders (Karimi, Gupta and Somers 1996). As more firms begin to recognize the power of technology to reengineer their business and improve their effectiveness, there is an increasing need for CIOs who not only understand technology but comprehend the technology's potential to affect business strategy (Moad1994a, 1994b).

As a result, an increasing number of IS researchers began to explore the effects of matching IT leaders with firm strategies on firm value. Researchers suggest that a company's IT decision-making strategy should be aligned with its business strategy (Boynton, Jacobs and Zmud 1992) and a misalignment between IT management strategy and competitive strategy would result in situations where IT becomes a "competitive burden" and may result in decreased business performance (Warner 1987; Floyd and Wooldridge 1990). After examining CIOs in 60 firms, Earl and Feeny (1994) implied that IT increases business value only when the CIO is capable of ensuring IT strategy a consistent and integral component of business strategy. For another example, based on the responses from 213 IT leaders in the financial service industries, the study of Karimi et al. (1996) found that the role of a firm's IT leaders must be aligned with the firm's competitive

strategy, while a misalignment between a firm's competitive strategy and the role of IT leaders may have an adverse effect on firms. Along the same line, Klein and Sobol (2009) pointed out that a good match of IT direction led by IT leaders and the strategic goals set by the organization should lead to success. More recently, Banker, Hu, Pavlou and Luftman (2011) provided strong evidence that when an appropriate CIO reporting structure is matched with a firm's strategic positioning, there would be a positive impact on the firm's market value.

Extending the alignment view, my basic premise is that the stock market will appreciate the alignment between the CIO type and firm's strategic positioning and thereby positively react to properly aligned CIO appointments. This is because a properly aligned CIO has the necessary knowledge and skills to lead IT initiatives and design IT-enabled internal controls that are best around firm's strategic positioning.

Therefore, I propose the hiring of two CIO types that correspond to a firm's strategy: (1) differentiator hiring technical CIOs and (2) cost leaders hiring business CIOs. Both aligned CIO appointments will make sure that IT initiatives are used to support internal controls that are best for a firm's strategy implementation. As a result, this paper proposes a 2×2 configuration diagram including two aligned and two misaligned configurations between CIO type and firm strategic positioning. More specially, two aligned configurations are differentiators hiring technical CIOs and cost leaders hiring business CIOs while two misaligned configurations are differentiators hiring business CIOs and cost leaders hiring technical CIOs.

In terms of the alignment of differentiators hiring technical CIOs, I argue that differentiation strategy requires substantial investments in new technology and R&D (Greve, 1998) and a technical CIO is more risk-taking and is more likely to be in favor of high levels of IT spending (Tyler and Steensma 1998 and Barker and Mueller 2002). Also, the investment in IT and R&D usually requires a longer payback period and presents a lower rate of return in the short-term, which is not a major concern for a technical CIO who is less financial number oriented. Thus, a differentiation strategy aligns with a technical CIO.

For the alignment of cost leaders hiring business CIOs, practitioners have suggest that a business CIO is more capable of building teams, managing relationships and understanding operations so that they are better at supervising internal controls and designing operation flows to be more cost-efficient (CIO Insight, January 2012). For cost leaders whose strategic goal is to minimize cost per unit by improving operation excellence and efficiency, all these skills of a business CIO contribute to a better firm performance and strategy implementation.

For one of the misalignments – differentiators hiring business CIOs, this paper proposes that business CIOs are more risk-averse and number-conscious and thus are less likely to favor R&D projects and IT investments that are usually highly risky (Baker and Mueller 2002; Finkelstein and Hambrick 1996; Hambrick and Mason 1984) and takes a longer payback period. Therefore, business CIOs will have a difficult time in understanding and accepting the substantial investment required by differentiation strategy. Also, compared to technical CIOs, business CIOs are less capable of supervising the ever-

changing and risky R&D and innovation projects (Khan and Kukalis 1990). Accordingly, hiring a business CIO will adversely affect a differentiator to implement its strategy.

As to the other misalignment of cost leaders hiring technical CIO, I argue that cost leaders who require "aggressive construction of efficient-scale facilities, vigorous pursuit of cost reduction from experience, tight cost and overhead control and cost minimization in areas like R&D, service, sales force, advertising, and so on." (Porter 1980, pp.35) will find a hard time in communicating this goal with technical CIOs who are less cost-conscious and more focusing on updating with new technology which requires substantial investments. Summarizing these arguments, I propose:

H2: CIO appointment announcements that have an alignment between strategic positioning and CIO appointment (differentiators appointing technical CIOs and cost leaders appointing business CIOs) are associated with higher abnormal stock returns.

Data and Research Design

Data

I started with the 100 firms listed on the Nasdaq100 index and 500 firms listed in S&P500 Index as of Dec 2, 2010, and I identified its current CIO for each firm. The reason I chose these two sets of samples is because they represent firms with different characteristics: S&P500 firms represent larger firms by market capitalization, while Nasdaq100 firms represent smaller, more growth-oriented and more high-tech firms. CIO personal information, including educational background and appointment date, was hand-collected from Capital IQ by reading through each biography. The rest of the data was collected from company official website, or Business Week, or LinkedIn or other professional online resmyces. The timing of CIO appointments in my sample covers both

pre-SOX period and post-SOX period, which allows us to examine the effect of the passage of SOX on the matching paradigm and market reactions.

Table 1
Demographics of Sample Firms

Item	Nasdaq100			S&P500		
	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation
Operating Income over Sales	0.1623	0.1817	0.3142	0.1753	0.1601	0.1122
Sales over Assets	0.9247	0.6690	0.7163	2.4922	1.4577	6.5450
CIO Type	0.7304	1	0.4441	0.6433	1	0.4792
High Tech Dummy	0.5800	0	0.4941	0.2600	0	0.4388
Automate Dummy	0.0593	0	0.2364	0.1100	0	0.3130
Informate Dummy	0.6711	1	0.4703	0.5433	1	0.4983
Transform Dummy	0.2696	0	0.4442	0.3467	0	0.4761
Sales ($B)	47.7167	18.4986	70.6047	92.3643	16.9105	37.2001
Abnormal Stock Return	-0.0150	-0.0064	0.1500	0.3016	-0.0057	6.7876

Variable Measurement

CIO Type

Using CIO educational background as a surrogate of CIO type (Hambrick and Mason 1984; Hitt and Tyler 1991), I categorize CIOs into technical and business types and view a CIO as a technical (or business) CIO when he/she has an undergraduate degree in technical (or business) related disciplines . Prior researchers (i.e. Brooks and Everett 2008) have shown that, undergraduate degree, as the first education degree achieved from formal educational training, has the most impact on a person's life-long learning and career performance. Consistent with the National Science Foundation who first introduced "STEM" (shorthand for "Science, Technology, Engineering and Mathematics") in the 1990s (Sanders 2009) and many other organizations who later on began official use of the term "STEM" representing all sectors of technical fields, I code the binary variable CIO_Tech= 1 for a technical CIO having a bachelor or equivalent degree in science, technology, engineering or mathematics, including computer science and electronic

engineering. Otherwise, CIO_Tech= 0, indicating a business CIO having an undergraduate degree in business-related disciplines. As a result, in this paper, the types of CIOs are categorized into two types: technical CIOs and business CIOs.

Strategic Positioning

The operationalization of strategic positioning was adopted from Porter's (1980, 1996) typology of generic strategies---differentiation and cost leadership, which is still of high relevance in today's business world (Kald 2003). The DuPont analysis method is employed by this study to analyze ROA into accounting two ratios: profit margin and assets turnover (Banker et al. 2011; Fairfield and Yohn 2001; Nissim and Penman 2001; Stickney and Brown1998).

Differentiation: Differentiators distinguish their products by providing unique or superior features that are attractive to customers. Their competitive advantage is achieved by superior designs, innovative research and development, advanced engineering, customer intimacy and brand image (Porter 1980, 1996). Investments in R&D and scientific projects are extremely essential and necessary for differentiators who aim at providing customers with products of cutting-edge technology and superior customer experience. Differentiators are able to require price premium and command higher margin by creating customer value (Kald 2003; Kim et al. 2004). A good example of differentiator is 3M Corporation with its emphasis on technology leadership and innovation. This paper uses profit margin ratio to capture product differentiation strategy because differentiators can command higher margins as returns for their advanced product/service quality or superior customer intimacy (Selling and Stickney 1989).

Cost Leadership: Cost leaders aim at offering the lowest cost per unit in the industry. Their competitive advantage is achieved by economies of scale, cost efficiencies, and operational excellence (Banker, Hu, Pavlou and Luftman, 2011). To quote Porter (1980, p.35): "Cost leadership requires aggressive construction of efficient-scale facilities, vigorous pursuit of cost reduction from experience, tight cost and overhead control and cost minimization in areas like R&D, service, sales force, advertising, and so on." Therefore, in order to achieve cost leadership, managers are more likely to emphasis on controlling cost, promoting tight monitoring, and improving operation efficiency. A good example of cost leadership is Dell Computer who is famous for its efforts in keeping inventory low and only producing computers when orders are placed. Assets turnover ratio is used in this paper to capture cost leadership strategy because firms must utilize their assets efficiently and main lean operations (Fairfield and Yohn 2001) in order to achieve the lowest cost per unit and sustain their competitive advantages as cost leaders. Since the ratio of sales over assets is a good proxy to reflect how well the firm utilizes its assets to generate sales, it is used in this paper to capture cost leadership strategy.

Alignment between CIO Educational background and Strategic Positioning

I take a snapshot at the year end of 2010 to investigate what happened before in a firm has an impact on its CIO hiring choice[8]. More specifically, I test if the realized strategic positioning has a significant effect on a firm's CIO choice in terms of a CIO's type. The first logistic regression uses firms' realized strategic positioning (as reflected by

[8] I chose to take a snapshot to make CIO appointment observations comparable. And, the auto regression analysis of my data suggests that a firm's strategic positioning is consistent in my sample period.

its Operating Income/Sales and Sales/Assets ratios) to predict its hiring strategy of CIO, that is, whether to hire a technical CIO or a business CIO.

$$\begin{aligned}\text{logit}(\text{CIO\_Tech}_{i,t}) = {} & \beta_0 + \beta_1 average(\text{Operating Income/Sales})_{i,t-4,\ldots,t} + \\ & \beta_2 average(Sales/Assets)_{i,t-4,\ldots,t} + \beta_3 High\_Tech_{i,t} + \beta_4 Automate_{i,t} + \\ & \beta_5 Informate_{i,t}, \end{aligned} \quad (1)$$

where:

Operating income/sales (OPIS) = operating income after depreciation (Compustat annual item #178) in year t divided by the average of net total sales (item #12) in year t;

Sales over assets (Sales/Assets) = net total sales (item #12) in year t divided by net operating assets in year t;

High_Tech = a dummy variable equals to 1 if firm i is a high technology firm in year t and equals to 0 otherwise;

Automate = a dummy variable equals to 1 if the role of IT in firm i is automate in year t, and equals to 0 otherwise;

Informate = a dummy variable equals to 1 if the role of IT is firm i is informate in year t, and equals to 0 otherwise;

The sign of β_1 is expected to be positive as my hypothesis H2-a suggests that differentiators tend to hire technical CIOs and the sign of β_2 is expected to be negative as my hypothesis H2-b suggests that cost leaders tend to hire business CIOs.

In addition, I expect the coefficient direction of β_3 is positive as high technology firms are more likely to hire technical CIOs to lead their IT initiatives that facilitate R&D investments for new product development. For a long-term survival and renewal, intellectual capital and innovation have become the key smyces of sustaining competitive advantages for firms in the high technology industries and many have argued that the key to the future competitiveness of organizations in the U.S. and abroad is the ability to innovate and swiftly bring new products to the market (Scandura, 2009). The innovation management literature suggests that R&D investments are associated with high quality innovation and new product development. Greve (1998) has pointed out that innovation and the associated scientific and technological knowledge it involves have increasing become important features for value creations for high technology firms . Most importantly, R&D investments are one of the most vital decisions that executives of high technology firms must take. As a result, for firms in high technology industries, the need for high quality innovation and new product development calls for the leaders who can foster an environment that encmyages innovation and development of new products. CIOs, as the highest IT executives of high technology firms, are responsible for making such decisions regarding R&D spending. Makri and Scandura (2010) suggest that in high technology firms, operational leadership which focuses on the development of new products is positively related to the quantity and quality of innovations using a sample of 77-high technology firms. In another study of executive characteristics and innovation, Barker and Mueller (2002) used a sample of publicly traded firms and found CEO characteristics explain a significant proportion of the sample variance in firm R&D spending when other firm-level attributes are controlled. They discovered that a firm whose

CEO has career experience in the R&D/engineering function spend more on R&D, compared to a firm whose CEO has no experience in R&D/engineering function. All the above arguments imply the notion that executives with knowledge in technical areas, such as science and engineering, compared to business CIOs, tend to be more willing to spend on R&D investments and scientific projects, resulting in higher quality of innovation and new product development, which are essential for high technology firms to sustain their competitive advantage in the ever-changing high-tech market.

Following Francis and Schipper (1999), I code High_Tech= 1 if a firm is in a high technology industry defined as SIC codes 283(Drugs), 357(Computer and Office Equipment), 360-368(Electronics and Computer Hardware), 481(Telephone Communications), 737(Telephone Communications), and 873(Research, Development, Testing Services).

Other control variables include Automate and Informate dummies for the role of the IT function is playing within the industry (Chatterjee, Richardson, and Zmud 2001): Automate, Informate, or Transform, which is consistent with Schein (1992) regarding categories of strategic IT vision. As described by the definitions below, automate represents no IT-driven transformation efforts, Informate represents an intermediate level of IT-driven transformation efforts and transform represents a high level of IT-driven transformation efforts. This paper uses Transform dummy as the base scenario in Equation (2) and thus only include Automate and Informate dummies. Since the study of Banker, et al. (2011) suggested that a lower degree of transformation is linked with more quantifiable IT, a lower degree of transformation is more likely to be linked with non-technical CIO who emphasis more on quantifications.

Automate[9]: Replace human labor by automating business processes.

Informate Up/Down: Provide data/information to empower management and employees.

Transform: Fundamentally alter traditional ways of doing business by redefining business processes and relationships.

Since the binary variable CIO_Tech has a value of 0 or 1, indicating that a business CIO or a technical CIO, the predicted probability has a value between 0 and 1. The threshold value I use for predicting the type of CIO is adopted from the empirical distribution in my samples. Then, I rank the predicted probabilities in a descending order, and classify those firms ranked above the threshold as firms having a technical CIO; otherwise, they are classified as firms having a business CIO, as suggested by the predictive model.

Based on my predictive model, firms are divided into two groups: aligned groups and misaligned groups. For firms in Group Tech_PD,the CIO of those firms actually having a technical CIO,and, based on my predictive model (Equation 1), I predict that those CIOs should have a technical background because those firms are classified as differentiators due to higher profit margin ratios. This is an aligned group (Aligned), as they have a fit between the type of CIO and the firm's realized strategic positioning. Similarly, for the firms in Group Biz_CL, their CIOs are actually business CIOs. And based on my model, these firms are classified as cost leaders due to higher assets turnover ratios. The matching between the actual CIO type (business CIO) and the firm's realized strategic positioning (cost leader) also denotes an aligned configuration. On the contrary, there are two

[9] Definitions of Automate, Informate and Transform are adopted from Chatterjee et al.(2001).

misaligned groups (Misaligned) in which the CIO's actual type is misaligned with the firm's realized strategic positioning, based on my predictive model. More specifically, product differentiators are misaligned with business CIOs (Group Biz_PD) and cost leaders are misaligned with technical CIOs (Group Tech_CL).

As a result, I create fmy dummy variables (Tech_PD, Biz_CL, Tech_CL and Biz_PD) to present the alignment (Aligned) between the actual and predicted CIO type relative to the misalignment (Misaligned) that serves as the base case.

• Aligned groups: firms in the Group Tech_PD or firms in the Group Biz_CL.

• Misaligned groups: firms in the Group Tech_CL or firms in the Group Biz_PD.

Stock Performance

I use accumulative abnormal returns to capture the market reactions on CIO appointments when the CIOs in my samples were assigned to their current position. The data I collected allows us to track down the exact appointment month for each CIO. Therefore, I accumulated the abnormal returns for the month of the CIO appointment to capture the market reactions towards this event. More specifically, I set the 16th as the middle day of the month of appointment (Day 0)[10]. If the middle day of the month of appointment is not a trading day, I set the first trading day after the middle day (the 16th of the month) as Day 0. Then I accumulated the abnormal returns from 15 trading days before the CIO appointment (Day -15) to 15 trading days after the CIO appointment (Day +15). In other words, the event window is [-15, 15].

[10] I set the 15th as Day 0 for the month of February

The market return model is based on the classic CAPM model (Capital Asset Pricing Model), and the following regression computes the daily common stock returns for the jth firm:

$$R_{jt} = \alpha_{jt} + \beta_j R_{mt} + \varepsilon_{jt} \qquad (2)$$

where:

R_{jt} = the rate of return on the common stock of the j^{th} firm on day t;

R_{mt} = the market rate of return using the equally-weighted CRSP index on day t;

α_{jt} = the intercept;

β_j = the slope parameter that captures the sensitivity of to the market index;

ε_{jt} = the error term of the OLS regression;

Then, the abnormal stock return AR for the j^{th} firm on day t is computed as:

$$AR_{jt} = R_{jt} - (\alpha_j + \beta_j R_{mt}) \qquad (3)$$

Lastly, I cumulate abnormal stock returns CAR_j for the j^{th}firm for the event window [-15, +15].

By looking at cumulative abnormal returns, I examine the market reactions to two groups (Aligned and Misaligned) with the following model:

Where:

CAR= cumulative abnormal stock returns for firm ifor the event window [-15, +15];

Aligned = Dummy variable equals to 1 if the educational background of the appointed CIO is aligned with firm strategic positioning for firm i, and equals to 0 otherwise;

Automate = Dummy variable equals to 1 if the role of IT in firm i is automate, and equals to 0 otherwise;

Informate = Dummy variable equals to 1 if the role of IT is firm i is informate, and equals to 0 otherwise;

High_Tech = Dummy variable equals to 1 if firm i is a high technology firm and equals o 0 otherwise.

If the market values the quality of CIO appointment, that is to say, how well the CIO type is aligned with the firm's strategic positioning, abnormal stock returns are expected to be positive for the aligned groups (Tech_PD and Biz_CL). Therefore, based on my hypothesis H1, the coefficient of in Equation (2) is expected to be positive.

Dummy variables representing the role of IT planning are included in Equation (2) is because Chatterjee et al. (2001) argued that firms in industries undergoing IT-driven transformation would feel a compelling need for "digital strategies" to help shape new business model and implement strategies, leading to positive market reactions of newly created CIO positions. Therefore, in the model of this paper, it is more likely to have more pronounced market reactions to aligned CIO appointments for firms undergoing a higher degree of IT-driven transformation.

The motivation of including a high technology dummy High_Tech here as a control variable is that past studies (i.e. Kettinger et al. 1994) have shown that the CIO's role in

influencing a firm's strategy and opportunities is more pronounced in more dynamic and competitive industries. Therefore if the results suggest a positive coefficient for the high technology dummy, it means a high technology firm's announcement of a new CIO appointment would be expected to create a higher shareholder value. Otherwise it means the market under-reacted to the announcement for high-tech firms.

Empirical Results

Main Results

To test my hypotheses, I use the logistic regression (Equation 1) to predict its CIO's background based on the firm's realized (actual) strategy. Table 2 shows that in the post-SOX period the coefficients of β_1 across these models are positive and significant and the coefficients of β_2 across these models are negative and significant, consistent with my predicted directions (H1-a and H1-b). Firms with higher operating profit margins are more likely to appoint a CIO with a technical educational background while firms with higher assets turnover are more likely to appoint a CIO with a non-technical background. However, the coefficients of β_1 and β_2 are not significant in the pre-SOX period, supporting my logic that firms are paying much more attention on selecting the right CIO who has the right skills as the role of IT becomes significant in firm strategy implementation after SOX. The coefficient of high tech dummy is significantly positive, suggesting that high-tech firms are more likely to appoint a CIO with a technical educational background, consistent with my expectation that the role of a technical CIO is more significant for high-tech firms. Correlation between operating income over sales and sales over assets is -1.104 (p-value = 0.289) for Nasdaq100 Pre-SOX samples, 0.117 (p-value = 0.0200) for Nasdaq100 Post-SOX samples, -0.035 (p-value = 0.615) for S&P500

Pre-SOX samples and -0.0093 (p-value = 0.739) for S&P500 Post-SOX samples, suggesting no multicollinearity between these two strategy ratios.

Table 2
Predicting CIO Background Based on Strategic Positioning

Variable	Predicted Sign	Coefficients (P-value)			
		Pre-SOX		Post-SOX	
		Nasdaq100	S&P500	Nasdaq100	S&P500
Operating Income/Sales	+	3.428 (0.315)	0.856 (0.373)	10.020*** (0.005)	2.751** (0.044)
Sales/Assets	-	-0.395 (0.221)	-0.032 (0.312)	-0.084*** (0.006)	-0.0588*** (0.009)
High_Tech	?	0.698 (0.515)	0.677 (0.507)	2.525*** (0.006)	1.013*** (0.009)
Automate	?	-3.402 (0.428)	-1.640 (0.179)	0.235 (0.802)	0.318 (0.526)
Informate	?	1.550 (0.429)	-0.131 (0.889)	1.150 (0.185)	0.408 (0.246)
Intercept	?	-0.565 (0.733)	0.786 (0.460)	-2.017** (0.043)	-0.205 (0.648)
N		21	42	78	254
Pseudo R2		0.2400	0.0833	0.3786	0.0534
Prob > chi		0.3121	0.5122	0.006	0.0113

* For coefficients with predicted signs, the significance level is adjusted to one-sided.
** p<.1, ** p<0.05, *** p<0.01

Then, as shown in Table 3-a (Pre-SOX) and 3-b (Post-SOX), I classify samples firms into groups based on the CIO's background and the firm's realized strategic positioning as given by the predictive model above.

To test H2, I examine whether firms with an alignment between the CIO's background and the firm's realized strategic positioning are more likely to have a higher accumulated abnormal stock returns over misaligned firms. I build my model based on Chatterjee et al.'s (2001) model to explore the market reactions to a CIO's appointment announcements with my alignment variable Aligned.

Table 3
Configurations between Actual and Predicted CIO Background (Pre-SOX)

		Predicted Background (Based on Strategic Positioning)				
		Higher Operating Income over Sales (Product Differentiation)			Lower Sales over Assets (Cost Leadership)	
		Nasdaq100	S&P500		Nasdaq100	S&P500
Actual Background		Pre-SOX	Pre-SOX		Pre-SOX	Pre-SOX
Technical	**Group Tech_PD**	12	22	Group Tech_CL	2	6
Business	**Ground Biz_PD**	2	6	Group Biz_CL	5	8

Configurations between Actual and Predicted CIO Background (Post-SOX)

		Predicted Background (Based on Strategic Positioning)				
		Higher Operating Income over Sales (Product Differentiation)			Lower Sales over Assets (Cost Leadership)	
		Nasdaq100	S&P500		Nasdaq100	S&P500
Actual Background		Pre-SOX	Pre-SOX		Pre-SOX	Pre-SOX
Technical	**Group Tech_PD**	54	123	Group Tech_CL	5	42
Business	**Ground Biz_PD**	5	42	Group Biz_CL	14	47

Table 4
Event Study: 30-day Cumulative Abnormal Stock Returns

Variable	**Predicted Sign**	**Coefficient (P-value)**			
		Pre-SOX		**Post-SOX**	
		Nasdaq100	**S&P500**	**Nasdaq100**	**S&P500**
Aligned	+	0.162 (0.180)	0.055 (0.432)	0.129*** (0.003)	0.053* (0.069)
Automate	?	-0.280 (0.178)	1.512 (0.314)	-0.094 (0.195)	-0.042 (0.375)
Informate	?	0.080 (0.614)	-0.060 (0.474)	-0.025 (0.454)	-0.041 (0.443)
High_Tech	?	0.034 (0.768)	-0.031 (0.787)	-0.093*** (0.005)	0.057 (0.429)
Intercept	?	-0.205 (0.341)	0.059 (0.413)	-0.045 (0.371)	-0.002 (0.929)
N		14	32	74	238
R^2		0.416	0.214	0.176	0.014

* For coefficients with predicted signs, the significance level is adjusted to one-sided.
** p<.1, ** p<0.05, *** p<0.01

Consistent with H2, Table 4 shows the positive effects of the fit between strategic positioning and CIO background on cumulative abnormal returns to the month of CIO appointment announcement in the post-SOX period rather than the pre-SOX period. Results show that the market positively reacted to CIO appointments that are aligned with firm strategic positioning in the post-SOX period. It suggests that, as a new CIO position is no longer a new concept to the market, what really matters to the investors more is how well the CIO is influencing IT initiatives that are justified by the firm's strategic objectives.

The sign of High_Tech is significantly negative for Nasdaq100 firms in the post-SOX period, suggesting that the stock market is responding negatively towards CIO appointments made by Nasdaq100 firms after SOX. Since these firms are more high-tech oriented, the role of the CIO is more pronounced in terms of setting up the road map of IT, initiating IT projects to support innovation, and supervising internal controls. If a high-tech firm makes an inappropriate CIO appointment decision, the effect on its performance could be more devastating than a low-tech firm. Therefore, investors tend to act in a very conservative way in regards to high-tech firms, that is, react negatively regardless of whether the CIO appointment is aligned or misaligned with the firm's strategic positioning.

Robustness Tests

A CIO's MBA degree indicates having obtained a certain level of business skills and may reduce the firm's incentive to appoint a CIO with business undergraduate degree. Also, an MBA degree may increase the chance of the CIO getting into the inner circle that helps the communication between the CIO and other executives, and thus lead to better firm performance (Mackay 2007). As a result, the stock market may react more positively to appointments of CIOs with an MBA degree. Therefore, I include CIO's MBA degree as

a dummy variable both in the predictive model and the stock reaction model as a robustness check. I also include a control variable for prior experience as a CIO . The results of my robustness tests are consistent with my hypotheses. For the post-SOX period, results of both Nasdaq100 and S&P500 showed that differentiators tend to appoint technical CIOs and cost leaders tend to appoint business CIOs. The results also support H3 that the stock market positively reacted to aligned CIO appointments in the post-SOX period.

Table 5
Predictive Model based on realized strategic positioning

Variable	Predicted Sign	Coefficients (P-value)			
		Pre-SOX		Post-SOX	
		Nasdaq100	S&P500	Nasdaq100	S&P500
Operating Income/Sales	+	4.155 (0.229)	0.917 (0.388)	9.799** (0.013)	2.271* (0.087)
Sales/Assets	-	-0.292 (0.183)	-0.0393 (0.287)	-0.126*** (0.001)	-0.0639*** (0.004)
High_Tech	?	1.262 (0.388)	0.785 (0.393)	2.547** (0.020)	0.680 (0.116)
Automate	?	-2.256 (0.456)	-1.445 (0.221)	-0.198 (0.855)	0.250 (0.668)
Informate	?	2.390 (0.256)	0.203 (0.806)	1.506 (0.145)	0.296 (0.456)
MBA	?	-2.470 (0.141)	0.0258 (0.977)	-0.0407 (0.970)	-1.015*** (0.006)
Experience	?	-0.00541 (0.996)	-0.714 (0.385)	-0.866 (0.216)	0.902*** (0.006)
Intercept	?	-1.319 (0.471)	0.674 (0.526)	-1.396 (0.249)	-0.255 (0.617)
N		21	43	75	185
Pseudo R2		0.3386	0.0956	0.4097	0.1057
Prob > chi		0.2142	0.6214	0.0055	0.0010

* For coefficients with predicted signs, the significance level is adjusted to one-sided.
** p<.1, ** p<0.05, *** p<0.01

Table 6
Event Study----30-day Cumulative Abnormal Stock Returns

Variable	Predicted Sign	Coefficient (P-value)			
		Pre-SOX		Post-SOX	
		Nasdaq100	S&P500	Nasdaq100	S&P500
Aligned	+	-0.0884	-0.240	0.143***	0.0235*
		(0.164)	(0.147)	(0.001)	(0.091)
Automate	?	-0.230	1.796**	-0.113	0.00256
		(0.155)	(0.017)	(0.145)	(0.946)
Informate	?	0.154	-0.0642	-0.0279	0.0157
		(0.113)	(0.884)	(0.441)	(0.363)
High_Tech	?	0.0950	0.0100	-0.0988***	0.00224
		(0.391)	(0.982)	(0.004)	(0.894)
MBA	?	-0.321	-0.665	-0.0256	0.0183
		(0.138)	(0.216)	(0.549)	(0.245)
Experience	?	0.101	-0.0365	-0.0131	0.0104
		(0.392)	(0.938)	(0.701)	(0.480)
Intercept		-0.0861	0.308	-0.0372	-0.0475*
		(0.687)	(0.558)	(0.551)	(0.080)
N		14	33	71	168
R^2		0.528	0.268	0.213	0.029

* For coefficients with predicted signs, the significance level is adjusted to one-sided.
** p<.1, ** p<0.05, *** p<0.01

The data in this study allows us to track down the exact month of each CIO appointment and conduct an event study to examine stock reactions to aligned/misaligned CIO appointments. As a robustness check, I were able to identify the exact appointment date for 39 post-SOX CIO appointments in my sample . As a result, I use this subset sample to conduct a 3-day [-1, 0, 1] event study on abnormal stock returns to CIO appointments. The results strongly support my hypothesis that the stock market only positively reacts to aligned CIO appointments.

Table 7
Event Study----3-day Cumulative Abnormal Stock Returns

Variable	Predicted Sign	Coefficient (P-value)	
		S&P500 (Post-SOX)	
Aligned	+	0.0119**	0.0145**
		(0.025)	(0.044)
Automate	?	-0.0047	-0.0130
		(0.596)	(0.335)
Informate	?	-0.0086	-0.0125
		(0.226)	(0.223)
High_Tech	?	-0.0034	-0.0015
		(0.632)	(0.871)
MBA	?		0.0033
			(0.667)
Experience	?		-0.0003
			(0.976)
Intercept		-0.0032	-0.0024
		(0.660)	(0.883)
N		39	39
R^2		0.1416	0.1852

* For coefficients with predicted signs, the significance level is adjusted to one-sided.
** p<.1, ** p<0.05, *** p<0.01

My main analyses include strategy ratios (operating income over sales and sales over assets) computed by taking a snapshot of 2010. This is to make sure all the firms are subject to the same economic environment. Untabulated auto-regression results on strategy ratios suggest that firms' strategy ratios are stable over years, supporting my research design. However, as a robustness check, I calculate strategy ratios centered on each appointment and the results are qualitatively unchanged.

Table 8
Predicting CIO Background Based on Strategic Positioning
(Strategy ratios centered on appointment)

Variable	Predicted Sign	Coefficients (P-value)			
		Pre-SOX		Post-SOX	
		Nasdaq100	S&P500	Nasdaq100	S&P500
Operating Income/Sales	+	22.614 (0.112)	2.445 (0.119)	2.556** (0.011)	3.159** (0.024)
Sales/Assets	-	-0.052 (0.458)	-0.044 (0.319)	-0.102** (0.023)	-0.068** (0.043)
High_Tech	?	2.238 (0.181)	0.671 (0.566)	2.665*** (0.005)	0.821*** (0.043)
Automate	?	-5.145 (0.207)	-0.985 (0.465)	-0.784 (0.353)	0.253 (0.624)
Informate	?	3.227 (0.193)	0.393 (0.707)	0.829 (0.325)	0.368 (0.334)
Intercept	?	-6.452 (0.147)	0.524 (0.603)	-0.325** (0.660)	-0.201 (0.686)
N		14	33	74	236
Pseudo R2		0.365	0.117	0.306	0.048
Prob > chi		0.223	0.476	0.033	0.043

In addition to computing strategy ratios, I construct an aggregated strategy score following Ittner et al. (1997) and Bentley et al. (2013). It is a discrete construct (using consecutive integers) to capture firm strategic positioning with product differentiators receiving higher scores and cost leaders receiving lower scores. It is constructed using each of the fmy ratios (R&D over sales, sales growth, sales over cost of goods sold and S&GA over sales) which are measured by firm and year. Then each of these ratios is ranked into quintiles by industry (2-digit SIC code) and year. Observations in the highest quintiles are given a score of 5, those in the second highest quintile are given a score of 4, etc., while those observations in the lowest quintiles are given a 1 score. The scores are summed over the 4 measures per firm-year. Each company could have receive a maximum score of 20

(Product differentiator) and a minimum score of 4 (Cost leader). My results remain robust to this strategy measurement.

Table 9
Predicting CIO Background Based on Strategic Positioning
(Strategy score centered on appointment)

Variable	Predicted Sign	Coefficients (P-value)			
		Pre-SOX		Post-SOX	
		Nasdaq100	S&P500	Nasdaq100	S&P500
Strategy	+	0.485 (0.209)	0.068 (0.600)	0.121* (0.69)	0.073** (0.046)
High_Tech	?	2.166 (0.142)	0.111 (0.915)	2.376*** (0.002)	0.810** (0.027)
Automate	?	4.499 (0.242)	-1.188 (0.412)	-1.495 (0.158)	0.234 (0.637)
Informate	?	1.980 (0.297)	-0.038 (0.971)	-0.700 (0.929)	0.0003 (0.999)
Intercept	?	-9.705 (0.143)	0.298 (0.852)	-1.399 (0.337)	-0.512** (0.376)
N		14	33	68	239
Pseudo R2		0.251	0.036	0.248	0.030
Prob > chi		0.308	0.814	0.003	0.065

CHAPTER 4

CIO COMPENSATION

Motivation

The stricter regulatory environment and the increased emphasis of internal controls associated with SOX is one factor that has dramatically raised the importance of recruiting the right CIOs and linked the evolving role of CIOs to firm strategies (Sutton and Arnold 2005). Internal controls such as such as authorization, collaboration between segregated duties, application controls and auditability are essential to ensure business processes are handled in a most effective and efficient manner and are vital to the success of a firm's business (Natovich 2009). Nowadays, a firm's internal control system is heavily built on its IT system and the quality of IT system has a significant impact on the performance of internal controls. For example, firms with materials weaknesses in their IT systems tend to have less informative financial data, resulting in less accurate business decision-makings (Li et al 2012). As a consequence, it is critical to have an effective IT leadership, the CIO, to ensure IT to support the firm's internal control system and maintain the company's business model, thereby successfully implementing firm strategy (KPMG 2008).

In addition to SOX, the IT spending recovery and the transformation to a technology-based economy also increased the demand for CIOs (Ang and Slaughter 2000). Annual worldwide IT capital spending has increased to approx. 3 trillion dollars since 2002, compared to approx. 2 trillion dollars prior to the recovery (Flom 2011). The recovery from the Dotcom Bubble burst resulted in a stream of innovative technologies, including new social networks and e-business platforms. Emerging technologies created a

marked opportunity for CIOs to "deliver both internally and externally focused technology innovation to help their organization outmaneuver the competition." (Harvey Nash 2011).

However, the position of CIO is experiencing a shortage in supply as the demand for new CIOs rises year over year. Recent studies have shown a continuous growth in the number of CIO appointments each year in the last decade and most of them are newly created positions to meet emerging business needs (Chatterjee et al, 2001; Khallaf and Skantz 2011). According to CIO Insight (2007), Agarwal and Beath (2007) noted that "a shortage of qualified chief information officers looms in the next few years. Growing demand for CIOs is not being offset by an increasing supply of talented, well-prepared executives".

As with any shortage in supply, the price is adjusted in order to achieve equilibrium in demand and supply. The severe supply-demand imbalance has already been translated into a steadily increasing CIO compensation over the last decade despite a slow-growing economy in the US (Nash Harvey 2012). As shown in Figure 1, CIO compensation is on a steady rise over the recent ten years while CEO and CFO compensation indicate no such trend[11]. As firms face the growing new challenge to attract and retain CIOs within desired characteristics after 2002 (CIO Insight, 2007), it has become one of the most important managerial issues of the firm to design an effective compensation contract for competent CIOs (Ranganathan and Jha 2005; Yayla and Hu 2008; Richardson et al. 2014). This study examines the impact of CIO's educational characteristics on determining their compensation. I look at three dimensions of CIO educational characteristics, including

[11] CIOs, CEOs and CFOs are matched for each firm. CEO and CFO compensation data is obtained from ExecuComp. CFO compensation data is not available in ExecuComp until 2006. Compensation trends are smoothed.

education majors, education quality and professional certificate, while controlling for firm and industry characteristics.

Figure 1 - Average Annual Total Compensation of Matched CIO/CFO/CEO Samples

Hypotheses

Existing literature on executive compensation shows that educational characteristics are important determinants for CEO and CFO compensation (Jalbert et al. 2010; Gottesman and Morey 2006; Chahyadi and Abusalim 2011) because it is the most important signal for *ability* (Becker and Chiswick 1966; Spence 1973; Becker 1975). A person's educational background is one of few salient observable characteristics that are considered indicative of a person's knowledge and skill base (Hambrick and Mason 1984) and has a life-long impact on his or her subsequent behaviors (Schein 1971; Maanen 1979; Brooks and Everett 2008). CIO's education has been considered by both academia and practitioners as an important indicator of CIO's ability and can significantly affect their future executive and firm performance (ExecRank 2013; Sobol and Klein 2009; Khallaf

and Skantz 2007; Ang et al. 2002). In this paper, I examine three sets of CIO educational characteristics: (1) Educational background, (2) Educational quality, and (3) Professional certificate.

There has been an ongoing debate regarding which background is more important for CIOs – technical expertise or business acumen. The CIO job requires a solid knowledge base of complicated technical-related concepts such as process engineering and system design to fully understand the benefit, costs and risks associated with IT initiatives (Ang et al 2002). Meanwhile, the CIO job requires the CIO to have sufficient business skills to manage the IT department and leverage strategic IT resmyces to create business value. Curran (2009) pointed out that a CIO needs to acquire both technical knowledge and business skills to be successful: a CIO with pure technical knowledge is often seen as an outsider of the executive team, limiting the role of IT to a supporting rather than a strategic function; on the contrary, a CIO with pure business skills is often seen as lacking of credibility and tend to overly lay on their supporting team. Therefore, I expect that CIOs with a hybrid educational background receive a higher compensation compared to CIOs without a hybrid educational background.

H3: CIO's hybrid educational background is positively associated with CIO compensation.

A news report by Gopal from Bloomberg Businessweek (August 2008) reveals that "graduates of prestigious institutions earn the biggest salary". Pascarella and Smart (1990) followed the incomes of individuals for a period of nine years after college and found that university selectivity is a significant determinant in their income. Jalbert Rao and Jalbert

(2002) and Jalbert et al. (2010) ranked schools based on the number of degrees held by large-firm CEOs and found that where a CEO has a degree has an impact on his/her total compensation, salary and bonus. In addition to school ranking, they also found that CEOs with a graduate degree receive a higher compensation compared to CEOs who only have an undergraduate degree. Gottesman and Morey (2006) documented similar evidence that CEOs who attended more prestigious schools receive a higher compensation. Therefore, I hypothesize:

H4: CIO's education quality is positively associated with CIO compensation.

Professional certificates not only show that the knowledge and skills specific to the task are adequate, but also show that the knowledge and skills are up-to-date. Prior literature has examine the impact of professional certificate on compensation. Chahyadi and Abusalim (2011) examined the educational background of CFOs and found that CFO's specific knowledge such as CPA and M.Acc degree is significantly negatively associated with CFO total compensation.

It is reported that obtaining professional IT certificates has an impact on CIO's compensation (Global Knowledge 2013). IT projects are often big and complex has an assigned start and end date, with specific milestones and goals to meet during the development cycle. All IT projects are constrained by time, costs and scope and if any of the three constrains falls short, the whole IT project is most likely to fail (Philips 2014). In fact, more than half of IT projects are completed within the budgeted time and costs (Kogekar 2013). CIOs not only play a critical role in ensuring that the project completion is on time and within budget, but also have to adapt the ongoing project to the ever-

changing technology and new business needs and shareholders' demands. Professional certificates specifically relating to managing IT projects are indicators of higher ability CIOs who can complete IT projects with most updated technical knowledge.

H5: CIO's professional certificate is positively associated with CIO compensation.

Data and Research Design

Data

I obtain 961 CIOs' compensation (salary, bonus, and total compensation) and educational background data from Capital IQ database [12]. Professional certificates information is hand-collected vie public online resmyces[13]. Internal/External promotion information is hand-collected from a combination of Capital IQ, LinkedIn and corporate official websites. Firm financial information is obtained from Compustat and internal control weakness information is from AuditAnalytics. The sample period is from 2002 to 2011.

CIOs in my sample are highly compensated executives[14] from a wide range of industries (Table 2). As shown in Table 1, the average total compensation is $870,810 over the sample period of 2002 to 2011, with an average yearly increase of 16%. The average total amount of cash compensation (salary + bonus) is $330,660, with an average yearly increase of 5% in salary and an average yearly decrease of 3% in bonus.

[12] I require every CIO to have at least one bachelor degree in the sample. It is documented that 80% of current CIOs have at least an undergraduate degree (The Higher Education CIO. 2011).
[13] https://certification.pmi.org/registry.aspx and http://www.itil-officialsite.com/ITILEISCRquery.aspx.
[14] The average ranking of my CIO samples is top 4 based on ranking information from Execucomp database.

Table 10
Changes in CIO Compensation (2002-2011)

Year	Average Total Comp ($ in thousands)	Percentage Change	Average Salary ($ in thousands)	Percentage Change	Average Bonus ($ in thousands)	Percentage Change
2002	404.29	-	198.88	-	110.62	-
2003	430.57	6%	204.79	3%	121.94	10%
2004	527.10	22%	215.01	5%	112.43	-8%
2005	677.10	28%	224.86	5%	131.02	17%
2006	983.86	45%	243.25	8%	82.33	-37%
2007	1,014.13	3%	255.25	5%	49.93	-39%
2008	1,099.51	8%	262.55	3%	58.64	17%
2009	941.36	-14%	265.58	1%	47.26	-19%
2010	1,206.75	28%	291.17	10%	54.62	16%
2011	1,423.46	18%	311.02	7%	64.49	18%
Average	**870.81**	**16%**	**247.23**	**5%**	**83.33**	**-3%**

Table 11
Firm-Year Observation Breakdown by Industry

Year	Industry (1-digit SIC code)										
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
2002	1	1	27	130	24	24	33	108	13	5	**366**
2003	1	6	33	141	29	28	35	106	13	6	**398**
2004	1	6	33	138	25	26	28	106	12	7	**382**
2005	1	6	32	124	21	17	25	97	8	6	**337**
2006	1	8	37	138	25	20	27	80	9	4	**349**
2007	1	12	35	124	32	21	28	81	10	4	**348**
2008	1	12	34	109	29	16	22	76	10	4	**313**
2009	1	13	29	102	26	14	26	70	11	2	**294**
2010	1	12	26	98	30	15	28	66	11	0	**287**
2011	1	9	17	76	25	12	21	63	10	0	**234**
Total	**10**	**85**	**303**	**1,180**	**266**	**193**	**273**	**853**	**107**	**38**	**3,308**

Notes:
SIC 0 - Agriculture, Forestry, and Fishing
SIC 1 - Mining and Construction
SIC 2 and 3 - Manufacturing
SIC 4 - Transportation, Communications, Electric, Gas, and Sanitary Services
SIC 5 - Wholesale Trade and Retail Trade
SIC 6 - Finance and Insurance
SIC 7 and 8 - Services
SIC 9 - Public Administration

Variable Measurement

CIO Education

I create dummy variables *TECH* and *BIZ* to capture whether a CIO has a technical educational background and whether a CIO has a business educational background. The interacted term between *TECH* and *BIZ* is *HYBRID* which captures whether a CIO has a *hybrid background* of both technical and business. I measure CIO *education quality* by coding a dummy variable for whether a CIO has earned a degree from a top 10 ranking school in the US (USNEWS School Ranking 2012) and a dummy variable for whether a CIO has obtained a graduate degree or higher (Jalbert et al. 2010; Jalbert et al. 2002; Gottesman and Morey 2006). Regarding *professional certification*, I are able to collect publicly available data on two of the most highly recognized IT certification Project Management Professional (PROJMGT) and ITIL Level 3 (*ITINFRA*) according to Global Knowledge (2013).

Control Variables

CIO personal characteristics. I measure a CIO's *personal characteristics* by *AGE, TENURE, INTERNAL* (internal/external promotion) and *GENDER*. Prior literature has documented that age is a determinant for CEO compensation. Garen (1994) used the age of the CEO to measure how close the CEO is to retirement and found that age is positively related to CEO compensation. McKnight et al. (2000) found that CEO compensation is positively related to CEO age in UK and Baptista (2010) found similar evidence in CEOs and their compensation in France. Bouvier (2010) examined the impact of CEO age on various CEO compensation component and documented that age is a significant determinant for base salary, short-term incentives, and total direct compensation, but not

for long-term incentives. Therefore I expect *AGE* to be positively associated with compensation.

TENURE measures how many years a CIO has been at current position. It is documented that executive compensation is positively impacted by tenure (Cordeiro and Veliyath 2003; Fisher and Govindrajan 1992; Gerhart and Milkovich 1990). I expect TENURE to be positively associated with compensation for two main reasons. First, executives who has been on the position longer should have established relationship and credibility with the board, thus enabling them to negotiate a higher compensation (Balkin et al. 2000; Hill and Phan1991). Second, executives with longer tenure on the job have accumulated experience and skills to enhance their human capital and maximize their performance, making their service more expensive (Cordeiro and Velivath 2003; Banker et al 2003).

INTERNAL is a dummy variable that captures whether a CIO is an internal hire to the current position. I expect internally hired CIO receive a higher compensation. IT project's success requires a higher degree of specific knowledge and experience specific to the firm's business processes and internal controls procedures (Stinchcombe and Heimer 1988). It is reported that the success rate of internal hires is higher for the CIO position because internally hired CIOs have established their ability and experience with their firm and their fit with the organization's culture throughout the years before the promotion (Russell Reynolds Associates 2013; Hein 2013).

GENDER is a dummy variable that equals to 1 if a CIO is male and 0 if a CIO is female. Although female executives have better presence in top executive positions, their

pay remain significantly lower compared to male executives (Elkinawy and Stater 2011; Bell (2005). Burress and Zucca (2004) examined the most highly compensated executives for the period of 1992-97 and found that females executives are paid significantly lower than male executives. They argued that the gender gap may be due to a lack of opportunity than to wage discrimination. Lam et al. (2013) documented that although female CEO participation is on the rise, female CEOs receive less favorable compensation terms than their male counterparts in China's listed companies. Elkinawy and Stater (2011) examined the gender-pay differences in executive compensation for the period of 1996-2004 in the U.S. and found strong evidence on gender-pay gap among executives. More specifically, they found that the gap is significantly larger in firms with fewer females in the top executive team. The position of CIO has been dominated by males and the proportion of female CIOs has been stagnated in the last ten years (Eddy 2014). Therefore, following prior studies, I expect males CIOs receive a higher compensation, compared to female CIOs.

Firm performance and characteristics. Consistent with prior studies on executive compensation (Banker et al. 2012; Balsam et al. 2011; Balsam et al. 2011), I measure financial performance by accounting performance *ROE* (Return on Stockholders' Equity), *GROWTH* (sales growth) and *LOSS* in net income (profitability). There is a rich body of literature that examined traditional financial performance measures and CEO/CFO compensation (Gomez-Mejia 1994; Gomez-Mejia et al 1995; Gomez-Mejia and Wiseman 1997; Banker et al 2013; Pavlik et al 1993; Clinch 1991; Lambert and Larcker 1987; Balsam et al 2012). Contrary to CEO and CFO, a CIO's contributions are not strongly reflected by financial performance measures. The value created by IT is achieved through

proper integration of enterprise architecture, business architecture, process design, organization design, and performance metrics. Therefore, the value-creation activities led by CIOs to support business processes and strategy are not effectively reflected in financial performance measures. Their contributions can often take a longer period of time to be realized and is less quantifiable to be observed than that of CEOs and CFOs (Banker et al 2011). According to Banker and Datar (1989), the sensitivity of using financial measures to evaluate a CIO's performance is low and thus not a good indicator. Furthermore, due to the complex and non-routine nature of IT projects, it is difficult to isolate a CIO's contributions from other influential factors in a firm's overall financial performance (Kirsch 1996). Consequently, given the noises introduced, the precision of using firm financial performance measures as CIO can also be low (Banker and Datar 1989). Therefore, following extant executive literature, I expect a significant relationship between CIO compensation and firm financial performance measures but not as strong as that of CEO and CFO compensation.

In addition, I control for *ITWEAKNESS* (whether receiving material IT internal control weakness as flagged in the audit report) as one of firm characteristics. A CIO's direct responsibility is to ensure that the firm's IT system successfully supports business processes and facilitates strategy implementation. More specifically, one of the critical aspects of a CIO's duties is to oversee the firm's IT infrastructure that forms the backbone of internal controls (Sutton and Arnold 2005). Particularly, IT internal controls play a crucial role to capture, process and record raw transactional data and support financial restatement preparation (Stoel and Muhanna 2011). A firm with ineffective IT governance tends to have material IT internal control weaknesses (ICWs) (Li et al. 2007) which can

severely damage the firm's financial performance (Klamm et al., 2012; Klamm and Watson, 2009). Firms reporting fewer material IT internal control weaknesses have higher accounting earnings and market value (Stoel and Muhanna 2011). In light of the linkage between IT ICWs and firm performance, the positive relationship between CEO/CFO turnover and firm performance became stronger after SOX (Kaplan and Minton 2008). Furthermore, receiving IT ICWs is associated with a higher likelihood of CEO and CFO turnover (Li et al 2010; Haislip et al 2013) and an decrease in executive compensation (Hoitash et al. 2011). The position of CIO is to provide better IT governance and prevent IT deficiencies (Li et al 2007). Haislip et al. (2011) document that receiving material IT weaknesses in the audit report leads to subsequent CIO turnover. Therefore I expect a significant negative impact of IT weakness on CIO compensation.

I measure a firm's strategic positioning by including STRATEGY variable that is a discrete construct (using consecutive integers) which captures strategy with prospectors receiving higher scores and defenders receiving lower scores (Ittner et al. 1997; Bentley et al. 2013). Each of the fmy ratios (*RDS*, *GROWTH*, *EMPS* and *SGAS*) is measured by company by year. Then each of these ratios is ranked into quintiles by industry (2-digit SIC code) and by year. Those observations in the highest quintiles are given a score of 5, those in the second highest quintile are given a score of 4, etc., while those observations in the lowest quintiles are given a 1 score. The scores are summed over the 4 measures per company-year such that a company could have receive a maximum score of 20 (Prospector-type) and a minimum score of 4 (Defender-type). I expect the more prospector the firm is, the higher their CIO pay is. Because achieving effective prospector strategy requires a perception of exclusivity that can be created by technological leadership (Govidarajan,

1989), thereby requiring a substantial amount of R&D investments (Greve, 1998). Executives who deal with risky R&D investments should be compensated commensurate with the risk that they undertake insofar as to justify acceptance of the position and thereby secure the stream of innovations a firm needs to enhance its economic performance (Makri et al., 2006).

I further control for *FIRMSIZE* (natural logarithm of total assets) because larger firms require executives to handle complex situations and thus compensate them with a higher pay (Cordeiro and Veliyath 2003; Henry Moore 1911; Brown and Medoff 1989; Kalleberg and Van Buren 1996; Hubbard and Palia 1995; Ke et al 1999). As the firm size increases, the amount of processes and requests handled by its IT system and the associated risks will dramatically increase (The New York Times 2011). Therefore I expect a significant positive relation between *FIRMSIZE* and compensation.

Industry characteristics. Following Francis and Schipper (1999), I define high technology industries as SIC codes 283 (Drugs), 357 (Computer and Office Equipment), 360-368 (Electronics and Computer Hardware), 481 (Telephone Communications), 600-699 (Finance and Insurance), 737 (Telephone Communications), and 873 (Research, Development, Testing Services). *HIGHTECH* is a dummy variable that equals to 1 if a firm is in high technology industries; otherwise zero. High technology firms offer products or services that contain high information contents and advanced technologies (Palmer and Griffith 1998). A high technology firm's core business is more leveraged by sophisticated information and leading technology (Arora et al. 2001). As a result, firms in high technology industries need to focus on innovation which requires substantial investments in R&D (Hill and Snell 1988). Yanadori and Marler (2006) documented that high

technology firms pay a higher compensation to employees who are directly involved in R&D activities. Banker et al. (2009) found that CEO compensation is positively associated with a firm's R&D intensity, indicating a higher CEO compensation in high technology industry (Balkin and Gomez-Mejia 2000). Also, firms in high technology industries manage more complex and risky IT resmyces, processes, staff and assets, resulting in a greater responsibility for the CIO to align IT with the organizational goal (Richardson et al. 2014). Therefore, I expect CIOs in high technology industry receive a higher compensation.

The definition of IT orientation in the industry is adopted from Richardson et al. (2014), Chatterjee et al. (2001) and Armstrong and Sambamurthy (1999). *Automate* orientation of IT refers to the role of IT as replacing human labor with automate information technology in key processes, providing improved efficiency and cost savings. *Informate* orientation refers to IT providing better information to both high and low levels of the organization to achieve better decision making. *Transform* orientation refers to IT fundamentally and innovatively altering the business models, customer and supplier relationships, product/market/organizational structures, and the management processes. In this study, I create dummy variables for each of the IT role to have a closer look at the impact of each role on CIO compensation: *AUTOMATE* equals to 1 if the firm operates in an industry where IT plays an automate role, *INFORMATE* equals to 1 for inforamte role and *TRANSFORM* equals to 1 for transform role. From the spectrum between automate and transform, a more transform IT orientation indicates a greater reliance of IT in the firm's strategic planning but also a higher vulnerability to IT risks (Richardson et al. 2014). I expect CIOs in industries where IT plays a more transform role (i.e. a less automate role)

receive a higher compensation due to their greater importance in strategic IT resmyces allocation and compensation to a higher risk exposure (Finkelstein and Hambrick 1996).

At last, I calculate average CIO pay (*INDPAY*) for each industry (2-dig SIC) per year to control for the average industry pay level. Agency theory suggests that industry pay is an influential factor in determining executive compensation (Oyer 2004; Banker et al. 2013; Rajgopal et al. 2006). Industry pay – the average pay within industry - reflects the executive's outside employment opportunity. Firms have an incentive to retain their executive by matching its pay to the industry pay because executive turnover is usually costly (Oyer 2004; Himmelberg and Hubbard 2000). Banker et al. (2013) proposed an analytical model suggesting that reservation rent is an important component in CEO compensation. Rajgopal et al. (2006) examined CEOs from S&P500 firms for the period of 1993-2001 and found that the sensitivity of CEO compensation to industry pay is higher for CEOs who enjoy more favorable press visibility, consistent with the outside employment opportunity explanation. As a result, assuming CIO talent is scarce, I expect that when industry pay is higher, the CIO has a higher outside employment opportunity. In order to retain their CIO, firms must adjust their CIO compensation based on the industry pay. Thus I expect a significant positive relation between *INDPAY* and compensation.

Table 12 shows the descriptive statistics for CIO characteristics including educational and personal. 85% of CIOs have a degree in technical-relate areas (*TECH*) and 26.3% of CIOs have a degree in business-related areas (*BIZ*). However, only 12.7% of CIOs have a combined educational background of technical and business (*HYBRID*), thus consistent with my expectation that hybrid CIOs should be paid with a higher compensation due to a low supply in such a highly demanded background.

Table 12
Variable Definition

	Variable		Definition
CIO Educational Characteristics	**Educational Background**	***TECH***	= 1 if a CIO has majored in STEM degrees (Science, Technology, Engineering and Mathematics); 0 otherwise.
		BIZ	= 1 if a CIO has majored in STEM degrees (Science, Technology, Engineering and Mathematics); 0 otherwise.
		HYBRID	An interaction term of TECH and BIZ.
	Education Quality	***TOPSCH***	= 1 if a CIO is a graduate from USNEWS Top 10 US School List.
		GRAD	= 1 if a CIO has a graduate degree; 0 otherwise.
	Professional Certificate	***PROJMGT***	= 1 if a CIO has a Project Management certificate; 0 otherwise.
		ININFRA	= 1 if a CIO has an Information Technology Infrastructure Library level 3 certificate; 0 otherwise.
CIO Personal Characteristics		***AGE***	CIO's biological age.
		GENDER	= 1 if a CIO is male; 0 otherwise.
		INTERNAL	= 1 if a CIO has been internally promoted to the CIO position; 0 otherwise.
		TENURE	CIO's tenure at current position.
Firm Financial Performance		***ROE***	Return on Stockholders' Equity at year t
		LOSS	= 1 if a firm has a loss in net income; 0 otherwise.
		GROWTH	Percentage change in sales at year t
Firm Characteristics		***ITWEAKNESS***	= 1 if a firm has IT-related material internal control weaknesses at year t; 0 otherwise.
		FIRMSIZE	Natural logarithm of total assets
		STRATEGY	A discrete construct (using consecutive integers) to capture strategy with prospectors receiving higher scores and defenders receiving lower scores. Each of the fmy ratios (RDS, GROWTH, EMPS and SGAS) is measured per company per year. Then each of these ratios is ranked into quintiles per industry (2-digit SIC code) and year. Those observations in the highest quintiles are given a score of 5, those in the second highest quintile are given a score of 4, etc., while those observations in the lowest quintiles are given a 1 score. The scores are summed over the 4 measures per company-year such that a company could have receive a maximum score of 20 (Product differentiation) and a minimum score of 4 (Cost leadership).
Industry Characteristics		***HIGHTECH***	= 1 if a firm is in high tech industries; otherwise zero.
		AUTOMATE	A dummy variable that equals to 1 if the ultimate role of IT is to replace expensive, unreliable human labor; 0 otherwise.
		INFORMATE	= 1 if the ultimate role of IT is to provide information to the organization; 0 otherwise.
		TRANSFORM	= 1 if IT is a vehicle for fundamentally altering the landscape of the industry where the firm operates; 0 otherwise.
		INDPAY	Average log of total compensation/salary/bonus per industry per year

About of a half of CIOs have a graduate degree (*GRAD*) but only a small portion of CIOs have obtained a professional certification such as Project Management certificate (*PROJMGT*) (5.3%) and ITIL Level 3 certificate that focuses on IT infrastructure knowledge (*ITINFRA*) (9.5%). Regarding to CIO personal characteristics, my samples show that 95% of CIOs are male (GENDER=1) and the average age of CIOs is 47.7 years old. About 18% of CIOs are internal hires (*INTERNAL*) and the average tenure at the CIO position (*TENURE*) is 3.2 years.

The average assets of my sample firms is 6.8 million and and about half of the firms are in high technology industries (*HIGHTECH*). My sample firms are relatively fast growing firms, indicated by an annual sales growth rate (*GROWTH*) of 38.5%. IT plays an automate role (*AUTOMATE*) in 18% of the industries where the sample firms operate, an informate role (*INFORMATE*) in 38% of the industries, and a transform role (*TRANSFORM*) in 44% of the industries.

Research Design

Main Model

In this study, I examine the determinants of CIO compensation from three broad perspectives: CIO, firm and industry. More specifically, I look at (1) CIO's educational background and personal characteristics, (2) firm financial performance measures and firm characteristics, and (3) industry characteristics. I also include a separate examination on the salary and bonus components in CIO compensation due to their divergent roles in rewarding CIOs. The research framework is shown in the following Figure 2.

Table 13
Descriptive Statistics

Perspective	Variable		Mean	Median	Bottom 10 Percentile	Top 10 Percentile	Standard Deviation
CIO Characteristics	Education	***TECH***	0.850	1	0	1	0.357
		BIZ	0.263	0	0	1	0.440
		HYBRID	0.127	0	0	1	0.332
		TOPSCHOOL	0.139	0	0	1	0.346
		GRAD	0.515	1	0	1	0.500
		PROJMGT	0.053	0	0	0	0.224
		ITINFRA	0.095	0	0	0	0.293
	Personal	***AGE***	47.770	48	38	58	7.997
		GENDER	0.950	1	1	1	0.218
		INTERNAL	0.175	0	0	1	0.380
		TENURE	3.207	3	1	6	2.176
Firm Characteristics	Financial Performance	***ROE***	-0.068	0.051	-0.943	0.411	7.698
		GROWTH	0.385	0.090	-0.207	0.618	5.191
		LOSS	0.468	0	0	1	0.499
	Institutional	***ITWEAKNESS***	0.008	0	0	0	0.087
		TOTAL ASSETS ($ in thousands)	6,792.833	226.677	12.252	9,041.177	32,072.75
		STRATEGY	12.360	12	8	17	3.331
Industry Characteristics		***HIGHTECH***	0.489	0	0	1	0.500
		AUTOMATE	0.179	0	0	1	0.384
		INFORMATE	0.380	0	0	1	0.485
		TRANSFORM	0.441	0	0	1	0.497
CIO Compensation ($ in thousands)		***TOTALCOMP***	870.81	376.2105	132.414	1,950	1,397.285
		SALARY	247.23	213.333	102.968	422.488	159.461
		BONUS	83.33	0	0	213.184	289.176

Consistent with Ang et al. (2002) and Richardson et al. (2014), I develop the following OLS model to examine CIO compensation determinants:

$$\log(COMPENSATION_{i,t}) = \beta_0 + \beta_1 TECH_{i,t} + \beta_2 BIZ_{i,t} + \beta_3 HYBRID_{i,t} +$$
$$\beta_4 TOPSCH_{i.t} + \beta_5 GRAD_{i.t} + \beta_6 PROJMGT_{i.t} + \beta_7 ITINFRA_{i.t} + \beta_8 AGE_{i.t} +$$
$$\beta_9 TENURE_{i.t} + \beta_{10} INTERNAL_{i.t} + \beta_{11} GENDER_{i.t} + \beta_{12} ROE_{i,t-1} + \beta_{13} ROE_{i.t} +$$
$$\beta_{14} LOSS_{i.t} + \beta_{15} GROWTH_{i.t} + \beta_{16} ITWEAKNESS_{i,t-1} + \beta_{17} ITWEAKNESS_{i.t} +$$
$$\beta_{18} FIRMSIZE_{i.t} + \beta_{19} STRATEGY_{i.t} + \beta_{20} HIGHTECH_{i.t} + \beta_{21} INFORMATE_{i.t} +$$
$$\beta_{22} TRANSFORM_{i.t} + \beta_{23} INDPAY_{i.t} + \varepsilon \quad (3)$$

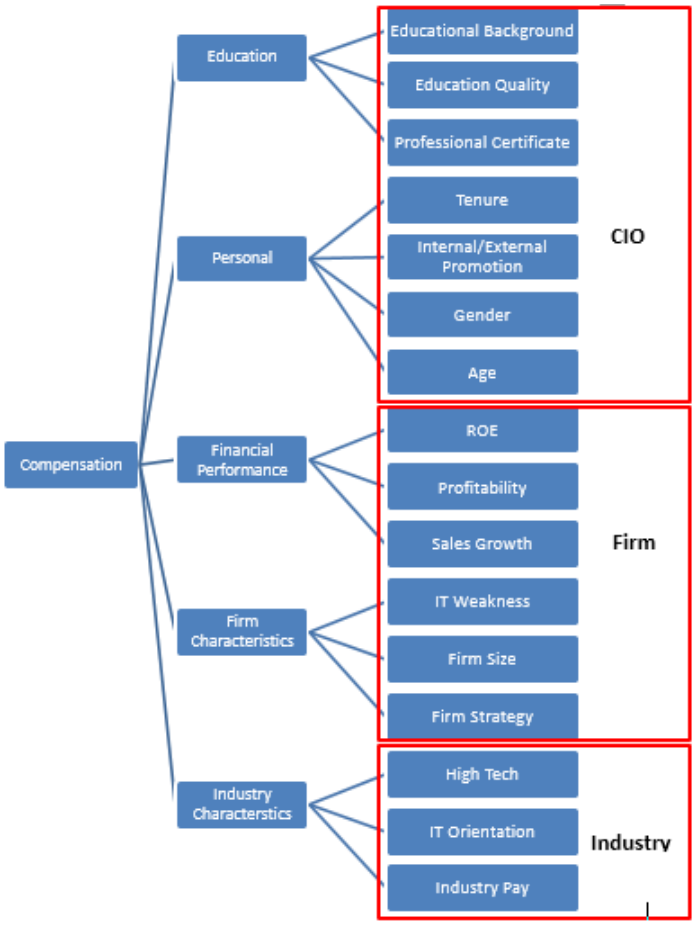

Figure 2 - Research Framework

Equation (1) is to examine the impacts of determinants from three broad perspectives: i) CIO educational and personal characteristics, ii) Firm financial performance and characteristics, and iii) Industry Characteristics on CIO compensation. First, I test whether CIO educational characteristics including educational background, education quality and professional certificate are significant determinants of CIO compensation. I expect β_3 for *HYBRID* to be significantly positive as expected in H3. I also expect measures of education quality *TOPSCH* and GRAD and measures of professional certificate *PROJMGT* and *ITINFRA* to be significantly positive associated with CIO compensation (H4 and H5).

Disaggregation of Cash Compensation into Salary and Bonus

In this study, I further disaggregate cash compensation into two important component *Salary* and *Bonus*. Grounded in *agency theory*, Finkelstein and Hambrick (1989) and Banker et al (2013) pointed out the importance of disaggregating cash compensation into salary and bonus components because they work in distinct ways in terms of incentivizing and compensating agents. Both papers suggested that salary is the fixed component which is determined at the beginning of period *t* to reflect signals of ability whereas the variable bonus component is settled based on the realized performance at the end of period *t* to induce effort during the period. Therefore, one finding that could be expected with confidence is that firm traditional financial performance such as *ROE*, *LOSS* and *GROWTH* should be less strongly associated with *SALARY* than *BONUS*. In addition, since CIO educational and personal characteristics are signals of CIO ability and IT weaknesses are signals of CIO effort, I expect CIO salary to be strongly determined by CIO characteristics. On the contrary, as bonus rewards CIO's effort, I expect CIO bonus to be weakly associated with CIO characteristics.

Empirical Results

As shown in Table 14 column (1) below, I find that CIO education is a significant determinant of CIO compensation. First, I document that the coefficient of *HYBRID* background is significantly positive (β_3 = 0.335, p-value = 0.000), indicating that CIOs with a combined background of technical and business education receive a 33.5% premium in their total compensation. I also find that the coefficient of *PROJMGT* is significantly positive (β_4 = 0.101, p-value = 0.031), suggesting that CIOs with a project management certification receive a 10.1% premium in their total compensation. Both results regarding CIO educational characteristics are consistent with my expectation of H3 and H5. I do not

find a strong association between CIO education quality as measured by *TOPSCHOOL* and *GRAD* and CIO compensation (H4).

Besides CIO educational characteristics, I also document that CIO personal characteristics significantly influence CIO compensation. Results in Table 14 column (1) show that *GENDER* is significantly positively associated with CIO compensation (β_8 = 0.148, p-value = 0.000) and male CIOs receive a 14.8% premium in their total compensation compared to their female counterparts. Also, I find that whether a CIO is promoted to the position internally or externally has an impact on their compensation (β_9 = 0.079, p-value = 0.033). It shows that the compensation of internally hired CIOs is 7.9% higher than that of externally hired CIOs. Results also indicate that longer tenure CIOs are paid with a higher compensation (β_{10} = 0.067, p-value = 0.000), suggesting that every one more year of tenure increases CIO compensation by 6.7%, after controlling for other influential factors.

In addition, the results from Table 14 column (1) indicate a significant but weak relationship between traditional financial performance measures and CIO compensation. I document that there is a significantly positive association between *GROWTH* and CIO compensation (β_{15} = 0.003, p-value = 0.001). However, the influence of sales growth on CIO compensation is relatively weak as indicated that 100% increase in sales only results in 0.3% increase in compensation. Moreover, I do not find ROE and LOSS to be significant determinants for CIO compensation. This is consistent with my expectation that traditional financial performance measures are not as strong determinants for CIO compensation as those for CEO and CFO compensation because CIO's contributions in IT take a longer

period to be reflected in financial numbers and the outputs of IT projects are less quantifiable (Kirsch 1996; Banker et al. 2011).

Another dimension of firm perspective is firm characteristics such as *ITWEAKNESS*, *FIRMSIZE* and *STRATEGY*. I find that CIOs with firms receiving material IT internal control weaknesses in their audit report receive a significantly lower salary (β_{17} = -0.266, p-value = 0.007). This is consistent with my expectation that ensuring effective IT controls is an important responsibility of CIOs after the enactment of SOX and CIOs who failed to meet such expectation receive a lower compensation. I also document that larger firms pay their CIOs a higher compensation. When the firm's total assets increase by 1%, their CIO compensation goes up by 0.29%.

Finally, I document industry characteristics also play a significant role in determining CIO compensation. I find that CIOs in high technology firms are paid with a premium of 7.4% in total compensation (β_{20} = 0.074, p-value = 0.007), compared to CIOs in non-high technology firms. Also, I document that the strategic orientation of IT in the industry is a significant determinant of CIO compensation (β_{21} = 0.116, p-value = 0.003; β_{22} = 0.118, p-value = 0.000), suggesting that CIOs in industries of *TRANSFORM* and *INFORMATE* orientations receive a 11.8% and 11.6% higher compensation, compared to CIOs in industries of *AUTOMATE* orientation. Moreover, my results show that the average industry pay which reflects CIO's outside employment opportunity significantly determines CIO compensation. Firms match the industry pay in the compensation to avoid losing their CIO to other firms in the same industry.

In this study, I further disaggregate cash compensation into two important component *Salary* and *Bonus*. Grounded in *agency theory*, Finkelstein and Hambrick (1989) and Banker et al. (2013) pointed out the importance of disaggregating cash compensation into salary and bonus components because they work in distinct ways in terms of incentivizing and compensating agents. Both papers suggested that salary is the fixed component which is determined at the beginning of period *t* to reflect signals of ability whereas the variable bonus component is settled based on the realized performance at the end of period *t* to induce effort during the period. Therefore, one finding that could be expected with confidence is that firm traditional financial performance such as *ROE*, *LOSS* and *GROWTH* should be less strongly associated with *SALARY* than *BONUS*. In addition, since CIO educational and personal characteristics are signals of CIO ability and IT weaknesses are signals of CIO effort, I expect CIO salary to be strongly determined by CIO characteristics. On the contrary, as bonus rewards CIO's effort, I expect CIO bonus to be weakly associated with CIO characteristics.

Results from Table 14 column (2) and (3) are consistent with my expectations: salary strongly are significantly associated with signals of CIO ability as captured by CIO educational background variable *HYBRID* (β_3 = 0.306, p-value = 0.000), education quality variable *TOPSCH* (β_5 = 0.03, p-value = 0.06), professional certificate variable *PROJMGT* (β_6 = 0.096, p-value = 0.000), and CIO personal characteristics *AGE* (β_8 = 0.002, p-value = 0.013), *TENURE* (β_9 = 0.028, p-value = 0.000), *INTERNAL* (β_{10} = 0.075, p-value = 0.000). Additionally, the results suggest that bonus rewards CIO effort by punishing CIOs with firms occurring a *LOSS* (β_{14} = -0.228, p-value = 0.000). The link between signals of CIO ability and *BONUS* is not statistically significant as expected.

Interestingly, despite the insignificant association between firm strategy and CIO total compensation, I find that firms that are more prospector type (on a strategy spectrum between prospector and defender) pay a lower level of bonus. A possible explanation is that IT initiatives in prospector firms are more risky and have less quantifiable output in a short term and if a prospector firm places more weights on bonus which is largely based on quantifiable financial numbers, it will discourage their CIO to conduct IT initiatives that are best for a prospector strategy.

Table 14
Determinants of CIO Compensation

$$\log(COMPENSATION_{i,t}) = \beta_0 + \beta_1 TECH_{i,t} + \beta_2 BIZ_{i,t} + \beta_3 HYBRID_{i,t} + \beta_4 PROJMGT_{i.t} + \beta_5 TOPSCH_{i.t} + \beta_6 GRAD_{i.t} + \beta_7 ITINFRA_{i.t} + \beta_8 GENDER_{i.t} + \beta_9 INTERNAL_{i.t} + \beta_{10} TENURE_{i.t} + \beta_{11} AGE_{i.t} + \beta_{12} ROE_{i,t-1} + \beta_{13} ROE_{i.t} + \beta_{14} LOSS_{i.t} + \beta_{15} GROWTH_{i.t} + \beta_{16} ITWEAKNESS_{i,t-1} + \beta_{17} ITWEAKNESS_{i.t} + \beta_{18} FIRMSIZE_{i.t} + \beta_{19} STRATEGY_{i.t} + \beta_{20} HIGHTECH_{i.t} + \beta_{21} INFORMATE_{i.t} + \beta_{22} TRANSFORM_{i.t} + \beta_{23} INDPAY_{i.t} + \varepsilon$$

VARIABLES	**Log(TOTALCOMP)** **Coefficient (p-value)**	**Log(SALARY)** **Coefficient (p-value)**	**Log(BONUS)** **Coefficient (p-value)**
CIO Educational Background			
TECH	0.001	-0.086	0.176
	(0.992)	(0.289)	(0.620)
BIZ	-0.186	-0.121	-0.108
	(0.115)	(0.183)	(0.812)
HYBRID	0.335***	0.306***	0.578
	(0.000)	(0.000)	(0.272)
GRAD	0.017	-0.003	-0.101
	(0.591)	(0.868)	(0.367)
TOPSCHOOL	-0.006	0.030*	0.060
	(0.857)	(0.060)	(0.444)
PROJMGT	0.101**	0.096***	0.040
	(0.031)	(0.000)	(0.666)
ITINFRA	-0.012	0.008	-0.141
	(0.775)	(0.702)	(0.343)
CIO Personal Characteristics			

Table 14, continued			
AGE	-0.001	0.002**	0.004
	(0.572)	(0.013)	(0.448)
GENDER	0.148***	-0.011	-0.147
	(0.000)	(0.711)	(0.574)
INTERNAL	0.079**	0.075***	-0.047
	(0.033)	(0.000)	(0.627)
TENURE	0.067***	0.028***	0.005
	(0.000)	(0.000)	(0.814)
Firm Financial Performance Measures			
ROE_{t-1}	0.000	0.000	-0.006
	(0.858)	(0.937)	(0.547)
ROE_t	0.001	-0.000	0.015
	(0.752)	(0.798)	(0.169)
LOSS	-0.032	0.010	-0.228***
	(0.323)	(0.651)	(0.000)
GROWTH	0.003***	0.002***	0.006***
	(0.001)	(0.000)	(0.000)
Firm Characteristics			
$ITWK_{t-1}$	0.162	-0.042	-0.952***
	(0.308)	(0.749)	(0.000)
$ITWK_t$	-0.266***	-0.041	0.132
	(0.007)	(0.590)	(0.705)
FIRMSIZE	0.290***	0.139***	0.339***
	(0.000)	(0.000)	(0.000)
STRATEGY	-0.000	-0.001	-0.045***
	(0.947)	(0.470)	(0.002)
Industry Characteristics			
HIGHTECH	0.074***	0.050***	-0.134
	(0.007)	(0.010)	(0.269)
INFORMATE	0.116***	0.021	0.171**
	(0.003)	(0.417)	(0.028)
TRANSFORM	0.118***	-0.016	0.167*
	(0.000)	(0.396)	(0.100)
INDPAY	0.470***	0.342***	0.643***
	(0.000)	(0.000)	(0.000)
Constant	4.832***	7.170***	2.389***
	(0.000)	(0.000)	(0.001)
Observations	1,364	1,489	747
Adjusted R-squared	0.655	0.511	0.459

Notes: COMPENSATION equals to SALARY, BONUS and TOTALCOMP, respectively.
Robust p-value in parentheses; Clustered by year.
*** p<0.01, ** p<0.05, * p<0.1

CHAPTER 5

CIO TURNOVER

Motivation

Prior executive turnover literature finds that CEOs and CFOs turnover when they fail to meet financial performance expectations (Fredrickson et al. 1988; Puffer and Weintrop 1991; Farrell and Whidbee 2003; Jenter and Kanaan 2005; Mergenthaler et al. 2013). However, unlike CEO/CFOs, CIOs are directly responsible for a firm's IT system performance (Ernst & Young 2013). When IT systems fail, proprietary data are at risk of being exposed or misused, jeopardizing organizational goals and shareholders' value (Kwon et al. 2013; Acquisti et al. 2006). The average cost of data breaches in the United States is 195 dollars per record (IBM and Ponemon 2014). Due to the high cost of data breaches, CIOs face the direct pressure from boards and shareholders to implement an effective information system to prevent such breaches, and hence yielding unfavorable consequences upon occurrence of a data breach.

Recent high profile data breaches have imposed substantial costs on firms. Target lost data relating to 70 million customers' personal information and 40 million debit/credit card accounts in December 2014 (Ziobro 2014), resulting in at least 148 million dollars loss and forecast profit drop (Abram 2014). Their CIO Beth M. Jacob and CEO Gregg Steinhafel subsequently resigned within five months following the breach (Harris 2014; O'Connor 2014). In line with these recent incidents, the Securities and Exchange Commission (SEC) held a roundtable conference on March 25, 2014 addressing concerns surrounding data breaches and related risks for firms and market participants.

Hypotheses

Executive Turnover and Expected Performance

Prior literature has documented the impact of performance expectation from the board of directors on CEOs and CFOs turnover. Fredrickson et al (1988) propose that the board of directors develops performance expectations and that CEOs are more likely to turnover when they fail to meet performance expectation from the board.

Financial measures are often used to proxy performance expectations for CEOs and CFOs. Puffer and Weintrop (1991) use analysts' forecasts of firm performance as a surrogate for the expected performance and find that CEO turnover occurs when the realized accounting per share falls short of analysts' forecasts. Similarly, Farrell and Whidbee (2003) use the analyst forecast error as a proxy for performance expectation and find that analyst forecast error significantly contributes to CEO turnover and there is a stronger relation between analyst forecast error and CEO turnover when the consensus among analysts is high.

Mergenthaler et al. (2012) extend the line of research to CFO turnover. As the head of finance department, CFOs are responsible for generating and presenting financial statements and they are more directly facing the pressures of meeting analysts' forecasts (Erhemjamts et al. 2009). Empirical results suggest that CFOs are also subject to performance expectations from the board and experience a higher turnover and receive bonus cuts when missing the latest quarterly analyst forecast. Humphreys et al. (2011) point out that using analysts' forecast as performance expectation potentially suffers from the tendency to manage analysts' forecasts. They look at the association between performance expectation and college football CEO turnover using a market-determined measure of

expected performance. Their results show that the unbiased market-determined performance expectation significantly determines the likelihood of college football CEOs' turnover.

Data Breach and Its Consequences

Existing literature on data breach has focused on the disclosure of data breach and stock market reaction (Acquisti et al. 2006; Cavusoglu et al. 2002; Campbell et al. 2002). Acquisti et al. (2006) examined the data breaches relating to personal privacy information and found a significant negative impact of data breach on stock market reactions on the announcement day of the breach. Cavusoglu et al (2002) document that firms with data breach on average lost 2.1 percent of their market valuation within the two days of breach announcement. Further investigation reveals that market reaction to data breach vary across the types of breaches. Campbell et al. (2003) document a significant negative market reaction for data breaches relating to unauthorized access to confidential data, but insignificant reaction when the breach does not relate to confidential information.

Despite the rich body of literature on data breach and stock market reaction, there is a limited amount of research that examines the consequence of data breach from a managerial perspective (IBM and Ponemon 2014; Kwon et al. 2013). An independent report by IBM and Ponemon (2014) revealed that firms with data breach experience a customer loss and a lower rate of customer acquisition, compared to firms without data breach. Kwon, Ulmer and Wang (2013) investigated the association between the likelihood of data breach and top IT executive compensation during a sample period of 2003-08. They found that the likelihood of data breach has a significant negative impact on top IT executives' salary.

In this study, I focus on the impact of data breach on CIO turnover because CIOs are directly accounted for IT performance (Ernst & Young 2012) and data breach is a major indicator of IT failures. Following executive turnover literature that suggests a higher CEO/CFO turnover likelihood when failing to meet expected performance, I hypothesize:

H6: The occurrence of data breach is positively associated with CIO turnover

Following Campbell et al. (2003) that suggests a varying consequence of data breach based on their nature, I categorize data breaches into fmy groups based on their reasons: (1) system glitch, (2) criminal attack, (3) human error, and (4) others (IBM and Ponemon 2014). System glitch type involves data being exposed/lost resulted from a system glitch[15]. Criminal attack type relates to data being exposed/lost due to fraud or hack activities. Human error type involves careless human conduct that comprise confidential data to potential risks and others type relates to data breach due to unrelated or unknown reasons. Since CIOs are more responsible for establishing an IT system that minimize the risk of system glitch, compared to other types of data breach, I expect:

H7: Among data breaches, system glitch is more positively associated with CIO turnover, compared to other types of data breaches.

Data and Research Design

Data

InformationWeek annually lists 500 most innovative firms with their CIOs. I collect these lists from 2008-13. I identify CIO turnover by observing name changes for each firm over the sample period. Since not every firm is listed every year, I hand collect CIO

[15] As a robustness check, I categorize hack into system glitch and the results main consistent with expected.

turnover data for the missing years mainly through LinkedIn, BusinessWeek and corporate websites. I initially have 544 US public firms with 375 turnovers from InformationWeek lists. Then I remove 20 CIO turnovers due to retirement, Merger & Acquisition and promotion. After merging with Compustat database for firm level financial data, ExecuComp database for CEO/CFO turnover data, RiskMetric database for board size data, AuditAnalystics database for internal control weakness data, my final sample consists of 368 firms with 225 turnovers during 2008-13.

Table 15
CIO Turnover between 2008 - 2013

No. of Firms	No. of Turnovers per Firm
187	0
144	1
30	2
7	3
Total = 368 Firms	**Average Turnover per Firm = 0.611**

I hand collect data breach information from http://datalossdb.org/. This website updates daily with data breach news from news feeds, blogs and legal fillings. Prior studies (Sullivan 2010; Kwon et al. 2013) have used it as their major data smyce. In order to examine whether the types of data breach have an impact on CIO turnover, I categorize data breaches into fmy groups due to their reasons: (1) system glitch, (2) criminal attack, (3) human error, and (4) others (IBM and Ponemon 2014). There are 190 data breaches including 54 system glitches, 72 criminal attacks, 47 human errors and 17 other breach incidents.

Table 16
Data Breach Category

Variable	Definition	Example
SYSGLITCH	Data exposed/lost due to system glitch	Web site glitch exposes customer account data to other customer(s) with same last name (Bank of America 2/12/2011)
CRIMINAL	Data exposed/lost due to hack or fraud activities	Employee stole 2,100 co-workers' Social Security numbers and dates of birth (AT&T 7/8/2009)
HUMANERR	Data exposed/lost due to human errors	Employee discarded hard drive through normal trash collection (Pfizer Inc 5/7/2009)
OTHER	Data exposed/lost due to unrelated or unknown reasons	Fax machine sent faxes to wrong numbers after its automatic software patch (MetLife Inc 2/12/2009)

As shown in Table 17, there are 275 firms without any data breaches during my sample period. Other firms mostly experience one data breach and at most experience 4 data breaches. On average, each firm has experienced 0.443 data breach between 2008-2013. Table 18 lists the distribution of data breach incidents by year. I can see that there is no major clustering of data breach incidents across sample years and a slight decline of the number of incidents over years.

Table 17
Data Breach between 2008-2013

No. of Breach	No. of Firms with System Glitch	No. of Firms with Criminal Attack	No. of Firms with Human Error	No. of Firms with Other Breach
0	328	320	331	351
1	31	32	29	17
2	4	10	6	0
3	5	4	2	0
4	0	2	0	0
Total	**54**	**72**	**47**	**17**

Table 18: Data Breach by Year

Year	*SYSGLITCH*	*CRIMINAL*	*HUMANERR*	*OTHER*
2008	14	10	18	3
2009	16	11	13	3
2010	9	15	6	4
2011	7	12	6	3
2012	6	17	3	3
2013	2	7	1	1
Total	**54**	**72**	**47**	**17**

Research Design

In order to test H6 and H7 that test the impact of data breach and CIO turnover, I develop the following logistic regressions:

$$logit(TURNOVER) = BREACH + CIOPOWER + BOARDSIZE + FIRMSIZE + ROA + LOSS + MTOB + ICW + HITECH + TURNOVER_{CEO} + TURNOVER_{CFO} + YEAR\ DUMMY + INDUSTRY\ DUMMY + \varepsilon \quad (1)$$

,where TURNOVER is $TURNOVER_1$, $TURNOVER_2$, $TURNOVER_3$, alternatively.

$$logit(TURNOVER) = SYSGLITCH + CRIMINAL + HUMANERR + OTHER + CIOPOWER + BOARDSIZE + FIRMSIZE + ROA + LOSS + MTOB + ICW + HITECH + TURNOVER_{CEO} + TURNOVER_{CFO} + YEAR\ DUMMY + INDUSTRY\ DUMMY + \varepsilon \quad (2)$$

,where TURNOVER is $TURNOVER_1$, $TURNOVER_2$, $TURNOVER_3$, alternatively.

$TURNOVER_1$ ($TURNOVER_2$ or $TURNOVER_3$) is a dummy variable indicating whether there is a CIO turnover within 1 (2 or 3) year of data breach incident(s). I expect the coefficient of Breach in Model (1) to be significantly positive and the coefficient of SYSGLITCH in Model (2) to be significantly positive. I include a set of control variables that have been documented by prior literature to impact on the likelihood of executive turnover. The first set of control variables are firm-level controls including *ROA*, *LOSS*, *MTO*, *FIRMSIZE,* and *ICW*. I control overall firm performance by *ROA*, profitability by *LOSS*, and growth opportunity by *MTB*. I predict that firms with better accounting

performance (*ROA*) and firms without a loss (LOSS) are less likely to make governance changes including CIO turnover and firms with a greater growth opportunity (*MTB*) are more likely to experience CIO turnover. *FIRMSIZE* affects a firm's tendency to make governance changes and prior studies have shown that larger firms tend to turnover their executives more frequently (Gordon and Rosen 1981). I also include control for whether the firm has internal control weaknesses as flagged in the audit report. Another set of control variables include $TURNOVER_{CEO}$, $TURNOVER_{CFO}$, and BOARDSIZE. Prior studies indicated a significant association between CEO turnover and subsequent departure of other TMT member (Barron et al. 2011). CIOs work closely with CEOs and CFOs. Banker et al. (2011) suggested that CIOs report directly to CEOs and CFOs to implement firm's strategic initiatives. When there is a CEO or CFO turnover, it is likely that there will a regime change that may affect other TMT members who have been closely working with the CEO or CFO. Therefore I control for whether there is a CEO or CFO turnover at the year of data breach incidents. Lastly, consistent with Boritz and Lim (2011), I control for CIOPOWER a dummy variable indicating whether the CIO holds other executive titles besides the title of CIO.

Descriptive statistics and variable correlation matrix are shown in Table 19 and Table 20. On average, 13.6% of firm-year observation experience a CIO turnover at the year of breach and 9.3% of firm-year observation has data breach incident(s). Majority of CIOs hold other titles beside the tile of "CIO". About a quarter of samples are from high tech industry. Firm level matrix such as FIRMSIZE, ROA, MTOB, LOSS, ICW are not statistically different from samples of other studies. Table 20 suggests that there is no multicollinearity relationship among variables.

Table 19
Variable Descriptive Statistics

VARIABLE	Mean	Median	Min	Max	Standard Deviation	No. of Firm-Year Obs
TURNOVER$_1$	0.136	0	0	1	0.343	1653
TURNOVER$_2$	0.228	0	0	1	0.420	1653
TURNOVER$_3$	0.288	0	0	1	0.453	1653
BREACH	0.099	0	0	1	0.298	1653
SYSGLITCH	0.033	0	0	1	0.178	1653
CRIMINAL	0.044	0	0	1	0.204	1653
HUMANERR	0.028	0	0	1	0.166	1653
OTHER	0.010	0	0	1	0.101	1653
CIOPOWER	0.793	1	0	1	0.405	1653
BOARDSIZE	10.485	10	5	34	2.606	1653
TURNOVER$_{CEO}$	0.104	0	0	1	0.305	1653
TURNOVER$_{CFO}$	0.146	0	0	1	0.354	1653
FIRMSIZE	9.207	9.048	5.361	14.674	1.713	1653
ROA	0.050	0.051	-1.217	0.555	0.081	1653
LOSS	0.106	0	0	1	0.309	1653
MTOB	2.982	1.884	-84.857	759.589	20.270	1535
ICW	0.010	0	0	1	0.101	1653
HITECH	0.247	0	0	1	0.432	1653

Empirical Results

Univariant Analysis

I conduct a univariant analysis to examine the impact of different types of data breach on CIO turnover. Table 21 suggests that when there is a system glitch, 25.9% of firm-year observations have a CIO turnover while when there is no system glitch, 13.2% of firm-year observations have a CIO turnover. T-test shows that the difference in the proportion of CIO turnovers between system glitch years and no system glitch years is statistically significant, indicating that there is a higher likelihood of CIO turnover when system glitch occurs. However, I do not find such difference for other types of data breach, consistent with my expectation from H6.

Table 20
Variable Correlation Matrix

	TURNOVER$_1$	*TURNOVER$_2$*	*BREACH*	*SYSGLITCH*	*CRIMINAL*	*HUMANERR*	*OTHER*	*CIOPOWER*	*BOARD SIZE*	*CEO TURNOVER*	*CFO TURNOVER*	*FIRM SIZE*	*ROA*	*LOSS*	*MTOB*	*ICW*
TURNOVER$_2$	0.73	1.00														
	0.00															
BREACH	0.02	0.02	1.00													
	0.50	0.45														
SYSGLITCH	0.07	0.05	0.56	1.00												
	0.01	0.03	0.00													
CRIMINAL	-0.01	-0.02	0.65	0.14	1.00											
	0.78	0.49	0.00	0.00												
HUMANERR	0.01	-0.01	0.52	0.05	0.05	1.00										
	0.80	0.80	0.00	0.04	0.03											
OTHER	-0.02	0.00	0.31	0.08	0.04	0.13	1.00									
	0.35	0.94	0.00	0.00	0.13	0.00										
CIOPOWER	-0.02	-0.01	-0.07	-0.02	-0.06	-0.04	-0.02	1.00								
	0.54	0.56	0.01	0.33	0.02	0.12	0.37									
BOARDSIZE	0.02	0.04	0.09	0.09	0.04	0.07	0.02	0.13	1.00							
	0.32	0.09	0.00	0.00	0.08	0.00	0.36	0.00								
CEO TURNOVER	0.09	0.06	0.06	0.06	0.00	0.04	-0.02	0.03	0.07	1.00						
	0.00	0.02	0.01	0.01	0.84	0.13	0.54	0.27	0.00							
CFO TURNOVER	0.06	0.06	0.00	0.00	0.01	0.00	-0.03	-0.01	-0.01	0.08	1.00					
	0.02	0.02	0.97	0.97	0.62	0.96	0.30	0.74	0.80	0.00						
FIRMSIZE	0.05	0.07	0.25	0.18	0.17	0.12	0.11	0.03	0.56	0.04	0.03	1.00				
	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.10	0.29					
ROA	0.00	0.00	-0.03	-0.03	-0.02	-0.04	0.01	-0.03	-0.06	-0.06	-0.09	-0.05	1.00			
	0.86	0.91	0.19	0.27	0.52	0.08	0.59	0.22	0.02	0.01	0.00	0.04				
LOSS	-0.01	0.00	-0.02	-0.01	-0.02	-0.01	-0.02	0.03	-0.02	0.11	0.09	-0.05	-0.55	1.00		
	0.82	0.98	0.37	0.74	0.52	0.63	0.52	0.29	0.52	0.00	0.00	0.05	0.00			
MTOB	-0.01	-0.02	-0.01	-0.01	-0.01	-0.01	0.00	0.02	0.00	-0.01	-0.01	0.01	0.03	-0.03	1.00	
	0.70	0.50	0.64	0.74	0.81	0.72	0.94	0.47	0.98	0.69	0.77	0.70	0.18	0.30		
ICW	-0.01	-0.01	-0.01	-0.02	0.01	-0.02	-0.01	-0.01	-0.03	0.02	0.04	-0.06	-0.03	0.04	0.00	1.00
	0.82	0.61	0.58	0.45	0.76	0.48	0.67	0.77	0.18	0.33	0.08	0.01	0.16	0.08	0.86	
HITECH	0.03	0.04	-0.01	-0.01	0.00	0.01	0.00	-0.12	-0.19	-0.04	0.01	-0.08	0.10	-0.06	-0.01	0.04
	0.22	0.11	0.80	0.66	0.96	0.64	0.91	0.00	0.00	0.11	0.73	0.00	0.00	0.02	0.79	0.11

Table 21
Univariate Analysis - Proportion of CIO Turnover by Types of Data Breach

No Breach (1)	System Glitch (2)	Criminal Attack (3)	Human Error (4)	Others (5)	(1)-(2)	(1)-(3)	(1)-(4)	(1)-(5)
0.132	0.259	0.125	0.149	0.059	-0.127** (0.020)	0.012 (0.613)	-.0132 (0.403)	0.078 (0.897)

Logit Regression

Empirical results in Table 22 show that there is an insignificantly positive relationship between *BREACH* and *TURNOVER*, suggesting that CIOs are not likely to turnover following general data breach incidents. Therefore, H1 is not supported. Future investigation in Table 23 shows that what really determines CIO turnover is the type of data breaches. My empirical results suggest that, with everything else being equal, the likelihood of CIO turnover within one (two) year(s) is about 2 (1.22) times higher when there is a system glitch, compared to when there is no system glitch (Column 4 and 5 in Table 23). In addition, it is suggested that the impact of system glitch on CIO turnover is insignificant after two years of breach by Colum (6) in Table 23, indicating a limited lasting effect. This is consistent with my expectations in H7 since CIOs are directly held accountable for establishing an effective IT systems without glitches. When they fail to meet such performance expectation, they are more likely to turnover.

Table 23 also shows that CEO/CFO turnover at the year of breach has a significant impact on increasing the likelihood of CIO turnover. This is consistent with prior literature that suggests subsequent departure of other TMT member following corporate governance regime change (Barron et al. 2011). Banker et al. (2011) suggested that CIOs work closely with CEOs and CFOs to implement firm's strategic initiatives. My results show that when

there is a CEO (CFO) turnover, the likelihood of CIO turnover within one year increases by 95% (72%), compared to when there is no CEO (CFO) turnover. Similar to data breach, the influence of CEO (CFO) turnover on CIO turnover becomes insignificant after two years.

Table 22
Empirical Results on CIO Turnover and Data Breach

$$logit(TURNOVER) = BREACH + CIOPOWER + BOARDSIZE + FIRMSIZE + ROA + LOSS + MTOB + ICW + HITECH + TURNOVER_{CEO} + TURNOVER_{CFO} + YEAR\ DUMMY + INDUSTRY\ DUMMY + \varepsilon$$

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	**$TURNOVER_1$**	**$TURNOVER_2$**	**$TURNOVER_3$**	**$TURNOVER_1$**	**$TURNOVER_2$**	**$TURNOVER_3$**
BREACH	0.117	0.001	-0.120	0.061	-0.025	-0.129
	(0.669)	(0.998)	(0.596)	(0.826)	(0.915)	(0.568)
CIOPOWER	-0.075	-0.113	-0.136	-0.089	-0.121	-0.139
	(0.714)	(0.508)	(0.398)	(0.666)	(0.478)	(0.390)
BS	0.048	0.060	0.063*	0.047	0.060	0.063*
	(0.282)	(0.112)	(0.081)	(0.295)	(0.111)	(0.079)
FIRMSIZE	0.063	0.129**	0.188***	0.062	0.130**	0.188***
	(0.400)	(0.035)	(0.001)	(0.409)	(0.035)	(0.001)
ROA	-0.439	0.041	0.501	-0.345	0.122	0.542
	(0.718)	(0.967)	(0.605)	(0.782)	(0.904)	(0.577)
LOSS	-0.221	0.069	0.056	-0.379	-0.019	0.015
	(0.519)	(0.800)	(0.827)	(0.279)	(0.944)	(0.953)
MTOB	-0.002	-0.005	-0.008	-0.002	-0.005	-0.008
	(0.784)	(0.626)	(0.444)	(0.812)	(0.639)	(0.445)
ICW	-0.432	-0.867	-0.393	-0.571	-0.976	-0.426
	(0.604)	(0.256)	(0.551)	(0.504)	(0.213)	(0.522)
HITECH	0.132	0.120	0.231	0.143	0.119	0.229
	(0.639)	(0.603)	(0.297)	(0.616)	(0.612)	(0.301)
$TURNOVER_{CEO}$				0.720***	0.394*	0.170
				(0.002)	(0.055)	(0.403)
$TURNOVER_{CFO}$				0.541***	0.477***	0.263
				(0.009)	(0.007)	(0.133)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-2.991**	-3.755***	-4.185***	-3.088**	-3.858***	-4.246***
	(0.041)	(0.002)	(0.000)	(0.037)	(0.001)	(0.000)
Observations	1,432	1,432	1,428	1,432	1,432	1,428

* p-value in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 23
Empirical Results on CIO Turnover and Data Breach Types

$$logit(TURNOVER) = SYSGLITCH + CRIMINAL + HUMANERR + OTHER + CIOPOWER + BOARDSIZE + FIRMSIZE + ROA + LOSS + MTOB + ICW + HITECH + TURNOVER_{CEO} + TURNOVER_{CFO} + YEAR\ DUMMY + INDUSTRY\ DUMMY + \varepsilon$$

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	**$TURNOVER_1$**	**$TURNOVER_2$**	**$TURNOVER_3$**	**$TURNOVER_1$**	**$TURNOVER_2$**	**$TURNOVER_3$**
SYSGLITCH	1.231***	0.862**	0.547	1.123***	0.801**	0.519
	(0.001)	(0.015)	(0.117)	(0.004)	(0.024)	(0.139)
CRIMINAL	-0.582	-0.590	-0.344	-0.573	-0.592	-0.342
	(0.189)	(0.115)	(0.312)	(0.198)	(0.117)	(0.317)
HUMANERR	0.017	-0.551	-0.616	-0.069	-0.594	-0.623
	(0.972)	(0.211)	(0.130)	(0.889)	(0.183)	(0.127)
OTHER	-1.110	0.034	0.390	-1.000	0.089	0.409
	(0.307)	(0.959)	(0.514)	(0.355)	(0.890)	(0.494)
$TURNOVER_{CEO}$				0.671***	0.365*	0.147
				(0.004)	(0.077)	(0.471)
$TURNOVER_{CFO}$				0.543***	0.480***	0.263
				(0.009)	(0.007)	(0.134)
CIOPOWER	-0.084	-0.131	-0.146	-0.100	-0.141	-0.148
	(0.686)	(0.443)	(0.369)	(0.629)	(0.411)	(0.360)
BOARDSIZE	0.043	0.057	0.063*	0.042	0.058	0.064*
	(0.344)	(0.134)	(0.078)	(0.357)	(0.128)	(0.075)
FIRMSIZE	0.052	0.131**	0.183***	0.051	0.132**	0.183***
	(0.490)	(0.034)	(0.002)	(0.498)	(0.034)	(0.002)
ROA	-0.456	-0.038	0.422	-0.345	0.045	0.464
	(0.710)	(0.970)	(0.663)	(0.785)	(0.965)	(0.633)
LOSS	-0.256	0.044	0.040	-0.403	-0.040	0.003
	(0.458)	(0.871)	(0.874)	(0.252)	(0.884)	(0.992)
MTOB	-0.002	-0.005	-0.008	-0.002	-0.004	-0.008
	(0.786)	(0.630)	(0.456)	(0.816)	(0.643)	(0.458)
ICW	-0.393	-0.835	-0.396	-0.525	-0.940	-0.429
	(0.634)	(0.268)	(0.547)	(0.534)	(0.224)	(0.518)
HITECH	0.118	0.114	0.239	0.131	0.113	0.238
	(0.677)	(0.625)	(0.283)	(0.648)	(0.631)	(0.286)
Constant	-2.732*	-3.707***	-4.121***	-2.830*	-3.815***	-4.185***
	(0.064)	(0.002)	(0.000)	(0.057)	(0.002)	(0.000)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.043	0.057	0.082	0.056	0.064	0.083
Prob>Chi2	0.601	0.002	0.000	0.175	0.000	0.000
Observations	1,432	1,432	1,428	1,432	1,432	1,428

*p-value in parentheses; *** p<0.01, ** p<0.05, * p<0.1

CHAPTER 6

CONTRIBUTION

First, this dissertation re-examines whether appointing CIOs adds value to a firm's market value and proposes an alignment framework between firm strategic positioning and CIO educational background, following the research of Banker et al. (2011) and extending the model of Chatterjee et al. (2001). This is the first study that links the CIO's educational background at the undergraduate level to the firm's strategic positioning and suggests that the education and knowledge obtained by CIOs in college effectively have underlying, profound influence on their future problem-solving and leadership style. It also builds on prior CIO appointment research by looking into what the stock market really cares in the post SOX period when CIO appointments are expected by investors. The predictive model examines the actual CIO appointment choices in terms of the CIO's background (technical or business) based on the firm's realized (actual) strategic positioning and develops a model to predict which CIO is likely to be hired by firms with a differentiation or a cost leadership strategy. The normative model, by introducing the notion that CIO appointments are contingent on the firm's strategic positioning, examines the market reactions to aligned firms that have their CIO's background matched with their strategic positioning. Hence, building upon contingency theory, I extend the literature on investors' reactions to CIO appointment announcements and highlights the strategic role of the CIO after the enactment of the SOX Act of 2002 and IT spending recovery after the dot.com bust.

Second, this dissertation extends existing executive compensation to CIOs following SOX. Despite that compensation is identified as a critical strategy to attract and retain competent CIOs, there are limited studies on determinants of CIO compensation

(Richardson et al. 2014; Yayla and Hu 2008; Ranganathan and Jha 2005; Ang et al. 2002). Although prior studies have examined determinants of CEO compensation in IT firms (Talmor and Wallence 1998), compensation strategies for top IT executives in IT and non-IT firms (Anderson et al. 2000), human capital and institutional determinants of lower-level IT professionals (Ang et al. 2002), it is not clear that whether the indicators of non-CIO compensation significantly determine the compensation of CIOs who are high level IT executives leading and managing strategic IT resmyces. This study capitalizes on a large dataset that contains 962 CIOs' individual characteristics and detailed compensation for a sample period of 2002-11 and finds that indicators from three broad perspectives (CIO, firm and industry characteristics) are significant determinants for CIO compensation. I also extend *Agency* theory to CIO compensation by examining s*alary* (the fixed component) and *bonus* (the variable component) separately due to their distinct roles in rewarding and incentivizing CIOs. Since salary and bonus are two distinct components of total compensation, I expect that their determinants will vary based on what they capture. Banker et al. (2013) argue and find that CEO's salary component is a reflection of their *ability* signals whereas CEO's bonus component is used to reward *effort* (Banker et al. 2013). Building upon prior studies, I expect and document that CIO educational and personal characteristics (signals of CIO ability) are more significantly associated with CIO salary whereas firm financial performance (signals of CIO effort) are more significantly associated with CIO bonus. This is consistent with Finkelstein and Hambrick (1989) and Banker et al. (2013)'s argument that salary reflects ability whereas bonus rewards effort.

Third, this dissertation connect executive turnover literature that examine the association between expected financial performance and CEOs/CFOs turnover (Haislip et

al 2013; Klamm et al., 2012; Stoel and Muhanna 2011; Li et al 2010; Klamm and Watson 2009) to CIOs who are directly held accountable for the performance of IT system. When IT systems fail, confidential data are potentially subject to be exposed or misused, jeopardizing organizational goals and shareholders' value (Kwon et al. 2013; Acquisti et al. 2006). Due to the high cost of data breaches (IBM and Ponemon 2014), CIOs face the direct pressure from boards and shareholders and hence may suffer unfavorable consequences upon occurrence of a data breach. Therefore, it is important for firms and CIOs to understand the impact of data breach on subsequent CIO turnover.

Further research can explore whether the desired competency and the role of CIOs vary in different stage of a business, i.e. start-ups, fast-growing firms, mature firms, and exiting firms. If so, when is best for the firm replace their CIO based on their business cycle and when is best for the firm to keep their CIO and allow them grow with the business? Furthermore, it is interesting to examine different roles of CIOs when IT is mainly build in-house and when IT is mainly outsourced and what kind of competency of CIOs is required by the two different types of firms.

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