Count on it: The Influence of CEO Numeracy on Acquisition Decisions and Outcomes

by

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ABSTRACT

This dissertation examines the impact of chief executive officers' (CEO) numeracy on strategic decisions and outcomes. CEO numeracy refers to the capacity of a CEO to perform one or more mental activities on information and/or concepts that are numerical in nature. Although numeracy is widely studied in disciplines such as health sciences, education, and psychology and is commonly associated with superior and more effective decision making, it is largely missing from organizational scholarship. Numeracy is particularly relevant in the context of top management teams as the conditions in which executives operate compromise the effectiveness of strategic decision making. As such, I examine the effect of CEO numeracy on acquisition decisions and outcomes. Despite global growth in acquisition investments over the years, studies suggest that acquisitions more often erode instead of improve acquiring firm value. Therefore, I propose that CEO numeracy is negatively associated with acquisition decisions such as the number of acquisitions, value of acquisitions, and number of large acquisitions undertaken by a firm. Moreover, among CEOs that engage in acquisitions, I propose that more numerate CEOs will experience better acquisition-related outcomes compared to less numerate CEOs. Specifically, I hypothesize that CEO numeracy is negatively related to acquisition premiums and positively related to post-acquisition performance. I use a longitudinal sample comprised of 250 randomly selected U.S. based firms from the S&P 500 index to empirically test my hypothesized relationships. Furthermore, I use CEO-attributed text from earnings calls transcripts and a closed-language analytical approach to develop a novel and accessible measure of CEO numeracy. My analyses did not yield support for my hypotheses. I discuss potential

theoretical and empirical explanations for the null findings in my research and propose directions to mitigate those issues in future research.

To my amazing children:

May you never give up on your dreams.

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CHAPTER 1

INTRODUCTION

Research in strategic management has provided considerable evidence on how chief executive officers (CEOs) influence organizational decisions and outcomes (e.g., Hambrick & Mason, 1984; Hambrick & Quigley, 2014; Mackey, 2008; Quigley & Hambrick, 2015). The central premise of Hambrick and Mason's (1984) upper echelons theory is that top executives' experiences, values, and personalities affect the decisions they make. While Hambrick and Mason (1984) proposed using demographic characteristics of executives as a proxy for their underlying attributes, scholars have sought to assess such attributes more directly in recent years (Carpenter, Geletkanycz, & Sanders, 2004; Priem, Lyon, & Dess, 1999). Consequently, a stream examining managerial cognition, or the inner workings of the mind, has become vital in the upper echelons literature (Buyl, Boone, & Matthyssens, 2011; Certo, Connelly, & Tihanyi, 2008). As cognition influences how individuals perceive, processes, and choose between different alternatives (Datta & Rajagopalan, 1998; March & Simon, 1958), examining CEO cognitive attributes allows us to gain a better understanding of CEO strategic decisions and subsequent organizational outcomes.

Building on the managerial cognition literature, Helfat and Peteraf (2015) introduce the concept of managerial cognitive capabilities to refer to an executive's capacity to perform mental activities. The authors emphasize that the content or context domain (e.g., playing chess, coding, or diagnosing patients) in which cognitive capabilities are applied contributes to differences in how individuals perform mental activities (Ericsson & Lehmann, 1996). Building on that premise, I examine the influence

of managerial capabilities in a particular content domain on strategic decisions and outcomes. Since organizations depend on profits to survive, a particularly relevant cognitive capability for executives relates to their capacity to work with numbers. Numeracy is the capacity of a CEO to perform one or more mental activities on information and/or concepts that are numerical in nature (Golbeck, Ahlers-Schmidt, Paschal, & Dismuke, 2005; Helfat & Peteraf, 2015).

Scholars in education, health sciences, and psychology have pointed to the impact of numeracy on a wide array of fundamental behaviors, perceptions, decisions, and outcomes. For example, research has shown that numeracy influences individuals' perceptions of risks and benefits, susceptibility to biases, and deliberation efforts (Elliott, Grant, & Rennekamp, 2017; Peters, 2020; Reyna, Nelson, Han, & Dieckmann, 2009; Tiede, Bjälkebring, & Peters, 2021). Collectively, scholarship on numeracy demonstrates that highly numerate individuals tend to make more effective decisions compared to those less numerate (Peters, 2020; Peters, Västfjäll, Slovic, Mertz, Mazzocco, & Dickert, 2006). In other words, studies demonstrate that numerate individuals make decisions that ultimately lead to better outcomes compared to less numerate individuals. Studies have also documented that numeracy varies even among highly educated individuals, such as surgeons, physicians, and medical students (Garcia-Retamero, Wicki, Cokely, & Hanson, 2014; Lipkus, Samsa, & Rimer, 2001; Peters, 2020). As such, we can expect numeracy to vary among CEOs and thus affect their decisions differently.

The primary objective of my study is to examine the influence of CEO numeracy on organizational decisions and outcomes. Scholarship suggests that the efficiency of CEO decision making is often compromised because executives operate under conditions

of information overload and uncertainty (March & Simon, 1958) and because they are boundedly rational (Cyert & March, 1963). Consequently, there is substantial heterogeneity in the effectiveness of CEO decisions and firm outcomes. Understanding this heterogeneity is fundamental to strategic management scholarship. For instance, Gary and Wood (2011: 569) propose that "understanding why some firms and not others adopt strategies ultimately associated with competitive success is of central importance to strategy scholars." Furthermore, Quigley and Graffin (2017: 799) highlight that the extent to which CEOs influence organizational decisions and outcomes is "one of the most fundamental research questions in strategic management scholarship." To this end, I propose that CEO numeracy allows us to better understand strategic decisions and outcomes.

I examine the impact of CEO numeracy on firm strategies in the domain of mergers and acquisitions (hereafter referred to simply as *acquisitions*), which I believe is an ideal context for my research. Acquisitions involve a significant deal of risk and potential for loss (Pablo, Sitkin, & Jemison, 1996), and research suggests that acquisitions typically destroy instead of improve firm value (Devers, Wuorinen, McNamara, Haleblian, Gee, & Kim, 2020). In their review of the acquisitions' literature, Haleblian and colleagues (2009: 470) find that "acquisitions were often found to erode acquiring firm value…and produce highly volatile market returns." Christensen and colleagues (2011: 3) speak to this phenomena, highlighting that "companies spend more than $2 trillion on acquisitions every year…yet study after study puts the failure rate of mergers and acquisitions somewhere between 70% and 90%." Importantly, studies suggest that CEOs are essential drivers of acquisition decisions and outcomes (Meyer-

Doyle, Lee, & Helfat, 2019). Knowing this, CEO numeracy could be a critical antecedent that sheds light on why some firms acquire while others do not, as well as on the variation in acquisition outcomes.

Building on upper echelons theory (Hambrick & Mason, 1984), I suggest that numeracy is an important factor that explains why CEOs engage in acquisitions despite evidence that acquisitions typically fail (King, Dalton, Daily, & Covin, 2004). Studies on numeracy document that numerate individuals not only have better utilization of numbers, but also more accurate perceptions of risks and benefits, are able to minimize biases, and tend to engage in more thorough and elaborative exploration and deliberations compared to those who are less numerate (Peters, 2020). Collectively, these studies highlight that numeracy improves the effectiveness of decisions and outcomes (Peters et al., 2006). Accordingly, I hypothesize that CEO numeracy is negatively related to the number of acquisitions, value of acquisitions, and number of large acquisitions undertaken by a firm. Furthermore, I propose that CEO numeracy improves acquisition outcomes, since highly numerate CEOs would not engage in acquisitions unless the decision is extensively scrutinized and accurately deemed beneficial. Therefore, I hypothesize that CEO numeracy is negatively related to acquisition premiums and positively related to post-acquisition performance.

Additionally, I build on research exploring the interaction of individual differences and prevalent corporate governance characteristics on organizational outcomes (Gamache, McNamara, Mannor, & Johnson, 2015; Wowak & Hambrick, 2010). More specifically, I examine how CEO stock options and CEO power, both of which influence strategic decisions and managerial risk-taking, interact with CEO

numeracy to influence the acquisition decisions and outcomes of interest to my study. Drawing on agency theory (Berle & Means, 1932; Jensen & Meckling, 1976), I hypothesize that the relationships between CEO numeracy and acquisition decisions and outcomes are strengthened with higher levels of CEO stock options and CEO power.

This study aims to contribute to strategy scholarship in three primary ways. First, I extend the work on upper echelons theory by introducing CEO numeracy as an important, yet overlooked, managerial cognitive capability that can help scholars better understand the antecedents and consequences of CEO decision making. I propose that numeracy can improve the efficiency of strategic decision making. I further examine the interaction of CEO numeracy and prominent governance mechanisms (i.e., CEO stock options and CEO power) on firm decisions and outcomes. In doing so I answer calls for studies to examine how the alignment of governance mechanisms to individual differences of CEOs can influence firm-level outcomes (Hambrick, 2007; Wowak & Hambrick, 2010).

Second, I strive to offer an empirical contribution by introducing a novel and accessible measure for CEO numeracy. Numeracy is often measured with tests or survey items (Peters, 2020; Peters et al., 2006). Thus, creating a measure that utilizes archival data is particularly helpful given the constraints that exist pertaining to access to CEOs and other top executives. Specifically, I utilize spoken text attributed to CEOs from earnings calls transcripts to measure numeracy. Studies illustrate that earnings calls serve as an appropriate context because, compared to other CEO communications such as letters to shareholders, CEOs' words and responses are likely to be their own (Harrison, Thurgood, Boivie, & Pfarrer, 2019; Matsumoto, Pronk, & Roelofsen, 2011).

Finally, I hope to contribute to the acquisitions literature by responding to calls for scholars to examine how executive characteristics influence acquisition decisions and outcomes (Devers et al., 2020). Most research examining the role of CEOs in acquisitions focuses on how executive self-interest, often through executive compensation (Agrawal & Walkling, 1994; Sanders & Hambrick, 2007), impacts acquisitions (Haleblian et al., 2009). Research directly examining how the cognitive characteristics of top executives influence acquisition behaviors and outcomes, however, remains limited (Gamache et al., 2015). Accordingly, exploring how CEO numeracy is a relevant differentiating factor in (a) influencing CEOs to pursue acquisitions despite evidence that they erode firm value, and (b) a CEO's ability to recognize and pursue successful acquisition prospects, can improve our understanding of acquisition behaviors and outcomes.

The remainder of this document is organized as follows. In Chapter 2, I present a review of the streams of literature that were central in the development of my dissertation. In Chapter 3, I build my arguments and propose hypotheses on the influence of CEO numeracy on acquisition decisions and outcomes. In Chapter 4, I detail the research design and methodology I utilize to empirically test my hypotheses. In Chapter 5, I present the results from my primary and supplementary analyses. Finally, in Chapter 6, I discuss the findings, implications, limitations, as well as future research directions.

CHAPTER 2

LITERATURE REVIEW

In this chapter, I provide a literature review on topics that are central to the development of my dissertation. I begin with a review of the upper echelons literature with a specific focus on managerial cognition and managerial cognitive capabilities in strategic decision making. Next, I review the literature on numeracy, how it has been conceptualized and measured in different fields, as well as the antecedents and outcomes associated with the construct.

Upper Echelons

Hambrick and Mason's (1984) upper echelons theory emphasizes the impact that top executives' experiences, values, and personalities have on strategic decisions and outcomes. The theory suggests that executives' characteristics and attributes influence what executives see, how they interpret what they see, their overall perceptions, and consequently the choices they make. Hambrick and Mason's publication was a catalyst that inspired an entire stream of research dedicated to examining how various executive characteristics influence strategic decisions and outcomes (e.g., Chatterjee & Hambrick, 2007; Chin, Hambrick, & Treviño, 2013; Nadkarni & Herrmann, 2010; Zhu & Chen, 2015a).

Research in this stream of literature initially focused on examining how demographic attributes influence strategic decisions (e.g., Knight, Pearce, Smith, Olian, Sims, Smith et al., 1999; Tihanyi, Ellstrand, Daily, & Dalton, 2000). This was perhaps due to Hambrick and Mason's (1984) suggestion to use executives' background

characteristics as proxies for their underlying attributes. However, in response to calls to go beyond the use of demographic characteristics (e.g., Carpenter et al., 2004; Priem et al., 1999) scholars have since examined more complex attributes such as executive personalities (e.g., Chatterjee & Hambrick, 2007; Tang, Qian, Chen, & Shen, 2015; Zhu & Chen, 2015b), values (e.g., Chin & Semadeni, 2017; Gupta, Briscoe, & Hambrick, 2017), and cognition (e.g., Certo et al., 2008; Levine, Bernard, & Nagel, 2017; Marcel, Barr, & Duhaime, 2011). Collectively, these studies have provided considerable theoretical and empirical evidence for the view that organizations are reflections of their top managers (e.g., Finkelstein, Hambrick, & Cannella, 2009; Hambrick & Mason, 1984; Hambrick & Quigley, 2014; Mackey, 2008; Quigley & Hambrick, 2015). (Refer to Carpenter et al., 2004 for a comprehensive review of the upper echelons literature.).

Managerial cognition and strategic decision making. A critical stream in the upper echelons literature examines how CEO cognition influences strategic decisions. The roots and underpinnings of cognition research stem from fields such as cognitive psychology, social psychology, and cognitive science. Yet, there are inconsistencies across and within disciplines in what cognition is or what it entails. As Helfat and Peteraf (2015: 832) put it, "scholars often differ (sometimes strongly) across these fields in their views on cognition, even for very specific elements of cognition such as attention." Building on research in psychology and cognitive science, Helfat and Peteraf (2015: 834) propose that cognition embodies two meanings: "(1) mental activities (also termed "mental processes" or "mental operations"), and (2) mental structures (or representations)." In psychology, mental activities refer to those related to acquiring and processing information, as well as the content of those activities (Colman, 2015).

Conversely, mental structures refer to how information is represented in the mind (Schneider & Angelmar, 1993). As such, studies of managerial cognition examine how executive mental activities and/or mental structures influence decision making.

Research on managerial cognition has become central in the upper echelons literature as cognition more directly impacts executive decision making compared to other observable factors (e.g., Buyl et al., 2011; Narayanan, Zane, & Kemmerer, 2011). Indeed, organizational theorists suggest that executives tend to make strategic decisions under conditions of information overload and uncertainty (Cyert & March, 1963; March & Simon, 1958). Since decision-making processes are inherently complex, researchers have argued that such decisions do not necessarily provide economic optimization but are instead the outcome of behavioral and cognitive factors. Thus, the concept of bounded rationality (Cyert & March, 1963) is foundational in upper echelons theory. Simply put, because executives are faced with more information than they can handle, cognitive characteristics simplify and facilitate decision-making (March & Simon, 1958).

Managerial cognitive capabilities. The literature on CEO cognition illustrates that heterogeneity in managerial cognition is a significant contributor to heterogeneity in decision making. Accordingly, Helfat and Peteraf (2015: 835) introduced the concept of managerial cognitive capabilities and define it as "the capacity of an individual manager to perform one or more of the mental activities that comprise cognition." Though the authors' intention was to explain the cognitive underpinnings of dynamic managerial capabilities, the concept of managerial cognitive capabilities is relevant to other areas in strategic management as well.

From an upper echelons perspective, heterogeneity in managerial cognitive capabilities contributes to heterogeneity in strategic decisions and subsequent outcomes. For example, managerial cognitive capabilities, like other capabilities, develop through practice and change with age. Ericsson and Lehmann (1996) highlight that training and repetition are essential for learning and improving memory. This study also cites evidence that individuals eventually reach peak performance in cognitive capabilities, after which they experience a decline. The peak ages, however, significantly differ across cognitive domains. Studies further illustrate that cognitive capabilities are influenced by prior experience and familiarity in the specific domain or context of application (Ericsson & Lehmann, 1996; Helfat & Peteraf, 2015). Accordingly, the domain in which the cognitive capabilities are utilized contributes to the heterogeneity of cognitive capabilities. In the next section, I introduce numeracy as a cognitive capability in a specific content-domain (i.e., numbers).

Numeracy

Numeracy has been extensively studied in fields such as health sciences (e.g., Donelle, Arocha, & Hoffman-Goetz, 2008; Schwartz, Woloshin, Black, & Welch, 1997), psychology (e.g., Peters et al., 2006; Sinayev & Peters, 2015; Tiede et al., 2021), education (e.g., Reyna & Brainerd, 2007, 2008), and mathematical sciences (e.g., Ehrenberg, 1977; O'Donoghue, 2002). Studies illustrate that numeracy is an important predictor of decision making processes and outcomes (e.g., Peters, 2008; Reyna et al., 2009). This section provides an overview of the numeracy literature. I start with the definitions and conceptualizations of numeracy in various fields. I then explain how

numeracy differs from related constructs in organizational scholarship. Finally, I provide an overview of the antecedents and outcomes of numeracy.

Definitions and conceptualizations. Numeracy can be broadly defined as the "ability to comprehend, use, and attach meaning to numbers" (Nelson, Reyna, Fagerlin, Lipkus, & Peters, 2008: 262). Nonetheless, there is no universally agreed upon definition of numeracy. For instance, some definitions focus on specific numeracy-related content such as the different representations of numerical information which include probabilities, fractions, and ratios (Fagerlin, Zikmund-Fisher, Ubel, Jankovic, Derry, & Smith, 2007). Other definitions link numeracy to a particular context or purpose. For example, Golbeck, Ahlers-Schmidt, Paschal and Dismuke (2005) define numeracy as the "degree to which individuals have the capacity to access, process, interpret, communicate, and act on numerical, quantitative, graphical, biostatistical, and probabilistic health information needed to make effective health decisions." The Organisation for Economic Co-operation and Development (OECD), on the other hand, defines numeracy as "the ability to access, use, interpret and communicate mathematical information and ideas in order to engage in and manage the mathematical demands of a range of situations in adult life" (Desjardins, Thorn, Schleicher, Quintini, Pellizzari, Kis et al., 2013: 59). While the definitions vary, they all involve a person's ability to perform mental activities with numbers.

By definition, individuals who are high in numeracy perform mental activities on numeric information more effectively and accurately than those low in numeracy. For instance, more numerate individuals have better comprehension of numbers, while the less numerate often misunderstand numerical information (Ben-Joseph, Dowshen, &

Izenberg, 2009). Furthermore, more numerate individuals are able to perform complex calculations with numeric information and have a greater ability to recall numbers compared to less numerate individuals (Gibson, Callison, & Zillmann, 2011). Moreover, unlike those who are less numerate, more numerate individuals focus their attention on, and seek, numeric information (Peters, 2020). Relatedly, Peters (2020) illustrates that numerate individuals integrate more numerical information in their communications compared to those who are less numerate. Overall, numerate individuals have a higher capacity to perform mental activities with numbers compared to those who are less numerate.

Measuring numeracy. Numeracy is generally assessed by objective questionnaires (Fagerlin et al., 2007) that vary in length, format, and style. The assessments of numeracy are further tailored to factors such as the context of the study, the content of the study, and characteristics of the respondents. For example, Schwartz and colleagues (1997) examine the influence of numeracy on understanding the benefits of screening mammograms. The authors measure numeracy using three simple questions that assess 1) basic familiarity with probability and 2) ability to convert numerical information from one format (e.g., percentages) to another (e.g., proportions). A sample item from this questionnaire is: "In the ACME Publishing Sweepstakes, the chances of winning a car is 1 in 1,000. What percent of tickets to ACME Publishing Sweepstakes win a car?" (Schwartz et al., 1997: 967). The questionnaire was subsequently modified by Lipkus and colleagues (2001) to assess numeracy in highly educated samples. Specifically, eight questions aimed at assessing a person's ability to understand disease-related risks were added to the original three. A sample question from the modified

questionnaire is: “The chance of getting a viral infection is 0.0005. Out of 10,000 people, about how many of them are expected to get infected?” (Lipkus et al., 2001). Overall, the literature indicates that researchers either utilize existing questionnaires to measure numeracy or construct new ones that are more suitable for their purposes.

Distinction from related constructs. Scholars sometimes use the terms numerical ability (Peters et al., 2006), numerical literacy (Hill & Brase, 2012), and numerical intelligence (Mascia, Fastame, Agus, & Penna, 2019) synonymously with numeracy. In these cases, the different terms refer to the same construct and do not necessitate further clarification. However, I distinguish numeracy from general intelligence because though people may presume that they are similar, general intelligence and numeracy represent two different constructs.

General intelligence is a “a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience” (Gottfredson, 1997: 13; Spearman, 1904). Thus, general intelligence is a broader construct compared to numeracy. In fact, studies indicate that general intelligence consists of three content domains: quantitative/numerical, spatial/mechanical, and verbal/linguistic (Lubinski, 2004). Numeracy, then, is associated with only one of the content domains captured in general intelligence.

Antecedents of numeracy. Research demonstrates that there is considerable variance in numeracy among people. In fact, studies illustrate that numeracy varies even among highly educated individuals such as surgeons, physicians, and medical students (Garcia-Retamero et al., 2014; Lipkus et al., 2001; Peters, 2020). This finding also

extends to those outside of the medical profession. Lipkus and colleagues (2001), for instance, find that in a sample where approximately 84 percent had at least some college education, only 15 percent answered all three questions of a basic numeracy scale correctly. In the same sample, approximately 25 percent were not able to identify which of the following represents the biggest risk: 1 in 100, 1 in 1000, or 1 in 10. This suggests that even highly educated individuals may have difficulty answering fairly simple numeracy questions. Examining the antecedents of numeracy allows us to better understand why there is large variance in numeracy among individuals (Peters, 2020). Scholars have illustrated that demographics, such as education, gender, and age, as well as genetic factors are important drivers of numeracy.

Studies reveal that formal education is a significant predictor of numeracy. However, it remains inconclusive about whether the extent of schooling impacts numeracy levels (Peters, 2020). Some studies illustrate that the extent of schooling does not have an impact numeracy levels, particularly in countries where schooling is mandatory (Nys, Ventura, Fernandes, Querido, Leybaert, & Content, 2013). Conversely, others show that individuals that took more math courses as a degree requirement improved their numeracy levels (Lindskog, Winman, & Juslin, 2014). This finding suggests that the extent of schooling potentially influences numeracy levels.

Research exploring the effects of gender on numeracy also offers mixed findings. Some studies indicate that gender does not explain differences in numeracy (Dowker, 2016), while others suggest that gender gaps in numeracy do exist, as males score higher on numeracy than females (Borgonovi, Choi, & Paccagnella, 2021; Rothman & McMillan, 2003). Researchers indicate that gender differences in numeracy are a result of

gender norms and stereotypes that are projected onto females at a young age, putting them at a disadvantage (UNICEF, 2022).

Studies linking age to numeracy offer relatively consistent results. Specifically, cross-sectional studies indicate that there is an inverted-U shaped relationship between the two (e.g., Geary & Lin, 1998; Peters, Slovic, Västfjäll, & Mertz, 2008; Ratcliff, Thapar, & McKoon, 2010). In other words, these studies show that age is positively related to numeracy from childhood up to a certain point in adulthood. Yet, beyond that point, the relationship between age and numeracy becomes negative. Longitudinal studies lend support to comparable findings within individuals. For example, Grasby and Coventry (2016) track students from grade three to grade nine and report growth in numeracy levels over this period. Further, Best and colleagues (2022) examine the longitudinal trends of numeracy on adults over a span of eleven years. The authors report a decline in numeracy beginning in later middle age (i.e., 45 years), and find that older members in the sample experienced a greater decrease in numeracy compared to the younger members between the two time periods. The study reveals that males and those with higher levels of education experienced lower declines in numeracy.

Moving past demographics, scholars have proposed that genetics are significant predictors of numeracy (Haworth, Kovas, Petrill, & Plomin, 2007). In fact, studies indicate that the heritability—or the "proportion of observed variation among individuals in a population that can be attributed to underlying genetic differences" (Rusconi & McLean, 2017: 30)—in numeracy ranges from 62 percent to 75 percent during primary-school years (Haworth et al., 2007). Nonetheless, studies have suggested that heritability decreases with age, while the impact of demographic and environmental factors become

more prominent in explaining variation in numeracy and other cognitive abilities (Haworth, Dale, & Plomin, 2009). Research also highlights that the impact of genetics on numeracy is moderated by socioeconomic status. Particularly, genetic influences on numeracy are more prominent for people with higher economic status compared to ones with lower economic status (Peters, 2020; Tucker-Drob, Briley, & Harden, 2013).

Outcomes of numeracy. Scholarship indicates that numeracy has a substantial effect on a wide array of outcomes. However, scholars have mostly focused on the benefits of numeracy with limited attention to its potential drawbacks or downfalls. Since most studies on numeracy are from the health sciences, health-related outcomes are the most prominent (Peters, 2020). For instance, a study by Martin and colleagues (2012) reported that for every 1-point increase in numeracy the odds of quitting smoking increased by approximately 24 percent. Numeracy in health sciences has also been linked to diabetes (e.g., Zikmund-Fisher, Exe, & Witteman, 2014), seeking medical attention in a timely manner (e.g., Petrova, Garcia-Retamero, Catena, Cokely, Heredia Carrasco, Arrebola Moreno et al., 2017), and physician-patient interactions (e.g., Garcia-Retamero et al., 2014).

However, the influence of numeracy is not limited to health-related outcomes. In the context of labor markets, scholars have found that numeracy is positively associated to income levels (Charette & Meng, 1998) and employment (Kelly, McGuinness, & O'Connell, 2012). Furthermore, studies show that numeracy is positively related to financial behaviors such as investments (e.g., Christelis, Jappelli, & Padula, 2010), savings (e.g., Sinayev & Peters, 2015) and wealth (e.g., Banks, o'Dea, & Oldfield, 2010).

Research on numeracy further illustrates that more numerate individuals tend to make more effective decisions (Peters et al., 2006). Scholars propose that this is due to cognitive mechanisms that mediate the relationship between cognitive capabilities and decision-making (Cokely & Kelley, 2009). These mechanisms are well documented in the numeracy literature (Peters, 2020). Below, I categorize them for two purposes. First, it helps to distinguish numeracy from other constructs related to cognition and cognitive capabilities. And second, it generates greater theoretical insight and clarification for building my hypotheses.

***Extent of deliberations*.** Research finds that numerate individuals engage in more elaborative exploration and deliberation in decision making compared to those that are less numerate (Cokely & Kelley, 2009; Ghazal, Cokely, & Garcia-Retamero, 2014). Relatedly, findings indicate that more numerate individuals spend more time on deliberations, particularly those that involve numbers, compared to those that are less numerate (Ghazal et al., 2014; Peters, 2020). Further, unlike those with low levels of numeracy, highly numerate individuals process information in greater depth early in the process, and encode it in a way that is efficient for subsequent decision making (Baron, 1978; Cokely, Kelley, & Gilchrist, 2006). Research also suggests that highly numerate individuals put more effort in high-payoff decisions than those lower in numeracy (García Retamero Imedio & Traczyk, 2018). Misuraca, Teuscher and Carmeci (2016) propose that such extensive deliberations allow individuals with high levels of numeracy to choose the most optimal option possible (i.e., maximize) instead of one that is merely good enough (i.e., satisfice). Numeracy research also demonstrates that highly numerate individuals reduce deliberations when it is to their advantage (Cokely & Kelley, 2009).

This indicates that individuals with high numeracy levels only spend time deliberating when it is efficient to do so.

Perceptions of risks and benefits. Evaluating risks and benefits is a central component of decision making. Inaccurate evaluations potentially lead to suboptimal choices and/or undesired outcomes. Since the assessment of risks and benefits involves comprehending and assigning weights and probabilities to various factors, numeracy directly impacts how individuals evaluate and perceive risks (Peters, 2020; Reyna et al., 2009). Certainly, studies suggest that individuals lower in numeracy have distorted perceptions of both risks and benefits compared to those higher in numeracy (Reyna et al., 2009). For instance, in a study of cancer patients, Weinfurt and colleagues (2003) found that less numerate patients perceived greater benefit from experimental treatments than their more numerate counterparts. Furthermore, Gurmankin, Baron, and Armstrong (2004), found that patients lower in numeracy were more likely to overestimate their risk of cancer compared to those higher in numeracy. In short, studies suggest that individuals lower in numeracy tend to overestimate both the risks and benefits, whereas those higher in numeracy tend to have more accurate perceptions of both.

Minimization of biases. Traditional models of decision making are built on the assumption that individuals are rational (Bazerman & Moore, 2012). In reality, however, decision making processes are confounded by biases that potentially undermine the effectiveness of decisions (Cyert & March, 1963; March & Simon, 1958). Research illustrates that high levels of numeracy minimize biases in decision making processes. Specifically, numeracy minimizes biases associated with affect and emotions, framing effects, and self-evaluations of knowledge.

Individuals rely in part on emotions, or affect, in their decision making (König, Graf-Vlachy, Bundy, & Little, 2020; Slovic, Finucane, Peters, & MacGregor, 2002). Studies indicate that numeracy influences both the type of information that individuals derive affect from, as well as the extent to which they rely on affect in decision making (Peters, 2020). More specifically, more numerate individuals derive affect from objective numeric information, whereas less numerate individuals derive affect from subjective non-numeric information such as stories or experiences (Bateman, Dent, Peters, Slovic, & Starmer, 2007; Peters et al., 2006). Furthermore, more numerate individuals are less reliant on affect, particularly moods or feelings in the moment (i.e., incidental affect), in decision making than those that are less numerate (Peters, 2020). In fact, those high in numeracy tend to minimize the influence of incidental affect from decision making. (Peters, Dieckmann, Västfjäll, Mertz, Slovic, & Hibbard, 2009). Accordingly, more numerate individuals tend to make more objective decisions compared to less numerate individuals.

Second, the way in which information is framed can influence decision making. For example, informing patients that a treatment leads to a 90 percent chance of survival may influence their decisions differently than highlighting the 10 percent chance of death. Furthermore, presenting information in frequency format (e.g., 1 out of 10), as opposed to in percentage format (e.g., 10 percent), can yield different responses from individuals (Schapira, Davids, McAuliffe, & Nattinger, 2004). While less numerate individuals are susceptible to such framing effects, research suggests that more numerate individuals are less so since they are able to transform the information to alternative, equivalent formats (Garcia-Retamero & Galesic, 2010; Peters, 2012). Accordingly, the

way that numeric information is presented does not influence those that are higher in numeracy as much as those lower in numeracy.

Finally, realizing the extent of one's knowledge is critical for effective decision making (Peters, 2020). Nonetheless, individuals are typically overconfident and think that they know more than they actually do (Griffin & Brenner, 2004; Moore & Healy, 2008). Studies indicate that more numerate individuals are more calibrated regarding what they know, whereas less numerate individuals often overestimate the extent of their knowledge. (Ghazal et al., 2014; Winman, Juslin, Lindskog, Nilsson, & Kerimi, 2014). While these calibration studies focus on general knowledge questions, the findings are consistent when examining numeracy-related questions (Tompkins, 2018).

Summary

Utilizing an upper echelons perspective, scholars have provided important insights on how various CEO characteristics influence organizations (Chatterjee & Hambrick, 2007; Chin et al., 2013; Nadkarni & Herrmann, 2010; Zhu & Chen, 2015a). A particularly important stream in this literature focuses on how heterogeneity in managerial cognition leads to heterogeneity in strategic decision making and subsequent outcomes. Building on research by Helfat and Peteraf (2015) I presented numeracy as a cognitive capability in the domain of numbers. A review of the numeracy literature illustrates that numeracy improves decision making efficiency. Following this logic, in the next chapter I introduce CEO numeracy to strategic management scholarship as an important managerial cognitive capability and illustrate how it impacts strategic decision making and subsequent outcomes in the context of acquisitions.

CHAPTER 3

THEORY DEVELOPMENT AND HYPOTHESES

Building on upper echelons theory (Hambrick & Mason, 1984), scholars have provided considerable insight into how managerial cognitive attributes influence decision making and organizational outcomes (Buyl et al., 2011; Certo et al., 2008). I extend this literature by introducing CEO numeracy as a managerial cognitive capability in the domain of numbers. I define CEO numeracy as the capacity of a CEO to perform one or more mental activities on information and/or concepts that are numerical in nature (Golbeck et al., 2005; Helfat & Peteraf, 2015). These include mathematical, quantitative, probabilistic, and time-related concepts. Mental activities are vast and involve—but are not limited to—attention, perception, problem solving, reasoning, and language/communication (Helfat & Peteraf, 2015). Since numeracy influences cognitive processes such as what information CEOs pay attention to and how they interpret that information, it allows us to gain a better understanding of CEO behaviors and strategic decisions. Moreover, as numeracy varies even among highly educated samples (e.g., Garcia-Retamero et al., 2014; Lipkus et al., 2001; Peters, 2020), it is likely to vary among CEOs and affect their decisions differently. Indeed, Helfat and Peteraf (2015: 845) acknowledge that "individuals managers may not be equally skilled at all types of mental activities." As such, numeracy could be a crucial component that explains heterogeneity in strategic decision making and outcomes.

In this chapter, I expand on the upper echelons literature and build arguments on how numeracy influences CEO decisions and outcomes in the context of acquisitions. In short, I suggest that numeracy is an important factor that explains why CEOs engage in

acquisitions in spite of evidence that acquisitions have limited benefits (King et al., 2004). Studies illustrate that numeracy improves the effectiveness of decisions and outcomes by means of various cognitive mechanisms (Peters et al., 2006), as such, I theorize that numeracy is negatively associated with the number of acquisitions, value of acquisitions, and number of large acquisitions undertaken by the firm. Furthermore, I hypothesize that for CEOs that do engage in acquisitions, CEO numeracy is negatively related to acquisition premiums and positively related to post-acquisition performance. Finally, I present CEO stock options and CEO power—two prominent governance mechanisms that influence acquisitions—as important moderators for my main hypotheses. A model of my hypothesized relationships is presented in Figure 1.

Acquisitions as a Research Context

Acquisition investments have been increasing in recent decades, with global acquisition volumes reaching an all-time high of $5.8 trillion in 2021 (Nishant, 2021). Perhaps fueled by the trend in acquisition activity, acquisition scholarship has gained significant traction in several academic disciplines including strategic management, finance, and economics (for a review of this interdisciplinary literature, see Devers et al., 2020). Acquisitions require significant resources and are viewed as among the most important strategic decisions in both theory and practice (Wally & Baum, 1994).

Scholars often explore acquisitions when examining managerial risk taking, or executives' strategic decisions associated with uncertainty and probabilistic variation in outcomes (Arrfelt, Mannor, Nahrgang, & Christensen, 2018; Hoskisson, Chirico, Zyung, & Gambeta, 2017). Such decisions have important consequences on organizational risk,

or “uncertainty pertaining to the organization’s income stream” (Hoskisson et al., 2017: 138). In other words, though managerial risk taking may lead to increases in firm performance, risk taking may also result in significant losses. Because executives are continuously confronted with uncertainty surrounding their organizations, their decisions inherently involve risks related to such uncertainty. These actions are particularly crucial for the survival of organizations in increasingly competitive environments.

Risk plays a central role in acquisitions decisions and outcomes (Pablo et al., 1996). In fact, the risk characteristics associated with acquisitions distinguish them from other strategic decisions (Haspeslagh & Jemison, 1991). Specifically, acquisition outcomes involve a significant deal of uncertainty and potential for loss; a notion supported by the high rate of acquisition failures (Pablo et al., 1996). Indeed, some studies report that 40 to 60 percent of acquisitions fail (Bauer & Matzler, 2014), while others suggest that the failure rate is between 70 and 90 percent (Christensen et al., 2011).

Scholars have explored the antecedents of acquisitions to better understand why firms acquire despite evidence that acquisitions often fail. Studies have shown, for example, that CEO personality and cognition are important predictors of acquisition decisions and subsequent outcomes. Chatterjee and Hambrick (2007), in their study of CEOs in the computer hardware and software industries, found that CEO narcissism is positively related to the number and size of acquisitions. The premise for these relationships, according to the authors, lies in a narcissistic CEO’s tendency to exhibit attention-grabbing behaviors to fulfill the narcissistic need for attention and admiration. Gamache and colleagues (2015), examined the influence of CEO regulatory focus, which

impacts how individuals view their goals and the means used to achieve them, on acquisitions. The authors theorized and found that CEO promotion focus is positively related to the number and value of acquisitions due to three reasons: a stronger motivation to acquire, a higher propensity to search for and favorably evaluate potential acquisitions, and a stronger need to exploit opportunities. CEO prevention focus, on the other hand, is negatively related to the number and value of acquisitions since CEOs with this regulatory focus attempt to avoid making mistakes and are particularly sensitive to negative information when evaluating opportunities.

Studies suggests that factors such as managers' lack of due diligence (Puranam, Powell, & Singh, 2006), overestimating acquisition benefits and synergies (Hayward & Hambrick, 1997), and paying substantial premiums (i.e., the price paid in excess of the market value) (Haunschild, 1994; Hayward & Hambrick, 1997) contribute to the high failure rates of acquisitions (Chatterjee, 1992; Devers et al., 2020; Haleblian et al., 2009; King et al., 2004). Scholars have thus examined executive attributes that drive such behaviors. For instance, studies suggest that CEO narcissism (e.g., Aktas, De Bodt, Bollaert, & Roll, 2016; Chatterjee & Hambrick, 2007) is negatively related to post-acquisition performance since narcissism leads to impulsive, self-serving decisions instead of ones that are rational and more thought-out. Similarly, Hayward and Hambrick (1997) found that CEO hubris, or excessive self-confidence, is linked to higher acquisition premiums for large acquisitions. In their paper, the authors argue that hubris leads CEOs to overestimate their ability to extract benefits and thus pay higher premiums. Cho and colleagues (2016), on the other hand, find that CEO celebrity, which is a peer-granted social status, is negatively related to acquisition premiums. The authors

argue that non-celebrity CEOs tend to pay higher premiums due to some of the social pressures they face to gain celebrity status.

Although studies point to variance in acquisition decisions and outcomes, the majority find that acquisitions are not beneficial for firms in both the short- or long term (e.g., Devers et al., 2020; Haleblian et al., 2009; King et al., 2004). Moreover, research suggests that CEOs contribute to approximately 47 percent of the variance in acquisition decisions (e.g., the number of acquisitions undertaken by a firm) and to over 30 percent of the variance in acquisition performance (Meyer-Doyle et al., 2019). Therefore, CEO attributes that influence the effectiveness of strategic decision making and risk taking are particularly relevant in the context of acquisitions. In the next section, I introduce CEO numeracy as a critical antecedent that sheds light on why some CEOs acquire while others do not, as well as on the heterogeneity in acquisition outcomes.

CEO Numeracy and Acquisition Decisions

As developed previously, the purpose of this study is to examine the influence of numeracy on strategic decisions and outcomes. I do so in the context of acquisitions mainly due to their low success rates (Bauer & Matzler, 2014; Devers et al., 2020). If CEO numeracy influences the effectiveness of strategic decisions, CEO numeracy should also influence decisions regarding acquisitions. However, I do not suggest that more numerate CEOs are more intelligent than less numerate CEOs. Intelligence, as illustrated in the previous chapter, and cognitive capabilities represent two different constructs. Helfat and Peteraf (2015: 845) support this notion and state that “although some

managers are likely to have more effective cognitive capabilities than others, this does not imply simply that some managers are smarter than others."

The pre-deal phase of acquisitions involves complex interdependent sub-activities, including target selection, bidding and negotiation, valuation and financing, and deal closure, that all require extensive due diligence and effort (Welch, Pavićević, Keil, & Laamanen, 2020). Building on the literature on numeracy, I propose three mechanisms that lead more numerate CEOs to engage in fewer acquisitions compared to less numerate CEOs. Although I do not assess these mechanisms in my study, they provide a better understanding of how numeracy ultimately impacts acquisition behaviors.

First, studies suggest that numeracy leads to extensive deliberations (Misuraca et al., 2016), so highly numerate CEOs are likely to conduct more thorough and comprehensive due diligence compared to less numerate CEOs. Stated differently, highly numerate CEOs will ensure that all information pertaining to acquisitions is collected and analyzed to make the best decision possible given the circumstances (Simon, 1976, 1978). Due to limitations in CEOs' attention, or "noticing, encoding, interpreting, and focusing of time and effort" to issues and answers (Ocasio, 1997: 189), extensive deliberations will cause more numerate CEOs to engage in fewer acquisitions compared to less numerate CEOs. Furthermore, extensive deliberations will also cause highly numerate CEOs to spend more time than less numerate CEOs when assessing targets, particularly since acquisitions involve complex valuation and financing decisions (Ghazal et al., 2014). Long deliberations mean that it takes longer to ultimately reach a decision, particularly one supporting the acquisition. In other words, long deliberations allow

highly numerate CEOs to avoid rushed decisions and instead make thorough and effective choices (Pavićević & Keil, 2021). Accordingly, more numerate CEOs will engage in fewer acquisition compared to less numerate CEOs.

Second, more numerate CEOs are expected to form more accurate risk assessments and overall cost-benefit analyses related to acquisition targets compared to less numerate CEOs (Reyna et al., 2009). Since acquisitions often fail (Devers et al., 2020), the risk-reward assessments of more numerate CEOs will lead them engage in fewer acquisitions compared to less numerate CEOs who have distorted assessments. Furthermore, because numeracy entails superior utilization of numbers (Peters, 2020), numeracy allows CEOs to understand and perform the complex calculations with numeric information necessary for acquisition decisions. Better utilization of numbers will lead to more accurate valuations of financial costs and revenues. Because the costs of implementing acquisitions are typically higher than the benefits (Devers et al., 2020), more numerate CEOs will eliminate more targets compared to less numerate CEOs.

Finally, research suggests that biases are significant predictors of acquisitions (e.g., Hayward & Hambrick, 1997). Since numeracy minimizes biases in decision making (Peters, 2020) more numerate CEOs will undertake fewer acquisitions than less numerate CEOs. More specifically, CEOs who overestimate their strategic judgements and capabilities undertake more, and larger, acquisitions (Malmendier & Tate, 2008). Unlike CEOs with low levels of numeracy, highly numerate CEOs are calibrated with their knowledge and will therefore make unbiased assessments of their own capabilities, as well as the overall benefits and synergies associated with acquisitions. Furthermore, highly numerate CEOs are less reliant on affect in their decision making (Peters, 2020),

and instead rely on objective as opposed to subjective information (Bateman et al., 2007; Slovic et al., 2002). This makes highly numerate CEOs less susceptible than less numerate CEOs to social and stakeholder pressures that could potentially lead to suboptimal acquisition decisions (Devers et al., 2020; Seo, Gamache, Devers, & Carpenter, 2015; Shi, Zhang, & Hoskisson, 2017).

To summarize, more numerate CEOs are less likely than less numerate CEOs to engage in acquisitions because they engage in extensive and thorough deliberations, have more accurate risk-benefit assessments, and are able to minimize biases in their decision making. Collectively, these reasons suggest that highly numerate CEOs are likely to block acquisition deals since acquisitions are not typically beneficial to organizations. Less numerate CEOs, on the other hand, are likely to engage in less extensive due diligence, are more likely to have distorted risk-benefit assessments, and are more susceptible to biases compared to more numerate CEOs. Together, these reasons suggest that less numerate CEOs will engage in more acquisitions compared to more numerate CEOs. Formally, I hypothesize the following:

> ***Hypothesis 1****: CEO numeracy is negatively related to the number of acquisitions undertaken by the firm.*

Utilizing the same logic, I further suggest that CEO numeracy influences the total dollar value of acquisitions undertaken by the firm. A high value of acquisitions can result from a firm engaging in numerous small and/or large acquisitions or in one large acquisition in a given year. However, since the

complexity of acquisitions increases as the value of acquisitions increases (Chen, Crossland, & Huang, 2016; Ellis, 2011), so too does the time and effort required to assess and approve such acquisitions. This is particularly true for CEOs with high levels of numeracy who engage in extensive and thorough deliberations. Furthermore, because numeracy allows CEOs to gain a better understanding of the risks associated with acquisitions and the low potential for success, CEO numeracy will be negatively related to value of acquisitions undertaken by the firm. Finally, numeracy minimizes biases such as social pressures and reliance on affect in decision making. Therefore, more numerate CEOs are less likely than less numerate CEOs to increase the value of acquisitions in response to CEO biases that can lead to ineffective decisions. Accordingly, higher levels of numeracy will lead CEOs to block acquisition deals and ultimately result in a lower value of acquisitions. Formally, I propose the following:

> ***Hypothesis 2****: CEO numeracy is negatively related to the value of acquisitions undertaken by the firm.*

Studies suggests that larger acquisitions are less successful than smaller ones (Moeller, Schlingemann, & Stulz, 2004). This finding may be due to the fact that larger acquisitions are riskier and pose more integration challenges for a firm compared to smaller acquisitions (Chen et al., 2016; Ellis, 2011). Therefore, combining the logic from the previous two hypotheses, I hypothesize that CEO numeracy will be negatively associated with the number of large acquisitions undertaken by a firm.

Large acquisitions are much more complex and intricate than smaller acquisitions. Accordingly, the deliberation process for large acquisitions is expected to consume significantly more time and effort compared to that for smaller acquisitions, particularly for more numerate CEOs. Partly due to limitations in CEOs' attention, there is a significant opportunity cost of engaging in such extensive deliberations, suggesting that more numerate CEOs are less likely than less numerate CEOs to consider large acquisitions in the first place. However, if they do, it will take longer to reach a decision—especially one that supports the acquisition.

Furthermore, I argue that because highly numerate CEOs have more precise assessments than less numerate CEOs of the extensive risks and limited benefits associated with large acquisitions, more numerate CEOs will favor smaller acquisitions that are evidently more successful (Moeller et al., 2004). Additionally, larger acquisitions involve more complex numerical information compared to smaller acquisitions. Since more numerate CEOs perform more accurate valuations and assessments of acquisitions compared to less numerate CEOs, more numerate CEOs will likely eliminate larger acquisitions which often lead to destruction in firm value.

Finally, research suggests that biases influence decisions to engage in large acquisitions (e.g., Hayward & Hambrick, 1997). Since highly numerate CEOs are more calibrated with what they know (Peters, 2020) and are less susceptible to social pressures (Devers et al., 2020; Seo et al., 2015), they are less likely than less numerate CEOs to engage in large acquisitions. Taken together, I hypothesize the following:

Hypothesis 3*: CEO numeracy is negatively related to the number of large acquisitions undertaken by the firm.*

So far, I have hypothesized that CEO numeracy influences acquisition decisions. More specifically, I proposed that more numerate CEOs will engage in fewer acquisitions compared to less numerate CEOs. Further, I hypothesized that CEO numeracy is negatively associated with the value of acquisitions as well as the number of large acquisitions undertaken by the firm. Next, I illustrate how CEO numeracy influences acquisition outcomes. In brief, I theorize that among CEOs that acquire, more numerate CEOs will experience better outcomes than less numerate CEOs.

CEO Numeracy and Acquisition Outcomes

Until now, my hypotheses have focused on the acquisition decisions of all firms. In this section, I focus on outcomes related to acquisitions. In other words, the following hypotheses pertain only to those firms undertaking acquisitions. I propose that CEO numeracy represents an important differentiating factor in understanding two acquisition outcomes: acquisition premiums and post-acquisition performance.

Acquisition premiums, or the price that acquirors pay in excess of the market value (Haunschild, 1994), directly impact acquisition performance (2016). Certainly, evidence suggests that there is great variation in premiums and that large premiums can be detrimental for acquisitions performance (Cho et al., 2016; Haunschild, 1994). Therefore, building on my previous arguments, I propose three reasons why more numerate CEOs will pay lower premiums compared to less numerate CEOs.

First and foremost, due to their superior capacity in processing, interpreting, and utilizing numerical information, more numerate CEOs will reach more accurate estimates of targets compared to less numerate CEOs. Given that numeracy allows for accurate assessments of risks and benefits, highly numerate CEOs are more likely than less numerate CEOs to underpay—or pay the right price—than overpay for acquisitions. Relatedly, research posits that the bidding and negotiations in the pre-deal phase influences the ultimate price paid for acquisitions (Welch et al., 2020). When an acquirer approaches a target firm with an initial offer, it merely acts as a starting point for the ultimate price that will be agreed upon (Welch et al., 2020). Since more numerate CEOs are more capable of valuing targets than less numerate CEOs, the initial offer proposed is expected to be closer to, instead of higher than, the fair price. This is important since once an initial offer have been made, it is difficult to revert later and can jeopardize the acquirer's bargaining position (Pavićević & Keil, 2021).

Second, for highly numerate CEOs, the due diligence required to reach an optimal decision will uncover critical information and reduce the information asymmetry between the acquiring CEO and target firm (Welch et al., 2020). This not only allows for accurate valuations, but also increases the bargaining power of highly numerate CEOs. Furthermore, extensive due diligence allows CEOs to maximize and only go through with an acquisition if they are confident that the deal that both parties eventually agree on is the best one possible. This in large depends on the price paid for the acquisition. As such, highly numerate CEOs are unlikely to pay high premiums. Less numerate CEOs, however, may settle for a deal that is simply good enough, and thus are more likely than more numerate CEOs to pay higher premiums.

Finally, more numerate CEOs are less susceptible to biases (Peters, 2020) including social pressures and inflated self-views compared to less numerate CEOs. As such, more numerate CEOs are less likely to pay high premiums compared to less numerate CEOs. Certainly, studies suggest that social pressures not only influence a CEO's likelihood of engaging in acquisitions (Shi et al., 2017), but also acquisition premiums (Cho et al., 2016). Since highly numerate CEOs are less susceptible than less numerate CEOs to such social pressures, they are unlikely to justify paying higher premiums for gaining social approval or status. In addition, highly numerate CEOs are calibrated with their knowledge and are therefore less likely than less numerate CEOs to overestimate their abilities of extracting acquisition benefits. Accordingly, more numerate CEOs are expected to pay lower acquisition premiums compared to less numerate CEOs. Formally, I hypothesize the following:

Hypothesis 4*: CEO numeracy is negatively related to acquisition premiums.*

Performance is by far the most widely studied, and most important, outcome in the acquisitions literature (Devers et al., 2020). Research suggests that the success of acquisitions depends in large on prudent target selection (Harrison, Hitt, Hoskisson, & Ireland, 1991; Hitt, Hoskisson, Ireland, & Harrison, 1991). Accordingly, I propose that the same factors that drive the acquisition decisions of more numerate CEOs will allow these CEOs to enjoy superior post-acquisition performance compared to less numerate CEOs.

Because lack of due diligence (Puranam et al., 2006) and biases that produce inaccurate estimations of acquisition benefits and synergies (Hayward & Hambrick, 1997) lead to acquisition failures, more numerate CEOs are expected to experience more positive (or less negative) post-acquisition performance compared to less numerate CEOs. As described earlier, highly numerate CEOs engage in thorough and comprehensive due diligence that enables them to uncover critical information and walk away from value-destroying acquisitions (Puranam et al., 2006). Further, since more numerate CEOs have more accurate estimations of the risks and benefits associated with the acquisition, as well as of their own capabilities to extract such benefits, they are likely to face fewer surprises in the post-acquisition phase compared to less numerate CEOs. Moreso, highly numerate CEOs are less susceptible to biases compared to less numerate CEOs, and are therefore less likely to engage in acquisitions as a result of social pressures or biases—both of which have been linked to lower post-acquisition performance (Devers et al., 2020).

Valuation and financing decisions also allow more numerate CEOs to experience more favorable performance compared to less numerate CEOs. More specifically, since acquisition premiums are critical to the success of acquisitions (Cho et al., 2016), more numerate CEOs are expected to enjoy superior post-acquisition performance compared to less numerate CEOs due to the lower premiums that these CEOs pay. Furthermore, studies suggest that factors such as method of payment (King et al., 2004) and deal financing decisions (Welch et al., 2020) are critical for acquisition performance and market reactions. Accordingly, since more numerate CEOs are able to comprehend such

factors better than less numerate CEOs, more numerate CEOs will likely make better financing and payment choices that will ultimately lead to better acquisition performance.

In summary, I argue that prudent selection of targets, minimization of biases, and better target valuation and financing decisions allow highly numerate CEOs to experience superior post-acquisition performance compared to less numerate CEOs. Formally, I hypothesize:

> ***Hypothesis 5****: CEO numeracy is positively related to post-acquisition performance.*

So far, I have examined the influence of CEO numeracy on acquisition decisions and outcomes. I explained that while more numerate CEOs are expected to engage in fewer and smaller acquisitions compared to less numerate CEOs, more numerate CEOs will enjoy superior acquisition outcomes if they do in fact acquire. Specifically, CEO numeracy will lead to lower acquisition premiums and more favorable post-acquisition performance. In the remaining sections, I explore the moderating effects of two commonly examined mechanisms of corporate governance in strategic management research (Aguilera, Desender, Bednar, & Lee, 2015)—executive compensation and CEO power—on my main hypotheses. Executive compensation is commonly used to align the interests of principals and agents and to influence executives' risk-related preferences and behaviors. CEO power, on the other hand, demonstrates the extent to CEOs influence acquisition decisions and outcomes. Accordingly, I examine the moderating effects of CEO

compensation and CEO power on the relationships between CEO numeracy and acquisition decisions and outcomes.

Moderating Effect of CEO Stock Options

My main hypotheses suggest that less numerate CEOs take on more risks in the realm of acquisitions compared to more numerate CEOs, as evident by their acquisition decisions and subsequent outcomes. However, the effect of CEO numeracy is bounded by situational characteristics such that the effect is amplified when the situation is congruent with a CEO's level of numeracy. In both theory and practice, executive incentive compensation is commonly used to address variation in managerial risk taking and encourage executives to take more risks in strategic actions (e.g., Devers, McNamara, Wiseman, & Arrfelt, 2008; Sanders & Hambrick, 2007). For instance, agency theory (Berle & Means, 1932; Jensen & Meckling, 1976) suggests that compensation incentives are tools used to align the risk preferences of agents and principals. Alternatively, the behavioral agency model (Wiseman & Gomez-Mejia, 1998), suggests that executive compensation shapes managerial prospect framing and, in turn, influences strategic risk taking. In this vein, I propose that incentive compensation will strengthen the relationships between CEO numeracy and acquisitions. More specifically, I argue that less numerate CEOs will be further propelled by incentive compensation to engage in more acquisitions, whereas highly numerate CEOs are unlikely to be swayed by incentive compensation to engage in strategies that are frequently unsuccessful.

Among the components of executive compensation, stock options are commonly used to increase CEO risk taking propensities (Sanders & Hambrick, 2007). A stock option is an "option granted to an employee by an employer giving the employee the right to purchase a share of the firm's stock within a specified period of time, for a fixed price" (Devers, Cannella, Reilly, & Yoder, 2007: 193). Consequently, since stock options provide executives with an opportunity for significant gains while limiting losses, they are a powerful tool for encouraging risk taking (Devers et al., 2007; Gamache et al., 2015). Sanders and Hambrick (2007), for example, examine the influence of CEO stock options on company risk taking and find that CEO stock option engender high levels of investment outlays in areas such as R&D and capital expenditures.

I expect that stock options strengthen the relationship between CEO numeracy and acquisition decisions. Studies demonstrate that the inclination of CEOs to engage in acquisition behaviors is influenced by stock options (Datta, Iskandar-Datta, & Raman, 2001; Sanders, 2001). More specifically, research examining the influence of executive pay structure on acquisition activity proposes that stock options frame acquisitions as an opportunity for large gains with potentially no downside risk (Sanders, 2001). In turn, executives paid with options are motivated to engage in acquisitions due to the potential, though unlikely, gains. Since executives paid with stock options are not penalized if the acquisition fails, there is no risk to their personal wealth.

Nonetheless, there is substantial variation in the effectiveness of CEO stock options in influencing strategic risk taking and outcomes (Gamache et al., 2015). Scholars propose that this is due to the interaction of executive characteristics with stock options (Wowak & Hambrick, 2010). More numerate CEOs, for instance, are less

susceptible to biases such as framing effects compared to less numerate CEOs. Thus, highly numerate CEOs are unlikely to be influenced by stock options to undertake acquisition decisions which are commonly ineffective for acquiring firms. Further, theory suggests that since stock options limit losses to a CEO's personal wealth, stock options encourage CEOs to engage in risky acquisitions (Devers et al., 2007). However, stock options do not limit losses to the organization. More numerate CEOs are more able than less numerate CEOs to accurately assess the loss to their firm. Together, this suggests that the influence of stock options on the relationships between CEO numeracy and acquisition decisions will be weaker for more numerate CEOs compared to less numerate CEOs. Formally stated, I expect the following:

> ***Hypothesis 6****: CEO stock options will moderate the relationship between CEO numeracy and the number of acquisitions undertaken by the firm such that the relationship is more negative for higher (versus lower) levels of CEO stock options.*

> ***Hypothesis 7****: CEO stock options will moderate the relationship between CEO numeracy and the value of acquisitions undertaken by the firm such that the relationship is more negative for higher (versus lower) levels of CEO stock options.*

> ***Hypothesis 8****: CEO stock options will moderate the relationship between CEO numeracy and the number of large acquisitions undertaken by the*

firm such that the relationship is more negative for higher (versus lower) levels of CEO stock options.

Similarly, I expect that stock options moderate the relationships between CEO numeracy and acquisition outcomes. Since stock options increase a CEO's tendency to engage in acquisitions (Datta et al., 2001; Sanders & Hambrick, 2007), stock options likely lead to CEOs paying higher acquisition premiums (Hayward & Hambrick, 1997). Certainly, higher acquisition premiums increase the chances that acquisition deals are completed (Welch et al., 2020). Accordingly, stock options strengthen the relationship between CEO numeracy and acquisition premiums.

I propose that the influence of stock options on the relationship between CEO numeracy and acquisition premiums also varies with CEO numeracy. Because of the extensive due diligence process that more numerate CEOs undertake (Misuraca et al., 2016), more numerate CEOs are less likely than less numerate CEOs to pay high premiums in response to pay incentives. Relatedly, more numerate CEOs are better able to accurately value acquisitions compared to less numerate CEOs and will therefore be less likely to increase acquisition premiums beyond what they view as a fair price. Less numerate CEOs, however, may increase premiums to finalize acquisition deals in response to stock option pay. Finally, stock options increase biases in decision making as they frame acquisitions as an opportunity for large gains and limited losses. This will lead less numerate CEOs to pay higher acquisition premiums compared to more numerate CEOs who are able to minimize such biases. Formally, I propose the following:

Hypothesis 9*: CEO stock options will moderate the relationship between CEO numeracy and acquisition premiums such that the relationship is more negative for higher (versus lower) levels of CEO stock options.*

Research examining the influence of executive pay incentives on firm performance suggests that stock options lead to performance extremes (Sanders & Hambrick, 2007). Particularly, Sanders and Hambrick (2007) propose that stock options incentivize executives to take more risks, and are therefore associated with large gains and large losses. Further, the authors theorize and find that in instances of extreme performance associated with stock option pay, large losses occur more frequently than large gains. Utilizing these findings, I propose that stock options will strengthen the positive relationship between CEO numeracy and post-acquisition performance. Particularly, I expect that stock options will have a weaker impact on the relationship between CEO numeracy and post-acquisition performance for more numerate CEOs compared to less numerate CEOs due to three reasons.

First and foremost, I expect that stock options are less effective in influencing more numerate CEOs to engage in acquisitions than they are for less numerate CEOs. In other words, stock options are unlikely to bias the decisions of highly numerate CEOs and cause them to engage in behaviors that they otherwise would not engage in. Accordingly, the large wins and large losses associated with risk taking in response to stock options (Sanders & Hambrick, 2007) are more likely to apply to less numerate CEOs than for more numerate CEOs.

Second, because CEOs with high numeracy levels only engage in acquisitions that they conclude are beneficial after comprehensive due diligence, they are less likely than less numerate CEOs to experience extremes in performance—particularly those associated with large losses. CEOs low in numeracy—who are susceptible to the framing effects and biases arising from stock option incentives—however, may engage in risky acquisitions that lead to performance extremes.

Finally, compared to less numerate CEOs, more numerate CEOs are expected to make superior valuation and financing decisions that allow them to experience more favorable and stable performance, regardless of pay incentives. For example, as illustrated earlier, I expect that stock option pay will be more impactful in increasing acquisition premiums for less numerate CEOs compared to more numerate CEOs. Acquisition premiums directly influence post-acquisition performance, with higher premiums leading to lower performance. This, in turn, suggests that the influence of stock option pay on the relationship between CEO numeracy and post-acquisition performance will be stronger for less numerate CEOs compared to more numerate CEOs. As such, I hypothesize the following:

> ***Hypothesis 10****: CEO stock options will moderate the relationship between CEO numeracy and post-acquisition performance such that the relationship is more positive for higher (versus lower) levels of CEO stock options.*

In this section, I examined how CEO stock options moderate the relationships between CEO numeracy and acquisition behaviors and outcomes. Figure 2 depicts the proposed moderating effects of CEO stock options on my main hypotheses. Specifically, I suggest that CEO stock options strengthen the relationships between CEO numeracy and acquisition decisions and outcomes, such that stock options have weaker effects on the main relationships for highly numerate CEOs compared to less numerate CEOs. In the next and final section, I explore how CEO power influences the relationships between CEO numeracy and acquisitions.

Moderating Effect of CEO Power

The effect of CEO numeracy on acquisitions is also bounded by the firm's governance characteristics. While CEOs are able to exert substantial influence on acquisitions (Meyer-Doyle et al., 2019), their influence on strategic decisions and outcomes depends on CEO power vis-à-vis the board (Haynes & Hillman, 2010; Zhu & Chen, 2015a). CEO power refers to the capacity of CEOs to exert their will (Finkelstein, 1992) and stems from several sources such as CEO duality (e.g., Krause & Semadeni, 2014), CEO tenure (e.g., Simsek, 2007), and board independence (e.g., Westphal & Graebner, 2010). Agency theory suggests that decisions associated with pursuing important strategies such as acquisitions require the support of board members, who are responsible for control of managerial behavior through monitoring and oversight. Boards engage in duties such as CEO monitoring (Daily & Schwenk, 1996), strategy implementation (Rindova, 1999), CEO succession planning (Pitcher, Chreim, & Kisfalvi, 2000 2000) as well as setting CEO compensation (Conyon & Peck, 1998). Thus, a firm's

strategies and outcomes are influenced by the board of directors that ensure that agents act in the best interest of principals.

Research has demonstrated, however, that the board is less likely to influence strategic decisions when the CEO has more power vis-à-vis the board (Golden & Zajac, 2001). Similarly, boards are more likely to indulge a CEO's preferences when they are relatively weak compared to the CEO (Zajac & Westphal, 1996). Scholars have suggested that this may occur because powerful CEOs undermine the independent judgement of the board (Haynes & Hillman, 2010) and reduce directors debates and discussions (Zahra & Pearce, 1989). In other words, powerful CEOs attenuate the role and effect that the board has in shaping strategic decisions and outcomes (Boyd, 1994). Accordingly, while I submit that CEO numeracy has direct effects on acquisitions, I propose that CEO power moderates my hypothesized relationships.

I argued earlier that more numerate CEOs will engage in fewer and smaller acquisitions compared to less numerate CEOs. I highlighted that these preferences were due to differences in factors such as the extent of the deliberations, assessments of risks and benefits, and minimization of biases of these respective CEOs. Powerful CEOs, however, are more likely to get board members to adhere to their preferences compared to less powerful CEOs. Research illustrates that for a given board decision, the outcome will reflect the CEO's preference if the CEO is more powerful than the board, and will reflect the board's preference if the board is more powerful than the CEO (Haynes & Hillman, 2010; Krause, Withers, & Semadeni, 2017; Westphal & Zajac, 1995). Grinstein and Hribar (2004), for instance, found that powerful CEOs engage in larger acquisition deals and receive larger acquisition bonuses compared to less powerful CEOs.

Furthermore, Dutta and colleagues (2011) show that powerful CEOs engage in more acquisitions compared to less powerful CEOs. These findings suggest that when CEOs are more powerful than the board, their preferences with respect to acquisition decisions prevail since powerful CEOs are likely to undermine the independent judgement of the board. In short, though preferences or inclinations are certainly important predictors of strategic decisions, power strengthens the observed effect of those preferences (Golden & Zajac, 2001).

Powerful CEOs are also able to "enhance board support for their initiatives and decisions or minimize the risk of dissension" (Westphal & Zajac, 1995: 62). Accordingly, powerful CEOs have more discretion in the decision-making process, implementation, and outcomes. This suggests that when the CEO is powerful the board will support the CEO's efforts, processes, and assessments without considerable resistance. For example, in my context, CEOs with low levels of numeracy will be able to get away with less extensive due diligence if they are powerful CEOs, whereas they might may not be able to do so if they are less powerful compared to the board. This is in line with scholarship that argues that CEO power influences acquisition decisions (Devers, McNamara, Haleblian, & Yoder, 2013; Finkelstein et al., 2009). Moreover, if CEOs also serve as board chairs in their organization, irrespective of their numeracy levels, they will be more likely to receive the support needed from other board members to pursue their preferred strategies (e.g., Westphal & Zajac, 2013). In this vein, Kang and colleagues (2021) found that powerful CEOs with uncommon names were more likely to pursue distinctive strategies than less powerful CEOs with uncommon names. In sum, weak CEOs, regardless of their cognitive capabilities, general inclinations, or preferences, will not be

able to influence acquisition decisions to the same extent as similarly inclined powerful CEOs.

My arguments suggest that CEO power strengthens the relationships between CEO numeracy and acquisition decisions. Because organizations are commonly resistant to change (Hannan & Freeman, 1989; Kaplan & Henderson, 2005), I expect that the influence of CEO power on the relationship between CEO numeracy and acquisition decisions will be stronger for less numerate CEOs compared to more numerate CEOs. Since less numerate CEOs engage in a greater number of acquisitions, greater value of acquisitions, and a greater number of large acquisitions compared to more numerate CEOs, they are more likely to encounter greater resistance to their acquisition decisions especially since acquisitions often erode firm value. CEO power thus amplifies the ability of less numerate CEOs to overcome organizational resistance and to implement their acquisition decisions. Highly numerate CEOs, on the other hand, will not encounter as much resistance in response to their comparatively modest acquisition decisions. Therefore, CEO power strengthens the relationship between CEO numeracy and acquisition decisions such that the influence will not be as prominent for highly numerate CEOs as it would for less numerate CEOs. Formally stated, I propose the following:

> ***Hypothesis 11****: CEO power will moderate the relationship between CEO numeracy and the number of acquisitions undertaken by the firm such that the relationship is more negative for higher (versus lower) levels of CEO power.*

Hypothesis 12*: CEO power will moderate the relationship between CEO numeracy and the value of acquisitions undertaken by the firm such that the relationship is more negative for higher (versus lower) levels of CEO power.*

Hypothesis 13*: CEO power will moderate the relationship between CEO numeracy and the number of large acquisitions undertaken by the firm such that the relationship is more negative for higher (versus lower) levels of CEO power.*

Using the same logic, I propose that CEO power positively moderates the relationships between CEO numeracy and acquisition outcomes. More precisely, because powerful CEOs undermine the independent judgement of the board, they are able to get board members to adhere to their preferences and support their decisions. Furthermore, powerful CEOs are less likely to face significant opposition from board members compared to less powerful CEOs. Accordingly, more powerful CEOs are less likely to face substantial pressures from board members to adjust acquisition premiums compared to less powerful CEOs. Instead, powerful CEOs will be able to overcome any resistance and garner the support of other board members in paying the premium that the CEO deems appropriate. Moreso, because powerful CEOs limit directors debates and discussions (Zahra & Pearce, 1989), they are likely to minimize board deliberations surrounding acquisition premiums. Relatedly, Zhu (2013) argues and finds that board characteristics and biases are more likely to influence acquisition premium decisions when the board has adequate power to influence strategic decisions. These arguments are

particularly relevant for less numerate CEOs who are expected to pay higher acquisition premiums and thus face greater resistance than more numerate CEOs. As such, I expect that the impact of CEO power on the relationship between CEO numeracy and acquisition premiums will be stronger for less numerate CEOs compared to more numerate CEOs. Formally stated, I hypothesize the following:

> ***Hypothesis 14****: CEO power will moderate the relationship between CEO numeracy and acquisition premiums such that the relationship is more negative for higher (versus lower) levels of CEO power*.

Finally, I propose that power strengthens the positive relationship between CEO numeracy and post-acquisition performance. While CEOs are generally viewed as the most important individuals in organizations, their influence on post-acquisition performance depends on their power relative to the board. More powerful CEOs have greater latitude to influence post-acquisition performance compared to less powerful CEOs. Precisely, studies suggest that vigilant board monitoring, which is reflective of board power vis-à-vis the CEO, positively influences post-acquisition performance (Kolasinski & Li, 2013) and attenuates the likelihood of experiencing extremes in post-acquisition performance (Goranova, Priem, Ndofor, & Trahms, 2017).

Power is particularly relevant for CEOs with low levels of numeracy who are likely to face organizational resistance in response to their acquisition decisions and subsequent implementation efforts. If these CEOs are powerful relative to the board, they will be able to overcome resistance and thus have a stronger impact on post-acquisition

performance. Otherwise, the board of directors will interfere and attenuate the influence of CEOs with low levels of numeracy on post-acquisition performance. Highly numerate CEOs, on the other hand, are associated with prudent selection of targets, fewer biases, and superior valuation and financing decisions. These highly numerate CEOs are unlikely to face much board resistance to acquisition-related decisions and implementation efforts that influence post-acquisition performance. Accordingly, the moderating effect of CEO power on the relationship between CEO numeracy and post-acquisition performance will be weaker for CEOs with higher levels of numeracy compared to CEOs with lower levels of numeracy. Formally, I hypothesize the following:

> ***Hypothesis 15****: CEO power will moderate the relationship between CEO numeracy and post-acquisition performance such that the relationship is more positive for higher (versus lower) levels of CEO power.*

Figure 3 illustrates the expected moderating effects of CEO power on my main hypotheses.

Summary

In this chapter, I introduced CEO numeracy as a managerial cognitive capability that ultimately improves decision-making efficiency. Utilizing acquisitions as a context for my study, I illustrated how CEO numeracy is expected to influence firm acquisition decisions and outcomes. I argued that while CEO numeracy is negatively related to acquisition decisions, more numerate CEOs will experience more favorable acquisition

outcomes compared to less numerate CEOs if they do engage in acquisitions. I also examined the role of CEO stock options and CEO power in moderating my hypotheses. In the next chapter, I describe the research methodology I intend to apply to test my hypotheses.

CHAPTER 4

RESEARCH METHODOLOGY

Sample

My initial sample included 250 randomly selected publicly traded U.S. based firms in the S&P 500 index from 2012 to 2016. I began my sample in 2012 due to limitations in the availability of earnings calls transcripts in the prior years. I ended my sampling period in 2016 to ensure that I did not capture the effects of the COVID-19 pandemic, which became evident in early 2020. This is particularly important due to the nature of my post-acquisition performance variable in which I examine performance up to three years after the acquisition date. I restricted my sample to publicly traded U.S. firms due to limitations in the reliability of data available for firms outside this sample (Busenbark, Lange, & Certo, 2017; Campbell, Busenbark, Graffin, & Boivie, 2021; Graffin, Haleblian, & Kiley, 2016). More precisely, I needed earnings calls transcripts and sufficient data for acquisitions, performance, and controls that are only reliably available for publicly traded U.S. firms. Without accounting for missing data, my initial acquisition decisions dataset consisted of 1,220 firm-year observations, while my initial acquisition outcomes dataset consisted of 531 observations.

I followed research by Harrison, Thurgood, Boivie, and Pfarrer (2019) and Matsumoto, Pronk, and Roelofsen (2011) who used earnings calls transcripts to capture CEO attributes, personalities, and cognitions. Specifically, I utilized earnings calls transcripts, downloaded from Thomson Reuters StreetEvents, to estimate CEO numeracy and CEO personality. I collected firm financial data from Compustat, executive

compensation data from Execucomp, executive and board background data from BoardEx and Institutional Shareholder Services (ISS), and firm acquisition data from the Securities Data Corporation (SDC) database. I also utilized Event Study by Wharton Research Data Services (WRDS) for market returns data which is originally provided by the Center for Research on Securities Pricing (CRSP).

Dependent Variables

Acquisition Decisions. Consistent with acquisition research, I used three dependent variables to capture CEO acquisition decisions: number of acquisitions (Sanders, 2001), value of acquisitions (Sanders & Hambrick, 2007), and number of large acquisitions (Meyer-Doyle et al., 2019). I collected information on all majority completed acquisitions that occurred during my sample period, where the acquiring firm obtained more than 51 percent ownership of the target firm after the acquisition transaction. In line with prior studies, I computed acquisition activity on an annual basis (e.g., Sanders & Hambrick, 2007). ***Number of acquisitions*** is a count variable representing the total number of acquisitions completed in a given firm-year. ***Value of acquisitions*** is operationalized as the total value (in millions of dollars) of all acquisitions completed in a given firm-year. To construct the ***number of large acquisitions*** variable, I first divided the transaction value of each acquisition by the value of the acquirer's total assets. Large acquisitions are defined as those in the top 25^{th} percentile of the acquisition size measure in my sample (Meyer-Doyle et al., 2019). Therefore, the final measure is a count variable representing the number of large acquisitions made by each firm in a given year. Firms that did not engage in acquisitions in a given firm-year received a value of

"0" for the number of acquisitions, value of acquisitions, and number of large acquisitions variables.

Acquisition Outcomes. My dissertation explores two acquisition outcomes: acquisition premium and post-acquisition performance. ***Acquisition premium*** is calculated as the percentage difference between the offer price and the target firm's stock price four weeks prior to the public announcement of the acquisition (Pavićević & Keil, 2021). Utilizing a four-week time lag avoids information leakage prior to the public announcement of the acquisition deal that may cause distortions in stock price (Laamanen, 2007). For robustness, I also analyzed other time periods such as one day and one week prior to the public announcement date (Cho et al., 2016).

I used three different measures to capture ***post-acquisition firm performance.*** First, I utilized the cumulative abnormal security returns (CARs) to capture short-term post-acquisition performance for a period of three days surrounding the announcement of the deal (Goranova, Dharwadkar, & Brandes, 2010). For robustness, I calculated the measure using an 11-day event window from five days prior to the acquisition announcement to five days after the announcement date (Meyer-Doyle et al., 2019). CARs are suitable for capturing the market's sentiment and immediate assessment of the acquisition and are thus suitable for measuring short-term post-acquisition performance. Second, I used both stock and accounting-based measures to capture long-term post-acquisition performance. I captured stock market performance using three-year equally weighted buy-and-hold abnormal returns (BHARs) without annual rebalancing (Cowan & Sergeant, 2001; Mitchell & Stafford, 2000). Both CARs and BHARs were obtained through the Event Study by WRDS. For my accounting-based measure, I used the change

in the acquiring firm's net income (NI) from one year prior to the acquisition to three years after the acquisition. This window is appropriate since studies suggest that the integration and reconfiguration process following acquisitions typically lasts from one to three years (Huang, Pierce, & Tsyplakov, 2015). Accordingly, this measure reflects the acquiring firm's efforts to create and capture value from acquisitions (Meyer-Doyle et al., 2019). In supplementary analyses, I utilized both NI three years after the acquisition as well as the change in the acquiring firm's return on assets (ROA) from one year prior to the acquisition to three years after the acquisition (Ellis, 2011). Although the latter has been adopted in previous studies, I do not employ it in my main analysis due to the problems associated with the use of ratios in statistical analyses (Certo, Busenbark, Kalm, & Lepine, 2020; Cohen, Cohen, West, & Aiken, 2003).

Independent Variable

Objective questionnaires that are commonly used to assess numeracy are not feasible for my study. Executives of publicly traded firms are often unwilling to participate in survey research, thus questionnaires and surveys would likely yield low response rates (Cycyota & Harrison, 2006). As an alternative, scholars have utilized written or spoken text attributed to executives to assess psychological attributes (Gamache et al., 2015; Harrison et al., 2019). Following the majority of language-based studies, I used a closed-language approach (Harrison et al., 2019). This method involves calculating word frequencies from a predefined dictionary of words theoretically related to the construct of interest. Research has illustrated that numeracy of individuals is positively associated to the use of numerical information and concepts in their

communications (Peters, 2020). Following this logic, I rely on spoken text attributed to CEOs from earnings calls transcripts as a proxy for numeracy. Earnings calls transcripts serve as an applicable context since, relative to other CEO communications (e.g., letters to shareholders), CEOs' words and responses to analysts are more likely to be their own (Harrison et al., 2019; Matsumoto et al., 2011). I used Python to extract all text attributed to CEOs from the questions and answers (Q&A) portion of earnings calls transcripts.

In line with my definition of numeracy, I obtained a count of both numbers and numerical concepts from the extracted text. Because numbers in Thomson Reuters StreetEvents can be represented in numeric form (e.g., 2) and written form (e.g., two), I used two separate methods to obtain the count of numbers from earnings calls transcripts. First, to capture numbers that are expressed in written form in the transcripts, I used the Linguistic Inquiry and Word Count (LIWC). LIWC includes a predefined dictionary (i.e., NUMBER) to count numbers in text files. However, numbers in numeric form cannot be captured by LIWC. As such, I used Regular Expression (RegEx) in Python to capture numbers in numeric form. More specifically, I build on Campbell and colleagues (2021) and implemented the following criteria: I counted all numbers beginning with a space or dollar sign, and required that the rest of the number consist of numeric characters (0-9). I counted fractions as well as numbers that include commas or periods (e.g., thousands and decimal separators). Finally, I excluded all years from the 2000 to 2022.

Furthermore, I developed a dictionary of words that are reflective of numerical information and/or concepts, but are not numbers. Following recommendations by Short and colleagues (2010), I first utilized a deductive approach and then supplemented it with an inductive approach to develop my dictionary. A deductive process utilizes *a priori*

theory for creating coding schemes (Potter & Levine-Donnerstein, 1999). Accordingly, I began by creating a list of words that are theoretically aligned with my conceptualization of numeracy from both the definition of numeracy and from commonly utilized survey measures and questionnaires that assess numeracy. I then used Rodale's *Synonym Finder* (1978) to capture the relevant synonyms for each word in my list. This deductive approach resulted in 1,175 potential words.

Following an inductive approach, which identifies potential words from the texts that are being analyzed, I then randomly selected 50 transcripts from my sample and extracted all words attributed to the CEO in the entire transcript. I excluded all single and double-letter words from the list as none of them were aligned with my conceptualization of numeracy. This resulted in a total of 2,750 words. I, along with a colleague familiar with the study, then reviewed each word in both lists and rated the words based on whether they are reflective of my conceptualization of numeracy. After excluding all words that are clearly not reflective of numeracy, duplicates, and ones that are included in LIWC's predefined NUMBERS dictionary, the condensed list consisted of a total of 471 potential words.

To establish content validity, the list of 471 potential words was independently evaluated by three expert raters, each with numerous top-tier journal publications on corporate governance and executive characteristics. The raters were provided with the definition of numeracy and were asked to rate whether each word was reflective of numerical information and/or concepts. The three raters unanimously agreed that 180 words were clearly reflective of numeracy and 86 words were not. Disagreements on the

remaining 205 words resulted in Holsti's interrater reliability of 0.56, which is below the acceptable range (Short et al., 2010).

As an alternative, I assessed the interrater reliabilities of the different rater pairs. In all cases, the interrater reliability coefficient for each pair (0.67, 0.70, and 0.76) was higher than that for all three raters (0.56). Accordingly, I proceeded with the pair with the highest interrater reliability coefficient. The selected rater pair mutually agreed that 234 words were clearly reflective of numeracy and 123 words were not. The raters disagreed on the remaining 114 words. Holsti's interrater reliability for the two raters was 0.76, which is within the acceptable range and demonstrates consistency between those raters.

The final validated dictionary, which is presented in Table 1, consisted of the 234 words that the two raters agreed were reflective of numeracy. I used LIWC to capture word frequencies from my dictionary for each CEO in a given year. My ultimate measure represents the total raw count of all numerical information and/or concepts mentioned by the CEO in the Q&A portion of earnings calls transcripts in a given year. For comparability within and between CEOs, I controlled for the total number of words spoken by the CEO in the Q&A portion of earnings calls transcripts in a given year. In supplementary analyses, I instead utilized a ratio measure that captures CEO numeracy as a percentage of total word count.

To further validate my measure, I recruited two Ph.D. students to manually code CEO numeracy for 30 randomly selected CEOs from my sample. This number represents approximately 10 percent of the CEOs in my sample. The human coders were provided with the definition of CEO numeracy along with passages from the 30 CEOs. The coders were asked to rate each of the executives on their level of numeracy from a Likert scale

of 1 (*very low*) to 5 (*very high*). To ensure that the raters' assessments were constructed strictly based on the information provided in the passages, no information regarding the CEOs' identities was provided. Inter-rater reliability, as measured by Cohen's kappa, was 0.79, and inter-rater agreement was 83 percent, indicating substantial agreement.

The final step involved examining how the raters' assessments align with my measure of CEO numeracy. Since there were discrepancies in the ratings provided by the two coders for some CEOs, I computed the average rating for each CEO. The correlation between the raters' assessments of each executive's numeracy level, and my measure of CEO numeracy was 0.88. This indicates that the two measures are extremely similar and provides validation for using the measure that I have constructed (Uotila, Maula, Keil, & Zahra, 2009).

Moderating Variables

CEO Stock Options. My measure of ***CEO stock options*** is based on the Financial Accounting Standards (FAS 123R) value of individual stock options granted to the CEO in each firm-year (Gamache et al., 2015). I utilized this measure since it is the value of stock options reported by public firms since 2005 (Kuhnen & Niessen, 2012). Prior to 2005, public firms reported the Black-Scholes value of stock option awards (Seo et al., 2015). The Black-Scholes value of stock options from Execucomp was missing for all observations in my sample.

CEO Power. I followed governance scholarship (e.g., Finkelstein, 1992; Finkelstein et al., 2009; Krause, Semadeni, & Cannella Jr, 2014) to generate a composite measure of CEO power relative to the board. Because CEO power may stem from

multiple sources, I measured it using dimensions that are consistent with my arguments: CEO duality, CEO tenure relative to the directors, and the proportion of inside directors. The final measure is the sum of the standardized scores of the dimensions (Krause et al., 2017). CEO duality is a binary variable assigned a value of "1" if the CEO is also a board chair in a given year, and "0" otherwise. CEO tenure relative to directors is measured as the CEO's tenure divided by the average tenure of directors. Finally, the proportion of inside directors is the proportion of directors who are also top executives in the firm.

Control Variables

Since I have various dependent and moderating variables, I utilized different sets of control variables that are appropriate for the respective models. All my models include a comprehensive set of CEO, firm, and board controls that prior research suggested could potentially impact acquisition decisions and outcomes. Specifically, for CEO characteristics, I controlled for ***CEO total words*** from the Q&A portion of earnings calls transcripts in a given year. I also controlled for ***CEO age***, since younger CEOs may have a greater incentive to engage in acquisitions (Matta & Beamishi, 2008). Likewise, I controlled for ***CEO turnover*** with a binary variable taking a value of "1" if there was a turnover event in a given firm-year and "0" otherwise. I controlled for ***CEO compensation***, which includes salary, bonuses, common stock holdings, options held, and restricted stock held, because it can influence managerial risk taking (Devers et al., 2008). I controlled for both ***CEO highest degree earned*** (e.g., Ph.D., master's, bachelor's, or other) and ***CEO openness*** measured from earnings calls transcripts using Harrison and colleagues' (2019) personality tool, as proxies for CEO intellect. I further

controlled for CEO gender with the variable ***CEO is female***, which represents a binary variable taking a value of "1" if the CEO is female and "0" otherwise, since gender influences may impact the variables of interest (Chen et al., 2016). I controlled for ***CEO functional background*** (e.g., output, throughput, or peripheral) by determining the area in which the CEO had the most years of experience. Finally, I controlled for CEO outsider status with the variable ***CEO is an outsider*** measured as a binary variable taking a value of "1" if the CEO joined the company in year t or year t-1, and "0" otherwise.

For firm characteristics, I controlled for ***firm size***, which I measured as the log of employees, since it demonstrates a firm's ability and willingness to engage in acquisitions and has been shown to affect post-acquisition performance (Haleblian et al., 2009). I also controlled for ***firm performance***, measured as net income, since it may impact a firm's likelihood of engaging in acquisitions and subsequent post-acquisition performance. Furthermore, I controlled for acquirer's acquisition experience because past acquisition experience may influence a firm's engagement and performance of subsequent acquisitions (Reuer, Tong, & Wu, 2012). Specifically, for models predicting the number of acquisitions and acquisition performance, I controlled for the total ***number of acquisitions in the prior three years***. Similarly, for models predicting the value of acquisitions, I controlled for the total ***value of acquisitions in the prior three years***. Finally, for models predicting the number of large acquisitions, I controlled for the total ***number of large acquisitions in the prior three years***. For models predicting acquisition premiums, I controlled for the ***number of bidders***, since bidders are likely to drive up the offer price and increase premiums.

For board and C-suite characteristics, I controlled for ***board size***, ***average age of the board***, and for ***female board representation***, which is operationalized as the number of female directors divided by the total board size. Prior research has suggested that all three variables are likely to influence acquisition activity and are thus likely to impact post-acquisition performance (Chen et al., 2016). Additionally, I controlled for Chief Financial Officer (CFO) numeracy—***CFO numeracy***—to disentangle its effect from CEO numeracy as CFOs are likely to be highly numerate. Finally, I included ***year-fixed effects*** and ***industry-fixed effects*** in all my models.

Analysis

My hypotheses potentially apply to both the within and between effects of CEO numeracy on various acquisition decisions and outcomes variables. Thus, I first examined the intraclass correlation coefficients (ICCs) to better understand the relative influence of between versus within variance in the CEO numeracy variable, and to confirm that I am utilizing the appropriate analytical techniques to test my hypotheses. Table 2 reports the ICCs for CEO numeracy, CEO word count, and all dependent and moderating variables in the acquisition decisions and acquisition outcomes datasets. The ICCs are clustered by CEO-firm combination (*co_per_rol* variable from Execucomp).

As illustrated, the ICCs for CEO numeracy is 74.3% and 83.0% in the acquisition decisions and acquisition outcomes datasets, respectively. This suggests that the majority of the variance in my independent variable is *between* CEOs. The same pattern is observed for CEO total words and the ratio measure of CEO numeracy. I also examined ICCs for the two components (i.e., numbers vs. words from the dictionary) that I utilized

to create my independent variable. In both datasets, the ICCs for the individual components are consistent with the ICCs of the CEO numeracy measure. This finding is expected since CEO numeracy is unlikely to significantly fluctuate or change within CEOs over a short time period.

However, in all but one case (i.e., BHARs), most of the variance in my dependent variables is *within* CEOs. For instance, only 2.1% of the variance in the number of large acquisitions is between CEOs, while 97.9% of variance in that variable is within CEOs. In the case of the long-term BHARs variable, 52.1% of the variance is between CEOs while 47.9% is within CEOs. Such stark discrepancies in the influence of within versus between variance in my independent and dependent variables could potentially be problematic (Certo, Withers, & Semadeni, 2017).

Accordingly, I used multilevel models that account for the nested structure in my data. Due to the different types and characteristics of the dependent variables I examine, I used various estimation techniques to test my hypotheses. I explain those in more detail next.

Models for acquisition decisions. Acquisition decisions are firm or CEO-year level variables. Since *number of acquisitions* and *number of relatively large acquisitions* are both count variables, and *value of acquisitions* is censored at "0", I used generalized estimation equations (DeGeest, Seibert, & O'Boyle) to test these hypotheses (Liang & Zeger, 1986). GEEs (-*xtgee*- command in Stata) take into account both within and between firm effects (Certo et al., 2017) and are suitable for nonlinear models. For both count variables, I specified a Poisson distribution with a log link function (Ballinger, 2004). For the value of acquisitions, I specified a gamma distribution with a reciprocal

link function. For all three variables, I specified an exchangeable correlation structure, which is the default choice, with robust standard errors. To select the appropriate model specifications, I relied on the quasi-likelihood under the independence criterion (QIC) which is a criterion for model selection in GEE analyses. The QIC is a modification of the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC), that accounts for correlations within clusters (Cui, 2007). I selected the distributions, link functions, and correlation structures that minimized the QIC values. In supplementary analyses, I utilized fixed effects (- *xtreg, fe* – in Stata) and hybrid (- *xthybrid* – in Stata) models to test the hypotheses pertaining to acquisition decisions (Certo et al., 2017). I measured the independent and control variables at time t and all dependent variables at time t+1 for models from this dataset.

Models for acquisition outcomes. In my study, acquisition outcomes are deal-level variables. Accordingly, scholars create a deal-level dataset for post-acquisition outcomes (e.g.,Meyer-Doyle et al., 2019). In this case, sample-induced endogeneity may be a concern. Specifically, since CEO numeracy is observed for all firms regardless of whether they complete an acquisition, and potentially predicts completing an acquisition, it induces sample selection bias. My hypotheses measure whether more numerate CEOs experience more favorable post-acquisition outcomes compared to less numerate CEOs. Accordingly, there are observations for CEO numeracy that are not included in the sample given that I only observe the post-acquisition outcomes for firms that completed an acquisition. This is referred to as incidental truncation. However, my analyses revealed that CEO numeracy is not a significant predictor of acquisitions in the first

stage, which suggests sample selection bias is not a concern (Certo, Busenbark, Woo, & Semadeni, 2016).

To account for dependence between observations, I utilized multilevel mixed-effects linear regression models (*-mixed-* command in Stata) to test the hypotheses pertaining to acquisition outcomes. I clustered observations by CEO-firm combination (*co_per_rol* variable from Execucomp), and specified robust standard errors to address unobserved heterogeneity. In supplementary analyses, I instead utilized ordinary least squares (OLS) regression and GEEs to test these hypotheses.

Summary

This chapter described the research methodology I utilized to test my hypotheses. I introduced the sample that I used for my study as well as the data sources for my variables. I also provided a detailed description of the operationalizations of my variables and the steps that I followed to create and validate my measure of CEO numeracy. Finally, I presented the primary and supplementary analytical methods I used to empirically test my predictions.

CHAPTER 5

RESULTS

Descriptive Statistics

Table 3 and Table 4 report descriptive statistics, including means, standard deviations, as well as skewness and kurtosis for my acquisition decisions and acquisition outcomes samples, respectively. Table 5 and Table 6 report the correlations among the variables included in the respective samples. In both samples, there is a high correlation ($r > 0.85$, $p<0.001$) between CEO numeracy and CEO total words. Kalnins (2018) points out that correlations of 0.3 or greater between independent and control variables may bias estimation results due to multicollinearity. In other words, high correlations between variables make it difficult to estimate the unique effect of each variable on the dependent variable. Variance inflation factors (VIFs) confirm that multicollinearity may be a concern between CEO numeracy and CEO total words as the VIF values are greater than 5.2. However, CEO total words is an important control to allow for comparability of CEO numeracy within and across CEOs. Accordingly, I included it in my models.

Primary Analysis

Model 1 in Tables 7-11 is a base model that only includes the control variables. In Model 2, I include CEO numeracy as an independent variable. Model 3 includes the interaction between CEO numeracy and CEO stock options. Finally, Model 4 includes the interaction between CEO numeracy and CEO power.

In Hypothesis 1, I predicted that CEO numeracy will be negatively related to the number of acquisitions undertaken by the firm. The coefficient of CEO numeracy in

Model 2 in Table 7 is positive and not significant (β=0.000, p=0.535). Thus, Hypothesis 1 is not supported.

In Hypothesis 2, I predicted that CEO numeracy will be negatively related to the value of acquisitions undertaken by the firm. The coefficient of CEO numeracy in Model 2 in Table 8 is positive and significant (β=0.000, $p < 0.01$). Although the coefficient is statistically significant, it suggests that CEO numeracy is positively related to the value of acquisitions undertaken by the firm. More specifically, the coefficient suggests that for every one-unit increase in CEO numeracy, total value of acquisitions is predicted to increase by $2,330. Thus, Hypothesis 2 is not supported.

In Hypothesis 3, I predicted that CEO numeracy will be negatively related to the number of large acquisitions undertaken by the firm. The coefficient of CEO numeracy in Model 2 in Table 9 is negative and not significant (β=-0.000, p=0.772). Therefore, Hypothesis 3 is not supported.

My next two hypotheses focus on acquisition outcomes. In Hypothesis 4, I predicted that CEO numeracy will be negatively related to acquisition premiums. Although the coefficient of CEO numeracy in Model 2 in Table 10 is in the hypothesized direction, it is not statistically significant (β= -0.000, p=0.686). Hypothesis 4 is therefore not supported.

In Hypothesis 5, I predicted that there is a positive relationship between CEO numeracy and acquisition performance. Model 2a in Table 11 shows the results with three-day CARs as the dependent variable. The coefficient for CEO numeracy is negative and not significant (β= -0.000, p=0.758). Model 2b in Table 10 reports the results for three-year BHARs as the outcome variable. The coefficient for CEO numeracy is positive

but not statistically significant (β= 0.000, p=0.657). Model 2c in Table 10 reports the results with the change in NI as the outcome variable. Although the coefficient for CEO numeracy is positive, it is not statistically significant (β= 0.000, p=0.267). Accordingly, I do not find support for Hypothesis 5.

In Hypotheses 6, 7, and 8, I posited that stock options strengthen the negative relationship between CEO numeracy and the number of acquisitions, value of acquisitions, and number of large acquisitions undertaken by the firm, respectively. The interaction term in Model 3 in Table 7 is negative and not significant (β=-0.000, p=0.278). Hypothesis 6 is therefore not supported. The interaction term in Model 3 is positive and significant (β=0.000, p <0.001) in Table 8. This suggests that the positive relationship between CEO numeracy and the total value of acquisitions is strengthened by higher (versus lower) levels of CEO stock options. Figure 4 represents a plot of this interaction. Though I predicted that stock options will strengthen the effect of the main relationship, the main relationship itself is the opposite of the hypothesized direction. As such, Hypothesis 7 is not supported. In Table 9, the interaction term in Model 3 is negative and significant (β=-0.000, p=0.027), suggesting that the effect of CEO numeracy on the number of large acquisitions is attenuated by higher (versus lower) levels of CEO stock options. However, since the main effect of CEO numeracy on the number of large acquisitions is not statistically significant it is difficult to interpret the interaction. I do not find support for Hypothesis 8.

In Hypotheses 9 and 10 I predicted that stock options strengthen the hypothesized relationships between CEO numeracy and both acquisition premiums and acquisition performance. Model 3 in Table 10 indicates that the interaction is negative and not

significant (β=-0.000, p=0.121) with acquisition premium as the dependent variable. Since all acquisition performance variables yielded similar results, and none of the main effects are significant, I report the influence of my moderators with BHARs as the dependent variable. The coefficient for the interaction term in Model 3 in Table 11 is positive and not statistically significant (β=0.000, p=0.137). Thus, both hypotheses 9 and 10 are not supported.

In Hypotheses 11, 12, and 13, I predicted that CEO power strengthens the negative relationship between CEO numeracy and the number of acquisitions, value of acquisitions, and number of large acquisitions undertaken by the firm, respectively. The interaction term in Model 4 in Table 7 is negative and not significant (β=-0.000, p=0.511), indicating that Hypothesis 11 is not supported. The interaction term in Model 4 in Table 8 (β=0.000, p=0.118) and Table 9 (β=0.000, p=0.502) are both positive and not significant. Thus, Hypotheses 12 and 13 are also not supported.

Finally, in Hypotheses 14 and 15, I posited that CEO power strengthens the hypothesized relationships between CEO numeracy and acquisition premiums and acquisition performance, respectively. Model 4 in Table 10 demonstrates that the interaction is negative and not significant (β=-0.000, p=0.302) with acquisition premium as the outcome variable. Model 4 in Table 11 reports a positive but not statistically significant interaction coefficient (β=0.000, p=0.616) with BHARs as the dependent variable. Therefore, I do not find support for Hypotheses 14 and 15.

Supplemental Analyses

I conducted additional analyses using alternative operationalizations of my variables and various analytical models. These supplemental analyses allowed me to

examine how different analytical methods and variable specifications influence my results. I discuss each in more detail in this section.

CEO Numeracy and Multicollinearity. As indicated earlier, high correlations between CEO numeracy and CEO total word count are problematic as they can bias the results from analytical models. In supplemental analyses, I utilized a ratio measure of CEO numeracy as a percentage of the total word count. As reported in Table 12, the coefficient for the ratio measure of CEO numeracy in is negative and not significant (Model 1: β= -0.076, p=0.977) for Hypothesis 1, positive and significant (Model 2: β=0.024, p<0.001) for Hypothesis 2, and positive and not significant (Model 3: β= 0.122, p=0.979) for Hypothesis 3. Similarly, the coefficient for the ratio measure is positive and not significant (Model 4: β= 0.349, p=0.965) for Hypothesis 4 and was not statistically significant for all three acquisition performance measures (Model 4: β= 0.374, p=0.965). Thus, the results are consistent with those from my primary analysis.

As another robustness check, I omitted CEO total word count as a control variable. As illustrated in Table 13, the coefficient for CEO numeracy is only significant for Hypothesis 1 (Model 1: β= 0.000, p<0.01), predicting the number of acquisitions. The finding suggests that for every one unit increase in CEO numeracy, the total number of acquisitions is predicted to increase by 0.0004 units. Unlike the results from my main analysis, Model 2 indicates that the relationship between CEO numeracy and the total value of acquisitions is negative and not statistically significant (β= - 0.000, p = 0.342) when CEO total words is omitted as a control variable. The results for all remaining dependent variables are not statistically significant.

Alternative Operationalizations of Acquisition Outcomes. As indicated in the previous chapter, there are different ways to measure and operationalize the acquisition outcomes variables that I focus on. In supplementary analysis, I test the influence of these different operationalizations on my findings. Specifically, for Hypothesis 4, I utilized different time periods such as one day and one week prior to the announcement of the acquisition to calculate acquisition premiums. For Hypothesis 5, I utilized an 11-day event window, instead of a three-day window, to calculate short-term CARs. I also I utilized both the change in ROA and NI at time t+3 (i.e., not a difference score) instead of the change in NI to examine the influence of CEO numeracy on long-term accounting performance. The results for these alternative operationalizations were consistent with those reported in my primary analysis.

Supplementary Analytical Techniques. The results from my primary analysis could be driven by the models that I utilized. Accordingly, I tested my hypotheses using different analytical models to examine the impact of model specification on my results. For hypotheses examining acquisition decisions, a Hausman test suggested that fixed effects models are most appropriate. However, results from those models were not statistically significant for Hypotheses 1-3. As an alternative, I examined hybrid models which take into account both within and between effects (Certo et al., 2017). The results from the hybrid models were consistent with those reported here.

In my acquisition outcomes dataset, I had multiple firm-year observations. Accordingly, as an alternative to using mixed models I tested Hypotheses 4 and 5 using OLS regression with clustered standard errors. The results from the OLS models were also not statistically significant and are consistent with those reported in my primary

analysis. In line with Cho and colleagues (, 2016 #49), I also utilized GEEs to test these hypotheses. I used the *co_per_rol* variable from Execucomp as the panel variable to set up the data (using the - *xtset* – command in Stata), but did not specify a time variable. As was the case the my primary analysis, results from the GEE models were not statistically significant for the acquisition outcomes hypotheses.

CHAPTER 6

DISCUSSION

In this study I introduce CEO numeracy to strategy scholarship and examine its influence on strategic decision making. Research suggests that numeracy improves the effectiveness of decisions and subsequent outcomes (Peters, 2006). I utilize acquisitions as the domain for my study to shed light on why CEOs engage in acquisitions despite evidence that acquisitions typically fail, as well as on the variation in acquisition outcomes. Building on research on numeracy and managerial cognition, I argue that more numerate CEOs have more accurate perceptions of risks and benefits, are able to minimize biases in decision making, and are more likely to engage in thorough deliberations compared to those who are less numerate (Peters, 2020). Accordingly, I hypothesize that more numerate CEOs are less likely to engage in acquisitions compared to less numerate CEOs. Further, among CEOs who engage in acquisitions, I suggest that more numerate CEOs will experience more favorable outcomes compared to less numerate CEOs. I also propose that CEO stock options and CEO power both strengthen the effect of CEO numeracy on acquisition decisions and outcome variables.

I empirically tested my hypotheses utilizing data from 250 randomly selected S&P 500 firms from 2012 to 2016. As CEO numeracy is new to organizational scholarship, I created a novel measure to capture the construct using earnings calls transcripts and content analysis techniques. More precisely, I captured both numbers as well as words that are reflective of numerical information and/or concepts from earnings calls transcripts. Following Short et al., (2010), I used both deductive and inductive techniques to develop a unique dictionary for CEO numeracy. This entailed creating a list

of words that are theoretically aligned with my conceptualization of CEO numeracy from a) my definition of numeracy, b) questionnaires and surveys of numeracy, and c) CEO attributed text from a sample corpus of earnings calls transcripts. I validated and finalized the dictionary with the help of experts in upper echelons research, who selected a total of 234 words that are reflective of numeracy. I then used LIWC to count the dictionary words that appear in earnings calls transcripts. Finally, I recruited human coders to manually code CEO numeracy from earnings calls transcripts and assessed how their ratings compared with my measure. The results from this exercise indicated a high correlation between the two measures and provided further validation for utilizing the dictionary measure that I constructed.

I built my arguments on existing studies that examine the influence of numeracy on decision making, and yet, I did not find support for my hypotheses. In my primary analysis, I did not find evidence that CEO numeracy influences either the number of acquisitions (Hypothesis 1) or the number of large acquisitions (Hypothesis 3) undertaken by the firm. The results did indicate that, contrary to my prediction in Hypothesis 2, CEO numeracy is positively associated with the value of acquisitions undertaken by a firm. I also find that the positive relationship between CEO numeracy and the value of acquisitions is strengthened by CEO stock options. However, in supplementary analyses, the relationship between CEO numeracy and the value of acquisitions is not statistically significant when CEO total words is omitted as a control variable. Further, contrary to my prediction for Hypothesis 1, the results from those analyses indicated that CEO numeracy is positively related to the number of acquisitions undertaken by the firm. Accordingly, there are inconsistencies in the findings for

Hypotheses 1 and 2. Finally, although I expected that CEO numeracy will improve acquisition outcomes, results from both my primary and supplementary analyses do not lend support for my predictions regarding acquisition premiums or performance. I discuss the implications of my findings in the next section.

Theoretical Implications

This study contributes to upper echelons theory by introducing CEO numeracy as a potentially important yet unstudied managerial cognitive capability that can help scholars better understand CEO decision making. Numeracy is widely studied in other fields, and its impact on decision making has been empirically tested and proven. Accordingly, examining CEO numeracy in strategic management scholarship can shed light on the heterogeneity in organizational decisions and on the effectiveness of the outcomes of such decisions. Although researchers have examined how various executive characteristics impact firm strategies, exploring CEO numeracy could prove beneficial as there is still so much to uncover.

In the context of acquisitions, my objective was to examine if CEO numeracy can clarify why CEOs engage in acquisitions despite their low success rates as well as explain heterogeneity in acquisition outcomes (King et al., 2004). My findings, however, do not provide evidence of the influence of CEO numeracy on acquisition decisions or outcomes.

From a theoretical standpoint, I propose three potential explanations for these results. First, the relationships between CEO numeracy and the acquisition decision variables that I examine are perhaps more nuanced than I theorized. I posited that because

acquisitions have a high failure rate, numerate CEOs who are expected to make effective decisions will opt to stay away from them. My arguments assume that sound acquisition choices are limited and rare. In reality, however, this is not necessarily the case. A numerate CEO may engage in an equal or even greater number of acquisitions, value of acquisitions, or total number of large acquisitions as a less numerate CEO, but there may exist differences in the quality and effectiveness of the acquisition decisions. This could potentially explain why I found the opposite of the predicted effects for Hypothesis 2 in my primary analysis and for Hypothesis 1 in my supplementary analyses. Nonetheless, this logic implies that CEO numeracy should at least influence acquisition outcomes, and particularly performance—which I do not find support for in my study. Furthermore, the lack of consistency between the findings from my primary analysis and supplementary analyses for Hypotheses 1 and 2 make it difficult to make definitive conclusions about the influence of numeracy on acquisition decisions.

Second, there potentially lies a threshold of numeracy (i.e., a point of maximum return) beyond which any further increase may not result in significant improvements or differences in decision making and outcomes. Though existing research highlights differences in numeracy and its impact on decision making in highly educated samples (Garcia-Retamero et al., 2014; Lipkus et al., 2001; Peters, 2020), these finding may not necessarily extend to CEOs. Individuals who ascend to CEO positions—especially in S&P 500 firms—represent a highly exclusive and distinctive sample (e.g., Finkelstein et al., 2009). Since organizational decision making is highly dependent on numerical information, perhaps all CEOs possess at least a baseline numeracy level that is comparable to the highest levels of numeracy found in other highly educated samples. In

other words, although I do find variance in CEO numeracy, CEOs are potentially all considered highly numerate compared to those from existing studies. Variance in CEO numeracy beyond such high base-levels of numeracy may not necessarily lead to noticeable differences in their decision making or subsequent organizational outcomes.

Finally, studies on numeracy predominantly focus on *individual* decision making, but CEOs are ultimately responsible for organizational decisions that involve entire teams of executives, board members, and experts who contribute throughout the decision-making process. In group decisions, one individual's numeracy—even that of a CEO—may not substantively influence decision making. Stated differently, in strategic decision making numeracy levels of other top management team members potentially make up for any shortcomings in CEO numeracy. In this scenario, it is unlikely that I find evidence of the influence of CEO numeracy on acquisition decisions or outcomes.

Empirical Implications

My dissertation also offers a novel and accessible measure of CEO numeracy that utilizes archival data instead of commonly utilized numeracy questionnaires. I followed recommendations by prominent scholars (Short et al., 2010) in creating my dictionary measure of CEO numeracy. Moreso, I further validated my measure by comparing it to human coded CEO numeracy scores. Considering the theoretical and practical advantages of CEO numeracy, developing a measure for CEO numeracy from archival data is worthwhile.

Though I do not find evidence to suggest that CEO numeracy is a significant predictor of acquisition decisions and outcomes, a close examination of my data leads to

three possible empirical explanations of why I did not find support for my hypotheses. Most notably, the correlations and VIFs between CEO numeracy and the CEO total words control variable are both indicative of multicollinearity. Multicollinearity makes it difficult to determine the unique effect of each variable on the outcome variables. This not only leads to unreliable estimates of the coefficients, but it also make it harder to detect statistically significant effects as it increases the standard errors of the estimates (Cohen et al., 2003). The discrepancies in the results for Hypotheses 1 and 2 in my primary versus supplementary analyses confirm this view (Kalnins, 2018). In my primary analysis, the coefficient for CEO numeracy was statistically significant for Hypothesis 2 but was not significant for Hypothesis 1. The opposite was true when CEO total words was omitted as a control in supplementary analyses. Nonetheless, dropping CEO total word count is not a suitable option as it hinders the ability to compare results within and between CEOs.

In supplementary analyses, I instead utilized a ratio measure of numeracy to test my hypotheses. Not surprisingly, these models also did not yield significant findings, as ratio variables are likely to produce inaccurate parameter estimates and result in lower levels of statistical power (Certo et al., 2020). Figure 5 presents a plot of the relationship between my measure of CEO numeracy and the ratio measure of CEO numeracy. The figure illustrates that when the ratio measure is approximately 0.10, the raw numeracy measure ranges from 75 to 2152. The total word count at these points is 737 and 21,086, respectively. Scaling the variable to account for word count is problematic because word count itself may also affect the dependent variables. However, using a ratio measure as an independent variable does not account for this confounding effect.

Second, my examination of ICCs uncovered interesting insights. Specifically, I found that most of the variance in my independent variable is between CEOs, while most of the variance in my dependent variables is within CEOs. In other words, I am utilizing an independent variable that is relatively stable within CEOs to predict dependent variables that mainly vary within CEOs. This mismatch in within versus between variance suggested that it is almost impossible to find that CEO numeracy is a significant predictor of my outcome variables. Yet, studies suggest that CEOs contribute to a significant portion of the variance in both acquisition decisions and acquisition performance (Meyer-Doyle et al., 2019). Many of these studies, like mine, examine the influence of relatively stable CEO characteristics on acquisitions and find significant results (e.g., Chatterjee & Hambrick, 2007; Gamache et al., 2015). Accordingly, further research is necessary to understand the influence of the mismatch in within- versus between-CEO variance in analytical models.

Finally, my sample was limited to only 250 randomly selected firms and was further reduced by missing data. This may have contributed to the mismatch in ICCs that I discussed earlier and impacted the ability to detect statistically significant relationships. For instance, acquisition premiums are only available for publicly traded target firms. As such, the models testing acquisition premiums consisted of only 78 observations of 57 unique CEO-firm combinations. Such sample size is considered small in strategy scholarship and possibly contributed to my null findings.

Managerial Implications

By theoretically explaining the impact of CEO numeracy on organizational decisions and outcomes, I provide valuable insight for stakeholders to better understand strategic decisions. First, since numeracy improves the effectiveness of CEO decisions, it is beneficial for organizations to consider CEO numeracy in CEO selection, succession, and monitoring decisions. Second, employees, investors, and analysts can better predict and/or make sense of organizational decisions by assessing CEO numeracy. Finally, because numeracy is developed with practice, executives can work on improving their numeracy levels, or at least surround themselves with numerate executives, so that they can ultimately make better decisions. In view of my findings, however, it is important to note that my arguments are theoretical and thus require further analyses and empirical evidence to substantiate them.

Future Research Directions

My dissertation provides several interesting opportunities for future research. I propose three various directions for future extensions. The first is related to the measure of CEO numeracy, the second targets research methodology more generally, and the third focuses on examining numeracy in other contexts. I discuss each in more detail next.

Measuring CEO numeracy. My proposed measure of CEO numeracy provides a starting point for future development and refinement. Certainly, my measure introduced issues of multicollinearity because it required that I control for total word count in empirical analyses. To overcome this problem, scholars can use supervised machine learning to scale human-coded data (Harrison, Josefy, Kalm, & Krause, 2022). Future researchers can potentially use the dictionary that I have created, along with the human-

coded data that I used for validating my measure, to train models to predict CEO numeracy. Though my dictionary has face validity, it may also warrant additional refinement. Scholars could add new words might to the dictionary that I have created, or drop current words as part of the refinement process, before training the models. Alternatively, scholars may survey security analysts or other individuals that work closely with CEOs—and are therefore able to provide insight regarding cognitive attributes of CEOs—to measure CEO numeracy.

Second, my measure of numeracy was based on inductively and deductively derived word lists that required choices (e.g., limiting the number of synonyms) to make the task more manageable. Though I take adequate steps to minimize biases (e.g., I test for and ensure interrater reliability), decisions involving which words to keep and which ones to eliminate are based on subjective interpretations that potentially add noise to the measure. In line with Bellstam and colleagues (2021), future researchers can utilize supervised machine learning techniques such as latent Dirichlet allocation (LDA) models to create a measure of numeracy based on books or articles on numeracy, instead of my dictionary. This approach would potentially also circumvent the problems with multicollinearity associated with my measure.

Finally, and relatedly, my measure of numeracy does not consider the context in which the words are utilized or the pattern in which they appear in a sentence. Certain words (e.g., returns, royalties, etc.,) may reflect numeracy if utilized in some ways but not in others. I did not include these words in my measure. Moreso, some questions from analysts may warrant a numeracy-heavy answer, while others do not. My current measure does not examine the context and instead simply relies on word frequencies. Machine

learning techniques, such as Latent Semantic Analysis (e.g., Kjell, Kjell, Garcia, & Sikström, 2019), however, account for the context and can therefore result in a more refined measure of CEO numeracy utilizing earnings calls transcripts. Furthermore, scholars can detect repetition in the words from the dictionary that are used in the transcripts and assess how to adequately account for these in the measure of CEO numeracy. For instance, should the measure involve counting each word just once? Should the measure have varying weights for successive occurrences of a word? Answers to these questions can improve the measure and perhaps mitigate the problems that arose from it.

Research methodology. The empirical issues that I encountered in my dissertation are also opportunities for future extensions and methodological improvements. First, my findings uncovered potential limitations related to use of dictionaries in content analyses. It is possible that the larger the dictionary, the higher the correlations between the measure of interest and the number of words in the corpus. These high correlations, as discussed earlier, introduce multicollinearity issues that bias analytical results. Even in studies utilizing smaller dictionaries, there is likely a correlation between the dictionary measure and the total word count, which would introduce similar problems. Though scholars sometimes utilize ratios to account for the total words in the text, this practice can lead to inaccurate results (Certo et al., 2020). Future researchers can run simulations to examine the impact of dictionary size and total word count in content analyses. These simulations can shed light on ways to mitigate the need to control for total word count.

Further, future research can investigate how a mismatch in within- versus between-CEO variance in the main variables of interest impact the findings in statistical analyses. Scholars can explore questions such as how are relatively stable within-CEO traits significant predictors of outcomes that vary predominately within CEOs? Is this mismatch always problematic or is it problematic only under certain conditions? A combination of simulations and an effort to duplicate existing studies can shed light into this very interesting phenomenon.

Numeracy in other contexts. Apart from research that would validate and improve my measure, I can envision other valuable projects on numeracy. First, to my knowledge, there is no research exploring variance in decision making among highly *numerate* individuals. Exploring numeracy in this context is important for determining if there is a point of maximum return in numeracy levels. This would likely entail creating and validating a questionnaire or survey of numeracy that is more advanced than those that are currently available, which is not an easy task. However, it would provide valuable insights for scholars examining CEOs and other individuals that do not necessarily represent the general population.

Second, it is important to explore the antecedents of CEO numeracy to better understand the variance in numeracy among CEOs. For instance, studies on numeracy suggest that gender is an important predictor of numeracy and indicate that females are typically less numerate than males (Borgonovi, Choi, & Paccagnella, 2021; Rothman & McMillan, 2003). However, these findings are not necessarily generalizable to CEOs. Female CEOs in particular face significant barriers indicating that they possess

extraordinary characteristics that enable them to break glass ceilings and get to C-suite positions.

Third, though most scholarship thus far has highlighted the benefits of numeracy, it is important to understand the disadvantages of numeracy as well. One potential direction involves examining the effects of CEO numeracy on individuals at different levels of the organization. Does CEO numeracy create a barrier in communication when there is a mismatch between CEO numeracy and employee numeracy? When is a mismatch in numeracy levels most problematic? How can organizations overcome this problem? Understanding the downside of numeracy could provide significant insights and allows researchers to provide more reliable recommendations and implications.

Lastly, future research can explore the effects of CEO numeracy on firm governance and performance. For example, it is likely that CEO numeracy impacts CEO compensation in terms of both level as well as structure. Furthermore, since CEO numeracy improves decision making, it may also affect board monitoring efforts and CEO turnover. A better understanding of these relationships allows for more effective corporate governance. Simply put, countless research questions on numeracy, of both executives and employees, await organizational scholars.

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APPENDIX A

TABLES & FIGURES

Table 1. Numeracy Dictionary

accumulation	eps	majority	purchase
add	equal	many	purchases
added	equal	margin	purchasing
adding	equaled	margins	quantifiable
addition	equalize	mathematical	quantify
additional	equalized	maximize	quantitative
additions	equally	mean	quantities
additive	equate	measure	quantity
age	equates	measured	quota
aggregate	equation	mensurable	quotient
aggregation	equational	metric	range
algebraic	equidistant	metrics	ranked
allotment	equity	midpoint	rate
amount	equivalent	minus	rated
amounts	estimate	monetization	rates
analysis	estimated	money	ratio
analytic	expense	multiple	reduced
analytics	expenses	multiplicational	reimbursement
analyze	exponential	multiplicity	repurchase
analyzed	fee	multiplied	repurchased
annualized	fewer	multitude	repurchases
arithmetic	finance	multitudinous	revenue
arithmetical	financial	multitudinousness	revenues
average	financials	nanometer	risk
averages	financing	number	risks
binal	fiscal	numbers	sale
budget	forecast	numerative	sales
budgets	forecasting	numerical	savings
calculable	forecasts	numerous	scale
capex	fraction	optimization	score
computable	fractional	optimize	scores
computing	fund	optimized	sell
correlative	funded	optimizing	selling
cost	funds	pay	sequential
costly	gaap	payment	sequentially
costs	gains	payments	series
count	gdp	per	several
couple	geometrical	percent*	sole
currency	high-priced	plentiful	statistical
data	income	plenty	subtractive
database	increase	plus	sum
debt	increased	premium	summation
decimal	increases	pretax	surplus
declined	increasing	price	tax
declines	increasingly	priced	tens
declining	indivisible	prices	time
decrease	inflation	pricing	timed
decreased	integer	probability	times
digit	invest	probableness	timing
digits	invested	proceeds	ton
discount	investing	profit	tons
dividend	investment	profitability	trigonometrical
dividends	investments	profitable	valuable
division	least	profitably	value
dollar	less	profits	valued
dollars	likelihood	proportion	velocity
earnings	logarithmic	proportional	weighable
ebit	macroeconomic	proportionate	weighted
ebitda			

* Denotes a stem word.

Table 2. Intraclass Correlation Coefficients (ICCs)

	Acquisition Decisions	Acquisition Outcomes
Variable	**ICC**	**ICC**
CEO numeracy	0.743	0.830
CEO total words	0.709	0.727
CEO numeracy ratio measure	0.666	0.747
CEO numeracy (use of numbers)	0.749	0.818
CEO numeracy (use of words from dictionary)	0.730	0.838
CEO stock options	0.512	0.768
CEO power	0.899	0.948
Number of acquisitions	0.249	-
Value of acquisitions	0.056	-
Number of large acquisitions	0.021	-
Acquisition premium	-	0.078
Short-term Performance (CARs)	-	0.112
Long-term Stock market performance (BHARs)	-	0.521
Long-term accounting performance (Change in NI)	-	0.435

Table 3. Descriptive Statistics - Acquisition Decisions Sample

Variable	N	Mean	S.D.	Skewness	Kurtosis	Min	Max
CEO numeracy	1032	566.57	375.34	1.06	4.24	0.00	2153.52
Number of acquisitions (t+1)	1204	0.42	0.76	2.37	11.27	0.00	7.00
Value of acquisitions (t+1)	1204	794.07	3207.86	9.71	141.76	0.00	62141.06
Number of large acquisitions (t+1)	1220	0.12	0.33	2.51	7.82	0.00	2.00
CEO stock options	1216	2410.93	4224.09	8.70	127.09	0.00	76893.60
CEO power	1070	0.05	1.85	0.82	5.08	-4.49	12.08
CEO total words	1033	8481.75	4723.61	0.67	3.53	0.00	30937.00
CEO age	1216	56.89	6.13	0.13	3.64	39.00	80.00
CEO turnover	1220	0.12	0.33	2.32	6.38	0.00	1.00
CEO is female	1211	0.05	0.22	4.03	17.28	0.00	1.00
CEO is an outsider	1211	0.06	0.24	3.67	14.43	0.00	1.00
CEO openness	1035	4.65	0.51	-0.68	3.22	1.89	5.67
CEO functional background	1109	1.82	0.93	0.37	1.26	1.00	3.00
CEO highest degree earned	1108	1.72	0.72	0.00	2.60	0.00	3.00
CEO compensation	1216	11614.66	7330.85	2.73	18.72	0.00	79606.16
Firm size	1211	3.23	1.37	0.06	2.96	-0.55	7.74
Firm performance	1216	1960.16	4651.05	4.91	42.61	-23119.00	53394.00
Board size	1077	10.47	1.94	0.28	3.89	5.00	20.00
Average age of the board	1077	62.96	3.00	0.11	3.31	54.00	73.08
Female board representation	1077	0.19	0.09	0.28	3.34	0.00	0.50
CFO numeracy	1016	54.46	39.71	2.03	9.83	0.00	339.73
CFO total words	1016	3913.90	2996.88	1.77	8.01	0.00	21555.00
Number of acquisitions in the prior three years	1220	1.32	1.79	2.48	12.27	0.00	14.00
Value of acquisitions in the prior three years	1220	635.51	2285.35	5.62	39.35	0.00	22847.79
Number of large acquisitions in the prior three years	1220	0.28	0.52	1.77	5.70	0.00	3.00

Table 4. Descriptive Statistics - Acquisition Outcomes Sample

Variable	N	Mean	S.D.	Skewness	Kurtosis	Min	Max
CEO numeracy	452	610.51	401.79	0.98	3.61	3.00	2095.84
Acquisition premiums	113	46.69	43.94	3.63	22.29	-5.58	347.08
CARs	496	0.01	0.05	1.68	20.27	-0.18	0.42
BHARs	478	0.17	0.60	1.23	6.87	-1.14	3.34
Change in NI	494	211.58	3681.19	-1.62	27.67	-27703.00	27472.00
CEO stock options	529	3231.30	7156.56	7.13	65.50	0.00	76893.60
CEO power	463	0.14	1.77	0.67	4.45	-4.49	7.22
CEO total words	454	8976.72	5003.81	0.84	4.23	0.00	30937.00
CEO age	529	57.00	6.35	-0.05	3.47	39.00	80.00
CEO turnover	531	0.13	0.33	2.25	6.07	0.00	1.00
CEO is female	528	0.05	0.21	4.36	20.05	0.00	1.00
CEO is an outsider	528	0.10	0.29	2.77	8.67	0.00	1.00
CEO openness	455	4.73	0.48	-0.52	2.64	3.42	5.67
CEO functional background	510	1.82	0.90	0.37	1.33	1.00	3.00
CEO highest degree earned	510	1.81	0.71	-0.03	2.55	0.00	3.00
CEO compensation	529	12993.33	9785.73	3.15	17.98	0.00	79606.16
Firm size	529	3.31	1.22	0.02	3.00	-0.37	7.74
Firm performance	531	2580.77	4799.19	3.28	22.73	-14454.00	41733.00
Board size	466	10.48	1.86	0.00	3.28	5.00	16.00
Average age of the board	466	63.00	2.72	-0.05	2.76	54.08	71.42
Female board representation	466	0.20	0.09	0.11	3.46	0.00	0.50
CFO numeracy	448	52.50	37.33	2.10	10.52	0.00	284.10
CFO total words	448	3651.59	2789.36	1.66	7.62	0.00	19047.00
Number of bidders	531	1.02	0.12	7.96	64.39	1.00	2.00
Number of acquisitions in the prior three years	531	2.64	2.77	1.60	5.84	0.00	14.00

Table 5. Correlation Coefficients – Acquisitions Decisions Sample

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. CEO numeracy	1.00											
2. Number of acquisitions (t+1)	0.11	1.00										
3. Value of acquisitions (t+1)	0.00	0.40	1.00									
4. Number of large acquisitions (t+1)	0.04	0.44	0.59	1.00								
5. CEO stock options	-0.06	0.10	0.09	-0.02	1.00							
6. CEO power	-0.10	0.05	-0.01	-0.01	0.21	1.00						
7. CEO total words	0.87	0.11	0.03	0.06	-0.05	-0.11	1.00					
8. CEO age	-0.19	0.02	0.02	-0.04	0.10	0.35	-0.29	1.00				
9. CEO turnover	-0.02	-0.01	-0.02	0.00	-0.08	-0.24	-0.02	-0.19	1.00			
10. CEO is female	-0.09	-0.04	-0.05	-0.06	0.00	-0.08	-0.09	0.02	-0.02	1.00		
11. CEO is an outsider	0.03	0.07	0.00	0.03	0.16	0.20	0.02	0.07	-0.08	-0.06	1.00	
12. CEO openness	-0.17	0.08	0.08	0.03	0.05	0.05	-0.01	-0.15	-0.03	-0.03	0.01	1.00
13. CEO functional background	-0.13	0.00	-0.03	-0.02	0.03	0.12	-0.12	0.13	-0.02	0.06	0.13	-0.11
14. CEO highest degree earned	-0.13	0.10	0.05	0.02	-0.11	0.02	-0.08	0.04	-0.05	0.00	-0.07	0.02
15. CEO compensation	-0.12	0.08	0.11	-0.07	0.58	0.15	-0.11	0.11	-0.08	0.13	0.14	0.12
16. Firm size	-0.13	0.02	0.07	-0.05	0.17	0.05	-0.06	0.10	-0.02	0.19	0.00	0.23
17. Firm performance	-0.08	0.05	0.07	-0.05	0.11	-0.05	-0.10	-0.01	0.02	0.07	-0.03	0.13
18. Board size	-0.09	-0.04	0.02	-0.03	0.06	-0.06	-0.08	0.01	0.00	0.16	-0.12	0.07
19. Average age of the board	-0.03	0.02	0.04	0.02	0.01	0.05	-0.06	0.24	-0.05	-0.02	0.01	-0.20
20. Female board representation	-0.11	0.02	0.05	0.01	0.02	-0.07	-0.06	0.06	0.04	0.23	-0.12	0.26
21. CFO numeracy	-0.14	-0.03	-0.03	-0.04	-0.06	0.00	-0.13	0.08	0.07	0.08	-0.08	0.09
22. CFO total words	-0.23	-0.05	0.00	-0.02	-0.02	0.03	-0.15	0.12	0.08	0.02	-0.05	0.20
23. Number of acquisitions in the prior three years	0.08	0.41	0.16	0.07	0.11	0.04	0.06	0.04	0.03	-0.10	0.08	0.17
24. Value of acquisitions in the prior three years	-0.03	0.05	0.12	0.01	0.01	-0.01	-0.01	0.03	0.00	-0.06	-0.02	0.11
25. Number of large acquisitions in the prior three years	0.05	0.12	0.07	0.08	0.11	0.06	0.04	-0.02	-0.03	-0.04	0.08	0.10

Variables	13	14	15	16	17	18	19	20	21	22	23	24	25
13. CEO functional background	1.00												
14. CEO highest degree earned	0.02	1.00											
15. CEO compensation	0.09	0.00	1.00										
16. Firm size	0.20	0.03	0.34	1.00									
17. Firm performance	0.03	0.09	0.22	0.32	1.00								
18. Board size	0.06	0.03	0.23	0.34	0.09	1.00							
19. Average age of the board	0.02	0.10	0.04	-0.01	0.04	0.03	1.00						
20. Female board representation	0.05	0.01	0.17	0.29	0.12	0.29	-0.18	1.00					
21. CFO numeracy	0.10	0.03	-0.05	0.20	0.05	-0.05	-0.06	0.03	1.00				
22. CFO total words	0.02	0.05	-0.01	0.23	0.09	-0.04	-0.04	0.11	0.67	1.00			
23. Number of acquisitions in the prior three years	0.01	0.07	0.15	0.09	0.16	0.00	0.02	0.10	-0.03	-0.03	1.00		
24. Value of acquisitions in the prior three years	-0.06	0.03	0.10	0.12	0.12	0.05	-0.03	0.09	-0.07	-0.05	0.25	1.00	
25. Number of large acquisitions in the prior three years	-0.01	-0.02	0.07	-0.06	-0.07	-0.08	0.01	-0.05	-0.09	-0.09	0.36	0.32	1.00

Table 6. Correlation Coefficients – Acquisitions Outcomes Sample

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. CEO numeracy	1.00											
2. Acquisition premiums	-0.20	1.00										
3. CARs	0.10	-0.05	1.00									
4. BHARs	-0.19	0.05	-0.08	1.00								
5. Change in NI	-0.09	0.14	0.00	0.22	1.00							
6. CEO stock options	-0.23	-0.06	0.04	-0.10	-0.12	1.00						
7. CEO power	-0.05	-0.09	0.13	0.11	-0.11	0.81	1.00					
8. CEO total words	0.86	-0.21	0.08	-0.09	-0.20	-0.25	-0.08	1.00				
9. CEO age	-0.13	-0.10	0.16	-0.08	-0.15	0.52	0.61	-0.25	1.00			
10. CEO turnover	0.07	0.04	0.05	0.02	0.23	-0.11	-0.15	0.10	-0.34	1.00		
11. CEO is female	-0.07	-0.01	0.04	0.05	-0.02	-0.01	0.09	-0.08	0.05	-0.05	1.00	
12. CEO is an outsider	-0.23	-0.12	0.09	-0.15	-0.07	0.75	0.65	-0.28	0.52	-0.13	-0.04	1.00
13. CEO openness	-0.19	0.30	-0.08	0.16	0.09	0.16	0.17	-0.08	-0.03	0.01	0.02	-0.06
14. CEO functional background	-0.23	-0.12	0.10	0.18	-0.03	0.08	0.11	-0.20	0.29	0.06	-0.11	0.26
15. CEO highest degree earned	-0.01	0.22	-0.14	0.31	0.20	-0.55	-0.34	-0.02	-0.22	0.07	0.04	-0.27
16. CEO compensation	-0.24	0.00	0.01	-0.04	-0.14	0.95	0.79	-0.25	0.52	-0.20	0.01	0.74
17. Firm size	-0.20	0.04	0.08	0.03	0.04	0.28	0.30	-0.07	0.21	0.12	0.21	0.31
18. Firm performance	-0.10	0.26	0.01	-0.09	0.67	0.32	0.19	-0.20	0.19	0.21	0.03	0.26
19. Board size	-0.31	0.16	0.23	-0.06	-0.10	0.15	0.15	-0.14	0.15	-0.02	0.10	0.20
20. Average age of the board	-0.23	-0.04	0.11	-0.06	0.00	0.23	0.21	-0.35	0.45	-0.18	-0.12	0.25
21. Female board representation	0.03	-0.03	-0.14	-0.02	-0.09	-0.08	0.04	0.19	-0.07	-0.09	0.06	-0.13
22. CFO numeracy	-0.06	-0.09	0.19	0.16	0.18	-0.27	-0.26	-0.05	-0.18	0.21	0.14	-0.16
23. CFO total words	-0.16	-0.14	0.11	0.05	0.10	-0.19	-0.36	-0.04	-0.11	0.33	0.03	-0.06
24. Number of bidders	-0.01	0.02	0.04	0.07	0.03	-0.02	0.00	0.04	-0.18	-0.05	-0.02	-0.04
25. Number of acquisitions in the prior three years	0.20	0.03	-0.11	0.20	0.07	0.15	0.28	0.20	0.07	0.04	-0.14	0.16

Variables	13	14	15	16	17	18	19	20	21	22	23	24	25
13. CEO openness	1.00												
14. CEO functional background	0.00	1.00											
15. CEO highest degree earned	-0.21	0.13	1.00										
16. CEO compensation	0.22	0.08	-0.47	1.00									
17. Firm size	0.37	0.11	0.05	0.37	1.00								
18. Firm performance	0.26	-0.10	-0.08	0.32	0.35	1.00							
19. Board size	0.16	0.27	0.09	0.22	0.43	0.04	1.00						
20. Average age of the board	-0.18	0.08	-0.03	0.18	-0.11	0.01	0.04	1.00					
21. Female board representation	0.25	0.14	0.08	-0.05	0.14	-0.13	0.15	-0.23	1.00				
22. CFO numeracy	0.00	0.07	0.24	-0.33	0.15	0.01	-0.02	-0.17	-0.06	1.00			
23. CFO total words	0.04	0.07	0.08	-0.23	0.30	0.05	0.16	-0.09	-0.08	0.57	1.00		
24. Number of bidders	0.01	-0.11	0.04	0.01	0.05	-0.02	-0.03	-0.14	-0.01	-0.12	-0.10	1.00	
25. Number of acquisitions in the prior three years	0.09	0.10	-0.03	0.15	0.03	0.06	-0.08	-0.15	0.11	-0.08	-0.06	0.03	1.00

Table 7. GEE Results (DV: Number of Acquisitions)

	Model 1	Model 2	Model 3	Model 4
CEO total words	0.000**	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
CEO age	0.005	0.005	0.004	0.004
	(0.009)	(0.009)	(0.009)	(0.009)
CEO turnover	-0.059	-0.060	-0.037	-0.055
	(0.175)	(0.175)	(0.174)	(0.178)
CEO is female	-0.010	-0.013	0.019	-0.016
	(0.341)	(0.342)	(0.343)	(0.344)
CEO is an outsider	0.037	0.034	-0.010	0.049
	(0.160)	(0.160)	(0.171)	(0.166)
CEO openness	0.396**	0.411**	0.446**	0.414**
	(0.144)	(0.152)	(0.157)	(0.153)
1. CEO functional background	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
2. CEO functional background	0.366*	0.366*	0.321*	0.346*
	(0.156)	(0.157)	(0.154)	(0.158)
3. CEO functional background	0.066	0.066	0.082	0.057
	(0.132)	(0.132)	(0.132)	(0.134)
0. CEO highest degree earned	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
1. CEO highest degree earned	0.074	0.091	0.287	0.107
	(0.308)	(0.316)	(0.343)	(0.316)
2. CEO highest degree earned	0.042	0.064	0.298	0.080
	(0.306)	(0.312)	(0.355)	(0.313)
3. CEO highest degree earned	0.269	0.290	0.512	0.306
	(0.318)	(0.329)	(0.367)	(0.331)
CEO compensation	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Firm size	0.018	0.020	0.028	0.018

	(0.063)	(0.064)	(0.064)	(0.064)
Firm performance	-0.000	-0.000	-0.000*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Board size	-0.070*	-0.070*	-0.063	-0.070*
	(0.035)	(0.035)	(0.036)	(0.035)
Average age of the board	0.018	0.018	0.015	0.017
	(0.018)	(0.018)	(0.018)	(0.018)
Female board representation	-0.447	-0.458	-0.365	-0.409
	(0.658)	(0.660)	(0.668)	(0.667)
CFO numeracy	0.000	-0.000	-0.000	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)
CFO total words	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Number of acquisitions in the prior three years	0.190***	0.188***	0.181***	0.190***
	(0.027)	(0.027)	(0.027)	(0.027)
CEO numeracy		0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)
CEO stock options			0.000	
			(0.000)	
CEO power				0.002
				(0.029)
CEO numeracy x CEO stock options			-0.000	
			(0.000)	
CEO numeracy x CEO power				-0.000
				(0.000)
Constant	-4.361**	-4.417**	-4.506***	-4.324**
	(1.337)	(1.367)	(1.330)	(1.341)
N	831	830	830	830

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Year and Industry dummies included in all models.

Table 8. GEE Results (DV: Value of Acquisitions)

	Model 1	Model 2	Model 3	Model 4
CEO total words	-0.000**	-0.000**	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
CEO age	0.000	0.000**	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
CEO turnover	-0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
CEO is female	0.003	0.003	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)
CEO is an outsider	0.001*	0.001	0.001*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
CEO openness	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
1. CEO functional background	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
2. CEO functional background	0.000	0.000	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
3. CEO functional background	0.001***	0.001*	0.001***	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
0. CEO highest degree earned	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
1. CEO highest degree earned	-0.001	-0.000	-0.003	-0.002*
	(0.001)	(0.001)	(0.002)	(0.001)
2. CEO highest degree earned	-0.002*	-0.001	-0.004*	-0.003*
	(0.001)	(0.001)	(0.002)	(0.001)
3. CEO highest degree earned	-0.003***	-0.002**	-0.005**	-0.004**
	(0.001)	(0.001)	(0.002)	(0.001)
CEO compensation	-0.000***	-0.000***	-0.000*	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Firm size	-0.000***	-0.000***	-0.001***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Firm performance	0.000*	0.000	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)

Board size	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Average age of the board	-0.000***	-0.000***	-0.000***	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Female board representation	0.001	0.001	0.001	0.001
	(0.001)	(0.002)	(0.001)	(0.002)
CFO numeracy	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
CFO total words	-0.000**	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Value of acquisitions in the prior three years	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
CEO numeracy		0.000**	0.000***	0.000***
		(0.000)	(0.000)	(0.000)
CEO stock options			0.000*	
			(0.000)	
CEO power				0.000***
				(0.000)
CEO numeracy x CEO stock options			0.000***	
			(0.000)	
CEO numeracy x CEO power				0.000
				(0.000)
Constant	0.023***	0.017***	0.022***	0.021***
	(0.003)	(0.003)	(0.003)	(0.004)
N	831	830	830	830

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Year and Industry dummies included in all models.

Table 9. GEE Results (DV: Number of Large Acquisitions)

	Model 1	Model 2	Model 3	Model 4
CEO total words	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
CEO age	-0.007	-0.006	-0.005	-0.003
	(0.016)	(0.016)	(0.017)	(0.016)
CEO turnover	0.029	0.031	0.042	-0.012
	(0.324)	(0.324)	(0.328)	(0.335)
CEO is female	-1.539	-1.543	-1.558	-1.590*
	(0.815)	(0.814)	(0.806)	(0.776)
CEO is an outsider	0.257	0.270	0.218	0.256
	(0.322)	(0.331)	(0.342)	(0.337)
CEO openness	0.252	0.229	0.231	0.231
	(0.250)	(0.263)	(0.269)	(0.272)
1. CEO functional background	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
2. CEO functional background	-0.119	-0.124	-0.174	-0.089
	(0.344)	(0.347)	(0.335)	(0.342)
3. CEO functional background	-0.020	-0.024	-0.019	0.007
	(0.224)	(0.224)	(0.223)	(0.229)
0. CEO highest degree earned	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
1. CEO highest degree earned	0.629	0.602	0.613	0.598
	(0.480)	(0.483)	(0.516)	(0.475)
2. CEO highest degree earned	0.279	0.246	0.256	0.233
	(0.502)	(0.512)	(0.537)	(0.503)
3. CEO highest degree earned	0.841	0.810	0.846	0.814
	(0.503)	(0.513)	(0.544)	(0.498)
CEO compensation	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Firm size	0.017	0.015	0.033	0.021
	(0.097)	(0.097)	(0.097)	(0.096)
Firm performance	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)

Board size	-0.050	-0.049	-0.040	-0.050
	(0.063)	(0.064)	(0.061)	(0.065)
Average age of the board	0.052	0.051	0.052	0.053
	(0.033)	(0.033)	(0.033)	(0.034)
Female board representation	1.415	1.434	1.659	1.354
	(1.154)	(1.168)	(1.174)	(1.206)
CFO numeracy	-0.001	-0.001	-0.001	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)
CFO total words	0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Number of large acquisitions in the prior three years	0.339*	0.342*	0.301	0.329
	(0.171)	(0.171)	(0.176)	(0.176)
CEO numeracy		-0.000	-0.000	-0.000
		(0.001)	(0.001)	(0.001)
CEO stock options			-0.000	
			(0.000)	
CEO power				-0.035
				(0.054)
CEO numeracy x CEO stock options			-0.000*	
			(0.000)	
CEO numeracy x CEO power				0.000
				(0.000)
Constant	-7.198**	-7.073**	-7.491**	-7.372**
	(2.536)	(2.557)	(2.564)	(2.567)
N	832	831	831	831

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Year and Industry dummies included in all models.

Table 10. Mixed Models Results (DV: Acquisition Premiums)

	Model 1	Model 2	Model 3	Model 4
CEO total words	-0.000	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
CEO age	-0.020	-0.018	-0.021	-0.004
	(0.019)	(0.019)	(0.020)	(0.025)
CEO turnover	-0.429	-0.433	-0.421	-0.289
	(0.388)	(0.379)	(0.381)	(0.396)
CEO is female	0.188	0.240	0.669	0.134
	(0.409)	(0.448)	(0.406)	(0.535)
CEO is an outsider	-0.040	-0.051	0.074	-0.044
	(0.352)	(0.345)	(0.283)	(0.323)
CEO openness	0.054	0.047	0.027	0.081
	(0.405)	(0.396)	(0.417)	(0.382)
1. CEO functional background	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
2. CEO functional background	0.076	0.104	0.219	-0.041
	(0.298)	(0.300)	(0.332)	(0.350)
3. CEO functional background	0.053	0.061	0.034	-0.121
	(0.177)	(0.178)	(0.173)	(0.270)
0. CEO highest degree earned	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
1. CEO highest degree earned	0.263	0.199	0.154	0.164
	(0.521)	(0.573)	(0.572)	(0.543)
2. CEO highest degree earned	0.518	0.460	0.307	0.356
	(0.488)	(0.577)	(0.491)	(0.494)
3. CEO highest degree earned	0.079	0.043	-0.091	-0.063
	(0.423)	(0.468)	(0.413)	(0.433)
CEO compensation	-0.000	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Firm size	0.126	0.124	0.163	0.129
	(0.157)	(0.157)	(0.163)	(0.155)
Firm performance	0.000	0.000	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)

Board size	-0.025	-0.030	-0.047	-0.020
	(0.050)	(0.046)	(0.054)	(0.049)
Average age of the board	-0.042	-0.041	-0.030	-0.036
	(0.036)	(0.036)	(0.035)	(0.034)
Female board representation	-1.154	-1.233	-0.963	-0.892
	(1.236)	(1.357)	(1.441)	(1.531)
CFO numeracy	-0.004	-0.004	-0.003	-0.002
	(0.002)	(0.002)	(0.003)	(0.003)
CFO total words	0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Number of bidders	-1.289	-1.276	-1.292*	-1.272
	(0.674)	(0.665)	(0.638)	(0.659)
CEO numeracy		-0.000	-0.001	-0.000
		(0.001)	(0.000)	(0.001)
CEO stock options			-0.000	
			(0.000)	
CEO power				-0.101
				(0.120)
CEO numeracy x CEO stock options			-0.000	
			(0.000)	
CEO numeracy x CEO power				-0.000
				(0.000)
Constant	8.875**	8.913**	7.967*	7.193*
	(3.195)	(3.160)	(3.152)	(3.095)
lns1_1_1 _cons	-16.725	-13.645***	-10.057	-15.016
	(2.60e+07)	(1.587)	(2.49e+06)	(5.35e+07)
lnsig_e _cons	-0.332	-0.333*	-0.344	-0.339
	(0.510)	(0.167)	(0.225)	(0.381)
N	78	78	78	78

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Year and Industry dummies included in all models.
DV is inverse hyperbolic sine transformed to correct for skewness.

Table 11. Mixed Models Results (DV: Post-Acquisition Performance)

	Model 1	Model 2a CARs	Model 2b BHARs	Model 2c Change in NI	Model 3 BHARs	Model 4 BHARs
CEO total words	0.000	0.000	-0.000	-0.000	-0.000*	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CEO age	-0.000	-0.000	-0.004	-0.001	-0.004	-0.006
	(0.000)	(0.000)	(0.004)	(0.001)	(0.004)	(0.004)
CEO turnover	0.001	0.002	0.002	0.005	0.002	0.004
	(0.007)	(0.007)	(0.058)	(0.022)	(0.058)	(0.058)
CEO is female	-0.001	0.001	-0.125	-0.002	-0.108	-0.130
	(0.007)	(0.007)	(0.081)	(0.019)	(0.082)	(0.078)
CEO is an outsider	0.011	0.011	-0.096	0.000	-0.087	-0.104
	(0.015)	(0.016)	(0.066)	(0.015)	(0.060)	(0.065)
CEO openness	-0.005	-0.004	0.113	0.006	0.097	0.106
	(0.007)	(0.008)	(0.062)	(0.014)	(0.063)	(0.061)
1. CEO functional background	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
2. CEO functional background	-0.011	-0.011	-0.059	-0.000	-0.030	-0.058
	(0.007)	(0.007)	(0.068)	(0.010)	(0.069)	(0.071)
3. CEO functional background	-0.007	-0.007	-0.027	-0.008	-0.024	-0.025
	(0.006)	(0.006)	(0.051)	(0.013)	(0.051)	(0.050)
0. CEO highest degree earned	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
1. CEO highest degree earned	-0.056	-0.056	-0.032	-0.015	-0.117	-0.023
	(0.032)	(0.032)	(0.158)	(0.021)	(0.151)	(0.167)
2. CEO highest degree earned	-0.050	-0.050	-0.106	-0.009	-0.192	-0.099
	(0.031)	(0.031)	(0.151)	(0.020)	(0.148)	(0.161)
3. CEO highest degree earned	-0.041	-0.041	-0.012	-0.024	-0.089	-0.005
	(0.033)	(0.032)	(0.159)	(0.028)	(0.155)	(0.169)
CEO compensation	-0.000	-0.000	-0.000	-0.000*	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm size	-0.003	-0.003	-0.004	-0.006	-0.008	-0.004
	(0.004)	(0.004)	(0.027)	(0.007)	(0.026)	(0.026)
Firm performance	0.000	0.000	-0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Board size	0.003	0.003	-0.000	0.002	-0.002	0.001
	(0.002)	(0.002)	(0.012)	(0.003)	(0.012)	(0.012)
Average age of the board	0.000	0.000	0.011	-0.003	0.012	0.010
	(0.001)	(0.001)	(0.009)	(0.003)	(0.009)	(0.009)
Female board representation	-0.034	-0.034	0.629*	-0.046	0.546	0.600*
	(0.024)	(0.024)	(0.298)	(0.072)	(0.295)	(0.288)
CFO numeracy	0.000	0.000	0.003***	0.000	0.003***	0.003***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
CFO total words	-0.000	-0.000	-0.000**	-0.000	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of acquisitions in the prior three years	-0.001	-0.000	0.008	0.002	0.012	0.007
	(0.001)	(0.001)	(0.010)	(0.003)	(0.011)	(0.011)
CEO numeracy		-0.000	0.000	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

CEO stock options					0.000 (0.000)	
CEO power						0.016 (0.013)
CEO numeracy x CEO stock options					0.000 (0.000)	
CEO numeracy x CEO power						0.000 (0.000)
Constant	0.223* (0.089)	0.215* (0.088)	-0.028 (0.641)	10.503*** (0.180)	0.082 (0.629)	0.140 (0.639)
lns1_1_1 _cons	-3.926*** (0.366)	-3.888*** (0.330)	-1.599*** (0.146)	-11.105 (1.92e+06)	-1.624*** (0.152)	-1.629*** (0.161)
lnsig_e _cons	-3.459*** (0.102)	-3.469*** (0.101)	-1.599*** (0.093)	-2.444 (29.946)	-1.599*** (0.097)	-1.591*** (0.095)
N	374	372	362	382	362	362

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Year and Industry dummies included in all models.
CARs and Change in NI are log-transformed and BHARs is inverse hyperbolic sine transformed to correct for skewness.

Table 12. Results for Hypotheses 1-5 Using a Ratio Measure of CEO Numeracy

	(1) Number of acquisitions	(2) Value of acquisitions	(3) Number of large acquisitions	(4) Acquisition premiums	(5) BHARs
CEO numeracy ratio	-0.076	0.024***	0.122	0.349	0.374
	(2.678)	(0.006)	(4.622)	(7.834)	(1.079)
CEO age	-0.001	0.000	-0.014	-0.020	-0.001
	(0.009)	(0.000)	(0.014)	(0.019)	(0.004)
CEO turnover	-0.125	-0.000	-0.042	-0.447	0.020
	(0.174)	(0.000)	(0.323)	(0.382)	(0.061)
CEO is female	-0.052	0.004	-1.614*	0.140	-0.042
	(0.330)	(0.002)	(0.815)	(0.506)	(0.085)
CEO is an outsider	0.065	-0.000	0.294	-0.050	-0.086
	(0.151)	(0.000)	(0.308)	(0.357)	(0.076)
CEO openness	0.335*	-0.001**	0.188	0.106	0.155*
	(0.149)	(0.000)	(0.262)	(0.407)	(0.062)
1. CEO functional background	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
2. CEO functional background	0.360*	0.000	-0.114	0.079	-0.046
	(0.159)	(0.000)	(0.345)	(0.300)	(0.072)
3. CEO functional background	0.026	0.001***	-0.047	0.018	0.008
	(0.132)	(0.000)	(0.227)	(0.162)	(0.050)
0. CEO highest degree earned	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
1. CEO highest degree earned	-0.026	-0.001	0.509	0.448	-0.004
	(0.299)	(0.001)	(0.493)	(0.580)	(0.175)
2. CEO highest degree earned	-0.050	-0.001	0.136	0.610	-0.069
	(0.296)	(0.001)	(0.511)	(0.568)	(0.170)
3. CEO highest degree earned	0.199	-0.002***	0.696	0.160	0.002
	(0.314)	(0.001)	(0.518)	(0.513)	(0.179)
CEO compensation	0.000	-0.000***	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm size	0.028	-0.001***	0.023	0.098	0.003
	(0.060)	(0.000)	(0.095)	(0.165)	(0.028)
Firm performance	-0.000*	0.000	-0.000	0.000*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Board size	-0.072*	-0.000	-0.051	-0.014	-0.005
	(0.035)	(0.000)	(0.063)	(0.048)	(0.012)
Average age of the board	0.016	-0.000***	0.052	-0.025	0.007
	(0.018)	(0.000)	(0.033)	(0.038)	(0.009)
Female board representation	-0.475	0.001	1.465	-1.288	0.447
	(0.681)	(0.001)	(1.195)	(1.186)	(0.326)
CFO numeracy ratio	1.032	0.005	-1.796	-1.576	0.620
	(1.517)	(0.005)	(3.679)	(7.211)	(1.226)
Number of acquisitions in the prior three years	0.200***				0.004
	(0.025)				(0.011)
Value of acquisitions in the prior three years		-0.000***			
		(0.000)			
Number of large acquisitions in the prior three years			0.323		
			(0.171)		
Number of bidders				-1.259	
				(0.703)	
Constant	-3.369*	0.018***	-6.185*	7.231*	-0.200
	(1.312)	(0.003)	(2.534)	(3.053)	(0.662)
lns1_1_1					

_cons				-12.448	-1.630***
				(7.85e+06)	(0.123)
lnsig_e					
_cons				-0.323	-1.521***
				(0.327)	(0.089)
N	829	829	830	78	362

Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Year and Industry dummies included in all models.
CARs and Change in NI are log-transformed and BHARs is inverse hyperbolic sine transformed to correct for skewness.

Table 13. Results for Hypotheses 1-5 Omitting CEO Word Count as a Control

	(1) Number of acquisitions	(2) Value of acquisitions	(3) Number of large acquisitions	(4) Acquisition premiums	(5) BHARs
CEO numeracy	0.000**	0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CEO age	0.003	0.000**	-0.010	-0.018	-0.003
	(0.009)	(0.000)	(0.015)	(0.019)	(0.004)
CEO turnover	-0.069	-0.000	0.005	-0.435	0.010
	(0.175)	(0.000)	(0.325)	(0.380)	(0.059)
CEO is female	-0.021	0.003	-1.556	0.255	-0.122
	(0.343)	(0.002)	(0.819)	(0.381)	(0.082)
CEO is an outsider	0.029	0.001	0.252	-0.046	-0.094
	(0.155)	(0.000)	(0.322)	(0.330)	(0.070)
CEO openness	0.437**	-0.001***	0.267	0.049	0.098
	(0.147)	(0.000)	(0.259)	(0.390)	(0.062)
1. CEO functional background	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
2. CEO functional background	0.369*	0.000	-0.108	0.110	-0.069
	(0.159)	(0.000)	(0.345)	(0.289)	(0.070)
3. CEO functional background	0.063	0.001***	-0.024	0.064	-0.030
	(0.133)	(0.000)	(0.224)	(0.172)	(0.051)
0. CEO highest degree earned	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
1. CEO highest degree earned	0.114	-0.001	0.631	0.198	-0.049
	(0.321)	(0.001)	(0.505)	(0.573)	(0.161)
2. CEO highest degree earned	0.095	-0.001	0.288	0.456	-0.124
	(0.321)	(0.001)	(0.533)	(0.566)	(0.154)
3. CEO highest degree earned	0.324	-0.003***	0.843	0.046	-0.031
	(0.330)	(0.001)	(0.530)	(0.475)	(0.163)
CEO compensation	0.000	-0.000***	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm size	0.027	-0.001***	0.026	0.122	-0.009
	(0.062)	(0.000)	(0.098)	(0.157)	(0.026)
Firm performance	-0.000*	0.000*	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Board size	-0.071*	-0.000	-0.052	-0.031	0.000
	(0.035)	(0.000)	(0.062)	(0.046)	(0.013)
Average age of the board	0.017	-0.000***	0.053	-0.040	0.012
	(0.018)	(0.000)	(0.033)	(0.033)	(0.009)
Female board representation	-0.486	0.001	1.386	-1.264	0.649*
	(0.661)	(0.001)	(1.170)	(1.197)	(0.303)
CFO numeracy	-0.000	0.000***	-0.002	-0.003	0.004***
	(0.002)	(0.000)	(0.004)	(0.002)	(0.001)
CFO word count	-0.000	-0.000***	0.000	0.000	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of acquisitions in the prior three years	0.186***				0.010
	(0.026)				(0.010)
Value of acquisitions in the prior three years		-0.000***			
		(0.000)			

Number of large acquisitions in the prior three years			0.323 (0.170)		
Number of bidders				-1.276 (0.663)	
Constant	-4.402** (1.360)	0.020*** (0.003)	-7.028** (2.572)	8.846** (2.947)	-0.090 (0.653)
lns1_1_1 _cons				-14.346 (32.298)	-1.581*** (0.138)
lnsig_e _cons				-0.333* (0.167)	-1.600*** (0.091)
N	830	830	831	78	362

Standard errors in parentheses.
* p < 0.05, ** p < 0.01, *** p < 0.001
Year and Industry dummies included in all models.
CARs and Change in NI are log-transformed and BHARs is inverse hyperbolic sine transformed to correct for skewness.

Figure 1: Theoretical Model

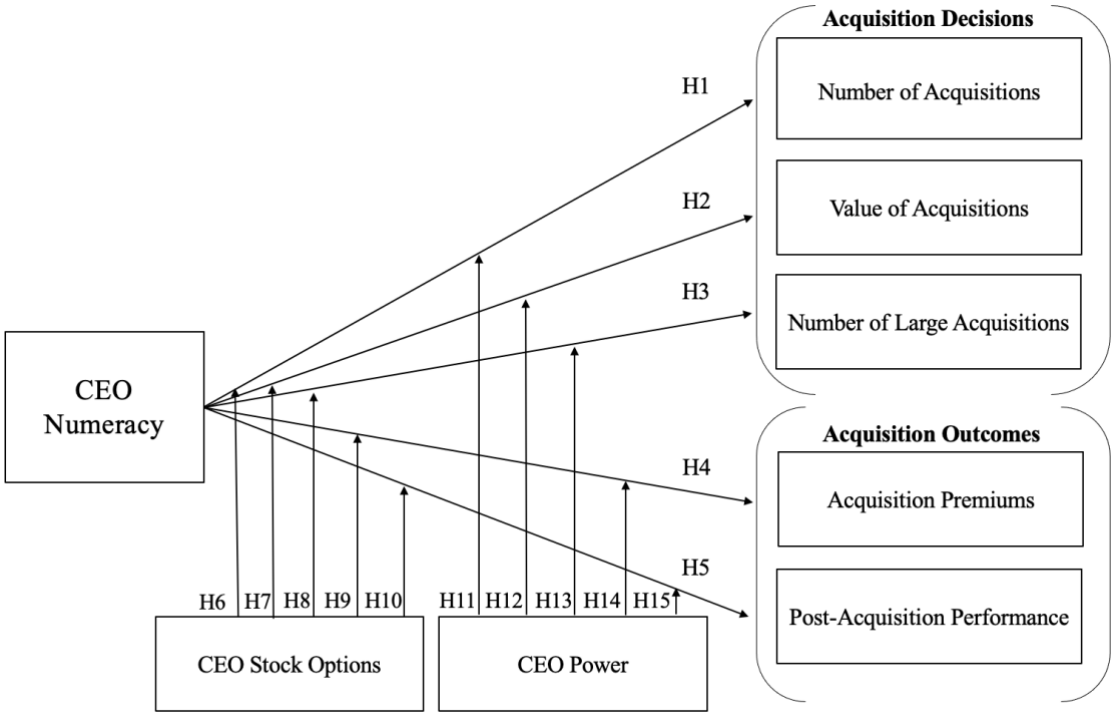

Figure 2: The Predicted Moderating Effects of CEO Stock Options

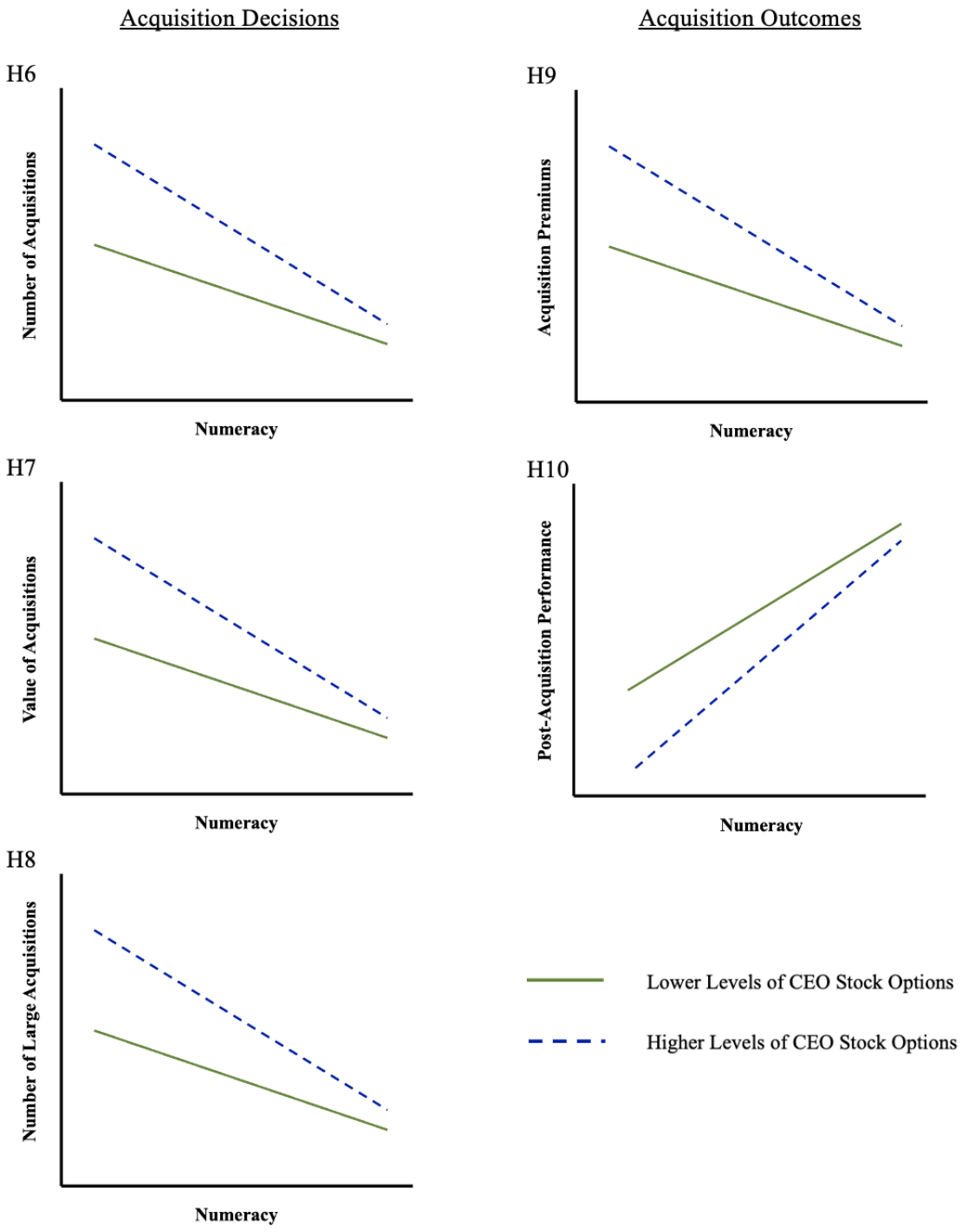

Figure 3: The Predicted Moderating Effects of CEO Power

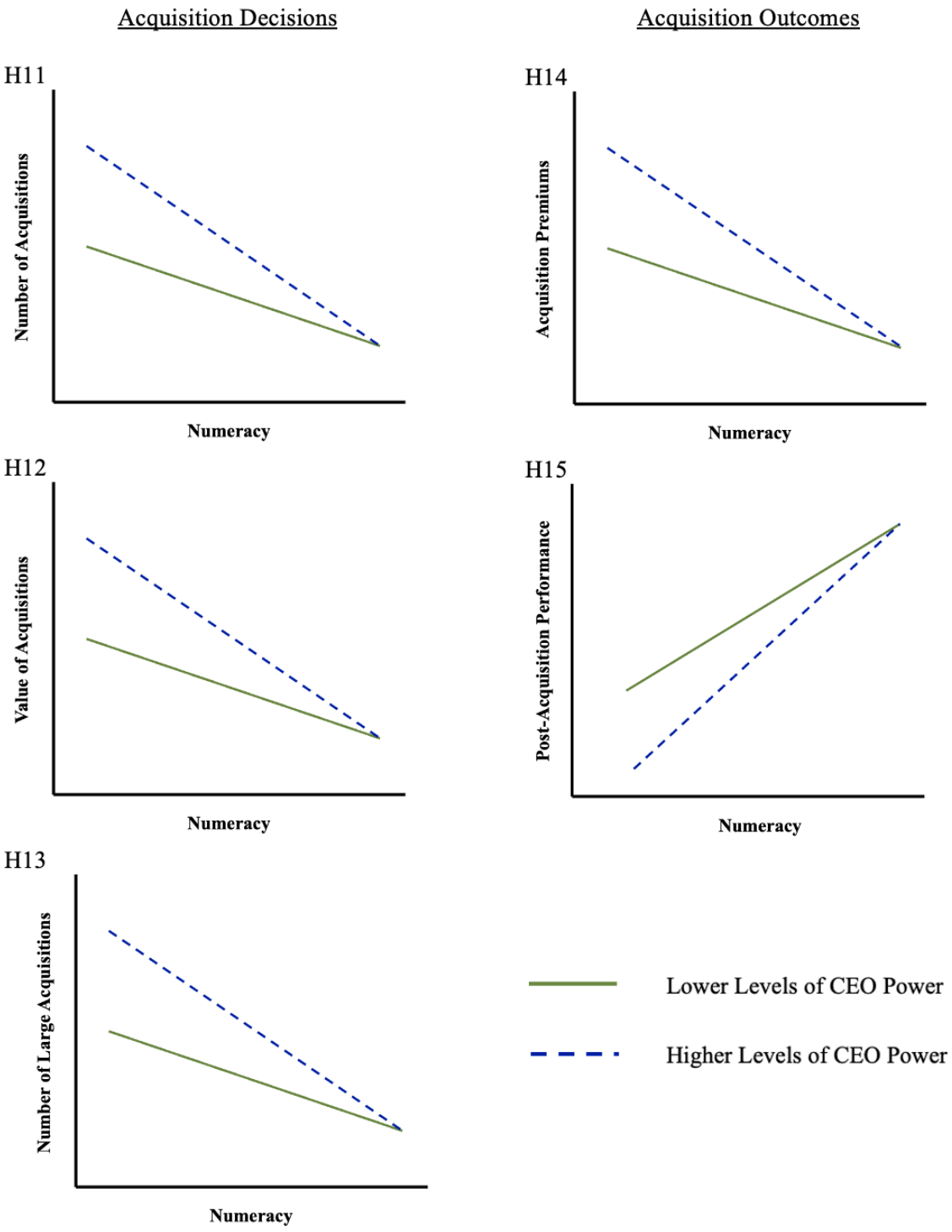

Figure 4: Moderating Effect of Stock Options on Total Value of Acquisitions

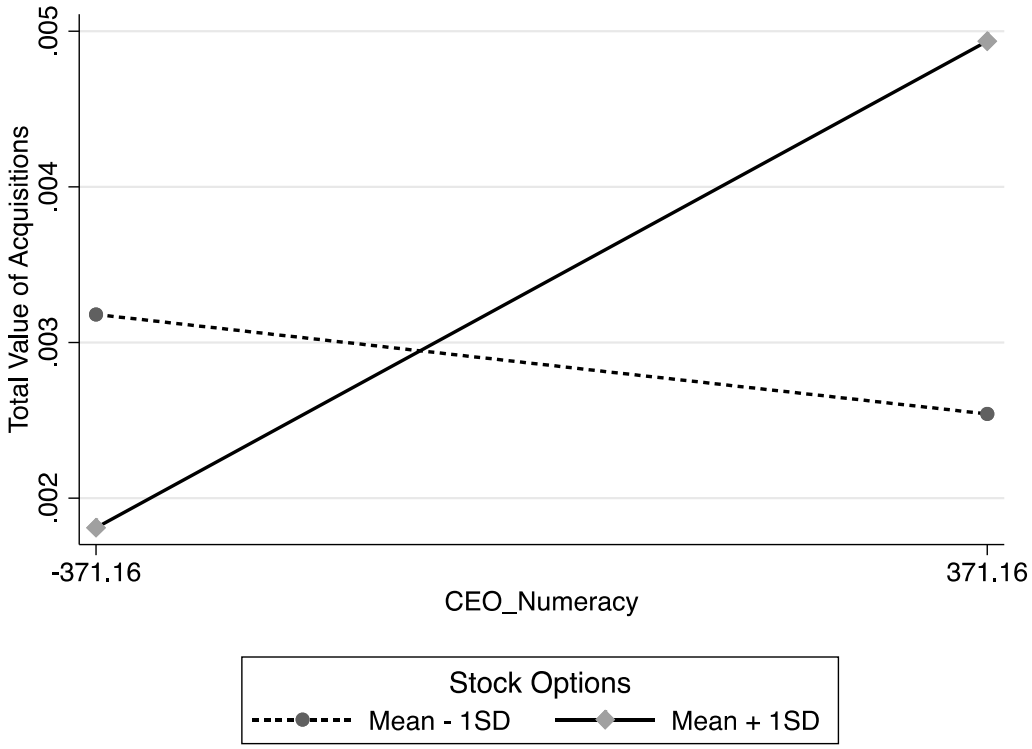

Figure 5: Relationship of Ratio vs. Raw Measure of CEO Numeracy