WHEN DO CIOS MATTER? THE INFLUENCE OF CIO PRESENCE IN TMT AND SHARED DOMAIN KNOWLEDGE ON FIRM PERFORMANCE

by

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(Under the Direction of Amrit Tiwana)

ABSTRACT

It is broadly believed that Chief information officers (CIO) should be formal members of their firms' top management teams (TMT) for information systems to have a valuable contribution towards a firm's performance. The CIO presence in the TMT promises several important benefits for the CIO position itself, and for IT and the firm in general. However, this belief is problematic. CIO presence does not always yield good business outcomes. Historically, the CIO position is not a core function in the TMT. Many CIOs lack the business background necessary to be part of the C-suite. This is mainly due to the dominance of knowledge specialization at the top level. Moreover, in the last few years, CIOs have been facing new pressures and uncertainties due to evolutions in the technology landscape and new organizational demands for digitalization and transformation.

In this dissertation, we theoretically propose that for the CIO to generate valuable organizational contributions, the CIO presence in the TMT is not enough. There should overlap in domain knowledge between CIOs and TMT executives to elevate CIO presence impact. More specifically, we propose that TMT digital savviness will augment the contribution of CIO business savviness on relative firm performance for those CIOs who are part of the TMT. To achieve that, we study two ideas related to the impact of the CIO presence. First, we directly examine the CIO presence in the TMT impact on relative firm performance. Second, we examine how to increase the CIO presence impact on relative firm performance by proposing that TMT digital savviness will augment the CIO's business savviness impact on relative firm performance. Data about public U.S. firms in the period 2015-2018 were collected and analyzed by utilizing a lagged cross-sectional design and using econometric techniques.

The results show that the CIO presence has a negative impact on relative firm performance. However, for those CIOs in the TMT, their business savviness impact on relative firm performance is augmented with high TMT digital savviness. Such an impact is only significant when CIO business savviness is low. Our findings challenge the IS field's current dominant view that the CIO presence would result in positive outcomes and show that TMT executives should be digitally savvy for CIOs to show greater influence. Moreover, we show how to measure the CIOs and TMTs shared domain knowledge using archival data. We theoretically contribute to the knowledge-based view of the firm, knowledge specialization, and the information processing perspective.

INDEX WORDS: Chief information officer, Top management team, Relative firm performance, Shared domain knowledge, CIO business savviness, TMT digital savviness

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For my father Harbi Shawosh, mother Refaa Ramzi, and son Muthanna.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background and Motivation

The increased dependence on information systems (IS) by firms not only as a source of competitive advantage but as a competitive necessity has made Information Systems (IS) leadership a central concern in both practice and academia. With IT investments accounting for around 50% of capital investments(Heller, 2016), firms want to extract competitive advantages from these investments to outperform their rivals. However, extracting a competitive advantage from IT is not a trivial task. Firms' archrivals are also investing in IT to achieve a competitive advantage. When firms in the same cohort of rivals compete in continuous IT investments, a vicious cycle of the Red Queen effect occurs, punishing those who slow down or slip (Tiwana, 2017). Moreover, the recent COVID-19 pandemic is causing unprecedented disruption, leading many firms to accelerate digitization and the adoption of digital technologies and innovations. In contrast, many other firms are either struggling or failing. It is imperative, therefore, that firms understand how to use IT strategically to create a valuable, rare, and imperfectly imitable competitive advantage. Excellent management and leadership of IS are important complementary resources that firms need to create business value out of IS assets and capabilities (Mata et al., 1995; Wade & Hulland, 2004).

IS leadership is mainly about planning, managing, and implementing IS-related resources and strategies at all organizational levels. The research stream on the leadership of IS at the executive level is known as IS strategic leadership. It is concerned with IT executives' (i.e., Chief Information Officers "CIOs") roles, effectiveness, relationship with Top Management Team

(TMT), and their impact on organizational performance (Karahanna & Watson, 2006). The CIO is the highest IT executive in a firm responsible for making strategic decisions related to the firm's information systems (Karahanna & Preston, 2013). An essential aspect of IS strategic leadership is the IT executive's membership in the firm's top management team (TMT). Over around twenty years, scholars have been championing the idea that for information systems to have a valuable contribution towards a firm's financial performance and future business prospects, the IT executive should be a formal member of the TMT (Armstrong & Sambamurthy, 1999; Chan et al., 2006; Chen et al., 2010; Karahanna & Preston, 2013; Lim et al., 2013; Preston & Karahanna, 2009; Smaltz et al., 2006).

However, IT executives confront many challenges that might put their careers at stake or reduce their effectiveness as members of the TMT. IT executives are frequently fired. It is reported that one-quarter of CIOs are fired due to poor performance, especially in large organizations (Nash, 2009). Even if a senior IT executive is present in the firm, this does not guarantee a formal membership in the TMT (McCormack, 2014). Some practitioners claim that the CIO position is becoming irrelevant or, even worse, dying out (Darrow, 2015; Kretzman, 2012). Moreover, with firms becoming more data-driven and digitally enabled, IT is no longer in the back office. Business units, such as marketing, use different technologies (e.g., analytical tools, social media) more frequently. This might create tension and conflict between IT executives and other executives like the CMO regarding the responsibilities and control of these technologies and data (Sleep & Hulland, 2019).

With all these challenges, is the IT executive membership in TMT still valuable? We aim to address this question in two parts. The first part relates to studying the contribution of the IT executive's TMT membership on relative firm performance. The second part extends the previous idea and looks at how the CIO TMT membership's contribution and effectiveness can be enhanced. We present domain knowledge overlap between business executives and IT executives as an essential factor influencing the relationship between IT executive membership in TMT and relative firm performance.

As IT investments take time to materialize and create visible impact (Bharadwaj, 2000; Bharadwaj et al., 1999), so does the CIO TMT membership. When being a member in the TMT, the CIO gains structural power and can have a holistic view of the firm problems, strategies, and opportunities as the CIO officially engages with the CEO and executives from different functions (Chen et al., 2010; Lim et al., 2013; Preston & Karahanna, 2009). This increases the CIO's opportunities to enhance both the short-term (e.g., operational) and long-term (e.g., strategic) benefits and contribution of IT. Concerning short-term benefits, membership in TMT allows the CIO to support the needs of business units with IT solutions, refine current IT competencies and resources to achieve operational efficiency, and enhance the assimilation of IT into the firm's day-to-day business activities (Armstrong & Sambamurthy, 1999; Chen et al., 2010). CIO membership in the TMT can also help in enhancing the firm's future performance potential. The CIO can establish a shared understanding with the business executives regarding IT's strategic role to the firm (Preston & Karahanna, 2009). With such a shared understanding, IT strategies will likely be more aligned with business strategies (Liang et al., 2017; Preston & Karahanna, 2009). Moreover, TMT membership will increase the CIO's ability to lead business growth, innovation, and transformation by exploring IT-driven innovations and opportunities (Chen et al., 2010). Membership in the TMT can also make the CIO more effective in increasing IT contribution to a portfolio of intangible assets such as better customer services, higher quality in products and services, and better coordination with suppliers (Bharadwaj et al., 1999). Thus, CIO membership in TMT can help firms survive the present and think strategically about how IT can play a role in the firm's evolving competitive landscape. Accordingly, we present the first research question: (**RQ1**) ***How does CIO presence in the TMT influence relative firm performance***?

The division of labor and specialization have many benefits to firms. Employees specialize by dividing the work into tasks, working on specific subsets of tasks, and cooperating to produce a common product, hence maximizing the productivity of the specialist employees (Becker & Murphy, 1992). These employees invest in specialized knowledge and capabilities that make them more productive. Such division of labor and specialization have been the dominant principle to design firms for the last several centuries (Becker & Murphy, 1992).

Specialization at the firm's executive level is also evident. Over the last thirty years, the size of the executive team has grown from around five executives in the late 1980s to around 10 in the mid-2000s (Guadalupe et al., 2014). This increase is attributed to the increase in the number of specialized functional executives who manage corporate-level functional activities like marketing, HR, and R&D to harness synergies and coordinate activities across the firm's different business units (Guadalupe et al., 2014; Menz, 2012).

However, specialization among employees can exacerbate the chances of poor coordination (Becker & Murphy, 1992). In other words, when employees become more specialized in knowledge – with no or limited overlap of knowledge – communication among the employees and coordination of the task that requires information exchange can become more difficult. Problems of specialization can be more serious in the firm's top management and the strategic leadership of IT. In the case of perfect specialization, IT executives are technically savvy but lack the depth of business domain knowledge, and TMT executives focus on their domain knowledge and possess no IT-related knowledge. Such a situation might result in information asymmetries and create challenges in IT leadership.

Nevertheless, over the years, as IT became more strategic and assimilated into every aspect of modern organizations, both IS scholars and practitioners have been emphasizing that IT leadership should be a shared responsibility between both TMT executives and IT executives (Bassellier et al., 2003; Doll, 1985; Rockart et al., 1996). This IT leadership interdependence means that business executives should possess IT-related knowledge and experience, and IT executives should have business-related knowledge. Such knowledge overlap is valuable because it helps reduce information asymmetries, enhances communication and idea exchange, and facilitates better understanding regarding the strategic role and contribution of IT to the firm (Preston & Karahanna, 2009; Ranganathan & Sethi, 2002).

Papers studying executives' business-IT knowledge overlap assume that the two sides should equally know each other's domain knowledge and that high symmetry in knowledge overlap is valuable (Chen et al., 2010; Nelson & Cooprider, 1996; Preston & Karahanna, 2009; Ranganathan & Sethi, 2002). However, this view obscures valuable nuances that knowledge overlap can be asymmetrical and, depending on the levels of the two types of domain knowledge, there can be different impacts. Moreover, these studies did not look at how each dimension can enhance or limit the other dimension's impact.

Hence, in this study, we extend the prior conceptualization of domain knowledge overlap (i.e., shared domain knowledge). We add theoretical nuances by presenting knowledge overlap as an interaction of the two dimensions (i.e., business executives digital savviness and IT executives business savviness). Specifically, for CIO who are members of the TMT, we investigate how TMT digital savviness can augment the impact of CIO business savviness on relative firm performance.

We propose that high TMT digital savviness will facilitate the work of the IT executive as part of the TMT, leading to better relative firm performance. Accordingly, we present the second research question: (**RQ2**) ***How does TMT digital savviness enhance the impact of CIO business savviness on relative firm performance for those CIOs in the TMT***?

### 1.2 Dissertation Objectives

The dissertation has three objectives. First, we focus on studying the impact of CIO membership in TMT on relative firm performance. Second, we delve deeper into the concept of domain knowledge overlap between business executives and the CIOs and add theoretical nuances by theorizing how TMT digital savviness influence CIO business knowledge impact. Thus, the relationship between the first and second objectives is about expanding our understanding of how the contribution of CIO membership in TMT to relative firm performance will be dependent on the interaction of shared domain knowledge dimensions. Third, we present measures of domain knowledge overlap using firm's and TMT archival data for U.S. public firms and use statistical techniques to address the endogenous nature of CIO membership in TMT.

### 1.3 Roadmap of the Dissertation

To address the two research questions, we collected financial, executive-level, board-level, and CIO-related data for 1,146 U.S. public firms. For the first research question, we utilized several econometric techniques to estimate the relationship between the CIO presence in the TMT and relative firm performance. The findings show that the CIO presence is significant but negatively related to relative firm performance. Although surprising, we provide justifications for such results. Advanced econometric techniques (i.e., two-stage treatment effects model) allowed us to have the following interesting results. Even though firms have CIOs in their TMT with the intention to leverage IT investments and gain positive outcomes, they are still penalized by the market due to IT fast evolution and the new technological advances. Nevertheless, firms that have the CIO to the TMT when they should not have (i.e., over-presence) will still be rewarded in the form of better market reaction and long-term valuation compared to competitors in the same sector. By self-selecting to over-present CIOs to the TMT, firms try to convey signals to the shareholders, market, and competitors about the commitment to improving IS management capabilities and increasing the role and importance of IT.

For the second research question, we look at how TMT digital savviness influences the relationship between CIO business savviness and relative firm performance. We find that for CIOs who are part of the TMT, higher TMT digital savviness amplifies the impact of CIO business savviness on relative firm performance when CIO business savviness is low. However, when CIO business savviness is high, TMT digital savviness has no impact. By answering the second research question, we attempt to add theoretical nuances to how the CIO presence can create value for the firm.

We argue that our study has several theoretical and practical contributions. From a theoretical standpoint, we continue with the core of IS strategic leadership research stream. Namely, we attempt to understand and inform how CIOs influence their firms and impact organizational value creation. We provide an extension to understand how the dimensions of shared domain knowledge interact and, hence, see how such a knowledge integration structure functions and leads to beneficial impact. From a practical perspective, we identify and discuss how different shared domain knowledge levels can benefit firms. These knowledge overlap profiles between the CIO and TMT can help guide firms in positioning themselves and evaluate their knowledge sharing practices to harness the best outcomes.

This dissertation is divided into six chapters, beginning with this introductory chapter. Chapter 2 presents the literature review of the IS strategic leadership literature. This chapter provides an overview of the literature, details on the theories used in studies to argue for the CIOs and how they impact their organizations, and a detailed discussion of the literature organized in themes. Chapter 3 develops the theoretical logic for the hypotheses. The first hypothesis predicts the impact of CIO membership in TMT on relative firm performance. For the second hypothesis, I first present shared domain knowledge and its dimensions. Then, I discuss how TMT digital knowledge moderates the relationship between CIO business savviness and relative firm performance for those CIOs who are part of the TMT. Chapter 4 describes the research methodology that is adopted to test each hypothesis. Here, I describe the sampling frame and sample, data collection steps and sources, pre-processing plan of the data, operationalization of the dependent, independent, moderator, and control variables, proposed analysis techniques, and potential limitation of the proposed study design. In chapter 5, we present the results of the hypothesis testing. Finally, in chapter 6, we discuss the findings, elaborate on the theoretical implication, practical implication, study limitation, and future research.

# CHAPTER 2

# LITERATURE REVIEW

In this chapter, we present the prior studies in the IS strategic leadership literature. Specifically, the chapter includes: (1) what is information systems strategic leadership, (2) theories used in the literature to argue for CIOs and their organizational impact, and (3) a detailed discussion of the literature organized in themes.

## 2.1. IS Strategic Leadership

This study falls under the IS strategic leadership research stream (Karahanna & Watson, 2006), which focuses on IT executives at firms' top management levels and their roles, impact, and contribution to firms' strategic decision making. The title commonly used to refer to senior IT executives is the Chief Information Officer (CIO). Formally, the CIO is the highest IT executive in a firm who is responsible for making the strategic decisions related to the firm's information systems (Karahanna & Preston, 2013). The CIO position emerged in the 1980s (C. Stephens & Loughman, 1994) as a result of the increased use of IT in firms. Technology evolved over time and so did the roles, responsibilities, and importance of the CIO (Chun & Mooney, 2009), from a manager handling operational and tactical issues, to a key player in organizational strategy formation and execution, and business digital transformation.

The IS researchers have studied the CIO from various perspectives, creating the IS strategic leadership research stream. Early works focused on understanding the CIO and what makes such position unique compared to others in the TMT. Studies investigated the CIO role (Applegate &

Elam, 1992; Grover et al., 1996), relationships with the CEO and TMT (Armstrong & Sambamurthy, 1999; Feeny et al., 1992; Johnson & Lederer, 2005), effectiveness (Salancik & Pfeffer, 1974; Smaltz et al., 2006), characteristics and behaviors (Enns et al., 2003; Y. P. Gupta, 1991; C. S. Stephens et al., 1992), CIO and IS-business strategy alignment (Karimi et al., 1996), and CIO organizational impact (Chatterjee et al., 2001; Raghunathan & Raghunathan, 1989).

Recent studies show an enduring emphasis on the same topics, and attention on additional new topics such as CIO compensation (Yayla & Hu, 2014), IT governance (Jewer & McKay, 2012; Wu et al., 2015), CIO and IT-related deficiencies and security breaches (Benaroch & Chernobai, 2017; Masli et al., 2016; Zafar et al., 2016), and the CIO relationship with new technology-related executives (Singh & Hess, 2017; Tumbas et al., 2017). These recent studies are more rigorous, theoretically based, and empirical in nature.

### 2.2. Theories Used in the Literature

Several theories have been utilized in the IS strategic leadership literature. These theories range from economic theories like agency theory and transaction cost economics to theories from sociology such as social capital and institutional theory to theories from management like the upper echelon theory and the resource-based view of the firm. These theoretical lenses allow for a better understanding of the CIOs and their contribution to the firms (Karahanna & Watson, 2006). Under this section, we provide a brief discussion of the theories and how they are utilized in the literature. Table 2.1 lists these theories, their core ideas, and the IS papers that used these theories.

**Table 2.1: Theories Used in the IS Strategic Leadership Studies**

| Theory/Perspective | Core Idea | Example of IS studies |
|---|---|---|
| Agency Theory | An agency problem occurs when the agent has incongruent goals with the principal and when it is difficult to monitor the agent's behavior. Mechanisms are established to minimize the principal-agency problem. | Benaroch & Chernobai (2017)<br>Dawson et al. (2016)<br>Karake (1992, 1995)<br>Pang et al. (2016) |
| Transaction Cost Economics | Based on coordination and transaction costs, a firm should produce using hierarchies, the market, or other forms of production. Transaction costs are the costs of pre-contractual and post-contractual activities. | Ang & Straub (1998)<br>Aubert et al. (2004)<br>Pang et al. (2016) |
| Resource Dependence Theory | Firms are viewed as coalitions linked to each other based on resources exchange. Firms try to reduce interdependencies and uncertainties of their environments. | Benaroch & Chernobai ((2017)<br>Grover et al. (1996)<br>Jayatilaka et al. (2003) |
| Social Capital Theory | Ties and relationships among actors in networks are important for receiving valuable resources and benefits and facilitating actions. | Karahanna & Preston (2013)<br>Wasko & Faraj (2005) |

| | | |
|---|---|---|
| Human Capital Theory | Individuals' learning capabilities, skills, and experience are as important as other types of capital and are involved in goods and services production. | Chen et al. (2010)<br>Joseph et al. (2015)<br>Mithas & Krishnan (2008a) |
| Institutional Theory | Firms take actions that are considered legitimate practices in their perspective environments to gain cultural support or achieve organizational legitimacy. | Lim et al. (2013)<br>Wang (2010) |
| Upper Echelon Theory | Firms, their outcomes, and their strategic decisions are reflections of the characteristics of firms' top executives. | Karahanna & Preston (2013)<br>Preston & Karahanna (2009) |
| Resource-Based View | A firm's resource is said to generate a competitive advantage if it is valuable, rare, imitable, and non-substitutable. | Bharadwaj (2000)<br>Wade & Hulland (2004)<br>Wu et al. (2015) |
| Organizational Learning | Firms can leverage and use their resources, knowledge, and competencies by following two distinct paths of learning: exploitation and exploration. | Chen et al. ((2010)<br>Mithas et al. (2011)<br>Nazir & Pinsonneault (2012) |

| | | |
|---|---|---|
| Coordination Theory | The achievement of integration of interdependent tasks among organizational units and under uncertainty through the use of coordination mechanisms. | Kudaravalli & Faraj (2008)<br>Liang et al. (2017) |
| Power | Power is defined as the ability of a firm's subunits and individuals to influence other subunits and people, and the capacity to influence a firm's outcomes. | Chen et al. (2010)<br>Lim et al. (2013)<br>Preston et al. (2008) |
| Organizational Inertia | Firms' tendency to continue in the same status quo and escalate the commitment to the current structures and strategies. | Liang et al. (2017)<br>Seddon et al. (2010) |

### 2.2.1 Agency Theory

Agency theory revolves around the idea of goal incongruence between an agent and a principal (Tiwana & Bush, 2007). It is proposed to understand the principal-agent problem due to the information asymmetry where the agent has private information that the principal can only get with added effort and cost.

Agency theory (Alchian & Demsetz, 1972; Jensen & Meckling, 1992) proposes mechanisms to reduce two problems that happen in agency relationships, in which principals delegate work to agents: (1) agency problem, and (2) risk preference (Eisenhardt, 1989). The first problem is related to the goal and desire conflict between the principal and agent, as it is difficult for the principal to verify the appropriateness of the agent's actions. Because of the information asymmetry, principals (e.g., shareholders) face difficulty verifying what agents are doing. At the same time, agents (e.g., managers) can have private information, behave in self-interest, and act opportunistically to maximize their utilities against the desires of the principals (Dawson et al., 2016; Jensen & Meckling, 1976). When there is a divergence in goals between agents and principals, monitoring and identifying the behaviors of agents become costs for principals.

The second problem is concerned with the difference in risk-taking preferences between principles and agents (Eisenhardt, 1989). The principal might prefer different actions than the agent due to differences in risk-taking attitude. The principal-agent relationship is governed by coming up with "the most efficient contract" given certain factors such as information asymmetry, certainty and measurability of outcomes, and risk aversion (Eisenhardt, 1989, p. 58). Here, contracts can be outcome-based contracts or behavior-based contracts. The objective of contracts is to reduce conflict in goals by limiting agents' opportunism and self-interest. Governance structure is another mechanism that is used to manage agents' opportunism (Dawson et al., 2016; Jensen & Meckling, 1976). Here, principals create structures to monitor and oversee agents' actions "to ensure they are acting to maximize value to the shareholders" (Dawson et al., 2016, p. 1184).

Agency theory is one of the first theories used in the IS strategic leadership research stream to theorize about the factors related to the presence of a CIO position in the TMT (Karake, 1992, 1995). Agency theory emphasizes the importance of information systems to align the agents' goals to those of the principals. When there is an increase in the equity ownership (i.e., an outcome-based contract), agents tend to exercise tighter control over the firm's operations (Jensen & Meckling, 1976) and require timely information to perform such control. Thus, an information agent (i.e., CIO) becomes important to help top executives receive the needed information (Karake, 1992). Moreover, as the number of independent directors increases, the need for a CIO position in the TMT also increases. The board of directors acts as a mechanism that reduces the opportunism and self-interest of executives. They monitor the work and decisions made by executives to ensure their alignment with shareholders' interests. The board's composition is important since some board members are inside executives (e.g., CEOs) who might pursue self-interest. With outside board members, better control and monitoring can be exercised. Those outside board members require accurate and timely information (Benaroch & Chernobai, 2017) since they are not directly involved in the firm's operations (e.g., IT operations and others). The more the proportion of outside board members, the higher the need for an information agent to provide the required information for better decisions (Karake, 1995). Both equity ownership of the firm's executives and the board composition were associated with the CIO's presence in the TMT.

According to the agency theory thinking, the board of directors exercises IT Governance (henceforth ITG) monitoring function to reduce any chances of business failures and inefficiencies in managers' actions and decisions with regard to IT investments, IT contribution, and IT threats

(Benaroch & Chernobai, 2017; J. L. Y. Ho et al., 2011). The presence of a CIO in the TMT is considered an ITG monitoring mechanism to ensure designing IT resources controls, recognize what are the risky IT resources, deliver secure IT services, and ensure the implementation and adherence of IT resources controls (Benaroch & Chernobai, 2017). The CIO presence in TMT is a determinant of the board IT competency by allowing the board to have better and informed involvement in IT governance, and to reduce IT failures (e.g., data breaches). When the firm's market value negatively changes due to IT failures, this signals a weakness in the board's ability to govern IT and that the firm should change to regain the investors' confidence. One main result of such change is CIO turnover (Benaroch & Chernobai, 2017) since IT failures are directly linked to CIO's primary responsibilities.

The IS strategic leadership literature has also used agency theory to study CIOs in the public sector. First, state CIOs' IT budget size is associated with smaller state governance (Pang et al., 2016). From an agency perspective, the implementation of enterprise-wide systems and digital infrastructures helps in reducing the information asymmetry between the legislatures and citizens (principals) and government agencies (agents) that will lead to lower government expenditures. With such systems, better information (e.g., state-wide performance) can be consolidated and generated, helping legislatures monitor agencies' decisions and actions regarding state expenditures. Second, since there is a big difference between the public and private sectors, the legal view of agency theory (Lan & Heracleous, 2010) can be used as an extension to the classical agency theory to understand the impact of effective IT governance on IT department (i.e., agent) and state (i.e., principal) performance outcomes (Dawson et al., 2016). Here, in combination with other public sector governance elements, an independent office of the CIO who provides IT services to the state will contribute to better state IT department and overall state performance (Dawson et al., 2016).

### 2.2.2. Transaction Cost Economics

The basic idea of transaction costs economics (TCE) goes beyond the consideration of only production costs when it comes to buying (procuring) or making (producing) decisions in firms. Transaction costs can be defined as "the costs of planning, adapting, and monitoring task completion" (Susarla et al., 2009, p. 210). TCE brings important contributions to the understanding of firms such as bringing behavioral assumptions, adopting a micro-analytic approach (i.e., focus on the internal governance of the firm and contracts as opposed to focusing on price and firm's environment), seeing firms as governance structures, and subscribing to the view that the core problem of firms is that of economizing.

The two main assumptions underlying the TCE are humans' bounded rationality and opportunism (Williamson, 1989). Bounded rationality relates to the inability of humans to process all information out there about a specific matter or a transaction in the case of TCE (Aubert et al., 2004). Thus, TCE abandons the view that humans are rational utility maximizers (Williamson, 1989). Opportunism is seeking self-interest that allows guile (Williamson, 1989). These two assumptions result in information asymmetry (Aubert et al., 2004) from both sides of the transaction, rendering contracts incomplete (Williamson, 1989). Incomplete contracts mean that the two parties cannot cover all the possible contingencies when writing the contract (Powell, 1990).

Firms have two choices when it comes to either make or buy decisions: Markets or hierarchies. TCE says that a transaction's recurrence frequency, the degree of asset specificity, and the degree of outcome uncertainty (Powell, 1990; Williamson, 1989) influence firms' decisions. On the one hand, transactions with high asset specificity, recurrence frequency, and uncertainty will more likely be performed within the hierarchy (i.e., inside the firm) (Powell, 1990). On the other hand, transactions with low assets specificity, less or non-repetitive, and certain outcomes will occur in the market (Powell, 1990). Many examples illustrate the two forms of exchange. Outsourcing a firm activity is a typical example of market exchange. Vertical integration is an example of hierarchies. Asset specificity is recognized as one of the main factors for deciding between the market and hierarchy exchanges. Williamson (1989) listed five kinds of assets that can vary in the degree of specificity; these are site, physical assets, human assets, dedicated assets, and brand name. Time specificity has also subsequently been proposed (Malone et al., 1987).

Many articles in the IS literature have utilized the TCE to understand technology-related phenomena. Others studied the impact of IT on the use of either markets or hierarchies (Malone et al., 1987). IT Outsourcing is one main example where IS researchers try to explain the decision to outsource/insource based on TCE aspects. Ang and Straub (1998) investigated the relationship between transaction cost and the degree of outsourcing and found a significant negative relationship. Another study by Aubert et al. (2004) studied the impact of asset specificity and uncertainty on outsourcing levels. Interestingly, even with the strong arguments from the TCE perspective and even with the logical and seamless integration of these arguments in the case of IT outsourcing, we see puzzling results (Aubert et al., 2004). Aubert et al. (2004) found that asset specificity degrees have a negative effect on outsourcing, which is the opposite of their hypothesis. Ang and Straub (1998) found that although transaction costs negatively influence outsourcing, it is much weaker compared to the influence of production cost advantages. Others did not find any relationship between asset specificity and outsourcing (Aubert et al., 2004). Types of contracts and contract design from the TCE perspective are also important when investigating why some outsourcing decisions fail or succeed (Susarla et al., 2010). TCE helped in informing IS-related theories in a great matter. The argument by Malone et al. (1987) that information technologies, with their impact on reducing the cost and time of processing and communicating information, will reduce the coordination costs and, thus, firms will use the markets to coordinate economic activities.

#### 2.2.3. Resource Dependence Theory

Rooted in sociology, the Resource Dependence Theory (RDT) argues that firms are viewed as coalitions linked to each other based on resources exchange (e.g., the interdependence between buyers and suppliers). The RDT tries to explain “how organizations reduce environmental interdependence and uncertainty” (Hillman et al., 2009, p. 1404). Firms alter their patterns and structures of behavior to obtain and maintain needed resources from their environment, and firms’ success depends on maximizing their power (Ulrich & Barney, 1984). In this view, firms increase their power and acquire external resources by reducing the dependence on other firms and/or increasing their dependence on them. The RDT rests on three main assumptions: (1) firms consist of internal and external coalitions emerging from social exchanges, (2) the environment contains valuable and scarce resources to the survival of firms, which raises the issue of resource acquisition uncertainty, and (3) firms take actions to acquire control over resources to reduce environmental dependence and increase the dependence of other firms on them (Ulrich & Barney, 1984). These actions include merger and acquisitions (M&A), joint ventures, and other kinds of inter-organizational relationships, political actions, executives’ successions, and board of directors (Hillman et al., 2009; Pfeffer & Salancik, 1978).

Studies in the IS strategic leadership research stream used RDT logic to explain CIO presence and turnover. The board of directors not only exercise monitoring function, but also provide resource provision (Hillman & Dalziel, 2003). Benefits provided by the board of directors include counsel and advice, access to information channels and preferential and competitive resources, and legitimacy (Hillman et al., 2009; Pfeffer & Salancik, 1978). From an IT governance perspective, board directors help in "reinforcing the public image of the firm's IT capability, providing IT expertise and IT counsel to management, enabling preferential access to external IT providers and other third parties, and aiding in the formulation of IT strategy." (Benaroch & Chernobai, 2017, p. 733). With this view, the CIO presence is considered a mechanism to help achieve all these IT governance-related activities by the board directors.

#### 2.2.4. Social Capital Theory

Social capital is "the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit" (Nahapiet & Ghoshal, 1998, p. 243). Social capital highlights the importance of ties and relationships among actors in networks. These networks are social structures that provide their members with valuable resources and benefits and facilitate individuals' actions (Adler & Kwon, 2002; Nahapiet & Ghoshal, 1998).

The concept has been applied in many organizational studies to explain the relative success of actors, such as how social capital influences cross-team effectiveness, facilitates product innovation and entrepreneurship, strengthens interfirm learning, and helps create intellectual capital (Adler & Kwon, 2002). Nahapeit and Ghoshal (1998) present an integrative framework of social capital that explains the creation and exchange of knowledge in organizations. They suggest that knowledge creation and sharing is facilitated by three interrelated dimensions of social capital: structural, relational, and cognitive. First, the structural dimension represents the overall pattern of linkage among the individuals [i.e., "who you reach and how you reach them" (Nahapiet &

Ghoshal, 1998, p. 244)]. Second, the relational dimension characterizes the kinds of assets embedded and leveraged within the social network (e.g., trust, identification, norms). Third, the cognitive dimension of social capital describes the interpretations, shared representations, and shared language among members in a social unit (Nahapiet & Ghoshal, 1998).

A good working relationship between the CIO and the firm's top executives is key to harness IT-related business value. The social capital theory explains how such a beneficial relationship can be established (Karahanna & Preston, 2013; Preston & Karahanna, 2009). The three dimensions of social capital facilitate the combination and sharing of knowledge between the CIO and TMT. This allows for knowledge integration from different perspectives (e.g., business and IS knowledge) that results in the alignment of business strategy and IS strategy and, eventually, leads to positive organizational financial performance. Benefiting from their position in the upper echelon network, CIOs interact and engage with top executives. This facilitates the creation of a common language and a shared understanding of the role of IS in the firm. Higher levels of CIO-TMT cognitive social capital are linked to increased TMT trust in the CIO (Karahanna & Preston, 2013).

### 2.2.5. Human Capital Theory

Fundamentally, the human capital theory argues that individuals' learning capabilities, skills, and experience are as important as other types of capital (e.g., physical capital, land, financial capital) and are involved in the production of goods and services. People acquire skills and knowledge through investing in training and education (formal and informal), growing their human capital. Such capital will contribute to the development, productivity, and profitability of the people, firms, and society (Nafukho et al., 2004). Human capital can be classified into specific and general. Specific human capital is related to the skills that are specialized and unique to a specific domain (e.g., an occupation or a firm). General human capital refers to those skills that can be easily transferred to other domains (e.g., problem-solving skills, communication abilities) (Joseph et al., 2015).

The human capital theory has been used in the IS literature to study the impact of IT education and experience (two important human capital factors) on IT professionals' compensation (Joseph et al., 2015; Kim et al., 2014; Mithas & Krishnan, 2008a). Such studies try to explain the difference in IT professionals' compensation along with other firm and industry-specific contingency factors. IT professionals hold two kinds of specific human capital: IT-specific and firm-specific (Joseph et al., 2015; Mithas & Krishnan, 2008a). IT-specific human capital is related to those skills and experiences that are unique to IT occupations. Firm-specific human capital refers to skills and experiences unique to a particular firm and cannot be easily transferred to other firms (e.g., a firm's specific methodology of systems development).

Prior Knowledge and background influence the development of CIO leadership styles (Chen et al., 2010). CIOs can assume two leadership types: supply-side and demand-side leaderships (Chen et al., 2010). Demand-side leadership is related to the ability of the CIO to explore new IT to increase the firm's innovativeness and growth. Supply-side leadership is about the ability of the CIO to exploit current IT resources to improve the firm's efficiency. Both supply-side leadership and demand-side leadership require the CIO to have a high business and IS knowledge and possess relevant skills. Chen et al. (2010) show that the achievement of supply-side leadership capabilities mediates the effect of CIO human capital (in terms of CIO educational level, organizational tenure, and IT experience) on demand-side leadership. This is logical because supply-side leadership represents the fundamental abilities that the CIO must possess. Those CIOs who struggle with keeping the efficiency and reliability of IT will not have the opportunity to exercise demand-side leadership requirements since such requirements involve making risky decisions as the results are highly uncertain (Liu, 2006).

### 2.2.6. Institutional Theory

Institutional theory asks the question of why different organizational practices and forms prevail without clear economic or technical values. Its core assumption is that an organization takes actions to protect or enhance its legitimacy (Meyer & Rowan, 1977; Staw & Epstein, 2000). Institutional theorists argue that firms take actions (e.g., using popular management techniques, adopting an IT innovation) that are considered legitimate practices (i.e., adopted and institutionalized) in their environments to gain cultural support or achieve organizational legitimacy, even if such actions will lead to little impact on their performance (Meyer & Rowan, 1977; Wang, 2010). Organizational legitimacy is "a generalized perception or assumption that actions of an organization are desirable or appropriate within the organization's socially constructed environment of norms, values, and beliefs." (Wang, 2010, p. 64). By gaining organizational legitimacy, firms will enjoy benefits such as access to different resources, have social approval, or increase the chances of organizational growth and survival (Wang, 2010).

Firms can work to gain external and internal legitimacy (Staw & Epstein, 2000). External legitimacy is about a firm gaining legitimacy from its environment, whereas internal legitimacy is about managers gaining credibility within the firm by internal stakeholders. For instance, firms that associate themselves or invest in IT innovation fashions reward their CEOs with higher pay (internal legitimacy) and gain better corporate reputation (external legitimacy), regardless of the impact of such IT on firm performance (Wang, 2010).

Organizational legitimacy can be achieved by signaling a positive corporate reputation to internal and external stakeholders (e.g., press, trade association). Corporate reputation refers to "a relatively stable, issue specific aggregate perceptual representation of a company's past actions and future prospects compared against some standard." (Walker, 2010, p. 370). Establishing and maintaining corporate reputation is important because it can result in short and long-term consequences such as charging premium prices, attracting customers and investors, and creating barriers to entry (Walker, 2010).

IT capability reputation is an important strategic resource from which firms can gain sustainable competitive advantage (Lim et al., 2013). CIOs may try to reflect their firms' superior IT capabilities to gain positive public recognition (Lim et al., 2013). Those CIOs who possess more structural and expert power will be more likely to project their firms' IT capabilities over time. CIOs who work to gain superior IT capabilities recognition from external stakeholders aspire to be rewarded (e.g., with direct rewarding such as fixed payment or a promotion). Those CIOs who get rewarded will likely stay longer in their firms. Such success in IS strategic leadership continuity will increase the chances of firms sustaining their IT capability recognition and, as a result, will reward their CIOs (Lim et al., 2013). This highlights the importance of aligning the firm's internal and external environment by developing a cycle of reciprocity between projecting IT capability superiority reputation and rewarding CIOs for such work.

### 2.2.7. Upper Echelon Theory

The premise of the Upper Echelons theory is that organizations, their outcomes, and their strategic decisions are reflections of the characteristics (observed or cognitive) of firms' top executives (Carpenter et al., 2004; Hambrick & Mason, 1984). In other words, "organizational outcomes can be partially predicted from managerial backgrounds" (Hambrick & Mason, 1984, p. 197).

Since the publication of the seminal work by Hambrick and Mason (1984) titled "Upper Echelons: The Organization as a Reflection of its Top Managers", the strategy literature has witnessed a prolific stream of research making valuable contributions to understanding top management teams and how they impact organizational and strategic actions (Pitcher & Smith, 2001). The theory is about the influence of the TMT's (i.e., the dominant coalition) backgrounds, cognitive bases, and values on firms' strategic choices and outcomes (Carpenter et al., 2004; Hambrick & Mason, 1984; Pitcher & Smith, 2001; Preston & Karahanna, 2009). The theory utilizes top executives' demographics and backgrounds as proxies for the "difficult to measure" cognitions, perceptions, and values (Carpenter et al., 2004; Hambrick, 2007). Put succinctly by Hambrick (2007): "If we want to understand why organizations do things they do, or why they perform the way they do, we must consider the biases and dispositions of their most powerful actors – their top executives." (p. 334)

Unsurprisingly, many studies show significant links between different TMT proxies and important organizational and strategic outcomes. One of the manifestations of this theory is the study of TMT heterogeneity. Whether diversity in the upper echelon's characteristics will influence organizational decisions and outcomes (Hambrick et al., 1996; Miller et al., 1998; West & Anderson, 1996) is a central question in the literature. The importance of such heterogeneity comes from its association with outcomes such as firm performance, innovativeness, and openness to ideas (Carpenter, 2002; Marcel, 2009). Other studies looked at different executives' demographics and backgrounds. Examples include the relationships and network ties among the top management members (Collins & Clark, 2003; Geletkanycz & Hambrick, 1997; Iaquinto & Fredrickson, 1997), experience and firm's decisions and outcomes (Carpenter et al., 2001; Kor, 2003), and team change and tenure (Bergh, 2001; Keck, 1997; Tihanyi et al., 2000; Tushman & Rosenkopf, 1996).

TMT members and CIOs are strategic decision-makers who, with their expertise, managerial backgrounds, and cognition, can influence organizational strategic choices and outcomes. Shared understanding between the CIO and TMT represents the shared cognition of those decision-makers on the role of IS and its impact on the firm. The IS strategic alignment is a strategic choice that is impacted by the developed shared understanding (Preston & Karahanna, 2009).

### 2.2.8. Resource-Based View of the Firm

From the resource-based view (RBV) of the firm perspective, firms are seekers of costly-to-copy-inputs for production and distribution (Conner, 1991). The theory examines the link between firm resources and sustained competitive advantage (Barney, 1991). A firm's resource is said to generate a competitive advantage if it is valuable, rare, imitable, and non-substitutable. Before RBV, the focus was on the external sources of competition (i.e., firm related opportunities & threats). However, the RBV shifts the focus to the firm's internal strengths and weaknesses, especially resources that can be leveraged to achieve a competitive advantage. RBV assumes that resources are heterogeneously distributed among firms, and that resource heterogeneity is stable over time (Barney, 1991). Firm resources are composed of assets and capabilities (Wade & Hulland, 2004). Assets are "anything tangible or intangible that firm can use in its processes for creating, producing, and/or offering its products" (Wade & Hulland, 2004, p. 109). On the other hand, capabilities are "repeatable patterns of actions in the use of assets to create, produce, and/or offer products to a market" (Wade & Hulland, 2004, p. 109). These resources can be viewed as bundles of assets (tangible and intangible), including information, knowledge, processes and routines, and management skills (Barney, 1991).

A firm possesses many resources. However, not all these resources have the potential to create a competitive advantage, and certainly, not all potential resources can sustain the firm competitive advantage. According to Barney (1991), potential advantage-creating resources must be valuable, rare, imperfectly imitable, and non-substitutable. A resource that is valuable, rare, and high in rent earning potential (i.e., high appropriability) will help the firm in attaining competitive advantage. A resource that is difficult to imitate, with no available substitutes, and imperfectly mobile will facilitate the creating of sustained competitive advantage (Mata et al., 1995; Wade & Hulland, 2004).

The resource-based view has been utilized in many IS research. Three types of IS resources were studies: outside-in, spanning, and inside-out resources (Day, 1994; Wade & Hulland, 2004). First, outside-in resources include external relationship management and market responsiveness. Second, spanning resources include IS-business partnerships and IS planning and change management. Finally, inside-out kind of IS resources include IS infrastructure, IS technical skills, IS development, and cost-effective IS operations (Wade & Hulland, 2004).

The IS resources can have direct, no effect, and indirect influence on firms' competitive position and performance. The indirect effect of IS resources is known as the complementarity effect, which means "how one resource may influence another, and how the relationship between them affects competitive position or performance" (Wade & Hulland, 2004, p. 123). Prior studies have shown that IS resources can create competitive advantages for firms. However, sustaining these advantages is difficult since IS resources such as computers and software are not rare and, thus, other companies can imitate these resources. That is why we see that many studies have found an indirect relationship between IS resources and competitive advantage (Wade & Hulland, 2004). This complementarity characteristic of IS resources adds value and augment other firms' resources and can lead to sustainable competitive advantage (Wade & Hulland, 2004). The absence of a direct link between IS resources and sustained competitive advantage does not mean that there is not one. The idea here is that, in order for an IS resource to have a sustainable competitive advantage, it needs complementarity resources that would augment its value and make it inimitable. Therefore, the argument here is that creating a social complexity and causal ambiguity around IS (intangible) resources would make them imperfectly imitable and, thus, can create a potential source of a more sustainable competitive advantage. Thus, IS resources are complementary resources that can compensate, enhance, or suppress/destroy other firm resources (Wade & Hulland, 2004).

IT governance can be considered a unique firm IS resource that complements IT assets in driving organizational value (Wu et al., 2015). An important mechanism of IT governance by which firms facilitate IS strategic alignment is the CIO reporting structure (i.e., structural mechanism of ITG). Such reporting structure "enable[s] the CIO to obtain a global and holistic perspective on the organization, its goals and strategies, and enhances the CIO's understanding of the TMT's vision of the organization." (Wu et al., 2015, p. 504).

#### 2.2.9. Organizational Learning

Firms can leverage and use their resources, knowledge, and competencies by following two distinct paths of learning: exploitation and exploration (Levinthal & March, 1993; March, 1991). Exploitation refers to the organizational ability to use and refine existing internal resources and knowledge to achieve efficiency. In contrast, exploration relates to discovering and acquiring external knowledge and competencies to create new organizational opportunities. Exploitation entails "adopting, synthesizing, and applying current or existing knowledge", whereas exploration involves "highly uncertain and unpredictable activity, reflecting the ability of a firm to acquire new knowledge rather than merely learning how to use current knowledge more efficiently" (Liu, 2006, p. 145).

Exploration and exploitation are two distinctive learning processes and are viewed as contradictory approaches (Gibson & Birkinshaw, 2004). The tension between the two processes stems from the fact that both compete for scarce resources, both are self-reinforcing that can result in path dependence on one of them, and both demand different ways of thinking (A. K. Gupta et al., 2006; Im & Rai, 2008). However, to be successful in today's turbulent environment, it is neither enough to be innovative and adaptable, nor it is sufficient to exploit assets and achieve efficiency. To sustain success over the long term, organizations should strive to achieve a simultaneous balance between exploration and exploitation (March, 1991). This balance is known as organizational ambidexterity (Gibson & Birkinshaw, 2004; Tushman & O'Reilly, 1996), which is defined as "the capacity to simultaneously achieve alignment and adaptability at a business-unit level" (Gibson & Birkinshaw, 2004, p. 209). Organizational ambidexterity can lead to superior performance (He & Wong, 2004; Raisch et al., 2009).

IT competencies and knowledge are important for organizations and their performance (Mithas et al., 2011; Nazir & Pinsonneault, 2012). Literature shows that information systems can support and impact organizational exploration and exploitation and that IT ambidexterity can lead to organizational agility (Attewell, 1992; Kane & Alavi, 2007; O.-K. Lee et al., 2015; Pentland, 1995). IT ambidexterity is the firm's dual ability to exploit and explore IT resources (O.-K. Lee et al., 2015).

The literature suggests different ways of achieving ambidexterity. Through different designs, firms can promote ambidexterity. Firms can build systems, tasks, and structures to help in reconciling both exploration and exploitation activities (this mechanism is referred to as structural ambidexterity), such as partitioning business units where some adopt exploration orientation and others become exploitation-oriented units. Alternative mechanisms to achieve ambidexterity is by building contexts in business units in which employees are encouraged to make the call on how to conduct their daily tasks between tasks that are explorative and exploitative at the same time

(Gibson & Birkinshaw, 2004). The literature shows that ambidextrous organizations are associated with high firm performance (Gibson & Birkinshaw, 2004; He & Wong, 2004).

Pursuing both exploration and exploitation, however, is not a trivial task as "organizational learning is viewed as routine-based, history-dependent, and target oriented" (Levitt & March, 1988, p. 319). Thus, making organizations more competent in either exploration or exploitation (Liu, 2006). Organizations learn and build on their competencies and knowledge to become more competent and specialized in some activities and less in others, leading to positive outcomes (Levitt & March, 1988).

CIO leadership can be categorized into demand-side and supply-side leadership (Chen et al., 2010). Supply-side leadership can be linked to the exploitation path of organizational learning, and demand-side leadership can be linked to exploration. Supply-side leadership is about the ability of the CIO to exploit and refine current IT competencies and resources to achieve operational efficiency. It is about "keeping the lights" on and ensuring that IT is reliably supporting the day-to-day operations. Other capabilities that fall under such leadership include CIO being: IT architect leader, resource allocator, technology advisor, and contract facilitator (Chen et al., 2010; Feeny et al., 1992; Grover et al., 1993; C. S. Stephens et al., 1992). Demand-side leadership represents the ability of the CIO to lead business growth, innovation, and transformation by exploring IT-driven opportunities and innovations. Such leadership requires the CIO to be a relationship builder and partner with other business functions and executives, to think strategically about how to represent organizational change with IT, and to be an innovator (Chen et al., 2010; Feeny et al., 1992; Karimi et al., 1996). CIOs who only fulfill the requirements of the supply-side leadership without performing the demand-side leadership responsibilities "could easily become outdated and unable to keep up with the changing business environment." (Chen et al., 2010, p. 237). On the other hand, CIOs who solely focus on the demand-side leadership requirements will fail to assimilate IT-driven opportunities (Chen et al., 2010).

### 2.2.10. Coordination Theory

Rooted in the information-processing paradigm, coordination is about integrating interdependent tasks among organizational units and under uncertainty through the use of coordination mechanisms (Faraj & Xiao, 2006; Okhuysen & Bechky, 2009). It is about managing interdependencies among activities and resources to solve organizational coordination problems or design new processes. Coordination mechanisms are "the organizational arrangements that allow individuals to realize a collective performance." (Okhuysen & Bechky, 2009, p. 472), which can take the form of formal processes (e.g., routines, rules, and plans) or emergent arrangements. The older literature on coordination focused on devising and designing coordination arrangements for optimal work and performance (e.g., the work by Frederick Taylor and the Gilbreths). Such organizational arrangements were built in an era where the dominant form of work was the production of tangible goods and manufacturing (Okhuysen & Bechky, 2009). Such work could be directly observed, measured, and decomposed into its basic elements. Sub-elements are interdependent and mostly co-located, which means that finding the issues and solving them were easier. With the massive shift to services, the older coordination mechanisms were of limited benefits. This is because work became less tangible, the progress of work could be hard to estimate, optimal solutions could be hard to find or even did not exist, and interdependencies among the parties became hard to identify (Okhuysen & Bechky, 2009). Another problem with the older mechanisms is "the portrayal of processes and structures as formal elements planned by organizations rather than as ongoing work activities that emerge in response to coordination challenges." (Okhuysen & Bechky, 2009, p. 468). Firms face uncertainties and different contingency factors, under which formal coordination mechanisms might be greatly subject to failure. Such conditions require emergent and informal coordination arrangements to tackle and solve organizational problems. In the more recent coordination literature, researchers are interested in the emergent nature of the coordination process used to regulate and integrate interdependent activities to achieve collective performance (Faraj & Xiao, 2006; Okhuysen & Bechky, 2009).

The notion of coordination has been applied in the IS strategic leadership research stream to explain how social alignment (i.e., CIO-TMT shared understanding) can help in increasing organizational agility through emergent coordination. Drawing from the work of Faraj and Xiao (2006) on coordination under environmental unpredictability and complexity, Liang et al. (2017) define emergent coordination as "the contextualized process of input regulation and interaction articulation to realize a collective performance based on informal communication and mechanisms." (p. 870). When the firm's environment is unpredictable and performing tasks become uncertain, informal coordination that is based on information exchange and communication between IT and business executives can help in gaining competitive advantage. This leads to improving leadership performance, and, hence, increasing organizational agility and performance (Liang et al., 2017; Rai & Tang, 2013; Sambamurthy et al., 2003). Social alignment is about the trust of TMT on CIO and the shared understanding about the role of strategic IS in the firm (Karahanna & Preston, 2013; Preston & Karahanna, 2009). However, it is static and, alone, will not cause any effect unless it results in actionable and dynamic coordination activities and collaboration efforts at the executive level that aim to make changes (Liang et al., 2017). Social alignment facilitates emergent coordination by creating shared language between IT and business executives that eliminates any language barriers, establishing shared knowledge that enables the understanding and contribution of each executive and minimizes conflict, and enabling shared understanding of the role IS in solving emergent problems (Liang et al., 2017).

### 2.2.11. Power Theory

Power is defined as the ability of a firm's subunits and individuals to influence other subunits and people (Hickson et al., 1971; Pfeffer, 1981) and the capacity to influence firm's outcomes (Mintzberg, 1983). In this view, firms are viewed as coalitions of "… decision-making power systems interacting with their environments in conditions of uncertainty" (Hinings et al., 1974, p. 22). Each system (i.e., subunit) has its own objectives and preferences (Cyert & March, 1963; March, 1962; Salancik & Pfeffer, 1974). Nevertheless, the distribution of power among subunits is not uniform (Perrow, 1970; Salancik & Pfeffer, 1974), meaning that some subunits exert more power and influence than others and raise the issue of resource allocation and contribution. Thus, "organizational subunits may contribute resources to the organization that are of lesser or greater importance and may be more or less successful than other subunits in these pursuits" (Salancik & Pfeffer, 1974, p. 455). Accordingly, subunit power is critical as it relates to bargaining, negotiations, and decisions (Feng et al., 2015; Perrow, 1970; Pfeffer, 1981).

IS leadership research looked at CIO power as an antecedent to the CIO likelihood of projecting firm's IT capability to external stakeholders (Lim et al., 2013), as a factor that influences the CIO demand and supply-side leadership (Chen et al., 2010), and as a source for CIO strategic decision-making authority (Preston et al., 2008). Such power can come from either the CIO's structural position in the firm's hierarchy, or the CIO's knowledge and expertise. Structural power is important because more powerful CIOs will have greater opportunities to participate in shaping the mission and vision of their firms by prompting ideas to the TMT, can act as entrepreneurs, will have multiple responsibilities that can affect several aspects of the firms/functions, and will gain internal legitimacy (Chatterjee et al., 2001; Chen et al., 2010; Grover et al., 1993; Lim et al., 2013). Structural power can be in the form of official membership in the TMT and reporting structure (Chen et al., 2010). From the power perspective, a CIO who is a member of the TMT or report directly to the CEO will have a greater influence on critical decisions that may interrupt daily work and cause changes in the business (e.g., implementation of ERP). Such decisions require persuading other executives to cooperate and influencing users to adopt and accept the changes IT caused (Chen et al., 2010). Expert power refers to the human capital (i.e., IT-related experience, expertise, and knowledge) that the CIO possesses. This power helps the CIO in understanding business and IT-related problems and implementing IT strategies and solutions (Lim et al., 2013).

### 2.2.12. Organizational Inertia

Organizational inertia can be defined as "an overarching concept that encompasses personal commitments, financial investments and institutional mechanisms supporting the current way of doing things" (Huff et al., 1992, p. 55). There are firm-related internal and external forces that produce resistance to change. These change-inhibiting factors tend to make firms remain with their status quo and escalate the commitment to the current structures and strategies (Huff et al., 1992). Internal factors that cause inertial pressures include standardization of procedures, political alliances and their dynamics, and tangible assets suck cost (Hannan & Freeman, 1984). Inertial forces tend to hinder or slow firms from radically changing their structures and strategies when faced with environmental uncertainty and threats (Hannan & Freeman, 1984). External factors include legal forces, intra-organizational coalitions and investments, and the loss of organizational legitimacy. As such, when a firm experiences a poor performance that may signal a need for organizational change, these inertial forces, in many times, inhibit the firm from initiating the change (Shimizu & Hitt, 2005).

Organizational inertia consists of two categories: resource rigidity and routine rigidity (Gilbert, 2005). First, resource rigidity relates to the firm's failure to change its patterns of resource investment. It contains three types of rigidities: suck cost, resource bundling, and resource dependency (Liang et al., 2017). Sunk cost is about the continuation of investment and commitment in an action or a decision, even if such decision or action shows negative outcomes. Firms invest heavily in IT. Over the years, it becomes costly and risky to replace existing systems with new ones. What makes things more complicated is that older IT do not easily disappear. They become legacy technologies (Tiwana, 2017). Resource bundling relates to the way that organizational resources are bundled for capability development. Firms bundle IT resources with business resources to develop core competencies and support specific strategies (Liang et al., 2017). When strategies change to respond to market threats or opportunities, such core competencies can become irrelevant. However, the complexity of resource bundling makes it difficult to change and, thus, firms choose to reinforce the status quo. Resource dependency refers to the extent of power and influence of external resource providers have on a focal firm's behaviors and decisions.

Second, routine rigidity is related to the firm's failure to change its routines and processes that use resource investments (Gilbert, 2005; Liang et al., 2017). Organizational routine is "a repetitive, recognizable pattern of interdependent actions, involving multiple actors." (Feldman & Pentland, 2003, p. 96). Path dependence and cognitive inertia are two categories of resource rigidity (Liang et al., 2017). Path dependence is a "rigidified, potentially inefficient action pattern built up by the unintended consequences of former decisions and positive feedback processes." (Sydow et al., 2009, p. 696). It stresses the importance of previous events for present and future actions.

Cognitive inertia is the extent to which an individual resists any change that deviates from existing mental models or fixed cognitive maps (Liang et al., 2017).

The IS leadership research has examined how IS strategic social alignment mitigates the rigidifying influence of IS strategic intellectual alignment on organizational inertia under dynamic and uncertain environments (Liang et al., 2017). Firms strive to interrelate their business and IT strategies, missions, and objectives to achieve IS strategic alignment that results in strategic and focused use of IT (Chan & Reich, 2007). Thus, intellectual alignment represents a state that reflects the fit and harmony between business and IT strategies. Such tight coupling between business and IT strategies can cause problems when the firm's environment is changing or turbulent (Chan & Reich, 2007). IT can become rigid and an impediment whenever lines functions and firms want to change their operational and strategic activities to adapt to market and competition evolutions (Tiwana, 2017, p. 34). Intellectual alignment leads to organizational inertia by resulting in resource routine and resource rigidities (Liang et al., 2017). High levels of social alignment between the CIO and TMT help alleviate the negative impact of intellectual alignment on organizational inertia. With the presence of social alignment, CIO and TMT exchange information, coordinate to solve unforeseen issues, foster informal communications, and share business and IT knowledge to achieve better alignment between IT and business strategies. When the firm faces change, high social alignment helps weaken the rigidity of formal IS alignment (Liang et al., 2017).

### 2.3. A Synthesis of Themes across Prior Studies

To graphically depict the IS strategic leadership literature, we draw Figure 2.1 that represents a nomological string (Tiwana & Kim, 2019). This figure helps in summarizing the literature and showing the contribution of this study. The literature can be thematically clustered into three streams: (Stream 1) buckets representing a grouping of constructs in block (I) are linked to CIO membership in the TMT and other CIO-related constructs in block (II), (Stream 2) explanatory mechanisms representing IT-related and intermediate organizational outcomes in block (III) that are influenced by the constructs in block (II), and (Stream 3) CIO organizational impact in block (IV) that represents the downstream impact of CIO membership in the TMT. In the nomological string, the outcome of an upstream block turn to inputs to the downstream block. The highlighted buckets represent the focus of this study. In this section, we synthesize the literature according to the three streams of research, starting from upstream.

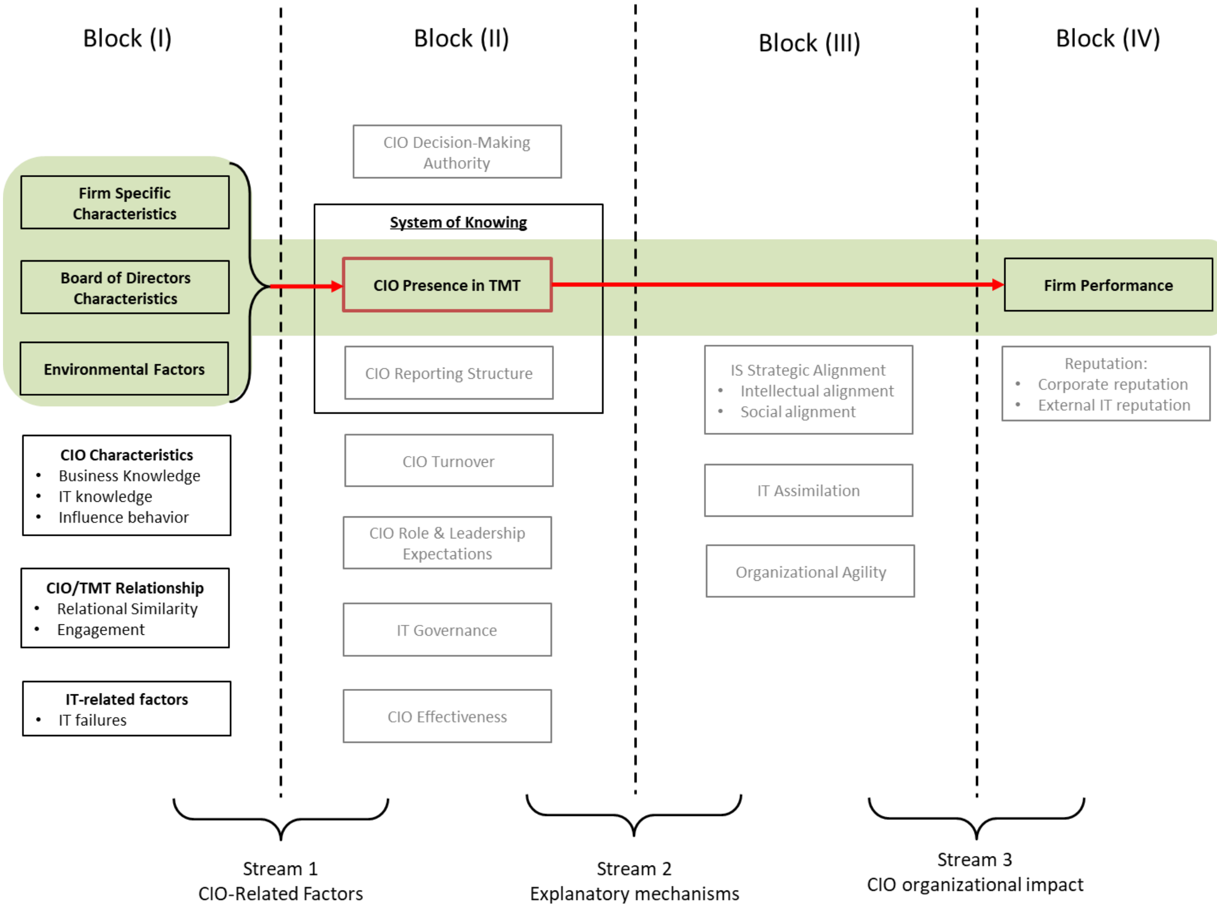



**Figure 2.1: Nomological String of IS Strategic Leadership Literature.**

### 2.3.1. CIO-Related Factors (Stream 1)

The IS strategic leadership shed light on several important aspects of the CIO position like the CIO reporting structure, role and leadership expectations, turnover, CIO and IT governance, and CIO membership in the TMT.

#### 2.3.1.1. CIO Membership in the TMT

CIO membership in the TMT has been studied extensively in the IS leadership literature as an important mechanism that leads to positive outcomes (Armstrong & Sambamurthy, 1999; Karahanna & Preston, 2013; Smaltz et al., 2006). Researchers have conceptualized the CIO membership in the TMT in different ways such as a system of knowing (Armstrong & Sambamurthy, 1999; Preston & Karahanna, 2009), a structural dimension of social capital (Karahanna & Preston, 2013), and structural power (Chen et al., 2010; Lim et al., 2013). Moreover, the membership of the CIO in the TMT is associated with the CIO/TMT relational similarity (Preston & Karahanna, 2009), and CIO capabilities (Smaltz et al., 2006).

The TMT can be viewed as an organizational structure in which senior executives integrate individual knowledge. Two knowledge integration structures are available. First, objective knowledge (i.e., explicit knowledge) that is possessed by top executives. This knowledge can be decomposed into CIO business knowledge, CIO IT knowledge, and TMT strategic IT knowledge (Armstrong & Sambamurthy, 1999). Second, systems of knowing are organizational arrangements that help in guiding the interaction and facilitating business and IS knowledge exchange between the CIO and TMT (Preston & Karahanna, 2009). Three systems of knowing have been suggested in prior IS research: (1) CIO/CEO reporting structure, (2) CIO participation in the TMT (i.e., CIO membership), and (3) informal interaction with members of the TMT (Armstrong & Sambamurthy, 1999; Feeny et al., 1992; Lederer & Mendelow, 1988; Watson, 1990). When the

CIO is a member in the TMT, members of the top management and the CIO formally interact and have better chances to open rich channels for knowledge exchange about business issues and opportunities, share ideas, understand the potential IS contribution and value, and increase the CIO and IT department influence (Armstrong & Sambamurthy, 1999; Smaltz et al., 2006). When formally becoming part of the top management, the CIO gains a more holistic view of the firm, and its strategies and objectives (Preston & Karahanna, 2009).

Business and IS knowledge integration between CIO and TMT is facilitated by three dimensions of social capital, namely: structural, cognitive, and relational. The structural capital dimension is the “overall patter of connections between actors.” (Karahanna & Preston, 2013, p. 20) and represented by CIO/TMT informal interaction and structural position. CIO structural position (i.e., CIO formal membership in the TMT and CIO/CEO reporting distance) and informal ties with other executives increase the interactions that help in exchanging knowledge.

CIO membership in the TMT can also be conceptualized as a kind of managerial power (Chen et al., 2010; Lim et al., 2013). Specifically, it is a structural power due to the CIO position in the firm’s hierarchy. The structural position in the TMT gives the CIO a legitimate power to influence superiors and peers, advocate for the IT agenda, accrue more resources, and effectively exercise proper leadership (Chen et al., 2010; Lim et al., 2013; Preston et al., 2008).

Not many prior articles have examined the factors that influence the presence of the CIO in the TMT. Nevertheless, two factors have been studied in the literature. The first one is the relational similarity between the CIO and TMT (Preston & Karahanna, 2009). Relational similarity is the likeness in the CIO and TMT’s backgrounds. CIOs who share similar demographics (e.g., age, gender, or nationality) and experiential characteristics (e.g., tenure, functional expertise) with other top executives are more likely to become formal members in the TMT (Preston & Karahanna, 2009). The second factor is the CIO capabilities (Smaltz et al., 2006) represented in CIO knowledge, abilities, and skills. Those CIOs who are politically savvy, can clearly communicate with other executives, and possess strategic IT and business knowledge have better chances in becoming part of the TMT (Smaltz et al., 2006).

#### 2.3.1.2. CIO Reporting Structure

The reporting structure is about CIO's hierarchical proximity to the CEO in the form of reporting arrangement within a firm. A closer reporting structure to the CEO is considered to be a more authoritative arrangement for the CIO and would lead to positive consequences (Li & Ye, 1999; Watson, 1990). Practitioners and IS scholars have this implicit assumption that ideally CIOs should report directly to CEOs for reasons such as CIO direct reporting is indicative of the position power, IT is more likely to succeed with closer CIO-CEO reporting structure, and CIOs with direct reporting have greater understanding of firm's direction and goals (Armstrong & Sambamurthy, 1999; Raghunathan & Raghunathan, 1989; Watson, 1990). Succinctly put, CIO direct reporting to the CEO "enables the CIO to obtain a global and holistic perspective on the organization, its goals and strategies, and enhances the CIO's understanding of the TMT's vision of the organization" (Wu et al., 2015, p. 504).

Nevertheless, this ideal CIO/CEO reporting structure lacks strong empirical support. In addition, the CIO/CEO reporting structure is not optimal for all firms (Banker et al., 2011). CIO reporting structure facilitates the CIO role by having direct lines of communication, sharing the CEO's IT vision, exchanging opinions and ideas, and assuring that IT initiatives are communicated with the appropriate C-level executives. Thus, to create greater business value out of IT, CIOs should report to either the CEO or the CFO, depending on the firm strategic positioning and not on IT strategic role (Banker et al., 2011). Differentiator firms should have CIOs report to CEOs. With reporting to the CEO, the CIO will become more aware of the firm's differentiating strategies (e.g., customer intimacy and product innovation) and what IT initiatives are better for supporting these strategies. On the other hand, cost leader firms who focus on economies of scale and efficiencies should have CIOs report to CFOs. With such reporting structures, CIOs can guide IT initiatives that emphasize, for example, cost management, process automation, and operational excellence.

#### 2.3.1.3 CIO Turnover

Recent studies have empirically examined the consequences of organizational IT failures and weaknesses on CIO tenure and how CIO turnover impacts other top executives place in the firm (Banker & Feng, 2019; Benaroch & Chernobai, 2017; Masli et al., 2016). Such research highlights the importance of the CIO in IT governance, the importance in efficiently and effectively managing IT performance, and that any IT-related failures can negatively extend to other organizational aspects (e.g., firm's market value or CEO/CFO turnover).

When a firm market value drops because of recent operational IT failures, there will be an associated positive change in level of board of directors' IT competency (Benaroch & Chernobai, 2017). Operational IT failure occurrences signal the existence of weaknesses in firm's IT resources, which may result in value destruction and attrition of competitive advantage (coming from the resource weaknesses axis of the extended version of the Resource-based view (RBV) of the firm) (Benaroch & Chernobai, 2017). To remedy such negative change in market value, a firm signals an effort to change and commitment to investors by intensifying IT governance monitoring and performing improvements to its IT resource deficiencies. One major improvement is performing changes to the board IT competency level. These changes are reflected in the determinants/mechanisms of board IT competency, namely: directors' IT capital, CIO on the board, and board IT committees (Benaroch & Chernobai, 2017). Directors' IT capital refers to directors' expertise, experience, knowledge, and educational and industry background in IT. Board IT committees include IT steering and IT audit committees that help the board in performing its IT governance functions. Accordingly, when a firm market value drops because of recent operational IT failures, there will be an associated positive change in the board IT competency determinants in the following manner: "(a) increase in the ratio of independent directors with IT experience; (b) increase in the ratio of executive directors with IT experience; (c) turnover of a CIO serving on the board; and, (d) Establishment of board IT committees." (Benaroch & Chernobai, 2017, p. 739). Nevertheless, CIO changes can be costly and might result in disruptions to the business (Benaroch & Chernobai, 2017).

Dismissal of an incumbent CIO could result in issues such as risk the loss of the outgoing CIO's IT and business knowledge that can be used to prevent and correct weaknesses in IT resources, and risk of losing relationships established between the CIO and IT vendors (Luftman & Ben-Zvi, 2010). Moreover, new CIOs may suffer from handling a lot of legacy issues and decisions, which can have impacts on the utilization and future development of IT resources. Firms that are highly IT intensive may find the CIO turnover to be more challenging and disruptive (Benaroch & Chernobai, 2017).

IT failures and weaknesses might not only affect CIOs tenure in firms, but also other senior executives to whom those CIOs report (Masli et al., 2016). Because of their demanding responsibilities and IT management sophistication, senior executives usually delegate IT management responsibilities to CIOs (or other related IT specialists). But those senior executives might suffer if serious IT deficiencies happen (Masli et al., 2016). Within the context of post-SOX financial reporting, CEOs and CFOs are responsible for maintaining and establishing internal controls to strengthen the financial reporting of their firms. Part of this is the annual assessment and identification of any deficiencies (i.e., material weaknesses) that affect firms' financial reporting system and, hence, the reliability of the financial statements. Since IT (e.g., financial IS) is an integral part of firms' financial reporting system, any IT-related deficiencies (i.e., IT material weaknesses) can result in internal control problems. Accordingly, IT management skills became an important skill for executives to possess (Masli et al., 2016). Reporting of material weaknesses is a threat to firm's legitimacy and an indication of poor executive performance (e.g., poor IT management). Hence, there is a greater likelihood of CEOs and CFOs turnover when firms report higher numbers of IT material weaknesses. Moreover, since CEOs and CFOs have different responsibilities, they also have specific IT management responsibilities (Masli et al., 2016). CEOs are responsible for firm-wide IT management, and, hence, the more firm-wide IT material weaknesses the greater the likelihood of their turnover. Similarly, CFOs are responsible for demand-side IT management, and the greater the numbers of reported demand-side IT material weaknesses the higher the chances of their turnover (Masli et al., 2016). Results indicate that in the context of the Sarbanes-Oxley (SOX) financial reporting, serious IT-related deficiencies are related to the likelihood of CEO and CFO turnovers. More specifically, CEO turnover likelihood is associated with deficiencies related to IT architecture and financial IS and related technologies operated or developed by functions other than the IT department, whereas CFO turnover likelihood is associated with deficiencies in internal controls and management oversight of financial IS (Masli et al., 2016).

Since CIOs are directly responsible for IT performance (Banker et al., 2011; Chatterjee et al., 2001), any deficiencies can be detrimental to their tenure in their firms. Over the years, information security breaches have increased, putting CIOs on the spotlight (Banker & Feng, 2019). Security breaches harm firm's performance and market value (Benaroch & Chernobai, 2017; Wang et al.,

2013) and, hence, require corrective actions. CIOs are more likely to get dismissed when their firms experience information security breaches that are under the direct control of the CIOs.

#### 2.3.1.4. CIO Role & Leadership Expectations

CIO role and leadership expectations have evolved over time and are indications of the key part CIOs now play in firms these days. The literature has dedicated a lot of research to the CIO roles, factors that impact these roles, and roles' progression over time (Chun & Mooney, 2009; Grover et al., 1993). Roles are expectations, obligations, and duties that CIOs perform (Karahanna & Watson, 2006). CIOs perform several roles ranging from IT operational and infrastructural works to "keep the lights on" and firefighting any IT issues, to more strategic responsibilities such as leading organizational digital transformation, enabling the firm and its functions with IS capabilities, and building relationships with other executives (Chun & Mooney, 2009; Peppard et al., 2011; Weill & Woerner, 2013). These roles change with the change of several factors such as the technology advancement and its importance to the firm competitive landscape, other CxOs (e.g., CDOs or CMOs) who assume some of these responsibilities, and/or new laws and regulations (e.g., HIPPA and Sarbanes-Oxley Act) to which firms adapt (Chun & Mooney, 2009; Kohli & Johnson, 2011; Peppard et al., 2011).

CIOs can assume two types of leadership: supply-side and demand-side leadership (Chen et al., 2010). Building on exploitation/exploration conceptual framework (Levinthal & March, 1993; March, 1991), demand-side leadership is "the CIOs capability to lead the organization to explore new IT-driven business opportunities that will lead to organizational innovations and business growth" (Chen et al., 2010, p. 234), and supply-side leadership is "CIO capability to exploit existing IT resources and competencies to improve the efficiency of the firm's operations." (Chen et al., 2010, p. 234). There is a "staged maturity" relationship between the two sides of CIO leadership. CIOs who can achieve high capability in performing supply-side leadership responsibilities (e.g., maintaining IT efficiency and reliability) are able to advance to performing the demand-side responsibilities (e.g., exploring new IT-related innovations) (Chen et al., 2010).

There are individual-level and organizational-level factors (Armstrong & Sambamurthy, 1999; Combs & Skill, 2003; Harris & Helfat, 1997; Sambamurthy et al., 2003; Smaltz et al., 2006) that influence the development of CIO demand-side and supply-side leaderships (Chen et al., 2010). First, CIO human capital (accumulated skills and knowledge) in terms of educational background and organizational experience influence both sides of leadership (Chen et al., 2010). Second, CIO structural power in terms of membership in TMT and reporting structure are situational factors that influence both sides of leadership (Chen et al., 2010). Possessing high levels of legitimate power enable the CIO to exercise leadership when introducing IT-related changes, provide the right IT services to business units and the firm, reduce the power distance between the CIO and the CEO/TMT, and shape the IT strategic value and vision (Chen et al., 2010). Lastly, organizational IT support is another situational factor. Firms that support IT with resources and financial support will enable the CIO to more effectively perform supply-side and demand-side responsibilities (Chen et al., 2010).

**2.3.1.5. CIO & IT Governance**

Effective IT governance is not only important for the effective use of IT, but also for promoting "desirable IT behavior" that generates greater business value from IT investments. IT governance includes mechanisms that are promised to lead to positive organizational outcomes (e.g., (Bradley et al., 2012; Huang et al., 2010). IT governance mechanisms are IT capabilities (e.g., human IT resources) that complement IT in creating competitive advantage and driving value to firms (Wu et al., 2015). IT governance consists of formal processes, relational, and structural mechanisms

(Peterson, 2004; Weill & Woodham, 2002; Wu et al., 2015). Structural mechanisms include IT steering committees and CIO reporting structure. IT steering committees work to ensure the link between business strategy and IT strategy, provide IT initiatives visibility, and ensure coordination of IT and business. CIO reporting structure to CEO and/or COO makes IT part of the top executives' agenda and gives the CIO more opportunity to obtain a holistic view of firm, its strategies, and goals (Wu et al., 2015). Formal processes are firm's strategic planning, decision making, and monitoring processes that ensure that IT policies are aligned with the firm's business needs. These processes include processes for portfolio management, IS planning, and project governance (Wu et al., 2015). Communication approaches relate to establishing channels for proper communication between IT and business executives and ensuring the dissemination of the principles of IT governance. These approaches include CIO being member of executive committees, CIO articulating IT role in the firm, and CIO discussing IT issues with the TMT (Wu et al., 2015).

When examining the impact of IT governance in the public sector (Dawson et al., 2016), different configurations of IT governance mechanisms can lead to high state's IT department performance (i.e., state technology usage and deployment effectiveness) and state IT performance (i.e., state performance effectiveness in the areas of information, infrastructure, money, and people). These mechanisms are legislative oversight committee (LOC), business-centric IT steering committee, fee-for-service funding model, and independent office of CIO (OCIO) (Dawson et al., 2016; Haes & Grembergen, 2009; Karimi et al., 2000; Lan & Heracleous, 2010). The LOC in the public sector assumes the governance role, which is the board of directors' role in the private sector. It acts as a "strategic mediating hierarchy" that establishes strategy necessary IT capabilities for better performance of IT department, and considers the conflicting needs of different stakeholders with regard to the prioritization of scare IT resources allocation and initiatives to maximize the realized benefits (Dawson et al., 2016). Business-centric IT steering committee is the "tactical mediating hierarch" that possesses the needed business domain knowledge to make tactical decisions about the implementation of LOC strategies and priorities (Dawson et al., 2016). An independent office of CIO (i.e., with no reporting structure) would better balance the priorities with different interests to maximize the stakeholders' benefits, have better operational efficiency, and be less subject to political influence and overtones if to be reporting directly or indirectly to the governor (Dawson et al., 2016).

#### 2.3.2. Explanatory Mechanisms (Stream 2)

Many CIO-related factors (e.g., CIO/CEO reporting structure, CIO membership in the TMT) ultimately impact the firm's financial and market value. But such impact is mediated by intermediate IT-related and organizational factors (i.e., explanatory mechanisms). In the following section, we show how the CIO-related factors are linked to the explanatory mechanisms.

##### 2.3.2.1. IS Strategic Alignment

An important research stream in the IS field is the alignment of IS strategy with business strategy. IS-business alignment is still a top priority in the CIO agenda (Suer, 2018) to derive business value from IS investments and resources. CIOs play an important role in keeping IS aligned with the firm's ever-changing business models and strategies, and the intense persuasion of implementing digital initiatives. Several papers have examined CIO-related factors that influence the formation of the social and intellectual IS strategic alignment (Karahanna & Preston, 2013; Preston & Karahanna, 2009; Valorinta, 2011) and the consequences of such alignment on organizational outcomes (Karahanna & Preston, 2013; Liang et al., 2017; Wu et al., 2015).

Social IS strategic alignment is the shared understanding about the strategic role of IS in the firm (Preston & Karahanna, 2009). It is about the creation of executives' (i.e., CIO and TMT) shared cognitive structures and contents about business and IS (Preston & Karahanna, 2009). As the Upper Echelon perspective posits, executives' cognitions are linked to firms' outcomes and IS strategic alignment is one of these outcomes. There are five factors that influence the development shared understanding between the CIO and TMT about the IS role in firms. These factors play role by facilitating the integration and know exchange between CIOs and TMT that leads to the creation of shared knowledge and, hence, IS strategic alignment in the form of intellectual alignment (Preston & Karahanna, 2009). One factor is the shared language between CIO and TMT that allows for better communication, knowledge integration, convergence of opinions and meanings, and interpretation of situations. Shared language is reflected in CIO using business terminologies, avoidance of technical jargons, and using common language when engaging with TMT (Preston & Karahanna, 2009). The second factor is the CIO and TMT shared domain knowledge (i.e., objective knowledge) about business and IS, and the integration of such knowledge. CIOs should possess business-related knowledge and TMT should have some strategic IS knowledge. Such shared knowledge enhances the shared language and facilitates the creation of shared understanding (Preston & Karahanna, 2009). The third factor is the different systems of knowing that influence the shared knowledge, shared language, and shared understanding. One aspect in the structural system of knowing in terms of CIO-CEO reporting structure and formal membership in TMT. Such system of knowing allow for better communication and engagement with the CEO and enable the CIO to have better understanding of the firm's strategies and goals and TMT's organizational vision (Armstrong & Sambamurthy, 1999; Preston & Karahanna, 2009). The other aspect is social system of knowing in the form of CIO informal interaction and socialization with

TMT. The fourth factor is relational similarity in form of experiential and demographic similarities between the CIO and TMT. The last factor is CIO educational mechanisms, which are formal efforts by the CIO to educate TMT about IS strategic capabilities and manage their expectations about IS, that influence strategic IS knowledge of TMT (Preston & Karahanna, 2009).

Preston and Karahanna (2009) found that social alignment is a direct antecedent of and a mechanism for developing intellectual alignment. The main factors that directly facilitate shared understanding are: shared language, CIO business knowledge, TMT IS knowledge, and CIO formal membership in TMT (Preston & Karahanna, 2009). CIO business knowledge and experiential similarity in the form of common interests facilitate the development of shared language. Moreover, experiential similarity, CIO formal membership in TMT, and CIO educational mechanisms all influence the TMT IS knowledge (Preston & Karahanna, 2009). Structural systems of knowing has two parts: CIO reporting structure and CIO formal membership in TMT. Only the formal membership of CIO in TMT found significant (Preston & Karahanna, 2009). An explanation for such finding could be that with being a member in TMT, CIO will have greater exposure and opportunity to engage with TMT members and exchange perspectives and knowledge, whereas direct reporting to CEO only enables CIO to interact with CEO (Preston & Karahanna, 2009). There are several hypothesized relationships that were not supported. The relationships between structural systems of knowing and its impact on both CIO knowledge of business and the use of shared language between the CIO and TMT are not significant (Preston & Karahanna, 2009). It appears that having the CIO on TMT impacts the IS knowledge of the top executives but not the business knowledge of the CIO. CIO social systems of knowing were found to have no impact (Preston & Karahanna, 2009). This is a surprising finding since it contradicts with prior IS studies that show that informational interaction is an important mechanism that allow for knowledge exchange and better understanding (e.g., Lederer & Burky, 1988; Watson, 1990), but agrees with newer studies (e.g., Smaltz et al., 2006). Experiential similarity were found to have to enhance CIO business knowledge and shared understanding (Preston & Karahanna, 2009). Lastly, CIO/TMT demographic similarity had an impact on the social but not the structural systems of knowing. Over the years of CIO tenure, experiential similarity rather than demographic similarity becomes more important in influencing the CIO structural position in the firm (Preston & Karahanna, 2009).

The establishment of a good working relationship between the CIO and TMT can contribute to value creation in firms through the development of IS strategic alignment (Karahanna & Preston, 2013). Social capital is used as a theoretical lens to understand the factors that facilitate such relationship. The three dimensions of social capital are structural (e.g., CIO formal and informal interactions with the TMT), cognitive (e.g., CIO/TMT shared language and cognitions), and relational (e.g., TMT and CIO trusting each other) (Karahanna & Preston, 2013). CIO informal and formal network ties effect the levels of mutual trust with other executives. This happens when the CIO and other TMT members engage in interactions, know more about each other, and, hence, better assessing the reliability, honesty, and ability of each side in a concrete manner. Moreover, group membership plays role in trust creation, according to social identity theory. The cognitive capital dimension is the "shared cognition among members of the network as well as a shared language that facilitate a common understanding of collective goals and can influence organizational outcomes." (Karahanna & Preston, 2013, p. 20). The relational social capital dimension represents the "assets that are rooted in the relationship within the social network such as trust." (Karahanna & Preston, 2013, p. 21). Mutual trust between the CIO and TMT is fostered when both parties communicate using a shared language (i.e., CIO ability to communicate IS-related issues in business terms). Such shared language reduces TMT perceptions that the CIO is trying to serve her hidden agenda and increases transparency (Karahanna & Preston, 2013). Moreover, the perceptions that the other side has opportunistic motives is decreased when CIO and TMT have shared cognition about the IS strategic role in the firm (Karahanna & Preston, 2013). The creation of IS strategic alignment does not directly rely on CIO structural social capital, but on TMT trust in CIO and the development of shared cognition about the IS strategic role in the firm. Cognitive social capital has the strongest impact on IS strategic alignment among the social capital dimensions. CIO/TMT knowledge integration leads the creation of IS strategic alignment (i.e., the intellectual dimension of IS alignment) (Karahanna & Preston, 2013).

Only few papers have theoretically and empirically examined the relationship between IT governance and IT strategic alignment, even though one of the desirable outcomes of IT governance is to align IT strategies with firm's objectives (Wu et al., 2015). Based on the Resource-Based view of the firm, Wu et al. (2015) posit that IT governance mechanisms enable IT strategic alignment, which, in turn, leads to better firm performance. IT governance mechanisms help in clarifying the responsibilities and roles of individuals included and how the authority and accountability of IT are divided among the involved parties (Wu et al., 2015). Accordingly, these mechanisms are similar to organizational structures that help in the establishment of shared understanding about the IS (Wu et al., 2015). When IT steering committees include CIOs and other business managers and executives, better alignment of IS strategies with business strategies can occur (Bowen et al., 2007; Wu et al., 2015). In addition, CIO/CEO reporting structure allows the CIO to get better understanding of the top executives' vision of the firm, and the goals and strategies of the firm, thus allowing for better business and IS knowledge sharing (Karahanna & Preston, 2013; Wu et al., 2015).

#### 2.3.2.2. IT Assimilation

IT assimilation is the success in routinizing and integrating IT into day-to-day value-chain activities and business strategies (Armstrong & Sambamurthy, 1999). Drawing on the knowledge –based and resource-based views of the firm (Conner & Prahalad, 1996; Grant, 1996; Spender, 1996), IT assimilation can be achieved by combining and complementing business knowledge with IT knowledge "through a mosaic of strong intraorganizational relationships" (Armstrong & Sambamurthy, 1999, p. 306). Hence, one critical factor that leads to better IT assimilation is the quality of knowledge among the senior leadership in the firm (e.g., CIO and TMT) and establishment of organizational structures that facilitate the knowledge exchange (Armstrong & Sambamurthy, 1999).

TMT members who possess strategic IT knowledge and CIOs who possess business knowledge can better understand each other, share ideas, and better evaluate IT-related initiatives. The creation of organizational structures that enable knowledge combination and exchange (i.e., systems of knowing) are also critical for IT assimilation (Armstrong & Sambamurthy, 1999). With these structures, unique perspectives and knowledge by the CIO and TMT can be integrated, TMT members develop more appreciation of IT, and the CIO can become more involved in business strategy formulation and execution (Armstrong & Sambamurthy, 1999).

#### 2.3.2.3. Organizational Agility

IS strategic alignment can have contradicting impacts on firms. Some studies show positive association between business-IT alignment and firm performance (e.g., Gerow et al., 2014; Karahanna & Preston, 2013), while others show that some firms have negative or no association due to creating rigidity traps, rendering firms strategically inflexible and slow in responding to market change (e.g., Arvidsson et al., 2014; Palmer & Markus, 2000).

The key to explaining the paradoxical impact of IT alignment on firm performance is to theoretically and empirically examine how IT alignment impacts organizational agility (Liang et al., 2017). Failure in IT alignment will result in reduced organizational agility for timely responding to any external changes. Two more ideas are established for better understanding for the alignment-agility relationship. First, IT alignment is not unidimensional. It has two distinctive aspects: intellectual (i.e., alignment between IT strategy and business strategy) and social (i.e., mutual understanding between IT and business executives about IS role to firm's success) (Karahanna & Preston, 2013; Preston & Karahanna, 2009). Second, since intellectual and social alignments have different cause, focus, and effect, each would have a different mechanism through which they impact agility. Intellectual alignment impacts agility through organizational inertia (Gilbert, 2005). When there is an internal and external fit, intellectual alignment can have positive impact of firms. However, when the environment is dynamic, and changes happen, intellectual alignment can impede firm's agility by increasing inertia. On the other hand, social alignment (i.e., the shared understanding between the CIO and TMT about the IT role in the firm) influences agility through emergent coordination (Faraj & Xiao, 2006). Shared understanding, knowledge, and language between IT management and business executives help in creating common view about IT role in the firm and remove barriers in communication (Liang et al., 2017). This results in better emergent coordination of activities and collective performance via informational mechanisms that lead to enhancements in sensing and responding to changes. Thus, IT alignment has a dual and conflicting impact on organizational agility. Social alignment enhances agility through improving emergent coordination between IT and business executives, while intellectual alignment reduces agility via increasing organizational inertia toward changes in the environment (Liang et al., 2017). Moreover, social alignment can act as moderator that mitigates the impact of intellectual alignment on inertia. By having top management that is well informed and mindful about the role of IT, firms can be aware of myopic view and success trap due to past successes in intellectual alignment, especially in dynamic environments (Liang et al., 2017).

### 2.3.3. CIO Organizational Impact (Stream 3)

#### 2.3.3.1. Firm Performance

Firms that align the CIO reporting structure with their strategic position will have a superior firm performance (Banker et al., 2011). When reporting to the appropriate C-level executive, the CIO can lead IT initiatives that align with the strategic positioning and under the supervision of the executive with the most knowledge. Such alignment in firm's strategy-structure will lead to better firm performance in comparison to those firms with misalignment. CIO-CEO reporting misalignment might hinder the CIO efforts in guiding and executing IT initiatives (Banker et al., 2011). For example, when a CIO reports to the CEO for a firm following a cost leadership business strategy, the CIO might overspend of IT since she lacks the appropriate supervision for the CFO.

The relationship between CIO/CEO social capital and firm's financial performance is mediated through establishment of intellectual IS strategic alignment (Karahanna & Preston, 2013). Firms that establish intellectual IS strategic alignment are better in getting more benefits from IT investments and tightly linking IS planning with business planning (Karahanna & Preston, 2013; Preston & Karahanna, 2009; Wu et al., 2015). This is because firms that align IS and business strategies, plans, and processes get better in prioritizing IT investments and directing them to the right business needs, and, thus, creating greater business value.

CIO supply-side and demand-side leadership can influence how IT unit contributes to the firm efficiency and/or strategic growth (Chen et al., 2010). CIO supply-side leadership is about managing and integrating available IS, ensuring IT operations efficiency, and continuous incremental improvements. Such responsibilities will affect the IT unit contribution to the firm efficiency (e.g., process improvements, operational efficiency, and cost savings) (Chen et al., 2010). On the other hand, CIO demand-side leadership entails building IT vision, becoming a strategic leader, forming partnerships with other business units, changing business processes through IT, and introducing IT-related innovations. Such leadership will impact the both the IT unit contribution to firm's strategic growth (e.g., market share growth, and return on investment) and firm efficiency (Chen et al., 2010). The impact of supply-side leadership on IT unit contribution to strategic growth is indirect and goes through the demand-side leadership. This means that to make greater organizational impact, CIOs have to mature from only leading the exploitation of available IT competencies to the exploration of new IT opportunities and initiatives that would result in innovation and growth (Chen et al., 2010).

#### 2.3.3.2. Reputation

Firms try to achieve a good corporate reputation as it has several advantages. It can be a source of sustained competitive advantage and signal of organizational legitimacy (e.g., Deephouse, 2000; Pfarrer et al., 2010; Roberts & Dowling, 2002; Staw & Epstein, 2000; Wang, 2010). One understudied aspect of corporate reputation is the firm's IT capability reputation. Lim et al. (2013) argue that the IT executive (i.e., CIO) will work to increase the firm's IT capability reputation (e.g., "best & brightest technology innovators", "most effective IT users", "best place to work in IT") by promoting "an image of superior IT capability to external stakeholders" (p. 59) with the expectation that the firm (i.e., Board of Directors and TMT) will reciprocate by increasing the IT organization internal legitimacy by rewarding and promoting the IT executive. Rewarding the IT executive who succeeds in projecting superior IT capability reputation is seen as sign that the firm appreciates and values such efforts (Lim et al., 2013). IT executives with greater structural power (position in the firm's hierarchy) and expert power (IT-related knowledge and experience) are more likely to promote such superior images about their firms' IT capabilities (Lim et al., 2013). IT executives with greater structural power in the firm are more likely to be successful in increasing the IT budget and perusing other TMT members to support IT initiatives and vision. Those executives with more IT-related knowledge, experience, and expertise are better in dealing with technology uncertainty, handling complex problems, achieving firms' goals and objectives, and gaining competitive technological advantage (Lim et al., 2013). Such IT executives are also more likely to attain internal legitimacy (Lim et al., 2013). A consequence of such reciprocity and increase in organizational legitimacy is that the IT executive will likely have a longer tenure in the firm (i.e., continuity in the IS strategic leadership) and, thus, sustainable IT capability reputation (Lim et al., 2013). A cycle of reciprocity will be created where firms with sustainable IT capability reputation will grant more rewards to IT executives and, hence, longer continuity in the IS strategic leadership. IT executives with greater IT-related expert and structural powers are more likely to project an image of superior IT capability of the firm to external stakeholder (Lim et al., 2013). Firms that appreciate such efforts will reciprocate by rewarding IT executives in the form of promotion. Those firms will also have lower turnover rates compared to firms that do not appreciate the good external IT reputation achieved and do not reward the IT executives (Lim et al., 2013). This leads to continuity in IS strategic leadership that, in turn, results in sustainable IT capability reputation. Firms with sustainable IT reputation will have more likelihood to promote IT executives than firms who cannot sustain the external reputation (Lim et al., 2013).

The public sector also benefits from the CIO-related factors and their consequences. The presence of Independent OCIOs as part of IT governance configurations is an important mechanism that positively influences both the state's IT department performance and state performance in general

(Dawson et al., 2016). State CIO IT budget can also contribute in making the government smaller (Pang et al., 2016). Building on theories such as transaction cost economics, theory of bureaucracy, and agency theory, state CIO IT budgets and investments in statewide standardized infrastructures, integrated enterprise systems and inter-organizational systems enable the government to digitize and improve business processes, reduce information asymmetry and improve agencies monitoring, and reduce coordination and transaction costs (Pang et al., 2016). All these benefit result in smaller government size by decreasing the use of input factors (e.g., labor), improve citizens and legislatures control over expanded spending by agencies (agents seek to maximize their expenditures as it is an indication of authority, prestige, and power), and facilitate the privatization of services (Pang et al., 2016).

# CHAPTER 3

## THEORY DEVELOPMENT AND HYPOTHESES

This chapter theoretically develops the logic for the two hypotheses linking benefits CIO membership in the TMT to relative firm performance. The first hypothesis argues that CIO membership in the TMT will impact relative firm performance. The second hypothesis extends this idea to how the relative firm performance benefits of CIO membership in the TMT are enhanced by looking at the CIO-TMT shared domain knowledge. We elaborate on the CIO-TMT shared domain knowledge, its dimensions, and how we will conceptualize it.

It is important to explicitly mention the two assumptions on which we build the arguments for the positive relative performance impacts of CIO membership in the TMT. Following prior studies, we embrace the assumption that TMT cognitive and demographic diversity is an indication of variety that positively “broadens the cognitive and behavioral repertoire of the unit” (Harrison & Klein, 2007, p. 1204). In this view, effective and creative decisions will be made as members of the TMT, drawing upon different resources such as functional/education backgrounds and experiences (Harrison & Klein, 2007). With this variety in the upper echelon, top executives will engage in discussions and disagreements about strategic situations. They will become more aware of the options and issues surrounding them (Miller et al., 1998). Top executives have varied knowledge, experiences, dispositions, and biases, and, thus, may differently interpret situations that affect their organizations’ strategies. Knowing how firms formulate and execute strategies is essential to understanding why organizations behave and act in specific ways (Hambrick, 2007).

Accordingly, we assume that when CIOs become official members of organizations' TMTs, they bring diverse knowledge, backgrounds, and experience that enrich TMTs' cognitive and demographic heterogeneity and, in turn, organizational outcomes.

### 3.1 Impact of CIO Membership on Relative Firm Performance

The advantages of CIO membership in TMT are mutually beneficial for both the CIO and executives in the top management. First, the CIO can contribute to the upper echelon by bringing unique cognitive resources and unique IT knowledge (Preston & Karahanna, 2009; Sobol & Klein, 2009). CIOs also can influence TMT cognitions about IS via mechanisms like the creation of shared understanding (Johnson & Lederer, 2010; Preston & Karahanna, 2009), engagement (Smaltz et al., 2006), and shared vision (Armstrong & Sambamurthy, 1999; Preston & Karahanna, 2009). Shared understanding is a dynamic process that entails the exchange of information and interaction that, over time, will lead to convergence among the involved parties regarding the role of IS (Johnson & Lederer, 2005; Liang et al., 2017; Preston & Karahanna, 2009). In addition, the TMT will recognize the value of IS to value-chain activities and execution of the firm's objectives and goals, thereby enhancing the IS strategic alignment (Preston & Karahanna, 2009). Creating a shared vision about IS role in the firm is important for creating IS strategic alignment and IS assimilation (Armstrong & Sambamurthy, 1999; Preston & Karahanna, 2009). Second, CIOs will have the opportunity to enhance their understanding of business and functional strategies (Karahanna & Preston, 2013). When CEOs and CIOs have a shared understanding, CIOs will understand their firms' IS needs and demands, allowing for effective IS application and contribution (Johnson & Lederer, 2005, 2010). Effective engagement is important (Earl & Feeny, 1994; Smaltz et al., 2006) as "higher levels of engagements between CIOs and the TMT are likely to set up the appropriate structures of communication, collaboration, and coordination that will help CIOs be effective in their salient organizational roles" (Smaltz et al., 2006, p. 212). Those CIOs who are formal members of TMTs and who can develop trusting relationships with TMT members will have the chance to develop better capabilities (e.g., better knowledge and interpersonal skills) and be regarded as more effective CIOs (Smaltz et al., 2006). The closer the CIO to the CEO and TMT—either by formal membership in the TMT and/or by reporting structure—the greater the chances the CIO has for interaction and official engagement with TMT members to effectively address challenges and opportunities related to IT (Armstrong & Sambamurthy, 1999; Banker et al., 2011; Karahanna & Preston, 2013; Preston & Karahanna, 2009; Smaltz et al., 2006).

Next, we develop the logic for the CIO membership in the TMT impact on firm performance. We propose that CIO membership in the TMT will contribute to firm performance. Here, firm performance is the financial performance that is measured using accounting-based measures such as return on sales and return on assets. CIO membership in the TMT can have a positive impact on the firm's bottom-line financial metrics. When being a member in the TMT, the CIO gain structural power and can have a holistic view of the firm problems, strategies, and opportunities as the CIO officially engages with the CEO and executives from different functions (Armstrong & Sambamurthy, 1999; Chen et al., 2010; Lim et al., 2013; Wu et al., 2015). Such membership has positive consequences that ultimately lead to better firm performance for the following four reasons.

First, CIOs in the TMT have more structural power that reflects in the CIO development of demand-side leadership (i.e., CIO leading the exploration of new strategic opportunities and IT-enabled innovations) and increase in the position legitimacy. With demand-side leadership, CIOs gain capabilities that allow them to digitally transform their organizations and change business processes using IT-related technologies and innovations (Chen et al., 2010). Such leadership capabilities impact the contribution of IT to the firm efficiency and the contribution of IT to strategic growth (Chen et al., 2010). Second, CIOs present in the TMT are more likely to promote superior images about firms' IT capabilities to external stakeholders, such as shareholders (Lim et al., 2013). Success in such tasks might be reflected in rewards and promotions to CIOs that, in return, enhance CIOs standing in the firm, extend their tenure, and, hence, sustain IT capability reputation and improve the overall firm reputation (Lim et al., 2013). Third, CIO membership in the TMT helps in the creation of a shared understanding about IS role in the firm (Preston & Karahanna, 2009), which is also critical for increasing organizational agility (Liang et al., 2017). When the CIO and TMT have shared mental models about IT contribution, executives will enjoy better emergent coordination of activities and collective performance, leading to enhancements in sensing and responding to changes in the competitive landscape. Further, a common view of IT contribution within the TMT can reduce the rigidity of IT alignment that impacts organizational agility by creating organizational inertia (Liang et al., 2017). Fourth, CIO/TMT's common view about IS strategic role also influences firm performance by establishing IS-business strategic alignment (Karahanna & Preston, 2013).

CIOs not only contribute to firms' performance, but also to the firm's future prospects. CIO membership in the TMT contributes to the long-term value and future performance potential of firms. First, CIOs' membership impact firms' strategies, IT assimilation in daily value creation activities, IT alignment, and IT contribution (Applegate & Elam, 1992; Armstrong & Sambamurthy, 1999; Emery, 1991; Wu et al., 2015). Organizations are increasingly investing in ever-changing technological avenues, such as big data, advanced analytics, and cloud computing, that could drive growth and create a competitive edge. Good management is the mechanism to translate these new investments and technologies into growth by embedding these technologies across operations and functions. All these activities take time to plan and execute, and the anticipated results are expected to be in the future. Besides, CIOs' impact and their influence on firms' IT strategies and investments may take time to be reflected in the organization (Brynjolfsson & Hitt, 1998; Weill & Olson, 1989). Second, CIOs contribute to enhancing firms' portfolio of intangible assets. The impact of CIO membership might not be measured directly. However, there are many activities and aspects of organizations that the CIO might impact. One of them is the firm's intangible assets/value (Bharadwaj et al., 1999). Examples of which include increasing quality, productivity, efficiency, and others.

Overall, based on extant literature, we argue that CIO membership in TMT will positively reflect on firm performance by enhancing business value through IT assimilation, IS strategic alignment, better IT reputation capabilities, better CIO leadership, better collaboration among top management, and improved organizational agility. With that, we present the first hypothesis:

**$H_1$**: *CIO presence in TMT will enhance firm performance*.

### 3.2. CIO Business Savviness, TMT Digital Savviness, and Relative Firm Performance

Studies in the IS strategic leadership literature generally agree on the view that the CIO should be a member of the TMT and that this membership is associated with better IT and organizational outcomes. However, we argue further that for CIOs, who are members of the TMT, to have a higher impact on their firms' performance, they need to be business savvy. Moreover, such impact amplifies as TMT executives are digitally savvy. By proposing this argument, we theorize more about the relationship between the two dimensions of shared domain knowledge and how they interact to result in a greater influence. First, we delineate the meaning of shared domain knowledge and its importance to the relationship between the CIO and TMT members. Second, we elaborate on the CIO business savviness and TMT digital savviness, which are the two dimensions of shared domain knowledge. Lastly, we theorize on how TMT executives' digital savviness moderates the relationship between CIO business savviness and firm performance.

#### 3.2.1. Shared Domain Knowledge

Shared domain knowledge is "the ability of IT and business executives, at a deep level, to understand and be able to participate in the other's key processes and to respect each other's unique contribution and challenges." (Reich & Benbasat, 2000, p. 86). Shared domain knowledge means that the CIO and TMT members hold overlapping or common knowledge (i.e., CIO having business knowledge and TMT members having some IS knowledge) (Preston & Karahanna, 2009). For one executive with business knowledge to comprehend and understand another executive with unique technical knowledge, there should be "an underlying base of mutual knowledge" (Kearns & Sabherwal, 2006, p. 133). Shared domain knowledge is important to facilitate the development of shared understanding between the CIO and TMT about the strategic role of IS in the firm, affect the use of IT for strategic and operational activities, enhance the rationality in IT decision-making processes, and facilitate the development of IT-business alignment (Boynton et al., 1994; Kearns & Sabherwal, 2006; Preston & Karahanna, 2009; Ranganathan & Sethi, 2002). When CIO and TMT have shared domain knowledge, information asymmetries are reduced, information processing and analysis are augmented, and information inputs to decision-making processes will be broader. All will lead to better rationality in strategic IT decisions (Ranganathan & Sethi, 2002). Shared domain knowledge also influences communication between business and IT executives (Reich & Benbasat, 2000). This is important because executives with shared domain knowledge will respect and understand each other's contributions and trust that the other will give the best effort (Reich & Benbasat, 2000). Most importantly, shared knowledge has been shown to influence the development of strategic IT alignment. Shared domain knowledge facilitates the creation of CIO-TMT shared understanding, which is the social dimension of alignment (Preston & Karahanna, 2009). This overlap in domain knowledge helps CIOs better communicate in business language and allows both parties to integrate knowledge better, participate in each other's processes, and resolve any incongruence concerning the role of IS in the firm (Preston & Karahanna, 2009).

Prior studies identify two dimensions of shared domain knowledge: CIO business savviness and TMT digital savviness (Chan et al., 2006; Kearns & Sabherwal, 2006; Preston & Karahanna, 2009; Reich & Benbasat, 2000). For example, Reich and Benbasat (2000) proposed that shared domain knowledge is composed of IT executives' amount of business experience and business executives' amount of IT experience. Chan et al. (2006) examined shared domain knowledge as a composition of how well-informed IS managers about the firm's long-term plans and key business initiatives and how well-informed the TMT about IT.

#### 3.2.1.1. CIO Business Savviness

Broadly, the IT leadership literature has historically emphasized the importance of CIO business knowledge and savviness (e.g., Applegate & Elam, 1992; Boynton et al., 1994; Feeny et al., 1992). Business knowledge is about understanding and knowing the firm's strategies and competitive landscape (Smaltz et al., 2006). It is the knowledge related to organizational strategies, products and services, the firm's environment and contingencies, and competitors' strengths, weaknesses, and actions (Armstrong & Sambamurthy, 1999). CIOs should possess at least a broad business knowledge (Applegate & Elam, 1992) to be considered effective (Smaltz et al., 2006). It is what distinguishes IT executives from IT managers (C. S. Stephens et al., 1992). However, high levels of business knowledge are required to increase IS-business strategy alignment and enable businesses with IT-related innovations (Smaltz et al., 2006). Business savviness is important because it allows CIOs to understand their firms' strategic priorities, sense and capture internal and external opportunities, know when and how IT can be used strategically, and create CIO/TMT shared language and shared understanding about the strategic IS role to the firm (Preston & Karahanna, 2009; Smaltz et al., 2006).

#### 2.3.1.2. TMT Digital Savviness

We define TMT Digital savviness as the IT-related knowledge and experience possessed by members of the top management. Armstrong and Sambamurthy (1999) point out that TMT IT-related knowledge is about understanding the firm's IT infrastructure, the emerging technologies and IT-enabled innovations, and the competitors' strategic IT actions. Kearns and Sebherwal (2006) define such savviness as the "knowledge of the value and potential of IT" (p. 135). TMT digital savviness is important because it allows TMT members to support key IT initiatives, to actively participate in IS planning, to assimilate IT into the business strategies and value-chain activities, to facilitate the development of CIO/TMT mutual understanding about the IS strategic role, and to increase the participation of business managers in strategic IT planning (Armstrong & Sambamurthy, 1999; Chan et al., 2006; Kearns & Sabherwal, 2006; Preston & Karahanna, 2009).

### 3.2.2. The Moderating Role of CIO-TMT Shared Domain Knowledge

Prior studies conceptualized shared domain knowledge as either a single construct or two constructs representing the two dimensions separately. When studied as one construct, shared domain knowledge includes items about CIO business savviness and TMT digital savviness (e.g., Chan et al., 2006; Ranganathan & Sethi, 2002). On the other hand, other studies examined each dimension of shared domain knowledge separately (e.g., Armstrong & Sambamurthy, 1999; Preston & Karahanna, 2009; Reich & Benbasat, 2000). One study looked at shared domain knowledge as the interaction of the IS organization business knowledge and line organization IS knowledge (Nelson & Cooprider, 1996). Nevertheless, shared domain knowledge was analyzed as one construct. We add the following theoretical nuances to this body of work.

We propose that shared domain knowledge is best presented as an interaction of the two dimensions, where TMT digital savviness acts as an amplifier to the relationship between CIO business savviness and firm performance. This allows for richer theorizing and a better understanding of shared domain knowledge dimensions and how they impact the firm (see Figure 3.1 below for the moderation relationship). CIOs may possess low or high business savviness, depending on their prior education, experience, and expertise. Studies and reports indicate that different CIOs possess different levels of business experience and knowledge (e.g., Preston et al., 2008). At the same time, TMT members might have high or low digital savviness. This is not surprising as executives have their domain knowledge that is crucial to perform their tasks and responsibilities.

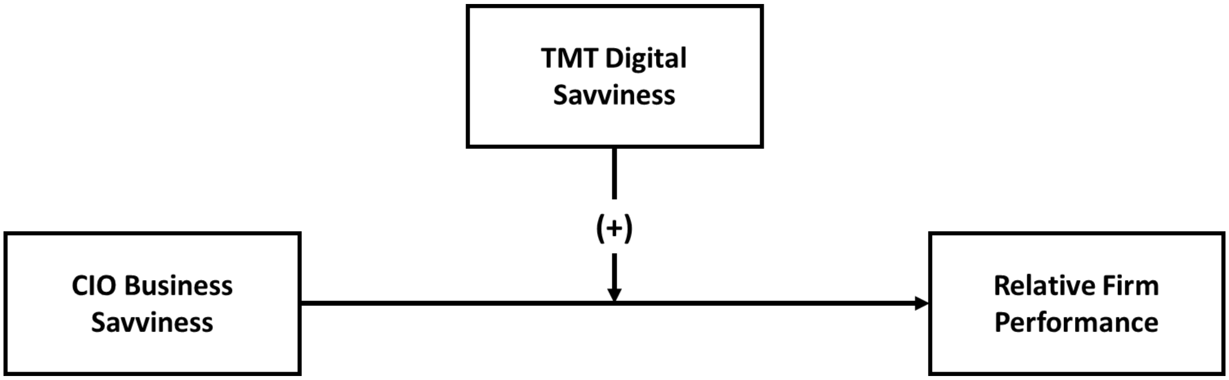



**Figure 3.1: The moderating impact of TMT digital savviness on the relationship between CIO business savviness and relative firm performance**

Studies in the IS strategic leadership literature generally view that CIOs should be members in their firms' TMT, and that this membership is associated with positive CIO-related, IT-related, and organizational outcomes, such as IS strategic alignment, better CIO decision-making authority, and better demand-side leadership (Chen et al., 2010, 2010; Karahanna & Preston, 2013; Preston et al., 2008). However, the effectiveness of CIO membership can be weakened or enhanced by the interaction of the shared domain knowledge dimensions. Depending on the two dimensions' levels, the interaction will either facilitate the CIO's work as part of the TMT or create obstacles and hinder gaining the potential benefits promised by the CIO membership. The general logic is the following. The effect of CIO membership on firm performance depends on CIOs being business savvy, and that TMT digital savviness would elevate such effect. Below, We present the justification for the moderation relationship.

Recently, the big driver of Target and Walmart's revenue growth was the tight integration between their online operations, store operations, and IT (Thomas, 2019). The execution of Target's "Site to store pick-up" strategy, for example, requires decision makers to have a good understanding of what to do, how to do it, and how technology enables it. Over the last few years, Target has made several structural changes in the top management to increase the presence of executives with experience, knowledge, and expertise in IT. Also, the CIO – currently Michael E. McNamara (EVP & CIO) – is a member of the TMT and has a diversity of business experiences and knowledge reflected in occupying senior managerial positions, business consulting, and membership in different boards.

As a member of the top management, the CIO has opportunities to interact with TMT executives and understand their objectives and needs. Hence, the CIO will be able to better direct and manage IT resources to support business initiatives and strategies and make valuable contributions to the firm (Armstrong & Sambamurthy, 1999; Karahanna & Preston, 2013). These benefits will be greater when both the CIO and TMT have high shared domain knowledge. Both sides can understand each other's domain knowledge, share ideas, and highlight any challenges that might face IT (Chan et al., 2006; Reich & Benbasat, 2000). With that, the CIO and TMT have a better understanding of the strategic role of IS to the firm (Preston and Karahanna (2009) refer to this as social alignment). When business and IT executives are socially aligned (i.e., have a high shared understanding), they share knowledge and communicate their goals and strategies, clarifying and understanding the strategic role of IT in supporting and driving the business (Gerow et al., 2016). This shared understanding will result in harmony between the mission, vision, and objectives of IT strategies and the mission, vision, and objectives of business strategies (i.e., IT-business intellectual alignment) (Gerow et al., 2016; Preston & Karahanna, 2009). Alignment between IT and business is important to increase the firm's profitability and generate a sustainable competitive advantage. Alignment is connected to increased sales revenue, cost reduction, operational efficiency, and customer value enhancement. When firms have IT-business alignment, they tend to effectively use IT resources and direct IT investment and resources to projects linked to overall organizational objectives (Gerow et al., 2014).

Nevertheless, CIOs can also possess low business savviness. This can be problematic to CIOs who are increasingly expected to possess high business knowledge, especially when they are part of the TMT. Statistics show that nearly one out of four CIOs are fired because of poor performance (Nash, 2009). Anecdotal evidence offers several reasons for such a high percentage (e.g., Andriole, 2017; Loten, 2017; Nash, 2009). One important reason is the CIO's lack of understanding of the business initiatives, strategies, and competitive nature. Hence, CIOs who do not possess the proper business knowledge might fail to harness the potential IT-related advantages.

Firms might have TMT members who are digitally savvy. Executives who have good digital knowledge and experience, thus, share IT-related knowledge with the CIO. With their digital savviness, CEO, CFO, and other TMT members can build common ground with the CIO. High TMT digital savviness can reduce information asymmetries, enhance CIO/TMT communication, lead to better rationality in strategic IT-related decisions, and establish shared understanding (Preston & Karahanna, 2009; Ranganathan & Sethi, 2002; Reich & Benbasat, 2000). In this case, the CIO in the TMT circle benefits from executives who understand IT and can guide and educate the CIO on applying IT to business-related projects and initiatives.

Accordingly, whether the CIO has low or high business savviness, TMT digital savviness will play a positive role in increasing the CIO's business savviness impact. The relationship between CIO business savviness and firm performance is conditional on TMT digital savviness level, such that the relationship is stronger when TMT digital savviness level is high and weaker when TMT digital savviness level is low. Hence, we present the second hypothesis:

**$H_2$**: *TMT digital savviness will strengthen the impact of CIO business savviness on firm performance*.

# CHAPTER 4

# METHODOLOGY

This chapter discusses the research methodology. Here, we describe (1) sampling frame and sample, (2) data collection and sources, (3) data pre-processing, and (4) dependent, independent, moderator, and control variables.

## 4.1. Population, Sampling Frame, and Sample

The population of interest is the firms in the United States. The sample inclusion criteria are all U.S. publicly traded firms with complete archival data about their financials, TMT characteristics, and board of directors. The sampling frame for the firms is available and accessible through CRSP and Compustat Databases. The databases contain multiple years of financial and market data for publicly traded firms. Given the archival nature of the data to be collected, the final sample contains firms listed in the S&P1500. Such a sample has been used in many firm-level studies (e.g., E. H. Chang et al., 2018; Dezsö & Ross, 2012; J. M. Lee et al., 2017; Shi et al., 2017). The S&P 1500 is a U.S. stock market index that combines all stocks of S&P 400, S&P 500, and S&P 600, and is designed to offer a measure of the performance of the overall U.S. equity market to investors (Dezsö & Ross, 2012). Rich data about the firms in the S&P 1500 are available via databases like Compustat, Execuomp, and RiskMetrics. In the next section, we will elaborate on the data collection and sources.

A total of 1,146 U.S. publicly listed firms that are part of the S&P1500 are gathered, and data about these firms are triangulated from Compustat, Execucomp, RiskMetrics, and SEC filings.

However, not all of these firms have complete data for all variables. Table 4.1 summarizes the definitions and operationalizations of the variables collected.

**Table 4.1 Summary of Variables**

| Variable | Definition | Measurement | Source |
|---|---|---|---|
| **Dependent Variable** | | | |
| Relative Firm Performance | Difference between a focal firm's financial performance and average industry financial performance. | Difference between the firm's Tobin's q and two-digit SIC code industry Tobin's q (ΔTQ). | Compustat |
| **Independent Variable** | | | |
| CIO presence in TMT | The presence of the CIO in the firm's TMT. | One if CIO title or CIO-related title is included in firm's business executives' section in SEC filings; zero otherwise. | ExecuComp<br>SEC filings |
| **Control Variables** | | | |
| Asset Tangibility | Tangible assets over sales. | Sum of total Property, plant and equipment, total inventories, equity investment and advances, and other investment and advances. All divided by net sales. | Compustat |
| Capital Intensity | Funds used by a firm to acquire/upgrade physical assets, scaled by assets. | The ratio of capital expenditures divided by total assets. | Compustat |
| COGS | The direct costs associated with producing goods. | The ratio of cost of goods sold to sales. | Compustat |

| | | | |
|---|---|---|---|
| Leverage | Total debt of the firm divided by its total assets. | The ratio of total liabilities to total assets. | Compustat |
| Firm Size | The market value of a firm. | Natural log of the firm's market value. | Compustat |
| Operating Cost | Firm's operating efficiency. | The ratio of total operating costs to sales. | Compustat |
| Organizational Slack | Firm's excess resources used for achieving innovation and immediate business requirements. | The ratio of total current assets to total current liabilities. | Compustat |
| R&D Innovation Intensity | Expenses related to research & development of and firm's goods and services scaled by assets. | The ratio of a firm's research and development to its total assets. | Compustat |
| Market Concentration | The extent to which a relatively small number of firms dominate an industry. | Herfindahl-Hirschman Index = $\sum_{i=1}^{N} s_i^2$, where s is the firm's market share in a 2-digit SIC. | Compustat |
| Environmental Dynamism | The rate and unpredictability of environmental change. | The volatility of 2-digit SIC industry sales. | Compustat |
| Environmental Munificence | The extent to which a firm's environment supports sustained growth. | Growth in 2-digit SIC industry sales. | Compustat |

To be consistent with other studies that used archival data to study TMT members and firm performance, we exclude firms with missing data from the final sample (Germann et al., 2015; Marcel, 2009; Nath & Mahajan, 2008). However, before this step is performed, we investigate the sources of data missingness. This step is essential because it shows what variables are missing many values, seeing if the missing values can be recovered by going back to the original dataset, and understanding why such values are missing. Moreover, many missing values will decrease the sample size used as listwise deletion is the default in the statistical analyses, and only observations with complete data are used in the analysis. The main reason for the missingness in our sample is how many variables in the dataset are calculated. They are based on equations (e.g., ROA is the ratio of income over assets). If a variable has missing values from the data source, this will result in missing values for the calculated variable. According to the data sources (e.g., Compustat, Execucomp), if values for a variable are missing, then it is because the firm did not report these values, for example, in 10-K or DEF 14A reports.

**4.2. Data Collection and Sources**

Archival data have been extensively used in the IS field for many years. Researchers can benefit from several advantages. First, archival data are used to get quantitative, objective measures that represent theoretical constructs (Ketchen et al., 2013) and reduce the biases associated with perceptual measures (e.g., data collected using surveys). Second, researchers can examine the hypothesized relationships across time and, thus, strengthen the arguments for causality (Barnes et al., 2018). With archival data, researchers can use panel (longitudinal) data design in addition to sophisticated econometric techniques to better argue for causality compared to cross-sectional data design. Third, research transparency and reproducibility are higher since archival data are accessible, and chances of deliberate misconduct are reduced (Barnes et al., 2018). Fourth, researchers can enjoy increased statistical power by collecting larger sample sizes, and thus, lowering the chances of Type I and Type II errors in hypothesis testing (Barnes et al., 2018).

WE collect and triangulate data from three archival data sources for firms. First, for the firms' financial data, WE use CRSP and Compustat Databases. The databases contain annual and quarterly data related to the firms' balance sheet, income statement, and other financial and market information. CRSP and Compustat databases draw their data from SEC filings (e.g., 10-K and 10-Q reports). Many studies in the IS field rely on these databases to get reliable, objective financial data about firms. For example, Lim et al. (2013) used Compustat to collect data about firms' performance to answer the question about the importance of IT capabilities reputation impact on firms IS leadership continuation and sustainability of IT reputation. Masli et al. (2016) collected data from the database about firms' characteristics such as growth, leverage, and size to test the hypotheses about CEOs and CFOs turnover with reported IT-related deficiencies.

Second, to identify the membership of the CIO in the TMT, we use Execucomp database. This database from Standard & Poor's contains data about the top executives in firms included in the S&P1500 (i.e., S&P 400 MidCap, S&P 500, and S&P SmallCap 600 indexes) since 1992. The database includes data about executives' compensation data such as salary, stock options, bonuses, and non-financial data such as the executive name, age, and title. This database has been utilized several times in our field (e.g., J. Ho et al., 2017; Talmor & Wallace, 1998; Wang, 2010).

Third, we collect data related to the board of directors (e.g., corporate governance) from RiskMetrics (formerly known as Investor Responsibility Research Center) database, which contains data about directors' characteristics such as title, name, age, tenure, gender, and other data for the S&P1500 firms. Several papers in the IS field have used this database to get information about the board of directors and their characteristics (e.g., J. Ho et al., 2017; Pan et al., 2018).

Since there is no dedicated database that contains structured data about CIOs and TMT business and digital savviness, we perform the data collection manually from SEC filings (e.g., 10-K and DEF 14A reports), executives bios websites such as LinkedIn and Bloomberg, firm's websites (e.g., press releases and investors relations section), and databases that contain firms historical information such as Mergent Online and Dun & Bradstreet's (D&B) Hoovers. Figure 4.1 summarizes the data collection procedure.

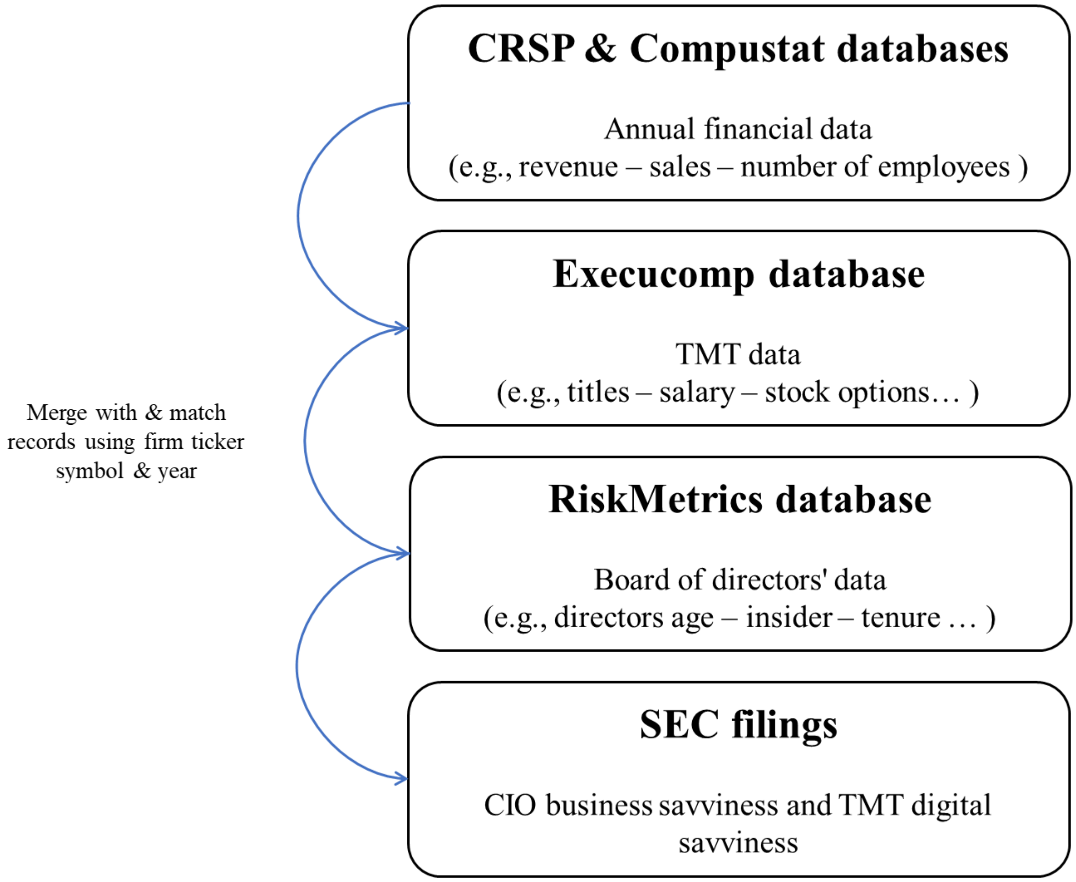



**Figure 4.1: Data Collection and Matching Procedure**

## 4.3. Data Pre-Processing

We utilize a lagged cross-sectional design. Proper lagging (i.e., temporal sequence) is used to account for causal ordering. The independent variable of interest, moderator variable, and control variables are measured in time ($t_0$ = 2016), the dependent variable in time ($t_1$ = 2017) and time ($t_2$ = 2018), and other variables (e.g., instrumental variables) in time ($t_{-1}$ = 2015).

As for the data preparation, we perform the following steps. First, after collecting combining the data using a unique key attribute for each firm (e.g., Global Company Key "GVKEY" from CRSP/Compustat), the data are checked for errors. Second, regarding missing data and to be consistent with other studies that used archival data to study TMT members and firm performance, we will eliminate any firm with missing data (e.g, Germann et al., 2015; Marcel, 2009; Nath & Mahajan, 2008) if we were not able to recover the missing value from the original source. Other IS studies that examined firm-level phenomena and used the same data sources also followed the same approach (e.g., Bardhan et al., 2013; Y. B. Chang & Gurbaxani, 2012; Dewan & Ren, 2011). Third, we perform data diagnostics to check for outliers, generate descriptive statistics, look at the shape of variables distributions, and check for multicollinearity.

## 4.4. Dependent, Independent, Moderator, and Control Variables

### 4.4.1 Dependent Variable

We define firm performance as the difference between a focal firm's financial performance and average industry financial performance (i.e., relative firm performance or Δ firm performance). Thus, the point of reference is the financial comparison with the focal firm's industry (Fiegenbaum & Thomas 1988; Han et al. 2017). This definition is similar to relative firm performance measures used in different IS studies based on primary data (e.g., Rai et al., 2006; Wu et al., 2015). Here, relative refers to the comparison of the focal firm performance against competitors' average performance. How the firm performs among its peers is an essential indicator of the relative position among a cohort of rivals. Relative performance influences organizational decision making rather than absolute performance (Han et al., 2017). Utilizing this measure, we look at how CIOs' presence to the TMT can affect firms' financial performance relative to their industries. This measure is also an indication of the relative competitive position of the focal firm. Also, it allows for better capturing of an industry's competitive dynamics.

The logic of this type of performance measure is rooted in the Red Queen perspective. In contexts where red queen competition is present, organizations that survive the history of competition become stronger competitors. As for weaker competitors, either they learn and adapt, or they fail. In this competitive race, running fast is not enough. According to the red queen perspective, focal organizations' actions, rivals' actions, and speed matter (Derfus et al., 2008) and strongly affect growth, founding, and failure (Barnett & McKendrick, 2004). An example of firms' actions from an IT perspective would be exploiting innovations such as merging technologies (e.g., IoT and additive manufacturing) that could disturb the landscape of competition and intensify the red queen effect (Tiwana, 2014).

The red queen effect is an incremental and self-reinforcing process where a focal organization's solution becomes its rival's problems (Barnett & McKendrick, 2004). As satisfaction level drops and aspiration level goes up, an organization engages in problemistic search due to scarcity and constraint in actions. When the organization's performance is restored, it becomes stronger. In turn, other rivals will engage in problemistic search as their relative performance decrease. The cycle repeats, and over time through selection and learning, organizations become adapted to their context and become better in exploitation (Barnett & Pontikes, 2008). Put succinctly: "Each firm is forced by the others in the industry to participate in continuous and escalating actions and development that are such that all the firms end up racing as fast as they can just to stand still relative to competitors." (Derfus et al., 2008, p. 61). Organizational learning (March, 1991) and natural selection are mechanisms through which the red queen evolution happens (Barnett & McKendrick, 2004; Barnett & Pontikes, 2008). Organizations satisfice when it comes to making decisions (e.g., responding to competition in the marketplace). When performance falls below an aspiration level, organizations engage in a problemistic search for alternatives until reaching a satisfactory level. Moreover, as competition builds up, those organizations that are less fit are selected out. Over time, organizations that survive a history of competition in their contexts have higher levels of fit.

We operationalize the dependent variable as the difference between the firm's Tobin's *q* and the two-digit SIC code industry Tobin's *q* (relative TQ or Δ Tobin's *q*). Tobin's *q* was introduced by James Tobin (Tobin, 1969, 1978) to predict a firm's future investments, and also as a measure of firm performance and an indicator of a firm's intangible value (Bharadwaj et al., 1999). Different IS studies have used Tobin's *q* to measure the impact of IT contribution to firms (e.g., Bharadwaj et al., 1999; Kohli et al., 2012). Tobin's *q* overcomes some of the limitations of the backward-looking accounting measures such as ROA and ROS (Karahanna & Preston, 2013; Kohli et al., 2012; Li & Ye, 1999). The formula for calculating Tobin's *q* is the following (Bharadwaj et al., 1999):

$$\text{Tobin's } q = \frac{\text{MVE} + \text{PS} + \text{DEBT}}{\text{TA}}$$

Where:
**MVE**: is the closing price of shares at the end of the financial year multiplied by the number of common shares outstanding
**PS**: is the liquidating value of the firm's outstanding preferred stock.
**DEBT**: is the sum of current liabilities, the book value of inventories, and long-term debt minus current assets.
**TA**: is the book value of total assets.

We suggest that this is a strong conceptualization of firm performance for the following reasons. CIO presence contributes to the long-term value and performance of firms. It has been shown from the CIO literature that CIOs impact firms' strategies, IT assimilation in daily activities and supply chain, IT alignment, and IT contribution in general. Organizations are increasingly investing in ever-changing technological avenues, such as big data and advanced analytics, and cloud computing, that could drive growth and competitive edge. Translating these new investments and technologies into growth is mediated by proper management that would embed these technologies across operations and functions. With CIOs in the C-suite, they can become more familiar with their organizations' opportunities and needs and gain a better business perspective (Applegate & Elam, 1992; D. Preston, 2004). This familiarity allows CIOs to better assimilate technologies into their organizations (Armstrong & Sambamurthy, 1999; Emery, 1991). All these activities take time to plan and execute, and the anticipated results are expected to be in the future and not at present. Thus, the impact of CIOs and their influence on firms' IT strategies and investments may take time to be reflected in the organization. Moreover, CIOs contribute to firms' intangible assets. The impact of CIO presence might not be measured directly. However, there are many activities and aspects of organizations that the CIO might impact. One of these aspects is the firm's intangible assets/value, such as increasing quality, productivity, efficiency, etc.

### 4.4.2 Independent Variable

The independent variable of interest (CIO membership in the TMT) is measured as a dichotomous variable (1 if the CIO is present in the TMT for year $t_0$; 0 otherwise). The same operationalization has been used to study other executives in the TMT (e.g., Nath & Mahajan (2008) and Germann et al. (2015) for CMO; Marcel (2009) for COO; and Menz & Scheef (2014) for the CSO). The title "Chief Information Officer" is used broadly in this study since such a title is not always used in all firms. Other titles used to represent the most senior IT executive/manager in the firm includes Director of IT, MIS Manager, VP of Technology, and more. To be consistent with other studies in the IS leadership literature (e.g., Banker et al., 2011; Chatterjee et al., 2001; Chen et al., 2010; Lim et al., 2013), we will use the term CIO to represent the most senior IT executive in firms (Karahanna & Preston, 2013). We conclude that a CIO is part of the TMT if the title (or similar ones) is available under the section "Executive Officers" in different SEC filings and ExecuComp database.

### 4.4.3 Moderator Variables

We measure CIO business savviness and TMT digital savviness using several proxy measures. CIO business savviness can be composed of CIO business-related experience, CIO business-related education, CIO board experience, and CIO practical experience. TMT digital savviness can be composed of TMT IT-related experience, TMT IT-related education, and TMT IT industrial experience. Table 4.2 and 4.3 show summaries of these proxy measures.

**Table 4.2: Proxy Measures of CIO Business Savviness**

| Variable | Construct | Definition | Measurement |
|---|---|---|---|
| CIO_EX | CIO managerial experience | Whether the CIO held managerial/functional positions. | Indicator variable: $\begin{cases} 1, & \text{if held at least one position} \\ 0, & \text{otherwise} \end{cases}$ |
| CIO_EDU | CIO business education | Whether the CIO has: business-related academic degrees (e.g., BBA, MBA), and/or certifications (e.g., PMP, six sigma). | Indicator variable: $\begin{cases} 1, & \text{if at least has a degree and/or certification} \\ 0, & \text{otherwise} \end{cases}$ |
| CIO_PE | CIO practical experience | Experience in business-related projects and initiatives. | Indicator variable: $\begin{cases} 1, & \text{if at least has one project experience} \\ 0, & \text{otherwise} \end{cases}$ |
| CIO_Board | CIO board membership | Whether the CIO has membership as a director in firms' boards. | Indicator variable: $\begin{cases} 1, & \text{if held at least one membership} \\ 0, & \text{otherwise} \end{cases}$ |

**Table 4.3: Proxy Measures of TMT Digital Savviness**

| Variable | Construct | Definition | Measurement |
|---|---|---|---|
| TMT_EX | TMT IT employment | Whether TMT executives have functional/managerial experience in IT or IT-related positions (e.g., CIO, VP of IT). | The sum of TMT executives with experience. For example, if two executives each have experiences, then TMT_EX = 2. |
| TMT_IE | TMT IT industrial experience | TMT executives have prior experience in an IT firm (e.g., Microsoft, Dell). | The sum of TMT executives with industrial experience. |
| TMT_EDU | TMT IT education | Whether TMT executives have IT-related academic degrees (IS, CS, EE), or certification (e.g., CSM, CISSP). | The sum of TMT executives with IT education. |

We create aggregate measures for CIO business savviness and TMT digital savviness from these proxies.

**CIO business savviness** is measured as a binary variable that equals to one when at least one of the business savviness proxies is equal to one.

**TMT digital savviness** is a continuous variable. First, we create a digital savviness binary variable for each executive in the TMT. It equals one when the executive has at least one of the digital savviness proxy measures equal to one. Then, we sum the individual executives TMT savviness and then divide by the TMT size.

It is hard to find representative, accurate proxies of the constructs as the archival data were collected for reasons other than what is intended in this research (Ketchen et al., 2013; Payne et al., 2003). We argue that the way we measure both CIO and TMT savviness is the best given the limitations of archival data and proxy measures. For CIO proxies, it is hard to assume that the proxy measures have similar weights and importance given their binary nature. For example, a CIO with years of business-related experience will be coded as one in business savviness. Another CIO who has business-related education will also be coded as one in business savviness. Can we assume that both CIOs have equivalent business savviness? The short answer is no. It is not possible to posit the weight of each proxy and compare it with the others. Moreover, if we sum the proxies of CIO business savviness to create a categorical variable, we cannot tell if the increase is equal. The measure would look ordinal, but assuming a natural ranking would be problematic and would require certain unrealistic assumptions. Accordingly, using a categorical CIO measure (e.g., with levels 0, 1, 2, 3, 4) would probably result in many issues. Thus, for the binary CIO business savviness measure, the interpretation of one in business savviness is that the CIO has business savviness. However, some CIOs would be better than others, but we cannot distinguish who is better given the aforementioned limitations.

To increase confidence in these measures, we perform the following steps. First, by using multiple proxies, we try to capture business and digital savviness from archival data as much as we can. Each proxy aims to collect information, such as experience and education, that would suggest how knowledgeable an executive is either digitally for the TMT or business-wise for the CIO. We relied on prior studies to either directly borrow measures of savviness [e.g., for CIO business savviness, we looked at Lim et al. (2013) and Reich and Benbasat (2000), and for TMT digital savviness we used measures from Benaroch & Chernobai (2017) and Masli et al. (2016)], or indirectly by finding measures that reflect the savviness items collected via primary data sources [e.g., Armstrong & Sambamurthy (1999) and Preston & Karahanna (2009)].

Second, the coding of these proxies was done manually by one person. To check the reliability of the coding, we use Interrater Reliability (IRR) to assess the consistency of the categorization and coding of CIO business savviness and TMT digital savviness from secondary text sources, and to justify the aggregation of lower-level data (LeBreton & Senter, 2008). Interrater Reliability (IRR) is defined as the "degree of agreement of correlation between the ratings of codings of two independent raters or observers of the same phenomenon" (Trochim et al., 2015, p. 212). We selected two independent coders to perform the coding on a randomly selected set of observations. The two coders were provided an online training session to explain the purpose of the study, demonstrate the coding procedure, and discuss any issues in the coding procedure. Besides, we provided coding instructions document to facilitate the coding task. The agreement between the researcher and the coders is calculated using Fleiss' kappa (similar to Cohen's kappa but for two raters and more). The results show high and good interrater reliability. For the CIO business savviness, Fleiss' kappa is 0.76 (p-value < 0.000), and for TMT digital savviness, the kappa is 0.83 (p-value < 0.000).

### 4.4.4 Control Variables

We control for other variables used in prior research (e.g., Banker et al., 2011; Bharadwaj et al., 1999; Khallaf & Skantz, 2011; Nath & Mahajan, 2008; Pan et al., 2018). We include control variables that are used to explain variations in firm performance. These control variables include Firm-level variables and Industry-level variables. We control for firm-level variables, which include firm-specific characteristics that have been utilized in extant studies and are considered key factors influencing firm performance. These variables are typically found in many studies on the top management team (e.g., Dezső et al., 2016; Dezsö & Ross, 2012; Fu et al., 2020; Kanashiro & Rivera, 2019). We also control for industry-level variables as the characteristics of an industry (e.g., structure, competitive dynamics, concentration) influence firms and their performance in the industry (Bharadwaj et al., 1999; Hansen & Wernerfelt, 1989).

We control for several firm characteristics that are associated with firm performance. *Asset tangibility* is one of the main determinants of firm performance. It is related to the tangible resources a firm has and linked to different performance aspects such as market power, economies of scale, organizational structure, and others (Mosakowski, 1991). *Capital intensity* is related to the amount of capital needed to generate sales. It is linked to firm performance (Capon et al., 1990; Russo & Fouts, 1997). Firms in the oil and gas industry, for example, are characterized by high capital intensity and investment (Clews, 2016). *The cost of goods sold* (COGS) relates to the firm's expenses to produce goods and services. It is an accounting-based measure of the costs of the firm's operations (Zhu & Kraemer, 2002). It has been used as both a control variable in previous CIO-related studies (e.g., Khallaf & Skantz, 2011) and used as a proxy for performance in other studies (e.g., Aral & Weill, 2007). *Leverage* is about using debt to finance projects or investments to increase return. It is a financial constraint that either impedes or facilitates firm innovation and performance (Becker-Blease, 2011). Larger firms may have greater performance than medium or small size firms due to differences in capabilities and resources, scale effects, and market power (Dean et al., 1998; Lahiri & Narayanan, 2013). Since the sample includes firms with different market capitalizations, we control for *Firm size* in our analysis. To control for the operating efficiency of a firm, we include *Operating costs* in the analysis. Firms enjoy high operating efficiency and better performance if they have low total operating costs to sales ratio (Moatti et al., 2015). *Organizational slack* represents the excess resources a firm possesses, allowing firms to identify, experiment, and pursue new opportunities (Iyer & Miller, 2008) and adapt to external and internal pressures and environmental changes (Wan & Yiu, 2009). It is linked to firm performance "because it can buffer a firm's technical core from environmental upheavals" or "allow it to pursue risky strategies." (Wan & Yiu, 2009, p. 794). *R&D innovation* represents an important type of intangible assets (Bharadwaj et al., 1999). Controlling for this variable corrects for any overstatement for firms with high intangible assets (Amit & Wernerfelt, 1990).

Also, we control for two types of industry characteristics: market concentration and environmental uncertainty. With *Market concentration*, we control for the level of competitive uncertainty in an industry (Benaroch & Chernobai, 2017). High market concentration means that a few firms dominate the industry, and low concentration indicates that the industry has more rivalry among firms (Nath & Mahajan, 2008). For environmental uncertainty, we control for both environmental dynamism and environmental munificence (Sabherwal et al., 2019). *Environmental dynamism* is about the rate of instability and unpredictability of change in the firm's environment (Newkirk & Lederer, 2006). A highly dynamic environment influences firm performance by increasing the challenges in adopting new tactics and strategies and sustaining competitive advantages (Sabherwal et al., 2019). On the other hand, *Environmental munificence* is related to how the environment supports firms' sustained growth (Sabherwal et al., 2019; Wade & Hulland, 2004). Mature or shrinking environments have low degrees of munificence. Under such an environment, firms suffer from high competition levels, affecting organizational goal attainment and survival and leading firms to focus more on increasing internal efficiencies to maintain profits (Sabherwal et al., 2019; Wade & Hulland, 2004).

# CHAPTER 5

# ANALYSIS AND RESULTS

This chapter shows the results of hypotheses testing. In the first part, we show the results for the first hypothesis about the relationship between the CIO presence in the TMT. We start by discussing the analytical procedure and the rationale for the econometric models' selection. Then we show diagnostics and preliminary analyses to the data collected. Next, we demonstrate the results for the main analyses. Finally, we show the results of the different sensitivity analyses and robustness checks.

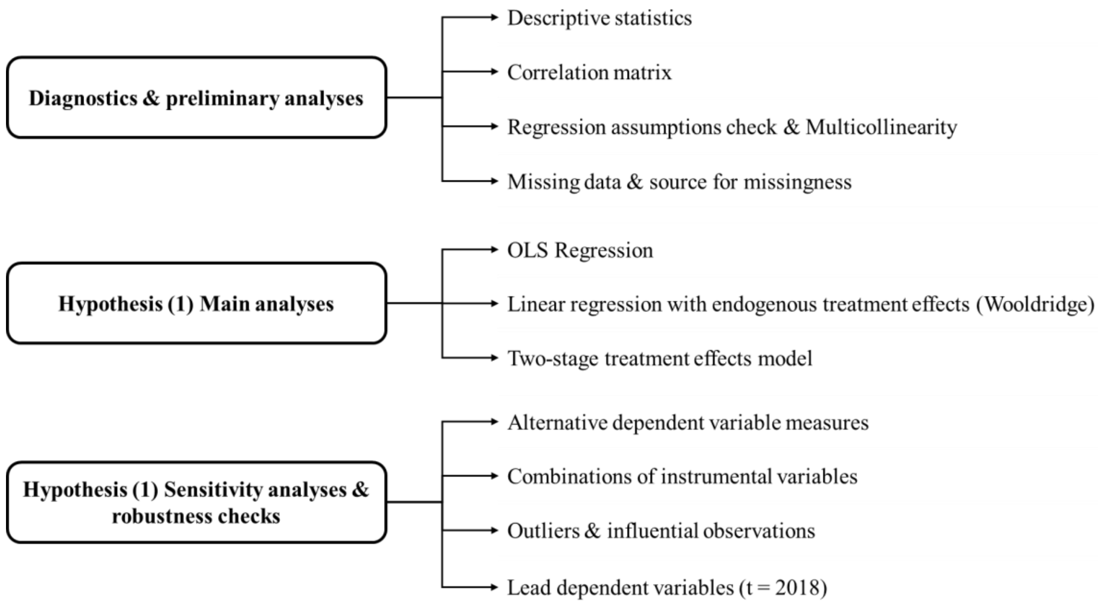
The second part of this chapter shows the results for the second hypothesis about the moderation relationship. First, we show the interaction test results, followed by split sample analysis, and then interaction probing the plotting. Next, we perform several robustness checks to observe the consistency of the main analyses results.

## 5.1 Hypothesis (1): CIO Presence in TMT

### 5.1.1 Analytical Procedures

Figure 5.1 summarizes the analysis plan for hypothesis one. The independent variable of interest (CIO presence in the TMT) is binary, and the dependent variable is continuous. Therefore, we will start by using OLS regression as a base model to test the first hypothesis. OLS regression results are consistent and efficient (Kennedy, 2008) if all assumptions are satisfied. However, we suspect that there is a self-selection bias, leading to the violation of the OLS assumptions.

**Figure 5.1 Summary of Hypothesis 1 Analyses**




Firms self-select to have (or not have) CIOs in their TMT. In reality, the decision to include the CIO in the executive C-suite is a rational choice that depends on a variety of firm-specific structural, strategic, environmental, and TMT and board-related factors (Menz, 2012; Nath & Mahajan, 2008). Such a decision is not random, but "rather endogenous to [its] expected performance implications" (Bascle, 2008, p. 286), which makes the presence of the CIO in TMT endogenous in nature. Failing to account for endogeneity means that studies implicitly assume that firms' choice of including CIOs in the TMT is random. More technically, in the self-selection issue, the treatment of interest becomes endogenous. Following (Wooldridge, 2010), we use the term "treatment" in its very broad meaning. The work on self-selection is based on Heckman's (1974) work on sample-selection (Clougherty et al., 2016). The treatment is endogenous because it is not randomly assigned. Participants/agents endogenously choose to be part of either the treatment or the control group (i.e., choices are not random, but selected by observational agents, such as firms choosing whether to enter a new market niche or engage in a merger decision). Following the same logic, firms' presence of CIOs in their TMT is a purposeful strategic choice based on observable firm-related conditions and factors (e.g., capabilities, industry, competition, among others) and unobservable factors.

Using the OLS to estimate a model with an endogenous treatment would lead to inconsistent estimates (Clougherty et al., 2016). Instrumental variable (IV) estimation techniques can be employed to solve this issue (Clougherty et al., 2016; Wooldridge, 2010). So, "By using the prediction from the selection model instead of the true values of the endogenous treatment, the error term is cleaned of the variability due to self-selection and this allows a consistent estimate of the treatment effect." (Clougherty et al., 2016, p. 296).

One IV estimation model is the two-stage least squares (2SLS) with approximating the estimation of the binary treatment using a linear probability model (Clougherty et al. 2015; Wooldridge 2016). However, this technique suffers from several disadvantages due to the binary nature of the treatment (Clougherty et al., 2016; Wooldridge, 2015). Plus, the performance of this model under weak instruments is inferior to other IV estimations models (Clougherty et al., 2016).

Wooldridge (2010) demonstrates a procedure that corrects for the endogeneity of a treatment variable (i.e., linear regression with endogenous treatment effects model). The procedure involves two steps. In the first step, we regress the binary treatment on the instruments and control variables using a Probit model. From this model, we get the fitted probabilities (i.e., propensity). Next, in the second stage, we run a single-equation IV regression, with the fitted probabilities as the instrument for the endogenous treatment (Wooldridge, 2010).

Another recommended type of IV estimation, given the binary nature of the endogenous variable and its superior performance, is the Endogenous treatment-regression model (command *etregress* with the two-stage option in Stata). Thus, to correct for the endogeneity of the CIO presence in the TMT, we will use the Two-stage treatment effects model with the two-step consistent estimator (J. J. Heckman, 1976; Maddala, 1983; Shaver, 1998). The model estimates the average treatment (program) effect when the linear regression model includes an endogenous binary variable (i.e., treatment). The estimation technique has two steps. The first step uses a Probit model to estimate the endogenous treatment equation, where the endogenous binary treatment is the outcome, and the instrumental variables are the regressors.

$$\Pr\left(t_j = 1 \middle| \mathbf{w}_j\right) = \Phi(\mathbf{w}_\mathrm{j}\gamma)$$

Where:
$t_j$: binary-treatment variable.
$\mathbf{w}_j$: covariates used to assign the treatment.

The second step is the regression equation estimated using the OLS estimation model. Relative firm performance is the dependent variable, and the regressors are the covariates, the treatment, and the hazard ($\lambda$).

$$E\left(y_j \middle| t_j, \mathbf{x}_j, \mathbf{w}_j\right) = \mathbf{x}_j\boldsymbol{\beta} + \delta t_j + \rho\sigma h_j$$

The estimation of the endogenous treatment gives the average treatment effect (ATE), which is "the average difference of the potential outcome of the treated group as compared to the potential outcome of the group that has not been treated." (Clougherty et al., 2016, p. 296).

### 5.1.2 Instrumental Variables

For both the Linear regression with endogenous treatment effects and Two-stage treatment effects models, it is imperative to choose the appropriate instrumental variable (IV) to produce a CIO estimator that is consistent and efficient (Bascle, 2008). Accordingly, a good IV is required to fulfill two critical conditions: instrument relevance and exclusion restriction (Bascle, 2008; Germann et al., 2015; Wooldridge, 2015). We choose and build the case for instrumental variables based on the Institutional perspective, the Red Queen perspective, Agency theory, and Upper echelon theory.

We define *CIO prevalence* as the number of peer firms with a CIO present in the TMT and operate in the same primary two-digit SIC code as the focal firm. Both the focal firm and peer firms face the same environmental conditions and have the same expectations. From an institutional theory perspective (DiMaggio & Powell, 1983), firms may imitate their peer firms in the same industry concerning having similar executives at the C-suite level (Fu et al., 2020). Also, from a Red Queen competition perspective, when a firm in an industry faces a strategic choice to improve in the face of the competition (e.g., have a CIO in TMT), this move becomes the focal firm's problem (Barnett, 2008). Thus, the focal firm triggers actions to improve and adapt in the face of the new changes in the competition. Moreover, we argue that CIO prevalence is uncorrelated with any omitted variables that would impact relative firm performance (Germann et al., 2015). Omitted variables that would influence a firm's relative performance are accounted for in the error term in the second equation of the IV estimation technique. Firm-level variables such as firm culture and processes are examples of these omitted variables. Theoretically, these variables are uncorrelated with CIO prevalence for the following reason. Peer firms would face difficulties in assessing and imitating the focal firm's cultures and processes or would have difficulties in acting on them strategically. This is because culture and processes are rooted in the fabric of the firms and are hard to quantify even for focal firms themselves (Germann et al., 2015; Granovetter, 1985; Grewal & Slotegraaf, 2007).

We also include three corporate governance characteristics as instruments influencing the presence of the CIO to the TMT. These characteristics are *Board independence*, *Board age*, and *Board size*. The firm's board members help provide oversight over and advise the top management and ensure that their actions align with the stakeholders' interests (Coles et al., 2008; Pan et al., 2018). An essential part of corporate governance is IT governance. Effective governance of IT leads to better IT use and generate more value from IT investments. CIOs are essential for achieving such governance (Wu et al., 2015). *Board age* is the average age of the firm's board members. In previous studies, age is considered a proxy for openness to change and risk-taking (Kunisch et al., 2017). Younger boards could be more open to strategic changes and embrace new technologies. Thus, firms with a relatively younger board are more likely to have the CIO in the TMT. *Board independence* is the ratio of outside directors to the total number of the board (Karake, 1995; Pan et al., 2018). The board is a mechanism for control, aiming to maximize the shareholders' benefits and reduce the chances of interest deviance and opportunism by inside directors (Pan et al., 2018). The higher the number of outside directors on the board, the higher the need for an informational agent (i.e., CIO) who is responsible for building information systems that provide relevant and timely information for outside directors since they are not directly involved in the firm's routine and internal operations (Karake, 1995). *Board size* is the total number of the firm's board members. When organizational complexity increases, the CEO and TMT need greater advice and provision from a bigger board (Coles et al., 2008). IT investment, IT governance, and digital transformation are complicated endeavors. These IT projects are high in uncertainty and require considerable changes in the firm. We argue that the bigger the board size, the more likely the firm to have an agent of information in the TMT who would be responsible for managing the new digital projects and advising the board about the firm's IT-related complexity.

TMT characteristics could also play an influential role in having CIOs in the top management team. Here, we look at *TMT age* and *CEO tenure*, as age and tenure are factors that can hinder or facilitate strategic changes (Kunisch et al., 2017). Both variables are based on the upper-echelon theory thinking (Hambrick & Mason, 1984). Regarding *TMT age*, compared to older executives, younger executives tend to be more willing to try new practices and are less conservative (Hambrick & Mason, 1984; Shi et al., 2017). For example, younger executives are more open to embracing digital technologies (Kunisch et al., 2020). Old managers, in general, are risk-averse and resist pursuing new strategies and changing the structure of the TMT (Karake, 1995). Thus, we argue that the older the TMT age, the less likely the firm will have a CIO in the TMT. *CEO tenure* is associated with the top management team's restructuring, such as changes in the composition of the top team, turnovers, and appointment of new types of executives (Zorn, 2004). The more the CEO's organizational tenure, the more he/she would attempt to maintain the status quo and, hence, resist strategic changes (Wiersema & Bantel, 1992), such as the creation of a CIO position (Karake, 1995) or even the presence of the CIO in the TMT.

### 5.1.3 Hypothesis (1) Results

The sample firms operate in a variety of industries. The majority of the firms fall under Manufacturing (39%), Finance and real estate (22%), and Services (12.5%). Around 328 (28.6%) firms have CIOs in their TMTs. The highest percentages of CIO presence are found in Manufacturing (38%), Finance and real estate (20%), and Services (15%).

Table 5.1 shows the descriptive statistics and pairwise correlations between the variables. Around 29 percent of firms in 2016 in the sample have CIOs present in their TMT. The variable of interest "CIO presence in TMT" has a negative but week correlation with dependent variable $\Delta$ Tobin's $q$ (i.e., relative firm performance) and significant positive correlations with Leverage, Firm size, and

R&D innovation. There are some high correlations between some variables. The correlation between Operating cost and COGS is around 0.73, and the correlation between Tobin's *q* and R&D innovation is around 0.41. We check the variance inflation factor (VIF) for multicollinearity. None of the VIFs are above 3.25, hence suggesting the absence of the multicollinearity issue. By looking at the different descriptive statistics and correlations and using several pre-estimation diagnostics, we tried to establish the face validity of the sample and measures that we have collected and constructed.

**Table 5.1: Descriptive Statistics and Correlation Coefficients**

| | Variable | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Δ Tobin's *q* | 0.42 | 1.51 | 1 | | | | | | | | | | | | |
| 2 | Asset Tangibility | 1.64 | 3.12 | -0.11 | 1 | | | | | | | | | | | |
| 3 | Capital Intensity | 0.04 | 0.04 | 0.07 | -0.09 | 1 | | | | | | | | | | |
| 4 | COGS | 0.58 | 0.25 | -0.13 | -0.17 | 0.24 | 1 | | | | | | | | | |
| 5 | Leverage | 0.60 | 0.25 | -0.03 | 0.17 | -0.05 | -0.02 | 1 | | | | | | | | |
| 6 | Firm Size | 8.46 | 1.53 | 0.16 | 0.05 | -0.01 | -0.13 | 0.24 | 1 | | | | | | | |
| 7 | Operating Cost | 0.79 | 0.18 | -0.04 | -0.36 | 0.20 | 0.73 | -0.15 | -0.28 | 1 | | | | | | |
| 8 | Organizational Slack | 2.27 | 2.01 | 0.11 | -0.09 | -0.11 | -0.08 | -0.47 | -0.25 | 0.04 | 1 | | | | | |
| 9 | R&D Innovation | 0.02 | 0.04 | 0.32 | -0.19 | -0.06 | -0.22 | -0.23 | -0.01 | 0.14 | 0.22 | 1 | | | | |
| 10 | Market Concentration (HHI) | 740.62 | 825.12 | 0.00 | -0.22 | 0.19 | 0.22 | -0.01 | -0.04 | 0.23 | -0.09 | -0.14 | 1 | | | |
| 11 | Environmental Dynamism | 1.01 | 0.01 | -0.06 | 0.13 | 0.25 | 0.24 | 0.03 | 0.01 | 0.17 | -0.11 | -0.18 | 0.14 | 1 | | |
| 12 | Environmental Munificence | 1.01 | 0.06 | 0.04 | -0.02 | -0.15 | 0.01 | -0.13 | -0.09 | 0.00 | 0.01 | 0.02 | 0.10 | -0.37 | 1 | |
| 13 | CIO Presence to TMT | 0.29 | 0.45 | -0.01 | -0.07 | 0.01 | -0.03 | 0.11 | 0.12 | 0.01 | -0.03 | 0.07 | 0.05 | -0.04 | -0.04 | 1 |

* The absolute values of correlations of 0.07 and larger are significant at 0.05 level for two-tailed tests.

Table 5.2 presents the results of the hierarchical OLS regression model. Model (1) shows the firm-level variables as the explanatory variables. In model (2), industry-level variables are added to the model. In model (3), the variable CIO presence in the TMT (CIO) was added to the model. The F-test for comparing nested models show that model (1) and (2) are not different ($F(3, 852) = 1.76$; $p = 0.14$). On the other hand, there is a significant difference in the F-value between model (2) and (3) ($F( 1, 851) = 7.48$; $p = 0.007$), indicating that the addition of the variable CIO presence in TMT adds to explanation of the dependent variable Δ Tobin's *q* and improves the model fit.

The coefficient of the CIO presence in the TMT variable is *negatively significant* ($\hat{\beta}$ = -0.31; $p < 0.01$). The results indicate that, on average, firms with CIOs present in their TMT will have their relative market value negatively impacted. Thus, hypothesis 1, which states that the presence of the CIO in TMT will positively impact relative firm performance, is not supported when using the OLS regression model.

**Table 5.2: OLS Regression Model with DV = Δ Tobin's *q***

| Variables | Model (1) | Model (2) | Model (3) |
|---|---|---|---|
| Asset Tangibility | -0.21*** | -0.28*** | -0.28*** |
| | (0.046) | (0.061) | (0.061) |
| Capital Intensity | 6.87*** | 6.95*** | 7.05*** |
| | (1.56) | (1.64) | (1.62) |
| COGS | -0.61 | -0.68 | -0.69 |
| | (0.76) | (0.78) | (0.77) |
| Leverage | 0.78 | 0.79 | 0.82 |
| | (0.70) | (0.71) | (0.71) |
| Firm Size | 0.23*** | 0.22*** | 0.24*** |
| | (0.034) | (0.034) | (0.034) |
| Operating Cost | 0.16 | 0.037 | 0.074 |
| | (0.58) | (0.58) | (0.58) |
| Organizational Slack | 0.099* | 0.10* | 0.10* |
| | (0.044) | (0.045) | (0.045) |
| R&D Innovation Intensity | 9.79** | 10.2** | 10.5** |
| | (3.77) | (3.83) | (3.83) |
| Market Concentration (HHI) | | 0.000059 | 0.000068 |
| | | (0.000040) | (0.000041) |
| Environmental Dynamism | | 9.61** | 9.30** |
| | | (3.11) | (3.12) |
| Environmental Munificence | | -0.15 | -0.15 |
| | | (0.74) | (0.74) |
| CIO | | | -0.31** |
| | | | (0.11) |
| Constant | -1.98*** | -11.4*** | -11.2*** |
| | (0.59) | (3.26) | (3.30) |
| Observations | 864 | 864 | 864 |
| $R^2$ | 0.188 | 0.193 | 0.200 |
| $R^2$-adjusted | 0.180 | 0.183 | 0.189 |
| F-statistic | 12.52 | 9.98 | 9.36 |

*** $p$<0.001, ** $p$<0.01, * $p$<0.05
Robust standard errors in parentheses.
The dependent variable is measured in the year 2017, and the independent and control variables are measured in the year 2016.

Table 5.3 presents the results for Woolridge's procedure (Linear regression with endogenous treatment effects). The first stage is a Probit model that estimates the CIO presence in TMT variable and uses the instruments and control variables (i.e., firm-level and industry-level variables) as predictors. From this stage, we get the fitted probabilities. The obtained fitted probabilities become the instrument for the CIO variable in the second stage (i.e., 2SLS). The results show that the CIO variables in *negative* and significant ($\hat{\beta}$ = -2.01; $p < 0.01$) and bigger in magnitude compared to the CIO variable in the OLS model. Accordingly, the first hypothesis is also not supported.

Table 5.4 demonstrates the results for the Two-stage treatment effects model, which is the main analysis for correcting for the endogeneity problem. The first stage is a Probit model that estimates the CIO presence in TMT variable and uses the instruments as predictors. Only CIO prevalence, Board age, Board independence, and Board size are significant. Firms operating in industries with high CIO in TMT prevalence are more likely to have CIOs in their TMT. The higher the proportion of independent directors on the board and the larger the board size, the greater the chances of having the CIO present in the TMT. This reflects the need for having a CIO – who is the information agent in the firm – to be close to the circle of strategic decision making to inform the board better and enhance IT governance. On the other hand, board age is negatively related to the likelihood of having a CIO in the TMT. Age is a proxy for openness to change and risk-taking. Older boards might be stuck with old managerial practices and do not see IT as a strategic and transformational component to the firm. However, TMT age and CEO tenure are nonsignificant.

In the second stage, an OLS model is estimated with the hazard ($\lambda$) added to the estimation of the model, in addition to the CIO and control variable. The hazard ($\lambda$) is calculated from the estimates of the Probit model. The coefficient of the CIO variable is negative and significant ($\hat{\beta}$ = -1.91; p <

0.01). The magnitude is somehow smaller than that of the CIO variable in Wooldridge's procedure, yet still much bigger, in absolute value, than the coefficient of the CIO in the OLS model. These results confirm the previous two models' results.

The Two-stage treatment effects model provides additional important information about the CIO presence in TMT, which is reflected in the lambda (λ). Here, we can interpret lambda as the over-presence of the CIO to the TMT. The coefficient of lambda is positive and significant ($\hat{\beta}$ = 0.99; $p < 0.05$). Hence, the probability of relative performance for firms that choose to have a CIO present in the TMT - when they should have not (i.e., over-presence) - is higher than all firms had they not chosen to have a CIO present in the TMT. In other words, firms that self-select to have a CIO present in the TMT will still be rewarded in terms of market reaction and relative long-term valuation of the firm among competitors. The market sees some potential value from such an presence.

**Table 5.3: Linear Regression with Endogenous Treatment Effects Model**

| **Variables** | **First stage (Probit)**<br>DV = CIO | **Second stage (2SLS)**<br>DV = Δ Tobin's *q* |
|---|---|---|
| Asset Tangibility | -0.071 | -0.32*** |
| | (0.069) | (0.071) |
| Capital Intensity | 1.59 | 7.43*** |
| | (1.28) | (1.75) |
| COGS | -0.28 | -0.80 |
| | (0.33) | (0.77) |
| Leverage | 0.25 | 1.02 |
| | (0.22) | (0.77) |
| Firm Size | 0.077* | 0.31*** |
| | (0.037) | (0.047) |
| Operating Cost | 0.55 | 0.29 |
| | (0.45) | (0.66) |
| Organizational Slack | 0.022 | 0.11* |
| | (0.025) | (0.049) |
| R&D Innovation Intensity | 2.16 | 11.7** |
| | (1.15) | (3.61) |
| Market Concentration (HHI) | 0.000081 | 0.00012* |
| | (0.000056) | (0.000055) |
| Environmental Dynamism | 0.19 | 7.50 |
| | (5.18) | (4.17) |
| Environmental Munificence | 0.29 | -0.28 |
| | (0.90) | (0.91) |
| CIO Prevalence | 0.89* | |
| | (0.42) | |
| Board Age | -0.029* | |
| | (0.015) | |
| Board Independence | 0.79 | |
| | (0.46) | |
| Board Size | 0.066* | |
| | (0.026) | |
| TMT Age | 0.017 | |
| | (0.014) | |
| CEO Tenure | -0.0090 | |
| | (0.0067) | |
| CIO | | -2.01** |
| | | (0.77) |
| Constant | -2.79 | -9.58* |
| | (5.66) | (4.54) |
| Observations | 859 | 859 |
| $R^2$ | 0.066 | |
| F-statistic | | 8.63 |
| LR $\chi^2$ | 53.09 | |

*** $p<0.001$, ** $p<0.01$, * $p<0.05$
Standard errors in parentheses.
Robust standard errors for the OLS regression.
For the first stage Probit model, the $R^2$ is the McFadden's pseudo R-squared.

**Table 5.4: Two-stage Treatment Effects Model**

| **Variables** | **First stage (Probit)** DV = CIO | **Second stage (OLS)** DV = $\Delta$ Tobin's *q* |
|---|---|---|
| Asset Tangibility | | -0.29*** |
| | | (0.069) |
| Capital Intensity | | 6.57*** |
| | | (1.39) |
| COGS | | -0.64 |
| | | (0.36) |
| Leverage | | 0.87*** |
| | | (0.24) |
| Firm Size | | 0.27*** |
| | | (0.040) |
| Operating Cost | | -0.022 |
| | | (0.49) |
| Organizational Slack | | 0.093*** |
| | | (0.027) |
| R&D Innovation Intensity | | 10.4*** |
| | | (1.30) |
| Market Concentration (HHI) | | 0.000067 |
| | | (0.000062) |
| Environmental Dynamism | | 7.23 |
| | | (5.40) |
| Environmental Munificence | | -0.40 |
| | | (0.96) |
| CIO Prevalence | 1.02** | |
| | (0.38) | |
| Board Age | -0.034* | |
| | (0.014) | |
| Board Independence | 0.74 | |
| | (0.45) | |
| Board Size | 0.083*** | |
| | (0.023) | |
| TMT Age | 0.014 | |
| | (0.014) | |
| CEO Tenure | -0.0066 | |
| | (0.0065) | |
| CIO | | -1.91** |
| | | (0.68) |
| lambda | | 0.99* |
| | | (0.41) |
| Constant | -0.79 | -8.56 |
| | (1.03) | (5.77) |
| Observations | 859 | 859 |
| Wald $\chi^2$ | | 222.42 |
| P > $\chi^2$ | | 0.000 |
| $R^2$ | 0.0332 | |
| LR $\chi^2$ | 34.46 | |

*** $p<0.001$, ** $p<0.01$, * $p<0.05$
Standard errors in parentheses.
For the first stage Probit model, the $R^2$ is the McFadden's pseudo R-squared.

### 5.1.4 Hypothesis (1) Robustness Checks:

We perform several robustness tests to check the consistency and generalizability of the findings. Table 5.5 presents a summary of the robustness checks results. Tables showing the results of these robustness checks are list in Appendeix A.

**Table 5.5 Summary of Robustness Checks for Hypothesis (1)**

| Robustness test | Potential Biases & Alternative Arguments | Supplemental Analysis | Results Compared to Main Model | Results |
|---|---|---|---|---|
| Alternative dependent variable measures | Are the results generalizable to alternative firm performance measures? | Tobin's *q* as the dependent variable | Consistent | Table A1 |
| | | ROA as the dependent variable | Consistent | Table A2 |
| Combinations of instrumental variables | Will the results be different with different combinations of instrumental variables? | Use CIO prevalence, Board age, Board independence, Board size, and TMT age as instruments | Consistent | Table A3 |
| | | Use CIO prevalence, Board age, Board independence, and Board size as instruments | Consistent | Table A4 |
| Outliers and influential observations | Will the results change after dropping outliers and influential observations? | Use 99% Winsorizing | Consistent | Table A5 |
| | | Use 95% Winsorizing | Consistent | Table A6 |
| Lead dependent variables (t = 2018) | Are the results contingent on the year of measuring firm performance? | Δ Tobin's *q* as the dependent variable | Consistent | Table A7 |
| | | Tobin's *q* as the dependent variable | Consistent | Table A8 |
| | | ROA as the dependent variable | Consistent | Table A9 |

First, we start by looking at different dependent variables. While relative firm performance is important, absolute performance measures are still crucial for assessing firms' performance and making strategic decisions and actions. We use two performance measures: absolute Tobin's *q* and absolute ROA. These specifications of the dependent variable help in looking at any changes in the finding after using both forward-looking and accounting measures of performance. The estimation technique is the Two-stage treatment effects. For both variables, the results are consistent with the main analysis.

Second, we look at two different combinations of instrumental variables in the first stage of the Two-stage treatment effects model. This robustness check helps in seeing any variations in the IV estimation technique under different instrumental variables since two instruments were found not significant in the main analysis. The results are consistent with the main analysis.

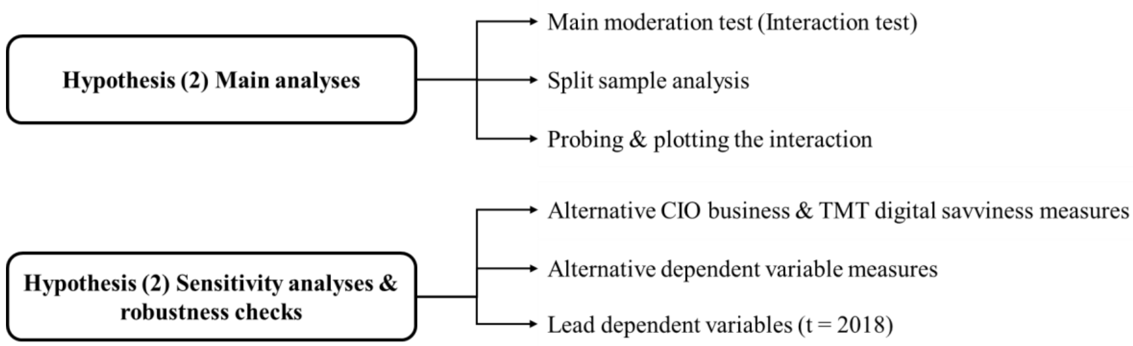
Third, to assess whether outliers and influential observations may affect the results, we run the Two-stage treatment effects model after dropping influential observations using outlier using Winsorizing – both 99% and 95%. The main benefit of Winsorizing is the conservation of cases to be included in the statistical estimation. With these different techniques, the results are consistent with the main analysis results.

Fourth, IT investments and their impact are unlikely to show immediately (Brynjolfsson, 1993; Pang et al., 2016; Santhanam & Hartono, 2003; Tiwana, 2017). Thus, research studying the impact of IT used lagged dependent variables to account for such nature of IT. Since the CIO is the executive responsible for the firm's IT, we consider looking at firm performance in a two-year lag (t = 2018) and compare the finding with that of the one-year lag (t = 2017) in the main analysis using the Two-stage treatment effects model. For the dependent variables in the year 2018, we use both the relative and absolute measures of performance. Results are consistent for models with dependent variables in the year 2017 and the year 2018.

### 5.2 Hypothesis (2): Moderation Analysis

Hypothesis two is the moderation relationship. It states that the relationship between CIO business savviness and relative firm performance is conditional on TMT digital savviness level, such that the relationship is stronger when TMT digital savviness level is high. We perform the following steps to test the relationship. Figure 5.2 shows a summary of the steps performed.

**Figure 5.2: Summary of Hypothesis 2 Analyses**




First, we perform the interaction test to see whether the association between CIO business savviness and relative firm performance changes systematically depending on different values of TMT digital savviness. We analyze the interaction with the dependent variable being relative firm performance (i.e., Δ Tobin's *q*) in both years 2017 and 2018. The CIO business savviness, TMT digital savviness, and control variables are all measured in the year 2016. The analysis is done in two ways: by including the interaction in an OLS hierarchical regression and by performing split sample analysis. Next, we probe the results to see the effect of the moderator at different levels of the independent variable of interest. Lastly, we depict the interaction in plots. Second, we perform several robustness checks to see whether the results hold when using different measures of CIO business savviness and TMT digital savviness, and to see whether the results are generalizable when using different measures and lags of relative firm performance.

### 5.2.1 Main Moderation Test (Interaction Test)

In the main moderation test, we will employ an OLS regression, including the interaction term (i.e., CIO business savviness x TMT digital savviness). In this analysis, the CIO business savviness measure is binary (with CIO business savviness = 0 as the reference group), and TMT digital savviness measure is continuous. Thus, this is a binary by continuous interaction analysis. Table 5.6 below shows the hierarchical (nested) OLS regression with the dependent variable being relative firm performance (i.e., Δ Tobin's *q*).

**Table 5.6: Interaction Analysis with DV = Δ Tobin's *q***

| Variables | (A) DV = Δ Tobin's *q* in 2017 | | | | | (B) DV = Δ Tobin's *q* in 2018 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Model (A1) | Model (A2) | Model (A3) | Model (A4) | Model (A5) | Model (B1) | Model (B2) | Model (B3) | Model (B4) | Model (B5) |
| Asset Tangibility | -0.41*** | -0.57*** | -0.54*** | -0.54*** | -0.54*** | -0.40** | -0.52** | -0.49** | -0.48** | -0.49** |
| | (0.12) | (0.15) | (0.15) | (0.15) | (0.15) | (0.13) | (0.17) | (0.17) | (0.17) | (0.16) |
| Capital Intensity | 7.46** | 7.30** | 7.24** | 7.30** | 7.65** | 6.31* | 5.78* | 5.71* | 5.77* | 6.19* |
| | (2.49) | (2.52) | (2.50) | (2.51) | (2.49) | (2.72) | (2.75) | (2.73) | (2.74) | (2.72) |
| COGS | -0.90 | -0.98 | -1.03 | -0.96 | -0.92 | -0.50 | -0.56 | -0.60 | -0.53 | -0.50 |
| | (0.62) | (0.62) | (0.62) | (0.62) | (0.62) | (0.68) | (0.68) | (0.67) | (0.68) | (0.67) |
| Leverage | 1.98*** | 1.98*** | 1.93*** | 1.94*** | 2.03*** | 2.20*** | 2.21*** | 2.15*** | 2.17*** | 2.27*** |
| | (0.34) | (0.34) | (0.33) | (0.34) | (0.34) | (0.37) | (0.37) | (0.36) | (0.37) | (0.37) |
| Firm Size | 0.26*** | 0.25*** | 0.26*** | 0.26*** | 0.27*** | 0.22*** | 0.21*** | 0.23*** | 0.23*** | 0.24*** |
| | (0.055) | (0.055) | (0.055) | (0.055) | (0.055) | (0.060) | (0.060) | (0.060) | (0.060) | (0.060) |
| Operating Cost | -0.22 | -0.40 | -0.34 | -0.40 | -0.30 | -0.84 | -1.09 | -1.02 | -1.08 | -0.96 |
| | (0.75) | (0.75) | (0.75) | (0.76) | (0.75) | (0.82) | (0.82) | (0.82) | (0.82) | (0.82) |
| Organizational Slack | 0.16*** | 0.18*** | 0.18*** | 0.19*** | 0.19*** | 0.094* | 0.11* | 0.12* | 0.12* | 0.12* |
| | (0.043) | (0.044) | (0.044) | (0.044) | (0.044) | (0.047) | (0.048) | (0.047) | (0.048) | (0.047) |
| R&D Intensity | 4.93* | 5.67* | 6.39** | 5.85* | 6.70** | 9.04*** | 10.2*** | 11.0*** | 10.5*** | 11.5*** |
| | (2.18) | (2.24) | (2.26) | (2.37) | (2.38) | (2.39) | (2.45) | (2.46) | (2.58) | (2.59) |
| HHI | | 0.000 | 0.000 | 0.000 | 0.000 | | 0.000 | 0.000 | 0.000 | 0.000 |
| | | (0.000) | (0.000) | (0.000) | (0.000) | | (0.000) | (0.000) | (0.000) | (0.000) |
| Dynamism | | 20.2* | 18.6 | 19.2 | 19.3 | | 19.6 | 17.8 | 18.4 | 18.5 |
| | | (10.2) | (10.2) | (10.2) | (10.1) | | (11.2) | (11.1) | (11.1) | (11.0) |
| Munificence | | -0.093 | -0.24 | -0.33 | -0.31 | | 0.85 | 0.67 | 0.58 | 0.61 |
| | | (1.79) | (1.78) | (1.79) | (1.77) | | (1.96) | (1.94) | (1.95) | (1.93) |
| CIO Business Savviness | | | -0.38* | -0.40* | -0.49* | | | -0.45* | -0.46* | -0.57** |
| | | | (0.19) | (0.19) | (0.20) | | | (0.21) | (0.21) | (0.21) |
| TMT Digital Savviness | | | | 0.24 | 1.65* | | | | 0.25 | 1.90* |
| | | | | (0.32) | (0.73) | | | | (0.35) | (0.79) |
| CIO*TMT Interaction | | | | | -1.69* | | | | | -1.99* |
| | | | | | (0.78) | | | | | (0.85) |
| Constant | -2.24** | -22.2* | -20.4 | -20.9 | -21.1* | -1.51 | -22.0 | -19.9 | -20.3 | -20.6 |
| | (0.82) | (10.8) | (10.7) | (10.8) | (10.7) | (0.89) | (11.7) | (11.7) | (11.7) | (11.6) |

Table continues on the next page.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Observations | 246 | 246 | 246 | 246 | 246 | 246 | 246 | 246 | 246 | 246 |
| $R^2$ | 0.312 | 0.326 | 0.337 | 0.339 | 0.352 | 0.306 | 0.321 | 0.334 | 0.336 | 0.351 |
| $\Delta R^2$ | | 0.014 | 0.011* | 0.002 | 0.013* | | 0.015 | 0.013* | 0.001 | 0.015* |
| $R^2$-adjusted | 0.289 | 0.294 | 0.303 | 0.302 | 0.313 | 0.282 | 0.289 | 0.300 | 0.298 | 0.312 |
| F-statistic | 13.44 | 10.29 | 9.89 | 9.15 | 8.97 | 13.05 | 10.06 | 9.75 | 9.02 | 8.93 |

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Variable TMT business savviness is mean centered.

The independent and control variables are measured in the year 2016.

For the dependent variable in the year 2017, Model (A1) shows the results with only firm-level variables. In Model (A2), industry-level variables are added. In Model (A3), the CIO business savviness is added to the model. In Model (A4), the moderator TMT digital savviness is included. Finally, Model (A5) includes the interaction between CIO business savviness and TMT digital savviness. The variable *CIO business savviness* is significant and negative in Model (3) ($\hat{\beta}$ = -0.38; $p$ = 0.047), Model (4) ($\hat{\beta}$ = -0.40; $p$ = 0.040), and Model (5) ($\hat{\beta}$ = -0.49; $p$ = 0.013). In Model (5), the coefficient of CIO business savviness estimates the difference in the relative firm performance between firms with high CIO business savviness and low business savviness among firms average in their TMT digital savviness. In other words, the coefficient is the average difference between a firm whose CIO is highly business savvy with an average TMT digital savviness and a firm whose CIO is low in business savviness with an average TMT digital savviness. Among firms with average TMT digital savviness, firms with high CIO business savviness where 0.49 units lower, on average, in their relative performance than firms with low CIO business savviness.

On the other hand, the variable *TMT digital savviness* is not significant in Model (4) ($\hat{\beta}$ = 0.24; $p$ = 0.451), but significant and positive in Model (5) ($\hat{\beta}$ = 1.65; $p$ = 0.024). The coefficient of TMT digital savviness in Model (5) estimates the effect of TMT digital savviness on relative firm performance when CIO business savviness is low (i.e., = 0). In other words, it is the difference in relative performance among two firms who differ by 1.65 units in their TMT digital savviness but who are low in CIO business savviness.

Of most interest is the *interaction* coefficient. The interaction in Model (5) is significant and negative ($\hat{\beta}$ = -1.69; $p$ = 0.032). It is interpreted as the conditional effect of CIO business savviness on relative firm performance when TMT digital savviness is average. The results tell us that the effect of CIO business savviness on relative firm performance is negatively moderated by TMT digital savviness.

The moderation results when the dependent variable is in the year 2018 are consistent with the previous results. The variables CIO business savviness is negative and significant in Model (B3) ($\hat{\beta}$ = -0.45; $p$ = 0.032), Model (B4) ($\hat{\beta}$ = -0.46; $p$ = 0.028), and Model (B5) ($\hat{\beta}$ = -0.57; $p$ = 0.01). the variables TMT digital savviness is positive but not significant in Model (B4) ($\hat{\beta}$ =0.25; $p$ =0.479), but significant in Model (B5) ($\hat{\beta}$ = 1.90; $p$ =0.017). the interaction in Model (B5) is negative and significant ($\hat{\beta}$ = -1.99; $p$ =0.020).

**5.2.2 Split Sample Analysis**

To further analyze the interaction, we perform a split sample analysis (see Table 5.7 and Table 5.8 below). Splitting the sample is done in two ways. First, we mean-split the sample according to TMT digital savviness. The first sub-sample contains observations that have lower than the average of TMT digital savviness. The other sub-sample contains observations that have higher than the mean of TMT digital savviness. Second, we split the sample according to the binary measure of CIO business savviness. The first sub-sample contains observations with CIO business savviness equal to zero, and the second sub-sample contains observations with CIO business savviness equal to one.

With the dependent variable in the year 2017 (Table 5.7), when we split the sample by the variable TMT digital savviness, we observe that CIO business savviness is not significant when TMT digital savviness below the average in Model (A1) ($\hat{\beta}$ = 0.10; $p$ = 0.589) – the average is zero because the TMT digital savviness is mean-centered. However, in Model (A2), when TMT digital savviness is above average, CIO business savviness is significant and negative ($\hat{\beta}$ = -1.11; $p$ = 0.004). Thus, in firms with above-average TMT digital savviness, relative performance is significantly lower for firms with high CIO business savviness than for the group of firms with low CIO business savviness. On the other hand, when we split the sample by the variable CIO business savviness, we observe the following. For the sample with CIO business savviness equal to zero (Model (B1)), TMT digital savviness has a significant and positive impact on relative firm performance ($\hat{\beta}$ = 2.06; $p$ = 0.018). However, this impact vanishes in Model (B2), where the sample is for firms with CIO business savviness equal to one ($\hat{\beta}$ = -0.16; $p$ = 0.620).

The results are consistent when the dependent variable is measured in the year 2018 (Table 5.8). CIO business savviness is not significant when TMT digital savviness is below average ($\hat{\beta}$ = 0.10; $p$ = 0.802) in Model (A1), but significant and negative when TMT digital savviness is above average ($\hat{\beta}$ = -1.11; $p$ = 0. 0.005) in Model (A2). TMT digital savviness is positive and significant when CIO business savviness is low (i.e., = 0) ($\hat{\beta}$ = 2.06; $p$ =0.009) in Model (B1), and not significant when CIO business savviness is high (i.e., = 1) ($\hat{\beta}$ = -0.16; $p$ =0.382) in Model (B2).

**Table 5.7: Split Sample Analysis with DV = Δ Tobin's *q* in 2017**

| | **(A) Split by TMT digital savviness** | | **(B) Split by CIO business savviness** | |
|---|---|---|---|---|
| **Variables** | Model (1) < 0 | Model (2) ≥ 0 | Model (1) = 0 | Model (2) = 1 |
| Asset Tangibility | -0.33* | -2.17*** | -0.82* | -0.43* |
| | (0.15) | (0.50) | (0.34) | (0.17) |
| Capital Intensity | 6.42* | 17.2** | 8.45 | 7.80* |
| | (2.59) | (5.17) | (4.41) | (3.18) |
| COGS | 0.23 | -1.81 | 0.64 | -1.35* |
| | (0.83) | (0.91) | (1.63) | (0.64) |
| Leverage | 2.58*** | -0.25 | 2.86*** | 0.27 |
| | (0.31) | (0.85) | (0.46) | (0.56) |
| Firm Size | 0.19** | 0.42*** | 0.35* | 0.26*** |
| | (0.062) | (0.099) | (0.13) | (0.059) |
| Operating Cost | -1.18 | -0.028 | -2.33 | -0.21 |
| | (1.17) | (1.03) | (1.99) | (0.79) |
| Organizational Slack | 0.12* | 0.39*** | 0.35 | 0.12** |
| | (0.053) | (0.082) | (0.19) | (0.043) |
| R&D Intensity | 3.89 | 5.57 | 2.38 | 6.41** |
| | (4.07) | (2.98) | (8.39) | (2.35) |
| HHI | 0.000062 | -0.000026 | -5.5e-06 | 0.00014 |
| | (0.000089) | (0.00020) | (0.00014) | (0.00013) |
| Dynamism | 8.89 | 23.5 | 25.4 | 15.2 |
| | (9.43) | (32.1) | (18.3) | (12.7) |
| Munificence | 1.49 | -8.33 | -0.0023 | -0.17 |
| | (1.67) | (4.30) | (2.79) | (2.37) |
| CIO Business Savviness | 0.10 | -1.11** | | |
| | (0.19) | (0.38) | | |
| TMT Digital Savviness | | | 2.06* | -0.16 |
| | | | (0.85) | (0.33) |
| Constant | -12.3 | -17.2 | -28.0 | -16.9 |
| | (9.78) | (33.3) | (18.7) | (13.6) |
| Observations | 152 | 94 | 75 | 171 |
| R-squared | 0.449 | 0.500 | 0.519 | 0.312 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

**Table 5.8: Split Sample Analysis with DV = Δ Tobin's *q* in 2018**

| | **(A) Split by TMT digital savviness** | | **(B) Split by CIO business savviness** | |
|---|---|---|---|---|
| **Variables** | Model (1) < 0 | Model (2) ≥ 0 | Model (1) = 0 | Model (2) = 1 |
| Asset Tangibility | -0.26 | -1.76** | -0.90* | -0.31 |
| | (0.16) | (0.56) | (0.37) | (0.18) |
| Capital Intensity | 5.06 | 14.3* | 8.68 | 5.59 |
| | (2.86) | (5.70) | (4.91) | (3.32) |
| COGS | -0.058 | -1.03 | 0.87 | -0.92 |
| | (0.92) | (1.01) | (1.82) | (0.67) |
| Leverage | 2.91*** | -0.61 | 3.25*** | 0.12 |
| | (0.34) | (0.94) | (0.51) | (0.58) |
| Firm Size | 0.18* | 0.38*** | 0.39* | 0.22*** |
| | (0.069) | (0.11) | (0.15) | (0.061) |
| Operating Cost | -0.60 | -1.40 | -2.59 | -1.05 |
| | (1.28) | (1.14) | (2.22) | (0.82) |
| Organizational Slack | 0.081 | 0.29** | 0.24 | 0.045 |
| | (0.058) | (0.091) | (0.21) | (0.045) |
| R&D Intensity | 4.43 | 12.0*** | 1.14 | 11.7*** |
| | (4.48) | (3.29) | (9.34) | (2.45) |
| HHI | 0.00012 | -0.000039 | 0.000078 | 0.00019 |
| | (0.000099) | (0.00022) | (0.00016) | (0.00013) |
| Dynamism | 6.51 | 32.4 | 21.1 | 15.1 |
| | (10.4) | (35.5) | (20.4) | (13.3) |
| Munificence | 2.27 | -6.38 | -0.45 | 2.34 |
| | (1.84) | (4.75) | (3.10) | (2.48) |
| CIO Business Savviness | 0.052 | -1.20** | | |
| | (0.21) | (0.41) | | |
| TMT Digital Savviness | | | 2.56** | -0.30 |
| | | | (0.94) | (0.35) |
| Constant | -10.9 | -27.0 | -23.2 | -18.5 |
| | (10.8) | (36.8) | (20.8) | (14.2) |
| Observations | 152 | 94 | 75 | 171 |
| R-squared | 0.435 | 0.481 | 0.519 | 0.338 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

### 5.2.3 Probing the Interaction

Table 5.9 below shows the effect of TMT digital savviness on CIO business savviness when it is equal to zero (low) and when it is equal to one (high). For relative firm performance in the year 2017, the effect of TMT digital savviness is significant and positive when CIO business savviness is equal to zero ($\hat{\beta}$ = 1.646; $p$ = 0.024). However, the effect is not significant when CIO business savviness is equal to one ($\hat{\beta}$ = -0.045; $p$ = 0.348). We get the same results when the dependent variable is measured in the year 2018.

**Table 5.9: Probing the Interaction**

| CIO business savviness | dy/dx | Delta-method SE | t | P>\|t\| | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| **DV = Δ Tobin's *q* in 2017** | | | | | | |
| **0** | 1.646 | 0.725 | 2.27 | 0.024 | 0.217 | 3.076 |
| **1** | -0.045 | 0.348 | -0.131 | 0.896 | -0.731 | 0.64 |
| **DV = Δ Tobin's *q* in 2018** | | | | | | |
| **0** | 1.902 | 0.790 | 2.409 | 0.017 | 0.347 | 3.458 |
| **1** | -0.091 | 0.379 | -0.242 | 0.809 | -0.838 | 0.655 |

### 5.2.4 Interaction Plot

The results can be clearly seen when plotting the interaction between CIO business savviness and TMT digital savviness. Figure 5.3a depicts the interaction when the dependent variable is measured in the year 2017. It is clear from the plot that there is a significant positive interaction when the CIO business is low (i.e., = 0). The impact increases as the average TMT digital savviness gets higher. This pattern of the interaction is known as a substituting effect, meaning that CIO business savviness has a significant positive impact on relative firm performance when TMT digital savviness is high rather than low. We get a similar interaction plot when the dependent variable is in the year 2018 (see Figure 5.3b).

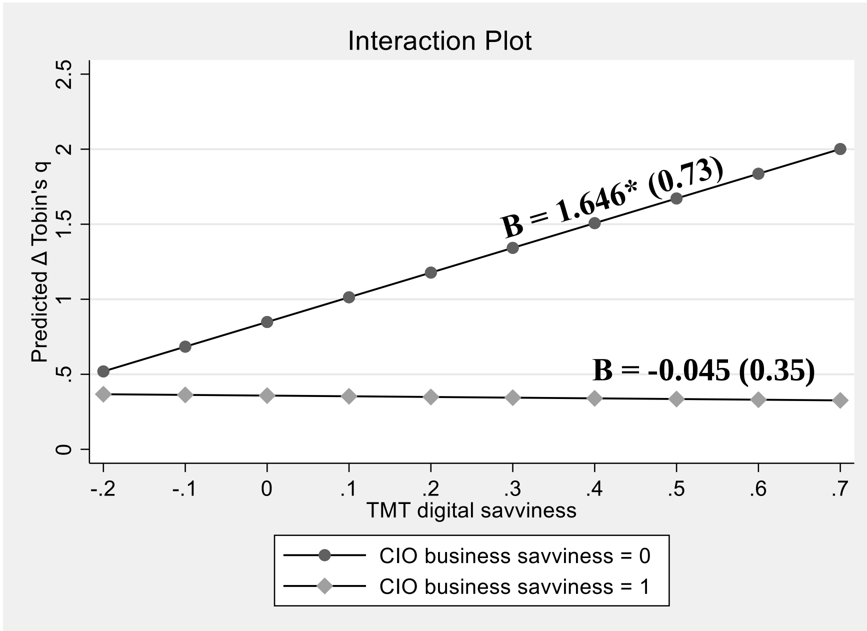



**Figure 5.3a: Interaction Plot with DV = Δ Tobin's *q* in 2017**

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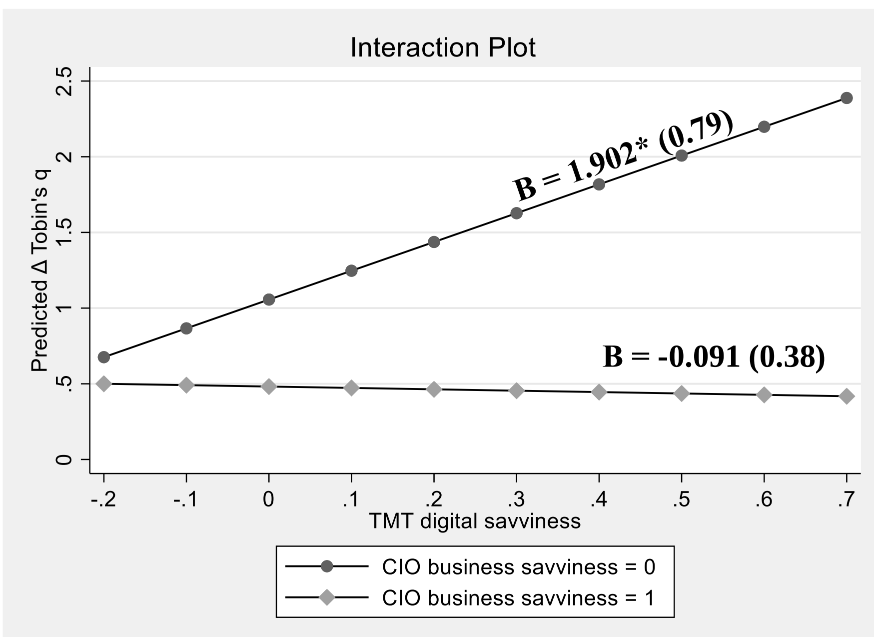


**Figure 5.3b: Interaction Plot with DV = Δ Tobin's *q* in 2018**

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### 5.2.5 Hypothesis (2) Robustness Checks

To check the consistency and generalizability of the moderation relationship findings, we perform the following robustness checks (Table 5.10 summarizes the results). In general, the results show consistency with the main results when using different measures of CIO business savviness and TMT business savviness, and evidence of generalizability across different measures and lags of firm performance. Appendix B includes the tables and figures of the robustness checks.

**Table 5.10: Summary of Robustness Checks for Hypothesis (2)**

| Robustness test | Potential Biases & Alternative Arguments | Supplemental Analysis | Results Compared to Main Model | Results |
|---|---|---|---|---|
| Alternative CIO business & TMT digital savviness measures | Are the results consistent with alternative CIO business savviness measures? | CIO managerial experience as the independent variable. | Consistent | Table B1<br>Figure B1 |
| | | CIO business education as the independent variable | Non-significant results. But same direction | Table B2<br>Figure B2 |
| | Are the results consistent with alternative TMT digital savviness measures? | TMT IT employment as the moderator | Consistent | Table B3<br>Figure B3 |
| | | TMT IT education as the moderator | Non-significant results. But same direction | Table B4<br>Figure B4 |
| | | TMT IT industrial experience as the moderator | Non-significant results. But same direction | Table B5<br>Figure B5 |
| | Will the results be different when looking at CEO and CFO digital savviness? | CEO digital savviness as the moderator | Consistent | Table B6<br>Figure B6 |

| | | | | |
|---|---|---|---|---|
| | Digital savviness of the most powerful executives is more important than the average savviness of the TMT. | CFO digital savviness as the moderator | Non-significant results. But same direction | Table B7<br><br>Figure B7 |
| | | CEO+CFO digital savviness as the moderator | Consistent | Table B8<br><br>Figure B8 |
| | | | | |
| Alternative dependent variable measures | Will the results be different with different measures of firm performance? | Tobin’s *q* as the dependent variable | Consistent | Table B9<br><br>Figure B9 |
| | | ROA as the dependent variable | Consistent | Table B10<br><br>Figure B10 |
| | | | | |
| Lead dependent variables (t = 2018) | Are the results contingent on the year of measuring firm performance? | Tobin’s *q* as the dependent variable | Consistent | Table B11<br><br>Figure B11 |
| | | ROA as the dependent variable | Consistent | Table B12<br><br>Figure B12 |

First, CIO business savviness is an aggregate measure of the proxies CIO managerial experience, CIO business education, CIO practical experience, and CIO board membership. As discussed earlier, given the limitations of the archival data, we could not assign weights for each measure, as weights indicate the importance of the proxy in the calculation business savviness of the CIO. The aggregate measure treats all proxies as equivalent. Thus, a logical robustness check is to see whether the moderation results would differ when using the proxies in place of the aggregate measure. We look at the proxies CIO managerial experience and CIO business education as alternatives to the aggregate measure. The proxy CIO managerial experience shows consistent results. However, CIO business education returns no significant results. One thing to clear is that this proxy has many missing values.

We also look at the changes in the interaction results when using the TMT digital savviness proxies in place of the aggregate measure. TMT digital savviness proxies are TMT IT employment, TMT IT education, TMT IT industrial experience. The results are consistent when using TMT IT employment as a moderator. However, the results are non-significant with both proxies TMT IT employment and TMT IT industrial experience.

An interesting observation is that with these alternative measures of CIO and TMT savviness, the interaction direction is the same. CIO savviness impact on relative performance is positive when it is low and TMT savviness is high.

Another argument for alternative measures is whether the average TMT digital savviness matters more compared with the savviness of the most powerful executives in the firm like the CEO and CFO. Power is the capacity to influence others (Hickson et al., 1971; Pfeffer, 1981). Power distribution among TMT executives is not uniform. This means that some executives can exert more power and have more influence than others regarding different organizational decisions (e.g., strategic decision making, resource allocation and contribution). CEOs' power comes from their broad knowledge of the firm, legitimate authority, and their impact on all aspects of the firm (Daily & Johnson, 1997). In addition, CFOs have gained more prominence in recent years for reasons such as the Sarbanes-Oxley Act introduction in 2002 and the increase in the demand for risk management and data security (McGregor, 2015). Thus, CEOs and/or CFOs who are digitally savvy have the clout to amplify the impact of CIO business savviness on relative firm performance. When interacting the aggregate measure of CIO business savviness with CEO digital savviness, we get similar results as the main analysis. CIO business savviness positively impacts relative firm performance when it is low, and CEO digital savviness is high. The results are not significant when the moderator is the CFO digital savviness, although the direction of the interaction is similar to that of the main findings. When combining both CEO and CFO business savviness, the results are significant.

Second, we look at different measures of firm performance, specifically absolute Tobin's *q* and absolute ROA. The results of Tobin's *q* are consistent with relative firm performance. The results for the ROA are also consistent, but when CIO business savviness is high (= 1), the impact on ROA is significant and negative when TMT digital savviness is high ($\beta$= -0.038; $p$ = 0.029).

Lastly, we look at what will happen to the interaction when the dependent variable is measured in a two-year lag (t= 2018). The results of the models when using the absolute measures for firm performance (Tobin's *q* and ROA) are consistent with the results of the model using the relative firm performance measure in the year 2018. For the model with ROA as the dependent variable, when CIO business savviness is high, the impact is marginally significant and negative when TMT digital is high ($\beta$= -0.038; $p$ = 0.087).

# CHAPTER (6)

# DISCUSSION AND CONCLUSION

The main premise of the dissertation is that the CIO presence in the TMT will lead to better relative firm performance. Harnessing valuable business outcomes out of IS assets and capabilities is key for creating a competitive advantage. Extant IS leadership studies point to the strategic importance of superior IT leadership and management for creating such an advantage (Karahanna & Watson, 2006; Mata et al., 1995; Wade & Hulland, 2004). To reach such superiority, IT should be present at firms' C-suite by formally having CIOs as part of the top management team (Chen et al., 2010; Karahanna & Preston, 2013; Preston & Karahanna, 2009). Nevertheless, this is not enough. For CIOs who are part of the TMT to have an impact on relative performance, they should be business savvy. Such impact is amplified when TMT executives are digitally savvy. We draw on the IS leadership literature to posit that shared domain knowledge between the CIO and TMT is important for a more effective CIO presence. Below, we discuss the findings of the dissertation.

Our contribution is twofold. First, the question of CIO presence in the TMT and its impact on intermediate IT and business outcomes has been investigated by several researchers using several theoretical justifications (Armstrong & Sambamurthy, 1999; Chen et al., 2010; Karahanna & Preston, 2013; Preston et al., 2008; Preston & Karahanna, 2009). We build on their contributions to theoretically and methodologically suggest how the CIO presence in the TMT influences relative firm performance and future market potential. We apply several econometric techniques to causally estimate the CIO presence impact. We also contribute to the line of studies about functional executives and their impact on firm performance (Menz 2012; Nath & Manajan 2008; Germann et al. 2015; Marcel et al. 2009; Menz & Scheef 2014). As they are the highest-ranked representative executives of IT in their organizations, investigating CIOs' relevance and value is a key endeavor in the IS strategic leadership literature that would contribute to the conversation about firms' top executives and business strategy (Menz 2012). Second, we contribute to the IS leadership research by theorizing and investigating how shared domain knowledge plays a role in enhancing CIO presence influence. By unpacking shared domain knowledge to its two dimensions and examining how they interact to affect relative firm performance, we bring new insights and theoretical nuances to the operating mechanism of CIO-TMT shared domain knowledge.

## 6.1 Findings

### 6.1.1 CIO Presence to TMT

The results show that the relationship between the CIO presence in the TMT and relative firm performance is negative. This goes in opposition to the justification and logic describing the benefits of having the CIO as part of the TMT (Armstrong & Sambamurthy, 1999; Chen et al., 2010; Karahanna & Preston, 2013; Preston et al., 2008; Preston & Karahanna, 2009). Armstrong and Sambamurthy (1999) looked at CIO participation in the TMT as an important form of systems of knowing, and showed how this system of knowing influences the assimilation of IT into a firm's strategies and value-chain activities. Systems of knowing are structures that improve sharing knowledge among top executives. They found that Systems of knowing influence IT assimilation indirectly through their impact on shared domain knowledge by enhancing CIO business knowledge. Preston and Karahanna (2009) also looked at CIO membership in TMT as a structure of systems of knowing. They found that CIO membership has a direct influence on CIO-TMT shared understanding about the strategic role of IS in the firm, and an indirect influence through augmenting TMT IS knowledge. Preston et al. (2008) examined CIO membership to TMT as a component of the CIO's organizational structural power and how it impacts the CIO's strategic decision-making authority. The CIO decision-making authority is the scope to participate in strategic decision making with the firm. When CIOs become members of their firms' TMT, they gain more legitimacy and, hence, structural power, allowing them to get more managerial discretion (Preston et al., 2008). Chen et al. (2010) examined the CIO presence in TMT as a structural power and how it impacts both CIO supply and demand-side leadership. They found that CIOs' structural power does have an impact on their demand-side leadership. This side of CIO leadership entails building IT vision, becoming a strategic leader, forming partnerships with other business units, changing business processes through IT, and introducing IT-related innovations (Chen et al., 2010). CIO demand-side leadership affects IT contribution to both firm efficiency and strategic growth. Lastly, Karahanna and Preston (2013) examined CIO membership in TMT as one dimension of structural social capital, which is defined as the overall connections between the CIO and TMT. The structural social capital is found to influence establishing shared cognition and language between CIO and TMT (i.e., cognitive social capital) and TMT executives trusting the CIO (relational social capital), which in turn influences the creation of IS strategic alignment (Karahanna & Preston, 2013).

One interpretation of our results is that even though firms have a CIO in the TMT with the intention to leverage IT investments and gain positive outcomes, they are still penalized by the market. This is due to the fast evolution of IT and the new digital innovations that appear in a fast fashion. Transforming IT investments to outcomes requires time to show and reflect in the form of operations payoffs and business outcomes (Tiwana, 2017). At the same time, other advances in IT might become more prominent and promising, rendering firms' current IT projects less competitive or even outdated. In industries with high levels of competition, laggard firms will suffer from not being ahead in using new IT innovations and quickly assimilating them into their daily operations.

Nevertheless, the advanced analyses we utilized show that firms that have the CIO present in the TMT when they should not have (i.e., CIO over-presence) will still be rewarded in the form of better market reaction and long-term valuation in comparison to competitors in the same sector. A plausible interpretation of such a finding is that by self-selecting to over-present CIOs to the TMT, firms want to convey several important signals to the shareholders, market, and competitors, such as the commitment to improving IS management capabilities and increasing the role and importance of IT. Prior research has acknowledged that the market reacts positively to similar strategic moves, such as the announcement of a new CIO position (Chatterjee et al., 2001).

### 6.1.2 CIO Business Savviness & TMT Digital Savviness

The findings provide more nuanced insights into the relationship between the two dimensions of the CIO-TMT shared domain knowledge. We hypothesized that for CIOs who are members in the TMT, the relationship between CIO business savviness and relative firm performance is conditional on the level of TMT digital savviness. The results show that higher TMT digital savviness amplifies the impact of CIO business savviness on relative firm performance when CIO business savviness is low. However, when CIO business savviness is high, TMT digital savviness has no impact. This substituting effect of the TMT digital savviness adds to our understanding of how shared domain knowledge creates value and how TMT executives can play a role in leveraging CIO and IT contributions in their firms.

Extant research looked at shared domain knowledge and its dimensions in different ways (Armstrong & Sambamurthy, 1999; Kearns & Sabherwal, 2006; Preston & Karahanna, 2009;

Ranganathan & Sethi, 2002). Armstrong and Sambamurthy (1999) found out that only CIO business and IT knowledge influence IT assimilation. However, senior executives' IT knowledge has no impact. With high IT and business knowledge, CIOs will be more capable of combining IT innovations with business requirements and needs (Armstrong & Sambamurthy, 1999). Preston and Karahanna (2009) examined how shared domain knowledge influences IS strategic alignment by influencing the establishment of a shared understanding between the CIO and TMT about the strategic role of IT in the firm. They looked at the impact of each domain knowledge dimension item separately. They found that CIO business knowledge directly affects shared understanding and indirectly through the creation of shared language between the CIO and TMT. TMT IS knowledge directly affects the establishment of shared understanding. Shared domain knowledge is the objective, visible knowledge possessed by top executives. The two previous studies looked at shared domain knowledge as a form of objective knowledge. Objective knowledge is an important structure of knowledge integration (Spender, 1996), which is a central aspect of the knowledge-based view of the firm (Grant, 1996). It is important for the TMT and CIO to have overlap in knowledge as this will enhance the ability to acquire new IT and business knowledge, learn and apply learning to manage IT strategically (Armstrong & Sambamurthy, 1999), and, thus, augment the top executives absorptive capacity (Cohen & Levinthal, 1990). Accordingly, the overlap in knowledge is the underlying mutual knowledge base on which the CIO and TMT rely to comprehend, assimilate, and integrate the knowledge of the other side (Kearns & Sabherwal, 2006). Ranganathan and Sethi (2002) investigated how shared domain knowledge enhances strategic IT decision rationality. Shared domain knowledge is based on the perspective of information-processing (Galbraith, 1973) that making strategic decisions requires high amount and variety of information. Strategic decision making is complex in nature due to the high information asymmetries and uncertainty. With shared domain knowledge, domain-specific knowledge, experience, and expertise are transferred and shared between executives, bringing information variety and amount necessary to augment rationality (Ranganathan & Sethi, 2002). Kearns and Sabherwal (2006) mainly investigated TMT IT knowledge and its impact on IS strategic alignment through increasing the participation of IT managers in business planning and participation of business managers in strategic IT planning. They argued that knowledge of IT by TMT is more important in facilitating knowledge integration than IT managers' knowledge of the business. Business knowledge of IT managers may have limited impact. It is the IT knowledgeable TMT executives who "create opportunities for business-IT alignment, expect such alignment to add value, be motivated to contribute to the process, and possess the ability to integrate business and IT knowledge." (Kearns & Sabherwal, 2006, p. 135).

Our interpretation of the results is the following. IT has become the backbone of any firm as it cuts across all departments, divisions, and operations. Non-IT executives have to directly or indirectly deal with IT in their daily activities. They need IT to enable and execute their respective department strategies and the firm's strategies as a whole. Digitally savvy executives understand emerging digital innovations and their potential business value (Kearns & Sabherwal, 2006). Such knowledge not only allows digitally savvy executives to support IT initiatives and actively participate in strategic IS planning (Chan et al., 2006; Preston & Karahanna, 2009), it also reflects in augmenting the CIO work to gain better firm outcomes. However, Armstrong and Sambamurthy (1999) found that TMT IT knowledge does not influence the assimilation and routinization of IT into the value chain activities and business strategies because. They provide a rationale for that by stating that "senior business executives might not wish to replicate the high IT knowledge of their CIO, but rather rely upon a knowledgeable CIO for strategic guidance." (p. 318). Such reasoning might be valid before the dot-com era. Nonetheless, in the era of digitalization and digital disruption, and with IT being the base for business strategies and competitive lead, top executives should be digitally savvy.

We find no support for the interaction when both CIO business savviness and TMT digital savviness are high. This is inconsistent with the findings of previous research that high shared domain knowledge is important to generate a greater business value of IT (Preston & Karahanna, 2009; Ranganathan & Sethi, 2002). However, our dependent variable(s) and the way we measure shared domain knowledge are different. Ranganathan and Sethi (2002) looked at shared domain knowledge as a formative construct with items representing the two dimensions. They looked at how shared domain knowledge would impact rationality in IT decision processes. On the other hand, Preston and Karahanna (2009) investigated the impact of both dimensions of shared domain knowledge on establishing a shared understanding of the strategic role of IS in the firm. However, they examine the impact of the two dimensions separately.

When both CIO business savviness and TMT digital savviness are low (i.e., low shared domain knowledge), impediments might occur. Low digital savviness might lead to TMT members lacking understanding or even underestimating the importance of IT to the firms' initiatives and strategies, shying away from supporting IT-related projects and initiatives, and having lower involvement in IT planning (Doll, 1985; Enns et al., 2003). CIOs with low business savviness might fail to harness the potential IT-related advantages.

### 6.1.3 What Factors Influence CIO Presence?

We look at what factors influence the presence of a CIO in the TMT. The inclusion of CIO in the executive C-suite is a rational choice that depends on various firm-specific structural, strategic, environmental, and board and TMT-related factors (Menz, 2012; Nath & Mahajan, 2008). Our findings suggest that CIO prevalence and board of directors age, independence, and size are significant factors that influence the likelihood of having a CIO in the TMT. Firms that operate in industries with a high percentage of CIOs in the TMT are more likely to have a CIO present in their TMT. This nuance finding is interesting as it reflects an imitation behavior, rather than structural decision, for explaining the presence of CIOs. Moreover, firms with a large board size and a high proportion of independent directors are more likely to have CIOs in their TMT. The larger the board size, the higher the need for a CIO in the TMT who would be the information agent, handling the complexity of IT. With a high ratio of independent directors on the board, a CIO needs to be a member of the TMT to view the firm better and provide relevant and timely information for outside directors since they are not directly involved in the firm's routine and internal operations. Lastly, the higher the average age of the board directors, the lower the probability of having a CIO in the TMT. This could be the case because older board members are less open to strategic changes and might be more reluctant to embrace new technologies. Thus, they do not see the need for a CIO to be part of the TMT.

By examining the endogenous nature of the CIO presence in the TMT, we are working towards fostering a greater theoretical accumulation of studies in IS strategic leadership literature (Tiwana & Kim, 2019). In other words, by investigating the factors that make firms have CIOs present in their top management teams and, then, examining such presence impact on firms' relative performance, we attempt to connect different themes of CIO research under the IS strategic leadership literature. This effort is directed toward building stronger inference and a larger "theoretical edifice" (Tiwana & Kim, 2019).

### 6.2 Study Limitations

Before discussing the implication and future potential research, we acknowledge the following limitations. We also describe remedies we employed to address or reduce the impact of such shortcomings.

First, although our sample is representative, consisting of S&P1500 firms, and although we control for both firm and industry-level factors, it is still possible that there is a systematic bias in the sample when lumping up all types of firms under one sample. This can lead to the issue of unit heterogeneity (Baltagi, 2013; Certo & Semadeni, 2006). The results of the CIO presence could be different when explicitly accounting for industry characteristics and recent environmental dynamics and changes. One example would be looking at CIO presence impact in high versus low information-intensive industries. With high information-intensive industries, the CIO presence in the TMT might become positive, and such a decision to have the CIO as part of the TMT becomes more prominent (Karahanna & Preston, 2013). Moreover, the years of study (2015-2018) might have influenced the findings. However, we do not recognize major exogenous shocks (e.g., bust cycles or economy-wide boom) that might make the results unique to the sample period.

Second, the cross-sectional design is considered weak when trying to draw causal inferences. To mitigate such shortcoming, we used lead dependent variables and lagged instruments when estimating the CIO presence in the TMT that allow for temporal order of the variables and, hence, improving the argument for causality. In addition, we employed endogeneity estimation technique and treatment effects technique based on Rubin causal model (Rubin, 1974; Wooldridge, 2010). These techniques strengthen causal inferences when appropriately used.

Third, measuring theoretical constructs from archival data can be challenging. The proxies collected for both CIO and TMT savviness are coarse measures. It is challenging to collect granular proxies that would tap into the executives' knowledge, experience, and expertise from archival sources. Several studies in the CIO-related literature measured the dimensions of shared domain knowledge using psychometrics by asking CIOs to evaluate TMT's digital savviness and asking TMT executives to evaluate CIOs business savviness (e.g., Armstrong & Sambamurthy, 1999; Elbashir et al., 2013; Kearns & Sabherwal, 2006; Preston & Karahanna, 2009; Ranganathan & Sethi, 2002). However, other studies measured the two dimensions using archival data. For example, Haislip and Richardson (2018) measured the CEO IT expertise by looking at the CEO working experience and educational background from archival sources. In addition, measuring shared domain knowledge from archival data can be challenging because of some firms' missing information. In addition, some sources might be changed, updated, or deleted, making it difficult to access the exact information at different times. These issues can be elevated by triangulating information from multiple reliable sources, which is what we performed when finding missing information.

Nevertheless, our approach of using proxies for the dimensions of shared domain knowledge is an effort towards coming up with better and more objective measures. We argue that the proxies used to measure CIO and TMT savviness follow the definition of objective knowledge used by Armstrong and Sambamurthy (1999) and Preston and Karahanna (2009). They define objective knowledge as "the explicit, visible knowledge possessed by individual team members." (Armstrong & Sambamurthy, 1999, p. 304). Such knowledge can be reflected in proxies such as prior managerial experience of the CIO and IT experience of business executives. Moreover, psychometric measures are subjective measures that can also suffer from biases. For instance, a CIO might not perfectly assess TMT executives' digital savviness, and vice versa. So, there is a chance for measurement error. However, triangulating the assessment from multiple informants and seeing the inter-rater reliability are methods to reduce such errors (Karahanna & Preston, 2013; Preston & Karahanna, 2009). We also performed an inter-rater agreement to check the reliability of our coding of the savviness proxies.

Forth, regarding correcting the CIO presence endogeneity, although we collected variables that would explain the decision to have CIOs present in the TMTs, there are two potential issues. First, it is challenging to find strong instruments that would theoretically and statistically correlate with the endogenous CIO presence variable, leading to some issues in the analysis (Semadeni et al., 2014). These issues are exacerbated by the difficulty of collecting relevant instruments from archival sources. Moreover, there is a scarcity in studies examining the factors contributing to the CIO presence. Preston and Karahanna (2009) looked at how CIO and TMT experiential similarities, such as tenure and functional specialization, would influence CIO membership in the TMT. This variable was collected using survey methodology. Karake (1995), as far as our search, was the first empirical study to look at different factors based on agency theory and upper echelon theory that would impact the likelihood of creating a CIO position as part of the TMT. Nevertheless, we present four instruments that are theoretically grounded and add to our understanding of what factors play significant roles in the presence of CIOs in the TMT. Moreover, in addition to performing a two-stage treatment effect technique for handing endogeneity, we supplement the analysis with several analyses to check the consistency and robustness of the results, thus having more confidence in our results.

### 6.3 Theoretical Implications

Continuing with the core of IS strategic leadership research stream, we are interested in understanding and informing how CIOs influence their firms and create organizational value (Karahanna & Preston, 2013; Karahanna & Watson, 2006). Specifically, we study the impact of

CIO presence in TMT on relative firm performance and how TMT digital savviness augments the effect of CIO business savviness for those CIOs who are members of the TMT on relative firm performance. We present the following theoretical implications.

First, our work has theoretical implications for the knowledge-based view of the firm and the knowledge integration processes at the top management. We provide an extension to the understanding of how the dimensions of shared domain knowledge interact and, hence, observing how such a structure of knowledge integration functions and leads to valuable impact. CIOs who are members of the TMT but have low business savviness can benefit from having executives in their TMT who have high digital savviness. With high digital savviness, top executives possess the ability to combine knowledge from both IT and business and be motivated to participate in the process of knowledge integration, hence facilitating the integration and exchange of IT and business knowledge (Kearns & Sabherwal, 2006; Nahapiet & Ghoshal, 1998). This, in turn, will enhance the impact of CIO business savviness on relative firm performance.

Second, our results have implications for the knowledge specialization at the top management. With IT and digital innovations becoming inextricably intertwined in the fabric of firms and being more critical for firms' survival and success (Zammuto et al., 2007), executives should be more digitally savvy. Knowledge specialization can hinder knowledge exchange and integration, leading to poor participation of TMT executives in planning and supporting IT-related initiatives, and creating more challenges and impediments in the way of the CIO. Thus, although specialization of knowledge had benefited organizations in running their operations in the past, it is currently a risky managerial practice with the significant changes IT have brought to organizations' work.

Third, our findings have implications for the information-processing perspective. Dimensions of shared domain knowledge do not only have an additive impact, but also they interact to augment each other's impact. With TMT being highly digitally savvy, information asymmetries between CIO and business executives are reduced, resulting in improvements in decision making and better coping with uncertainties (Ranganathan & Sethi, 2002). With high TMT digital savviness, firms will have a better information processing mechanism at the top management level. Such high digital savviness of the TMT will enhance the CIOs' low business savviness effect on relative firm performance. Thus, high TMT digital savviness is important for the competitive dynamics of firms.

### 6.4 Implications for Practice

The study findings provide implications for practice. We provide empirical insights to the discourse regarding CIO presence in the TMT and domain knowledge overlap between CIOs and TMT executives.

Although we expected that it would lead to better relative firm performance, the CIO presence in the TMT did not result in a positive impact. This is contrary to the popular belief that the CIO presence brings benefits to the C-suite, leading to a chain of positive organizational downstream impacts. In the IS community, there is a general agreement about CIO presence benefits. However, the reality is more nuanced and complicated. We suggest that necessary complementary TMT characteristics (i.e., digital savviness) need to exist for the benefits of the CIO presence to surface. In other words, having a CIO present in the TMT might only create some potential for enhancing relative firm performance. However, higher impact requires certain TMT complementary conditions. CEOs, more specifically, have a greater influence on IS leadership and CIOs' contributions. With high digital savviness, CEOs can understand the language of CIOs, exchange opinions and ideas, and assure that CIOs are involved in the decision-making process. This is reflected in our findings by showing that CEO digital savviness plays a significant role in enhancing the impact of CIO business savviness on relative firm performance.

Digital savviness of executives' importance is more evident in times of high uncertainty and environmental changes that not only disturb firms' everyday operations, but also reshape their business strategies. The situation of COVID-19 is a clear example. For firms to survive and thrive, they need to be agile. Organizational agility is the ability of a firm to sense and react effectively to market threats and opportunities (Liang et al., 2017). However, such agility and nimbleness "would be difficult to accomplish quickly without an established digital strategy and effective technology leadership" (Loten, 2020). A firm's agility is indirectly influenced by high shared understanding between the CIO and TMT about the strategic role of IS. Such shared understanding is influenced by both CIO business savviness and TMT digital savviness (Preston & Karahanna, 2009).

In light of the study results, firms can be positioned into one of the following four groups in the 2x2 matrix of shared domain knowledge (Figure 6.1).

With harmonious shared domain knowledge (cell A), both CIO and TMT executives have a high overlap in knowledge. This is an ideal position for the firm's C-suite to be in. with digital savviness, business executives have both tacit and explicit digital knowledge shaped by experiences, education, and exposure to digital technologies and innovations. On the other hand, business savviness forms from the CIO's managerial expertise, education, and involvement in the business initiatives, strategies, interaction with the CEO and top executives. Although our results did not show an impact of the harmonious shared domain knowledge on relative firm performance, one explanation is that we do not have enough firms in our sample that have both high CIO business savviness and high TMT digital savviness. This is an interesting observation. Among these few firms is the biotechnology company Illumina. The CIO Norm Fjeldheim (2016-2020) served as a board member for several firms like Amazon, SAP, and Oracle. Such membership in boards of giant firms reflects on the way a CIO thinks about business and how to use IT for creating values. In 2019, Illumina made it in the Best Places to Work in IT list. The firm showed high culture of IT empowerment and involvement in the development and design of the business solutions. In addition, in recent years, the firm added a number of executives to the TMT with high digital savviness accumulated over the years, such as the CEO Francis deSouza, the SVP of commercial operations Paula Dowdy, and the chief people officer Aimee Hoyt. Firms should aspire to reach high shared domain knowledge levels to create unique business competitive advantages that would lead to better relative performance.

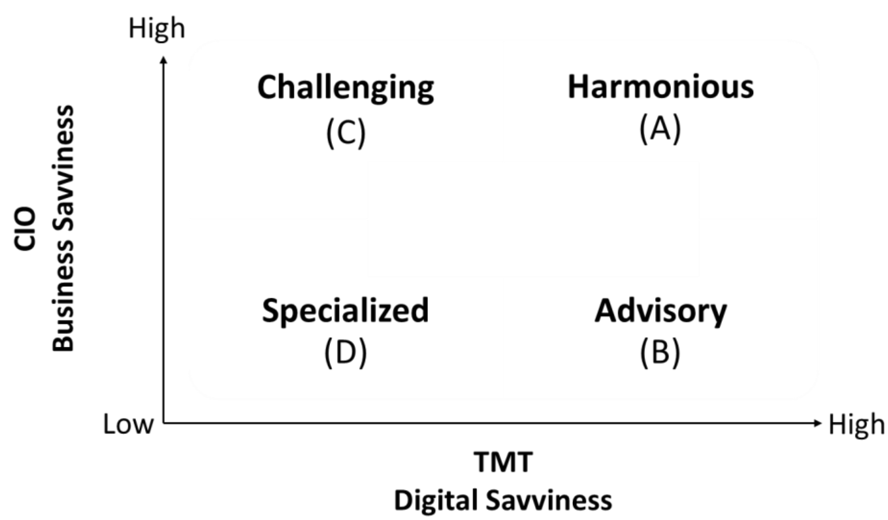


**Figure 6.1: Matrix of Shared Domain Knowledge Groups**

Our results clearly show that advisory shared domain knowledge (cell B) is beneficial and results in high firm performance in comparison to average industry performance. With high digital savviness, TMT executives are aware of the potential and limitations of current and future IT, have a vision about how digital technologies and innovations can bring business value, and champion IT-related initiatives. Such savviness complements the role of the CIO as a member of the TMT, even if the CIO has low business savviness. Here, the TMT members act as advisors to the CIOs and guide their work to not only align with the business direction and strategies, but also to transform the firm digitally. Our results reaffirm the opinion about the importance of business executives in leading and managing IT in firms.

With high CIO business savviness but low TMT digital savviness (cell C), it might be challenging for those CIOs who are members of the TMT to create value and impact their firms' relative performance. With business executives being low in digital knowledge, several impediments might rise, hindering the push of the IT agenda and reducing the effectiveness of CIO membership. Moreover, TMT members with limited IT knowledge and experience might feel threatened and challenged by a CIO with high business knowledge. For example, when they do not understand what CIOs are talking about in briefings, executives can become hostile and think that "the technologists were arrogant, condescending and incomprehensible." (Andriole, 2016). The IS literature has highlighted that CEOs and top executives sometimes have mixed perceptions and opinions about IS leadership and organizational IT in general (Peppard, 2007). For example, lack of trust and awareness regarding IT organizational impact (Lederer & Mendelow, 1988), dissimilar views about IS priorities (Earl & Feeny, 1994; Feld & Marmol, 1994), and lack of confidence in CIOs (Feld & Marmol, 1994; Tai & Phelps, 2000) are some of the issues that might surface with low digital savviness of the TMT.

With low shared domain knowledge on both sides (cell D), we have knowledge specialization, which is the old managerial practice in organizations. Such specialization will further impede gaining the benefits of CIO membership in the TMT and, hence, their impact on relative firm performance. Low digital knowledge might lead to TMT members not understanding or underestimating the importance of IT to the firm initiatives and strategies, shy away from supporting IT-related projects and initiatives, and have lower involvement in IT planning (Doll, 1985; Enns et al., 2003). Thus, there are many barriers to make the CIO membership effective in enhancing relative firm performance.

### 6.5 Future Research

Future research should work to collect more granular measures of CIO business savviness and TMT digital savviness. Moreover, the reliability and validity of such measures should be established to make sure that they represent the theoretical constructs. Failing to perform such validation steps will raise the issues of either misrepresentation or underrepresentation (Burton-Jones & Lee, 2017). Steps that can be taken to strengthen archival proxies include taking to who created such proxies or who understand these proxies from practice to see whether they reflect the constructs of interest (Burton-Jones & Lee, 2017). This is a qualitative validation of archival proxies. Statistical procedures can also be applied to increase the construct validity of proxy measures such as convergent and discriminant validities (Hoskisson et al., 1993). To achieve such validation steps, psychometric measures of CIO business savviness and TMT digital savviness must be collected.

In addition, more granular measures can be calculated by looking at richer archival sources. We mainly relied on SEC proxy statements to measures the proxies. However, there might be other sources that have richer information about the CIOs and TMT executives, resulting in higher quality proxies. One example of a superior proxy would be using the CIO years of experience in managerial positions instead of only whether the CIO has had such experiences.

Future research should also work on finding and measuring stronger instrumental variables. This will help in correcting for the endogeneity issue of the CIO presence. In the literature review chapter, we have tried to compile and visualize potential instrumental variables in the IS strategic leadership nomological string. However, most of these theoretically justifiable instruments either require extensive work to extract from archival sources (e.g., IT failures) or require collection via primary data collection methods (e.g., CIO influence behavior). Figure 6.2 shows these potential instruments.

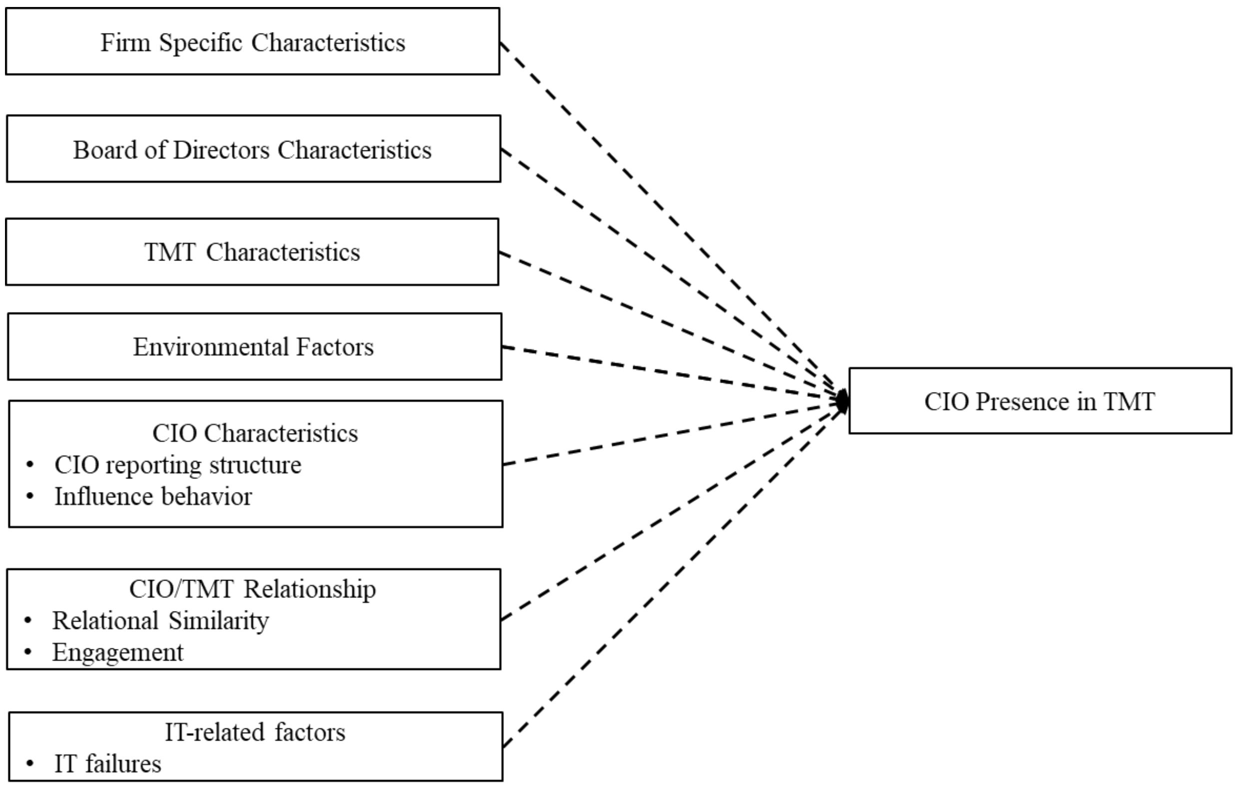


**Figure 6.2: Potential Factors Influencing CIO Presence in TMT**

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Although we applied several econometric techniques to test the hypothesis of CIO presence impact on relative firm performance, we believe that using a longitudinal design and use advanced causal techniques would enhance establishing the causal link between CIO presence and relative firm performance. Among the techniques to use are matching techniques that mimic randomized experiments in observational studies (Mithas & Krishnan, 2008b; P. Rosenbaum, 2019; P. R. Rosenbaum, 2020). Matching techniques are also used as an alternative for endogeneity statistical techniques, especially in the absence of strong instrumental variables. Using longitudinal design has several advantages over cross-sectional design, including more variability across both time and unit, efficient estimation, increase in degrees of freedom, and control for unit heterogeneity. Longitudinal designs will allow for a more nuanced understanding of the role of the CIO presence both within and between firms. For example, within a firm and over time, we can study how a CIO presence impacts relative firm performance. This will allow us to track and study the true CIO impact over time. The impact of the CIO presence can also be studied between firms with longitudinal designs. This is important because within and between effects "influence can operate simultaneously and even in opposite directions"(Curran & Bauer, 2011, p. 585). Hence, advanced econometric techniques can be applied to analyze panel data such as Fixed-effects, Random-effects, Allison's hybrid method, and others.

Future research can investigate the negative impact of CIO presence by looking at the idea that if the CIOs are not socially connected or accepted in the TMT, then their ability to influence decisions can become limited. When CIOs are unable to communicate the value of IT and the IT organization to the CEO and business executives, social conflicts at the top level about the CIO's importance and IT value might rise. When CIOs become part of the TMT, they are supposed to be key players participating in making strategic decisions and choices. This leads to the point that in addition to being business savvy, CIOs should also be socially savvy. Social savviness can help the CIO navigate uneven power distribution and politics, becoming more acceptable as an executive, building trusting and working relationships with TMT, and, ultimately, influencing organizational decisions and outcomes. Social savviness can be the CIO's ability to establish a trusting and working relationship with TMT members and leverage this relationship to generate business value through IT. A good working relationship between the CIO and the firm's top executives is critical to harness IT-related business value (Karahanna & Preston, 2013). Building such a relationship is difficult and might take years. Nevertheless, CIOs can work on such an important endeavor by following several techniques. These techniques fall under how the CIO can effectively create and communicate IT value. CIOs can work to establish and influence the relationship by using richer channels of communication such as face-to-face communication and increasing frequency of communication with the TMT (Johnson & Lederer, 2005). All will lead to a better mutual understanding of the current and future roles of IT. CIOs can use influence behavior tactics to gain TMT commitment to IT strategies and initiatives (Enns et al., 2003). These tactics include using rational persuasion (logical arguments & factual evidence), using personal appeal (CIO appealing to TMT feelings of loyalty and friendship), and avoiding pressuring executives. The CIO is a social actor who works in a social structure (i.e., TMT level). With such structure comes social capital that can either provide the CIO with valuable resources and facilitate actions, or hinder the CIO's actions and create impediments. Social capital is an important facilitator of knowledge exchange and integration, which is important for the transformation of IT investment to organizational outcomes. The social capital theory explains how such a beneficial relationship can be established. Social capital is about CIO-TMT formal and informal relationships, mutual cognition and language, and TMT trust in CIO. When it comes to trust, CIOs should work to reflect that they are acting in the firm's best interest, have honesty when dealing with TMT, and be competent in what they do (Karahanna & Preston, 2013).

### 6.6 Conclusion

We undertook this study to answer two IS strategic leadership questions*: How does the presence of the CIO in the TMT influence relative firm performance*? and *how does TMT digital savviness enhance the impact of CIO business savviness on relative firm performance for those CIOs in the*

*TMT*? Our empirical findings show that CIO presence does not generate a positive impact on relative firm performance, and what is needed is a set of complementary TMT characteristics in the form of digital savviness that elevate the impact of CIO membership even if CIO business knowledge is low.

# REFERENCES

Adler, P. S., & Kwon, S.-W. (2002). Social Capital: Prospects for a New Concept. *Academy of Management Review*, *27*(1), 17–40. https://doi.org/10.5465/amr.2002.5922314

Alchian, A. A., & Demsetz, H. (1972). Production, Information Costs, and Economic Organization. *The American Economic Review*, *62*(5), 777–795.

Amit, R., & Wernerfelt, B. (1990). Why Do Firms Reduce Business Risk? *Academy of Management Journal*, *33*(3), 520–533. https://doi.org/10.5465/256579

Andriole, S. (2016, August 19). *5 Ways CIOs Should Speak Digital to Executives*. Forbes. https://www.forbes.com/sites/steveandriole/2016/08/19/5-ways-cios-should-speak-digital-to-executives/

Andriole, S. (2017, March 5). *10 Ways To Kill (Or Coronate) Your CIO*. Forbes. https://www.forbes.com/sites/steveandriole/2017/03/05/10-ways-to-kill-or-coronate-your-cio/

Ang, S., & Straub, D. W. (1998). Production and Transaction Economies and IS Outsourcing: A Study of the U. S. Banking Industry. *MIS Quarterly*, *22*(4), 535–552. JSTOR. https://doi.org/10.2307/249554

Applegate, L. M., & Elam, J. J. (1992). New Information Systems Leaders: A Changing Role in a Changing World. *MIS Quarterly*, *16*(4), 469–490. https://doi.org/10.2307/249732

Aral, S., & Weill, P. (2007). IT Assets, Organizational Capabilities, and Firm Performance: How Resource Allocations and Organizational Differences Explain Performance Variation. *Organization Science*, *18*(5), 763–780. https://doi.org/10.1287/orsc.1070.0306

Armstrong, C. P., & Sambamurthy, V. (1999). Information Technology Assimilation in Firms: The Influence of Senior Leadership and IT Infrastructures. *Information Systems Research*, *10*(4), 304–327. https://doi.org/10.1287/isre.10.4.304

Arvidsson, V., Holmström, J., & Lyytinen, K. (2014). Information Systems Use as Strategy Practice: A Multi-Dimensional View of Strategic Information System Implementation and Use. *The Journal of Strategic Information Systems*, *23*(1), 45–61. https://doi.org/10.1016/j.jsis.2014.01.004

Attewell, P. (1992). Technology Diffusion and Organizational Learning: The Case of Business Computing. *Organization Science*, *3*(1), 1–19. https://doi.org/10.1287/orsc.3.1.1

Aubert, B. A., Rivard, S., & Patry, M. (2004). A Transaction Cost Model of IT Outsourcing. *Information & Management*, *41*(7), 921–932. https://doi.org/10.1016/j.im.2003.09.001

Baltagi, B. H. (2013). *Econometric Analysis of Panel Data* (5th edition). Wiley.

Banker, R. D., & Feng, C. (Qian). (2019). The Impact of Information Security Breach Incidents on CIO Turnover. *Journal of Information Systems*. https://doi.org/10.2308/isys-52532

Banker, R. D., Hu, N., Pavlou, P. A., & Luftman, J. (2011). CIO Reporting Structure, Strategic Positioning, and Firm Performance. *MIS Q.*, *35*(2), 487–504.

Bardhan, I., Krishnan, V., & Lin, S. (2013). Research Note: Business Value of Information Technology: Testing the Interaction Effect of IT and R&D on Tobin's Q. *Information Systems Research*, *24*(4), 1147.

Barnes, C. M., Dang, C. T., Leavitt, K., Guarana, C. L., & Uhlmann, E. L. (2018). Archival Data in Micro-Organizational Research: A Toolkit for Moving to a Broader Set of Topics. *Journal of Management*, *44*(4), 1453–1478. https://doi.org/10.1177/0149206315604188

Barnett, W. P. (2008). *The Red Queen among Organizations: How Competitiveness Evolves*. Princeton University Press.

Barnett, W. P., & McKendrick, D. G. (2004). Why are Some Organizations More Competitive than Others? Evidence from a Changing Global Market. *Administrative Science Quarterly*, *49*(4), 535–571. https://doi.org/10.2307/4131490

Barnett, W. P., & Pontikes, E. G. (2008). The Red Queen, Success Bias, and Organizational Inertia. *Management Science*, *54*(7), 1237–1251. https://doi.org/10.1287/mnsc.1070.0808

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, *17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Bascle, G. (2008). Controlling for Endogeneity with Instrumental Variables in Strategic mManagement Research. *Strategic Organization*, *6*(3), 285–327. https://doi.org/10.1177/1476127008094339

Bassellier, G., Benbasat, I., & Reich, B. H. (2003). The Influence of Business Managers' IT Competence on Championing IT. *Information Systems Research*, *14*(4), 317–336. https://doi.org/10.1287/isre.14.4.317.24899

Becker, G. S., & Murphy, K. M. (1992). The Division of Labor, Coordination Costs, and Knowledge. *The Quarterly Journal of Economics*, *107*(4), 1137–1160. https://doi.org/10.2307/2118383

Becker-Blease, J. R. (2011). Governance and innovation. *Journal of Corporate Finance*, *17*(4), 947–958. https://doi.org/10.1016/j.jcorpfin.2011.04.003

Benaroch, M., & Chernobai, A. (2017). Operational It Failures, It Value Destruction, and Board-Level It Governance Changes. *MIS Quarterly*, *41*(3), 729-A6.

Bergh, D. D. (2001). Executive Retention and Acquisition Outcomes: A Test of Opposing Views on the Influence of Organizational Tenure. *Journal of Management*, *27*(5), 603–622. https://doi.org/10.1177/014920630102700506

Bharadwaj, A. S. (2000). A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation. *MIS Quarterly*, *24*(1), 169–196. JSTOR. https://doi.org/10.2307/3250983

Bharadwaj, A. S., Bharadwaj, S. G., & Konsynski, B. R. (1999). Information Technology Effects on Firm Performance as Measured by Tobin's q. *Management Science*, *45*(7), 1008–1024. https://doi.org/10.1287/mnsc.45.7.1008

Bowen, P. L., Cheung, M.-Y. D., & Rohde, F. H. (2007). Enhancing IT governance practices: A model and case study of an organization's efforts. *International Journal of Accounting Information Systems*, *8*(3), 191–221. https://doi.org/10.1016/j.accinf.2007.07.002

Boynton, A. C., Zmud, R. W., & Jacobs, G. C. (1994). The Influence of IT Management Practice on IT Use in Large Organizations. *MIS Quarterly*, *18*(3), 299–318. JSTOR. https://doi.org/10.2307/249620

Bradley, R. V., Byrd, T. A., Pridmore, J. L., Thrasher, E., Pratt, R. M., & Mbarika, V. W. (2012). An Empirical Examination of Antecedents and Consequences of IT Governance in US Hospitals. *Journal of Information Technology*, *27*(2), 156–177. https://doi.org/10.1057/jit.2012.3

Brynjolfsson, E. (1993). The Productivity Paradox of Information Technology. *Communications of the ACM*, *36*(12), 66–77. https://doi.org/10.1145/163298.163309

Brynjolfsson, E., & Hitt, L. M. (1998). Beyond the Productivity Paradox: Computers are the Catalyst for Bigger Changes. *Communications of the ACM*, *8*, 49.

Burton-Jones, A., & Lee, A. S. (2017). Thinking About Measures and Measurement in Positivist Research: A Proposal for Refocusing on Fundamentals. *Information Systems Research*, *28*(3), 451–467. https://doi.org/10.1287/isre.2017.0704

Capon, N., Farley, J. U., & Hoenig, S. (1990). Determinants of Financial Performance: A Meta-Analysis. *Management Science*, *36*(10), 1143–1159. https://doi.org/10.1287/mnsc.36.10.1143

Carpenter, M. A. (2002). The Implications of Strategy and Social Context for the Relationship Between Top Management Team Heterogeneity and Firm Performance. *Strategic Management Journal*, *23*(3), 275–284. https://doi.org/10.1002/smj.226

Carpenter, M. A., Geletkanycz, M. A., & Sanders, W. G. (2004). Upper Echelons Research Revisited: Antecedents, Elements, and Consequences of Top Management Team Composition. *Journal of Management*, *30*(6), 749–778. https://doi.org/10.1016/j.jm.2004.06.001

Carpenter, M. A., Sanders, W. G., & Gregersen, H. B. (2001). Bundling Human Capital with Organizational Context: The Impact of International Assignment Experience on Multinational Firm Performance and CEO Pay. *Academy of Management Journal*, *44*(3), 493–511. https://doi.org/10.2307/3069366

Certo, S. T., & Semadeni, M. (2006). Strategy Research and Panel Data: Evidence and Implications. *Journal of Management*, *32*(3), 449–471. https://doi.org/10.1177/0149206305283320

Chan, Y. E., & Reich, B. H. (2007). IT Alignment: What Have we Learned? *Journal of Information Technology*, *22*(4), 297–315. https://doi.org/10.1057/palgrave.jit.2000109

Chan, Y. E., Sabherwal, R., & Thatcher, J. B. (2006). Antecedents and Outcomes of Strategic IS Alignment: An Empirical Investigation. *IEEE Transactions on Engineering Management*, *53*(1), 27–47. https://doi.org/10.1109/TEM.2005.861804

Chang, E. H., Milkman, K. L., Chugh, D., & Akinola, M. (2018). Diversity Thresholds: How Social Norms, Visibility, and Scrutiny Relate to Group Composition. *Academy of Management Journal*, *62*(1), 144–171. https://doi.org/10.5465/amj.2017.0440

Chang, Y. B., & Gurbaxani, V. (2012). An Empirical Analysis of Technical Efficiency: The Role of IT Intensity and Competition. *Information Systems Research*, *24*(3), 561–578. https://doi.org/10.1287/isre.1120.0438

Chatterjee, D., Richardson, V. J., & Zmud, R. W. (2001). Examining the Shareholder Wealth Effects of Announcements of Newly Created CIO Positions. *MIS Quarterly*, *25*(1), 43–70. https://doi.org/10.2307/3250958

Chen, D. Q., Preston, D. S., & Xia, W. (2010). Antecedents and Effects of CIO Supply-Side and Demand-Side Leadership: A Staged Maturity Model. *Journal of Management Information Systems*, *27*(1), 231–272. https://doi.org/10.2753/MIS0742-1222270110

Chun, M., & Mooney, J. (2009). CIO Roles and Responsibilities: Twenty-Five Years of Evolution and Change. *Information & Management*, *46*(6), 323–334. https://doi.org/10.1016/j.im.2009.05.005

Clews, R. (2016). *Project Finance for the International Petroleum Industry*. Academic Press.

Clougherty, J. A., Duso, T., & Muck, J. (2016). Correcting for Self-selection Based Endogeneity in Management Research: Review, Recommendations and Simulations. *Organizational Research Methods*, *19*(2), 286–347. https://doi.org/10.1177/1094428115619013

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*, *35*(1), 128–152. https://doi.org/10.2307/2393553

Coles, J. L., Daniel, N. D., & Naveen, L. (2008). Boards: Does one size fit all? *Journal of Financial Economics*, *87*(2), 329–356. https://doi.org/10.1016/j.jfineco.2006.08.008

Collins, C. J., & Clark, K. D. (2003). Strategic Human Resource Practices, Top Management Team Social Networks, and Firm Performance: The Role of Human Resource Practices in Creating Organizational Competitive Advantage. *Academy of Management Journal*, *46*(6), 740–751. https://doi.org/10.2307/30040665

Combs, J. G., & Skill, M. S. (2003). Managerialist and Human Capital Explanations for Key Executive Pay Premiums: A Contingency Perspective. *Academy of Management Journal*, *46*(1), 63–73. https://doi.org/10.5465/30040676

Conner, K. R. (1991). A Historical Comparison of Resource-Based Theory and Five Schools of Thought Within Industrial Organization Economics: Do We Have a New Theory of the Firm? *Journal of Management*, *17*(1), 121–154. https://doi.org/10.1177/014920639101700109

Conner, K. R., & Prahalad, C. K. (1996). A Resource-Based Theory of the Firm: Knowledge Versus Opportunism. *Organization Science*, *7*(5), 477–501. https://doi.org/10.1287/orsc.7.5.477

Curran, P. J., & Bauer, D. J. (2011). The Disaggregation of Within-Person and Between-Person Effects in Longitudinal Models of Change. *Annual Review of Psychology*, *62*(1), 583–619. https://doi.org/10.1146/annurev.psych.093008.100356

Cyert, R. M., & March, J. G. (1963). *Behavioral Theory of the Firm* (2 edition). Wiley-Blackwell.

Daily, C. M., & Johnson, J. L. (1997). Sources of CEO power and firm financial performance: A longitudinal assessment. *Journal of Management*, *23*(2), 97–117. https://doi.org/10.1016/S0149-2063(97)90039-8

Darrow, B. (2015). *CIOs are still important. Here's why.* Fortune. http://fortune.com/2015/07/01/yes-you-do-need-a-cio/

Dawson, G. S., Denford, J. S., Williams, C. K., Preston, D., & Desouza, K. C. (2016). An Examination of Effective IT Governance in the Public Sector Using the Legal View of Agency Theory. *Journal of Management Information Systems*, *33*(4), 1180–1208. https://doi.org/10.1080/07421222.2016.1267533

Day, G. S. (1994). The Capabilities of Market-Driven Organizations. *Journal of Marketing*, *58*(4), 37–52. https://doi.org/10.1177/002224299405800404

Dean, T. J., Brown, R. L., & Bamford, C. E. (1998). Differences in Large and Small Firm Responses to Environmental Context: Strategic Implications from a Comparative Analysis of Business Formations. *STRATEGIC MANAGEMENT JOURNAL*, *8*, 709.

Deephouse, D. L. (2000). Media Reputation as a Strategic Resource: An Integration of Mass Communication and Resource-Based Theories. *Journal of Management*, *26*(6), 1091–1112. https://doi.org/10.1177/014920630002600602

Derfus, P. J., Maggitti, P. G., Grimm, C. M., & Smith, K. G. (2008). The Red Queen Effect: Competitive Actions And Firm Performance. *Academy of Management Journal*, *51*(1), 61–80. https://doi.org/10.5465/AMJ.2008.30708624

Dewan, S., & Ren, F. (2011). Information Technology and Firm Boundaries: Impact on Firm Risk and Return Performance. *Information Systems Research*, *22*(2), 369.

Dezsö, C. L., & Ross, D. G. (2012). Does Female Representation in Top Management Improve Firm Performance? A Panel Data Investigation. *Strategic Management Journal*, *33*(9), 1072–1089. https://doi.org/10.1002/smj.1955

Dezső, C. L., Ross, D. G., & Uribe, J. (2016). Is There an Implicit Quota on Women in Top Management? A Large-Sample Statistical Analysis. *Strategic Management Journal*, *37*(1), 98–115. https://doi.org/10.1002/smj.2461

DiMaggio, P. J., & Powell, W. W. (1983). The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. *American Sociological Review*, *48*(2), 147–160.

Doll, W. J. (1985). Avenues for Top Management Involvement in Successful MIS Development. *MIS Quarterly*, *9*(1), 17–35. JSTOR. https://doi.org/10.2307/249271

Earl, M. J., & Feeny, D. F. (1994). Is Your Cio Adding Value? *Sloan Management Review; Cambridge, Mass.*, *35*(3), 11–20.

Eisenhardt, K. M. (1989). Agency Theory: An Assessment and Review. *Academy of Management Review*, *14*(1), 57–74. https://doi.org/10.5465/amr.1989.4279003

Elbashir, M. Z., Collier, P. A., Sutton, S. G., Davern, M. J., & Leech, S. A. (2013). Enhancing the Business Value of Business Intelligence: The Role of Shared Knowledge and Assimilation. *Journal of Information Systems*, *27*(2), 87–105. https://doi.org/10.2308/isys-50563

Emery, J. C. (1991). Editor’s Comments: What Role for the CIO? *MIS Quarterly*, *15*(2), vii–ix.

Enns, H. G., Huff, S. L., & Higgins, C. A. (2003). CIO lateral Influence Behaviors: Gaining Peers’ Commitment to Strategic Information Systems. *MIS Quarterly*, *27*(1), 155–176.

Faraj, S., & Xiao, Y. (2006). Coordination in Fast-Response Organizations. *Management Science*, *52*(8), 1155–1169. https://doi.org/10.1287/mnsc.1060.0526

Feeny, D. F., Edwards, B. R., & Simpson, K. M. (1992). Understanding the CEO/CIO Relationship. *MIS Quarterly*, *16*(4), 435–448. https://doi.org/10.2307/249730

Feld, C. S., & Marmol, G. G. (1994). Repairing the Dialogue between CEO and CIO. *The McKinsey Quarterly*, *3*, 15.

Feldman, M. S., & Pentland, B. T. (2003). Reconceptualizing Organizational Routines as a Source of Flexibility and Change. *Administrative Science Quarterly*, *48*(1), 94–118. https://doi.org/10.2307/3556620

Feng, H., Morgan, N. A., & Rego, L. L. (2015). Marketing Department Power and Firm Performance. *Journal of Marketing*, *79*(5), 1–20. https://doi.org/10.1509/jm.13.0522

Fu, R., Tang, Y., & Chen, G. (2020). Chief Sustainability Officers and Corporate Social (Ir)responsibility. *Strategic Management Journal*, *41*(4), 656–680. https://doi.org/10.1002/smj.3113

Galbraith, J. R. (1973). *Designing Complex Organizations*. Addison-Wesley Pub. Co.

Geletkanycz, M. A., & Hambrick, D. C. (1997). The External Ties of Top Executives: Implications for Strategic Choice and Performance. *Administrative Science Quarterly*, *42*(4), 654–681. https://doi.org/10.2307/2393653

Germann, F., Ebbes, P., & Grewal, R. (2015). The Chief Marketing Officer Matters! *Journal of Marketing*, *79*(3), 1–22. https://doi.org/10.1509/jm.14.0244

Gerow, J. E., Grover, V., & Thatcher, J. (2016). Alignment's Nomological Network: Theory and Evaluation. *Information & Management*, *53*(5), 541–553. https://doi.org/10.1016/j.im.2015.12.006

Gerow, J. E., Grover, V., Thatcher, J., & Roth, P. L. (2014). Looking Toward the Future of It–Business Strategic Alignment Through the Past: A Meta-Analysis1. *MIS Quarterly*, *38*(4), 1159–1186. https://doi.org/10.25300/misq/2014/38.4.10

Gibson, C. B., & Birkinshaw, J. (2004). The Antecedents, Consequences, and Mediating Role of Organizational Ambidexterity. *Academy of Management Journal*, *47*(2), 209–226. https://doi.org/10.2307/20159573

Gilbert, C. G. (2005). Unbundling the Structure of Inertia: Resource Versus Routine Rigidity. *Academy of Management Journal*, *48*(5), 741–763. https://doi.org/10.5465/amj.2005.18803920

Granovetter, M. (1985). Economic Action and Social Structure: The Problem of Embeddedness. *American Journal of Sociology*, *91*(3), 481–510.

Grant, R. M. (1996). Toward a Knowledge-Based Theory of the Firm. *Strategic Management Journal*, *17*(S2), 109–122. https://doi.org/10.1002/smj.4250171110

Grewal, R., & Slotegraaf, R. J. (2007). Embeddedness of Organizational Capabilities. *Decision Sciences*, *38*(3), 451–488. https://doi.org/10.1111/j.1540-5915.2007.00166.x

Grover, V., Jeong, S.-R., Kettinger, W. J., & Lee, C. C. (1993). The Chief Information Officer: A Study of Managerial Roles. *Journal of Management Information Systems*, *10*(2), 107–130. https://doi.org/10.1080/07421222.1993.11518002

Grover, V., Myun Joong Cheon, & Teng, J. T. C. (1996). The Effect of Service Quality and Partnership on the Outsourcing of Information Systems Functions. *Journal of Management Information Systems*, *12*(4), 89–116. https://doi.org/10.1080/07421222.1996.11518102

Guadalupe, M., Li, H., & Wulf, J. (2014). Who Lives in the C-Suite? Organizational Structure and the Division of Labor in Top Management. *Management Science*, *60*(4), 824–844. https://doi.org/10.1287/mnsc.2013.1795

Gupta, A. K., Smith, K. G., & Shalley, C. E. (2006). The Interplay Between Exploration and Exploitation. *Academy of Management Journal*, *49*(4), 693–706. https://doi.org/10.5465/AMJ.2006.22083026

Gupta, Y. P. (1991). The chief executive officer and the chief information officer: The strategic partnership. *Journal of Information Technology*, *6*(3–4), 128–139. https://doi.org/10.1057/jit.1991.28

Haes, S. D., & Grembergen, W. V. (2009). An Exploratory Study into IT Governance Implementations and its Impact on Business/IT Alignment. *Information Systems Management*, *26*(2), 123–137. https://doi.org/10.1080/10580530902794786

Haislip, J. Z., & Richardson, V. J. (2018). The Effect of CEO IT Expertise on the Information Environment: Evidence from Earnings Forecasts and Announcements. *Journal of Information Systems*, *32*(2), 71–94. https://doi.org/10.2308/isys-51796

Hambrick, D. C. (2007). Upper Echelons Theory: An Update. *Academy of Management Review*, *32*(2), 334–343. https://doi.org/10.5465/AMR.2007.24345254

Hambrick, D. C., Cho, T. S., & Chen, M.-J. (1996). The Influence of Top Management Team Heterogeneity on Firms' Competitive Moves. *Administrative Science Quarterly*, *41*(4), 659–684. https://doi.org/10.2307/2393871

Hambrick, D. C., & Mason, P. A. (1984). Upper Echelons: The Organization as a Reflection of Its Top Managers. *Academy of Management Review*, *9*(2), 193–206. https://doi.org/10.5465/AMR.1984.4277628

Han, K., Mittal, V., & Zhang, Y. (2017). Relative Strategic Emphasis and Firm-Idiosyncratic Risk: The Moderating Role of Relative Performance and Demand Instability. *Journal of Marketing*, *81*(4), 25–44. https://doi.org/10.1509/jm.15.0509

Hannan, M. T., & Freeman, J. (1984). Structural Inertia and Organizational Change. *American Sociological Review*, *49*(2), 149–164. JSTOR. https://doi.org/10.2307/2095567

Hansen, G. S., & Wernerfelt, B. (1989). Determinants of firm Performance: The Relative Importance of Economic and Organizational Factors. *Strategic Management Journal*, *10*(5), 399–411. https://doi.org/10.1002/smj.4250100502

Harris, D., & Helfat, C. (1997). Specificity of CEO Human Capital and compensation. *Strategic Management Journal*, *18*(11), 895–920. https://doi.org/10.1002/(SICI)1097-0266(199712)18:11<895::AID-SMJ931>3.0.CO;2-R

Harrison, D. A., & Klein, K. J. (2007). What's the difference? Diversity constructs as separation, variety, or disparity in organizations. *Academy of Management Review*, *32*(4), 1199–1228. https://doi.org/10.5465/AMR.2007.26586096

He, Z.-L., & Wong, P.-K. (2004). Exploration vs. Exploitation: An Empirical Test of the Ambidexterity Hypothesis. *Organization Science*, *4*, 481.

Heckman, J. (1974). Shadow Prices, Market Wages, and Labor Supply. *Econometrica*, *42*(4), 679–694. https://doi.org/10.2307/1913937

Heckman, J. J. (1976). *The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models*. National Bureau of Economic Research. https://www.nber.org/books-and-chapters/annals-economic-and-social-measurement-volume-5-number-4/common-structure-statistical-models-truncation-sample-selection-and-limited-dependent-variables-and

Heller, M. (2016). *CIO Paradox: Battling the Contradictions of IT Leadership*. Routledge.

Hickson, D. J., Hinings, C. R., Lee, C. A., Schneck, R. E., & Pennings, J. M. (1971). A Strategic Contingencies' Theory of Intraorganizational Power. *Administrative Science Quarterly*, *16*(2), 216–229. https://doi.org/10.2307/2391831

Hillman, A. J., & Dalziel, T. (2003). Boards of Directors and Firm Performance: Integrating Agency and Resource Dependence Perspectives. *Academy of Management Review*, *28*(3), 383–396. https://doi.org/10.5465/amr.2003.10196729

Hillman, A. J., Withers, M. C., & Collins, B. J. (2009). Resource Dependence Theory: A Review. *Journal of Management*, *35*(6), 1404–1427. https://doi.org/10.1177/0149206309343469

Hinings, C. R., Hickson, D. J., Pennings, J. M., & Schneck, R. E. (1974). Structural Conditions of Intraorganizational Power. *Administrative Science Quarterly*, *19*(1), 22–44. https://doi.org/10.2307/2391786

Ho, J. L. Y., Wu, A., & Xu, S. X. (2011). Corporate Governance and Returns on Information Technology Investment: Evidence From an Emerging Market. *Strategic Management Journal*, *32*(6), 595–623. https://doi.org/10.1002/smj.886

Ho, J., Tian, F., Wu, A., & Xu, S. X. (2017). Seeking Value Through Deviation? Economic Impacts of IT Overinvestment and Underinvestment. *Information Systems Research*, *28*(4), 850–862. https://doi.org/10.1287/isre.2017.0710

Hoskisson, R. E., Hitt, M. A., Johnson, R. A., & Moesel, D. D. (1993). Construct Validity of an Objective (Entropy) Categorical Measure of Diversification Strategy. *Strategic Management Journal*, *14*(3), 215–235. https://doi.org/10.1002/smj.4250140305

Huang, R., Zmud, R. W., & Price, R. L. (2010). Influencing the Effectiveness of IT Governance Practices Through Steering Committees and Communication Policies. *European Journal of Information Systems*, *19*(3), 288–302. https://doi.org/10.1057/ejis.2010.16

Huff, J. O., Huff, A. S., & Thomas, H. (1992). Strategic Renewal and the Interaction of Cumulative Stress and Inertia. *Strategic Management Journal*, *13*(S1), 55–75. https://doi.org/10.1002/smj.4250131006

Iaquinto, A. L., & Fredrickson, J. W. (1997). Top Management Team Agreement about the Strategic Decision Process: A Test of Some of Its Determinants and Consequences. *Strategic Management Journal*, *18*(1), 63–75.

Im, G., & Rai, A. (2008). Knowledge Sharing Ambidexterity in Long-Term Interorganizational Relationships. *Management Science*, *54*(7), 1281–1296. https://doi.org/10.1287/mnsc.1080.0902

Iyer, D. N., & Miller, K. D. (2008). Performance Feedback, Slack, and The Timing of Acquisitions. *Academy of Management Journal*, *51*(4), 808–822. https://doi.org/10.5465/amr.2008.33666024

Jayatilaka, B., Schwarz, A., & Hirschheim, R. (2003). Determinants of ASP Choice: An Integrated Perspective. *European Journal of Information Systems*, *12*(3), 210–224. https://doi.org/10.1057/palgrave.ejis.3000466

Jensen, M. C., & Meckling, W. H. (1976). Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics*, *3*(4), 305–360. https://doi.org/10.1016/0304-405X(76)90026-X

Jensen, M. C., & Meckling, W. H. (1992). *Specific and general knowledge and organizational structure* (SSRN Scholarly Paper ID 6658). Social Science Research Network. https://papers.ssrn.com/abstract=6658

Jewer, J., & McKay, K. N. (2012). Antecedents and Consequences of Board IT Governance: Institutional and Strategic Choice Perspectives. *Journal of the Association for Information Systems; Atlanta*, *13*(7), 581–617.

Johnson, A. M., & Lederer, A. L. (2005). The Effect of Communication Frequency and Channel Richness on the Convergence Between Chief Executive and Chief Information Officers. *Journal of Management Information Systems*, *22*(2), 227–252. https://doi.org/10.1080/07421222.2005.11045842

Johnson, A. M., & Lederer, A. L. (2010). CEO/CIO mutual understanding, strategic alignment, and the contribution of IS to the organization. *Information & Management*, *47*(3), 138–149. https://doi.org/10.1016/j.im.2010.01.002

Joseph, D., Ang, S., & Slaughter, S. A. (2015). Turnover or Turnaway? Competing Risks Analysis of Male and Female IT Professionals' Job Mobility and Relative Pay Gap. *Information Systems Research*, *26*(1), 145–164. https://doi.org/10.1287/isre.2014.0558

Kanashiro, P., & Rivera, J. (2019). Do Chief Sustainability Officers Make Companies Greener? The Moderating Role of Regulatory Pressures. *Journal of Business Ethics*, *155*(3), 687–701. https://doi.org/10.1007/s10551-017-3461-2

Kane, G. C., & Alavi, M. (2007). Information Technology and Organizational Learning: An Investigation of Exploration and Exploitation Processes. *Organization Science*, *18*(5), 796–812. https://doi.org/10.1287/orsc.1070.0286

Karahanna, E., & Preston, D. S. (2013). The Effect of Social Capital of the Relationship Between the CIO and Top Management Team on Firm Performance. *Journal of Management Information Systems*, *30*(1), 15–56. https://doi.org/10.2753/MIS0742-1222300101

Karahanna, E., & Watson, R. T. (2006). Information Systems Leadership. *IEEE Transactions on Engineering Management*, *53*(2), 171–176. https://doi.org/10.1109/TEM.2006.872247

Karake, Z. A. (1992). Chief Information Officers: Organizational Control and Company Characteristics. *Logistics Information Management*, *5*(4), 27–33. https://doi.org/10.1108/09576059210021355

Karake, Z. A. (1995). The Management of Information Technology, Governance, and Managerial Characteristics. *Information Systems Journal*, *5*(4), 271–284. https://doi.org/10.1111/j.1365-2575.1995.tb00099.x

Karimi, J., Bhattacherjee, A., Gupta, Y. P., & Somers, T. M. (2000). The Effects of MIS Steering Committees on Information Technology Management Sophistication. *Journal of Management Information Systems*, *17*(2), 207–230. https://doi.org/10.1080/07421222.2000.11045641

Karimi, J., Gupta, Y. P., & Somers, T. M. (1996). The Congruence between a Firm's Competitive Strategy and Information Technology Leader's Rank and Role. *Journal of Management Information Systems*, *13*(1), 63–88. https://doi.org/10.1080/07421222.1996.11518112

Kearns, G. S., & Sabherwal, R. (2006). Strategic Alignment between Business and Information Technology: A Knowledge-Based View of Behaviors, Outcome, and Consequences. *Journal of Management Information Systems*, *23*(3), 129–162. JSTOR.

Keck, S. L. (1997). Top Management Team Structure: Differential Effects by Environmental Context. *Organization Science*, *8*(2), 143–156. https://doi.org/10.1287/orsc.8.2.143

Kennedy, P. (2008). *A Guide to Econometrics. 6th edition* (6th edition). Wiley-Blackwell.

Ketchen, D. J., Ireland, R. D., & Baker, L. T. (2013). The Use of Archival Proxies in Strategic Management Studies: Castles Made of Sand? *Organizational Research Methods*, *16*(1), 32–42. https://doi.org/10.1177/1094428112459911

Khallaf, A., & Skantz, T. (2011). Does Long Term Performance Improve Following the Appointment of a CIO? *International Journal of Accounting Information Systems*, *12*(1), 57–78. https://doi.org/10.1016/j.accinf.2010.08.002

Kim, K., Mithas, S., Whitaker, J., & Roy, P. K. (2014). Research Note—Industry-Specific Human Capital and Wages: Evidence from the Business Process Outsourcing Industry. *Information Systems Research*, *25*(3), 618–638. https://doi.org/10.1287/isre.2014.0532

Kohli, R., Devaraj, S., & Ow, T. T. (2012). Does Information Technology Investment Influence a Firm's Market Value? A Case of Non-Publicly Traded Healthcare Firms. *MIS Quarterly*, *36*(4), 1145–1163.

Kohli, R., & Johnson, S. (2011). Digital Transformation in Latecomer Industries: CIO and CEO Leadership Lessons from Encana Oil & Gas (USA) Inc. *MIS Quarterly Executive*, *10*(4), 141–156.

Kor, Y. Y. (2003). Experience-Based Top Management Team Competence and Sustained Growth. *Organization Science*, *14*(6), 707–719.

Kretzman, P. (2012). *IT Consumerization, the Cloud and the Alleged Death of the CIO*. WIRED. https://www.wired.com/insights/2012/03/death-of-the-cio/

Kudaravalli, S., & Faraj, S. (2008). The Structure of Collaboration in Electronic Networks. *Journal of the Association for Information Systems*, *9*(10). https://doi.org/10.17705/1jais.00172

Kunisch, S., Bartunek, J. M., Mueller, J., & Huy, Q. N. (2017). Time in Strategic Change Research. *Academy of Management Annals*, *11*(2), 1005–1064. https://doi.org/10.5465/annals.2015.0133

Kunisch, S., Menz, M., & Langan, R. (2020). Chief digital officers: An exploratory analysis of their emergence, nature, and determinants. *Long Range Planning*, 101999. https://doi.org/10.1016/j.lrp.2020.101999

Lahiri, N., & Narayanan, S. (2013). Vertical Integration, Innovation, and Alliance Portfolio Size: Implications for Firm Performance. *Strategic Management Journal*, *34*(9), 1042–1064. https://doi.org/10.1002/smj.2045

Lan, L. L., & Heracleous, L. (2010). Rethinking Agency Theory: The View from Law. *Academy of Management Review*, *35*(2), 294–314. https://doi.org/10.5465/amr.35.2.zok294

LeBreton, J. M., & Senter, J. L. (2008). Answers to 20 Questions About Interrater Reliability and Interrater Agreement. *Organizational Research Methods*, *11*(4), 815–852. https://doi.org/10.1177/1094428106296642

Lederer, A. L., & Burky, L. B. (1988). Understanding Top Management's Objectives: A Management Information Systems Concern. *Journal of Information Systems*, *3*(1), 50.

Lederer, A. L., & Mendelow, A. L. (1988). Convincing Top Management of the Strategic Potential of Information Systems. *MIS Quarterly*, *12*(4), 525–534.

Lee, J. M., Hwang, B.-H., & Chen, H. (2017). Are Founder CEOs More Overconfident than Professional CEOs? Evidence from S&P 1500 Companies. *Strategic Management Journal*, *38*(3), 751–769. https://doi.org/10.1002/smj.2519

Lee, O.-K., Sambamurthy, V., Lim, K. H., & Wei, K. K. (2015). How Does IT Ambidexterity Impact Organizational Agility? *Information Systems Research*, *26*(2), 398–417. https://doi.org/10.1287/isre.2015.0577

Levinthal, D. A., & March, J. G. (1993). The myopia of learning. *Strategic Management Journal*, *14*(S2), 95–112. https://doi.org/10.1002/smj.4250141009

Levitt, B., & March, J. G. (1988). Organizational Learning. *Annual Review of Sociology*, *14*, 319–340.

Li, M., & Ye, L. R. (1999). Information technology and firm performance: Linking with environmental, strategic and managerial contexts. *Information & Management*, *35*(1), 43–51. https://doi.org/10.1016/S0378-7206(98)00075-5

Liang, H., Wang, N., Xue, Y., & Ge, S. (2017). Unraveling the Alignment Paradox: How Does Business—IT Alignment Shape Organizational Agility? *Information Systems Research*, *28*(4), 863–879. https://doi.org/10.1287/isre.2017.0711

Lim, J.-H., Stratopoulos, T. C., & Wirjanto, T. S. (2013). Sustainability of a Firm's Reputation for Information Technology Capability: The Role of Senior IT Executives. *Journal of Management Information Systems*, *30*(1), 57–96. https://doi.org/10.2753/MIS0742-1222300102

Liu, W. (2006). Knowledge exploitation, knowledge exploration, and competency trap. *Knowledge and Process Management*, *13*(3), 144–161. https://doi.org/10.1002/kpm.254

Loten, A. (2017, May 2). Lack of 'People' Skills Tops CIO Firing Offenses: Survey. *WSJ*. https://blogs.wsj.com/cio/2017/05/02/lack-of-people-skills-tops-cio-firing-offenses-survey/

Loten, A. (2020, October 12). Many Corporate Boards Still Face Shortage of Tech Expertise. *Wall Street Journal*. https://www.wsj.com/articles/many-corporate-boards-still-face-shortage-of-tech-expertise-11602537966

Luftman, J., & Ben-Zvi, T. (2010). Key Issues for It Executives 2009: Difficult Economy's Impact on It. *MIS Quarterly Executive*, *9*(1), 49–59.

Maddala, G. S. (1983). *Limited-Dependent and Qualitative Variables in Econometrics*. Cambridge University Press. https://doi.org/10.1017/CBO9780511810176

Malone, T. W., Yates, J., & Benjamin, R. I. (1987). Electronic Markets and Electronic Hierarchies. *Commun. ACM*, *30*(6), 484–497. https://doi.org/10.1145/214762.214766

Marcel, J. J. (2009). Why top management team characteristics matter when employing a chief operating officer: A strategic contingency perspective. *Strategic Management Journal*, *30*(6), 647–658. https://doi.org/10.1002/smj.763

March, J. G. (1962). The Business Firm as A Political Coalition. *The Journal of Politics*, *24*(04), 662–678. https://doi.org/10.2307/2128040

March, J. G. (1991). Exploration and Exploitation in Organizational Learning. *Organization Science*, *2*(1), 71–87. https://doi.org/10.1287/orsc.2.1.71

Masli, A., Richardson, V. J., Weidenmier Watson, M., & Zmud, R. W. (2016). Senior Executives' It Management Responsibilities: Serious It-Related Deficiencies and CEO/CFO Turnover. *MIS Quarterly*, *40*(3), 687-BB9.

Mata, F. J., Fuerst, W. L., & Barney, J. B. (1995). Information Technology and Sustained Competitive Advantage: A Resource-Based Analysis. *MIS Quarterly*, *19*(4), 487–505. JSTOR. https://doi.org/10.2307/249630

McCormack, A. (2014). *The digital CIO: The CIO is dead. Long live the CIO*. ComputerWeekly. http://www.computerweekly.com/opinion/The-digital-CIO-The-CIO-is-dead-Long-live-the-CIO

McGregor, J. (2015). Corporate CFOs are more powerful than ever. *Washington Post*. https://www.washingtonpost.com/news/on-leadership/wp/2015/08/19/corporate-cfos-are-more-powerful-than-ever/

Menz, M. (2012). Functional Top Management Team Members: A Review, Synthesis, and Research Agenda. *Journal of Management*, *38*(1), 45–80. https://doi.org/10.1177/0149206311421830

Menz, M., & Scheef, C. (2014). Chief Strategy Officers: Contingency Analysis of their Presence in Top Management Teams. *Strategic Management Journal*, *35*(3), 461–471. https://doi.org/10.1002/smj.2104

Meyer, J. W., & Rowan, B. (1977). Institutionalized Organizations: Formal Structure as Myth and Ceremony. *American Journal of Sociology*, *83*(2), 340–363. https://doi.org/10.1086/226550

Miller, C. C., Burke, L. M., & Glick, W. H. (1998). Cognitive Diversity among Upper-Echelon Executives: Implications for Strategic Decision Processes. *Strategic Management Journal*, *19*(1), 39–58.

Mithas, S., & Krishnan, M. S. (2008a). Human Capital and Institutional Effects in the Compensation of Information Technology Professionals in the United States. *Management Science*, *54*(3), 415–428. https://doi.org/10.1287/mnsc.1070.0778

Mithas, S., & Krishnan, M. S. (2008b). From Association to Causation via a Potential Outcomes Approach. *Information Systems Research*, *20*(2), 295–313. https://doi.org/10.1287/isre.1080.0184

Mithas, S., Ramasubbu, N., & Sambamurthy, V. (2011). How Information Management Capability Influences Firm Performance. *MIS Quarterly*, 237–256.

Moatti, V., Ren, C. R., Anand, J., & Dussauge, P. (2015). Disentangling the performance effects of efficiency and bargaining power in horizontal growth strategies: An empirical investigation in the global retail industry. *Strategic Management Journal*, *5*, 745.

Mosakowski, E. (1991). Organizational boundaries and Economic Performance: An Empirical Study of Entrepreneurial Computer Firms. *Strategic Management Journal*, *12*(2), 115–133. https://doi.org/10.1002/smj.4250120204

Nafukho, F. M., Hairston, N., & Brooks, K. (2004). Human capital Theory: Implications for Human Resource Development. *Human Resource Development International*, *7*(4), 545–551. https://doi.org/10.1080/1367886042000299843

Nahapiet, J., & Ghoshal, S. (1998). Social Capital, Intellectual Capital, and the Organizational Advantage. *Academy of Management Review*, *23*(2), 242–266. https://doi.org/10.5465/amr.1998.533225

Nash, K. S. (2009, March 11). *One in Four CIOs Fired for Performance*. CIO. http://www.cio.com/article/2430152/cio-role/one-in-four-cios-fired-for-performance.html

Nath, P., & Mahajan, V. (2008). Chief Marketing Officers: A Study of Their Presence in Firms'Top Management Teams. *Journal of Marketing*, *72*(1), 65–81. https://doi.org/10.1509/jmkg.72.1.65

Nazir, S., & Pinsonneault, A. (2012). IT and Firm Agility: An Electronic Integration Perspective. *Journal of the Association for Information Systems*, *13*(3), 150–171.

Nelson, K. M., & Cooprider, J. G. (1996). The Contribution of Shared Knowledge to IS Group Performance. *MIS Quarterly*, *20*(4), 409–432. JSTOR. https://doi.org/10.2307/249562

Newkirk, H. E., & Lederer, A. L. (2006). The Effectiveness of Strategic Information Systems Planning Under Environmental Uncertainty. *Information & Management*, *43*(4), 481–501. https://doi.org/10.1016/j.im.2005.12.001

Okhuysen, G. A., & Bechky, B. A. (2009). Coordination in Organizations: An Integrative Perspective. *Academy of Management Annals*, *3*(1), 463–502. https://doi.org/10.5465/19416520903047533

Palmer, J. W., & Markus, M. L. (2000). The Performance Impacts of Quick Response and Strategic Alignment in Specialty Retailing. *Information Systems Research*, *11*(3), 241–259. https://doi.org/10.1287/isre.11.3.241.12203

Pan, Y., Huang, P., & Gopal, A. (2018). Board Independence and Firm Performance in the It Industry: The Moderating Role of New Entry Threats. *MIS Quarterly*, *42*(3), 979–1000. https://doi.org/10.25300/MISQ/2018/14688

Pang, M.-S., Tafti, A., & Krishnan, M. S. (2016). Do CIO IT Budgets Explain Bigger or Smaller Governments? Theory and Evidence from U.S. State Governments. *Management Science*, *62*(4), 1020–1041. https://doi.org/10.1287/mnsc.2015.2164

Payne, S. C., Finch, J. F., & Tremble, T. R. (2003). Validating Surrogate Measures of Psychological Constructs: The Application of Construct Equivalence to Archival Data. *Organizational Research Methods*, *6*(3), 363–382. https://doi.org/10.1177/1094428103254455

Pentland, B. T. (1995). Information Systems and Organizational Learning: The Social Epistemology of Organizational Knowledge Systems. *Accounting, Management and Information Technologies*, *5*(1), 1–21. https://doi.org/10.1016/0959-8022(95)90011-X

Peppard, J. (2007). The conundrum of IT management. *European Journal of Information Systems*, *16*(4), 336–345. https://doi.org/10.1057/palgrave.ejis.3000697

Peppard, J., Edwards, C., & Lambert, R. (2011). Clarifying the Ambiguous Role of the CIO. *MIS Quarterly Executive*, *10*(1), 31–44.

Perrow, C. (1970). *Organizational Analysis: A Sociological View*. Wadsworth Publishing Company.

Peterson, R. (2004). Crafting Information Technology Governance. *Information Systems Management*, *21*(4), 7–22. https://doi.org/10.1201/1078/44705.21.4.20040901/84183.2

Pfarrer, M. D., Pollock, T. G., & Rindova, V. P. (2010). A Tale of Two Assets: The Effects of Firm Reputation and Celebrity on Earnings Surprises and Investors' Reactions. *Academy of Management Journal*, *53*(5), 1131–1152. https://doi.org/10.5465/amj.2010.54533222

Pfeffer, J. (1981). *Power in Organizations*. Financial Times Prentice Hall.

Pfeffer, J., & Salancik, G. R. (1978). *The External Control of Organizations: A Resource Dependence Perspective* (SSRN Scholarly Paper ID 1496213). Social Science Research Network. https://papers.ssrn.com/abstract=1496213

Pitcher, P., & Smith, A. D. (2001). Top Management Team Heterogeneity: Personality, Power, and Proxies. *Organization Science*, *12*(1), 1–18. https://doi.org/10.1287/orsc.12.1.1.10120

Powell, W. (1990). *Neither Market nor Hierarchy*. The sociology of organizations: classic, contemporary, and critical readings.

Preston, D. (2004). Mechanisms for the Development of Shared Mental Models between the CIO and the Top Management Team. *ICIS 2004 Proceedings*. http://aisel.aisnet.org/icis2004/37

Preston, D. S., Chen, D., & Leidner, D. E. (2008). Examining the Antecedents and Consequences of CIO Strategic Decision-Making Authority: An Empirical Study. *Decision Sciences*, *39*(4), 605–642. https://doi.org/10.1111/j.1540-5915.2008.00206.x

Preston, D. S., & Karahanna, E. (2009). Antecedents of IS Strategic Alignment: A Nomological Network. *Information Systems Research*, *20*(2), 159–179. https://doi.org/10.1287/isre.1070.0159

Raghunathan, B., & Raghunathan, T. S. (1989). Relationship of the Rank of Information Systems Executive to the Organizational Role and Planning Dimensions of Information Systems. *Journal of Management Information Systems*, *6*(1), 111–126. https://doi.org/10.1080/07421222.1989.11517852

Rai, A., Patnayakuni, R., & Seth, N. (2006). Firm Performance Impacts of Digitally Enabled Supply Chain Integration Capabilities. *MIS Quarterly*, *30*(2), 225–246. https://doi.org/10.2307/25148729

Rai, A., & Tang, X. (2013). Research Commentary—Information Technology-Enabled Business Models: A Conceptual Framework and a Coevolution Perspective for Future Research. *Information Systems Research*, *25*(1), 1–14. https://doi.org/10.1287/isre.2013.0495

Raisch, S., Birkinshaw, J., Probst, G., & Tushman, M. L. (2009). Organizational Ambidexterity: Balancing Exploitation and Exploration for Sustained Performance. *Organization Science*, *20*(4), 685–695. https://doi.org/10.1287/orsc.1090.0428

Ranganathan, C., & Sethi, V. (2002). Rationality in Strategic Information Technology Decisions: The Impact of Shared Domain Knowledge and IT Unit Structure. *Decision Sciences*, *33*(1), 59–86. https://doi.org/10.1111/j.1540-5915.2002.tb01636.x

Reich, B. H., & Benbasat, I. (2000). Factors That Influence the Social Dimension of Alignment between Business and Information Technology Objectives. *MIS Quarterly*, *24*(1), 81. https://doi.org/10.2307/3250980

Roberts, P. W., & Dowling, G. R. (2002). Corporate Reputation and Sustained Superior Financial Performance. *Strategic Management Journal*, *23*(12), 1077–1093. https://doi.org/10.1002/smj.274

Rockart, J. F., Earl, M. J., & Ross, J. W. (1996). Eight Imperatives for the New IT Organization. *MIT Sloan Management Review*. https://sloanreview.mit.edu/article/eight-imperatives-for-the-new-it-organization/

Rosenbaum, P. (2019). *Observation and Experiment: An Introduction to Causal Inference* (Reprint edition). Harvard University Press.

Rosenbaum, P. R. (2020). *Design of Observational Studies* (2nd ed. 2020 edition). Springer.

Rubin, D. B. (1974). Estimating causal effects of treatments in randomized and nonrandomized studies. *Journal of Educational Psychology*, *66*(5), 688–701. https://doi.org/10.1037/h0037350

Russo, M. V., & Fouts, P. A. (1997). A Resource-Based Perspective On Corporate Environmental Performance And Profitability. *Academy of Management Journal*, *40*(3), 534–559. https://doi.org/10.5465/257052

Sabherwal, R., Sabherwal, S., Havakhor, T., & Steelman, Z. (2019). How Does Strategic Alignment Affect Firm Performance? The Roles of Information Technology Investment and Environmental Uncertainty. *MIS Quarterly*, *43*(2), 453–474. https://doi.org/10.25300/MISQ/2019/13626

Salancik, G. R., & Pfeffer, J. (1974). The Bases and Use of Power in Organizational Decision Making: The Case of a University. *Administrative Science Quarterly*, *19*(4), 453–473. https://doi.org/10.2307/2391803

Sambamurthy, V., Bharadwaj, A., & Grover, V. (2003). Shaping Agility Through Digital Options: Reconceptualizing the Role of Information Technology in Contemporary Firms. *MIS Quarterly*, *27*(2), 237–263.

Santhanam, R., & Hartono, E. (2003). Issues in Linking Information Technology Capability to Firm Performance. *MIS Quarterly*, *27*(1), 125–165. https://doi.org/10.2307/30036521

Seddon, P. B., Calvert, C., & Yang, S. (2010). A Multi-project Model of Key Factors Affecting Organizational Benefits from Enterprise Systems. *MIS Quarterly*, *34*(2), 305–328.

Semadeni, M., Withers, M. C., & Trevis Certo, S. (2014). The Perils of Endogeneity and Instrumental Variables in Strategy Research: Understanding Through Simulations. *Strategic Management Journal*, *35*(7), 1070–1079. https://doi.org/10.1002/smj.2136

Shaver, J. M. (1998). Accounting for Endogeneity When Assessing Strategy Performance: Does Entry Mode Choice Affect FDI Survival? *Management Science*, *44*(4), 571–585. https://doi.org/10.1287/mnsc.44.4.571

Shi, W., Connelly, B. L., & Cirik, K. (2017). Short Seller Influence on Firm Growth: A Threat Rigidity Perspective. *Academy of Management Journal*, *61*(5), 1892–1919. https://doi.org/10.5465/amj.2016.1010

Shimizu, K., & Hitt, M. A. (2005). What Constrains or Facilitates Divestitures of Formerly Acquired Firms? The Effects of Organizational Inertia—Katsuhiko Shimizu, Michael A. Hitt, 2005. *Journal of Management*, *31*(1), 50–72.

Singh, A., & Hess, T. (2017). How Chief Digital Officers Promote the Digital Transformation of their Companies. *MIS Quarterly Executive*, *16*(1), 1–17.

Sleep, S., & Hulland, J. (2019). Is Big Data Driving Cooperation in the C-Suite? The Evolving Relationship Between the Chief Marketing Officer and Chief Information Officer. *Journal of Strategic Marketing*, *27*(8), 666–678. https://doi.org/10.1080/0965254X.2018.1464496

Smaltz, D. H., Sambamurthy, V., & Agarwal, R. (2006). The Antecedents of CIO Role Effectiveness in Organizations: An Empirical Study in the Healthcare Sector. *IEEE Transactions on Engineering Management*, *53*(2), 207–222. https://doi.org/10.1109/TEM.2006.872248

Sobol, M. G., & Klein, G. (2009). Relation of CIO background, IT Infrastructure, and Economic Performance. *Information & Management*, *46*(5), 271–278. https://doi.org/10.1016/j.im.2009.05.001

Spender, J.-C. (1996). Making Knowledge the Basis of a Dynamic Theory of the Firm. *Strategic Management Journal*, *17*(S2), 45–62. https://doi.org/10.1002/smj.4250171106

Staw, B. M., & Epstein, L. D. (2000). What Bandwagons Bring: Effects of Popular Management Techniques on Corporate Performance, Reputation, and CEO Pay. *Administrative Science Quarterly*, *45*(3), 523–556. https://doi.org/10.2307/2667108

Stephens, C., & Loughman, T. (1994). The CIO's Chief Concern: Communication. *Information & Management*, *27*(2), 129–137. https://doi.org/10.1016/0378-7206(94)90012-4

Stephens, C. S., Ledbetter, W. N., Mitra, A., & Ford, F. N. (1992). Executive or Functional Manager? The Nature of the CIO's Job. *MIS Quarterly*, *16*(4), 449–467. https://doi.org/10.2307/249731

Suer, M. F. (2018, December 20). *Top Priorities for CIOs in 2019*. CIO. https://www.cio.com/article/3329741/top-priorities-for-cios-in-2019.html

Susarla, A., Barua, A., & Whinston, A. B. (2009). A Transaction Cost Perspective of the "Software as a Service" Business Model. *Journal of Management Information Systems*, *26*(2), 205–240. https://doi.org/10.2753/MIS0742-1222260209

Susarla, A., Subramanyam, R., & Karhade, P. (2010). Contractual Provisions to Mitigate Holdup: Evidence from Information Technology Outsourcing. *Information Systems Research*, *21*(1), 37–55. https://doi.org/10.1287/isre.1080.0204

Sydow, J., Schreyögg, G., & Koch, J. (2009). Organizational Path Dependence: Opening the Black Box. *Academy of Management Review*, *34*(4), 689–709. https://doi.org/10.5465/AMR.2009.44885978

Tai, L. A., & Phelps, R. (2000). CEO and CIO Perceptions of Information Systems Strategy: Evidence from Hong Kong. *European Journal of Information Systems*, *9*(3), 163–172.

Talmor, E., & Wallace, J. S. (1998). Computer Industry Executives: An Analysis of the New Barons' Compensation. *Information Systems Research*, *9*(4), 398.

Thomas, L. (2019, June 13). *Target Expands Same-Day Shipping Option in the Latest Move in the Delivery Wars with Walmart and Amazon*. CNBC. https://www.cnbc.com/2019/06/12/target-expands-same-day-delivery-option-in-battle-with-walmart-amazon.html

Tihanyi, L., Ellstrand, A. E., Daily, C. M., & Dalton, D. R. (2000). Composition of the Top Management Team and Firm International Diversification. *Journal of Management*, *26*(6), 1157–1177. https://doi.org/10.1177/014920630002600605

Tiwana, A. (2014). Separating Signal from Noise: Evaluating Emerging Technologies. *MIS Quarterly Executive*, *13*(1), 45–61.

Tiwana, A. (2017). *IT Strategy for Non-IT Managers: Becoming an Engaged Contributor to Corporate IT Decisions*. https://mitpress.mit.edu/books/it-strategy-non-it-managers

Tiwana, A., & Bush, A. A. (2007). A Comparison of Transaction Cost, Agency, and Knowledge-Based Predictors of IT Outsourcing Decisions: A U.S.-Japan Cross-Cultural Field Study. *Journal of Management Information Systems*, *24*(1), 259–300. https://doi.org/10.2753/MIS0742-1222240108

Tiwana, A., & Kim, S. K. (2019). From Bricks to an Edifice: Cultivating Strong Inference in Information Systems Research. *Information Systems Research*, *30*(3), 1029–1036. https://doi.org/10.1287/isre.2019.0848

Tobin, J. (1969). A General Equilibrium Approach To Monetary Theory. *Journal of Money, Credit and Banking*, *1*(1), 15–29.

Tobin, J. (1978). Monetary Policies and the Economy: The Transmission Mechanism. *Southern Economic Journal*, *44*(3), 421–431.

Trochim, Donnelly, & Kanika, A. (2015). *Research Methods: The Essential Knowledge Base* (2nd edition). Cengage Learning.

Tumbas, S., Berente, N., & vom Brocke, J. (2017). Three Types of Chief Digital Officers and the Reasons Organizations Adopt the Role. *MIS Quarterly Executive*, *16*(2), 121–134.

Tushman, M. L., & O’Reilly, C. A. (1996). The Ambidextrous Organizations: Managing Evolutionary and Revolutionary Change. *California Management Review*, *38*(4), 8–30. https://doi.org/10.2307/41165852

Tushman, M. L., & Rosenkopf, L. (1996). Executive Succession, Strategic Reorientation and Performance Growth: A Longitudinal Study in the U.S. Cement Industry. *Management Science*, *42*(7), 939–953. https://doi.org/10.1287/mnsc.42.7.939

Ulrich, D., & Barney, J. B. (1984). Perspectives in Organizations: Resource Dependence, Efficiency, and Population. *Academy of Management Review*, *9*(3), 471–481. https://doi.org/10.5465/amr.1984.4279680

Valorinta, M. (2011). IT Alignment and the Boundaries of the IT Function. *Journal of Information Technology*, *26*(1), 46–59. https://doi.org/10.1057/jit.2010.28

Wade, M., & Hulland, J. (2004). Review: The Resource-based View and Information Systems Research: Review, Extension, and Suggestions for Future Research. *MIS Quarterly*, *28*(1), 107–142.

Walker, K. (2010). A Systematic Review of the Corporate Reputation Literature: Definition, Measurement, and Theory. *Corporate Reputation Review*, *12*(4), 357–387. https://doi.org/10.1057/crr.2009.26

Wan, W. P., & Yiu, D. W. (2009). From Crisis to Opportunity: Environmental Jolt, Corporate Acquisitions, and Firm Performance. *Strategic Management Journal*, *30*(7), 791–801. https://doi.org/10.1002/smj.744

Wang. (2010). Chasing the Hottest IT: Effects of Information Technology Fashion on Organizations. *MIS Quarterly*, *34*(1), 63. https://doi.org/10.2307/20721415

Wang, T., Kannan, K. N., & Ulmer, J. R. (2013). The Association Between the Disclosure and the Realization of Information Security Risk Factors. *Information Systems Research*, *24*(2), 201–218. https://doi.org/10.1287/isre.1120.0437

Wasko, M. M., & Faraj, S. (2005). Why Should I Share? Examining Social Capital and Knowledge Contribution in Electronic Networks of Practice. *MIS Quarterly*, *29*(1), 35–57. https://doi.org/10.2307/25148667

Watson, R. T. (1990). Influences on the IS Manager’s Perceptions of Key Issues: Information Scanning and the Relationship with the CEO. *MIS Quarterly*, *14*(2), 217–231. JSTOR. https://doi.org/10.2307/248780

Weill, P., & Olson, M. H. (1989). Managing Investment in Information Technology: Mini Case Examples and Implications. *MIS Quarterly*, *13*(1), 3–17. JSTOR. https://doi.org/10.2307/248694

Weill, P., & Woerner, S. L. (2013). The Future of the CIO in a Digital Economy. *MIS Quarterly Executive*, *12*(2), 65–75.

Weill, P., & Woodham, R. (2002). *Don't Just Lead, Govern: Implementing Effective it Governance* (SSRN Scholarly Paper ID 317319). Social Science Research Network. https://papers.ssrn.com/abstract=317319

West, M. A., & Anderson, N. R. (1996). Innovation in Top Management Teams. *Journal of Applied Psychology*, *81*(6), 680–693. https://doi.org/10.1037/0021-9010.81.6.680

Wiersema, M. F., & Bantel, K. A. (1992). Top Management Team Demography and Corporate Strategic Change. *The Academy of Management Journal*, *35*(1), 91–121. https://doi.org/10.2307/256474

Williamson, O. (1989). Transaction Cost Economics. In *Handbook of Industrial Organization* (Vol. 1–1, pp. 135–182). Elsevier. http://econpapers.repec.org/bookchap/eeeindchp/1-03.htm

Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel Data* (second edition edition). The MIT Press.

Wooldridge, J. M. (2015). *Introductory Econometrics: A Modern Approach* (6 edition). South-Western College Pub.

Wu, S. P.-J., Straub, D. W., & Liang, T.-P. (2015). How Information Technology Governance Mechanisms and Strategic Alignment Influence Organizational Performance: Insights from a Matched Survey of Business and It Managers. *MIS Quarterly*, *39*(2), 497–518.

Yayla, A. A., & Hu, Q. (2014). The Effect of Board of Directors' IT Awareness on CIO Compensation and Firm Performance. *Decision Sciences*, *45*(3), 401–436. https://doi.org/10.1111/deci.12077

Zafar, H., Ko, M. S., & Osei-Bryson, K.-M. (2016). The Value of the CIO in the Top Management Team on Performance in the Case of Information Security Breaches. *Information Systems Frontiers*, *18*(6), 1205–1215. https://doi.org/10.1007/s10796-015-9562-5

Zammuto, R. F., Griffith, T. L., Majchrzak, A., Dougherty, D. J., & Faraj, S. (2007). Information Technology and the Changing Fabric of Organization. *Organization Science*, *18*(5), 749–762. https://doi.org/10.1287/orsc.1070.0307

Zhu, K., & Kraemer, K. L. (2002). e-Commerce Metrics for Net-Enhanced Organizations: Assessing the Value of e-Commerce to Firm Performance in the Manufacturing Sector. *Information Systems Research*, *13*(3), 275–295. https://doi.org/10.1287/isre.13.3.275.82

Zorn, D. M. (2004). Here a Chief, There a Chief: The Rise of the CFO in the American Firm. *American Sociological Review*, *69*(3), 345–364. https://doi.org/10.1177/000312240406900302

# APPENDICES

## Appendix A:

Appendix A Shows the results of the robustness checks for the first hypothesis.

**Table A1: Two-stage Treatment Effects Model with DV Tobin's *q***

| VARIABLES | First stage (Probit)<br>DV = CIO | Second stage (OLS)<br>DV = Tobin's *q* |
|---|---|---|
| Asset Tangibility | | -0.29*** |
| | | (0.069) |
| Capital Intensity | | 6.20*** |
| | | (1.38) |
| COGS | | -1.17*** |
| | | (0.36) |
| Leverage | | 0.99*** |
| | | (0.24) |
| Firm Size | | 0.29*** |
| | | (0.039) |
| Operating Cost | | 0.39 |
| | | (0.49) |
| Organizational Slack | | 0.10*** |
| | | (0.027) |
| R&D Innovation Intensity | | 11.5*** |
| | | (1.30) |
| Market Concentration (HHI) | | 0.000047 |
| | | (0.000062) |
| Environmental Dynamism | | -2.98 |
| | | (5.39) |
| Environmental Munificence | | -0.034 |
| | | (0.96) |
| CIO | | -1.87** |
| | | (0.68) |
| CIO Prevalence | 1.02** | |
| | (0.38) | |
| Board Age | -0.034* | |
| | (0.014) | |
| Board Independence | 0.74+ | |
| | (0.45) | |
| Board Size | 0.083*** | |
| | (0.023) | |
| TMT Age | 0.014 | |
| | (0.014) | |
| CEO Tenure | -0.0066 | |
| | (0.0065) | |
| lambda | | 0.96* |
| | | (0.41) |
| Constant | -0.79 | 2.58 |
| | (1.03) | (5.75) |
| Observations | 859 | 859 |

**Table A2: Two-stage Treatment Effects Model with DV ROA**

| VARIABLES | First stage (Probit)<br>DV = CIO | Second stage (OLS)<br>DV = ROA |
|---|---|---|
| Asset Tangibility | | -0.028*** |
| | | (0.0033) |
| Capital Intensity | | 0.65*** |
| | | (0.065) |
| COGS | | 0.0090 |
| | | (0.017) |
| Leverage | | 0.057*** |
| | | (0.011) |
| Firm Size | | 0.011*** |
| | | (0.0018) |
| Operating Cost | | -0.16*** |
| | | (0.023) |
| Organizational Slack | | 0.0015 |
| | | (0.0013) |
| R&D Innovation Intensity | | 0.015 |
| | | (0.061) |
| Market Concentration (HHI) | | 4.6e-06 |
| | | (2.9e-06) |
| Environmental Dynamism | | 0.059 |
| | | (0.25) |
| Environmental Munificence | | -0.048 |
| | | (0.045) |
| CIO | | -0.083** |
| | | (0.032) |
| CIO Prevalence | 1.00** | |
| | (0.38) | |
| Board Age | -0.034* | |
| | (0.015) | |
| Board Independence | 0.74+ | |
| | (0.45) | |
| Board Size | 0.083*** | |
| | (0.023) | |
| TMT Age | 0.014 | |
| | (0.014) | |
| CEO Tenure | -0.0066 | |
| | (0.0065) | |
| lambda | | 0.044* |
| | | (0.019) |
| Constant | -0.78 | 0.15 |
| | (1.03) | (0.27) |
| Observations | 858 | 858 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

**Table A3: Two-stage Treatment Effects Model with CIO Prevalence, Board Age, Board Independence, Board Size, and TMT Age as Instruments**

| VARIABLES | First stage (Probit)<br>DV = CIO | Second stage (OLS)<br>DV = Δ Tobin's *q* |
|---|---|---|
| Asset Tangibility | | -0.29*** |
| | | (0.069) |
| Capital Intensity | | 6.63*** |
| | | (1.39) |
| COGS | | -0.66+ |
| | | (0.36) |
| Leverage | | 0.86*** |
| | | (0.24) |
| Firm Size | | 0.27*** |
| | | (0.039) |
| Operating Cost | | 0.0047 |
| | | (0.49) |
| Organizational Slack | | 0.094*** |
| | | (0.027) |
| R&D Innovation Intensity | | 10.4*** |
| | | (1.30) |
| Market Concentration (HHI) | | 0.000066 |
| | | (0.000062) |
| Environmental Dynamism | | 7.54 |
| | | (5.39) |
| Environmental Munificence | | -0.36 |
| | | (0.96) |
| CIO | | -1.79** |
| | | (0.68) |
| CIO Prevalence | 0.98** | |
| | (0.38) | |
| Board Age | -0.035* | |
| | (0.014) | |
| Board Independence | 0.80+ | |
| | (0.44) | |
| Board Size | 0.085*** | |
| | (0.023) | |
| TMT Age | 0.012 | |
| | (0.014) | |
| lambda | | 0.91* |
| | | (0.41) |
| Constant | -0.71 | -8.92 |
| | (1.02) | (5.75) |
| Observations | 859 | 859 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

**Table A4: Two-stage Treatment Effects Model with CIO Prevalence, Board Age, Board Independence, Board Size as Instruments**

| | **First stage (Probit)** | **Second stage (OLS)** |
|---|---|---|
| VARIABLES | DV = CIO | DV = Δ Tobin's *q* |
| Asset Tangibility | | -0.29*** |
| | | (0.069) |
| Capital Intensity | | 6.63*** |
| | | (1.38) |
| COGS | | -0.66+ |
| | | (0.36) |
| Leverage | | 0.87*** |
| | | (0.24) |
| Firm Size | | 0.27*** |
| | | (0.039) |
| Operating Cost | | -0.0091 |
| | | (0.49) |
| Organizational Slack | | 0.092*** |
| | | (0.027) |
| R&D Innovation Intensity | | 10.4*** |
| | | (1.30) |
| Market Concentration (HHI) | | 0.000066 |
| | | (0.000062) |
| Environmental Dynamism | | 7.39 |
| | | (5.40) |
| Environmental Munificence | | -0.37 |
| | | (0.96) |
| CIO | | -1.99** |
| | | (0.71) |
| CIO Prevalence | 0.96* | |
| | (0.38) | |
| Board Age | -0.030* | |
| | (0.013) | |
| Board Independence | 0.74+ | |
| | (0.44) | |
| Board Size | 0.088*** | |
| | (0.022) | |
| lambda | | 1.03* |
| | | (0.43) |
| Constant | -0.35 | -8.72 |
| | (0.94) | (5.76) |
| Observations | 859 | 859 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

**Table A5: Two-stage Treatment Effects Model Using 99% Winsorizing**

| VARIABLES | First stage (Probit)<br>DV = CIO | Second stage (OLS)<br>DV = Δ Tobin's *q* |
|---|---|---|
| Asset Tangibility | | -0.28*** |
| | | (0.059) |
| Capital Intensity | | 6.32*** |
| | | (1.18) |
| COGS | | -0.91** |
| | | (0.30) |
| Leverage | | 0.41* |
| | | (0.20) |
| Firm Size | | 0.26*** |
| | | (0.034) |
| Operating Cost | | -0.049 |
| | | (0.42) |
| Organizational Slack | | 0.076** |
| | | (0.023) |
| R&D Innovation Intensity | | 6.95*** |
| | | (1.11) |
| Market Concentration (HHI) | | 0.000055 |
| | | (0.000052) |
| Environmental Dynamism | | 7.51 |
| | | (4.60) |
| Environmental Munificence | | -0.49 |
| | | (0.82) |
| CIO | | -1.84** |
| | | (0.60) |
| CIO Prevalence | 1.02** | |
| | (0.38) | |
| Board Age | -0.034* | |
| | (0.014) | |
| Board Independence | 0.74+ | |
| | (0.45) | |
| Board Size | 0.083*** | |
| | (0.023) | |
| TMT Age | 0.014 | |
| | (0.014) | |
| CEO Tenure | -0.0066 | |
| | (0.0065) | |
| lambda | | 0.99** |
| | | (0.36) |
| Constant | -0.79 | -8.26+ |
| | (1.03) | (4.91) |
| Observations | 859 | 859 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

**Table A6: Two-stage Treatment Effects Model Using 95% Winsorizing**

| VARIABLES | First stage (Probit)<br>DV = CIO | Second stage (OLS)<br>DV = Δ Tobin's *q* |
|---|---|---|
| Asset Tangibility | | -0.22*** |
| | | (0.041) |
| Capital Intensity | | 4.73*** |
| | | (0.82) |
| COGS | | -0.69** |
| | | (0.21) |
| Leverage | | 0.19 |
| | | (0.14) |
| Firm Size | | 0.21*** |
| | | (0.024) |
| Operating Cost | | -0.14 |
| | | (0.29) |
| Organizational Slack | | 0.043** |
| | | (0.016) |
| R&D Innovation Intensity | | 4.05*** |
| | | (0.78) |
| Market Concentration (HHI) | | 0.000059 |
| | | (0.000037) |
| Environmental Dynamism | | 6.44* |
| | | (3.26) |
| Environmental Munificence | | -0.24 |
| | | (0.57) |
| CIO | | -1.60*** |
| | | (0.44) |
| CIO Prevalence | 1.02** | |
| | (0.38) | |
| Board Age | -0.034* | |
| | (0.014) | |
| Board Independence | 0.74+ | |
| | (0.45) | |
| Board Size | 0.083*** | |
| | (0.023) | |
| TMT Age | 0.014 | |
| | (0.014) | |
| CEO Tenure | -0.0066 | |
| | (0.0065) | |
| lambda | | 0.88*** |
| | | (0.27) |
| Constant | -0.79 | -7.03* |
| | (1.03) | (3.47) |
| Observations | 859 | 859 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

**Table A7: Two-stage Treatment Effects Model with DV (Δ Tobin's *q*) in 2018**

| VARIABLES | First stage (Probit)<br>DV = CIO | Second stage (OLS)<br>DV = Δ Tobin's *q* |
|---|---|---|
| Asset Tangibility | | -0.29*** |
| | | (0.063) |
| Capital Intensity | | 6.56*** |
| | | (1.26) |
| COGS | | -1.30*** |
| | | (0.33) |
| Leverage | | 1.00*** |
| | | (0.22) |
| Firm Size | | 0.24*** |
| | | (0.036) |
| Operating Cost | | -0.090 |
| | | (0.45) |
| Organizational Slack | | 0.067** |
| | | (0.025) |
| R&D Innovation Intensity | | 6.22*** |
| | | (1.19) |
| Market Concentration (HHI) | | 0.000066 |
| | | (0.000056) |
| Environmental Dynamism | | 6.27 |
| | | (4.92) |
| Environmental Munificence | | -0.17 |
| | | (0.87) |
| CIO | | -1.43* |
| | | (0.61) |
| CIO Prevalence | 1.02** | |
| | (0.38) | |
| Board Age | -0.034* | |
| | (0.014) | |
| Board Independence | 0.74+ | |
| | (0.45) | |
| Board Size | 0.083*** | |
| | (0.023) | |
| TMT Age | 0.014 | |
| | (0.014) | |
| CEO Tenure | -0.0066 | |
| | (0.0065) | |
| lambda | | 0.80* |
| | | (0.37) |
| Constant | -0.79 | -7.11 |
| | (1.03) | (5.25) |
| Observations | 859 | 859 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

**Table A8: Two-stage Treatment Effects Model with DV (Tobin's *q*) in 2018**

| VARIABLES | First stage (Probit)<br>DV = CIO | Second stage (OLS)<br>DV = Δ Tobin's *q* |
|---|---|---|
| Asset Tangibility | | -0.30*** |
| | | (0.063) |
| Capital Intensity | | 6.04*** |
| | | (1.27) |
| COGS | | -1.88*** |
| | | (0.33) |
| Leverage | | 1.12*** |
| | | (0.22) |
| Firm Size | | 0.26*** |
| | | (0.036) |
| Operating Cost | | 0.34 |
| | | (0.45) |
| Organizational Slack | | 0.073** |
| | | (0.025) |
| R&D Innovation Intensity | | 7.06*** |
| | | (1.19) |
| Market Concentration (HHI) | | 0.000014 |
| | | (0.000057) |
| Environmental Dynamism | | -1.41 |
| | | (4.93) |
| Environmental Munificence | | 0.61 |
| | | (0.88) |
| CIO | | -1.51* |
| | | (0.62) |
| CIO Prevalence | 1.02** | |
| | (0.38) | |
| Board Age | -0.034* | |
| | (0.014) | |
| Board Independence | 0.74+ | |
| | (0.45) | |
| Board Size | 0.083*** | |
| | (0.023) | |
| TMT Age | 0.014 | |
| | (0.014) | |
| CEO Tenure | -0.0066 | |
| | (0.0065) | |
| lambda | | 0.85* |
| | | (0.37) |
| Constant | -0.79 | 1.01 |
| | (1.03) | (5.27) |
| Observations | 859 | 859 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

**Table A9: Two-stage Treatment Effects Model with DV (ROA) in 2018**

| VARIABLES | First stage (Probit)<br>DV = CIO | Second stage (OLS)<br>DV = Δ Tobin's *q* |
|---|---|---|
| Asset Tangibility | | -0.024*** |
| | | (0.0035) |
| Capital Intensity | | 0.60*** |
| | | (0.069) |
| COGS | | 0.030+ |
| | | (0.018) |
| Leverage | | 0.086*** |
| | | (0.012) |
| Firm Size | | 0.014*** |
| | | (0.0020) |
| Operating Cost | | -0.16*** |
| | | (0.025) |
| Organizational Slack | | 0.0037** |
| | | (0.0014) |
| R&D Innovation Intensity | | 0.090 |
| | | (0.065) |
| Market Concentration (HHI) | | 5.3e-06+ |
| | | (3.1e-06) |
| Environmental Dynamism | | 0.17 |
| | | (0.27) |
| Environmental Munificence | | -0.081+ |
| | | (0.048) |
| CIO | | -0.067* |
| | | (0.033) |
| CIO Prevalence | 1.00** | |
| | (0.38) | |
| Board Age | -0.034* | |
| | (0.015) | |
| Board Independence | 0.74+ | |
| | (0.45) | |
| Board Size | 0.083*** | |
| | (0.023) | |
| TMT Age | 0.014 | |
| | (0.014) | |
| CEO Tenure | -0.0066 | |
| | (0.0065) | |
| lambda | | 0.035+ |
| | | (0.020) |
| Constant | -0.78 | 0.021 |
| | (1.03) | (0.29) |
| Observations | 858 | 858 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

**Appendix B**

Appendix B includes the tables and figures for the robustness checks for hypothesis 2.

**Table B1: Interaction Analysis with Independent Variable as CIO Managerial Experience**

| VARIABLES | **DV = Δ Tobin's *q* in 2017** |
|---|---|
| Asset Tangibility | -0.53** |
| | (0.16) |
| Capital Intensity | 7.72** |
| | (2.53) |
| COGS | -1.10+ |
| | (0.63) |
| Leverage | 2.03*** |
| | (0.34) |
| Firm Size | 0.27*** |
| | (0.056) |
| Operating Cost | -0.14 |
| | (0.79) |
| Organizational Slack | 0.19*** |
| | (0.049) |
| R&D Intensity | 6.25** |
| | (2.39) |
| HHI | 0.000039 |
| | (0.000092) |
| Dynamism | 21.0+ |
| | (11.3) |
| Munificence | 0.058 |
| | (1.86) |
| TMT Digital Savviness | 1.35* |
| | (0.62) |
| CIO Managerial Experience | -0.42* |
| | (0.18) |
| CIO*TMT Interaction | -1.44* |
| | (0.69) |
| Constant | -23.3+ |
| | (11.9) |
| Observations | 242 |
| $R^2$ | 0.350 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

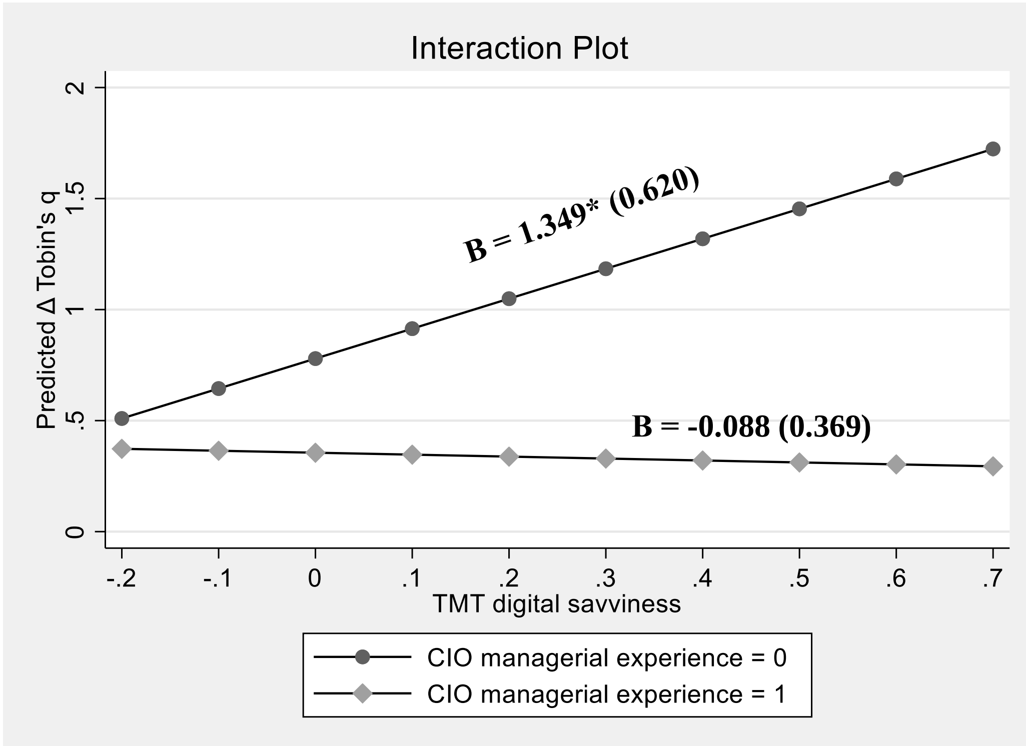


**Figure B1: Interaction Plot with Independent Variable as CIO Managerial Experience**

**Table B2: Interaction Analysis with Independent Variable as CIO Business Education**

| VARIABLES | **DV = Δ Tobin's *q* in 2017** |
|---|---|
| Asset Tangibility | -0.56** |
| | (0.18) |
| Capital Intensity | 7.26* |
| | (2.80) |
| COGS | -0.82 |
| | (0.69) |
| Leverage | 2.25*** |
| | (0.36) |
| Firm Size | 0.24*** |
| | (0.061) |
| Operating Cost | -0.30 |
| | (0.87) |
| Organizational Slack | 0.18*** |
| | (0.054) |
| R&D Intensity | 6.43* |
| | (2.62) |
| HHI | 0.000032 |
| | (0.00011) |
| Dynamism | 20.3+ |
| | (11.7) |
| Munificence | -2.04 |
| | (2.04) |
| TMT Digital Savviness | 0.76 |
| | (0.58) |
| CIO Business Education | -0.35 |
| | (0.21) |
| CIO*TMT Interaction | -0.53 |
| | (0.69) |
| Constant | -20.5+ |
| | (12.2) |
| Observations | 208 |
| $R^2$ | 0.355 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

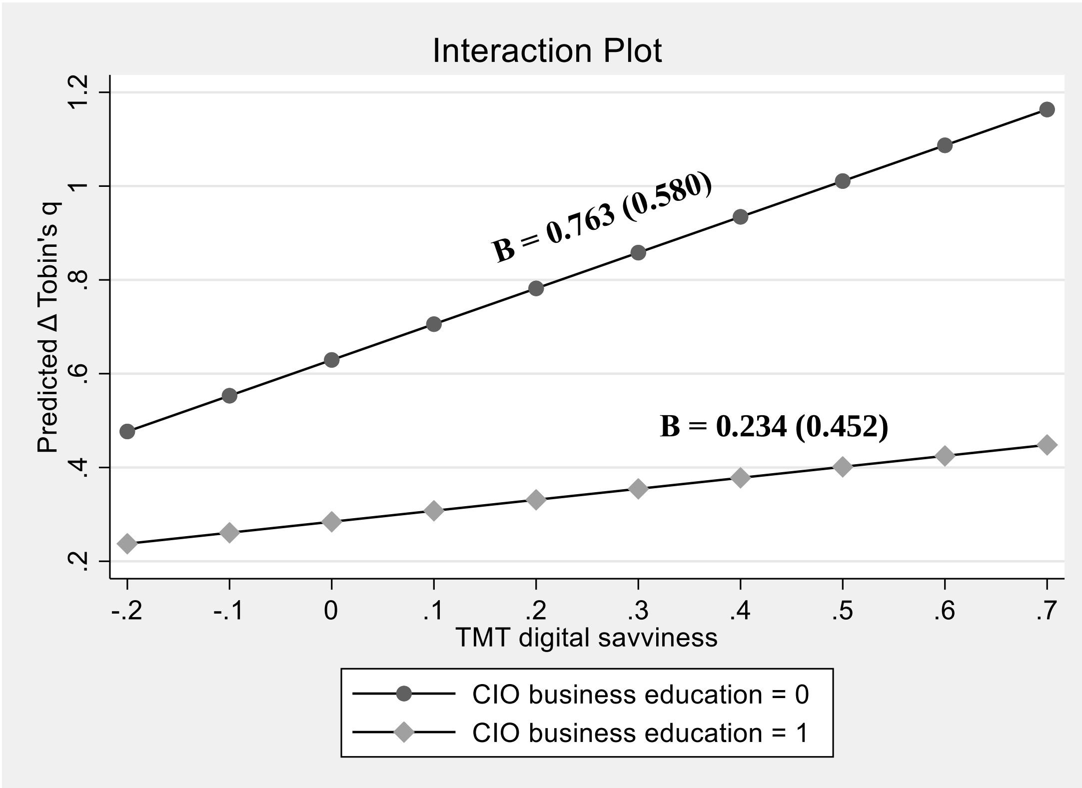


**Figure B2: Interaction Plot with Independent Variable as CIO Business Education**

**Table B3: Interaction Analysis with Moderator as TMT IT Employment**

| VARIABLES | **DV = Δ Tobin's *q* in 2017** |
|---|---|
| Asset Tangibility | -0.54*** |
| | (0.15) |
| Capital Intensity | 8.59*** |
| | (2.49) |
| COGS | -0.95 |
| | (0.61) |
| Leverage | 2.05*** |
| | (0.33) |
| Firm Size | 0.27*** |
| | (0.055) |
| Operating Cost | -0.22 |
| | (0.74) |
| Organizational Slack | 0.17*** |
| | (0.043) |
| R&D Intensity | 6.71** |
| | (2.22) |
| HHI | -2.8e-06 |
| | (0.000091) |
| Dynamism | 17.2+ |
| | (10.0) |
| Munificence | -0.43 |
| | (1.75) |
| TMT IT Employment | 6.55** |
| | (2.00) |
| CIO Business Savviness | -0.40* |
| | (0.19) |
| CIO*TMT Interaction | -7.26** |
| | (2.23) |
| Constant | -19.0+ |
| | (10.6) |
| Observations | 246 |
| $R^2$ | 0.368 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

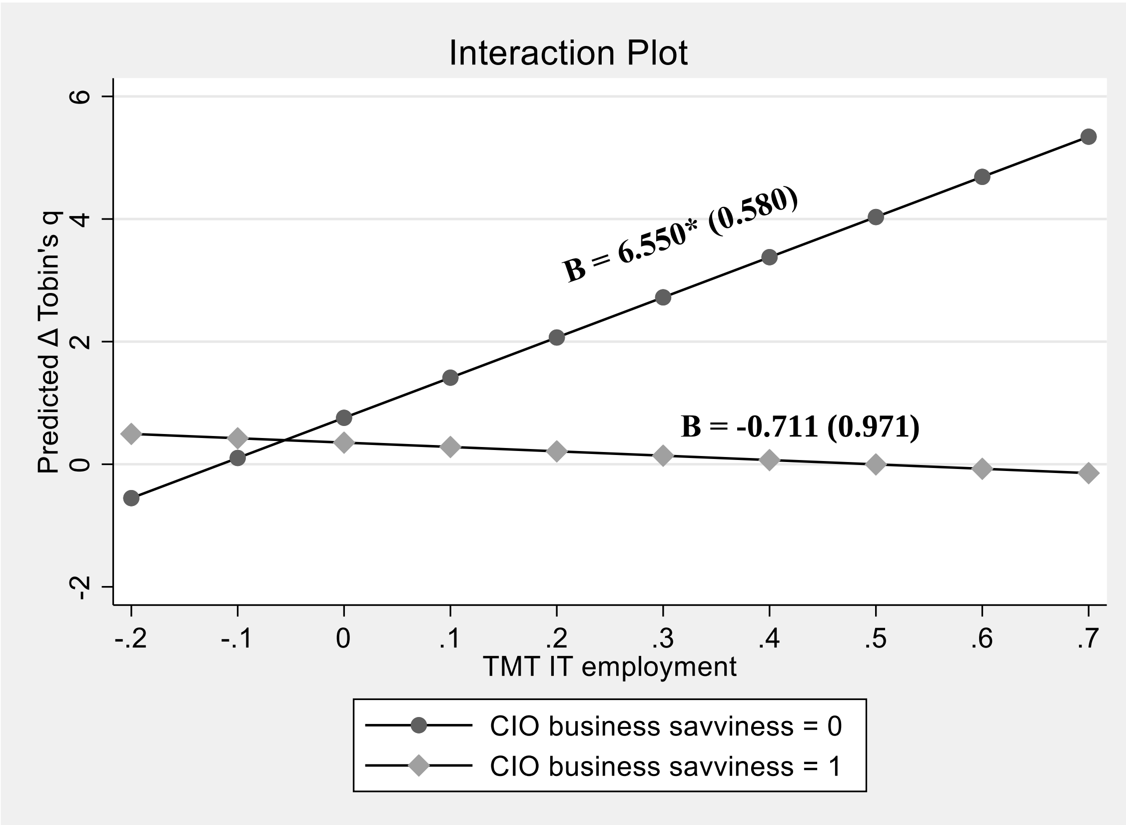


**Figure B3: Interaction Plot with Moderator as TMT IT Employment**

**Table B4: Interaction Analysis with Moderator as TMT IT Education**

| VARIABLES | **DV = Δ Tobin's *q* in 2017** |
|---|---|
| Asset Tangibility | -0.55*** |
| | (0.15) |
| Capital Intensity | 7.22** |
| | (2.51) |
| COGS | -1.00 |
| | (0.62) |
| Leverage | 1.92*** |
| | (0.33) |
| Firm Size | 0.27*** |
| | (0.057) |
| Operating Cost | -0.38 |
| | (0.77) |
| Organizational Slack | 0.18*** |
| | (0.044) |
| R&D Intensity | 6.33** |
| | (2.37) |
| HHI | 0.000048 |
| | (0.000093) |
| Dynamism | 19.6+ |
| | (10.2) |
| Munificence | -0.17 |
| | (1.78) |
| TMT IT Education | 2.21 |
| | (1.63) |
| CIO Business Savviness | -0.44* |
| | (0.20) |
| CIO*TMT Interaction | -2.05 |
| | (1.80) |
| Constant | -21.5* |
| | (10.8) |
| Observations | 246 |
| $R^2$ | 0.343 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

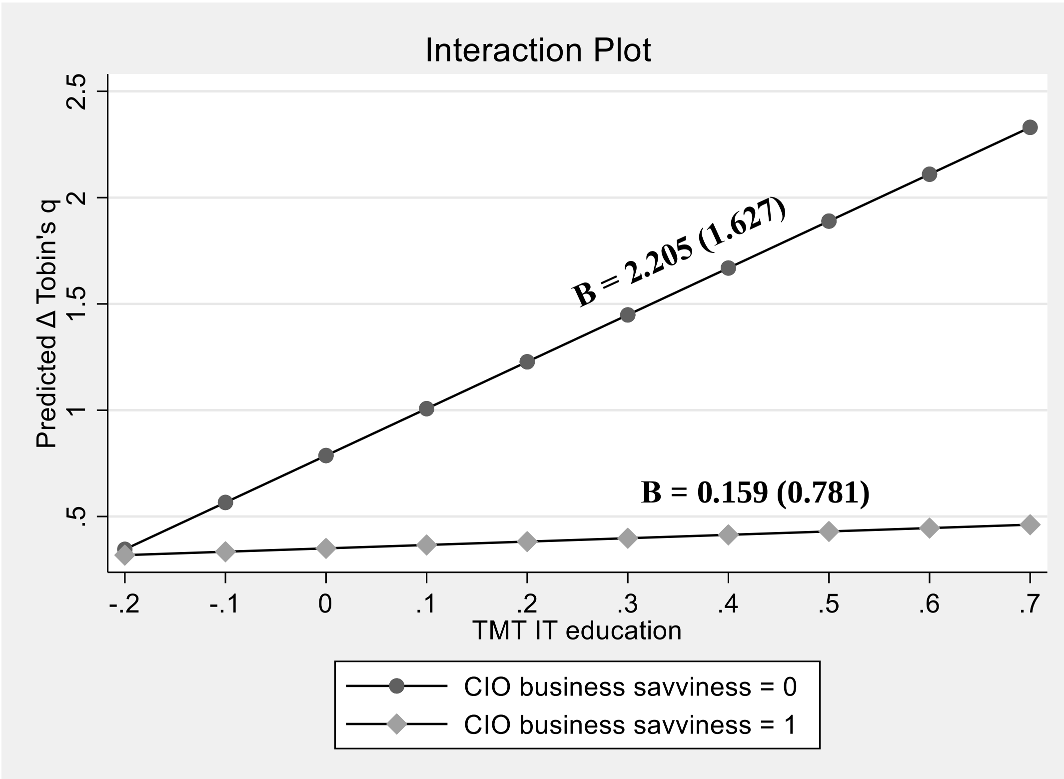


**Figure B4: Interaction Plot with Moderator as TMT IT Education**

**Table B5: Interaction Analysis with Moderator as TMT IT Industrial Experience**

| VARIABLES | **DV = Δ Tobin's *q* in 2017** |
|---|---|
| Asset Tangibility | -0.54*** |
| | (0.15) |
| Capital Intensity | 7.32** |
| | (2.51) |
| COGS | -1.00 |
| | (0.62) |
| Leverage | 1.96*** |
| | (0.34) |
| Firm Size | 0.27*** |
| | (0.056) |
| Operating Cost | -0.33 |
| | (0.75) |
| Organizational Slack | 0.18*** |
| | (0.044) |
| R&D Intensity | 6.55** |
| | (2.39) |
| HHI | 0.000035 |
| | (0.000093) |
| Dynamism | 18.8+ |
| | (10.2) |
| Munificence | -0.26 |
| | (1.80) |
| TMT IT Industrial Experience | 0.66 |
| | (0.80) |
| CIO Business Savviness | -0.42* |
| | (0.20) |
| CIO*TMT Interaction | -0.71 |
| | (0.84) |
| Constant | -20.7+ |
| | (10.8) |
| Observations | 246 |
| $R^2$ | 0.339 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

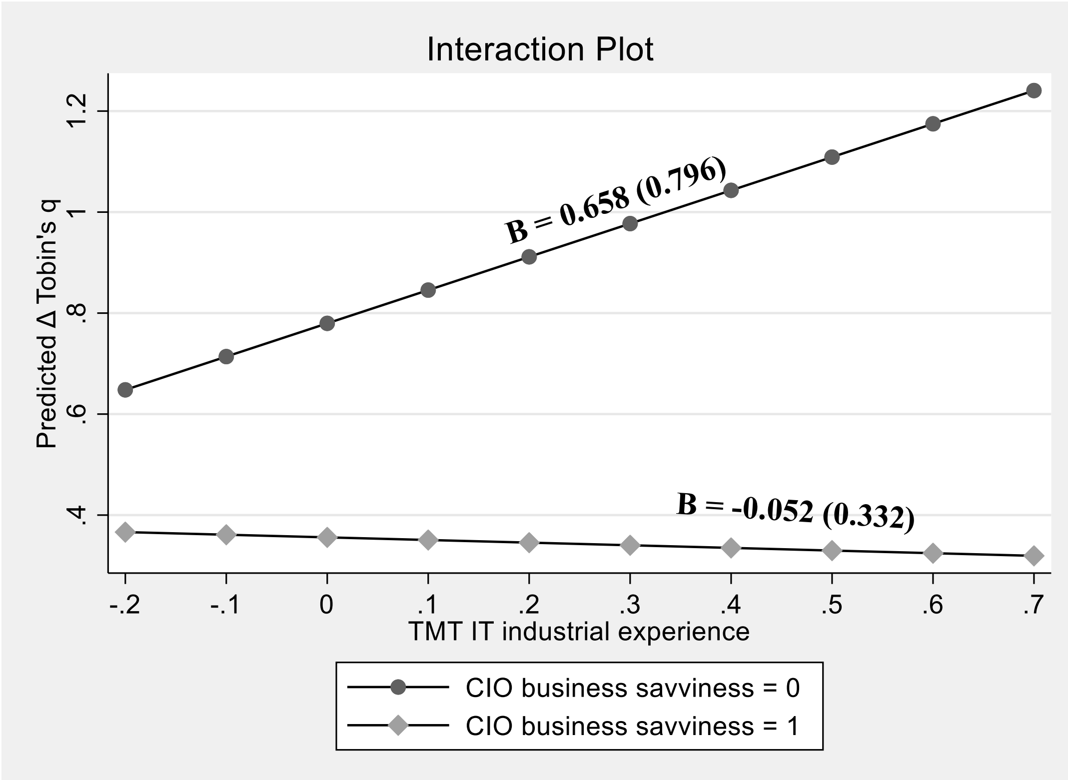


**Figure B5: Interaction Plot with Moderator as TMT IT Industrial Experience**

**Table B6: Interaction Analysis with Moderator as CEO Digital Savviness**

| VARIABLES | **DV = Δ Tobin's *q* in 2017** |
|---|---|
| Asset Tangibility | -0.53*** |
| | (0.15) |
| Capital Intensity | 7.89** |
| | (2.47) |
| COGS | -1.03+ |
| | (0.61) |
| Leverage | 2.03*** |
| | (0.33) |
| Firm Size | 0.27*** |
| | (0.055) |
| Operating Cost | -0.19 |
| | (0.74) |
| Organizational Slack | 0.19*** |
| | (0.043) |
| R&D Intensity | 7.01** |
| | (2.26) |
| HHI | 0.000040 |
| | (0.000090) |
| Dynamism | 17.3+ |
| | (10.0) |
| Munificence | -0.38 |
| | (1.75) |
| CEO Digital Savviness | 1.19** |
| | (0.38) |
| CIO Business Savviness | -0.094 |
| | (0.21) |
| CEO*CIO Interaction | -1.39** |
| | (0.43) |
| Constant | -19.5+ |
| | (10.5) |
| Observations | 246 |
| $R^2$ | 0.367 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

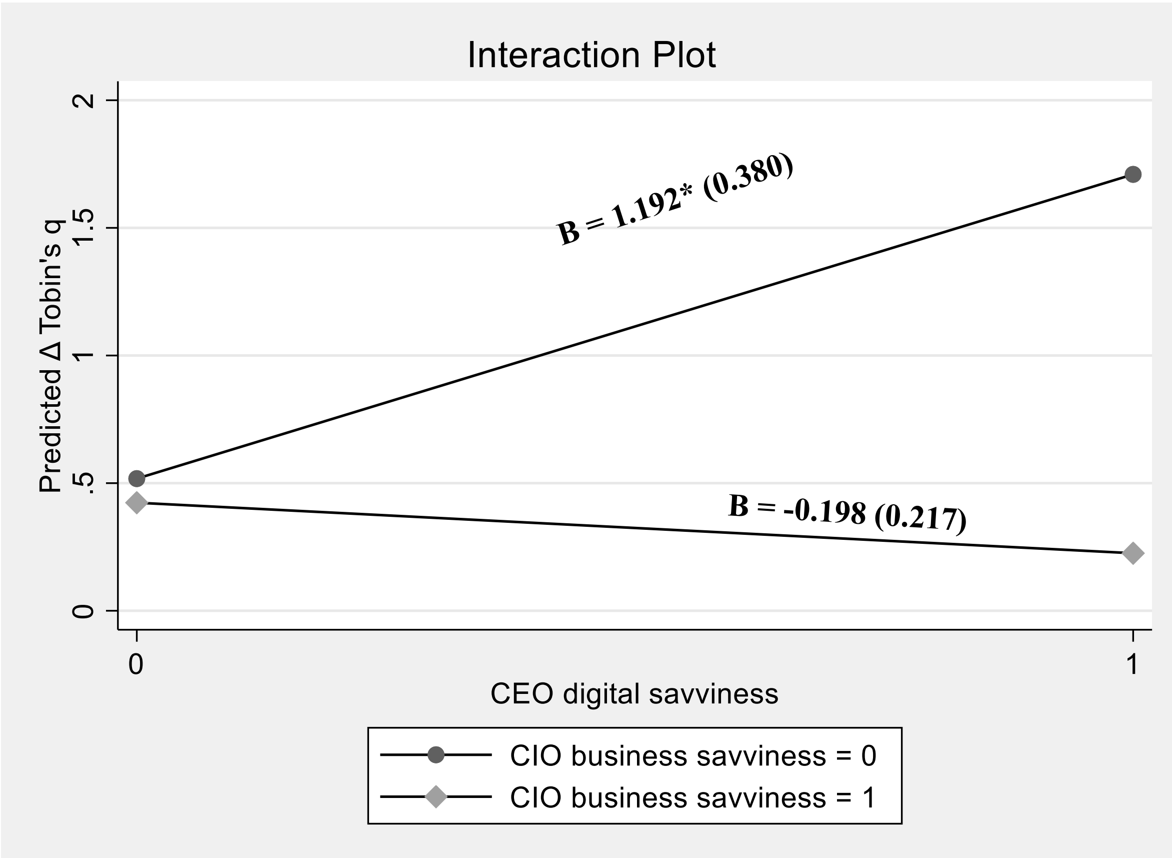


**Figure B6: Interaction Plot with Moderator as CEO Digital Savviness**

**Table B7: Interaction Analysis with Moderator as CFO Digital Savviness**

| VARIABLES | **DV = Δ Tobin's *q* in 2017** |
|---|---|
| Asset Tangibility | -0.53*** |
| | (0.15) |
| Capital Intensity | 7.25** |
| | (2.51) |
| COGS | -0.94 |
| | (0.62) |
| Leverage | 1.97*** |
| | (0.34) |
| Firm Size | 0.27*** |
| | (0.056) |
| Operating Cost | -0.38 |
| | (0.75) |
| Organizational Slack | 0.19*** |
| | (0.044) |
| R&D Intensity | 6.18** |
| | (2.31) |
| HHI | 0.000035 |
| | (0.000092) |
| Dynamism | 18.8+ |
| | (10.2) |
| Munificence | -0.24 |
| | (1.79) |
| CFO Digital Savviness | 0.33 |
| | (0.43) |
| CIO Business Savviness | -0.37+ |
| | (0.21) |
| CEO*CIO Interaction | -0.16 |
| | (0.49) |
| Constant | -20.7+ |
| | (10.8) |
| Observations | 246 |
| $R^2$ | 0.341 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

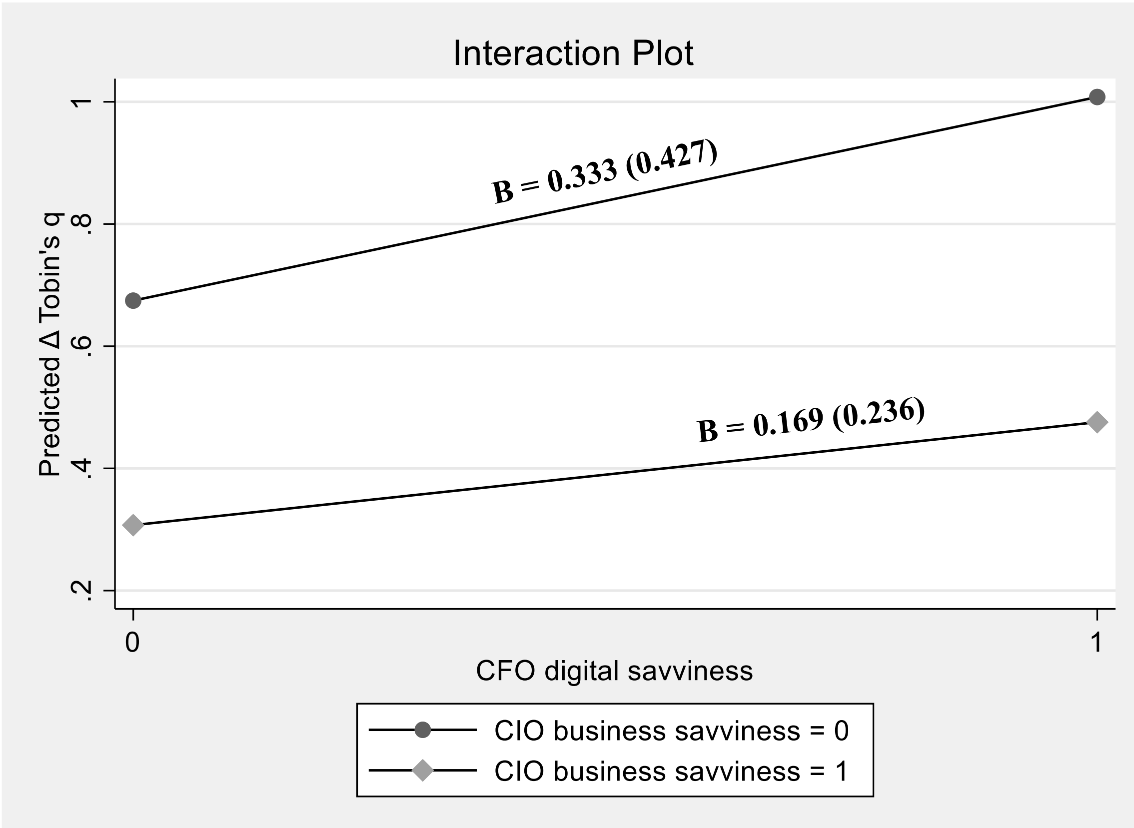


**Figure B7: Interaction Plot with Moderator as CFO Digital Savviness**

**Table B8: Interaction Analysis with Moderator as CEO+CFO Digital Savviness**

| VARIABLES | **DV = Δ Tobin's *q* in 2017** |
|---|---|
| Asset Tangibility | -0.54*** |
| | (0.15) |
| Capital Intensity | 7.65** |
| | (2.49) |
| COGS | -0.97 |
| | (0.62) |
| Leverage | 2.06*** |
| | (0.34) |
| Firm Size | 0.27*** |
| | (0.055) |
| Operating Cost | -0.37 |
| | (0.75) |
| Organizational Slack | 0.19*** |
| | (0.043) |
| R&D Intensity | 6.89** |
| | (2.32) |
| HHI | 0.000041 |
| | (0.000092) |
| Dynamism | 19.1+ |
| | (10.1) |
| Munificence | -0.39 |
| | (1.77) |
| CEO+CFO Digital Savviness | |
| 1.CEO+CFO Digital Savviness | 1.00** |
| | (0.38) |
| 2.CEO+CFO Digital Savviness | 0.83 |
| | (0.60) |
| CIO Business Savviness | -0.11 |
| | (0.22) |
| 1.CEOCFO*CIO Interaction | -1.01* |
| | (0.44) |
| 2.CEOCFO*CIO Interaction | -0.87 |
| | (0.66) |
| Constant | -21.2* |
| | (10.6) |
| Observations | 246 |
| $R^2$ | 0.360 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

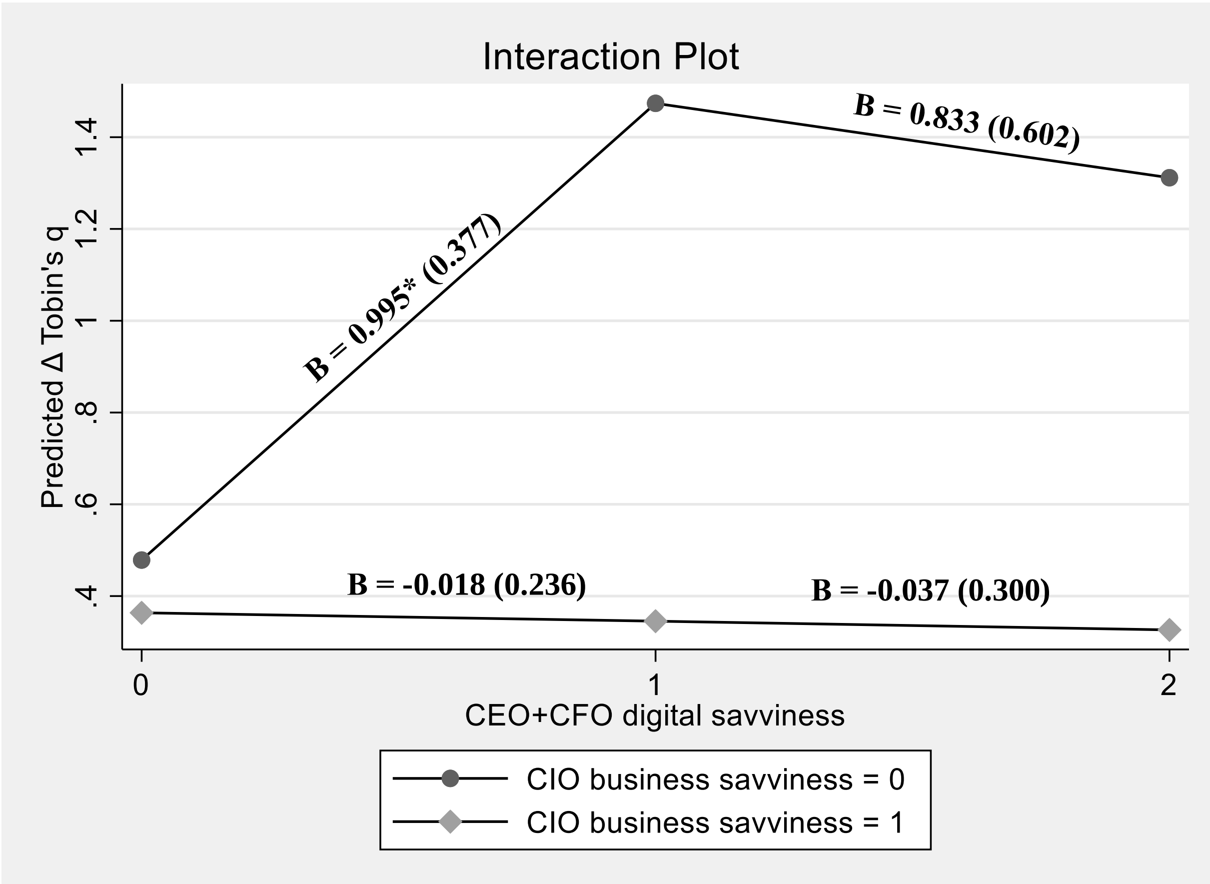


**Figure B8: Interaction Plot with Moderator as CEO+CFO Digital Savviness**

**Table B9: Interaction Analysis with DV as Tobin's *q***

| VARIABLES | **DV = Tobin's *q* in 2017** |
|---|---|
| Asset Tangibility | -0.47** |
| | (0.15) |
| Capital Intensity | 6.91** |
| | (2.42) |
| COGS | -1.59** |
| | (0.60) |
| Leverage | 2.21*** |
| | (0.33) |
| Firm Size | 0.29*** |
| | (0.053) |
| Operating Cost | 0.14 |
| | (0.73) |
| Organizational Slack | 0.19*** |
| | (0.042) |
| R&D Intensity | 8.01*** |
| | (2.31) |
| HHI | 0.000096 |
| | (0.000089) |
| Dynamism | 4.03 |
| | (9.83) |
| Munificence | 0.52 |
| | (1.72) |
| TMT Digital Savviness | 1.66* |
| | (0.70) |
| CIO Business Savviness | -0.53** |
| | (0.19) |
| CIO*TMT Interaction | -1.81* |
| | (0.76) |
| Constant | -5.38 |
| | (10.3) |
| Observations | 246 |
| $R^2$ | 0.424 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

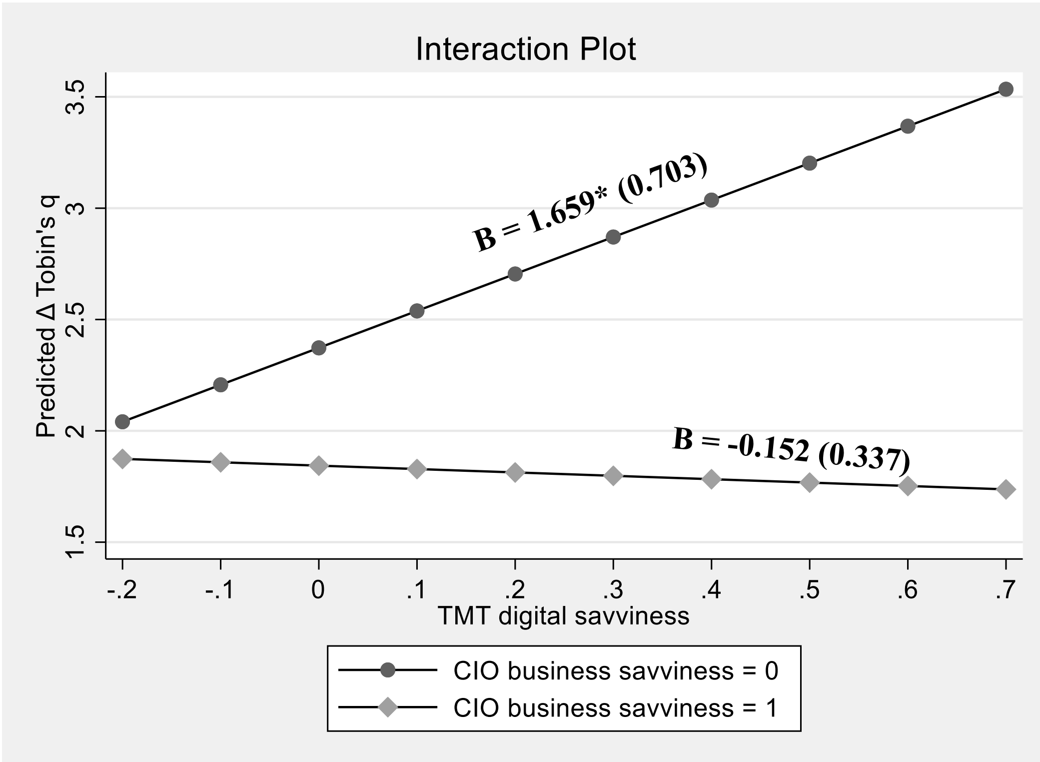


**Figure B9: Interaction Plot with DV as Tobin's *q***

**Table B10: Interaction Analysis with DV as ROA**

| VARIABLES | **DV = ROA in 2017** |
|---|---|
| Asset Tangibility | -0.030*** |
| | (0.0074) |
| Capital Intensity | 0.60*** |
| | (0.12) |
| COGS | -0.0034 |
| | (0.031) |
| Leverage | 0.12*** |
| | (0.017) |
| Firm Size | 0.012*** |
| | (0.0027) |
| Operating Cost | -0.18*** |
| | (0.037) |
| Organizational Slack | 0.0035 |
| | (0.0022) |
| R&D Intensity | 0.21+ |
| | (0.12) |
| HHI | 8.1e-06+ |
| | (4.5e-06) |
| Dynamism | 0.083 |
| | (0.50) |
| Munificence | -0.0058 |
| | (0.088) |
| TMT Digital Savviness | 0.072* |
| | (0.036) |
| CIO Business Savviness | -0.030** |
| | (0.0097) |
| CIO*TMT Interaction | -0.11** |
| | (0.039) |
| Constant | 0.067 |
| | (0.53) |
| Observations | 246 |
| $R^2$ | 0.524 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

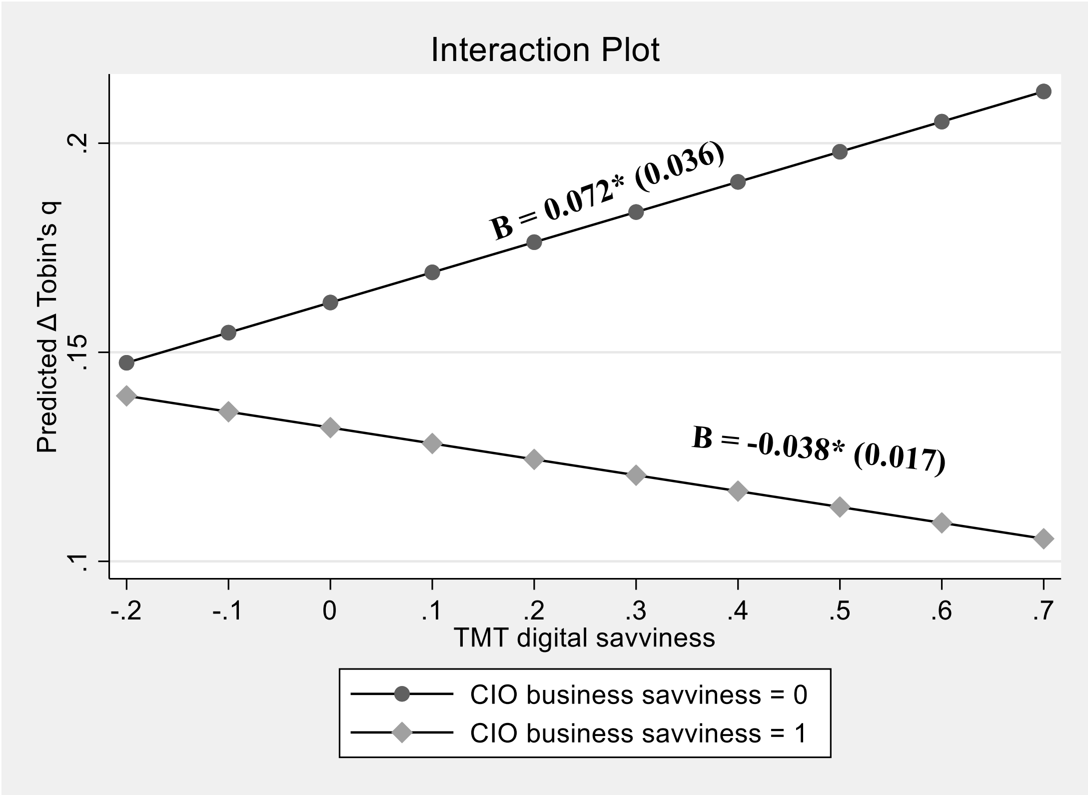


**Figure B10: Interaction Plot with DV as ROA**

**Table B11: Interaction Analysis with DV as Tobin's *q* in 2018**

| VARIABLES | **DV = Tobin's *q* in 2018** |
|---|---|
| Asset Tangibility | -0.44** |
| | (0.16) |
| Capital Intensity | 5.60* |
| | (2.66) |
| COGS | -1.18+ |
| | (0.66) |
| Leverage | 2.48*** |
| | (0.36) |
| Firm Size | 0.24*** |
| | (0.059) |
| Operating Cost | -0.60 |
| | (0.80) |
| Organizational Slack | 0.12* |
| | (0.046) |
| R&D Intensity | 12.2*** |
| | (2.54) |
| HHI | 0.000087 |
| | (0.000098) |
| Dynamism | 9.11 |
| | (10.8) |
| Munificence | 1.84 |
| | (1.89) |
| TMT Digital Savviness | 2.03** |
| | (0.77) |
| CIO Business Savviness | -0.57** |
| | (0.21) |
| CIO*TMT Interaction | -2.12* |
| | (0.84) |
| Constant | -11.0 |
| | (11.4) |
| Observations | 246 |
| $R^2$ | 0.410 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

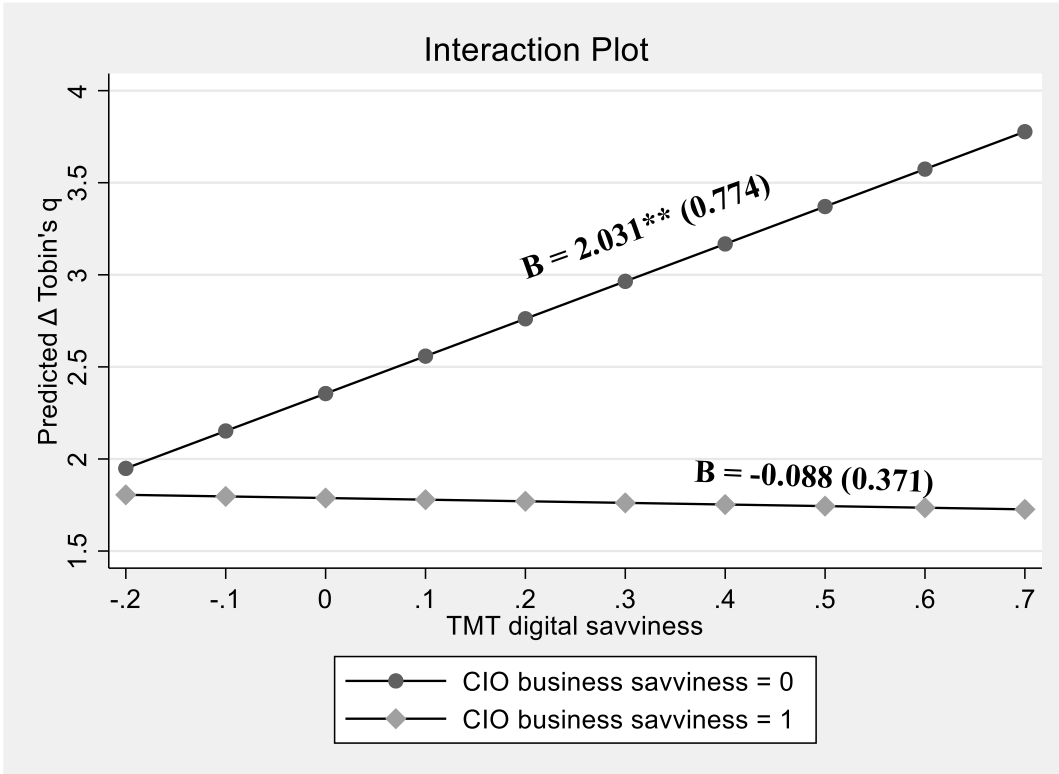


**Figure B11: Interaction Plot with DV as Tobin's q in 2018**

**Table B12: Interaction Analysis with DV as ROA in 2018**

| VARIABLES | **DV = ROA in 2018** |
|---|---|
| Asset Tangibility | -0.022* |
| | (0.0085) |
| Capital Intensity | 0.52*** |
| | (0.14) |
| COGS | 0.088* |
| | (0.035) |
| Leverage | 0.13*** |
| | (0.019) |
| Firm Size | 0.012*** |
| | (0.0031) |
| Operating Cost | -0.28*** |
| | (0.043) |
| Organizational Slack | 0.0053* |
| | (0.0025) |
| R&D Intensity | 0.39** |
| | (0.14) |
| HHI | 8.0e-06 |
| | (5.2e-06) |
| Dynamism | 0.090 |
| | (0.58) |
| Munificence | -0.0047 |
| | (0.10) |
| TMT Digital Savviness | 0.076+ |
| | (0.041) |
| CIO Business Savviness | -0.026* |
| | (0.011) |
| CIO*TMT Interaction | -0.11* |
| | (0.045) |
| Constant | 0.073 |
| | (0.61) |
| Observations | 246 |
| $R^2$ | 0.498 |

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

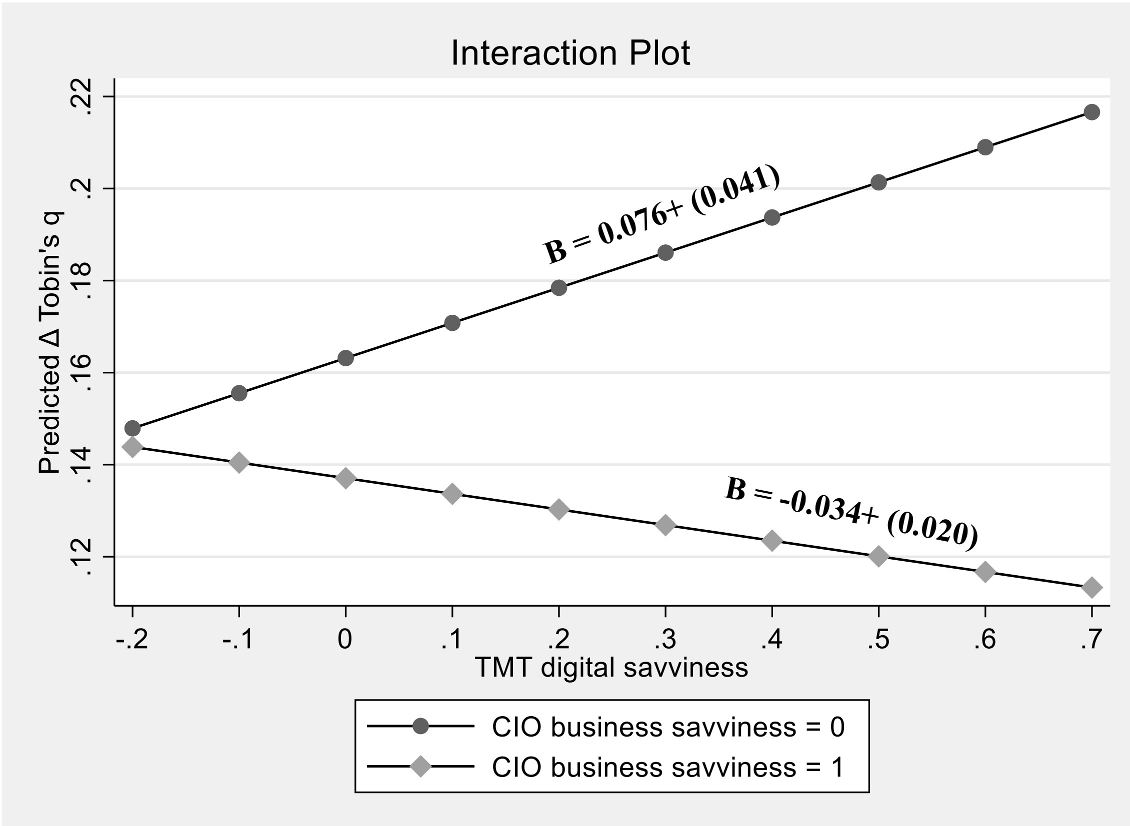


**Figure B12: Interaction Plot with DV as ROA in 2018**