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The Accumulation of IT Capability And Its Long-Term Effect on Financial Performance

Jin Ho Kim

Old Dominion University, jusin7772001@yahoo.com

THE ACCUMULATION OF IT CAPABILITY AND ITS LONG-TERM EFFECT ON FINANCIAL PERFORMANCE

by

Jin Ho Kim
B.A. February 1992, Han Yang University, Republic of Korea
M.B.A. May 2011, University of Minnesota

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Approved by:
Li D. Xu (Director)
Lan Cao (Member)
Timothy M. Komarek (Member)

ABSTRACT

THE ACCUMULATION OF IT CAPABILITY AND ITS LONG-TERM EFFECT ON FINANCIAL PERFORMANCE

Jin Ho Kim
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Director: Dr. Li D. Xu

Many scholars have been studying information technology (IT) capability and its impact on business performance. However, it has been debated whether the IT capability influences firm performance because prior literature shows mixed results. To understand this phenomenon, I performed two studies in this research, placed in two parts. First, by deploying the new concept of accumulation of IT capability, I attempted to reinvestigate the relationship between IT capability and business performance. Next, I examined what factors influence the accumulation of IT capability. In the first part, I suggested two novel constructs that measure the extent of the accumulation of IT capability: aggregated IT capability, which represents a firm's frequency of appearance on the IW500 list, and continuous IT capability, which indicates a firm's consecutive appearance on the list. From hypothesis tests, I confirmed that the extent of a firm's ability to keep its IT capability could influence its business performance based on timeline and types of ratios. In the second part, to examine the managerial and financial factors in firms' long-term retention of IT capability, I employed survival analysis to substantiate how various factors are related to a firm's risk of losing IT capability. The results show that turnover in IT managers, which can bring in outside knowledge and experience, allows firms to retain IT capability,

whereas IT managers' structural power does not contribute to firms sustaining their IT capability. I also find that continuous IT capability can be influenced by firms' industry characteristics, which may have different levels of information intensity.

This dissertation is dedicated to my wife, who motivated me to choose the Ph.D. program and then constantly supported me to finish this journey.

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LIST OF ABBREVIATIONS

A	Assets
CEO	Chief Executive Officer
CIO	Chief Information Officer
COO	Chief Operating Officer
CTO	Chief Technology Officer
E	Employee
EBIT	Earnings Before Interest and Taxes
IT	Information Technology
IW	InformationWeek
KBV	Knowledge-Based View
KM	Kaplan–Meier
OI	Operating Income
OPEXP	Operating expenses
Q	Tobin's Q
Q-Q	Quantile-Quantile
RBV	Resource-Based View
ROA	Return on Assets
ROS	Return on Sales
S	Sales
SGA	Selling, General and Administrative Expenses

1. INTRODUCTION

In the recent few decades, information technology (IT) has developed rapidly and penetrated many aspects of our daily lives. As the critical resource for a firm's competitive advantage, the concept of IT capability has been widely used in research. Several studies have shown a positive impact of IT capability on business. For example, Grewal, Comer, and Mehta (2001) proposed that the nature of organizations' participation in electronic markets depends on their organizational abilities, and they showed evidence that IT capability is more important than other factors in determining the nature of this participation. Di Benedetto and Song (2003) used empirical tests to investigate the relationships between the strategic types defined by Miles, Snow, Meyer, and Coleman Jr (1978)—prospector, analyzer, defender, and reactor—and firm-level capabilities, including IT capability. They suggested that for effective competition, prospectors must cultivate IT capabilities. Song, Nason, and Di Benedetto (2008) researched the relationship between strategic type and the development of IT capability and argued that "IT capabilities enable the organization to diffuse market information effectively across all relevant functional areas so that it can direct new product development" (p. 9). Prior literatures have examined the role of IT in international B2B relationships and supply-chain performance. The results suggested that IT capabilities contribute directly to improvements in such organizational processes as coordination, transaction-specific investment, absorptive capacity, and monitoring ("Bryan" Jean, Sinkovics, & Kim, 2008).

1.1 IT Capability and Firm Performance

Information technology (IT) capability has been treated as a critical factor that brings competitive advantages to firms and improves firm performance (A. S. Bharadwaj, 2000). Therefore, IT capability has been an important topic in the research area, and there are many studies investigating the capability and its relationship with business performance (Ashrafi & Mueller, 2015; A. S. Bharadwaj, 2000; Chae, Koh, & Prybutok, 2014; Dehning & Richardson, 2002; Mata, Fuerst, & Barney, 1995; Santhanam & Hartono, 2003). However, it has been debated whether the IT capability influences firm performance because prior literature shows mixed results, as follows. Based on the resource-based view (RBV), A. S. Bharadwaj (2000) defined IT capability as "its ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities" (p. 171). The author demonstrated that firms with superior IT capability have higher performance in terms of profits and costs than the corresponding control firms. Santhanam and Hartono (2003) strengthened the findings of A. S. Bharadwaj (2000) by conducting robustness tests that resolve some methodological issues in the research.

In contrast, Chae et al. (2014) did not find any significant relationship between IT capability and firm performance using a more recent dataset than that used by A. S. Bharadwaj (2000) and Santhanam and Hartono (2003). Chae et al. (2014) addressed possible causes of the finding that were contrary to previous research: "standardization and homogenization of IT systems," "ubiquitous and competitive necessity of IT," and a validity issue of the InformationWeek (IW) 500 list, which has been used as a proxy for firms' IT capability (p. 321). To understand this phenomenon that demonstrates inconsistent effects of IT capability, I performed two studies in this research as follows. First, by deploying the new concept of accumulation of IT capability, I attempted to reinvestigate the relationship between IT capability and business performance. Next, I examined what factors influence the accumulation of IT capability.

1.2 The Accumulation of IT Capability

Prior literature examining the impact of IT capability on business has only considered whether firms possess the IT capability. Using the matched sample group method, scholars compared the performance between firms with IT capability and others in the control group. If a firm demonstrated IT capability for a certain number of years, researchers considered the firm as having possessed superior capability. For example, A. S. Bharadwaj (2000), Santhanam and Hartono (2003), and Chae et al. (2014) treated firms as genuinely having IT capability if the firm demonstrated the capability for at least two of four years. Kim, Song, and Stratopoulos (2017); Lim, Stratopoulos, and Wirjanto (2012, 2013) considered that a firm truly possesses IT capability if it demonstrates the capability for a certain number of years consecutively However, this dichotomic approach, that is, comparing the treatment group and the control group, has limitations because firms' IT capability can be accumulated over time and the degree of the accumulation can influence performance over the length of time.

According to A. S. Bharadwaj (2000), IT capability needs time to be developed. Silvestre (2014) stated that firms could achieve technological capabilities through gradual learning processes over time. Nonetheless, to the best of my knowledge, previous researchers to date have not considered the accumulated aspect of IT capability. This gap prompts the research question examining the impact of the accumulation of IT capability on business performance. To investigate this relationship, I suggest two types of IT capability that can represent the extent of the accumulation of IT capability: *aggregated IT capability* and *continuous IT capability*. As an extension of the existing concept of IT capability, a firm's *aggregated IT capability* in this paper is defined as its ability to retain superior IT capability over a span of time. Next, I define a firm's *continuous IT capability* as its ability to sustain or maintain superior IT capability over a span of time consecutively, without interruption, which is a more intensified shape of accumulated IT capability. I use the concept of *accumulated IT capability* in this paper as an inclusive meaning of both the *aggregated IT capability* and *continuous IT capability*. Using these new constructs, I attempt to explain how the degree of a firm's *accumulated (aggregated and continuous) IT capability* influences its financial performance, including increasing profit, decreasing costs, and maximizing market performance.

This work makes two significant contributions to the information systems research area. First, I demonstrated that IT capability could not only be acquired but also accumulated over time, and the degree of this accumulation affects business outcomes. This result indicates that the influence of IT capability has not disappeared but has changed its shape to a more accumulated form. Hence, to gain competitiveness in the market, firms need to maintain their IT capability, not simply achieve it. Next, previous articles that investigated the impact of IT capability on financial performance have examined the relationship only from a short-term perspective by comparing the influence of each year (A. S. Bharadwaj, 2000; Chae et al., 2014; Santhanam & Hartono, 2003). Therefore, this paper highlights this issue and evaluates how the accumulation of firms' IT capability affects their business performance from a long-term perspective. The findings reveal that (1) although limited evidence was found of the relationship between accumulated IT capability and business performance, my research demonstrated how the degree of accumulated IT capability influences business performance, (2) the results varied based on the types of profits and costs, (3) the degree of accumulation of IT capability can help firms to maintain better market performance over firms without the capability from a long-term perspective.

1.3 Factors Influencing Continuous IT capability

A firm's IT capability can accumulate over time, and its degree of accumulation can affect its business performance. According to the resource-based view (RBV), IT capability can be considered a sustainable advantage. It needs time to be developed (A. S. Bharadwaj, 2000), however, and it can also be aggregated at both individual and organizational levels (Figueiredo, 2002). Therefore, the IT capability probably needs time to develop and is likely to be more significant and effectiveness when it has been sustained over a longer time (Kim et al., 2017; Lim, Stratopoulos, & Wirjanto, 2011; Lim et al., 2012, 2013). For these reasons, scholars who study IT capability consider firms that demonstrate sustainable IT capability to actually possess these abilities. However, they have not considered the specific effect of the continuity of IT capability; they have simply discussed IT capability and its impact on business performance—financial, supply chain, and organizational—and adopted the resource-based view (RBV) and the knowledge-based view (KBV) to study it. To the best of my knowledge, even though the sustainability of IT capability plays important role in business performance, no one has investigated the factors that affect it.

Some firms keep their IT capability for a long time and others lose theirs in a few years (Lim et al., 2012, 2013). To explain this phenomenon, I address the research question, "What factors influence firms' long-retention of IT capability?" I examine the impact of various internal factors, such as IT managers and financial elements, on firms' continuous IT capability. I define continuous IT capability as the ability to sustain or maintain IT capability over a span of time without interruption. To do this, I employ survival analysis that incorporates the time until a firm loses its IT capability. Based on my analysis, I expect to be able explain how internal factors help firms accumulate IT capability.

This study is organized in the following order. First, I review literature that utilized the concept of IT capability related to the accumulation of the capability. Then, I present how the prior literature identified and measured the existence of IT capability. Second, I describe the research methods, including sample selection, variable definitions, and research models. Last, I present the research findings, then discuss the implication of the results and limitations of this paper.

2. BACKGROUND AND THEORETICAL FRAMEWORK

2.1 The Accumulation of IT Capability

2.1.1 IT Investment

Several key studies have examined the impact of IT investment on country-level productivity. Dewan and Kraemer (2000) provided evidence on the returns from IT investments by using international data from 36 countries between 1985 and 1993. They estimated the intercountry production function, which relates GDP output to IT and non-IT inputs. The effect of IT investment on GDP in developed countries was positive and significant; however, the effect of IT investment in developing countries was not significant. Using more recent data on IT investment and national productivity for 45 countries from 1994 to 2007, Dedrick, Kraemer, and Shih (2013) found a positive effect of IT investment in developed countries, which is consistent with Dewan and Kraemer (2000). However, unlike Dewan and Kraemer (2000), they also found a positive effect of IT investment on economic development in developing countries. Specifically, they found that upper income developing countries had positive and significant productivity gains from IT investment. They also showed that the impact of IT investment on economic growth was stronger in developing countries with greater human capital and greater foreign direct investment, and high internet penetration.

Pohjola (2002) also examined the effect of IT investment on the economic growth between 1985 and 1999 for a sample of 42 countries. Their results did not show significant returns for IT investment in terms of national productivity growth. Instead of using the IT capital from previous studies, Park, Shin, and Sanders (2007) investigated the effect of imported IT on domestic productivity and found that “when IT products are traded across borders, IT investment in an economy has a positive influence on the productivity of its import partner country" (p. 86). The influence of IT on economic productivity has also been examined from a long-term perspective. For example, Venturini (2009) analyzed the impact of IT capital on GDP growth in the US and EU-15 members from 1980 to 2004 and showed that IT capital was a significant driver of long-term economic growth.

Some studies also performed industry- and firm-level analyses of returns to IT investment. Using data from 81 countries from 1995 to 2000, Lio and Liu (2006) examined the relationship between the adoption of IT and the productivity of agricultural industry. They showed empirical evidence that new IT plays a critical role in enhancing agricultural productivity. In addition, S. Lee, Xiang, and Kim (2011) explored the effect of IT investment on firm-level productivity in the Chinese electronics industry. They showed the positive effect of IT expenditures on firm-level outputs. They further showed that the effect of IT expenditures on firm-level outputs was similar in magnitude between the US and China. Tam (1998) found that IT investment was likely to improve firm-level performance in newly industrialized countries.

Other studies have focused on the spillover effect of IT investment. Using data from US manufacturing industries, Han, Chang, and Hahn (2011) showed that IT investment in supplier industries influenced the productivity of downstream industries, suggesting the existence of an IT spillover effect. Chang and Gurbaxani (2012) examined the long-term effect of IT-related spillovers on the improvements of firm-level productivity. Using the error correction model (ECM), which captures long-run economic relationships, they found that the effect of IT spillover between a firm and its trading partners was significant, especially for firms with high IT intensity.

Scholars have adopted various approaches to examine the association between IT investment and business performance. Especially, IT investment has been used as one of the essential IT-related constructs (Masli, Richardson, Sanchez, & Smith, 2011). In particular, a firm's investment in IT and its returns have received much attention in the information system research area. Sambamurthy, Bharadwaj, and Grover (2003) proposed a conceptual framework describing that information technology investment and capability influence firm performance based on organizational capabilities and strategic processes. Mahmood and Mann (1993) empirically proved that IT investment is closely related to organizational strategic and economic performance. Recently, Steelman, Havakhor, Sabherwal, and Sabherwal (2019) extended the prior studies that focuses on IT investment and its returns by separating the traditional concept of IT into adopting new IT and maintaining current IT. As above, it can be seen that the investments in IT have been considered and studied as an important factor in the company's performance.

2.1.2 IT Productivity Paradox

Although IT investment is an essential topic that has been investigated in research, there has been controversy over the influence of IT investment and its impact on business. Prior research in the 1990s could not find any evidence that IT investments increase firms' output. Based on production theory, Barua, Kriebel, and Mukhopadhyay (1995) investigated the relationship between IT investment and productivity and could not find any positive correlation between them. Moreover, the costs of IT couldn't exceed the returns on investments (Morrison, 1997). These contradictory results between investments and returns have been referred to as the "IT productivity paradox" (Brynjolfsson, 1993).

The productivity paradox is a phenomenon in which the productivity growth in the United States slowed in the 1970s despite widespread investment and rapid development in the IT sector during the same period (Brynjolfsson, 1993). According to Hitt and Brynjolfsson (1996), productivity, in economics, is the amount of output that is produced per unit of input. The output can be not only the tangible products of factories but also intangible ones such as product quality, customization, convenience, and others. The input includes the investment of human resources as well as various other resources such as materials and capital. Brynjolfsson (1993) observed four probable causes of this discrepancy between IT investment and output as follows: "1. Mismeasurement of outputs and inputs, 2. Lags due to learning and adjustment, 3. Redistribution and dissipation of profits, and 4. Mismanagement of information technology" (p. 73).

2.1.3 IT Capability

To address the IT productivity paradox, information systems scholars adopted an RBV, which considers that firms have valuable, rare, inimitable, and un-substitutable resources that bring competitive advantages to the firms (Barney, 1991; Verbeke, 2003). Based on RBV, A. S. Bharadwaj (2000) defined IT capability as "its ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities" (p. 171). A. S. Bharadwaj (2000) argued that firms could differentiate themselves by possessing IT capability, which can be considered as a sustainable advantage. By testing the robustness of IT capability and its impact on firm performance, A. S. Bharadwaj (2000), as well as Santhanam and Hartono (2003), showed that that firms with superior IT capability demonstrate better financial performance than firms without IT capability, and that the effect of IT capability can be sustained for a time.

Other researchers support the finding that IT capability brings competitive advantages to companies. By focusing on the role of IT capability, Doherty and Terry (2009) provided evidence that the sustainable enhancement of a firm's competitive position relies on its IT capability. Unlike IT investment, IT capability also promotes innovation, increases profits, and decreases costs of business (Aral & Weill, 2007). Muhanna and Stoel (2010) suggested that "Investors reward firms with superior IT Capability through increased market value, in recognition of the potential positive impact on the risk and magnitude of the firm's future income stream" (p. 33). As a mediator, IT capability also drives the performance of firms with IT managers who have structural power in the organization (Lim et al., 2012).

Even though IT capability based on the RBV has provided better insights about how IT influences firm performance (A. S. Bharadwaj, 2000; Muhanna & Stoel, 2010; Santhanam & Hartono, 2003), the results of the research have not been consistent with Chae et al. (2014). While the concept of IT capability based on RBV has successfully demonstrated the critical role of IT resources in increasing firm performance, Chae et al. (2014), using the same concept of IT capability and research methods (with a more recent dataset), found no significant relationship. The authors suggested two possible causes for the contradict result: (1) Due to the trends of standardization and commoditization of IT, firms can easily equip with IT capability so the superior IT capability cannot bring their competitive advantage into the organization, (2) The use of the IW500 list for measuring firms' IT capability is flawed because InformationWeek has changed the selection criteria of the list over time. Chae et al. (2014) suspect that this modified selection criteria could cause the contradictory results of the research.

2.1.4 Measurement of IT Capability

To examine the above controversy, it is necessary to know how IT capability has been measured in the research models in detail. The prior literature has paid little attention to the measurement of IT capability (Oz, 2005; Yoon, 2011); however, a few scholars have addressed the issue. Stoel and Muhanna (2009) argued that A. S. Bharadwaj (2000) and Santhanam and Hartono (2003) research models that measure the aggregation of IT capability are insufficient to examine the influence of IT capabilities on firm performance. However, Chae et al. (2014) suggested the possibility of having an issue with the IW500 lists, which have been widely used in research as a proxy for IT capability. The authors suspected that the constant changes of selection criteria in IW500 lists could affect the results of studies, resulting in contradictory findings among the literature that uses the lists.

IT reputation from InformationWeek (IW) 500 has been widely used in research papers as a proxy for IT capability. Scholars consider that firms have superior IT capability if the firms are listed in the IW500 for a certain period. Table 1 shows literature that used IW500 lists published by InformationWeek to investigate IT capability and its impact on business. All articles adopted the matched sample design. The method sets the companies with superior IT capability as the treatment sample, provide the matched control companies, and statistically tests the research model (Chae et al., 2014). In the lists, there are two types of IT capability measurement. First, to select companies with superior IT capability, some scholars employed aggregate measures of IT capability (Stoel & Muhanna, 2009). For example, A. S. Bharadwaj (2000), Chae et al. (2014), and Santhanam and Hartono (2003) considered that firms have genuine IT capability when they are recognized in the IW500 at least twice within four years. The total number of firms' appearances on the list during the given research period was the primary measure of superior IT capability. In contrast, the control samples were selected from the companies that have not appeared on the list at all during the period.

Table 1. Literature Measuring IT Capability based on IW500

References	Measures of IT capability	Types of Measure	Research method
Bharadwaj (2000)	Appeared in IW500 in at least two of the four year	Aggregation	Matched sample comparison
Santoanam & Hartono (2003)	Appeared in IW500 in at least two of the four year	Aggregation	Matched sample comparison
Chae et al. (2014)	Appeared in IW500 in at least two of the four year	Aggregation	Matched sample comparison
Lim et al. (2012)	Recognized in IW500 for 4 years	Continuity	Matched sample comparison
Lim et al., (2013)	Recognized in IW500 for 4 years	Continuity	Matched sample comparison
Kim, Song, & Stratopoulos (2017)	Recognized in IW500 for five consecutive years	Continuity	Matched sample comparison
Stoel & Muhanna (2009)	Appeared in IW500 at least once	Dummy	Matched sample comparison
Muhanna & Stoel (2010)	Appeared in IW500 at least once	Dummy	Matched sample comparison

Second, the continuity of firms' IT capability has been used as a measure of IT capability. Since IT capability takes time to be developed, Lim et al. (2012, 2013) used four-year rolling windows to measure firms' IT capability. If a firm has appeared four times in the IW500 for four years, which is a rolling window, it has achieved and sustained IT capability. If a firm has been listed in the IW500 fewer than four times, it has achieved but failed to maintain the capability. In contrast, Kim et al. (2017) argued that IT capability needs time to be developed, so they consider a firm has superior IT capability if it is listed in the IW500 for five years consecutively. Dehning and Stratopoulos (2003) also mentioned that IT capability takes 5 to 7 years to be developed.

2.1.5 Research Gap

Prior research has determined whether a firm has superior IT capability based on an aggregate or continuous measure of IT capability (A. S. Bharadwaj, 2000; Chae et al., 2014; Kim et al., 2017; Lim et al., 2012, 2013; Santhanam & Hartono, 2003). After specifying certain criteria, such as the number of a firm's appearances on the IW500, the existence or absence of the firm's IT ability is decided by dichotomy. Based on the criteria, firms are divided into two groups: a treatment group with superior IT capability and a control group. The two groups' performances are then empirically compared. These approaches, however, have not discussed how the extent of the accumulation of IT capability can influence firm performance over time. Since IT capability takes time to develop (Kim et al., 2017) and accumulates over time (A. S. Bharadwaj, 2000; Figueiredo, 2002), the dichotomous approach, which evaluates the possession of IT capability based on the criteria, is limited to explaining the relationship between the degree of IT capability accumulation and firm performance. Therefore, this study extends the literature by considering the degree of accumulation of IT capability in measuring firms' possession of IT capability.

2.2 Factors Influencing Continuous IT capability

2.2.1 IT capability from an RBV perspective.

Before the application of RBV, IT was treated as a simple resource that can be replicated easily and makes no contribution to the firm's performance. However, A. S. Bharadwaj (2000)'s resource-based view of IT suggests that firms can differentiate themselves by their IT resources. IT infrastructure, human IT skills, and the ability to leverage IT for intangible benefits are firm-specific resources that together create firm-wide IT capability. Santhanam and Hartono (2003) empirically showed the existence of a positive relationship between IT capability and firm performance. Their results also confirmed that the RBV framework is robust.

Wade and Hulland (2004) argued that the RBV is useful to information system (IS) research because it can help researchers explain how information systems are related to firms' strategies and performance and to evaluate the strategic value of information-system resources. Uhlenbruck, Meyer, and Hitt (2003) focused on the acquisition of IT resources and capabilities by examining the acquisition of online firms that provide resources and skills for internet marketing and enhanced efficiency. On the basis of the RBV, they argued that the acquisition of IT firms brings benefits to both the acquiring and the target firms by creating synergy.

2.2.2 IT capability from a KBV perspective.

The KBV adds to the RBV by extending its scope from tangible resources to intangible ones. Grant (1996) held that knowledge is the most valuable resource firms possess, and that it is created by individuals, not organizations. Judge et al. (2015) stated, "The KBV focuses on key knowledge workers operating inside the firm to explain organizational outcomes" (p. 1175).

Firms can aggregate knowledge from their past experiences, learning processes, and current business practices (Pavlou, Housel, Rodgers, & Jansen, 2005).

Because IT knowledge is an important resource for firms, scholars have applied the KBV to IS research. Armstrong and Sambamurthy (1999) showed that CIOs' business and IT knowledge significantly influences their firms' IT assimilation. They argued that superior business and IT knowledges help CIOs find innovative ways to integrate technological capabilities and business requirements. Also following the KBV, Pavlou et al. (2005) suggested a framework for allocating revenue to and estimating returns on IT investments. To assess the impact of IT investments, this model captures the knowledge needed to drive firm processes and assesses the actual cost of the knowledge needed to execute a given process.

As a critical branch of knowledge, IT capability can be acquired from external sources to help firms survive in the market. According to Link and Zmud (1987), in competitive markets large companies rely on external sources of technological knowledge as well as their internal R&D resources. Employees from outside a company can bring new knowledge into it, so firms can acquire external knowledge by hiring people who have it (Cassiman & Veugelers, 2006)

2.2.3 Continuous IT capability.

IT capability, as one of a firm's business capabilities, can accumulate over time, and its accumulation can influence business performance. A. S. Bharadwaj (2000) claimed, "Technical and managerial IT skills typically evolve over long periods of time through the accumulation of experience" (p. 173). Bell and Pavitt (1997) model of the accumulation of technological capability showed that technological accumulation influences industry output. The technological capability can be aggregated and implemented not only at the individual level as skills, knowledge, and experience, but at the organizational level (Figueiredo, 2002). Once knowledge has accumulated in an organization, it can be easily transferred between units in the company (Foss & Pedersen, 2002). This research considers the degree of accumulation of IT capability as an important factor. For example, to show the impact of firms' IT capability on their business performance, some scholars have regarded only companies that have consistently demonstrated IT abilities over multiple years as actually having those abilities (A. S. Bharadwaj, 2000; Kim et al., 2017; Lim et al., 2011, 2012, 2013).

On a resource-based view, scholars treat IT capability as a sustainable competitive advantage that differentiates a firm from its competitors. Clemons and Row (1991) defined competitive advantage as "the ability to earn returns on investment persistently above the average for the industry" (p. 277). They argued that IT, which can lead to sustainable competitive advantages, changes the value of key resources through reduced integration costs and enhanced coordination, which cannot be easily copied by competitors. Doherty and Terry (2009) examined the effect of IT capability on the sustainable enhancement of a firm's competitive position. They concluded that firms can make sustainable improvements in competitive position by using IT capabilities, which are inimitable and cannot be replaced easily.

2.2.4 Research Gap

The literature review for the second topic showed that IT has been treated as a means for firms to gain advantages that differentiate them from competitors. And as an intangible resource, managers' IT knowledge contributes to IT capability and innovation. To secure IT knowledge, firms can hire new people who have outside experience. Lastly, IT capability can be accumulated, and the extent of continuity of IT capability influences firms' performance.

Whereas research into IT capability and its impact has been studied in terms of resources and knowledge, to the best of my knowledge, factors such as IT managers' influence on the long-term retention of IT capability have not been discussed. I address this gap by suggesting the following hypotheses.

3. RESEARCH HYPOTHESES

3.1 The Accumulation of IT Capability

3.1.1 Accumulation of IT Capability and Firm Performance

IT capability can be accumulated over time, and the extent of accumulation can influence firm performance. Bell and Pavitt (1997) suggest a research model using the concept of the accumulation of technological capability, explaining that technological accumulation influences industry output. It is known that firms need time to develop IT capability (Kim et al., 2017, p. 189). A. S. Bharadwaj (2000) stated that "Technical and managerial IT skills typically evolve over prolonged periods of time through the accumulation of experience" (p. 173). Like knowledge, skills, and experience, IT capability can also be aggregated at individual and organizational levels over time (Figueiredo, 2002).

The prior literature demonstrated a positive relationship between a firm's IT capability and its impact on business performance (Kim et al., 2017; Lim et al., 2012, 2013). Dos Santos, Peffers, and Mauer (1993) also found positive and significant abnormal returns for firms that make innovative IT investments, indicating that first movers achieve the most benefits from IT. Investors evaluate the characteristics of firms, and according to RBV, IT capability is rare and heterogeneously distributed across firms. Therefore, IT is likely to serve as a source of competitive advantage. According to knowledge-based view (KBV) scholars, knowledge is the primary source of value for firms (Grant, 1996). By increasing the accessibility of information and providing intelligent methods to analyze it, IT can increase not only the value of the knowledge in the firm but also the managers' knowledge (Armstrong & Sambamurthy, 1999). IT capability plays a critical role not only in increasing firms' value (Muhanna & Stoel, 2010) but in bringing them long-term profitability. Likewise, IT-enabled firms showed greater profitability than a matched group (Dehning & Richardson, 2002).

Firms' performance can be influenced by the accumulation of IT capability. To measure superior IT capability, scholars use the extent of aggregation of IT capability over time (A. S. Bharadwaj, 2000; Chae et al., 2014; Santhanam & Hartono, 2003; Stoel & Muhanna, 2009). These studies classified companies that showed IT capability more than a specified amount of time over the period as genuinely possessing the capability. Since IT capability can be accumulated (A. S. Bharadwaj, 2000; Figueiredo, 2002) and can influence industrial output (Bell & Pavitt, 1997), I hypothesize that the aggregation of IT capability will also enhance firms' performance:

Hypothesis 1: *The degree of aggregated IT capability is associated with significantly higher profit ratios.*

Hypothesis 2: *The degree of aggregated IT capability is associated with significantly lower profit ratios.*

Hypothesis 3: *The degree of aggregated IT capability is associated with significantly higher market performance.*

3.1.2 Continuity of IT Capability and Firm Performance

Maintaining a firm's IT capability continuously over time plays a vital role in determining whether the firm has the ability and affects business performance. According to Dehning and Stratopoulos (2003), a firm's ability to sustain its IT capability is crucial because IT capability becomes its competitive advantage after having the capability at least for five years. Additionally, some scholars consider only firms that demonstrate their IT abilities consecutively over a period of time as actually having the capabilities (Kim et al., 2017; Lim et al., 2011, 2012). Based on this, Kim et al. (2017) argued that companies having continuous IT capability outperformed firms not having continuous IT capability. As a more intensified shape of accumulated IT capability, I assume that a firm's continuous IT capability is important in increasing firm performance. Based on these observations, I suggest the following hypotheses:

Hypothesis 4: *The degree of continuous IT capability is associated with significantly higher profit ratios.*

Hypothesis 5: *The degree of continuous IT capability is associated with significantly lower profit ratios.*

Hypothesis 6: *The degree of continuous IT capability is associated with significantly higher market performance.*

3.1.3 Influence of Financial Halo Effects on the Relationship between Accumulated IT capability and Firm Performance

Scholars found the possibility of a correlation between industry ranking and past financial performance, which is called the "financial performance halo effect" (Brown & Perry, 1994). Therefore, prior literature that tested the relationship between firms' IT capability and its impact on financial performance (A. S. Bharadwaj, 2000; Chae et al., 2014; Santhanam & Hartono, 2003) considered that a firm's selection in IW500 could be influenced by its prior financial performance. Santhanam and Hartono (2003) found that firms' prior financial performance significantly influenced their current financial performance, so that the higher performance of the firms with IT capability over the firms without IT capability became weak after adjusting for prior financial performance, but it was still statistically significant. Since a firm's degrees of aggregated IT capability and continuous IT capability is measured based on its appearance on the IW500, I need to confirm that a firm's current financial performance is determined by its degrees of these IT capabilities, not by its prior financial performance. Therefore, I perform additional tests after controlling for the financial halo effect in this research as follows:

Hypothesis 7: *The degree of aggregated IT capability is associated with significantly higher profit ratios after adjusting for prior financial performance.*

Hypothesis 8: *The degree of aggregated IT capability is associated with significantly lower profit ratios after adjusting for prior financial performance.*

Hypothesis 9: *The degree of aggregated IT capability is associated with significantly higher market performance after adjusting for prior financial performance.*

Hypothesis 10: *The degree of continuous IT capability is associated with significantly higher profit ratios after adjusting for prior financial performance.*

Hypothesis 11: *The degree of continuous IT capability is associated with significantly lower profit ratios after adjusting for prior financial performance.*

Hypothesis 12: *The degree of continuous IT capability is associated with significantly higher market performance after adjusting for prior financial performance.*

3.1.4 Influence of Financial Halo Effects on the Relationship between Accumulated IT capability and Firm Performance in a long-term perspective

While a firm's IT capability needs to be developed over long periods of time by accumulating its experiences (A. S. Bharadwaj, 2000), IT capability as a sustainable competitive advantage can reduce costs of business and enhance the process in the long run (Clemons & Row, 1991). However, the prior literature (A. S. Bharadwaj, 2000; Chae et al., 2014; Santhanam & Hartono, 2003), which are the sources for this paper, only examined the short-term effect of IT capability on business performance. The researchers simply compared the mean of each group's financial performance, and cross-sectionally tested the relationship between IT capability and financial performance year-by-year. Then, they did not consider the cause and effect relationships between them in a long-term perspective. Chae et al. (2014) and Santhanam and Hartono (2003) pointed out the limitation of using cross-sectional analysis in their studies and suggested a longitudinal study to investigate the sustained effect of IT capability on business performance as an avenue of the future research. Therefore, to explain how the aggregated and continuous IT capability is associated with financial performance in the long run, I adopted a longitudinal perspective and assumed my hypotheses as follows:

Hypothesis 13: *The degree of aggregated IT capability is associated with significantly higher profit ratios after adjusting for prior financial performance over time.*

Hypothesis 14: *The degree of aggregated IT capability is associated with significantly lower profit ratios after adjusting for prior financial performance over time.*

Hypothesis 15: *The degree of aggregated IT capability is associated with significantly higher market performance after adjusting for prior financial performance over time.*

Hypothesis 16: *The degree of continuous IT capability is associated with significantly higher profit ratios after adjusting for prior financial performance over time.*

Hypothesis 17: *The degree of continuous IT capability is associated with significantly lower profit ratios after adjusting for prior financial performance over time.*

Hypothesis 18: *The degree of continuous IT capability is associated with significantly higher market performance after adjusting for prior financial performance over time.*

3.2 Factors Influencing Continuous IT capability

3.2.1 IT managers and continuous IT capability.

The existing studies show that not only chief executive officers (CEOs) but top management teams significantly influence business performance. Using the concept of "dominant coalition," which moves the focus of organizational leadership studies from CEOs to top management teams (Cyert & March, 1963), Tihanyi, Ellstrand, Daily, and Dalton (2000) argued that certain characteristics of these teams are associated with firms' business performance in areas such as international diversification. According to upper echelons theory (Hambrick & Mason, 1984), there is a strong relationship between strategic leaders' characteristics and firms' innovation strategies. Elenkov, Judge, and Wright (2005) explored the influence of strategic leaders on innovation and concluded that strategic leadership behaviors do affect executive influence on innovation by organizations.

Nowadays, the role of IT executives in top executive teams is becoming more important. Byrd, Lewis, and Bradley (2006) considered senior IT leadership to be "the level of authority and responsibility of the CIO in an organization and the degree of participation of top business managers and users along with IT personnel in an IT advisory committee" (p. 101). They claimed that senior IT leadership plays an important role in strategic information system planning. Tripathi and Khazanchi (2018) also argued that IT leadership is very important for a firm's achieving its objectives. A firm's IT executives can increase its value. Khallaf and Skantz (2007) demonstrated that IT executives' characteristics are considered by investors and thus influence a firm's market value.

According to Feeny and Willcocks (1998), IT executives are instrumental in enhancing firms' IT capabilities. Using IT capability as a mediator between IT executives and firm performance, Lim et al. (2012, 2013) found a positive relationship between the hierarchical power of senior IT executives and the development of IT capability and determined that the impact of IT capability on a firm's competitive advantage is higher when IT executives have more power in the organization. They concluded that higher-level IT executives improve firm performance by increasing IT capability. Because IT capability can accumulate over time (A. S. Bharadwaj, 2000; Figueiredo, 2002), I expect IT executives who have more power to also contribute to continuous IT capability:

Hypothesis 19: *The structural power of senior IT executives is positively related to the development of continuous IT capability.*

Because a firm's performance and business strategies are influenced not only by its CEO but by its top management team (Hambrick & Mason, 1984), turnover on that team has a significant impact on organizational change and business performance. Manager turnover in particular appears to be able to improve a firm's performance (Parker, Peters, & Turetsky, 2002).

Sakano and Lewin (1999) claimed that in the United States, top executive turnover affects firms' strategic changes and organizational restructurings.

Shen and Cannella Jr (2002) argued that in certain conditions, such as CEO succession, senior executive turnover is positively associated with firms' returns on assets (ROA). A CEO with firm-specific knowledge can reduce poor replacement decisions and find new senior executives who fit the firm and are loyal and capable. As Lim et al. (2012, 2013) showed, IT executives are important factors in firms' IT capability. Because newly hired IT people can bring new knowledge into organizations (Caloghirou, Kastelli, & Tsakanikas, 2004; D. M. Lee & Allen, 1982), I assume that IT executive turnover can prolong a firm's continuous IT capability by adding the capacities and experiences of the new IT executives to the organization:

Hypothesis 20: *Turnover in IT executives is positively related to the development of continuous IT capability.*

3.2.2 Industry and Continuous IT Capability

Industry is an important determinant in various research areas. According to Mauri and Michaels (1998), industry-level characteristics influence firms' R&D intensity because "firms competing in the same industry tend to develop homogeneous competitive strategies for investing in technology and marketing resources" (p. 216). The significance of IT capability may differ between industries (Chae, Koh, & Park, 2018; Stoel & Muhanna, 2009). As an important variable in IS research, industry can influence factors such as IT impacts, IT uses, and IT practices (Chiasson & Davidson, 2005, p. 596). Broadbent, Weill, Brien, and Neo (1996) demonstrated that due to their differing levels of information intensity, firms in different industries have different forms of IT capability. Based on these studies, I presume that patterns of continuous IT capability also vary throughout industry:

Hypothesis 21: *Due to the different characteristics of their businesses, firms in different industries have different levels of continuous IT capability.*

4. RESEARCH METHODS

4.1 Research Methods for the Accumulation of IT Capability

I employ a "matched sample comparison group" methodology to investigate the relationship between continuous IT capability and its impact on business performance. The method has been widely used in not only accounting, finance, and marketing literature, but also information systems research area (A. S. Bharadwaj, 2000; Chae et al., 2014; Lim et al., 2011, 2012, 2013; Santhanam & Hartono, 2003). This is useful to compare the interest variables of two groups: the treatment sample and the control sample. In this research, the firms with aggregated or continuous IT capabilities are in the treatment sample. And then, I select the control sample, which includes firms matched to the treatment sample based on size and industry type of the companies. After that, I compared the performance of the two groups by using several research methods. All financial data for both treatment and control groups in this research was collected from Compustat, which is a global financial database provided by Standard & Poor's.

4.1.1 Samples

InformationWeek (IW) has conducted surveys to firms in the United States and published the list of 500 companies which are considered as IT leaders. Several important studies have used the InformationWeek (IW) 500 list as a proxy for firms' IT capability (A. S. Bharadwaj, 2000; Chae et al., 2014; Lim et al., 2011, 2012, 2013; Santhanam & Hartono, 2003). In this research, the firms in the treatment group were selected among companies listed in IW500 for a minimum of three consecutive years from 2005 to 2013. I initially found 295 companies in the list. As A. S. Bharadwaj (2000) and Chae et al. (2014) proposed in their research, matched control firms were chosen based on the same industry as the firms in the treatment group and the last five years' (2000–2004) average sales level just before the research period. The control firms' average sales from 2000 to 2004 are within 70 to 130 percent of the treatment firms' average sales. To distinct firms with superior IT capability and the control sample, I chose firms that were not listed in IW500. After removing the firms which don't have available control firms, the final sample includes 214 treatment firms and 214 control firms.

4.1.2 Key Variables and Measurement

IT capability. Some scholars have regarded companies that have demonstrated their IT abilities over the years as genuinely having superior capabilities (Kim et al., 2017; Lim et al., 2013). Therefore, I treat companies listed on the IW500 for more than three consecutive years as having superior IT capability, which is a traditional measure of IT capability. All companies in the treatment sample belong to the groups. In the regression model, these are represented as a dummy variable IT_CAP, which is set 1 and the variable in the control sample is set 0.

Aggregated IT capability. To measure the extent of aggregated IT capability, I use IW500, which is the annual rankings of IT leaders suggested by IW. As A. S. Bharadwaj (2000), Chae et al. (2014), and Santhanam and Hartono (2003) proposed, I employed aggregate measures of IT capability. A firm's aggregated IT capability is its total number of appearances on the IW500 from 2005 to 2013. Table 2 shows how the aggregated IT capability is measured from the IT500 list. Prior studies dichotomously used the frequency of firms' appearance on the list to determine whether they have superior IT ability. To the contrary, my research fully measures the aggregation of firms' appearance on the list and employs it to investigate how the degree of aggregated IT capability affects business performance.

Table 2. Examples of Aggregated IT Capability Possessed by Firms Listed in IW500 List

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Aggregated IT Capability
company A		**1**	**1**	**1**		**1**				**4**
company B		**1**	**1**	**1**		**1**	**1**			**5**
company C	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**9**

Based on the aggregated IT capability number, the treatment sample is divided into three subgroups: IT_AGG_{Low}, IT_AGG_{Med}, and IT_AGG_{High} (Table 3). Each group is represented as a dummy variable that shows the extent of aggregated IT capability. The first group (IT_AGG_{Low}) includes firms that appeared in the IW500 three times during the research period. The second group (IT_AGG_{Med}) has firms that appeared in the list from four to five times. The firms in the last group (IT_AGG_{High}) appeared on the list from six to nine times. Each group's matched control group is represented as $Control_{AL}$, $Control_{AM}$, and $Control_{AH}$, respectively.

Table 3. Number of Firms Based on The Degree of Aggregated IT Capability

Variables	Degree	# of Aggregated IT Capability	# of Firms	Matched Control Group	# of Firms
IT_AGG_{Low}	Low	3	41	$Control_{AL}$	41
IT_AGG_{Med}	Medium	4~5	75	$Control_{AM}$	75
IT_AGG_{High}	High	6~9	98	$Control_{AH}$	98

Continuous IT Capability. As a more intensive form of IT capability, scholars measured how long firms have sustained their IT capability continuously and use the concept in their research as one of the key variables. For example, Lim et al. (2012, 2013) considered that firms have sustainable IT capability when they appear in the IW500 for four years within the four-year rolling windows. Kim et al. (2017) suggested that a firm has true IT capability if it is listed in the IW500 for consecutive five years. Based on these studies, I also measure a firm's consecutive appearance in the IW500 without interruption and consider it as its continuous IT capability (Table 4).

Table 4. Examples of Continuous IT Capability Possessed by Firms Listed in IW500 List

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Continuous IT Capability
company A		**1**	**1**	**1**		1				**3**
company B		1			**1**	**1**	**1**	**1**	**1**	**5**
company C	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**9**

As for the sample with aggregated IT capability, the firms in the treatment sample are also divided into three subgroups based on the degree of continuous IT capability: IT_CON_{Low}, IT_CON_{Med}, and IT_CON_{High} (Table 5). The firms in the first group (IT_CON_{Low}) appeared in the IW500 for three years consecutively. The firms in the second group (IT_CON_{Med}) consecutively appeared in the list for four to five years. The last group (IT_CON_{High}) includes firms that appeared on the list for six to nine years, continuously. Each group's matched control group is indicated as $Control_{CL}$, $Control_{CM}$, and $Control_{CH}$, respectively.

Table 5. Number of Firms Based on the Degree of Continuous IT Capability

Variables	Degree	# of Continuous IT Capability	# of Firms	Matched Control Group	# of Firms
IT_CON_{Low}	Low	3	60	$Control_{CL}$	60
IT_CON_{Med}	Medium	4~5	71	$Control_{CM}$	71
IT_CON_{High}	High	6~9	83	$Control_{CH}$	83

Financial Performance. To measure business performance, I adopted the financial variables that were used by A. S. Bharadwaj (2000), Chae et al. (2014), and Santhanam and Hartono (2003). First, as profit-related ratios, I use return on assets (ROA), return on sales (ROS), operating income to assets (OI/A), operating income to sales (OI/S), and operating income to employees (OI/E). Second, as cost-related ratios, I measured total operating expenses to sales (OPEXP/S), cost of goods sold to sales (COG/S), and selling and general administrative expenses to sales (SGA/S).

I also used Tobin's Q ratio as a proxy for market performance. To predict a firm's future investment, James Tobin originally coined the ratio in 1969. It is defined as a firm's market value divided by the replacement cost of its assets (Lim et al., 2012, p. 27). As a measure of firm performance, Tobin's Q ratio has been widely used in the research area to explain various phenomena related to investments and returns. Particularly, A. S. Bharadwaj, Bharadwaj, and Konsynski (1999) argued that "Tobin's q provides a more appropriate measure of IT's impact on firm performance" (p. 1019) and provided empirical evidence that demonstrates the association between IT investments and market performance. Therefore, I adopted Tobin's Q ratio to examine how accumulated IT capability affects market performance. Details of financial variables, including formulae and data sources, are described in Table 6.

Table 6. Financial Variables

Ratio	Types	Formula (Compustat variables)	Components
ROA	Profits	Net Income/Assets (NI/AT)	**AT**: Assets **CEQ**: Common/Ordinary Equity **COG**: Cost of Goods Sold **CSHO**: Common Shares Outstanding **EBIT**: Earnings Before Interest and Taxes **EMP**: Employees NI: Net Income **PRCC_F**: Price Close - Fiscal **SALE**: Sales/Turnover **XOPR**: Operating Expenses **XSGA**: Selling, General, and Administrative expenses
ROS	Profits	Net Income/Sales (NI/SALE)	
OI/A	Profits	Operating Income/Sales (EBIT/SALE)	
OI/E	Profits	Operating Income/Employee (EMP)	
OI/S	Profits	Operating Income/Sales (EBIT/SALE)	
OPEXP/S	Costs	Operational Expenses/Sales (XOPR/SALE)	
COG/S	Costs	Cost of Goods Sold/Sales (COG/SALE)	
SGA/S	Costs	Selling, General, & Administrative Expenses/Sales (XSGA/SALE)	
Q	Market performance	Market Value of Firm/Asset Value of Firm (AT+(CSHO*PRCC_F) - CEQ)/AT	

* The boxplots for all financial ratios are attached in Appendix A.

4.1.3 Statistical Methods

By suggesting new concepts of IT capability, this research extends the prior literature that used traditional IT capability, which was shown in Table 1. I tested the proposed constructs, aggregated IT capability, and continuous IT capability, from multiple angles by replicating several econometric models that have been used to investigate the impact of simple IT capability on firm performance.

First, to evaluate the difference of business performance between firms with various levels of aggregated or continuous IT capability and matched control firms without the capability, I employed the Wilcoxon signed-rank test, which is a non-parametric statistical hypothesis test to compare paired samples, and can be used as an alternative to the paired t-test when the normality assumption cannot be assumed (A. S. Bharadwaj, 2000; Chae et al., 2014; Santhanam & Hartono, 2003). I checked the normality assumption of my dataset using the Q-Q (Quantile-Quantile) plot, confirming that the dataset did not fit a normal distribution. Next, I decided to deploy the Wilcoxon signed-rank test instead of the paired t-test, which requires a dataset satisfying a normality assumption.

A quantile-quantile (Q-Q) plot demonstrates the distribution of a given dataset against the expected normal distribution. A Q-Q plot has two quantiles: sample quantiles (Y-axis), which are generated from sample data, and theoretical quantiles (X-axis) are generated from a normal distribution. A dot in the graph represents a data point. If most of the dots are on a straight line, I can say that the data are normally distributed. Otherwise, I can say that the data are not normally distributed. I generated the Q-Q plots based on the data from all financial variables (ROA, ROS, OI/A, OI/E, OI/S, OPEXP, COG/S, SGA/S, and Q) from 2005 to 2013. The detail results of normality assumption checking are attached in Appendix B. Most of the data points in the graph are not exactly aligned with a straight line. As a result, I confirmed that the data do not follow the normal distribution. These results led us to use Wilcoxon signed-rank test, which is a non-parametric test and a method used Bharadwaj (2000), Santhanam and Hartono (2003), and Chae, Koh, and Prybutok (2014).

Second, to test the financial halo effect in Hypotheses 7–12, I used the regression analysis employed by Santhanam and Hartono (2003). The scholars conducted a regression analysis after placing a prior year's performance as an independent variable in the model. Likewise, I performed eight regression tests for each financial performance variable. The first regression model regresses the previous year's performance on the current year's performance, using all samples, including both the treatment and control sample. Next, each degree of aggregated or continuous IT capability is applied to the rest of the models as dummy variables, respectively. These models are described as follows. Model I is a regression without any dummy related to the degree of aggregated or continuous IT capability, and Model II represents regressions that include the dummies:

MODEL I.

$$FP_t = b_0 + b_1 FP_{(t-1)} + \epsilon_t, \quad (1)$$

MODEL II.

$$FP_t = b_0 + b_1 FP_{(t-1)} + b_2 IT\_AGG_{Low} + \epsilon_t, \quad (2)$$

$$FP_t = b_0 + b_1 FP_{(t-1)} + b_2 IT\_AGG_{Med} + \epsilon_t, \quad (3)$$

$$FP_t = b_0 + b_1 FP_{(t-1)} + b_2 IT\_AGG_{High} + \epsilon_t, \quad (4)$$

$$FP_t = b_0 + b_1 FP_{(t-1)} + b_2 IT\_CON_{Low} + \epsilon_t, \quad (5)$$

$$FP_t = b_0 + b_1 FP_{(t-1)} + b_2 IT\_CON_{Med} + \epsilon_t, \quad (6)$$

$$FP_t = b_0 + b_1 FP_{(t-1)} + b_2 IT\_CON_{High} + \epsilon_t, \quad (7)$$

where FP denotes financial performance variables (ROA, ROS, OI/A, OI/S, OI/E, OPEXP/S, COG/S, SGA/S, and Q); IT_AGG_{Low}, IT_AGG_{Med}, and IT_AGG_{High} are dummy variables that show the degree of a firm's aggregated IT capability; IT_CON_{Low}, IT_CON_{Med}, and IT_CON_{High} are dummy variables that demonstrate the degree of a firm's continuous IT capability; and ϵ is the random error term, representing the net influence of all unmeasured factors that affect the dependent variable.

Lastly, to investigate how the different degree of firms' IT capability affects their business performance as time changes, I use panel data analysis, which tests for my hypotheses. Stock and Watson (2015) stated that "Panel data, also called longitudinal data, are data for multiple entities in which each entity is observed at two or more time periods" (p. 11). They observed that panel data analysis could mitigate the omitted variable bias by examining changes in the dependent variables over time. Panel analysis is widely used in information systems research. For example, Lim et al. (2012, 2013) performed a panel analysis to examine how IT executives influence firm performance through IT capability. For country-level research, Dewan and Kraemer (2000) and Dedrick et al. (2013) studied the effect of ICT investment on GDP between developed and developing countries.

The values of the main key variables (IT_AGG_{Low}, IT_AGG_{Med}, IT_AGG_{High}, IT_CON_{Low}, IT_CON_{Med}, and IT_CON_{Hig}h) among companies in each group are the same and do not change over time. While the random effects model can include the time invariant variables, the fixed effect model can absorb these variables by the intercept. Therefore, I decided to use the random effects model in my analysis. I argue that IT capability can be accumulated over time, and the aggregated/continuous capability can influence a firm's financial performance. To provide the empirical evidence in the effects of the aggregated/continuous IT capabilities on a firm's financial performance over time, I assess the following model:

$$FP_{it} = b_0 + b_1 FP_{i\,(t-1)} + b_2 IT\_AGG_{Low\,i} + \epsilon_{it}, \qquad (8)$$

$$FP_{it} = b_0 + b_1 FP_{i\,(t-1)} + b_2 IT\_AGG_{Med\,i} + \epsilon_{it}, \qquad (9)$$

$$FP_{it} = b_0 + b_1 FP_{i\,(t-1)} + b_2 IT\_AGG_{High\,i} + \epsilon_{it}, \qquad (10)$$

$$FP_{it} = b_0 + b_1 FP_{i\,(t-1)} + b_2 IT\_CON_{Low\,i} + \epsilon_{it}, \quad (11)$$

$$FP_{it} = b_0 + b_1 FP_{i\,(t-1)} + b_2 IT\_CON_{Med\,i} + \epsilon_{it}, \quad (12)$$

$$FP_{it} = b_0 + b_1 FP_{i\,(t-1)} + b_2 IT\_CON_{High\,i} + \epsilon_{it}, \quad (13)$$

where *t* represents the time (1, . . . , T), and *i* represents firms (1, . . . , N), and ϵ is the random error term representing the net influence of all unmeasured factors that affect the dependent variable. The matched control firms ($Control_{AL}$, $Control_{AM}$, $Control_{AH}$, $Control_{CL}$, $Control_{CM}$, and $Control_{CH}$) are not specified in the formulas because there are considered as reference groups.

4.2 Research Methods for Factors Influencing Continuous IT Capability

4.2.1 Samples

The samples are companies ranked in the IW500 from 2005 to 2013. *InformationWeek* (IW) published an unranked list of 500 companies until 2013, but since 2014 has published only a ranked list of 100. To use 500 companies for each year, I focus on the period of 2005–2013. With duplicates removed, there are about 1,700 unique companies in the IW500 in this period, but almost half of them are private companies. Because IT capability can be accumulated over time, consecutive IT capability has also been used in the research (Kim et al., 2017; Lim et al., 2012, 2013). Therefore, I select firms with IT capability only when they have been listed in the IW500 for at least three consecutive years. On the basis of an estimate made using small samples to check data availability in the database, I selected 295 companies for a total sample of 2,655 firm-years.

4.2.2 Variables and Measurement

Continuous IT capability. To identify firms with continuous IT capability in an industry, I use the annual rankings of IT innovator firms provided by IW in its annual special issue since 1989. IW asks firms to fill out a questionnaire detailing their IT strategies, plans, and practices, and then publishes a ranked list of the top 500 companies. These companies all have strong reputations as technology leaders, and the list has been used frequently and widely in IS, finance, and accounting research (A. S. Bharadwaj, 2000; Chae et al., 2014; Kim et al., 2017; Masulis, Wang, & Xie, 2007). Because firms demonstrating IT capability for three to five years are likely to show same capability in the future (Kim et al., 2017, p. 189), I treat companies listed on the IW500 for at least three consecutive years as having IT capability. A firm's continuous IT capability is its number of consecutive appearances on the list, with a minimum of three. The year a firm leaves the list is deemed to be the time it loses its IT capability (Table 7). This number will be used as a key variable in the survival analysis.

Table 7. Examples of Continuous IT Capability of Firms on the IW500 List

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Continuous IT Capability
Company A		1	1	1						3
Company B		1	1	1	1	1				5
Company C	1	1	1	1	1	1	1	1	1	9

IT executives' structural power and IT executive turnover. Lim et al. (2012) claimed, "The structural power of senior IT executives is an antecedent to their firm's ability to develop superior organizational IT capability" (p. 25). On the basis of Lim et al.'s argument, I assume that IT managers in C-suite positions (e.g., CTO, or chief technology officer; CIO, or chief information officer; CTO, or chief operations officer) have more power than others. Therefore, I use these executives' official titles, as listed in the IW500, as a proxy for the variable *IT managers' structural power*. *IT executive turnover* is a binary indicator variable set to 1 if an IT executive is changed during a firm's period of continuous IT capability and 0 otherwise.

Industry. To investigate industry effects on continuous IT capability, I use major industry classifications based on the Standard Industrial Classification (SIC) division codes as categorical variables (Moeller, Schlingemann, & Stulz, 2004) and assign firms to industry categories on the basis of these codes (A: agriculture, B: mining, C: construction, D: manufacturing, E: transportation, F: wholesale trade, G: retail trade, H: finance, I: service). Due to the limited sample sizes in various industries, I merge some categories (Table 8). As a result, I assign six industry groups to companies' dummy-coded categorical variables (IND_1: manufacturing, IND_2: transportation, communication, electric, gas, and sanitary services, IND_3: wholesale and retail trade, IND_4: finance, insurance, and real estate, IND_5: services, IND_6: others).

Control variables. I consider several financial variables, including firm size (SIZE), performance (ROA), and market-to-book value (MV), to be possibly related to IT capability (Lim et al., 2011, 2012, 2013). First, because a firm's size can seriously affect its IT resources (Chae et al., 2014, p. 310), I include the natural log of total assets as a proxy of *firm size*. Second, *firm performance* is measured by ROA, which has been widely used to measure profitability (Bharadwaj, 2000; Peng & Luo, 2000). Lastly, as a firm's reputation can influence evaluations of its IT capability, I use MV as a proxy for *firm reputation* (Lim et al., 2013). All financial data were retrieved from COMPUSTAT.

Table 8. Number of Samples by Industry Group and SIC Division Code

Industry Group	Division	Industry Title	# of Samples (Division)	# of Samples (Group)
IND1	D	Manufacturing	103	103
IND2	E	Transportation, communication, electric, gas, and sanitary services	45	45
IND3	F	Wholesale trade	12	23
	G	Retail trade	11	
IND4	H	Finance, insurance, and real estate	47	47
IND5	I	Services	67	67
IND6	A	Agriculture, forestry, and fishing	1	10
	B	Mining	5	
	C	Construction	4	

* Detail industry group information is attached in Appendix C.

4.2.3 Research Model

Survival analysis and continuity of IT capability.

Survival analysis is a statistical method of analyzing data in which the outcome variable of interest is the time until an event occurs (Altman & Bland, 1998; Klein & Moeschberger, 2006; Kleinbaum & Klein, 2010). The event could be, for example, death, disease, marriage, divorce, or manufacturing failure (David Roxbee Cox, 2018). This mode of analysis was originally developed in medicine, but it has been used in business research to investigate corporate longevity and failure (Audretsch & Mahmood, 1995; Chen & LEE, 1993; Flagg, Giroux, & Wiggins Jr, 1991; Laitinen, 2005; Parker et al., 2002; Turetsky & McEwen, 2001). In particular, Li, Shang, and Slaughter (2010) adopted survival analysis to examine the influence of firms' capabilities, such as marketing, R&D, and operations, on their survival rates.

Survival analysis provides two major benefits over the traditional binary logistic analysis used in many articles (A. S. Bharadwaj, 2000; Kim et al., 2017; Lim et al., 2012, 2013): handling censored observations and using time as a variable (Parker et al., 2002; Turetsky & McEwen, 2001). First, censored observations usually happen when the period of the study is restricted in duration. Because a firm's continuous IT capability is measured from the time it first appears in the IW500 list to the time it disappears, there are firms in the sample that never lose their IT capability during the study period of 2005–2013. This situation is illustrated in Figure 1. For example, Normal Case is observed just from 2007 to 2010. By contrast, Censored Case A enters the study in 2008 and is followed until the end of the study, and Censored Case B is observed from the beginning of the study through to the end. These latter samples are said to have "censored data" because their data are only partially available. Censored data and missing data are not the same. Ignoring censored information may result in valuable information being thrown away and could produce biased results (Watt, Aitchison, MacKie, & Sirel, 1996). Therefore, it is essential to perform a survival analysis that consolidate all the information contained in these censored observations.

Second, survival analysis can use the time until a firm loses its IT capability as an outcome variable, whereas the customary logit regression model only takes into account binary outcomes (e.g., bankruptcy or not). By using a time variable indicating the length of a firm's stay on the IW500 list, I can investigate how independent variables such as managers and financial factors affect the extension of the time to the event of losing IT capability.

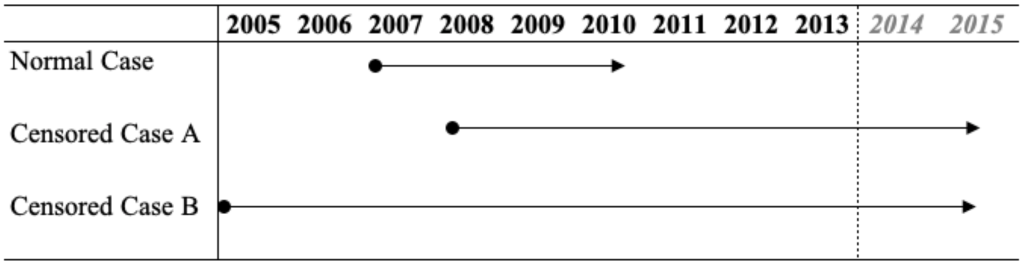


Figure 1. Examples of normal and possibly censored cases.

Kaplan-Meier method and logrank test.

The Kaplan-Meier (KM) method (Kaplan & Meier, 1958) is a popular non-parametric approach to estimating the survival function (Efron, 1988) that can be applied to bankruptcy of firms (Allen & Rose, 2006; Bunyaminu, 2015; Orbe, Ferreira, & Núñez-Antón, 2001) and unemployment (Meyer, 1990). An important advantage of the KM method is that it can take censored data into account. For each ordered event time, from smallest to largest, the survival probability can be estimated as the product of the survival estimate for the previous event time multiplied by the conditional probability of surviving past the current event time (Klein & Moeschberger, 2006). With this technique, I can predict a firm's likelihood of maintaining its IT capability past a certain time point and visually compare two or more groups' KM survival curves (Rich et al., 2010). The KM survival curve is plotted as a step function that begins with a horizontal line at a survival probability of 1 and steps down toward 0 as time increases.

The logrank test is the most commonly used statistical test for comparing the survival functions of two or more groups. It is widely used in medicine to test the efficiency of treatments by comparing a treatment group with a control group (Bland & Altman, 2004). Like the KM method, it can also handle censored data. The logrank test is a large-sample chi-square test, and its test statistic is obtained by comparing observed and expected numbers of events at specific times to give an overall comparison of survival rates (Kleinbaum & Klein, 2010). In summary, I can estimate and graph survival curves using the KM method and evaluate whether two or more KM survival curves are statistically equivalent by performing a logrank test.

Cox proportional hazards model.

The KM method and logrank test can assess the effect of only one variable at a time, and they are usually useful only when the variable is categorical. Although one extension of the logrank test, the stratified logrank test, can be used to account for the effects of multiple categorical predictors, it still has limitations, especially when there are many predictors, which can result in a loss of power in the test. One alternative is the Cox proportional hazards model (David R Cox, 1972), or the Cox model, which is one of the most important regression techniques for survival models (Fox, 2002, p. 1; Li et al., 2010, p. 645). The Cox model applies to both categorical and continuous predictors and can evaluate their effects on survival time simultaneously, much like multiple linear regression analysis. One of the main reasons for the popularity of the Cox model is that its estimates of regression coefficients are reasonably good even though the baseline hazard in the model is not specified. Therefore, to test the impact of corporate managers and financial factors on the continuity of IT capability, I use a Cox proportional hazards model. The model is represented as the hazard function denoted by $\lambda(t|\boldsymbol{X})$:

$$\lambda(t|\boldsymbol{X}) = \lambda_0(t) \exp\left(\beta_1 X_1 + \cdots + \beta_p X_p\right), \tag{14}$$

where $\boldsymbol{X} = (X_1, \cdots, X_p)$ is the set of p predictors, β is a $p \times 1$ vector of regression coefficients, and $\lambda_0(t)$ is an unspecified baseline hazard at time *t*, which corresponds to the value of the hazard if all the predictors are equal to 0. This expression gives the hazard function at time *t* with the predictor variables $X_1 \cdots, X_p$. Here, the exponential part of model (14) is called the hazard ratio and measures the effect of predictors on the hazard function. A hazard ratio greater than 1 indicates that a predictor is positively associated with the probability of the event occurring, and thus with a decrease in survival. Conversely, a hazard ratio less than 1 indicates that a predictor is related to improved survival. A hazard ratio equal to 1 means that the predictor does not affect survival. In my model, the event is the moment of losing IT capability and survival means continuity of IT capability. The associations between each predictor and the outcome are quantified by the regression coefficients. The estimated regression coefficient in the Cox model represents the change in the expected log of the hazard ratio related to a one-unit change for a continuous variable (e.g., ROA) while all other predictors are held constant. If a predictor is a binary variable (e.g., $\mathrm{IT_{TURNOVER}}$ = 1 or 0), the estimated regression coefficient indicates the expected log of the ratio of the hazard functions for one group (e.g., IT executive turnover) relative to the other (e.g., no IT executive turnover) while other predictors are held fixed.

I referred to the research of Lim et al. (2012) to select the financial variables. The structure of the statistical model can be written as follows:

$$\lambda(t|\boldsymbol{X}) = \lambda_0(t)\exp(\beta_1\,\mathrm{IT_{CSUITE}} + \beta_2\,\mathrm{IT_{TURNOVER}} + \beta_3\,\mathrm{SIZE} + \beta_4\,\mathrm{ROA} + \beta_5\mathrm{MV} + \beta_6\mathrm{IND}_2 + \beta_7\mathrm{IND}_3 + \beta_8\mathrm{IND}_4 + \beta_9\mathrm{IND}_5 + \beta_{10}\mathrm{IND}_6), \quad (15)$$

where $\mathrm{IT_{CSUITE}}$ is IT executives' structural power and is coded as 1 if IT managers are in C-suite positions and 0 otherwise. $\mathrm{IT_{TURNOVER}}$ is turnover of IT executives and is set to 1 if a firm experienced a change in IT executives while keeping its IT capability and 0 otherwise; SIZE is the natural log of total assets; ROA is return on assets; MV is the market-to-book-value ratio; and $\mathrm{IND}_2, \cdots, \mathrm{IND}_6$ are dummy variables related to the industry categories.

5. RESULTS

5.1 Results of the Research for the Accumulation of IT Capability

The test results are summarized in Table 9. To examine the impact of aggregated and continuous IT capability on firms' business performance, I used the Wilcoxon signed-rank test. I then tested the association between the proposed IT capabilities and firm performance using regression analysis in each year for eliminating financial halo effects in the research model. Lastly, the panel data analysis using a random-effects model was performed to study how the accumulated IT capability influence business performance over time. The detailed results of all hypothesis tests are displayed in Table 10 through Table 11. The p-values smaller than 0.1 in the tables are shown in bold in the tables.

5.1.1 Aggregated IT capability: The Results of Comparing the Mean Levels of Performance Variables

My hypotheses are tested based on the concepts of aggregated IT capability and continuous IT capability. Table 9 shows the results of the Wilcoxon signed-rank test. Since Chae et al. (2014) and Santhanam and Hartono (2003) mainly discussed the median of the results, I explained the results based on medians (MED) and p-values (P). The detailed results, including mean, median, z-score, and p-value, are displayed in Table 10 and Table 11. I did not find support for Hypothesis 1. Contrary to expectations, profit ratios showed conflicting results. ROA and OI/A of firms that have aggregated IT capability are higher than those of their matched control firms and show statistical significance in several cases. On the other hand, ROS,

Table 9. Results of Hypothesis Tests

H1.	The degree of aggregated IT capability is associated with significantly higher profit ratios.	No support
H2.	The degree of aggregated IT capability is associated with significantly lower profit ratios.	No support
H3.	The degree of aggregated IT capability is associated with significantly higher market performance.	Partial support
H4.	The degree of continuous IT capability is associated with significantly higher profit ratios.	No support
H5.	The degree of continuous IT capability is associated with significantly lower profit ratios.	No support
H6.	The degree of continuous IT capability is associated with significantly higher market performance.	Partial support
H7.	The degree of aggregated IT capability is associated with significantly higher profit ratios after adjusting for prior financial performance.	No support
H8.	The degree of aggregated IT capability is associated with significantly lower profit ratios after adjusting for prior financial performance.	No support
H9.	The degree of aggregated IT capability is associated with significantly higher market performance after adjusting for prior financial performance	No support
H10.	The degree of continuous IT capability is associated with significantly higher profit ratios after adjusting for prior financial performance.	No support

(Continued)

H11.	The degree of continuous IT capability is associated with significantly lower profit ratios after adjusting for prior financial performance.	No support
H12.	The degree of continuous IT capability is associated with significantly higher market performance after adjusting for prior financial performance.	No support
H13	The degree of aggregated IT capability is associated with significantly higher profit ratios after adjusting for prior financial performance over time.	No support
H14.	The degree of aggregated IT capability is associated with significantly lower profit ratios after adjusting for prior financial performance over time.	No support
H15.	The degree of aggregated IT capability is associated with significantly higher market performance after adjusting for prior financial performance over time.	Partial support
H16.	The degree of continuous IT capability is associated with significantly higher profit ratios after adjusting for prior financial performance over time.	No support
H17.	The degree of continuous IT capability is associated with significantly lower profit ratios after adjusting for prior financial performance over time.	No support
H18.	The degree of continuous IT capability is associated with significantly higher market performance after adjusting for prior financial performance over time.	No support

Table 10. Results of Wilcoxson Test Using Aggregated IT Capability

FP	Groups	2005				2006				2007			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
ROA	IT_AGG$_{Low}$	0.038	0.053	320	0.156	0.041	0.038	308	0.115	0.041	0.044	336	0.327
	Control$_{AL}$	0.069	0.053			0.086	0.048			0.066	0.044		
	IT_AGG$_{Med}$	0.062	0.057	1570	0.445	0.058	0.050	1530	0.581	0.058	0.063	1785	**0.058**
	Control$_{AM}$	0.058	0.055			0.057	0.053			0.051	0.051		
	IT_AGG$_{High}$	0.057	0.053	2620	0.492	0.074	0.056	2519	0.742	0.047	0.058	2144	0.404
	Control$_{AH}$	0.065	0.051			0.073	0.054			0.072	0.053		
ROS	IT_AGG$_{Low}$	0.034	0.055	280	0.051	0.040	0.050	259	0.026	0.034	0.054	303	0.154
	Control$_{AL}$	0.081	0.072			0.113	0.074			0.092	0.045		
	IT_AGG$_{Med}$	0.083	0.069	1329	0.614	0.080	0.067	1328	0.610	0.078	0.074	1553	0.501
	Control$_{AM}$	0.089	0.074			0.094	0.083			0.081	0.071		
	IT_AGG$_{High}$	0.072	0.061	2532	0.707	0.095	0.069	2468	0.882	0.070	0.072	2326	0.857
	Control$_{AH}$	0.076	0.069			0.081	0.073			0.084	0.072		
OI/A	IT_AGG$_{Low}$	0.098	0.092	365	0.404	0.097	0.084	412	0.818	0.097	0.080	427	0.826
	Control$_{AL}$	0.121	0.091			0.118	0.086			0.110	0.081		
	IT_AGG$_{Med}$	0.104	0.089	1619	0.307	0.102	0.084	1593	0.376	0.099	0.097	1654	0.228
	Control$_{AM}$	0.096	0.092			0.094	0.091			0.084	0.086		
	IT_AGG$_{High}$	0.103	0.089	2497	0.801	0.109	0.096	2504	0.782	0.103	0.090	2387	0.971
	Control$_{AH}$	0.112	0.090			0.119	0.088			0.113	0.086		
OI/E	IT_AGG$_{Low}$	66.471	26.975	240	**0.059**	84.740	30.953	273	0.242	86.133	38.081	280	0.288
	Control$_{AL}$	119.563	36.393			125.991	36.088			116.514	31.985		
	IT_AGG$_{Med}$	54.468	36.562	1101	0.171	59.402	38.726	919	**0.040**	56.832	38.716	1053	0.103
	Control$_{AM}$	83.084	46.007			131.787	53.897			117.067	50.532		
	IT_AGG$_{High}$	60.724	27.100	1848	0.148	68.110	32.751	2055	0.405	69.228	30.320	1908	0.222
	Control$_{AH}$	93.561	31.045			107.871	37.261			106.295	46.311		
OI/E	IT_AGG$_{Low}$	0.132	0.112	293	0.076	0.139	0.103	330	0.197	0.129	0.099	337	0.334
	Control$_{AL}$	0.162	0.113			0.161	0.103			0.143	0.098		
	IT_AGG$_{Med}$	0.141	0.116	1330	0.618	0.140	0.113	1319	0.577	0.136	0.117	1347	0.682
	Control$_{AM}$	0.152	0.134			0.155	0.131			0.144	0.135		
	IT_AGG$_{High}$	0.129	0.110	2233	0.496	0.135	0.115	2316	0.699	0.134	0.115	2258	0.671
	Control$_{AH}$	0.147	0.115			0.153	0.114			0.146	0.122		

(Continued)

FP	Groups	2008				2009				2010			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
ROA	IT_AGG_{Low}	-0.008	0.038	324	0.253	0.025	0.025	348	0.566	0.060	0.042	304	0.343
	$Control_{AL}$	0.029	0.043			0.005	0.029			0.063	0.056		
	IT_AGG_{Med}	0.037	0.048	1835	**0.031**	0.043	0.038	1595	0.180	0.052	0.046	1466	0.395
	$Control_{AM}$	0.016	0.036			0.030	0.027			0.041	0.040		
	IT_AGG_{High}	0.013	0.035	2437	0.829	0.044	0.036	2658	0.312	0.053	0.051	2484	0.700
	$Control_{AH}$	0.027	0.037			0.030	0.030			0.056	0.042		
ROS	IT_AGG_{Low}	-0.355	0.036	355	0.468	0.052	0.034	405	0.841	0.074	0.059	315	0.429
	$Control_{AL}$	-0.052	0.031			-0.033	0.023			0.116	0.070		
	IT_AGG_{Med}	0.038	0.045	1654	0.228	0.052	0.048	1366	0.934	0.069	0.059	1287	0.882
	$Control_{AM}$	0.004	0.044			0.061	0.041			0.069	0.067		
	IT_AGG_{High}	0.026	0.046	2446	0.804	0.071	0.049	2650	0.326	0.078	0.064	2432	0.843
	$Control_{AH}$	0.008	0.042			0.048	0.046			0.075	0.055		
OI/A	IT_AGG_{Low}	0.089	0.090	425	0.847	0.070	0.056	373	0.820	0.106	0.072	394	0.742
	$Control_{AL}$	0.081	0.081			0.066	0.064			0.084	0.068		
	IT_AGG_{Med}	0.092	0.090	1731	0.107	0.081	0.073	1700	**0.055**	0.096	0.088	1629	**0.078**
	$Control_{AM}$	0.076	0.078			0.061	0.056			0.076	0.067		
	IT_AGG_{High}	0.093	0.085	2456	0.776	0.079	0.077	2607	0.408	0.094	0.087	2588	0.448
	$Control_{AH}$	0.096	0.085			0.075	0.063			0.092	0.074		
OI/E	IT_AGG_{Low}	45.549	32.381	309	0.381	37.164	28.480	262	0.394	92.064	34.738	299	0.802
	$Control_{AL}$	92.763	30.386			51.140	30.626			90.260	37.341		
	IT_AGG_{Med}	47.649	36.545	1344	0.817	50.955	36.818	1184	0.734	60.815	39.044	980	0.125
	$Control_{AM}$	78.644	31.172			94.491	29.648			107.219	38.489		
	IT_AGG_{High}	58.462	25.003	2160	0.924	52.891	23.578	2151	0.964	68.500	30.727	2230	0.994
	$Control_{AH}$	65.128	30.639			60.060	24.491			72.751	38.465		
OI/E	IT_AGG_{Low}	-0.131	0.096	410	1.000	0.086	0.080	361	0.694	0.138	0.105	369	0.989
	$Control_{AL}$	0.079	0.076			0.079	0.077			0.119	0.107		
	IT_AGG_{Med}	0.118	0.106	1590	0.385	0.114	0.111	1382	0.865	0.134	0.122	1238	0.672
	$Control_{AM}$	0.092	0.105			0.107	0.086			0.134	0.114		
	IT_AGG_{High}	0.110	0.098	2480	0.711	0.111	0.090	2408	0.911	0.131	0.118	2451	0.790
	$Control_{AH}$	0.099	0.111			0.108	0.098			0.130	0.115		

(Continued)

FP	Groups	2011				2012				2013			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
ROA	IT_AGG_{Low}	0.048	0.036	353	0.988	0.035	0.050	358	0.929	0.042	0.036	297	0.420
	$Control_{AL}$	0.036	0.045			0.040	0.045			0.057	0.032		
	IT_AGG_{Med}	0.064	0.057	1620	**0.014**	0.048	0.046	1392	0.182	0.060	0.054	1532	**0.014**
	$Control_{AM}$	0.037	0.040			0.037	0.034			0.035	0.042		
	IT_AGG_{High}	0.053	0.052	2545	0.429	0.047	0.043	2693	0.183	0.051	0.042	2618	0.147
	$Control_{AH}$	0.048	0.046			0.039	0.035			0.044	0.038		
ROS	IT_AGG_{Low}	0.050	0.050	332	0.777	0.031	0.046	312	0.561	0.058	0.049	321	0.655
	$Control_{AL}$	0.067	0.042			0.055	0.034			0.076	0.054		
	IT_AGG_{Med}	0.084	0.073	1438	0.169	0.065	0.065	1112	0.712	0.088	0.079	1114	0.959
	$Control_{AM}$	0.051	0.043			0.078	0.061			0.078	0.063		
	IT_AGG_{High}	0.074	0.062	2578	0.269	0.067	0.056	2563	0.294	0.074	0.062	2334	0.449
	$Control_{AH}$	0.064	0.053			0.054	0.052			0.066	0.060		
OI/A	IT_AGG_{Low}	0.103	0.071	354	0.976	0.094	0.069	400	0.473	0.077	0.081	398	0.492
	$Control_{AL}$	0.083	0.077			0.080	0.074			0.084	0.074		
	IT_AGG_{Med}	0.101	0.087	1588	**0.023**	0.090	0.086	1460	**0.080**	0.094	0.091	1600	**0.004**
	$Control_{AM}$	0.076	0.073			0.072	0.068			0.070	0.068		
	IT_AGG_{High}	0.095	0.088	2602	0.318	0.090	0.080	2596	0.328	0.093	0.088	2721	**0.066**
	$Control_{AH}$	0.091	0.076			0.085	0.072			0.082	0.067		
OI/E	IT_AGG_{Low}	86.898	36.590	272	0.491	88.786	44.521	306	0.891	84.469	35.471	292	0.716
	$Control_{AL}$	101.880	41.653			91.938	36.423			102.623	38.751		
	IT_AGG_{Med}	63.188	41.587	994	0.367	61.505	42.277	766	**0.046**	64.416	41.366	899	0.188
	$Control_{AM}$	61.253	38.867			142.746	44.867			120.082	50.998		
	IT_AGG_{High}	68.842	32.563	2261	0.916	65.471	34.750	2238	0.985	72.290	34.527	2019	0.948
	$Control_{AH}$	71.702	40.060			70.959	33.107			74.885	38.969		
OI/E	IT_AGG_{Low}	0.137	0.112	328	0.732	0.137	0.106	367	0.823	0.128	0.107	348	0.964
	$Control_{AL}$	0.128	0.108			0.124	0.108			0.132	0.106		
	IT_AGG_{Med}	0.135	0.114	1244	0.830	0.129	0.114	1035	0.401	0.134	0.125	1014	0.561
	$Control_{AM}$	0.123	0.091			0.136	0.116			0.142	0.116		
	IT_AGG_{High}	0.129	0.108	2396	0.668	0.124	0.103	2392	0.679	0.131	0.110	2333	0.451
	$Control_{AH}$	0.126	0.110			0.122	0.114			0.130	0.115		

(Continued)

FP	Groups	2005				2006				2007			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
OPEXP/S	IT_AGG_{Low}	0.813	0.854	540	0.159	0.809	0.840	523	0.236	0.818	0.841	489	0.295
	$Control_{AL}$	0.786	0.814			0.789	0.835			0.803	0.864		
	IT_AGG_{Med}	0.812	0.836	1489	0.737	0.816	0.842	1537	0.556	0.819	0.843	1522	0.610
	$Control_{AM}$	0.801	0.831			0.798	0.838			0.808	0.834		
	IT_AGG_{High}	0.823	0.856	2786	0.202	0.818	0.841	2712	0.311	0.817	0.843	2623	0.376
	$Control_{AH}$	0.794	0.841			0.788	0.821			0.795	0.845		
COG/S	IT_AGG_{Low}	0.632	0.672	483	0.504	0.622	0.660	477	0.555	0.630	0.646	460	0.510
	$Control_{AL}$	0.607	0.646			0.607	0.652			0.615	0.651		
	IT_AGG_{Med}	0.605	0.646	1165	0.171	0.603	0.635	1171	0.181	0.609	0.630	1136	0.128
	$Control_{AM}$	0.661	0.696			0.659	0.701			0.669	0.694		
	IT_AGG_{High}	0.670	0.720	2613	0.508	0.664	0.719	2582	0.580	0.661	0.702	2430	0.849
	$Control_{AH}$	0.658	0.709			0.651	0.704			0.659	0.718		
SGA/S	IT_AGG_{Low}	0.182	0.166	378	0.695	0.187	0.172	380	0.673	0.188	0.176	338	0.944
	$Control_{AL}$	0.178	0.170			0.182	0.182			0.188	0.188		
	IT_AGG_{Med}	0.207	0.200	1474	**0.001**	0.212	0.207	1508	**0.001**	0.210	0.198	1493	**0.001**
	$Control_{AM}$	0.140	0.130			0.139	0.123			0.139	0.131		
	IT_AGG_{High}	0.153	0.116	1782	0.439	0.154	0.114	1792	0.537	0.156	0.120	1887	0.287
	$Control_{AH}$	0.136	0.114			0.137	0.113			0.136	0.100		
Q	IT_AGG_{Low}	1.781	1.502	431	1.000	1.885	1.531	402	0.720	1.798	1.449	386	0.755
	$Control_{AL}$	2.247	1.477			2.248	1.662			1.945	1.356		
	IT_AGG_{Med}	2.070	1.711	1868	**0.019**	2.062	1.630	1772	**0.067**	1.952	1.568	1809	**0.043**
	$Control_{AM}$	1.697	1.459			1.735	1.529			1.625	1.357		
	IT_AGG_{High}	1.875	1.577	2691	0.348	1.884	1.614	2624	0.483	1.746	1.541	2550	0.534
	$Control_{AH}$	2.046	1.454			2.123	1.486			1.804	1.397		

(Continued)

FP	Groups	2008				2009				2010			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
OPEXP/S	IT_AGG_{Low}	1.063	0.851	404	0.942	0.846	0.860	430	0.585	0.799	0.830	345	0.720
	$Control_{AL}$	0.864	0.879			0.848	0.860			0.821	0.853		
	IT_AGG_{Med}	0.835	0.850	1266	0.403	0.835	0.827	1318	0.860	0.819	0.843	1414	0.577
	$Control_{AM}$	0.857	0.862			0.840	0.855			0.816	0.840		
	IT_AGG_{High}	0.839	0.871	2408	0.911	0.832	0.863	2485	0.698	0.815	0.852	2459	0.768
	$Control_{AH}$	0.839	0.855			0.827	0.858			0.811	0.840		
COG/S	IT_AGG_{Low}	0.871	0.651	410	1.000	0.643	0.668	420	0.684	0.596	0.624	327	0.537
	$Control_{AL}$	0.654	0.665			0.631	0.651			0.623	0.648		
	IT_AGG_{Med}	0.615	0.633	946	**0.012**	0.610	0.617	995	**0.051**	0.594	0.617	1023	0.103
	$Control_{AM}$	0.715	0.728			0.686	0.715			0.665	0.718		
	IT_AGG_{High}	0.680	0.727	2315	0.826	0.666	0.695	2310	0.812	0.657	0.695	2259	0.674
	$Control_{AH}$	0.698	0.733			0.684	0.724			0.674	0.708		
SGA/S	IT_AGG_{Low}	0.192	0.170	302	0.632	0.203	0.194	290	0.688	0.203	0.186	303	0.932
	$Control_{AL}$	0.211	0.195			0.216	0.217			0.197	0.217		
	IT_AGG_{Med}	0.220	0.213	1544	**0.000**	0.225	0.209	1400	**0.001**	0.225	0.210	1529	**0.001**
	$Control_{AM}$	0.142	0.131			0.154	0.130			0.150	0.123		
	IT_AGG_{High}	0.159	0.112	1836	0.410	0.166	0.127	1890	0.281	0.158	0.123	1847	0.381
	$Control_{AH}$	0.141	0.112			0.143	0.113			0.137	0.110		
Q	IT_AGG_{Low}	1.411	1.165	362	0.527	1.487	1.235	357	0.654	1.560	1.376	398	0.699
	$Control_{AL}$	1.423	1.126			1.605	1.245			1.677	1.310		
	IT_AGG_{Med}	1.479	1.247	1866	**0.020**	1.641	1.383	1678	**0.072**	1.819	1.487	1701	**0.030**
	$Control_{AM}$	1.291	1.112			1.420	1.253			1.483	1.350		
	IT_AGG_{High}	1.429	1.269	2743	0.188	1.488	1.352	2493	0.676	1.551	1.417	2583	0.459
	$Control_{AH}$	1.412	1.126			1.509	1.227			1.550	1.287		

(Continued)

FP	Groups	2011				2012				2013			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
OPEXP/S	IT_AGG$_{Low}$	0.802	0.827	346	0.941	0.800	0.819	309	0.531	0.805	0.821	329	0.743
	Control$_{AL}$	0.814	0.842			0.819	0.850			0.813	0.848		
	IT_AGG$_{Med}$	0.821	0.844	1203	0.981	0.826	0.842	1313	0.394	0.821	0.834	1222	0.459
	Control$_{AM}$	0.829	0.866			0.815	0.845			0.807	0.843		
	IT_AGG$_{High}$	0.820	0.855	2409	0.633	0.823	0.855	2365	0.754	0.814	0.843	2157	0.946
	Control$_{AH}$	0.813	0.833			0.818	0.844			0.806	0.824		
COG/S	IT_AGG$_{Low}$	0.610	0.608	340	0.870	0.604	0.619	322	0.665	0.605	0.615	326	0.709
	Control$_{AL}$	0.621	0.654			0.626	0.659			0.624	0.646		
	IT_AGG$_{Med}$	0.607	0.638	912	**0.078**	0.605	0.610	963	0.201	0.600	0.617	956	0.341
	Control$_{AM}$	0.687	0.723			0.670	0.718			0.659	0.707		
	IT_AGG$_{High}$	0.663	0.700	2109	0.527	0.660	0.705	2066	0.428	0.652	0.722	1980	0.537
	Control$_{AH}$	0.683	0.731			0.687	0.719			0.675	0.709		
SGA/S	IT_AGG$_{Low}$	0.192	0.186	286	0.929	0.196	0.187	307	0.878	0.200	0.170	312	0.811
	Control$_{AL}$	0.193	0.196			0.193	0.200			0.190	0.181		
	IT_AGG$_{Med}$	0.214	0.188	1343	**0.002**	0.220	0.193	1354	**0.001**	0.221	0.195	1249	**0.002**
	Control$_{AM}$	0.142	0.101			0.145	0.102			0.148	0.108		
	IT_AGG$_{High}$	0.156	0.123	1805	0.189	0.163	0.119	1862	0.110	0.162	0.123	1681	0.177
	Control$_{AH}$	0.130	0.101			0.131	0.101			0.131	0.096		
Q	IT_AGG$_{Low}$	1.480	1.336	318	0.622	1.465	1.412	333	0.788	1.674	1.518	320	0.644
	Control$_{AL}$	1.579	1.263			1.563	1.332			1.875	1.538		
	IT_AGG$_{Med}$	1.629	1.417	1617	**0.014**	1.707	1.514	1629	**0.005**	1.903	1.710	1610	**0.003**
	Control$_{AM}$	1.373	1.279			1.426	1.324			1.553	1.386		
	IT_AGG$_{High}$	1.497	1.328	2607	0.309	1.550	1.325	2543	0.433	1.740	1.537	2558	0.220
	Control$_{AH}$	1.500	1.168			1.545	1.247			1.642	1.380		

OI/E, and OI/S of firms that have aggregated IT capability is lower than those of the control firms and shows statistical significance in several cases. For example, ROA is significantly higher for firms with a medium level of aggregated IT capability (IT_AGG_{Med}) four times (2007, 2008, 2011, and 2012) during the research period and OI/A is significantly higher for firms with a medium level of aggregated IT capability (IT_AGG_{Low}) five times (2009 – 2013) in the list. However, ROS is significantly lower for firms with a low level of aggregated IT capability (IT_AGG_{Low}) two times (2005 and 2006). OI/E of firms with low and medium levels of the capability (IT_AGG_{Low} and IT_AGG_{Med}) are significantly lower than the control sample once (2005) and twice (2006, and 2012), respectively. It seems that the effects of the extent of aggregated IT capability on the profit ratios vary depending on the types of performance variables.

I did not find support for Hypothesis 2, which predicts that the degree of firms' aggregated IT capability is negatively associated with their cost-related ratio. Each cost ratio also showed mixed results. Contrary to expectations, SGA/S is higher for firms with a medium level of aggregated IT capability (IT_AGG_{Med}) than the control group during all the research periods (2005 ~ 2013) consistently with a significance level, while COG/S is lower for firms with the firms, in three cases (2008, 2009, and 2011). OPEXP/S does not show any differences between the firms with any level of aggregated IT capability ($IT\_AGG_{Low,}$ $IT\_AGG_{Med,}$ and IT_AGG_{High}) and the control group during the whole research periods.

I found partial support for Hypothesis 3, which tests the relationship between the degree of firms' aggregated IT capability and market performance represented by Tobin's Q (Q). The result indicates that the degree of accumulated IT capability does not linearly affect firms' market performance. Firms with a medium level of aggregated IT capability (IT_AGG_{Med})

demonstrate significantly higher market performance than the control group in all cases. On the other hand, there was insufficient evidence that the market performances (Q) of the firms having low and high levels of aggregated IT capability (IT_AGG_{Low} and IT_AGG_{High}) are different from the firms in the control sample.

5.1.2 Continuous IT capability: The Results of Comparing the Mean Levels of Performance Variables

In Hypotheses 4, 5, and 6, I change the concept of aggregated IT capability with the concept of continuous IT capability from the Hypotheses 1, 2, and 3, and test its impact on profit ratio, cost-related ratio, and market performance. The results of Hypotheses 4, 5, and 6 are similar to the results of Hypotheses 1, 2, and 3, respectively. Table 11 demonstrates the results of these hypothesis tests with mean, medians, z-scores, and p-values.

First, I did not find support for Hypothesis 4. Based on the types of profit ratios, the Wilcoxon tests comparing firms with continuous IT capability, and the control sample showed inconsistent results. The ROA of firms that have a medium level of continuous IT capability is significantly higher than those of the control firms in three cases (2008, 2011, and 2013), but the OI/E of firms that have a medium level of continuous IT capability (IT_AGG_{Med}) is significantly lower than the ratio of the control form in six out of nine years (2005, 2006, 2010, 2011, 2012, and 2013). ROS and OI/S have shown no statistically significant difference between the treatment group ($IT\_CON_{Low,}$ $IT\_CON_{Med,}$ and IT_CON_{High}) and the control group.

I did not find support for Hypothesis 5, which expects that the degree of firms' continuous IT capability is related to their cost-related ratio. Similar to the result of Hypothesis 2, the test for Hypothesis 5 using cost ratios also shows mixed results. Some cost ratios of firms

Table 11. Results of Wilcoxson Test Using Continuous IT Capability

FP	Groups	2005				2006				2007			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
ROA	IT_CON_{Low}	0.054	0.059	819	0.482	0.056	0.054	798	0.391	0.056	0.053	798	0.514
	$Control_{CL}$	0.071	0.059			0.083	0.056			0.072	0.056		
	IT_CON_{Med}	0.057	0.050	1331	0.764	0.056	0.050	1338	0.733	0.054	0.054	1548	0.123
	$Control_{CM}$	0.054	0.050			0.054	0.048			0.043	0.046		
	IT_CON_{High}	0.055	0.045	1895	0.492	0.071	0.054	1757	0.951	0.041	0.053	1537	0.448
	$Control_{CH}$	0.066	0.050			0.074	0.055			0.075	0.053		
ROS	IT_CON_{Low}	0.061	0.059	758	0.249	0.069	0.063	761	0.258	0.063	0.065	775	0.409
	$Control_{CL}$	0.087	0.071			0.108	0.069			0.100	0.054		
	IT_CON_{Med}	0.078	0.068	1228	0.777	0.077	0.068	1254	0.893	0.074	0.076	1462	0.293
	$Control_{CM}$	0.081	0.073			0.086	0.076			0.061	0.071		
	IT_CON_{High}	0.067	0.060	1662	0.715	0.088	0.065	1557	0.400	0.061	0.065	1482	0.311
	$Control_{CH}$	0.078	0.071			0.084	0.076			0.094	0.073		
OI/A	IT_CON_{Low}	0.108	0.105	923	0.956	0.107	0.095	953	0.783	0.106	0.097	964	0.554
	$Control_{CL}$	0.118	0.094			0.116	0.091			0.112	0.095		
	IT_CON_{Med}	0.099	0.081	1349	0.686	0.100	0.081	1337	0.737	0.097	0.086	1437	0.364
	$Control_{CM}$	0.093	0.084			0.093	0.082			0.080	0.080		
	IT_CON_{High}	0.101	0.085	1784	0.854	0.106	0.091	1803	0.787	0.099	0.089	1702	1.000
	$Control_{CH}$	0.113	0.092			0.120	0.091			0.114	0.088		
OI/E	IT_CON_{Low}	67.851	30.124	671	0.218	80.740	34.404	736	0.616	81.940	39.466	713	0.491
	$Control_{CL}$	100.778	31.236			106.188	32.172			101.696	33.444		
	IT_CON_{Med}	51.777	30.973	864	**0.059**	59.102	37.431	715	**0.013**	57.350	36.574	887	0.116
	$Control_{CM}$	84.119	49.207			138.671	60.807			120.337	60.642		
	IT_CON_{High}	60.429	27.615	1331	0.166	66.970	30.244	1444	0.309	67.224	29.373	1320	0.109
	$Control_{CH}$	99.470	29.984			113.355	34.840			112.419	45.400		
OI/E	IT_CON_{Low}	0.145	0.115	827	0.519	0.150	0.118	882	0.811	0.142	0.117	847	0.777
	$Control_{CL}$	0.157	0.119			0.154	0.110			0.146	0.106		
	IT_CON_{Med}	0.135	0.116	1189	0.612	0.138	0.116	1197	0.645	0.134	0.123	1274	0.984
	$Control_{CM}$	0.144	0.130			0.152	0.130			0.132	0.138		
	IT_CON_{High}	0.124	0.109	1413	0.135	0.128	0.107	1449	0.183	0.128	0.105	1378	0.135
	$Control_{CH}$	0.155	0.117			0.159	0.116			0.154	0.122		

(Continued)

FP	Groups	2008				2009				2010			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
ROA	IT_CON_{Low}	0.014	0.042	764	0.363	0.034	0.029	812	0.739	0.066	0.046	731	0.450
	$Control_{CL}$	0.035	0.044			0.018	0.029			0.061	0.056		
	IT_CON_{Med}	0.039	0.050	1660	**0.029**	0.045	0.038	1481	0.103	0.048	0.046	1352	0.275
	$Control_{CM}$	0.004	0.026			0.028	0.028			0.041	0.036		
	IT_CON_{High}	0.001	0.032	1680	0.923	0.040	0.033	1849	0.497	0.051	0.051	1745	0.842
	$Control_{CH}$	0.031	0.037			0.028	0.026			0.055	0.042		
ROS	IT_CON_{Low}	-0.213	0.041	816	0.605	0.061	0.042	886	0.816	0.085	0.062	746	0.525
	$Control_{CL}$	-0.010	0.036			0.017	0.029			0.110	0.070		
	IT_CON_{Med}	0.040	0.045	1560	0.107	0.055	0.048	1300	0.582	0.069	0.060	1275	0.535
	$Control_{CM}$	-0.016	0.037			0.043	0.048			0.059	0.066		
	IT_CON_{High}	0.011	0.043	1646	0.799	0.066	0.048	1847	0.503	0.070	0.063	1590	0.608
	$Control_{CH}$	0.009	0.044			0.047	0.045			0.078	0.056		
OI/A	IT_CON_{Low}	0.096	0.094	937	0.697	0.077	0.066	912	0.665	0.109	0.077	945	0.348
	$Control_{CL}$	0.089	0.086			0.067	0.063			0.085	0.071		
	IT_CON_{Med}	0.091	0.088	1521	0.165	0.082	0.073	1475	0.110	0.092	0.081	1391	0.184
	$Control_{CM}$	0.073	0.070			0.062	0.055			0.078	0.065		
	IT_CON_{High}	0.090	0.085	1764	0.774	0.075	0.077	1826	0.566	0.092	0.086	1854	0.482
	$Control_{CH}$	0.095	0.084			0.074	0.064			0.091	0.075		
OI/E	IT_CON_{Low}	52.419	31.849	747	0.530	44.196	29.229	724	0.877	85.194	37.180	771	0.809
	$Control_{CL}$	82.236	31.183			47.134	25.888			78.560	33.264		
	IT_CON_{Med}	43.534	35.119	1142	0.698	49.859	35.067	955	0.445	60.122	39.044	787	**0.063**
	$Control_{CM}$	79.914	32.647			100.384	32.384			111.375	61.832		
	IT_CON_{High}	59.561	24.355	1549	0.882	52.370	23.265	1533	0.972	68.007	30.045	1574	0.827
	$Control_{CH}$	65.815	28.393			62.199	24.491			75.216	36.102		
OI/E	IT_CON_{Low}	-0.040	0.101	895	0.943	0.104	0.086	883	0.834	0.146	0.114	881	0.668
	$Control_{CL}$	0.099	0.087			0.091	0.071			0.127	0.106		
	IT_CON_{Med}	0.110	0.107	1473	0.265	0.112	0.093	1259	0.760	0.132	0.111	1181	0.963
	$Control_{CM}$	0.078	0.085			0.099	0.091			0.124	0.111		
	IT_CON_{High}	0.107	0.096	1675	0.904	0.106	0.090	1607	0.664	0.125	0.115	1573	0.554
	$Control_{CH}$	0.101	0.116			0.113	0.102			0.136	0.117		

(Continued)

FP	Groups	2011				2012				2013			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
ROA	IT_CON$_{Low}$	0.055	0.046	867	0.576	0.047	0.056	908	0.372	0.054	0.045	811	0.919
	Control$_{CL}$	0.034	0.046			0.040	0.041			0.054	0.040		
	IT_CON$_{Med}$	0.058	0.052	1343	**0.078**	0.043	0.044	1167	0.398	0.053	0.053	1321	**0.032**
	Control$_{CM}$	0.045	0.043			0.034	0.034			0.033	0.043		
	IT_CON$_{High}$	0.055	0.050	1939	0.191	0.045	0.040	1915	0.232	0.051	0.042	1846	0.194
	Control$_{CH}$	0.044	0.045			0.040	0.034			0.046	0.035		
ROS	IT_CON$_{Low}$	0.068	0.053	826	0.823	0.059	0.064	819	0.867	0.080	0.072	828	0.810
	Control$_{CL}$	0.058	0.041			0.062	0.052			0.078	0.059		
	IT_CON$_{Med}$	0.079	0.069	1280	0.176	0.057	0.056	958	0.586	0.081	0.066	944	0.822
	Control$_{CM}$	0.057	0.049			0.069	0.057			0.071	0.065		
	IT_CON$_{High}$	0.072	0.063	1800	0.389	0.061	0.053	1733	0.589	0.069	0.056	1577	0.703
	Control$_{CH}$	0.064	0.051			0.058	0.049			0.068	0.060		
OI/A	IT_CON$_{Low}$	0.107	0.087	907	0.376	0.097	0.081	937	0.259	0.088	0.086	953	0.208
	Control$_{CL}$	0.082	0.077			0.080	0.074			0.084	0.081		
	IT_CON$_{Med}$	0.096	0.086	1288	0.160	0.087	0.083	1252	0.157	0.091	0.082	1378	**0.011**
	Control$_{CM}$	0.081	0.077			0.073	0.067			0.070	0.065		
	IT_CON$_{High}$	0.094	0.088	1917	0.228	0.089	0.078	1862	0.344	0.092	0.088	1931	**0.087**
	Control$_{CH}$	0.089	0.071			0.085	0.070			0.081	0.065		
OI/E	IT_CON$_{Low}$	83.564	43.545	748	0.966	85.035	45.496	789	0.692	83.957	46.393	783	0.731
	Control$_{CL}$	84.613	34.466			80.577	35.427			91.067	35.589		
	IT_CON$_{Med}$	60.056	38.141	741	**0.099**	59.972	39.588	575	**0.012**	62.741	37.339	685	**0.062**
	Control$_{CM}$	65.860	46.898			151.887	65.974			127.108	63.935		
	IT_CON$_{High}$	69.106	33.561	1645	0.906	63.591	34.368	1599	0.922	70.640	34.263	1410	0.939
	Control$_{CH}$	71.908	37.934			71.162	32.284			73.496	35.323		
OI/E	IT_CON$_{Low}$	0.148	0.117	837	0.753	0.145	0.124	885	0.480	0.141	0.121	875	0.533
	Control$_{CL}$	0.127	0.107			0.124	0.104			0.132	0.102		
	IT_CON$_{Med}$	0.128	0.108	1085	0.937	0.124	0.104	915	0.405	0.129	0.116	915	0.669
	Control$_{CM}$	0.117	0.101			0.130	0.115			0.133	0.116		
	IT_CON$_{High}$	0.125	0.109	1582	0.857	0.119	0.102	1549	0.735	0.126	0.110	1498	0.988
	Control$_{CH}$	0.131	0.111			0.128	0.114			0.137	0.117		

(Continued)

FP	Groups	2005				2006				2007			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
OPEXP/S	IT_CON_{Low}	0.801	0.836	1024	0.424	0.798	0.839	976	0.656	0.806	0.841	963	0.559
	$Control_{CL}$	0.790	0.815			0.794	0.837			0.799	0.840		
	IT_CON_{Med}	0.820	0.848	1311	0.852	0.819	0.842	1350	0.682	0.822	0.840	1266	0.947
	$Control_{CM}$	0.811	0.848			0.804	0.851			0.822	0.853		
	IT_CON_{High}	0.827	0.855	2151	**0.064**	0.824	0.848	2160	**0.059**	0.823	0.849	2106	**0.062**
	$Control_{CH}$	0.785	0.836			0.779	0.813			0.784	0.821		
COG/S	IT_CON_{Low}	0.598	0.636	896	0.892	0.589	0.629	878	0.788	0.595	0.614	871	0.919
	$Control_{CL}$	0.606	0.654			0.607	0.659			0.610	0.649		
	IT_CON_{Med}	0.621	0.659	1001	0.113	0.618	0.648	1012	0.128	0.624	0.652	950	**0.061**
	$Control_{CM}$	0.690	0.735			0.684	0.723			0.700	0.722		
	IT_CON_{High}	0.686	0.724	2068	0.141	0.681	0.730	2058	0.153	0.678	0.713	1944	0.263
	$Control_{CH}$	0.646	0.695			0.640	0.701			0.647	0.702		
SGA/S	IT_CON_{Low}	0.203	0.182	918	0.330	0.210	0.191	932	0.276	0.211	0.197	880	0.359
	$Control_{CL}$	0.184	0.167			0.187	0.179			0.190	0.185		
	IT_CON_{Med}	0.198	0.187	1305	**0.001**	0.201	0.183	1311	**0.000**	0.198	0.175	1281	**0.001**
	$Control_{CM}$	0.121	0.113			0.120	0.120			0.122	0.109		
	IT_CON_{High}	0.141	0.106	1105	1.000	0.143	0.106	1124	0.928	0.145	0.112	1217	0.628
	$Control_{CH}$	0.139	0.118			0.140	0.133			0.137	0.105		
Q	IT_CON_{Low}	1.949	1.553	1051	0.319	1.980	1.637	981	0.630	1.902	1.525	878	0.961
	$Control_{CL}$	2.132	1.488			2.149	1.566			1.942	1.452		
	IT_CON_{Med}	2.045	1.564	1657	**0.030**	2.059	1.615	1584	**0.080**	1.914	1.541	1660	**0.029**
	$Control_{CM}$	1.674	1.454			1.693	1.562			1.563	1.325		
	IT_CON_{High}	1.807	1.548	1828	0.701	1.825	1.603	1779	0.872	1.703	1.516	1761	0.785
	$Control_{CH}$	2.086	1.421			2.182	1.483			1.818	1.390		

(Continued)

FP	Groups	2008				2009				2010			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
OPEXP/S	IT_CON_{Low}	0.977	0.848	862	0.865	0.831	0.848	855	1.000	0.793	0.828	733	0.460
	$Control_{CL}$	0.845	0.865			0.841	0.856			0.816	0.841		
	IT_CON_{Med}	0.844	0.859	1068	0.230	0.839	0.829	1147	0.720	0.823	0.847	1191	0.915
	$Control_{CM}$	0.874	0.889			0.850	0.865			0.829	0.861		
	IT_CON_{High}	0.841	0.871	1830	0.554	0.836	0.865	1909	0.339	0.820	0.850	1948	0.255
	$Control_{CH}$	0.834	0.844			0.819	0.845			0.801	0.830		
COG/S	IT_CON_{Low}	0.761	0.626	808	0.564	0.605	0.622	794	0.637	0.569	0.603	657	0.179
	$Control_{CL}$	0.640	0.679			0.629	0.659			0.621	0.679		
	IT_CON_{Med}	0.639	0.652	831	**0.011**	0.630	0.645	888	**0.056**	0.614	0.656	875	**0.069**
	$Control_{CM}$	0.747	0.762			0.714	0.741			0.697	0.729		
	IT_CON_{High}	0.691	0.733	1773	0.743	0.679	0.702	1784	0.705	0.671	0.701	1798	0.657
	$Control_{CH}$	0.692	0.726			0.675	0.711			0.660	0.694		
SGA/S	IT_CON_{Low}	0.216	0.210	833	0.601	0.226	0.208	810	0.564	0.225	0.209	834	0.296
	$Control_{CL}$	0.205	0.191			0.212	0.207			0.195	0.200		
	IT_CON_{Med}	0.205	0.173	1307	**0.000**	0.210	0.173	1180	**0.002**	0.209	0.186	1310	**0.001**
	$Control_{CM}$	0.127	0.109			0.136	0.101			0.132	0.106		
	IT_CON_{High}	0.150	0.111	1182	0.791	0.157	0.123	1233	0.559	0.149	0.117	1181	0.795
	$Control_{CH}$	0.142	0.121			0.144	0.117			0.141	0.112		
Q	IT_CON_{Low}	1.460	1.189	922	0.783	1.577	1.336	921	0.615	1.714	1.404	949	0.332
	$Control_{CL}$	1.411	1.133			1.571	1.271			1.652	1.332		
	IT_CON_{Med}	1.489	1.259	1593	**0.072**	1.621	1.365	1457	0.137	1.722	1.414	1428	0.120
	$Control_{CM}$	1.319	1.112			1.432	1.236			1.505	1.310		
	IT_CON_{High}	1.392	1.261	1970	0.215	1.449	1.342	1695	0.978	1.535	1.411	1848	0.500
	$Control_{CH}$	1.388	1.105			1.497	1.220			1.517	1.282		

(Continued)

FP	Groups	2011				2012				2013			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
OPEXP/S	IT_CON_{Low}	0.793	0.830	700	0.426	0.795	0.820	674	0.314	0.797	0.825	693	0.394
	$Control_{CL}$	0.816	0.851			0.820	0.849			0.813	0.848		
	IT_CON_{Med}	0.829	0.844	1079	0.969	0.832	0.846	1131	0.545	0.826	0.843	1061	0.556
	$Control_{CM}$	0.839	0.863			0.826	0.853			0.820	0.852		
	IT_CON_{High}	0.823	0.854	1851	0.269	0.827	0.853	1859	0.253	0.818	0.839	1675	0.380
	$Control_{CH}$	0.803	0.830			0.807	0.830			0.794	0.814		
COG/S	IT_CON_{Low}	0.581	0.597	665	0.280	0.578	0.594	653	0.239	0.578	0.587	663	0.273
	$Control_{CL}$	0.623	0.662			0.626	0.679			0.619	0.648		
	IT_CON_{Med}	0.628	0.656	793	**0.068**	0.625	0.659	815	0.133	0.619	0.644	801	0.220
	$Control_{CM}$	0.719	0.747			0.703	0.731			0.697	0.734		
	IT_CON_{High}	0.676	0.707	1638	0.933	0.673	0.714	1616	0.987	0.665	0.723	1542	0.839
	$Control_{CH}$	0.670	0.711			0.674	0.708			0.660	0.689		
SGA/S	IT_CON_{Low}	0.212	0.201	755	0.391	0.217	0.215	786	0.380	0.219	0.207	790	0.360
	$Control_{CL}$	0.193	0.197			0.195	0.199			0.194	0.183		
	IT_CON_{Med}	0.200	0.168	1187	**0.002**	0.206	0.173	1186	**0.002**	0.207	0.170	1104	**0.002**
	$Control_{CM}$	0.121	0.087			0.124	0.094			0.124	0.089		
	IT_CON_{High}	0.147	0.116	1158	0.432	0.155	0.114	1213	0.249	0.153	0.115	1058	0.421
	$Control_{CH}$	0.133	0.099			0.133	0.101			0.135	0.099		
Q	IT_CON_{Low}	1.567	1.408	848	0.686	1.611	1.426	883	0.491	1.800	1.630	848	0.686
	$Control_{CL}$	1.542	1.316			1.549	1.380			1.811	1.532		
	IT_CON_{Med}	1.584	1.357	1363	**0.058**	1.649	1.445	1407	**0.014**	1.855	1.574	1355	**0.018**
	$Control_{CM}$	1.385	1.258			1.400	1.296			1.521	1.386		
	IT_CON_{High}	1.482	1.318	1837	0.407	1.522	1.313	1752	0.668	1.713	1.543	1819	0.244
	$Control_{CH}$	1.492	1.156			1.565	1.225			1.653	1.371		

with continuous IT capability are lower than the ratios of the control group. For instance, COG/S of firms with a medium level of continuous IT capability (IT_AGG_{Med}) is lower that one of the control samples in five out of nine cases (2007–2011). However, SGA/S of the firms with continuous IT capability (IT_AGG_{Med}) is significantly higher than the ratio of the control sample during the whole research period (2005–2013). The OPEXP/S of the firms is also higher than the ratio of the control firms in several cases (2005–2007).

I found partial support for Hypothesis 6, which assumes that the degree of continuous IT capability influences firms' market performance. When compared to the firms in the control group, Tobin's Q ratio (Q), which is a proxy for firms' market performance, is significantly higher for the firms with a medium level of aggregated IT capability (IT_AGG_{Med}), in seven out of nine cases (2005–2008 and 2011–2013). Meanwhile, the ratios of firms with Low and Medium levels of aggregated IT capability (IT_AGG_{Low} and IT_AGG_{High}) are not statistically different from the ratio of the control group. The result is aligned with the result of Hypothesis 3.

5.1.3 The Results of Cross-sectional Regression Analysis

Regression analysis is performed to test Hypotheses 7 to 12, which are almost the same as Hypotheses 1 to 6, respectively, except adjusting for previous financial performance. The results of the regression analysis are displayed in Table 12. The table contains the coefficient and p-value of the variable for prior year's financial performance and the dummies that represent the degree of aggregated and continuous IT capability ($IT\_AGG_{Low,}$ $IT\_AGG_{Med,}$ IT_AGG_{High}, $IT\_CON_{Low,}$ $IT\_CON_{Med,}$ and IT_CON_{High}). A p-value less than a significance level ($p < 0.10$) is marked in bold. As Chae et al. (2014) and Santhanam and Hartono (2003) have shown, the prior

Table 12. Result of Regression Tests for Firms with Aggregated and Continuous IT Capability

FP	Groups	2006							2007						
		R^2_change	Model I		Model II				R^2_change	Model I		Model II			
			a_1	p	ß$_1$	p	ß$_1$	p		a_1	p	ß$_1$	p	ß$_1$	p
ROA	IT_AGG$_{Low}$	0.009	0.854	0.000	0.833	0.000	−0.020	0.235	0.000	0.562	0.000	0.560	0.000	−0.002	0.910
	IT_AGG$_{Med}$	0.000	0.793	0.000	0.793	0.000	−0.002	0.849	0.001	0.483	0.000	0.483	0.000	0.006	0.618
	IT_AGG$_{High}$	0.000	0.295	0.001	0.296	0.001	0.003	0.824	0.016	0.499	0.000	0.499	0.000	−0.025	**0.040**
ROS	IT_AGG$_{Low}$	0.025	0.681	0.000	0.640	0.000	−0.043	**0.083**	0.003	0.612	0.000	0.596	0.000	−0.017	0.594
	IT_AGG$_{Med}$	0.002	0.804	0.000	0.802	0.000	−0.009	0.479	0.000	0.460	0.000	0.461	0.000	0.004	0.825
	IT_AGG$_{High}$	0.004	0.041	0.646	0.043	0.634	0.015	0.387	0.007	0.407	0.000	0.412	0.000	−0.021	0.217
OI/A	IT_AGG$_{Low}$	0.000	1.004	0.000	1.006	0.000	0.002	0.828	0.000	0.940	0.000	0.941	0.000	0.004	0.712
	IT_AGG$_{Med}$	0.000	0.828	0.000	0.828	0.000	0.002	0.753	0.002	0.950	0.000	0.946	0.000	0.008	0.380
	IT_AGG$_{High}$	0.000	1.043	0.000	1.043	0.000	−0.001	0.795	0.000	0.904	0.000	0.904	0.000	0.000	0.999
OI/E	IT_AGG$_{Low}$	0.002	1.046	0.000	1.053	0.000	16.169	0.431	0.000	0.888	0.000	0.890	0.000	8.291	0.401
	IT_AGG$_{Med}$	0.031	−0.160	0.248	−0.192	0.164	−77.838	**0.034**	0.001	1.026	0.000	1.031	0.000	14.325	0.233
	IT_AGG$_{High}$	0.000	1.211	0.000	1.210	0.000	−1.565	0.785	0.000	0.991	0.000	0.993	0.000	4.745	0.423
OI/S	IT_AGG$_{Low}$	0.001	1.060	0.000	1.065	0.000	0.011	0.309	0.000	0.837	0.000	0.837	0.000	0.002	0.883
	IT_AGG$_{Med}$	0.000	0.893	0.000	0.892	0.000	−0.005	0.522	0.000	0.902	0.000	0.904	0.000	0.005	0.603
	IT_AGG$_{High}$	0.000	0.980	0.000	0.980	0.000	0.000	0.947	0.001	0.901	0.000	0.903	0.000	0.006	0.258
OPEXP/S	IT_AGG$_{Low}$	0.001	1.022	0.000	1.025	0.000	−0.009	0.400	0.000	0.850	0.000	0.850	0.000	0.000	0.986
	IT_AGG$_{Med}$	0.001	0.912	0.000	0.911	0.000	0.008	0.292	0.001	0.972	0.000	0.973	0.000	−0.006	0.485
	IT_AGG$_{High}$	0.000	0.974	0.000	0.973	0.000	0.002	0.693	0.000	0.910	0.000	0.912	0.000	−0.005	0.287
COG/S	IT_AGG$_{Low}$	0.001	1.000	0.000	1.002	0.000	−0.010	0.307	0.001	0.962	0.000	0.961	0.000	0.010	0.380
	IT_AGG$_{Med}$	0.000	0.955	0.000	0.954	0.000	−0.002	0.779	0.000	0.999	0.000	0.998	0.000	−0.005	0.551
	IT_AGG$_{High}$	0.000	0.971	0.000	0.971	0.000	0.001	0.816	0.001	0.966	0.000	0.967	0.000	−0.010	0.152
SGA/S	IT_AGG$_{Low}$	0.000	1.007	0.000	1.007	0.000	0.001	0.741	0.002	0.988	0.000	0.990	0.000	−0.012	**0.084**
	IT_AGG$_{Med}$	0.000	1.017	0.000	1.014	0.000	0.005	**0.072**	0.000	0.976	0.000	0.976	0.000	0.000	0.991
	IT_AGG$_{High}$	0.000	1.007	0.000	1.007	0.000	0.000	0.935	0.000	0.980	0.000	0.979	0.000	0.002	0.636
Q	IT_AGG$_{Low}$	0.000	0.859	0.000	0.860	0.000	0.037	0.798	0.001	0.652	0.000	0.654	0.000	0.072	0.666
	IT_AGG$_{Med}$	0.000	0.931	0.000	0.933	0.000	−0.021	0.705	0.001	0.805	0.000	0.800	0.000	0.066	0.317
	IT_AGG$_{High}$	0.000	1.015	0.000	1.014	0.000	−0.066	0.197	0.001	0.516	0.000	0.518	0.000	0.073	0.292

(Continued)

FP	Groups	2008							2009						
		R^2_change	Model I		Model II				R^2_change	Model I		Model II			
			a_1	p	ß1	p	ß1	p		a_1	p	ß1	p	ß1	p
ROA	IT_AGG$_{Low}$	0.003	0.826	0.000	0.815	0.000	−0.016	0.607	0.013	0.486	0.000	0.502	0.000	0.039	0.262
	IT_AGG$_{Med}$	0.011	0.604	0.000	0.600	0.000	0.017	**0.094**	0.001	0.483	0.000	0.480	0.000	0.004	0.626
	IT_AGG$_{High}$	0.000	0.626	0.000	0.625	0.000	−0.002	0.915	0.009	0.160	0.000	0.163	0.000	0.016	0.175
ROS	IT_AGG$_{Low}$	0.011	0.214	0.838	0.029	0.978	−0.301	0.362	0.017	0.029	0.317	0.032	0.263	0.095	0.250
	IT_AGG$_{Med}$	0.010	0.676	0.000	0.677	0.000	0.036	0.162	0.004	0.282	0.000	0.286	0.000	−0.018	0.427
	IT_AGG$_{High}$	0.003	0.547	0.000	0.552	0.000	0.025	0.410	0.007	0.186	0.000	0.184	0.000	0.019	0.205
OI/A	IT_AGG$_{Low}$	0.006	0.882	0.000	0.886	0.000	0.018	0.214	0.000	0.873	0.000	0.874	0.000	−0.002	0.890
	IT_AGG$_{Med}$	0.002	0.685	0.000	0.681	0.000	0.006	0.429	0.005	0.751	0.000	0.744	0.000	0.009	0.128
	IT_AGG$_{High}$	0.001	0.753	0.000	0.753	0.000	0.004	0.523	0.002	0.770	0.000	0.770	0.000	0.006	0.312
OI/E	IT_AGG$_{Low}$	0.004	0.670	0.000	0.665	0.000	−26.048	0.462	0.000	0.194	0.004	0.193	0.005	−4.580	0.866
	IT_AGG$_{Med}$	0.000	0.633	0.000	0.635	0.000	7.371	0.560	0.000	1.356	0.000	1.356	0.000	1.085	0.935
	IT_AGG$_{High}$	0.004	0.620	0.000	0.624	0.000	16.056	0.157	0.000	0.612	0.000	0.612	0.000	−2.878	0.681
OI/S	IT_AGG$_{Low}$	0.008	0.662	0.477	0.625	0.504	−0.201	0.436	0.001	0.020	0.217	0.020	0.211	0.012	0.740
	IT_AGG$_{Med}$	0.011	0.471	0.000	0.476	0.000	0.029	0.160	0.000	0.479	0.000	0.480	0.000	−0.004	0.785
	IT_AGG$_{High}$	0.003	0.570	0.000	0.572	0.000	0.016	0.365	0.000	0.462	0.000	0.462	0.000	−0.002	0.839
OPEXP/S	IT_AGG$_{Low}$	0.007	0.887	0.295	0.855	0.315	0.186	0.453	0.001	0.026	0.106	0.027	0.106	−0.007	0.839
	IT_AGG$_{Med}$	0.010	0.647	0.000	0.652	0.000	−0.030	0.147	0.001	0.619	0.000	0.621	0.000	0.009	0.565
	IT_AGG$_{High}$	0.002	0.743	0.000	0.747	0.000	−0.014	0.429	0.000	0.608	0.000	0.608	0.000	0.005	0.651
COG/S	IT_AGG$_{Low}$	0.008	1.610	0.013	1.591	0.014	0.195	0.429	0.000	0.061	0.005	0.061	0.005	−0.002	0.965
	IT_AGG$_{Med}$	0.007	0.969	0.000	0.956	0.000	−0.042	**0.066**	0.000	0.796	0.000	0.796	0.000	0.001	0.930
	IT_AGG$_{High}$	0.001	0.975	0.000	0.975	0.000	−0.017	0.311	0.000	0.824	0.000	0.824	0.000	−0.003	0.814
SGA/S	IT_AGG$_{Low}$	0.003	1.066	0.000	1.066	0.000	−0.019	0.179	0.000	0.903	0.000	0.904	0.000	0.006	0.513
	IT_AGG$_{Med}$	0.000	0.986	0.000	0.981	0.000	0.007	0.268	0.000	1.010	0.000	1.013	0.000	−0.005	0.396
	IT_AGG$_{High}$	0.000	1.042	0.000	1.042	0.000	−0.002	0.672	0.000	0.985	0.000	0.984	0.000	0.005	**0.045**
Q	IT_AGG$_{Low}$	0.002	0.545	0.000	0.546	0.000	0.068	0.519	0.004	0.963	0.000	0.963	0.000	−0.111	0.223
	IT_AGG$_{Med}$	0.000	0.546	0.000	0.545	0.000	0.009	0.870	0.001	0.944	0.000	0.938	0.000	0.051	0.387
	IT_AGG$_{High}$	0.001	0.621	0.000	0.621	0.000	0.046	0.410	0.001	0.928	0.000	0.928	0.000	−0.037	0.336

(Continued)

FP	Groups	2010							2011						
		R^2_change	Model I		Model II				R^2_change	Model I		Model II			
			a_1	p	ß$_1$	p	ß$_1$	p		a_1	p	ß$_1$	p	ß$_1$	p
ROA	IT_AGG$_{Low}$	0.001	0.079	0.185	0.079	0.184	−0.004	0.828	0.006	0.794	0.000	0.795	0.000	0.014	0.339
	IT_AGG$_{Med}$	0.000	0.581	0.000	0.578	0.000	0.003	0.753	0.033	0.590	0.000	0.576	0.000	0.022	**0.006**
	IT_AGG$_{High}$	0.003	0.231	0.000	0.233	0.000	−0.005	0.415	0.003	0.863	0.000	0.865	0.000	0.007	0.306
ROS	IT_AGG$_{Low}$	0.010	−0.102	0.062	−0.096	0.081	−0.034	0.394	0.000	0.350	0.000	0.349	0.000	−0.001	0.968
	IT_AGG$_{Med}$	0.000	0.305	0.000	0.306	0.000	0.003	0.839	0.023	0.633	0.000	0.637	0.000	0.036	**0.042**
	IT_AGG$_{High}$	0.001	0.332	0.000	0.335	0.000	−0.005	0.585	0.003	0.746	0.000	0.746	0.000	0.009	0.243
OI/A	IT_AGG$_{Low}$	0.006	0.880	0.000	0.879	0.000	0.018	0.133	0.000	0.844	0.000	0.844	0.000	0.000	0.970
	IT_AGG$_{Med}$	0.000	0.791	0.000	0.788	0.000	0.003	0.659	0.006	0.885	0.000	0.874	0.000	0.010	0.127
	IT_AGG$_{High}$	0.000	0.726	0.000	0.726	0.000	−0.001	0.813	0.001	0.964	0.000	0.964	0.000	0.004	0.259
OI/E	IT_AGG$_{Low}$	0.001	0.549	0.000	0.551	0.000	7.668	0.832	0.000	0.965	0.000	0.965	0.000	−6.194	0.614
	IT_AGG$_{Med}$	0.002	0.708	0.000	0.706	0.000	−14.792	**0.037**	0.005	−0.525	0.000	−0.534	0.000	−24.894	0.350
	IT_AGG$_{High}$	0.000	0.989	0.000	0.990	0.000	2.319	0.691	0.000	0.992	0.000	0.992	0.000	2.307	0.621
OI/S	IT_AGG$_{Low}$	0.003	0.619	0.000	0.618	0.000	0.014	0.538	0.001	0.922	0.000	0.924	0.000	−0.009	0.658
	IT_AGG$_{Med}$	0.001	0.760	0.000	0.760	0.000	−0.006	0.502	0.007	0.828	0.000	0.831	0.000	0.017	0.118
	IT_AGG$_{High}$	0.000	0.797	0.000	0.797	0.000	−0.001	0.829	0.000	0.940	0.000	0.940	0.000	0.003	0.421
OPEXP/S	IT_AGG$_{Low}$	0.004	0.793	0.000	0.793	0.000	−0.020	0.357	0.000	0.923	0.000	0.924	0.000	0.006	0.713
	IT_AGG$_{Med}$	0.001	0.840	0.000	0.840	0.000	0.007	0.384	0.005	0.915	0.000	0.918	0.000	−0.017	0.112
	IT_AGG$_{High}$	0.000	0.888	0.000	0.888	0.000	0.000	0.966	0.000	0.977	0.000	0.976	0.000	0.001	0.777
COG/S	IT_AGG$_{Low}$	0.006	0.820	0.000	0.821	0.000	−0.031	0.132	0.000	0.972	0.000	0.972	0.000	0.006	0.520
	IT_AGG$_{Med}$	0.000	0.935	0.000	0.935	0.000	0.001	0.922	0.001	1.007	0.000	1.003	0.000	−0.012	0.297
	IT_AGG$_{High}$	0.000	0.959	0.000	0.959	0.000	0.001	0.846	0.000	0.976	0.000	0.976	0.000	−0.003	0.504
SGA/S	IT_AGG$_{Low}$	0.002	0.942	0.000	0.942	0.000	0.012	0.125	0.000	0.943	0.000	0.943	0.000	0.001	0.914
	IT_AGG$_{Med}$	0.000	0.939	0.000	0.935	0.000	0.007	0.253	0.000	0.982	0.000	0.986	0.000	−0.005	0.314
	IT_AGG$_{High}$	0.000	0.948	0.000	0.948	0.000	−0.001	0.658	0.000	0.955	0.000	0.954	0.000	0.005	0.189
Q	IT_AGG$_{Low}$	0.000	0.764	0.000	0.763	0.000	−0.033	0.736	0.000	0.832	0.000	0.832	0.000	0.011	0.889
	IT_AGG$_{Med}$	0.003	1.093	0.000	1.081	0.000	0.092	0.141	0.000	0.704	0.000	0.702	0.000	0.018	0.634
	IT_AGG$_{High}$	0.000	0.972	0.000	0.972	0.000	0.022	0.528	0.000	0.937	0.000	0.937	0.000	0.000	0.994

(Continued)

FP	Groups	2012							2013						
		R^2_change	Model I		Model II				R^2_change	Model I		Model II			
			a_1	p	ß$_1$	p	ß$_1$	p		a_1	p	ß$_1$	p	ß$_1$	p
ROA	IT_AGG$_{Low}$	0.005	0.530	0.000	0.534	0.000	−0.012	0.440	0.005	0.042	0.774	0.039	0.790	−0.014	0.541
	IT_AGG$_{Med}$	0.001	0.522	0.000	0.530	0.000	−0.004	0.698	0.018	0.665	0.000	0.652	0.000	0.017	**0.035**
	IT_AGG$_{High}$	0.002	0.498	0.000	0.496	0.000	0.006	0.453	0.001	0.486	0.000	0.485	0.000	0.004	0.532
ROS	IT_AGG$_{Low}$	0.008	0.316	0.007	0.309	0.009	−0.019	0.442	0.002	0.176	0.231	0.170	0.254	−0.013	0.686
	IT_AGG$_{Med}$	0.014	0.276	0.000	0.291	0.000	−0.023	0.139	0.007	0.743	0.000	0.746	0.000	0.015	0.159
	IT_AGG$_{High}$	0.001	0.677	0.000	0.675	0.000	0.005	0.543	0.000	0.779	0.000	0.779	0.000	0.000	0.984
OI/A	IT_AGG$_{Low}$	0.000	0.652	0.000	0.652	0.000	0.001	0.932	0.011	0.722	0.000	0.730	0.000	−0.017	0.148
	IT_AGG$_{Med}$	0.001	0.846	0.000	0.854	0.000	−0.005	0.491	0.007	0.761	0.000	0.751	0.000	0.010	**0.070**
	IT_AGG$_{High}$	0.000	0.875	0.000	0.875	0.000	0.001	0.771	0.003	0.882	0.000	0.879	0.000	0.007	**0.081**
OI/E	IT_AGG$_{Low}$	0.001	0.798	0.000	0.799	0.000	8.822	0.243	0.003	0.931	0.000	0.931	0.000	−15.219	0.177
	IT_AGG$_{Med}$	0.020	−0.803	0.000	−0.802	0.000	−79.167	**0.056**	0.000	0.720	0.000	0.720	0.000	−0.979	0.914
	IT_AGG$_{High}$	0.000	0.845	0.000	0.845	0.000	−3.072	0.591	0.000	0.960	0.000	0.960	0.000	1.711	0.697
OI/S	IT_AGG$_{Low}$	0.000	0.746	0.000	0.745	0.000	0.006	0.655	0.004	0.932	0.000	0.935	0.000	−0.016	**0.097**
	IT_AGG$_{Med}$	0.008	0.700	0.000	0.706	0.000	−0.017	0.148	0.000	0.948	0.000	0.947	0.000	−0.002	0.759
	IT_AGG$_{High}$	0.000	0.925	0.000	0.926	0.000	−0.001	0.804	0.000	0.991	0.000	0.991	0.000	0.001	0.846
OPEXP/S	IT_AGG$_{Low}$	0.001	0.840	0.000	0.839	0.000	−0.009	0.496	0.001	0.974	0.000	0.976	0.000	0.010	0.229
	IT_AGG$_{Med}$	0.007	0.788	0.000	0.792	0.000	0.020	**0.094**	0.000	0.972	0.000	0.971	0.000	0.003	0.628
	IT_AGG$_{High}$	0.000	0.950	0.000	0.950	0.000	−0.001	0.888	0.000	0.994	0.000	0.994	0.000	−0.001	0.807
COG/S	IT_AGG$_{Low}$	0.001	0.916	0.000	0.915	0.000	−0.012	0.365	0.000	0.977	0.000	0.978	0.000	0.003	0.643
	IT_AGG$_{Med}$	0.001	0.903	0.000	0.909	0.000	0.013	0.284	0.000	0.982	0.000	0.984	0.000	0.006	0.386
	IT_AGG$_{High}$	0.000	0.989	0.000	0.988	0.000	−0.007	0.337	0.000	0.984	0.000	0.984	0.000	−0.002	0.518
SGA/S	IT_AGG$_{Low}$	0.000	0.937	0.000	0.937	0.000	0.004	0.773	0.001	1.041	0.000	1.040	0.000	0.008	0.110
	IT_AGG$_{Med}$	0.000	1.020	0.000	1.020	0.000	0.000	0.868	0.000	0.991	0.000	0.993	0.000	−0.003	0.126
	IT_AGG$_{High}$	0.000	0.988	0.000	0.986	0.000	0.006	0.281	0.000	0.990	0.000	0.990	0.000	0.001	0.635
Q	IT_AGG$_{Low}$	0.000	0.785	0.000	0.785	0.000	−0.020	0.820	0.002	1.136	0.000	1.132	0.000	−0.090	0.366
	IT_AGG$_{Med}$	0.000	0.952	0.000	0.948	0.000	0.025	0.602	0.001	1.026	0.000	1.016	0.000	0.053	0.278
	IT_AGG$_{High}$	0.000	0.978	0.000	0.978	0.000	0.009	0.768	0.001	1.077	0.000	1.076	0.000	0.051	0.237

(Continued)

FP	Groups	2006							2007						
		R^2_change	Model I		Model II				R^2_change	Model I		Model II			
			a_1	p	ß1	p	ß1	p		a_1	p	ß1	p	ß1	p
ROA	IT_CON_{Low}	0.003	0.896	0.000	0.888	0.000	−0.012	0.362	0.000	0.546	0.000	0.545	0.000	−0.003	0.803
	IT_CON_{Med}	0.000	0.748	0.000	0.748	0.000	0.000	0.970	0.003	0.556	0.000	0.555	0.000	0.010	0.461
	IT_CON_{High}	0.000	0.251	0.010	0.251	0.010	0.000	0.993	0.026	0.464	0.000	0.461	0.000	−0.032	**0.019**
ROS	IT_CON_{Low}	0.005	0.779	0.000	0.768	0.000	−0.019	0.312	0.003	0.615	0.000	0.607	0.000	−0.015	0.499
	IT_CON_{Med}	0.001	0.725	0.000	0.724	0.000	−0.006	0.631	0.004	0.485	0.000	0.489	0.000	0.018	0.398
	IT_CON_{High}	0.000	−0.034	0.728	−0.033	0.737	0.004	0.853	0.020	0.347	0.000	0.349	0.000	−0.034	**0.056**
OI/A	IT_CON_{Low}	0.000	1.004	0.000	1.005	0.000	0.001	0.847	0.000	0.896	0.000	0.896	0.000	0.000	0.975
	IT_CON_{Med}	0.000	0.837	0.000	0.837	0.000	0.001	0.858	0.003	1.048	0.000	1.044	0.000	0.010	0.253
	IT_CON_{High}	0.000	1.047	0.000	1.047	0.000	−0.001	0.872	0.000	0.891	0.000	0.891	0.000	−0.001	0.837
OI/E	IT_CON_{Low}	0.001	1.051	0.000	1.055	0.000	9.940	0.474	0.000	0.883	0.000	0.884	0.000	4.001	0.565
	IT_CON_{Med}	0.036	−0.177	0.218	−0.215	0.132	−86.481	**0.026**	0.002	1.031	0.000	1.039	0.000	20.616	0.109
	IT_CON_{High}	0.000	1.216	0.000	1.216	0.000	−0.869	0.891	0.000	0.991	0.000	0.992	0.000	3.152	0.641
OI/S	IT_CON_{Low}	0.001	1.042	0.000	1.043	0.000	0.009	0.275	0.000	0.839	0.000	0.839	0.000	−0.003	0.747
	IT_CON_{Med}	0.001	0.879	0.000	0.878	0.000	−0.006	0.421	0.004	0.923	0.000	0.928	0.000	0.015	0.134
	IT_CON_{High}	0.000	0.987	0.000	0.987	0.000	−0.001	0.890	0.000	0.893	0.000	0.894	0.000	0.002	0.738
OPEXP/S	IT_CON_{Low}	0.000	1.008	0.000	1.009	0.000	−0.007	0.408	0.000	0.871	0.000	0.871	0.000	0.004	0.622
	IT_CON_{Med}	0.001	0.910	0.000	0.909	0.000	0.007	0.360	0.003	0.956	0.000	0.959	0.000	−0.014	0.115
	IT_CON_{High}	0.000	0.976	0.000	0.975	0.000	0.003	0.479	0.000	0.912	0.000	0.913	0.000	−0.002	0.726
COG/S	IT_CON_{Low}	0.001	0.993	0.000	0.993	0.000	−0.010	0.168	0.001	0.973	0.000	0.974	0.000	0.010	0.241
	IT_CON_{Med}	0.000	0.951	0.000	0.950	0.000	−0.001	0.910	0.001	0.992	0.000	0.987	0.000	−0.012	0.161
	IT_CON_{High}	0.000	0.968	0.000	0.968	0.000	0.003	0.538	0.000	0.966	0.000	0.968	0.000	−0.008	0.303
SGA/S	IT_CON_{Low}	0.000	1.008	0.000	1.007	0.000	0.003	0.343	0.000	0.982	0.000	0.984	0.000	−0.006	0.186
	IT_CON_{Med}	0.000	1.019	0.000	1.017	0.000	0.003	0.370	0.000	0.987	0.000	0.990	0.000	−0.003	0.258
	IT_CON_{High}	0.000	1.003	0.000	1.003	0.000	0.001	0.819	0.000	0.966	0.000	0.966	0.000	0.004	0.530
Q	IT_CON_{Low}	0.000	0.844	0.000	0.844	0.000	−0.014	0.894	0.001	0.685	0.000	0.686	0.000	0.060	0.624
	IT_CON_{Med}	0.000	0.978	0.000	0.977	0.000	0.004	0.943	0.001	0.809	0.000	0.804	0.000	0.057	0.396
	IT_CON_{High}	0.000	1.023	0.000	1.021	0.000	−0.072	0.192	0.001	0.486	0.000	0.488	0.000	0.067	0.339

(Continued)

FP	Groups	2008							2009						
		R^2_change	Model I		Model II				R^2_change	Model I		Model II			
			a_1	p	ß1	p	ß1	p		a_1	p	ß1	p	ß1	p
ROA	IT_CON_{Low}	0.001	0.832	0.000	0.828	0.000	−0.007	0.725	0.009	0.511	0.000	0.519	0.000	0.027	0.254
	IT_CON_{Med}	0.020	0.704	0.000	0.695	0.000	0.028	**0.029**	0.001	0.374	0.000	0.371	0.000	0.004	0.660
	IT_CON_{High}	0.004	0.527	0.000	0.514	0.000	−0.017	0.417	0.009	0.140	0.006	0.147	0.004	0.017	0.210
ROS	IT_CON_{Low}	0.006	0.474	0.546	0.385	0.628	−0.189	0.394	0.006	0.034	0.165	0.036	0.145	0.051	0.391
	IT_CON_{Med}	0.014	0.758	0.000	0.749	0.000	0.047	0.107	0.000	0.225	0.000	0.226	0.000	0.000	0.988
	IT_CON_{High}	0.001	0.388	0.005	0.395	0.005	0.014	0.687	0.006	0.161	0.000	0.161	0.000	0.018	0.294
OI/A	IT_CON_{Low}	0.003	0.892	0.000	0.894	0.000	0.012	0.248	0.000	0.866	0.000	0.866	0.000	0.004	0.695
	IT_CON_{Med}	0.001	0.737	0.000	0.734	0.000	0.005	0.485	0.002	0.795	0.000	0.790	0.000	0.007	0.296
	IT_CON_{High}	0.001	0.708	0.000	0.709	0.000	0.004	0.559	0.001	0.736	0.000	0.737	0.000	0.005	0.467
OI/E	IT_CON_{Low}	0.002	0.678	0.000	0.675	0.000	−15.714	0.508	0.000	0.218	0.000	0.219	0.000	3.633	0.843
	IT_CON_{Med}	0.000	0.631	0.000	0.632	0.000	4.292	0.761	0.000	1.349	0.000	1.349	0.000	1.638	0.909
	IT_CON_{High}	0.005	0.617	0.000	0.623	0.000	20.643	0.105	0.001	0.608	0.000	0.607	0.000	−5.778	0.463
OI/S	IT_CON_{Low}	0.005	0.793	0.252	0.785	0.258	−0.136	0.433	0.003	0.025	0.079	0.026	0.073	0.017	0.526
	IT_CON_{Med}	0.012	0.420	0.000	0.419	0.000	0.031	0.168	0.000	0.440	0.000	0.440	0.000	−0.001	0.946
	IT_CON_{High}	0.005	0.515	0.000	0.524	0.000	0.019	0.341	0.002	0.427	0.000	0.428	0.000	−0.009	0.457
OPEXP/S	IT_CON_{Low}	0.005	0.967	0.117	0.956	0.121	0.126	0.450	0.002	0.033	0.029	0.034	0.027	−0.014	0.617
	IT_CON_{Med}	0.009	0.608	0.000	0.608	0.000	−0.030	0.185	0.001	0.578	0.000	0.580	0.000	0.007	0.674
	IT_CON_{High}	0.003	0.701	0.000	0.711	0.000	−0.017	0.362	0.003	0.589	0.000	0.588	0.000	0.012	0.352
COG/S	IT_CON_{Low}	0.006	1.436	0.001	1.450	0.001	0.144	0.387	0.006	0.080	0.000	0.082	0.000	−0.034	0.394
	IT_CON_{Med}	0.004	0.973	0.000	0.959	0.000	−0.034	0.178	0.000	0.777	0.000	0.776	0.000	−0.002	0.910
	IT_CON_{High}	0.004	0.940	0.000	0.945	0.000	−0.027	0.152	0.000	0.807	0.000	0.807	0.000	0.004	0.754
SGA/S	IT_CON_{Low}	0.001	1.042	0.000	1.045	0.000	−0.012	0.237	0.000	0.934	0.000	0.934	0.000	0.006	0.396
	IT_CON_{Med}	0.000	0.981	0.000	0.979	0.000	0.003	0.672	0.000	1.002	0.000	1.004	0.000	−0.002	0.689
	IT_CON_{High}	0.000	1.058	0.000	1.058	0.000	0.001	0.813	0.000	0.989	0.000	0.989	0.000	0.005	**0.093**
Q	IT_CON_{Low}	0.002	0.549	0.000	0.550	0.000	0.072	0.352	0.001	0.958	0.000	0.959	0.000	−0.047	0.492
	IT_CON_{Med}	0.001	0.629	0.000	0.634	0.000	−0.053	0.438	0.001	0.952	0.000	0.949	0.000	0.035	0.568
	IT_CON_{High}	0.002	0.569	0.000	0.571	0.000	0.062	0.251	0.002	0.909	0.000	0.909	0.000	−0.051	0.216

(Continued)

FP	Groups	2010							2011						
		R^2_change	Model I		Model II				R^2_change	Model I		Model II			
			a_1	p	ß$_1$	p	ß$_1$	p		a_1	p	ß$_1$	p	ß$_1$	p
ROA	IT_CON$_{Low}$	0.000	0.099	0.056	0.099	0.058	0.003	0.848	0.009	0.777	0.000	0.774	0.000	0.017	0.148
	IT_CON$_{Med}$	0.001	0.638	0.000	0.642	0.000	−0.004	0.654	0.004	0.639	0.000	0.635	0.000	0.008	0.345
	IT_CON$_{High}$	0.004	0.182	0.000	0.185	0.000	−0.006	0.413	0.014	0.845	0.000	0.852	0.000	0.015	**0.046**
ROS	IT_CON$_{Low}$	0.005	−0.080	0.071	−0.078	0.081	−0.021	0.452	0.008	0.448	0.000	0.454	0.000	0.022	0.266
	IT_CON$_{Med}$	0.000	0.607	0.000	0.606	0.000	0.003	0.783	0.008	0.542	0.000	0.538	0.000	0.019	0.238
	IT_CON$_{High}$	0.008	0.250	0.000	0.255	0.000	−0.013	0.203	0.010	0.754	0.000	0.761	0.000	0.015	**0.074**
OI/A	IT_CON$_{Low}$	0.006	0.875	0.000	0.872	0.000	0.016	**0.080**	0.000	0.829	0.000	0.827	0.000	0.004	0.613
	IT_CON$_{Med}$	0.000	0.770	0.000	0.772	0.000	−0.002	0.704	0.001	0.962	0.000	0.959	0.000	0.003	0.524
	IT_CON$_{High}$	0.000	0.714	0.000	0.714	0.000	0.000	0.976	0.003	0.966	0.000	0.966	0.000	0.006	**0.082**
OI/E	IT_CON$_{Low}$	0.001	0.585	0.000	0.585	0.000	7.297	0.760	0.000	0.962	0.000	0.962	0.000	−0.472	0.956
	IT_CON$_{Med}$	0.002	0.706	0.000	0.703	0.000	−14.725	**0.047**	0.009	−0.531	0.000	−0.545	0.000	−36.112	0.203
	IT_CON$_{High}$	0.000	1.005	0.000	1.005	0.000	2.019	0.757	0.001	0.992	0.000	0.994	0.000	5.522	0.296
OI/S	IT_CON$_{Low}$	0.002	0.654	0.000	0.652	0.000	0.010	0.512	0.000	0.942	0.000	0.942	0.000	0.002	0.882
	IT_CON$_{Med}$	0.000	0.734	0.000	0.734	0.000	−0.001	0.920	0.003	0.789	0.000	0.788	0.000	0.010	0.360
	IT_CON$_{High}$	0.001	0.813	0.000	0.812	0.000	−0.005	0.403	0.001	0.931	0.000	0.933	0.000	0.005	0.209
OPEXP/S	IT_CON$_{Low}$	0.002	0.810	0.000	0.809	0.000	−0.014	0.337	0.000	0.948	0.000	0.947	0.000	−0.003	0.784
	IT_CON$_{Med}$	0.000	0.833	0.000	0.834	0.000	0.002	0.827	0.002	0.894	0.000	0.894	0.000	−0.011	0.334
	IT_CON$_{High}$	0.000	0.889	0.000	0.888	0.000	0.005	0.412	0.000	0.970	0.000	0.970	0.000	0.000	0.971
COG/S	IT_CON$_{Low}$	0.004	0.860	0.000	0.856	0.000	−0.028	**0.054**	0.000	0.989	0.000	0.990	0.000	0.003	0.641
	IT_CON$_{Med}$	0.000	0.926	0.000	0.923	0.000	−0.005	0.563	0.000	1.003	0.000	0.999	0.000	−0.010	0.423
	IT_CON$_{High}$	0.000	0.972	0.000	0.972	0.000	0.008	0.128	0.000	0.967	0.000	0.968	0.000	−0.005	0.347
SGA/S	IT_CON$_{Low}$	0.002	0.948	0.000	0.946	0.000	0.012	**0.054**	0.000	0.954	0.000	0.956	0.000	−0.005	0.597
	IT_CON$_{Med}$	0.001	0.928	0.000	0.923	0.000	0.008	0.182	0.000	0.987	0.000	0.987	0.000	0.000	0.971
	IT_CON$_{High}$	0.000	0.958	0.000	0.958	0.000	−0.004	0.151	0.000	0.947	0.000	0.946	0.000	0.005	0.210
Q	IT_CON$_{Low}$	0.001	0.862	0.000	0.862	0.000	0.051	0.592	0.000	0.736	0.000	0.736	0.000	−0.014	0.824
	IT_CON$_{Med}$	0.000	1.063	0.000	1.062	0.000	0.013	0.774	0.000	0.805	0.000	0.803	0.000	0.027	0.435
	IT_CON$_{High}$	0.002	0.900	0.000	0.902	0.000	0.062	**0.079**	0.000	1.007	0.000	1.007	0.000	−0.023	0.566

(Continued)

FP	Groups	2012							2013						
		R^2_change	Model I		Model II				R^2_change	Model I		Model II			
			a_1	p	$ß_1$	p	$ß_1$	p		a_1	p	$ß_1$	p	$ß_1$	p
ROA	IT_CON$_{Low}$	0.001	0.547	0.000	0.550	0.000	−0.004	0.751	0.000	0.222	0.047	0.223	0.048	−0.002	0.913
	IT_CON$_{Med}$	0.001	0.436	0.000	0.433	0.000	0.003	0.768	0.012	0.593	0.000	0.585	0.000	0.014	0.111
	IT_CON$_{High}$	0.000	0.537	0.000	0.537	0.000	−0.001	0.920	0.003	0.456	0.000	0.456	0.000	0.005	0.400
ROS	IT_CON$_{Low}$	0.001	0.375	0.000	0.376	0.000	−0.007	0.735	0.000	0.417	0.000	0.417	0.000	0.003	0.901
	IT_CON$_{Med}$	0.010	0.246	0.001	0.256	0.001	−0.018	0.251	0.006	0.711	0.000	0.714	0.000	0.014	0.224
	IT_CON$_{High}$	0.000	0.706	0.000	0.706	0.000	−0.002	0.844	0.000	0.731	0.000	0.731	0.000	−0.001	0.916
OI/A	IT_CON$_{Low}$	0.000	0.694	0.000	0.695	0.000	−0.001	0.939	0.004	0.764	0.000	0.770	0.000	−0.009	0.255
	IT_CON$_{Med}$	0.000	0.825	0.000	0.825	0.000	0.001	0.881	0.007	0.773	0.000	0.764	0.000	0.010	**0.072**
	IT_CON$_{High}$	0.000	0.869	0.000	0.869	0.000	−0.001	0.851	0.003	0.863	0.000	0.860	0.000	0.007	0.127
OI/E	IT_CON$_{Low}$	0.000	0.815	0.000	0.815	0.000	5.313	0.348	0.002	0.951	0.000	0.952	0.000	−11.353	0.166
	IT_CON$_{Med}$	0.028	−0.810	0.000	−0.813	0.000	−96.219	**0.029**	0.000	0.720	0.000	0.720	0.000	−2.409	0.804
	IT_CON$_{High}$	0.001	0.828	0.000	0.828	0.000	−5.252	0.418	0.000	0.942	0.000	0.942	0.000	3.222	0.485
OI/S	IT_CON$_{Low}$	0.000	0.801	0.000	0.800	0.000	0.005	0.629	0.002	0.938	0.000	0.942	0.000	−0.011	**0.096**
	IT_CON$_{Med}$	0.006	0.632	0.000	0.637	0.000	−0.014	0.242	0.000	0.957	0.000	0.957	0.000	0.000	0.956
	IT_CON$_{High}$	0.001	0.915	0.000	0.914	0.000	−0.004	0.509	0.000	0.992	0.000	0.992	0.000	0.001	0.874
OPEXP/S	IT_CON$_{Low}$	0.000	0.883	0.000	0.882	0.000	−0.005	0.618	0.001	0.968	0.000	0.971	0.000	0.008	0.192
	IT_CON$_{Med}$	0.005	0.751	0.000	0.755	0.000	0.016	0.185	0.000	0.987	0.000	0.986	0.000	0.001	0.824
	IT_CON$_{High}$	0.000	0.944	0.000	0.944	0.000	0.001	0.813	0.000	0.991	0.000	0.992	0.000	−0.001	0.834
COG/S	IT_CON$_{Low}$	0.000	0.944	0.000	0.942	0.000	−0.007	0.412	0.000	0.982	0.000	0.984	0.000	0.005	0.341
	IT_CON$_{Med}$	0.000	0.898	0.000	0.902	0.000	0.009	0.474	0.000	0.982	0.000	0.982	0.000	0.000	0.941
	IT_CON$_{High}$	0.000	0.992	0.000	0.992	0.000	−0.007	0.423	0.000	0.982	0.000	0.982	0.000	−0.001	0.868
SGA/S	IT_CON$_{Low}$	0.000	0.972	0.000	0.971	0.000	0.003	0.705	0.000	1.023	0.000	1.023	0.000	0.003	0.413
	IT_CON$_{Med}$	0.000	1.014	0.000	1.014	0.000	0.000	0.887	0.000	0.989	0.000	0.989	0.000	0.000	0.825
	IT_CON$_{High}$	0.001	0.983	0.000	0.982	0.000	0.008	0.275	0.000	0.990	0.000	0.990	0.000	0.000	0.939
Q	IT_CON$_{Low}$	0.001	0.881	0.000	0.880	0.000	0.039	0.555	0.002	1.034	0.000	1.036	0.000	−0.075	0.328
	IT_CON$_{Med}$	0.003	0.851	0.000	0.844	0.000	0.069	0.177	0.001	1.074	0.000	1.067	0.000	0.056	0.205
	IT_CON$_{High}$	0.001	1.039	0.000	1.039	0.000	−0.033	0.200	0.001	1.100	0.000	1.100	0.000	0.059	0.228

year's financial performance significantly influences the current year's financial performance in the overall sample that includes both the treatment and control groups. The corresponding p-values of a_1, which is a coefficient value of $FP_{i(t-1)}$, are mostly significant.

I did not find support for Hypothesis 7. Like the results of Hypotheses 1 and 4, some profit ratios are positively associated with accumulated IT capability, while others are negatively associated with the capability. I observed that the dummy for firms with a medium level of aggregated IT capability (IT_AGG_{Med}) is positively associated with ROA at a significance level of 0.1 in three out of nine cases (2008, 2011, and 2013), but the dummy for firms with a high level of aggregated IT capability (IT_AGG_{High}) is negatively associated with ROS in one case (2007). In ROS, the dummy for firms with a medium level of aggregated IT capability (IT_AGG_{Med}) is positive and significant in one case (2006), while the dummy for firms with low and high levels of accumulated IT capability (IT_AGG_{Low}) is significantly negative in one case (2006). In OI/A, the dummies for firms with medium and high levels of aggregated IT capability (IT_AGG_{Med} and IT_AGG_{High}) are significantly positive in 2013. On the contrary, OI/E and OI/S are negatively associated with aggregated IT capability in three cases (2006, 2010, and 2012) and one (2013) case, respectively, at a significance level of 0.1.

I did not find support for Hypothesis 8. Similar to the results of Hypotheses 2 and 5, the cost ratios of firms with aggregated IT capability shows not only a few significant p-values but also conflicting results. The dummy for firms with a medium level of continuous IT capability (IT_CONMed) is negatively and significantly associated with COG/S in one case (2008) but positively and significantly associated with OPEXP/S in another case (2012). In SGA/S, the dummies for firms with medium and high levels of continuous IT capability (IT_CONMed and IT_CONHigh) show statistically positive in 2006 and 2009, respectively, but the dummy for firms with a low level of continuous IT capability (IT_CONLow) shows negative significance in 2007.

Contrary to the result of Hypothesis 6, I did not find any support for Hypothesis 9. After adjusting the prior year's financial performance, Tobin's Q ratio of the firms with aggregated IT capability (IT_AGG_{Low}, $IT\_AGG_{Med,}$ and IT_AGG_{High}) became no different from the ratio of the control sample. As Santhanam and Hartono (2003) have proved, the significance of the degree of aggregated IT capability in the regression analysis became less obvious than those of the Wilcoxon signed-rank test. Contrary to expectations, the degrees of aggregated and continuous IT capability in the regression analysis do not influence the Tobin' Q ratio, which was significantly affected by the degrees of aggregated and continuous IT capability in the previous Wilcoxon signed-rank test. This result means that firms' market performances are most likely determined by their prior year's market performance, rather than their IT capability.

I did not find support for Hypothesis 10. The profit ratios of the firms with continuous IT capability are significant in some cases, with mixed results. The profit ratios of firms with continuous IT capability are higher than the control group in a few cases, but they also demonstrated the opposite results in several cases. These results are aligned with those of Hypotheses 3 and 6. The dummy for the firms with a medium level of continuous IT capability (IT_CON_{Med}) is positively and significantly associated with ROA in 2008. Moreover, the dummies for firms with a high level of IT capability (IT_CON_{High}) are positively and significantly associated with ROA and ROS in 2007, but negatively and significantly associated with the ratios in 2011.

I found no support for Hypothesis 11. The cost-related ratios of each degree of continuous IT capability are statistically significant in a few cases. Since both positive and negative coefficients at the significance level exist in the results of cost ratios, it is difficult to say that the degree of continuous IT capability of firms is positively related to decreasing the cost-related ratio of the firms. In COG/S, the dummy for firms with a medium level of continuous IT capability (IT_CON_{Med}) shows a negative and significant coefficient in one case (2010). However, in SGA/S, the dummies for firms with low and high levels of continuous IT capability (IT_CON_{Low} and IT_CON_{High}) show positive significance in 2010 and 2009, respectively.

Lastly, I found no support for Hypothesis 12. The dummy for firms with a high level of continuous IT capability (IT_CON_{High}) is positively and significantly associated with Tobin's Q in one (2010) out of nine cases. Therefore, it is difficult to conclude that the market performance of firms with continuous IT capability is higher than one of the control samples. This result shows that a firm's market performance is mainly influenced by its prior performance, not by its continuous IT capability.

5.1.4 The Results of Panel Data Analysis

Longitudinal studies allow for examining the long-term effects of the degree of aggregated and continuous IT capability on financial performance as well as the cause and effect relationship between them. Therefore, I performed panel data analysis on each group, which has different degrees of accumulated and continuous IT capability. As a reference category, a dummy for each control group is not listed, so the results for the other IT capability variables (IT_AGG_{Low}, IT_AGG_{Med}, IT_AGG_{High}, IT_CON_{Low}, IT_CON_{Med}, and IT_CON_{High}) are shown in comparison to their corresponding control group. The results of the regression analysis are displayed in Table 13.

Table 13. Results of Regression Tests with the Random Effect Model

FP	Groups	β_0	SE	T	P	β_1	SE	T	P	β_2	SE	T	P	R^2
ROA	IT_AGG_{Low}	0.027	0.006	4.269	0.000	0.428	0.037	11.603	0.000	−0.007	0.008	−0.773	0.440	0.182
	IT_AGG_{Med}	0.014	0.003	5.574	0.000	0.574	0.024	24.267	0.000	0.008	0.003	2.282	**0.023**	0.347
	IT_AGG_{High}	0.030	0.003	9.428	0.000	0.370	0.023	16.109	0.000	0.000	0.004	0.017	0.986	0.144
ROS	IT_AGG_{Low}	0.052	0.031	1.666	0.096	0.034	0.040	0.847	0.397	−0.056	0.044	−1.264	0.207	0.004
	IT_AGG_{Med}	0.035	0.005	7.017	0.000	0.439	0.027	16.400	0.000	0.004	0.007	0.552	0.581	0.191
	IT_AGG_{High}	0.039	0.004	8.977	0.000	0.342	0.024	14.428	0.000	0.007	0.006	1.133	0.258	0.121
OI/A	IT_AGG_{Low}	0.009	0.004	2.614	0.009	0.850	0.019	43.797	0.000	0.002	0.004	0.414	0.679	0.757
	IT_AGG_{Med}	0.013	0.002	6.335	0.000	0.791	0.017	46.499	0.000	0.005	0.002	2.305	**0.021**	0.660
	IT_AGG_{High}	0.010	0.002	6.358	0.000	0.858	0.011	80.882	0.000	0.002	0.002	1.257	0.209	0.809
OI/E	IT_AGG_{Low}	21.255	6.999	3.037	0.002	0.734	0.026	28.366	0.000	−0.532	9.070	−0.059	0.953	0.579
	IT_AGG_{Med}	55.735	8.479	6.573	0.000	0.498	0.027	18.423	0.000	−25.810	11.340	−2.276	**0.023**	0.242
	IT_AGG_{High}	7.917	2.167	3.654	0.000	0.873	0.011	82.198	0.000	1.549	2.795	0.554	0.580	0.818
OI/S	IT_AGG_{Low}	0.108	0.025	4.333	0.000	0.099	0.040	2.479	0.013	−0.023	0.035	−0.678	0.498	0.011
	IT_AGG_{Med}	0.036	0.004	8.548	0.000	0.714	0.020	35.400	0.000	0.001	0.005	0.220	0.826	0.523
	IT_AGG_{High}	0.027	0.003	8.911	0.000	0.773	0.015	50.792	0.000	0.002	0.003	0.493	0.622	0.627
OPEXP/S	IT_AGG_{Low}	0.715	0.040	17.688	0.000	0.131	0.040	3.270	0.001	0.019	0.034	0.562	0.574	0.018
	IT_AGG_{Med}	0.156	0.014	10.800	0.000	0.810	0.017	47.068	0.000	0.000	0.004	0.054	0.957	0.659
	IT_AGG_{High}	0.118	0.010	11.391	0.000	0.857	0.012	68.688	0.000	−0.001	0.003	−0.288	0.774	0.755
COG/S	IT_AGG_{Low}	0.484	0.035	13.905	0.000	0.226	0.039	5.755	0.000	0.017	0.035	0.492	0.623	0.052
	IT_AGG_{Med}	0.046	0.008	5.809	0.000	0.932	0.011	88.443	0.000	−0.005	0.005	−1.117	0.264	0.876
	IT_AGG_{High}	0.037	0.006	6.327	0.000	0.949	0.008	119.303	0.000	−0.005	0.003	−1.551	0.121	0.903
SGA/S	IT_AGG_{Low}	0.007	0.003	2.261	0.024	0.974	0.011	85.530	0.000	0.000	0.003	0.091	0.928	0.922
	IT_AGG_{Med}	0.003	0.001	2.156	0.031	0.988	0.005	201.988	0.000	0.001	0.002	0.632	0.527	0.974
	IT_AGG_{High}	0.001	0.001	1.132	0.258	0.985	0.005	204.804	0.000	0.002	0.001	1.556	0.120	0.965
Q	IT_AGG_{Low}	0.392	0.045	8.749	0.000	0.753	0.018	42.372	0.000	−0.012	0.045	−0.259	0.796	0.746
	IT_AGG_{Med}	0.264	0.026	10.021	0.000	0.813	0.014	59.077	0.000	0.048	0.023	2.048	**0.041**	0.761
	IT_AGG_{High}	0.294	0.023	12.955	0.000	0.796	0.010	80.779	0.000	0.018	0.022	0.834	0.404	0.809

(Continued)

FP	Groups	β_0	SE	T	P	β_1	SE	T	P	β_2	SE	T	P	R^2
ROA	IT_CON_{Low}	0.026	0.005	5.691	0.000	0.465	0.029	15.763	0.000	0.000	0.006	−0.057	0.955	0.213
	IT_CON_{Med}	0.014	0.003	4.848	0.000	0.563	0.025	22.611	0.000	0.008	0.004	2.032	**0.042**	0.327
	IT_CON_{High}	0.032	0.003	9.157	0.000	0.333	0.025	13.225	0.000	−0.002	0.005	−0.541	0.589	0.119
ROS	IT_CON_{Low}	0.062	0.021	2.895	0.004	0.053	0.033	1.617	0.106	−0.030	0.030	−1.009	0.313	0.004
	IT_CON_{Med}	0.028	0.005	5.696	0.000	0.452	0.027	16.437	0.000	0.008	0.007	1.220	0.223	0.202
	IT_CON_{High}	0.045	0.005	9.262	0.000	0.279	0.026	10.681	0.000	0.000	0.006	−0.001	0.999	0.081
OI/A	IT_CON_{Low}	0.010	0.003	3.662	0.000	0.848	0.016	52.042	0.000	0.003	0.003	0.796	0.427	0.747
	IT_CON_{Med}	0.011	0.002	5.356	0.000	0.823	0.016	51.311	0.000	0.004	0.002	1.828	**0.068**	0.712
	IT_CON_{High}	0.011	0.002	6.270	0.000	0.844	0.012	71.313	0.000	0.002	0.002	1.147	0.252	0.796
OI/E	IT_CON_{Low}	18.398	4.701	3.914	0.000	0.748	0.021	36.303	0.000	1.169	6.097	0.192	0.848	0.597
	IT_CON_{Med}	58.900	9.132	6.450	0.000	0.495	0.028	17.685	0.000	−29.497	12.158	−2.426	**0.015**	0.242
	IT_CON_{High}	7.628	2.443	3.122	0.002	0.871	0.011	76.529	0.000	1.685	3.171	0.531	0.595	0.822
OI/S	IT_CON_{Low}	0.109	0.017	6.351	0.000	0.127	0.033	3.873	0.000	−0.007	0.023	−0.304	0.761	0.016
	IT_CON_{Med}	0.038	0.004	8.738	0.000	0.675	0.022	31.023	0.000	0.003	0.005	0.544	0.587	0.472
	IT_CON_{High}	0.030	0.003	8.650	0.000	0.761	0.017	45.254	0.000	−0.001	0.004	−0.228	0.820	0.613
OPEXP/S	IT_CON_{Low}	0.683	0.031	21.999	0.000	0.165	0.033	5.084	0.000	0.005	0.023	0.215	0.830	0.027
	IT_CON_{Med}	0.180	0.016	11.366	0.000	0.785	0.019	42.149	0.000	−0.002	0.005	−0.317	0.751	0.622
	IT_CON_{High}	0.124	0.011	10.885	0.000	0.848	0.014	61.204	0.000	0.001	0.004	0.396	0.692	0.745
COG/S	IT_CON_{Low}	0.428	0.026	16.525	0.000	0.312	0.031	9.942	0.000	−0.011	0.024	−0.447	0.655	0.097
	IT_CON_{Med}	0.055	0.009	6.181	0.000	0.923	0.012	79.807	0.000	−0.007	0.005	−1.439	0.151	0.860
	IT_CON_{High}	0.040	0.007	6.004	0.000	0.944	0.009	102.527	0.000	−0.004	0.004	−1.046	0.296	0.890
SGA/S	IT_CON_{Low}	0.006	0.002	2.380	0.017	0.981	0.008	121.648	0.000	0.001	0.002	0.263	0.793	0.942
	IT_CON_{Med}	0.002	0.001	1.911	0.056	0.986	0.005	195.130	0.000	0.001	0.002	0.767	0.443	0.974
	IT_CON_{High}	0.001	0.001	1.101	0.271	0.985	0.006	177.817	0.000	0.002	0.002	1.457	0.145	0.961
Q	IT_CON_{Low}	0.377	0.036	10.568	0.000	0.760	0.015	50.723	0.000	0.014	0.034	0.401	0.688	0.737
	IT_CON_{Med}	0.196	0.024	8.030	0.000	0.856	0.012	68.624	0.000	0.030	0.022	1.326	0.185	0.818
	IT_CON_{High}	0.331	0.025	13.099	0.000	0.774	0.011	70.858	0.000	0.015	0.024	0.627	0.531	0.794

First, I tested how the extent of aggregated IT capability affects financial performance over time by performing the regression analysis over the research period: 2005–2013. I did not find support for Hypothesis 13. As with the previous results, the profit ratios showed mixed results depending on the extent of aggregated IT capability. In comparison with the control variable, the dummy variable that represents firms with a medium level of aggregated IT capability (IT_AGG_{Med}) was positively associated with increases in ROA and OI/A but negatively associated with increasing OI/E at a significance level of 0.1. Additionally, the dummies for firms with low and high levels of aggregated IT capability (IT_AGG_{Low} and IT_AGG_{High}) do not show any significance in the profit ratios. Therefore, I cannot conclude that the degree of accumulated IT capability positively influences the profit ratio over time.

I didn't find support for Hypothesis 14. This is consistent with the results of the Wilcoxon test and the regression tests. The dummies for firms with all levels of of accumulated IT capability (IT_AGG_{Low}, $IT\_AGG_{Med,}$ and IT_AGG_{High}) are not significant in any cost-related ratios. It means that I can't assume that the extent of accumulated IT capability is associated with decreasing the cost ratios.

I found partial support for Hypothesis 15. Among three dummy variables that represent the degree of accumulated IT capability (IT_AGG_{Low}, IT_AGG_{Med}, and IT_AGG_{High}), only the dummy for firms with a medium level of accumulated IT capability (IT_AGG_{Med}) was positively associated with increasing Tobin's Q. It seems that the effect of accumulated IT capability on market performance appears when a firm achieves a medium level of IT capability and then becomes diminished after reaching a high level of capability.

Next, the relationship between the extent of continuous IT capability and financial performance over time was tested. I do not find support for Hypothesis 16. The profit ratios demonstrate both positive and negative effects. For example, the dummy for the firms with a medium level of continuous IT capability (IT_CON_{Med}) is positive and significant in ROA and OI/A but negative and significant in OI/E. In comparison, the dummies for the firms with low and high levels of continuous IT capability (IT_CON_{Low} and IT_CON_{High}) are not significant in all profit ratios. This indicates that the influence of continuous IT capability also varies depending on the types of profit ratios.

I didn't find support for Hypothesis 17. The dummies for firms with all levels of continuous IT capability (IT_CON_{Low}, $IT\_CON_{Med,}$ and IT_CON_{High}) are not significant in any cost-related ratios. In OPEXP/S, COG/S and SGA/S, there is no significant dummy that represents a firm's degree of continuous IT capability. It means that I can't assume that the degree of accumulated IT capability is associated with decreasing the cost ratios.

Last, I did not find support for Hypothesis 18. The relationship between the degree of continuous IT capability and Tobin's Q is not significant. The dummies for firms with all levels of continuous IT capability (IT_CON_{Low}, IT_CON_{Med}, and IT_CON_{High}) do not show any significance in the result. The result of Hypothesis 15 demonstrated the partial relationship between a firm's accumulated IT capability and its impact on market performance. Unlike the accumulated IT capability, a firm's continuous IT capability does not affect its market performance over time.

5.2 Results of the Research for Factors Influencing Continuous IT Capability

To examine the impact of executive managers and financial factors on continuous IT capability, I deploy the survival analysis: Kaplan-Meier Method, logrank test, and Cox Proportional Hazards Model. My sample consists of 295 companies that are listed in the IW500 and have financial data available in the COMPUSTAT database from 2005 to 2013. Table 14 provides the descriptive statistics for the variables in my model.

Table 14. Descriptive Statistics

Variable	Mean	SD
IT_{CSUITE}	0.81	0.39
$IT_{TURNOVER}$	0.64	0.48
SIZE	9.02	1.89
ROA	0.04	0.09
MV	1692.27	7013.46

Notes. SD is standard deviation; IT_{CSUITE} is IT executives' structural power; $IT_{TURNOVER}$ is IT executive turnover; SIZE is natural log of total assets; ROA denotes Return on Asset; and MV is market to book ratio.

5.2.1 Results of Kaplan-Meier Method and Logrank Test

Figure 2, 3 and 4 shows the KM survival curves and logrank test results for the companies that demonstrated continuous IT capability for at least three years in 2005–2013. The *x*-axis represents the number of consecutive years that a firm appeared on the IW500 list, and the *y*-axis shows the estimated probability of the firm's sustaining its IT capability. The survival rate of each group over time is thus visualized as a graph. The p-values in each graph are the results of a logrank test comparing survival rates. A p-value below the significance level (e.g, .05) indicates statistically sufficient evidence to reject the null hypothesis, in which case I can conclude that the survival distributions are significantly different.

In Figure 2, I compare the survival probabilities of companies whose IT managers have structural power with those whose managers do not. The graph shows no noticeable difference in the KM survival curves between the group with C-suite IT managers and a group with non-C-suite IT managers. It appears that IT managers' structural power doesn't influence the continuity of their firms' IT capabilities. This result is consistent with the non-significant findings in the logrank test. The p-value of .868 indicates that I do not have statistically significant evidence at the significance level of .05 that the survival probabilities differ between the two groups.

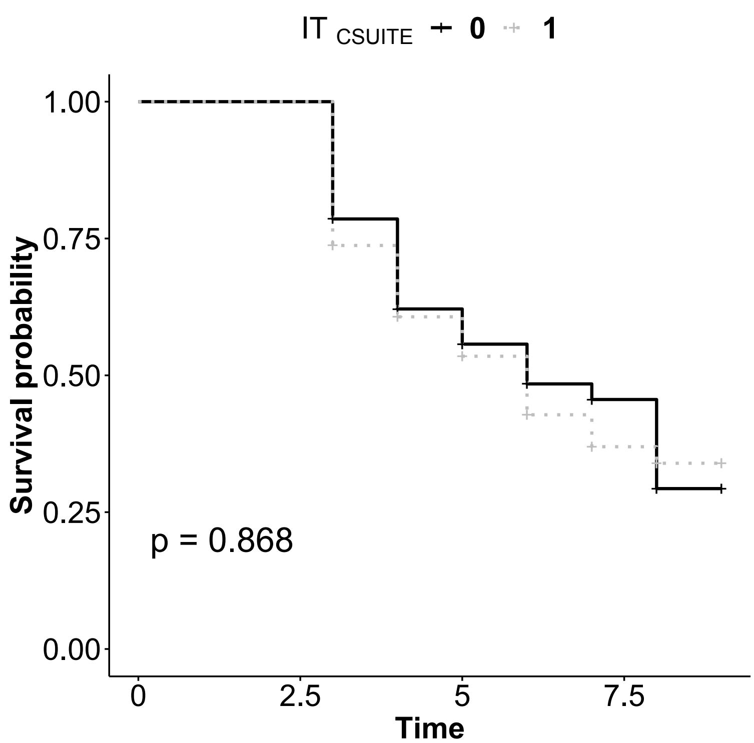


Figure 2. Results of Kaplan-Meier curves and logrank test using IT executives' structural power.

Figure 3 shows the KM survival curves of a group that experienced IT manager turnover and a group that didn't. The curve for the group with turnover lies above other curve, and there is a distinct gap between the two. Thus Figure 3 shows evident differences in the persistence of IT capability between the two groups, which means that IT manager turnover positively influences the continuity of firms' IT capability. This result is confirmed by the logrank test (p-value = .002).

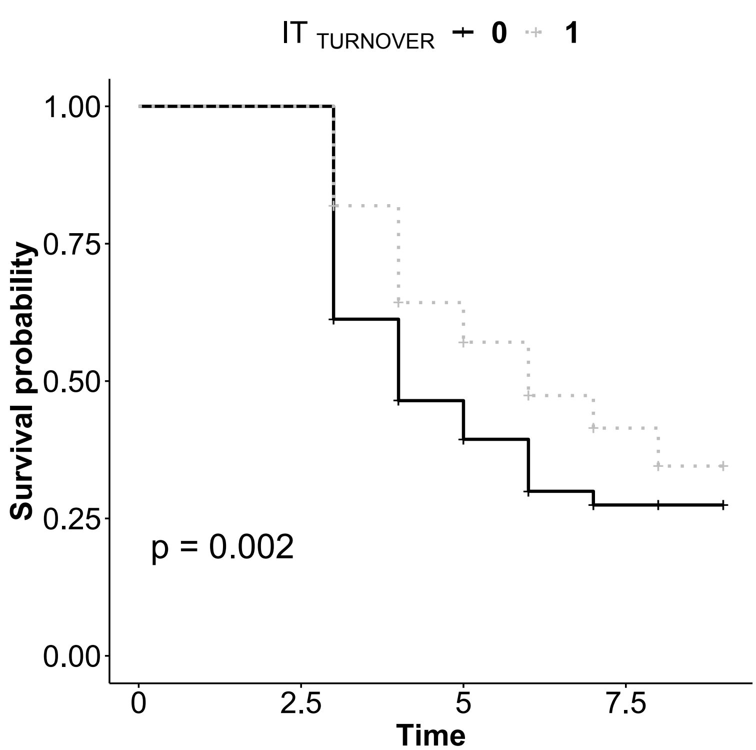


Figure 3. Results of Kaplan-Meier curves and logrank test using IT executive turnover.

Lastly, I analyze the continuous IT capability of each industry group. Because not all six groups differ statistically, the tests were conducted in those groups that did have significant differences. Figure 4 displays the KM survival curves and logrank tests for companies in the manufacturing (IND_1), finance (IND_4), and service (IND_5) industries. From the logrank test, I get p-value = .023, so the differences among the industry groups are statistically significant. In particular, the KM survival curves for the finance (IND_4) and service (IND_5) firms are higher than those of the manufacturing (IND_1) firms. I can infer that industry characteristics can affect firms' ability to retain IT capability.

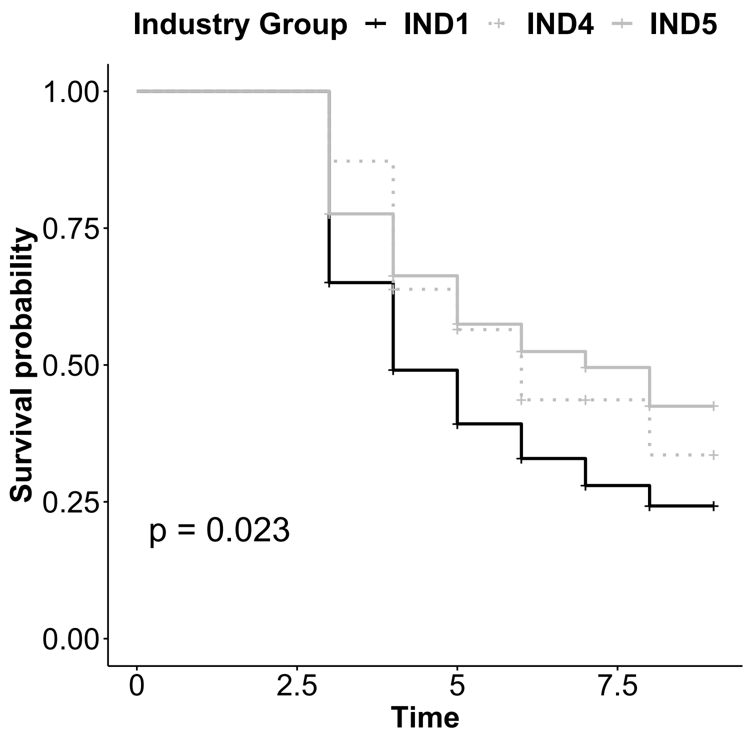


Figure 4. Results of Kaplan-Meier curves and logrank test using industry categories

5.2.2 Results of Cox Proportional Hazards Model

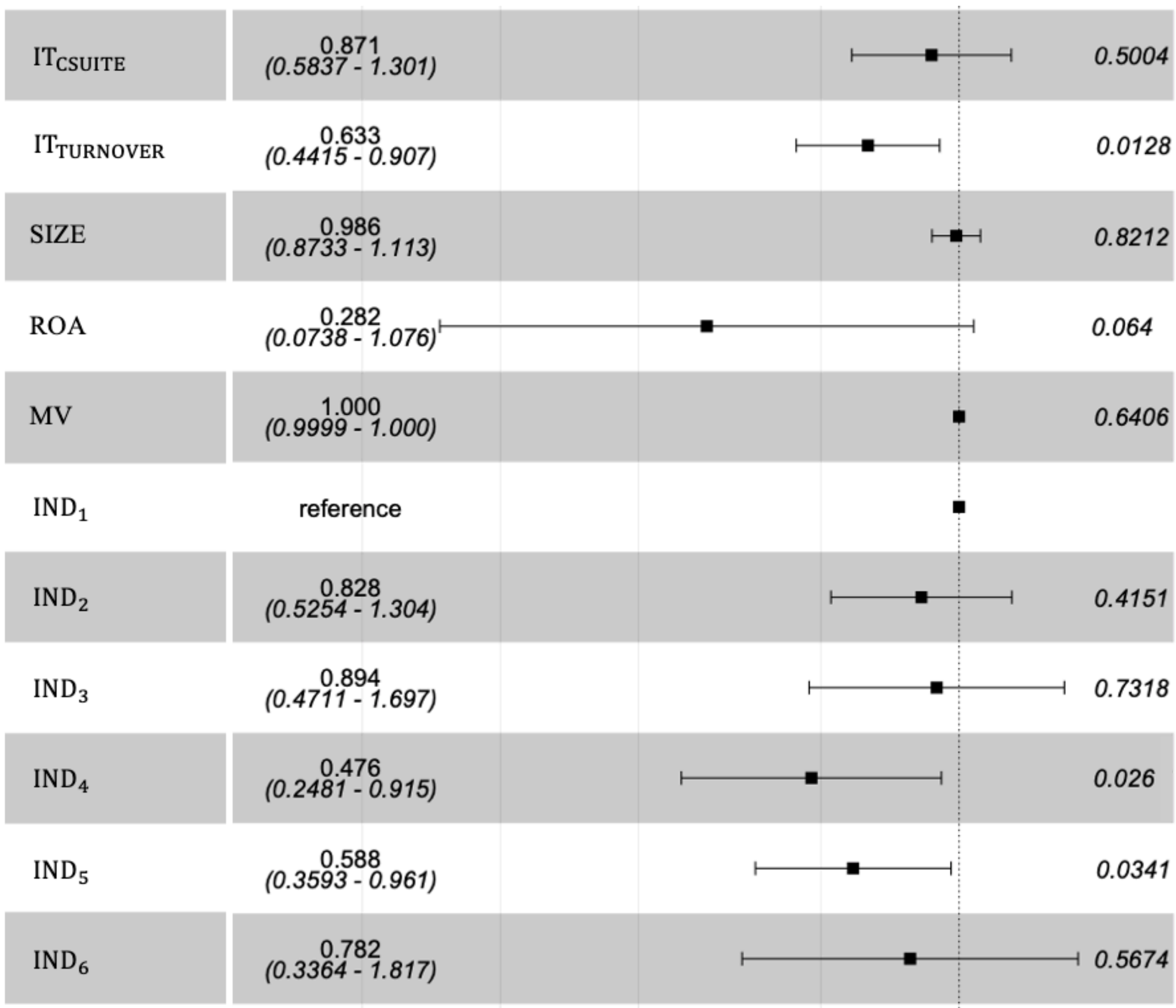
As the next step in testing our hypotheses, I use the Cox proportional hazard model to investigate whether IT managers and financial factors can meaningfully predict firms' continuous IT capability. Table 15 presents the results of the Cox proportional hazards regression model. The model includes the structural power of the IT executive, IT executive turnover, and financial variables as predictor variables. To allow more intuitive insights, I visualize the results of the test using forest plots in Figure 5 (Boyles, Harris, Rooney, & Thayer, 2011; Kassambara, Kosinski, Biecek, & Fabian, 2017). A horizontal line represents the 95% confidence interval for the hazard ratio, and a squared point in the middle of a line indicates the hazard ratio of a given variable. If the confidence interval for the hazard ratio for a predictor includes 1, it means that the predictor is not statistically significant.

Table 15. Result of Cox Proportional Hazards Regression

	Coefficient	Hazard Ratio	SE	P-value	
IT_{CSUITE}	–0.138	0.871	0.204	0.500	
$IT_{TURNOVER}$	–0.457	0.633	0.184	0.013	**
SIZE	–0.014	0.986	0.062	0.821	
ROA	–1.267	0.282	0.684	0.064	*
MV	0.000	1.000	0.000	0.641	
IND_2	–0.189	0.828	0.232	0.415	
IND_3	–0.112	0.894	0.327	0.732	
IND_4	–0.741	0.477	0.333	0.026	**
IND_5	–0.532	0.588	0.251	0.034	**
IND_6	–0.246	0.782	0.430	0.567	

Note: *** p<0.01, ** p<0.05, * p<0.1

I use the Cox proportional hazards model (2) to study the effect of firms' internal factors on continuous IT capability. The first column lists the predictor variables used in the model; Coefficient is the parameter related to each variable, with a negative value meaning a lower hazard; Hazard Ratio is the exponential value of the estimated coefficient in the second column and gives the effect size of the predictor; SE is the standard error of the estimated regression coefficient; and P-value is the result of testing whether the coefficient is statistically different from 0.



Note: A horizontal line indicates the 95% confidence interval for the hazard ratio. A squared point in the middle of a line shows the hazard ratio of each variable.

Figure 5. Forest plot for the result of Cox proportional hazards regression.

In Hypothesis 19, I predicted that the structural power of senior IT executives will have a positive association with a firm's development of continuous IT capability, but I don't find support for the hypothesis. Although the structural power of senior IT executives does help firms achieve IT capability (Lim et al., 2012), the p-value of .500 in column 5 shows that this power doesn't affect the firm's ability to keep its IT capability continuously. This finding is the same as the results of the Kaplan-Meier method and logrank test using the IT_{CSUITE} variable in Figure 2. I conjecture that IT executives' structural power plays a key role their firms' achieving IT capability (Lim et al., 2012), but that this effect can reach saturation over time and fail to contribute to building long-term continuous IT capability.

I do find support for Hypothesis 20, which predicts that turnover of IT executives will be positively associated with a firm's development of continuous IT capability. The p-value of .013 in column 5 suggests that a change in IT executives extends a firm's IT capability. The hazard ratio in column 2 represents the risk of IT executive change relative to IT executives remaining the same. Its value of 0.633 indicates that if a firm with continuous IT capability experiences changes in IT executives, its likelihood of losing IT capability is 0.633 times that of a firm that doesn't experience IT executive turnover. This means that IT executive turnover significantly mitigates the chance of losing IT capability for a firm that has retained IT capability continuously. This means that IT executive turnover helps firms keep their IT capability over time. Therefore, I can conclude that Hypothesis 20 is supported. I assume that when a firm with IT capability experiences a change in IT executives, the new executives' knowledge and experience help the firm sustain its IT capability (Caloghirou et al., 2004; D. M. Lee & Allen, 1982). Because information technology changes rapidly, the IT executives' new knowledge can help it extend its IT capability.

Lastly, with Hypothesis 21, I test whether a firm's continuous IT capability is affected by its industry characteristics. I find sufficient evidence to support this hypothesis. IND1 is set as a reference category, so the results for the other industry variables are shown in comparison to IND1. The p-values of IND4 and IND5 are .026 and .034, respectively, which are statistically significant at the significance level of .05. The hazard ratios of IND4 and IND5 are .477 and .588, respectively. In comparison with firms in IND1, those in IND4 and IND5 have lower chances of losing their IT capability. This is consistent with the results of the Kaplan-Meier method and logrank test. As hypothesized, industry type is associated with a firm's continuous IT capability.

In addition, ROA proves significant among the financial variables. ROA is negatively and marginally associated with the probability of losing IT capability. It has a p-value of .064, which is close to 0.05, and hazard ratio of 0.282, which means that a firm is about 72% less likely to lose its IT capability when its ROA changes by one unit, with all other predictor variables held constant. Because a firm's IT capability can be influenced by its performance (Lim et al., 2013), this result provides statistical evidence that firms' performances also affect their continuous IT capability.

6. DISCUSSION

6.1 Accumulation of IT Capability

By deploying the new concept of accumulation of IT, I attempt to reinvestigate the relationship between IT capability and business performance. From hypothesis tests, I confirmed that the extent of a firm's ability to keep its IT capability could influence its business performance based on types of ratios and timelines. To check the overall results and the association among the tests at once, I briefly summarize all test results in Table 16. First, the table includes the number of significant p-values in the Wilcoxon tests during the research period, 2005–2013, and whether each financial performance ratio of firms with accumulated IT capability (IT_AGG_{Low}, IT_AGG_{Med}, and IT_AGG_{High}, IT_CON_{Low}, IT_CON_{Med}, and IT_CONHigh) is higher or lower than the ratio of firms in the matched control groups. Next, the regression test results performed each year are summarized. Table 16 contains the number of significant results and the sign (positive or negative) of coefficient values for each dummy variable that represents the degree of accumulated IT capability. Last, the results of regression tests with a random effect include the sign (positive or negative) of coefficient values for the dummies. Apart from the findings from the hypothesis tests, I discovered additional unique aspects that represent the relationship between IT capability and business performance: (1) the impact of IT capabilities on business performance varies depending on the detailed performance indicators, (2) the degree of accumulated IT capability and financial performance does not show a linear relationship, (3) a firm's accumulation of IT capability does not contribute to improving market performance in the short term but does so in the long term.

Table 16. Summary of Overall Test Results

FP	IT Groups	Wilcox		Regression		Random Effect
		# of Sig	Effects	# of Sig	Effects	
ROA	IT_AGG_{Low}					
	IT_AGG_{Med}	4	Higher	3	Positive	Positive
	IT_AGG_{High}			1	Negative	
	IT_CON_{Low}					
	IT_CON_{Med}	3	Higher	1	Positive	Positive
	IT_CON_{High}					
ROS	IT_AGG_{Low}	2	Lower	1	Negative	
	IT_AGG_{Med}			1	Positive	
	IT_AGG_{High}					
	IT_CON_{Low}					
	IT_CON_{Med}					
	IT_CON_{High}			2	Mixed	
OI/A	IT_AGG_{Low}					
	IT_AGG_{Med}	5	Higher	1	Positive	Positive
	IT_AGG_{High}	1	Higher	1	Positive	
	IT_CON_{Low}			1	Positive	
	IT_CON_{Med}	1	Higher	1	Positive	Positive
	IT_CON_{High}	1	Higher	1	Positive	
OI/E	IT_AGG_{Low}	1	Lower			
	IT_AGG_{Med}	2	Lower	3	Negative	Negative
	IT_AGG_{High}					
	IT_CON_{Low}					
	IT_CON_{Med}	6	Lower	3	Negative	Negative
	IT_CON_{High}					
OI/S	IT_AGG_{Low}	1	Lower	1	Negative	
	IT_AGG_{Med}					
	IT_AGG_{High}					

(continued)

FP	IT Groups	Wilcox		Regression		Random Effect
		# of Sig	Effects	# of Sig	Effects	
OI/S	IT_AGG_{Low}			1	Negative	
	IT_AGG_{Med}					
	IT_AGG_{High}					
OPEXP/S	IT_AGG_{Low}					
	IT_AGG_{Med}			1	Positive	
	IT_AGG_{High}					
	IT_CON_{Low}					
	IT_CON_{Med}					
	IT_CON_{High}	3	Higher			
COG/S	IT_AGG_{Low}					
	IT_AGG_{Med}	3	Lower	1	Negative	
	IT_AGG_{High}					
	IT_CON_{Low}			1	Negative	
	IT_CON_{Med}	5	Lower			
	IT_CON_{High}					
SGA/S	IT_AGG_{Low}			1	Positive	
	IT_AGG_{Med}	9	Higher			
	IT_AGG_{High}			1	Positive	
	IT_CON_{Low}			1	Positive	
	IT_CON_{Med}	9	Higher			
	IT_CON_{High}			1	Positive	
Q	IT_AGG_{Low}					
	IT_AGG_{Med}	9	Higher			Positive
	IT_AGG_{High}					
	IT_CON_{Low}					
	IT_CON_{Med}	7	Higher			
	IT_CON_{High}			1	Positive	

6.1.1 Conflicting Results based on the Types of Financial ratios

A. S. Bharadwaj (2000) and Santhanam and Hartono (2003) demonstrated that all profit ratios are higher for the firms with IT capability than the control group, and all cost ratios are lower for the firms with IT capability than the control group. However, Chae et al. (2014) argued that IT capability did not contribute to increasing profit ratios and decreasing cost ratios in most cases. From the results of my research, I observed the phenomenon that the relationship between IT capability and business performance can vary based on the types of performance ratios and the degree of aggregated or continuous IT capability. Therefore, I compared the detailed components of each financial ratio between the treatment groups and the matched control groups and then analyzed what specifically led to the unexpected result. Table 17 contains the financial elements of the performance ratios, which demonstrate the unexpected results, and presents the comparison of the elements between firms with accumulated IT capability and firms in the control groups. The detailed results including all financial elements are attached in Appendix D.

As shown in Table 16, both aggregated IT capability and continuous IT capability tend to increase ROA and OI/A, except one case. On the contrary, the capabilities seem to decrease OI/E. OI/E is calculated by dividing operating income by the number of employees. To examine why OI/E demonstrates the opposite results of ROA and OI/A, I compared the detailed elements of OI/E between the groups with accumulated IT capability and the control groups (Table 17). The OI/E of firms with aggregated IT capability is significantly lower than the control sample in 2005 (IT_AGG_{Low}), 2005 (IT_AGG_{Med}), and 2012 (IT_AGG_{Med}). In Table 17, the operating income (OI) is significantly lower for firms with a low level of aggregated IT capability

Table 17. Results of Wilcoxon Tests using Key Financial Variables

Elements	Groups	2005				2006				2007			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
AT	IT_AGG_{Low}	53557	3994	287	0.06	57421	4032	289	0.07	65404	4473	283	0.09
	$Control_{AL}$	85917	3366			108040	4520			120604	4370		
	IT_AGG_{Med}	21213	5773	1293	0.49	24603	6173	1310	0.55	27035	6243	1302	0.52
	$Control_{AM}$	28312	7157			30520	8397			31250	9103		
	IT_AGG_{High}	33285	9166	2374	0.86	33640	9449	2127	0.29	35158	12087	2100	0.32
	$Control_{AH}$	37258	11004			41754	11586			47404	12458		
OI	IT_AGG_{Low}	1797	369	212	0.00	2520	330	258	0.02	2288	294	285	0.09
	$Control_{AL}$	3295	435			4503	401			4540	300		
	IT_AGG_{Med}	1724	456	1422	0.99	1935	574	1339	0.65	2132	609	1403	0.91
	$Control_{AM}$	1612	532			1805	656			2051	661		
	IT_AGG_{High}	1770	860	2316	0.70	2202	1004	2438	0.97	2329	1154	2276	0.72
	$Control_{AH}$	2188	949			2551	985			2960	1181		
EMP	IT_AGG_{Low}	21	13	424	0.64	21	14	383	0.86	19	14	374	0.74
	$Control_{AL}$	20	6			22	6			25	6		
	IT_AGG_{Med}	34	14	1581	0.30	35	14	1413	0.58	36	13	1500	0.55
	$Control_{AM}$	35	15			36	16			37	18		
	IT_AGG_{High}	56	27	2385	0.57	59	29	2293	0.96	60	29	2300	0.80
	$Control_{AH}$	58	26			59	26			59	26		
NI	IT_AGG_{Low}	329	139	228	0.01	811	134	200	0.00	617	131	305	0.16
	$Control_{AL}$	1359	206			1560	256			828	106		
	IT_AGG_{Med}	1066	255	1402	0.91	1259	359	1372	0.78	1478	332	1469	0.82
	$Control_{AM}$	975	308			1014	360			1178	357		
	IT_AGG_{High}	947	542	2611	0.51	1413	581	2693	0.34	625	616	2239	0.62
	$Control_{AH}$	1083	528			1162	568			1458	545		
SALE	IT_AGG_{Low}	9219	3284	244	0.01	9645	3192	228	0.01	10154	4028	310	0.18
	$Control_{AL}$	10643	3502			12514	3516			13999	3317		
	IT_AGG_{Med}	13009	5673	1238	0.32	14323	6142	1180	0.20	16072	6034	1282	0.45
	$Control_{AM}$	12889	5293			14678	5979			15305	6821		
	IT_AGG_{High}	15522	7703	2512	0.76	16840	8952	2155	0.34	18255	9735	1846	0.06
	$Control_{AH}$	16275	7769			18443	8234			20974	9411		
XSGA	IT_AGG_{Low}	625	423	255	0.88	692	435	218	0.40	723	445	210	0.47
	$Control_{AL}$	744	426			874	359			1011	440		
	IT_AGG_{Med}	3389	1204	808	0.05	3754	1284	761	0.08	4105	1362	776	0.05
	$Control_{AM}$	2523	675			2833	875			2980	1035		
	IT_AGG_{High}	3063	990	1084	0.94	3372	1066	1108	0.82	3771	1302	1071	0.67
	$Control_{AH}$	2709	1229			2902	1401			3321	1453		

(continued)

Elements	Groups	2008				2009				2010			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
AT	IT_AGG$_{Low}$	57414	4547	317	0.22	55478	4465	268	0.09	55071	3946	243	0.07
	Control$_{AL}$	109901	4588			96460	4864			104732	4594		
	IT_AGG$_{Med}$	27475	6469	1356	0.72	28160	6901	1219	0.47	30022	6777	1060	0.15
	Control$_{AM}$	30465	8819			35762	8675			41282	8744		
	IT_AGG$_{High}$	33767	11317	2217	0.57	37374	11134	2255	0.66	39235	11172	2251	0.65
	Control$_{AH}$	44062	12125			46311	12575			50611	13071		
OI	IT_AGG$_{Low}$	-983	333	358	0.49	1174	297	368	0.77	1627	412	364	0.93
	Control$_{AL}$	1733	193			1429	314			2576	397		
	IT_AGG$_{Med}$	1694	486	1549	0.51	1669	467	1361	0.96	1916	605	1185	0.47
	Control$_{AM}$	1396	465			1342	432			1931	604		
	IT_AGG$_{High}$	1977	846	2472	0.73	1866	725	2368	0.98	2450	1023	2368	0.98
	Control$_{AH}$	1982	730			1826	621			2389	1017		
EMP	IT_AGG$_{Low}$	19	14	437	0.52	17	13	379	0.48	16	11	354	0.75
	Control$_{AL}$	24	5			22	5			22	4		
	IT_AGG$_{Med}$	37	15	1604	0.35	36	15	1472	0.27	38	15	1476	0.26
	Control$_{AM}$	38	17			38	15			39	16		
	IT_AGG$_{High}$	63	29	2195	0.97	61	28	2113	0.92	61	27	2093	0.60
	Control$_{AH}$	60	30			57	29			60	31		
NI	IT_AGG$_{Low}$	-3073	60	312	0.19	332	148	425	0.63	634	228	340	0.67
	Control$_{AL}$	-701	59			284	49			1260	125		
	IT_AGG$_{Med}$	555	196	1654	0.23	1071	251	1406	0.76	1144	336	1195	0.51
	Control$_{AM}$	506	212			695	212			1248	369		
	IT_AGG$_{High}$	542	201	2514	0.62	2218	461	2703	0.24	1405	606	2444	0.81
	Control$_{AH}$	288	294			786	361			1367	508		
SALE	IT_AGG$_{Low}$	6802	4024	313	0.20	8483	3516	333	0.43	8508	3254	307	0.37
	Control$_{AL}$	11940	3360			10733	2879			12012	3105		
	IT_AGG$_{Med}$	15840	6263	1501	0.69	15271	5413	1456	0.56	16480	5884	1266	0.79
	Control$_{AM}$	14865	6111			14160	5201			16064	6336		
	IT_AGG$_{High}$	18316	9329	2327	0.86	17306	8867	2029	0.21	18808	8928	2128	0.37
	Control$_{AH}$	21090	9653			18673	9229			20721	9779		
XSGA	IT_AGG$_{Low}$	783	597	249	0.99	747	495	239	0.87	757	518	239	0.90
	Control$_{AL}$	1067	433			1048	411			1079	477		
	IT_AGG$_{Med}$	4109	1332	836	0.06	3991	1331	701	0.15	4191	1292	742	0.12
	Control$_{AM}$	2982	806			3148	828			3194	794		
	IT_AGG$_{High}$	3859	1221	1066	0.69	3845	1178	1078	0.63	4062	1135	1081	0.62
	Control$_{AH}$	3319	1632			3169	1274			3253	1314		

(continued)

Elements	Groups	2011				2012				2013			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
AT	IT_AGG$_{Low}$	53627	3924	242	0.10	50690	3739	241	0.10	49976	4103	235	0.08
	Control$_{AL}$	111240	5469			109653	5278			105376	6168		
	IT_AGG$_{Med}$	33562	7219	1067	0.40	35836	8043	1038	0.41	39034	8315	1008	0.41
	Control$_{AM}$	43158	9155			43845	9316			45664	10057		
	IT_AGG$_{High}$	41772	13293	2302	0.93	44925	12748	2335	0.98	46423	13208	2084	0.58
	Control$_{AH}$	53748	12907			55305	15681			57670	16428		
OI	IT_AGG$_{Low}$	1482	464	355	0.96	1544	476	368	0.81	1529	436	327	0.72
	Control$_{AL}$	2921	444			2595	452			2657	476		
	IT_AGG$_{Med}$	2090	698	1190	0.92	2253	679	1189	0.92	2601	794	1183	0.62
	Control$_{AM}$	1860	698			1860	679			1998	903		
	IT_AGG$_{High}$	2512	1142	2415	0.75	2327	1048	2425	0.72	2889	1134	2303	0.65
	Control$_{AH}$	2429	961			2160	1090			2360	1229		
EMP	IT_AGG$_{Low}$	17	10	364	0.64	17	11	361	0.67	17	9	358	0.70
	Control$_{AL}$	22	5			22	6			22	6		
	IT_AGG$_{Med}$	41	18	1408	0.15	42	17	1362	0.10	45	18	1431	0.04
	Control$_{AM}$	38	15			38	15			38	16		
	IT_AGG$_{High}$	63	28	2217	0.95	64	28	2240	0.98	63	30	2057	0.83
	Control$_{AH}$	61	32			62	32			57	31		
NI	IT_AGG$_{Low}$	836	143	345	0.93	294	126	253	0.14	639	124	259	0.17
	Control$_{AL}$	1300	90			1071	184			1429	214		
	IT_AGG$_{Med}$	1340	368	1348	0.40	1365	395	1215	0.80	1934	432	1190	0.59
	Control$_{AM}$	1103	196			1083	325			1251	397		
	IT_AGG$_{High}$	1436	609	2683	0.20	1109	531	2633	0.27	1713	627	2426	0.36
	Control$_{AH}$	1227	522			904	525			1149	560		
SALE	IT_AGG$_{Low}$	8594	3455	294	0.39	8701	4072	284	0.32	8910	3374	274	0.25
	Control$_{AL}$	13277	3024			13846	3432			14283	4104		
	IT_AGG$_{Med}$	18123	7178	1252	0.79	18842	8385	1283	0.50	20256	9561	1238	0.40
	Control$_{AM}$	17334	7213			17437	6543			17522	7332		
	IT_AGG$_{High}$	20048	10198	2202	0.65	20921	10175	2297	0.91	20470	10624	2211	0.92
	Control$_{AH}$	23039	10359			23282	11166			22411	10696		
XSGA	IT_AGG$_{Low}$	740	455	239	0.90	729	423	200	0.72	746	414	182	0.45
	Control$_{AL}$	1217	486			1389	513			1525	548		
	IT_AGG$_{Med}$	4548	1450	637	0.10	4700	1605	625	0.13	4937	1595	597	0.14
	Control$_{AM}$	3459	830			3459	867			3476	944		
	IT_AGG$_{High}$	4289	1236	1133	0.54	4494	1383	1160	0.42	4116	1463	991	0.58
	Control$_{AH}$	3450	1309			3456	1426			3604	1441		

(continued)

Elements	Groups	2005				2006				2007			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
AT	IT_CON_{Low}	47497	6662	811	0.45	52120	6522	803	0.41	58852	6683	770	0.39
	$Control_{CL}$	67876	6933			83701	7875			92094	9036		
	IT_CON_{Med}	23183	4851	1187	0.60	25891	5227	1181	0.58	27955	5796	1217	0.73
	$Control_{CM}$	26620	5274			29161	6969			30108	7594		
	IT_CON_{High}	30758	8735	1542	0.36	30492	9019	1350	0.07	31671	11297	1307	0.07
	$Control_{CH}$	40178	10529			44796	11144			51158	12282		
OI	IT_CON_{Low}	2520	549	803	0.41	3193	545	816	0.47	3170	609	800	0.52
	$Control_{CL}$	3003	647			3963	696			4250	797		
	IT_CON_{Med}	1284	408	1206	0.68	1499	498	1233	0.80	1618	536	1302	0.89
	$Control_{CM}$	1513	397			1710	418			1788	430		
	IT_CON_{High}	1615	745	1509	0.29	2003	957	1559	0.40	2140	1057	1462	0.27
	$Control_{CH}$	2203	949			2540	921			2986	1177		
EMP	IT_CON_{Low}	37	17	929	0.57	38	17	806	0.87	37	17	786	0.93
	$Control_{CL}$	37	10			39	11			41	14		
	IT_CON_{Med}	26	14	1386	0.29	28	14	1257	0.46	28	14	1310	0.40
	$Control_{CM}$	35	10			38	12			38	10		
	IT_CON_{High}	57	26	1727	0.61	61	27	1699	0.86	63	27	1742	0.70
	$Control_{CH}$	53	26			53	26			54	26		
NI	IT_CON_{Low}	1080	254	821	0.49	1741	270	753	0.23	1561	307	812	0.58
	$Control_{CL}$	1450	316			1678	412			1384	421		
	IT_CON_{Med}	748	253	1188	0.61	925	319	1274	0.98	1076	304	1423	0.41
	$Control_{CM}$	871	226			899	267			919	257		
	IT_CON_{High}	823	513	1715	0.90	1157	515	1731	0.96	337	577	1411	0.18
	$Control_{CH}$	1038	494			1076	564			1414	543		
SALE	IT_CON_{Low}	14357	5410	562	0.01	15538	6175	527	0.00	17308	6407	601	0.03
	$Control_{CL}$	16053	5570			18654	5607			19744	5329		
	IT_CON_{Med}	10302	4579	1126	0.39	11105	5174	1115	0.35	11997	5860	1214	0.72
	$Control_{CM}$	10242	4887			11795	5606			12935	6013		
	IT_CON_{High}	15446	6992	1926	0.41	16860	8882	1616	0.57	18407	9120	1383	0.14
	$Control_{CH}$	15754	7553			17646	7787			20233	9243		
XSGA	IT_CON_{Low}	2514	656	618	0.76	2769	681	584	0.97	2991	744	578	0.89
	$Control_{CL}$	1984	541			2251	592			2396	595		
	IT_CON_{Med}	2489	955	628	0.03	2723	1135	576	0.06	2999	1061	568	0.08
	$Control_{CM}$	1700	675			1927	792			2129	867		
	IT_CON_{High}	2926	879	763	0.78	3259	1011	787	0.93	3694	1089	761	0.88
	$Control_{CH}$	2859	1122			3015	1401			3463	1421		

(continued)

Elements	Groups	2008				2009				2010			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
AT	IT_CON$_{Low}$	53039	7166	817	0.61	54189	7969	732	0.34	54407	6928	685	0.26
	Control$_{CL}$	84537	8361			75764	8922			81823	9415		
	IT_CON$_{Med}$	27572	5281	1315	0.83	28063	5902	1205	0.99	29768	6237	1050	0.45
	Control$_{CM}$	29754	7203			34984	7315			40291	7488		
	IT_CON$_{High}$	31044	10765	1381	0.14	33723	10078	1417	0.19	35788	10066	1394	0.16
	Control$_{CH}$	47009	11940			49469	12419			54362	12890		
OI	IT_CON$_{Low}$	470	487	829	0.68	1928	499	849	0.96	2404	656	781	0.72
	Control$_{CL}$	2218	632			1635	451			2808	732		
	IT_CON$_{Med}$	1358	422	1465	0.29	1361	445	1233	0.88	1619	585	1161	0.94
	Control$_{CM}$	1166	350			1278	379			1670	513		
	IT_CON$_{High}$	1894	660	1698	0.99	1743	681	1647	0.80	2322	927	1613	0.68
	Control$_{CH}$	1861	689			1803	668			2379	990		
EMP	IT_CON$_{Low}$	36	17	853	0.98	35	16	774	0.98	34	16	715	0.65
	Control$_{CL}$	41	13			40	19			41	18		
	IT_CON$_{Med}$	29	15	1469	0.19	29	15	1343	0.13	30	15	1382	0.08
	Control$_{CM}$	37	10			34	8			35	8		
	IT_CON$_{High}$	66	27	1613	0.88	64	26	1545	0.99	64	25	1525	0.65
	Control$_{CH}$	56	30			55	30			58	31		
NI	IT_CON$_{Low}$	-1422	120	769	0.38	989	203	886	0.82	1284	350	701	0.32
	Control$_{CL}$	4	141			486	93			1673	382		
	IT_CON$_{Med}$	355	190	1513	0.18	830	209	1291	0.62	914	312	1251	0.64
	Control$_{CM}$	365	144			715	212			968	222		
	IT_CON$_{High}$	366	191	1761	0.79	2338	447	1944	0.26	1310	584	1671	0.89
	Control$_{CH}$	143	282			738	331			1331	508		
SALE	IT_CON$_{Low}$	14192	6336	679	0.12	15034	5155	659	0.13	16212	5759	607	0.08
	Control$_{CL}$	18601	5264			16218	4845			18265	5439		
	IT_CON$_{Med}$	12149	5948	1298	0.91	11933	5047	1309	0.55	12625	5884	1165	0.96
	Control$_{CM}$	13171	5808			12635	4834			14399	5837		
	IT_CON$_{High}$	18743	9053	1822	0.58	17426	8441	1565	0.53	18922	8864	1636	0.76
	Control$_{CH}$	19580	9297			17696	8978			19547	9698		
XSGA	IT_CON$_{Low}$	3048	889	612	0.62	3053	869	597	0.73	3363	939	605	0.49
	Control$_{CL}$	2404	591			2396	565			2510	580		
	IT_CON$_{Med}$	3018	965	617	0.08	2855	893	514	0.17	2993	992	538	0.17
	Control$_{CM}$	2239	799			2345	760			2387	729		
	IT_CON$_{High}$	3807	1143	764	0.86	3796	1087	771	0.81	3932	1099	764	0.86
	Control$_{CH}$	3401	1570			3243	1266			3337	1191		

(continued)

Elements	Groups	2011				2012				2013			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
AT	IT_CON_{Low}	54081	7353	671	0.30	52388	7489	662	0.27	52626	7834	638	0.19
	$Control_{CL}$	86368	9243			85806	8753			83717	9431		
	IT_CON_{Med}	32815	7071	1049	0.88	35136	7440	1030	0.95	37397	8209	944	0.66
	$Control_{CM}$	43820	7492			44795	7863			47567	8877		
	IT_CON_{High}	38872	10887	1454	0.33	42503	11170	1494	0.43	44621	12043	1361	0.29
	$Control_{CH}$	56403	12877			57728	15218			59424	16284		
OI	IT_CON_{Low}	2429	739	790	0.95	2588	735	839	0.74	2763	788	804	0.96
	$Control_{CL}$	3000	746			2789	760			2864	910		
	IT_CON_{Med}	1709	674	1115	0.78	1810	659	1076	0.81	2033	794	1048	0.62
	$Control_{CM}$	1743	601			1745	495			1852	651		
	IT_CON_{High}	2384	1013	1692	0.88	2134	935	1685	0.91	2779	983	1571	0.88
	$Control_{CH}$	2326	893			2001	1090			2236	1167		
EMP	IT_CON_{Low}	36	16	728	0.73	35	15	731	0.75	36	15	743	0.82
	$Control_{CL}$	44	19			44	19			43	11		
	IT_CON_{Med}	33	17	1300	0.05	34	17	1247	0.03	36	18	1294	0.01
	$Control_{CM}$	33	8			34	10			34	10		
	IT_CON_{High}	66	26	1636	0.94	68	26	1661	0.85	66	28	1501	0.69
	$Control_{CH}$	59	32			59	32			53	32		
NI	IT_CON_{Low}	1481	276	789	0.94	1339	304	727	0.57	1915	294	773	0.84
	$Control_{CL}$	1533	338			1365	273			1675	440		
	IT_CON_{Med}	1078	395	1231	0.30	973	352	1025	0.92	1387	432	955	0.88
	$Control_{CM}$	1033	225			1009	277			1108	358		
	IT_CON_{High}	1336	548	1944	0.18	899	469	1895	0.27	1515	517	1748	0.30
	$Control_{CH}$	1099	511			728	447			1023	518		
SALE	IT_CON_{Low}	16725	5895	587	0.09	16890	5677	609	0.12	17350	5614	624	0.16
	$Control_{CL}$	20471	6540			21348	6661			21424	6541		
	IT_CON_{Med}	14114	7178	1143	0.65	14777	7535	1145	0.48	15857	7960	1098	0.40
	$Control_{CM}$	16024	6126			16118	5455			16548	5866		
	IT_CON_{High}	20235	9880	1712	0.81	21236	10128	1762	0.63	20765	10480	1661	0.55
	$Control_{CH}$	21124	10325			21062	10894			19788	10391		
XSGA	IT_CON_{Low}	3397	1020	540	0.81	3362	913	465	0.73	3394	794	464	0.72
	$Control_{CL}$	2827	622			3015	744			3021	810		
	IT_CON_{Med}	3332	1195	498	0.07	3505	1138	508	0.05	3724	1234	480	0.05
	$Control_{CM}$	2448	730			2395	790			2473	796		
	IT_CON_{High}	4183	1190	814	0.72	4445	1254	830	0.62	4007	1384	681	0.87
	$Control_{CH}$	3511	1252			3498	1339			3668	1414		

(IT_AGG_{Low}) in 2005, and the number of employees of firms (E) is significantly higher for firms with a medium level of aggregated IT capability (IT_AGG_{Med}) in 2012. In comparison, the results in which OI/E is significantly lower for firms with a medium level of continuous IT capability (IT_CON_{Med}) from 2010 to 2013 were caused by the higher number of employees in the firms with the IT capability. It seems that both the operating income and the number of employees influence the contradictory results in firms with aggregated IT capability, while only the number of employees influences the results in firms with continuous IT capability.

As per the profit ratios, the cost ratios also show conflicting results for each variable. While both accumulated and continuous IT capabilities tend to lower COG/S as expected, the capabilities seem to significantly increase SGA/S, which is calculated by dividing the selling, general, and administrative expenses (SGA) by sales (S). In the result of the Wilcoxon test (Table 16), SGA/S is significantly higher for firms with a medium level of both aggregated and continuous IT capability in all cases. This opposite result is caused by higher numbers of SGA in the firms with accumulated IT capability over the research period (Table 17). To understand this phenomenon, it is necessary to know the components of SGA. Wahlen, Baginski, and Bradshaw (2014) described SGA as "General expenses include overhead expenses such as rent, utilities, communications, and insurance, whereas administrative expenses include top management's salaries and the cost of operating staff departments such as information systems, legal services, and R&D" (p. 280). It appears that firms with a medium level of aggregated and continuous IT capability (IT_AGG_{Med} and IT_CON_{Med}) have spent more in administrative expenses, which includes IT-related costs, to maintain their IT capability.

6.1.2 Nonlinear Relationship between Accumulated IT Capability and Financial performance

The test results show that a firm's IT capability affects its financial performance when it has accumulated the capability to some extent. However, if a firm has maintained the capability over a long period, the effect, whether it is expected (e.g., ROA and OI/A) or unexpected (e.g., OI/E and SGA/S), tends to be fading away. To study this phenomenon, I compared detail financial factors of firms with three levels (Low, Medium, and High) of aggregated and continuous IT capability. For instance, Table 16 indicates that ROA in the Wilcoxon test is significantly higher in the firms with only a medium level of aggregated and continuous IT capability (IT_AGG_{Med} and IT_CON_{Med}) than in the control group. On the contrary, the ratio is not different between firms with other levels of IT capability (IT_AGG_{Low}, IT_AGG_{High}, IT_CON_{Low}, and IT_CON_{High}) and the control sample.

ROA is the value of a firm's net income (NI) divided by its assets (AT). When ROA is significantly higher in firms with a medium level of IT capability (IT_AGG_{Med} and IT_CON_{Med}), I found that the median of NI, which is the numerator of ROA, linearly increases based on the degree of accumulated IT capability (IT_AGG_{Low} and $IT\_CON_{Low} < IT\_AGG_{Med}$ and $IT\_CON_{Med} < IT\_AGG_{High}$ and IT_CON_{High}) in Table 17. The median of AT, which is the denominator of ROA, also linearly increases based on the degree of aggregated IT capability ($IT\_AGG_{Low} < IT\_AGG_{Med} < IT\_AGG_{High}$). On the other hand, the median of AT is the largest in the firms with a high level of continuous IT capability, followed by the firms with a low level of IT capability, and then the firms with a medium level of IT capability ($IT\_CON_{Med} < IT\_CON_{Low} < IT\_CON_{High}$). It seems that having long-term accumulated IT capability leads to increasing a firm's assets, which include fixed assets (e.g., IT infrastructure) and intangible assets (e.g., patents).

As an opposite result of the prior literature, the Wilcoxon test shows that OI/E is mostly lower in firms with only a medium level of IT capability (IT_AGG_{Med} and IT_CON_{Med}), in many cases (Table 16). These findings are also consistent with regression and random effect tests. The dummy for firms with a medium level of IT capability in the regression test is significant with a negative coefficient in three cases, and the dummy for the same firms in the random effect test is also negatively associated with the ratio. More specifically, I can see that when OI/E is significantly lower in the firms with a medium level of IT capability (IT_AGG_{Med} and IT_CON_{Med}) than in the control group, the number of employees of firms (E) is significantly higher in the firms than those firms in the control group (Table 17). However, the number of employees of firms with a high level of accumulated IT capabilities (IT_AGG_{High} and IT_CON_{High}) is not different from the number of employees in the control group. It seems that increasing employment is necessary to sustain IT capabilities to some extent, but the long-term continuation of those capabilities appears to lead to no difference in the number of employments between the firms with accumulated IT capability and the control group.

SGA/S in the Wilcoxon test is also significantly higher in the firms with only a medium level of IT capability (IT_AGG_{Med} and IT_CON_{Med}) than in the control sample in all cases. However, the dummy for the firms is not significant in the following regression and random effect tests. From the previous test, I confirmed that the firms' high SGA, which is the numerator of the ratio, eventually led to a high SGA/S. The SGA become not significantly higher in firms with other levels of accumulated IT capability (IT_AGG_{Low}, IT_AGG_{High}, IT_CON_{Low}, and IT_CON_{High}) than in the control sample, which makes the SGA/S not significant in the test. I can guess that to sustain a firm's IT capability, it needs to increase the related expenses, but after maintaining the capability over time, it spends less on expenses.

6.1.3 The Long-Term Effect of Accumulated IT Capability on Market Performance

From the results of Hypotheses 3 and 6, I found the evidence that the market performance (Q) of the firms with accumulated IT capability is higher than that of the control group. On the other hand, the result of Hypotheses 9 and 12 indicates that the firms' higher market performance is mainly influenced by the firm's prior market performance, rather than their accumulated IT capability. However, the accumulated IT capability tends to be positively associated with market performance in a long-term perspective. This implies that if a firm maintains its IT capability, it can increase market performance in the long run, not in the short term.

A. S. Bharadwaj et al. (1999) argued that firms' IT expenditure is one of the important variables that explain Tobin's Q. Based on this study, I can conjecture that firm's increasing SGA, including IT expenses, leads to increasing Tobin' Q. A. Bharadwaj, Keil, and Mähring (2009) demonstrated that if a firm experiences IT failures, its market value is significantly and negatively affected by the events, which can decrease the firm's Tobin' Q ratio. This demonstrates that a lack of IT capability can damage a firm's market performance.

Similar to ROA in the Wilcoxon test, Tobin's Q is only higher in the firms with a medium level of accumulated IT capability than in the control sample. Maintaining the ability for a long time instead makes the positive effect of the IT capability insignificant. This diminished effect of the degree of accumulated IT capability on Tobin's Q can be explained by Hu (2004), who investigated the relationship between IT investment and Tobin's Q. Hu (2004) argued that IT spending does not linearly increase Tobin's Q. The empirical results demonstrated the relationship between IT spending and Tobin's Q as a bell-shaped curve, not a linear line. This means that the returns on IT investment have diminished over time. My study demonstrates that since sustaining IT capability requires increased IT spending, its impact on Tobin's Q can be diminished as well.

6.1.4 Limitations and Future Research

This study offered the opportunity to reinvestigate the relationship between IT capability and business performance by suggesting novel concepts of IT capability—aggregated and continuous IT capability—by deploying a longitudinal study. There are, however, limitations that remain to be explored. I solely relied on the InformationWeek (IW) 500 list to measure a firm's IT capability. As I have shown in this study, the IW500 has been widely used in some research areas such as information systems, finance, and accounting. Nevertheless, there are several scholars who addressed the issues of using the IW500. A. S. Bharadwaj (2000) pointed out that the process of determining a firm's IT capability cannot be based on objective evaluation. Santhanam and Hartono (2003) argued that the binary that represents only a firm's existence in the IW500 without ranking could be problematic to measure a firm's true IT capability. Chae et al. (2014) also stated that the IW500 could not be an accurate proxy for a firm's IT capability because InformationWeek has changed the evaluation criteria for selecting IT leaders frequently. Since I also use the IW500 list as a proxy for measuring IT capability, my study can embed the same issues as above.

The limitation mentioned above and the results of my research suggest avenues for future research as follows. First, to investigate the relationship between a firm's accumulated IT capability and its impact on business performance, scholars can use other measures than the

IW500 to evaluate a firm's IT capability. For instance, instead of the IW500 list from InformationWeek, the list of ComputerWorld's Premier 100 can be used as a proxy for IT capability (Dehning & Stratopoulos, 2003). The results of previous studies can be reverified using this new data. Second, it is necessary to conduct a detailed investigation of the new findings of this research. As a next step, I can study what factors contribute to the accumulated IT capability. Lim et al. (2012) proposed that a firm's senior IT executives play a critical role in increasing its IT capability and eventually influence the firm's competitive advantages. Likewise, the relationship between senior IT executives and accumulated IT capability can be a future research topic.

6.2 Factors Influencing Continuous IT Capability

6.2.1 Implications

This second part of the research is significant in two ways. First, it suggests a new construct for measuring a firm's ability to maintain its IT capability, which is a more intensive form of capability. Because IT capability, as knowledge, can be aggregated over time (A. S. Bharadwaj, 2000; Figueiredo, 2002), the traditional construct of IT capability, which considers only fragmented capability, can't properly represent the impact of accumulated IT capability. Past studies have only measured firms' IT capability in their research models, not the sustainability of that IT capability. On the other hand, the suggested concept of continuous IT capability enables the measurement of aggregated of IT capability that changes over time, and the description of how IT managers affect the capability.

Scholars can also enrich their research by applying the new construct, which is a deepening of the idea of IT capability that allows for the measurement of firms' accumulated capability. The impact of IT capability on a company can be examined in more detail as time changes. For example, research into the impact of firms' IT capability on their business performance (A. S. Bharadwaj, 2000; Lim et al., 2012, 2013; Santhanam & Hartono, 2003) can be extended to investigation of how this relationship changes over time as firms accumulate capability.

In the industry area, the concept of continuous IT capability can allow managers to focus on sustaining their firms' IT capabilities to get better performance and help their companies build strategies for maintaining that capability by considering the factors that influence continuous IT capability. The findings of our study can help them understand how new IT knowledge introduced by IT manager turnover contributes to the extension of firms' IT capability. This research has shown that IT manager turnover may improve continuous IT capabilities by bringing new knowledge into an organization. Therefore, when an IT manager in charge resigns, the firm can take this an opportunity to acquire new knowledge and secure its long-term retention of IT capability.

Second, this work involves a novel research method: the use of a survival analysis in information systems (IS) research to explain the factors in firms' continuous IT capability. Survival analysis has been used in medicine, economics, engineering, and the social sciences (Li et al., 2010), but not widely in IS research. The few articles that do apply it to business focus only on the longevity of firms. I shift the topic of interest to the persistence of IT capability in order to handle censored observations and utilize time as a variable.

By deploying survival analysis, researchers can understand the factors in firms' other characteristics too, such as financial capability, operational capability, and marketing capability. For example, a researcher can investigate the effects of marketing activities such as promotion on a firm's continuously growing revenue by employing survival analysis. In addition, researchers can examine the effects of IT capability on bankruptcy. Past researchers have used survival analysis to study corporate longevity and failure(Audretsch & Mahmood, 1995; Chen & LEE, 1993; Flagg et al., 1991; Laitinen, 2005; Parker et al., 2002; Turetsky & McEwen, 2001). In the research topic, scholars can use IT capability as a treatment effect to see how it influences firms' longevity over time.

6.2.2 Limitations and Future Research

Despite these findings, there remain two basic limitations inherent to this research. First, I considered only IT management and several financial variables as possible factors in continuous IT capability. This limitation suggests a new research question: "Other than IT managers and financial factors, what are the influences on continuous IT capability?" Because other internal factors could affect continuous IT capability, more and varied predictor variables must be considered in the research model. For instance, since CEO succession influences firms' ROAs (Shen & Cannella Jr, 2002), the types of CEO succession can be included in the research as a factor in continuous IT capability. IT-related factors such as number of patents possessed by a firm, number of IT engineers, and R&D expenses can be also added to the model.

Second, even though I identified the major managerial and financial influences on continuous IT capability in this research, the impact of continuous IT capability on business has not been researched yet. So, I need to investigate the question, "In comparison with traditional IT capability, how does continuous IT capability affect firms' performance?" To answer this research question, I can extend existing studies of the influence of IT capability on firm performance (A. S. Bharadwaj, 2000; Muhanna & Stoel, 2010; Santhanam & Hartono, 2003) by adding the concept of continuous IT capability.

7. CONCLUSION

Many scholars studied IT capability and its impact on business performance. Based on the resource-based view (RBV), A. S. Bharadwaj (2000), in particular, proved that a firm's IT capability is a unique and not easily replicable resource that contributes to increasing financial performance. This result was reconfirmed by Santhanam and Hartono (2003), who used different approaches. On the contrary, Chae et al. (2014) argued that there is no longer any effect of IT capability on financial performance because IT has been standardized and homogenized, resulting in it changing to a noncompetitive advantage. However, these studies only concerned a firm's development of IT capability based on a dichotomous standard without considering the extent of IT capability. These scholars regarded that a firm had effective IT capability if it had been listed in IW500 at least two times in a given research period that measured the aggregation of IT capability. Moreover, Lim et al. (2012, 2013) and Kim et al. (2017) recognized the existence of a firm's IT capability based on its continuous appearance on the IW500 over a certain period. The selection criteria may have a lack of rationale and can be too deterministic, which can lead to unintended results.

To mitigate this issue, I suggested two novel constructs that measure the extent of accumulation of IT capability: *aggregated IT capability,* which represents a firm's frequency of its appearance on the IW500 list, and *continuous IT capability,* which indicates a firm's consecutive appearance on the list. By deploying the proposed constructs, I attempt to reinvestigate the relationship between IT capability and business performance. After dividing the traditional IT leader group into subgroups based on the degree of IT accumulation and selecting symmetric control groups, I replicated the research methods used by Chae et al. (2014) and Santhanam and Hartono (2003). Then, I conducted a panel regression analysis to estimate how the IT accumulation influenced business performance over the period. Apart from profit and cost ratios, I also added Tobin's Q ratio to explore whether a firm's accumulation of IT capability affects its market performance. First, the results of Wilcox tests indicated that how much a firm can accumulate IT capability is irrelevant to increasing profits and decreasing costs but is partially related to enhancing market performance. Next, the year-by-year regression results also demonstrated that after adjusting for the financial halo effect, a firm's accumulated IT capability is not associated with profits and costs. Additionally, the partial impact of accumulated IT capability on market performance from the previous test disappeared after adjusting for a financial halo effect. This means that a firm's prior year market performance, not its accumulated IT capability, is the key determinant of current year market performance. However, from the penal regression test, I found empirical evidence that if a firm keeps aggregating or sustaining IT capability over time, it can have higher market performance than others without the capability at a particular point in time. A firm's market performance was partially influenced only by its aggregation of IT capability.

As a second part of this research, I also examined how the managerial and financial factors affect firms' long-term retention of IT capability. I employed survival analysis to substantiate how various factors are related to a firm's risk of losing IT capability. The conclusions that can be drawn from this study are the following: (1) Although IT managers' structural power helps firms achieve IT capability, it doesn't contribute to their sustaining IT capability. (2) IT manager turnover, which may bring new knowledge and experience into an organization, allows firms to keep their IT capability. (3) The extent of continuous IT capability can be influenced by firms' industry characteristics, which may differ in information intensity. Our research introduces a way to measure the continuity of firms' IT capability. Furthermore, our analysis of the survival model provides new knowledge about the accumulation of IT capability and its relationship with IT managers and financial variables.

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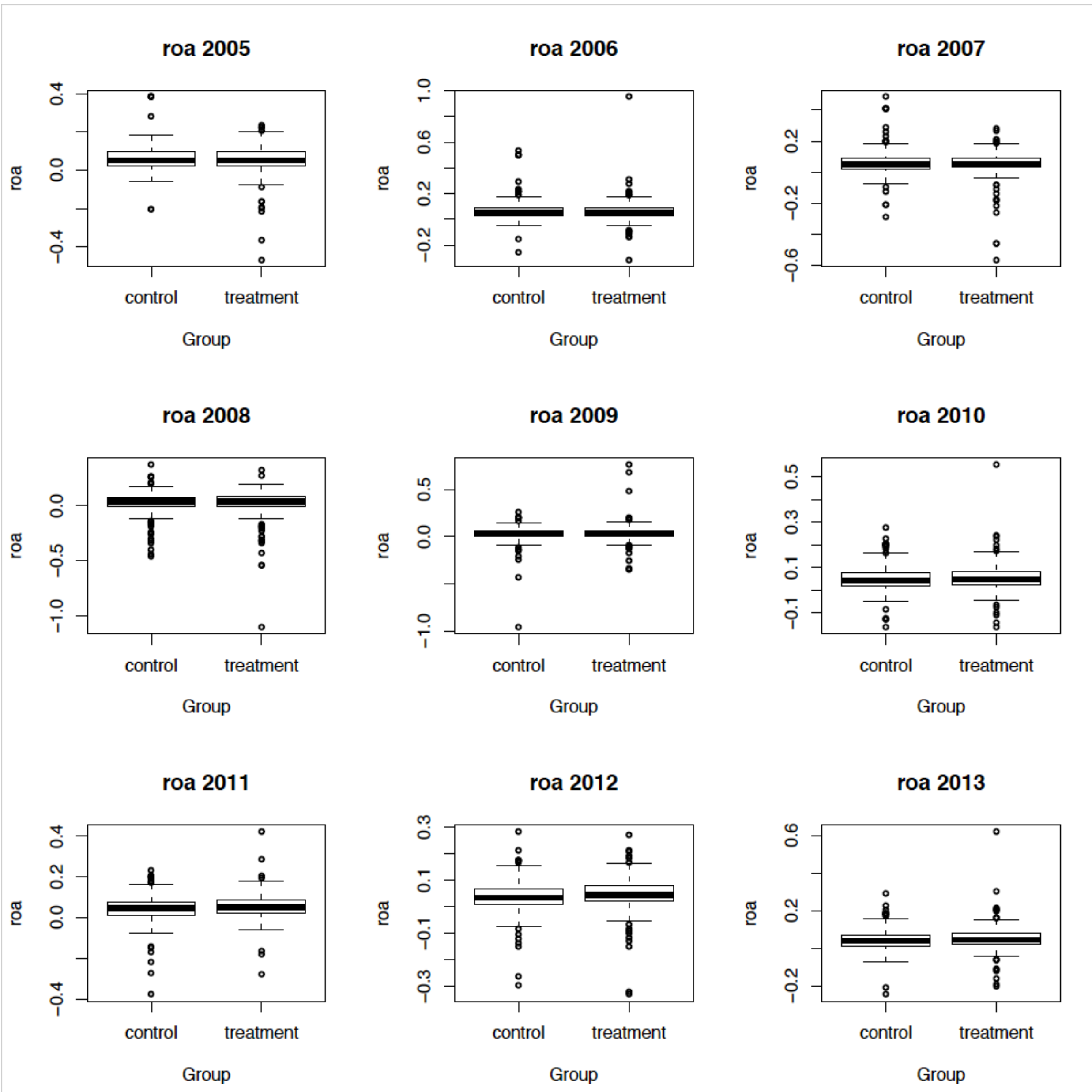
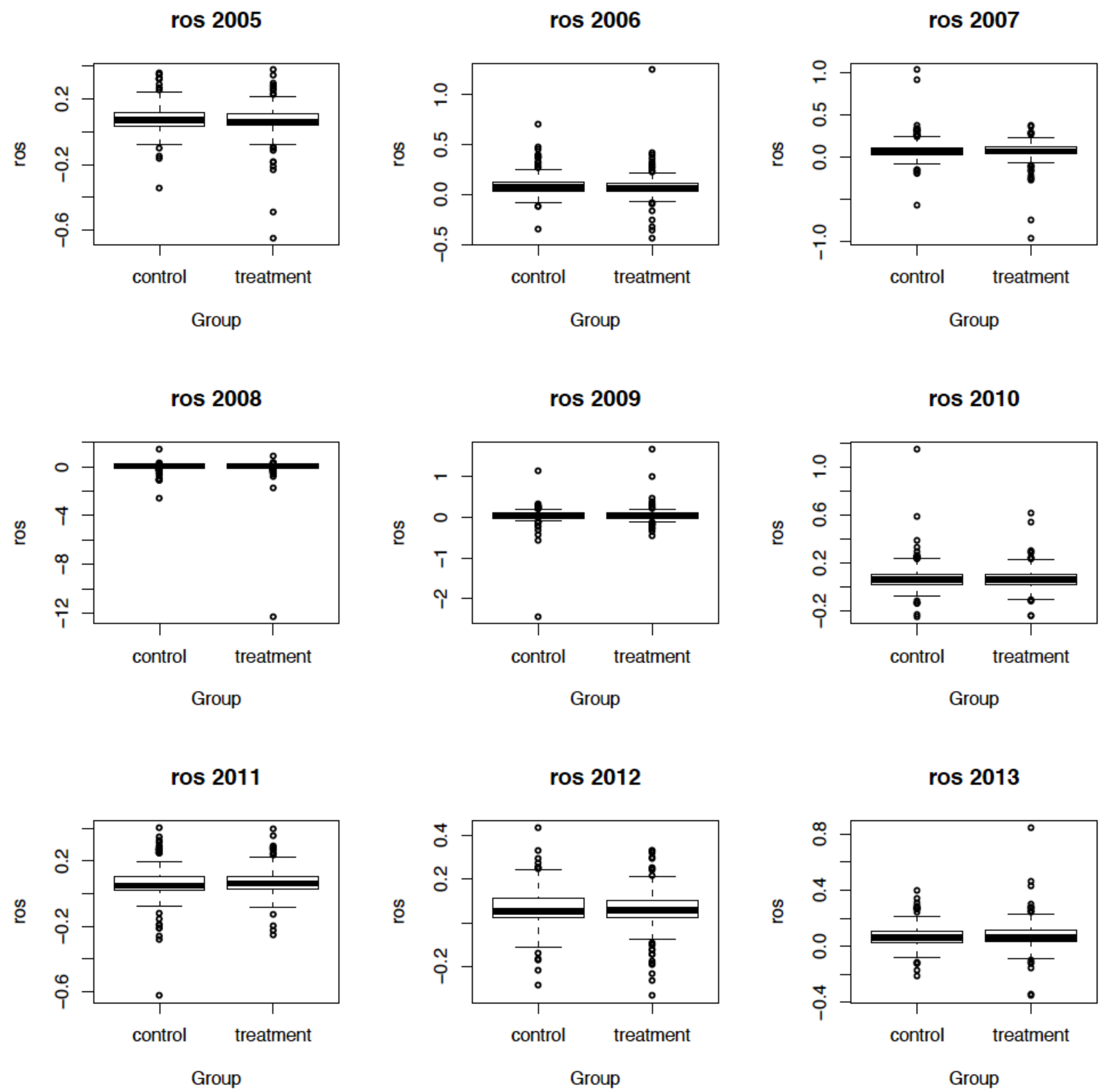
APPENDICES

APPENDIX A. Boxplots of financial ratios between the treatment and control groups

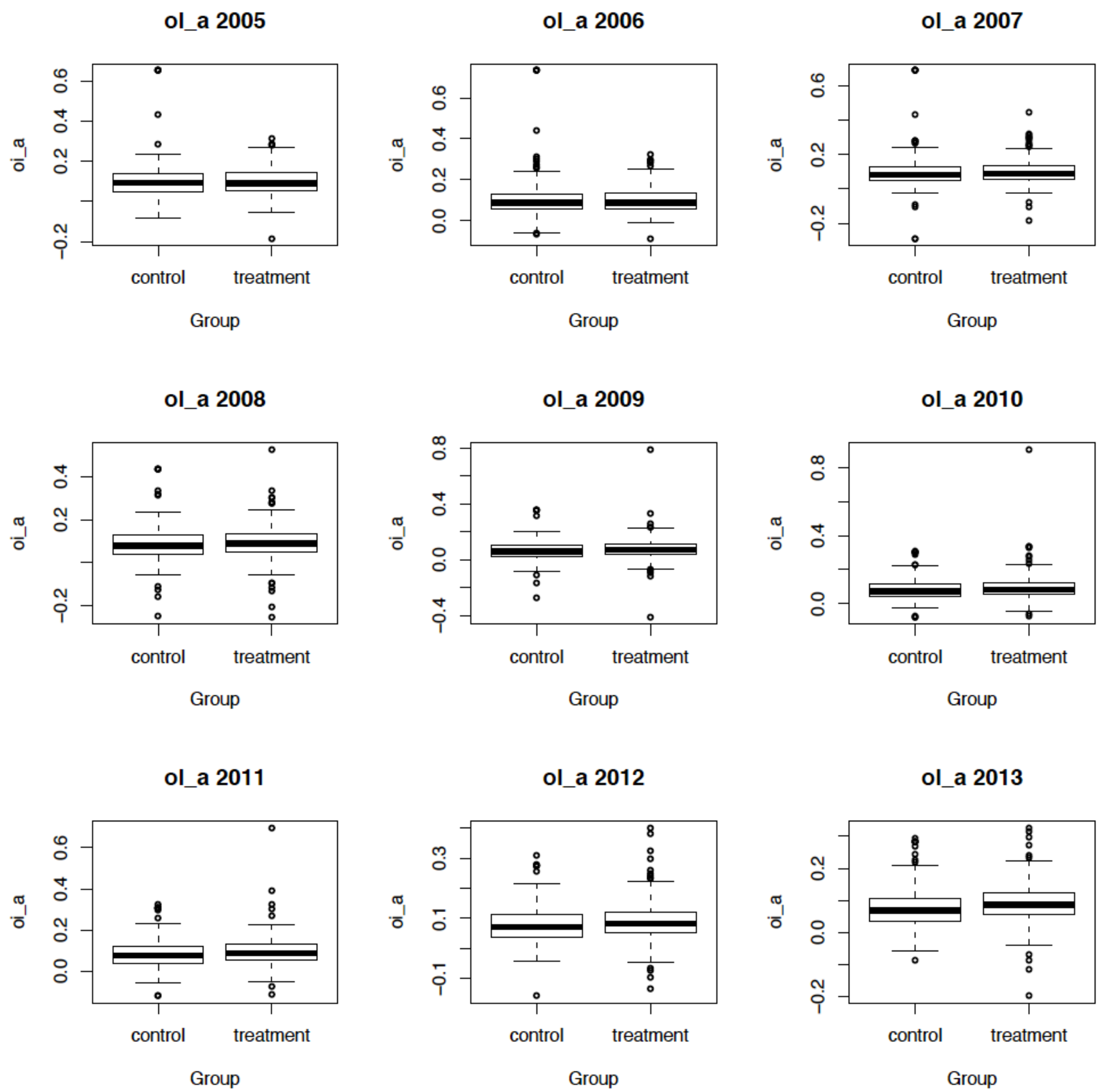
A.1. ROA



A.2. ROS

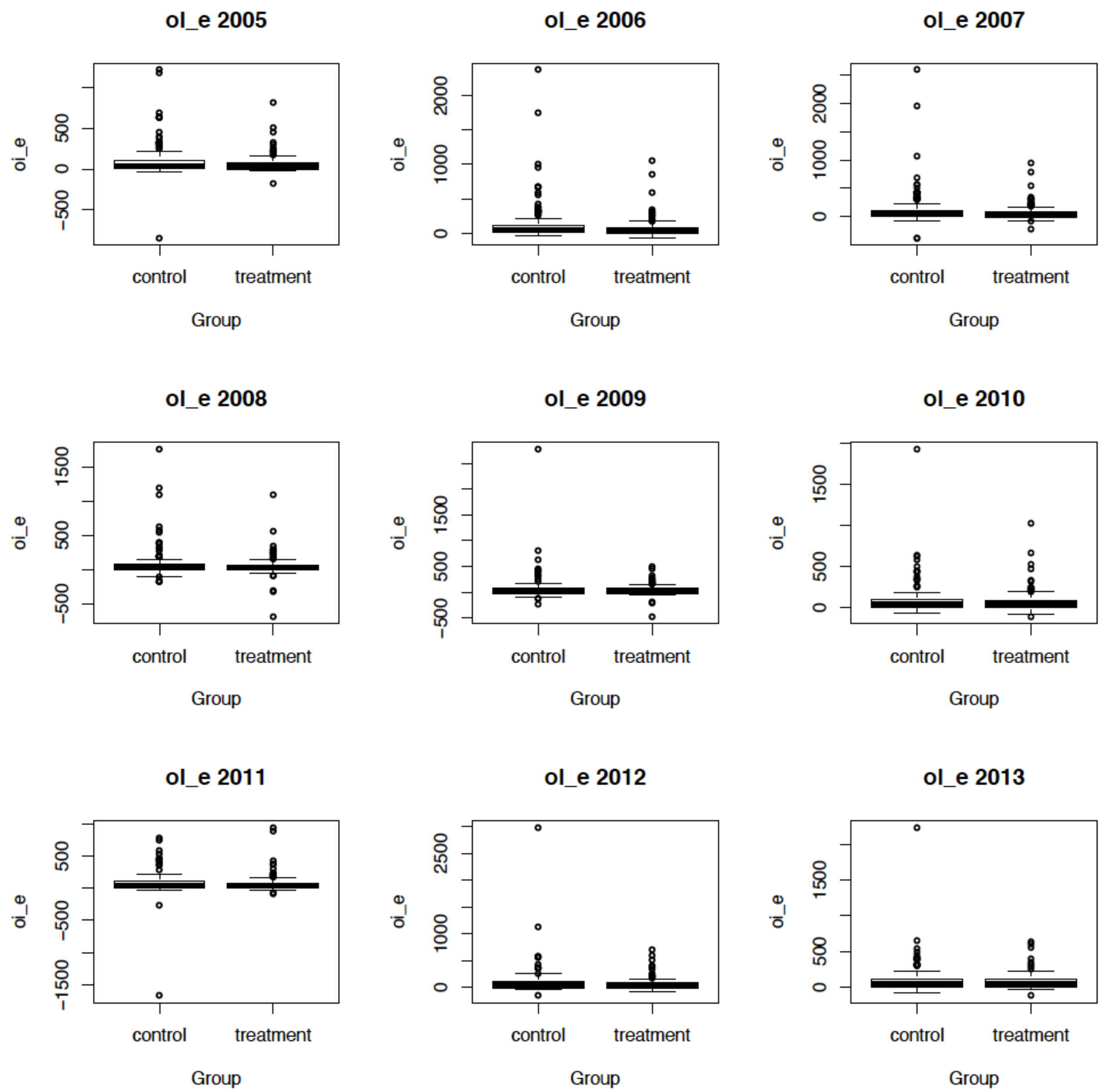

ros 2005
ros 2006
ros 2007
ros 2008
ros 2009
ros 2010
ros 2011
ros 2012
ros 2013
ros
control
treatment
Group

A.3. OI/A



oI_a 2005
oI_a 2006
oI_a 2007
oI_a 2008
oI_a 2009
oI_a 2010
oI_a 2011
oI_a 2012
oI_a 2013
oi_a
control
treatment
Group

A.4. OI/E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oi_e
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control
treatment
Group
oI_e 2006
oi_e
0
1000
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control
treatment
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oI_e 2009
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oI_e 2010
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oI_e 2011
oi_e
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Group
oI_e 2012
oi_e
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2500
control
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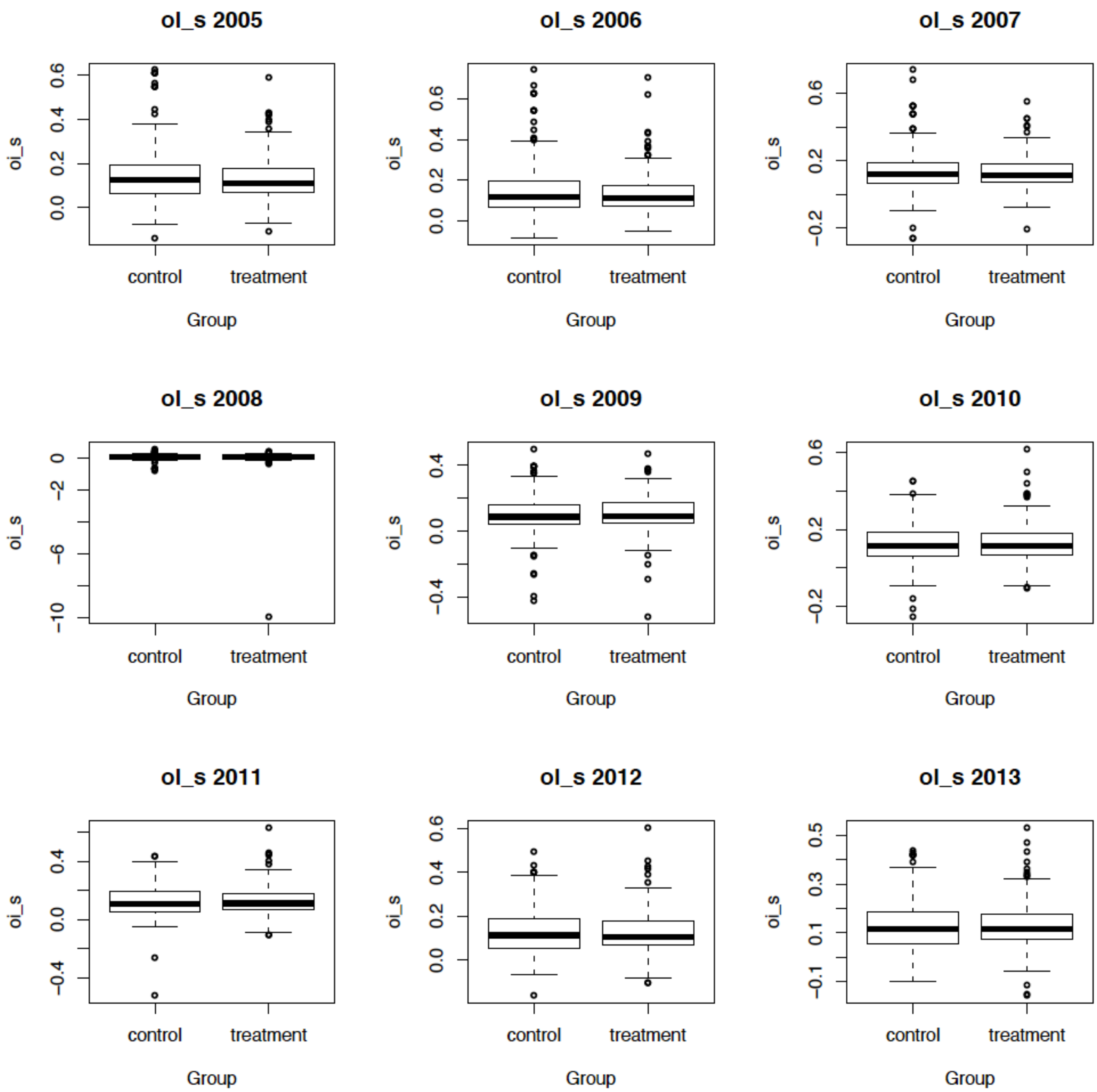
Group
oI_e 2013
oi_e
0
500
1500
control
treatment
Group

A.5. OI/S


oI_s 2005
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oI_s 2007
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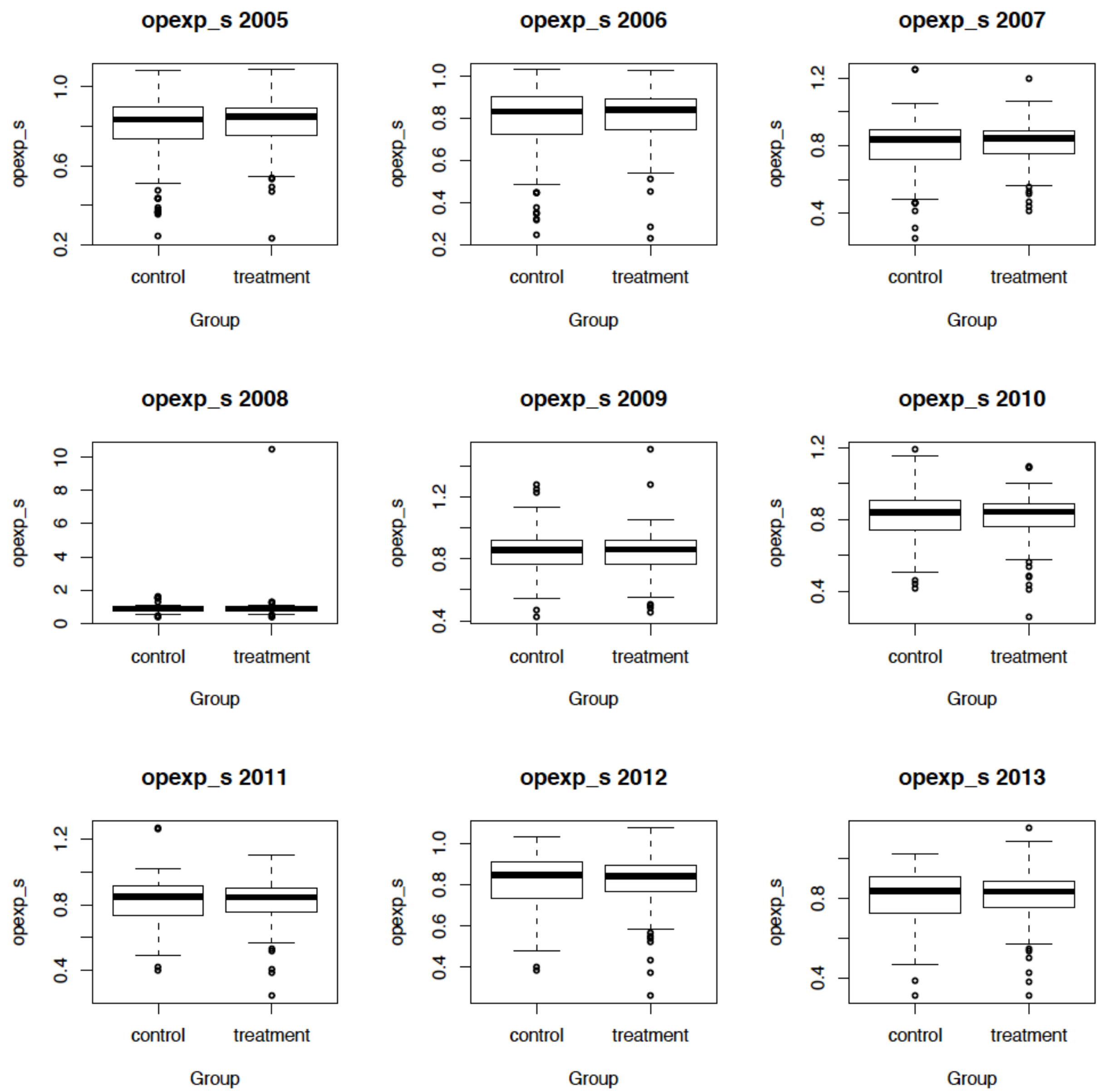
oi_s
control
treatment
Group

A.6. OPEXP/E


opexp_s 2005
opexp_s 2006
opexp_s 2007
opexp_s 2008
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opexp_s 2010
opexp_s 2011
opexp_s 2012
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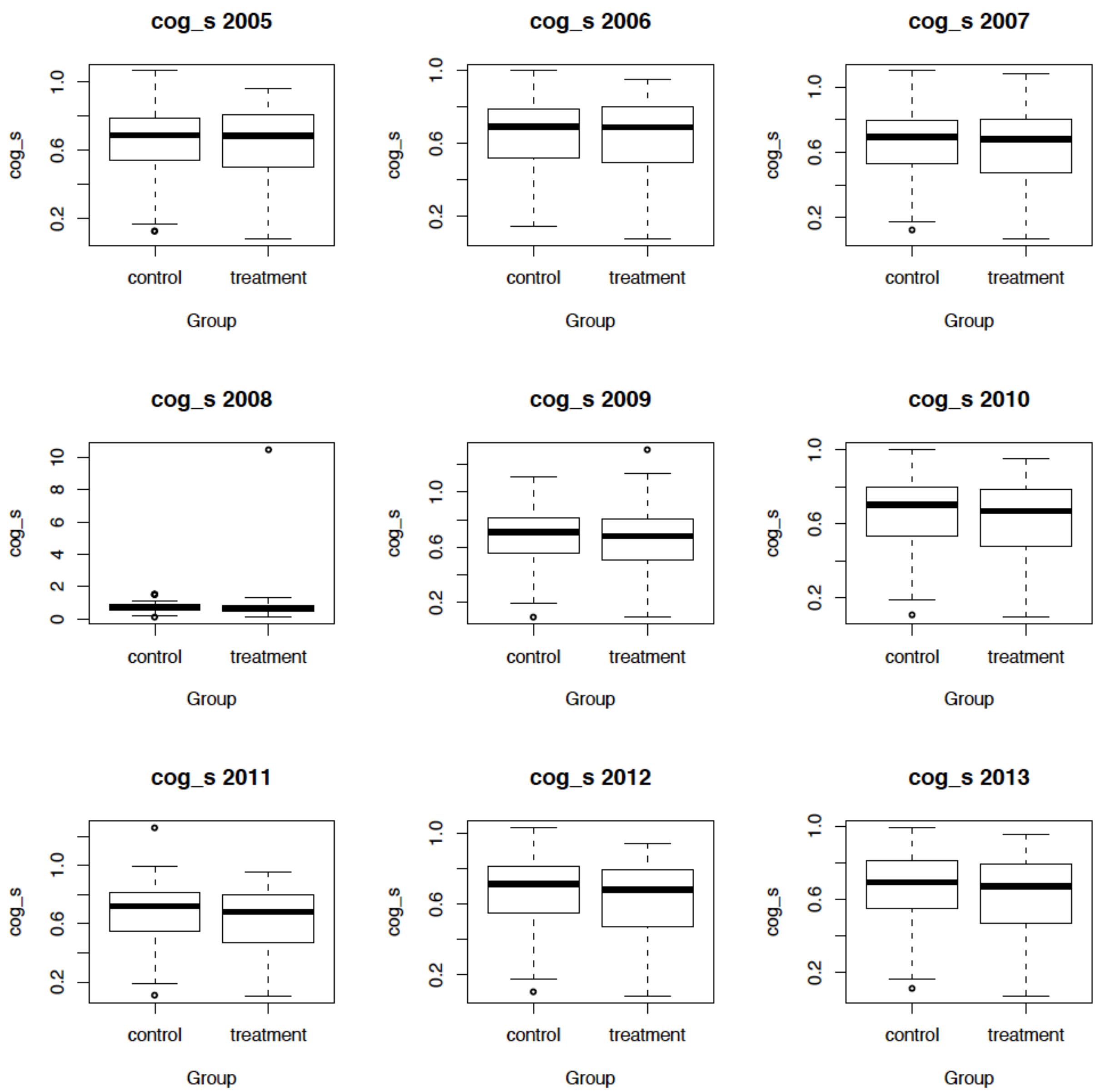
opexp_s
control
treatment
Group

A.7. COG/S


cog_s 2005
cog_s 2006
cog_s 2007
cog_s 2008
cog_s 2009
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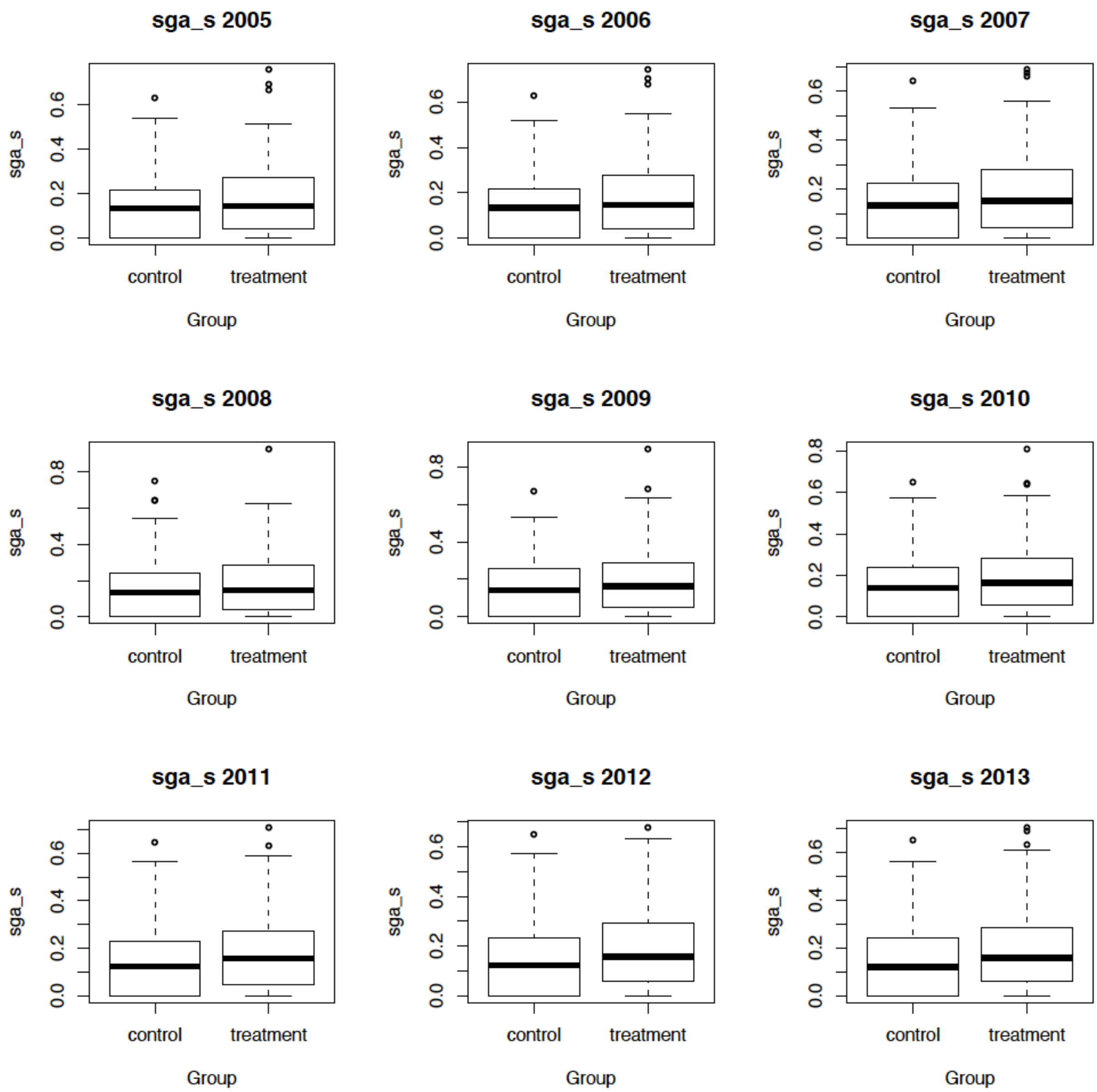
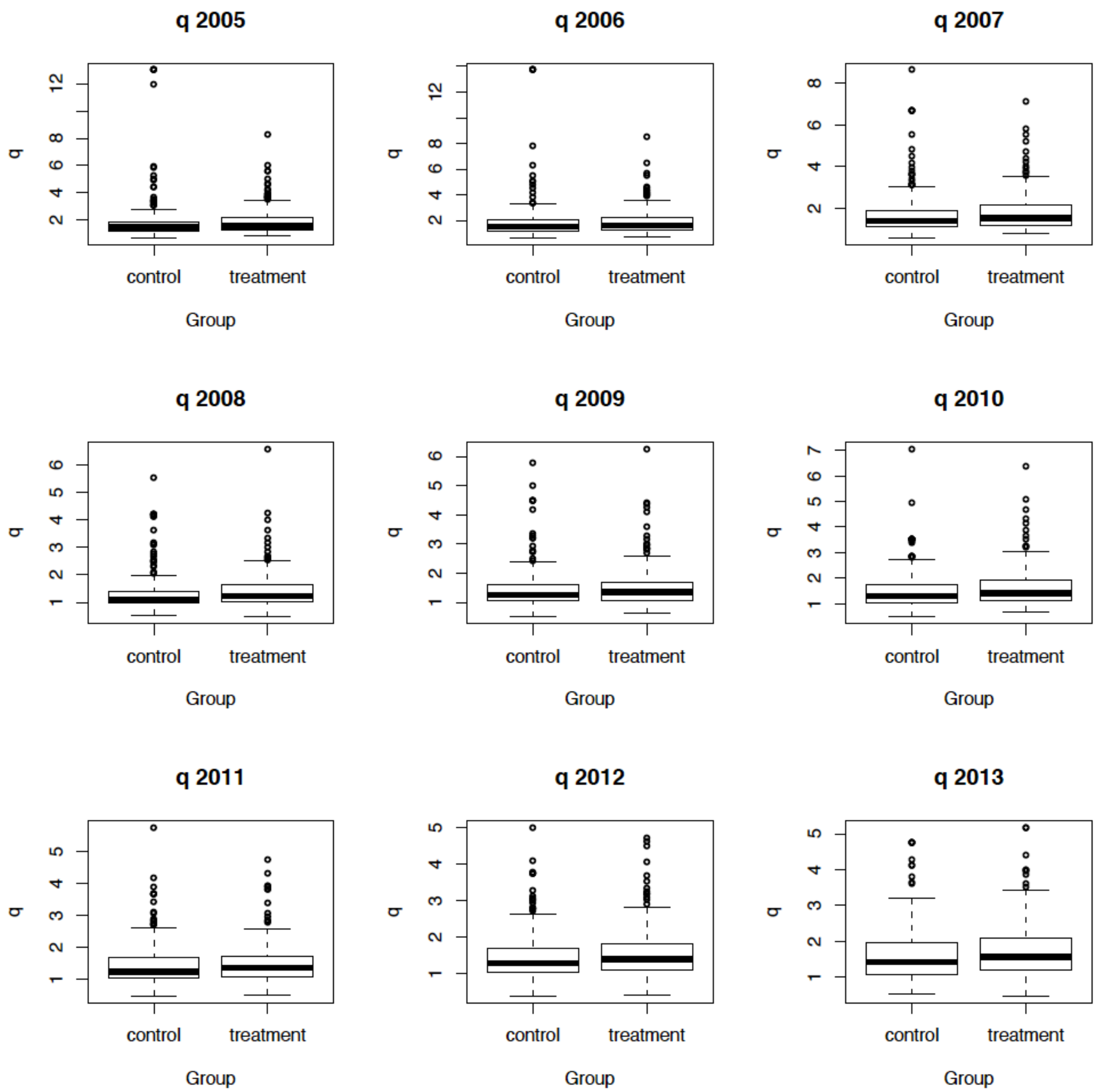
cog_s 2011
cog_s 2012
cog_s 2013
cog_s
control
treatment
Group

A.8. SGA/S

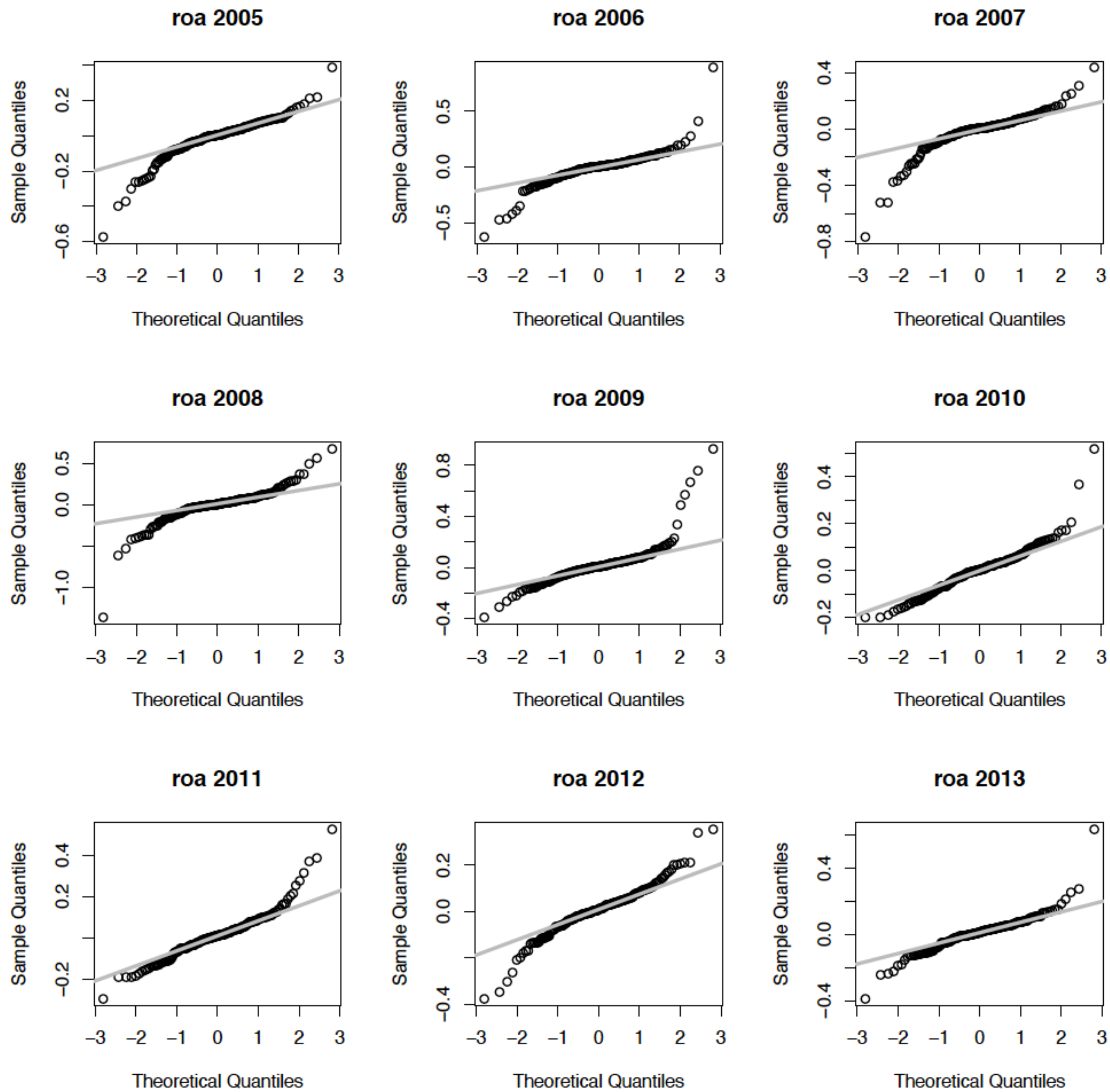

sga_s 2005
sga_s 2006
sga_s 2007
sga_s 2008
sga_s 2009
sga_s 2010
sga_s 2011
sga_s 2012
sga_s 2013
sga_s
control
treatment
Group

A.9. Tobin's Q

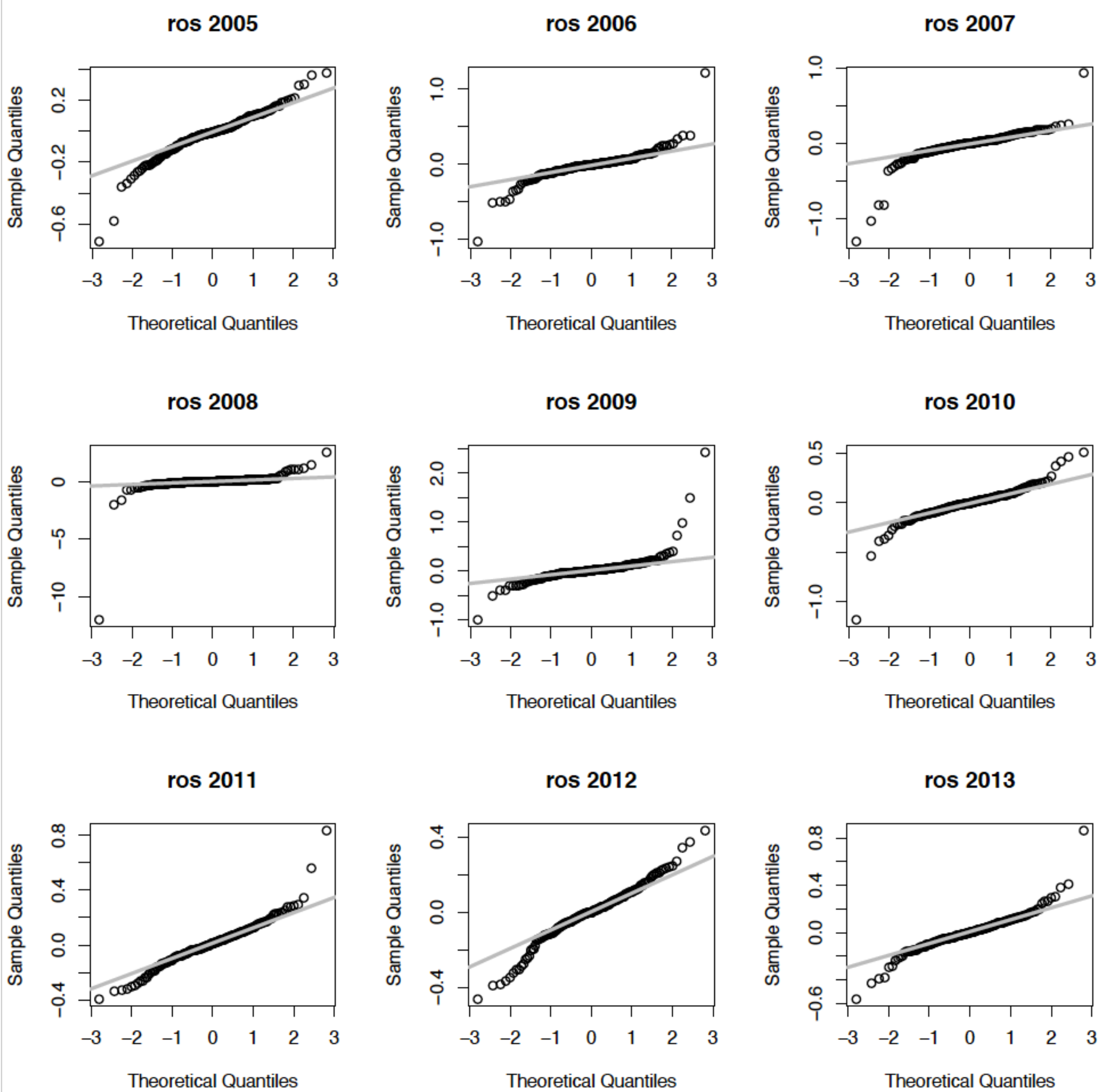

q 2005
q 2006
q 2007
q 2008
q 2009
q 2010
q 2011
q 2012
q 2013
q
control
treatment
Group

APPENDIX B. The Results of Normality Assumption Check using Q-Q plot

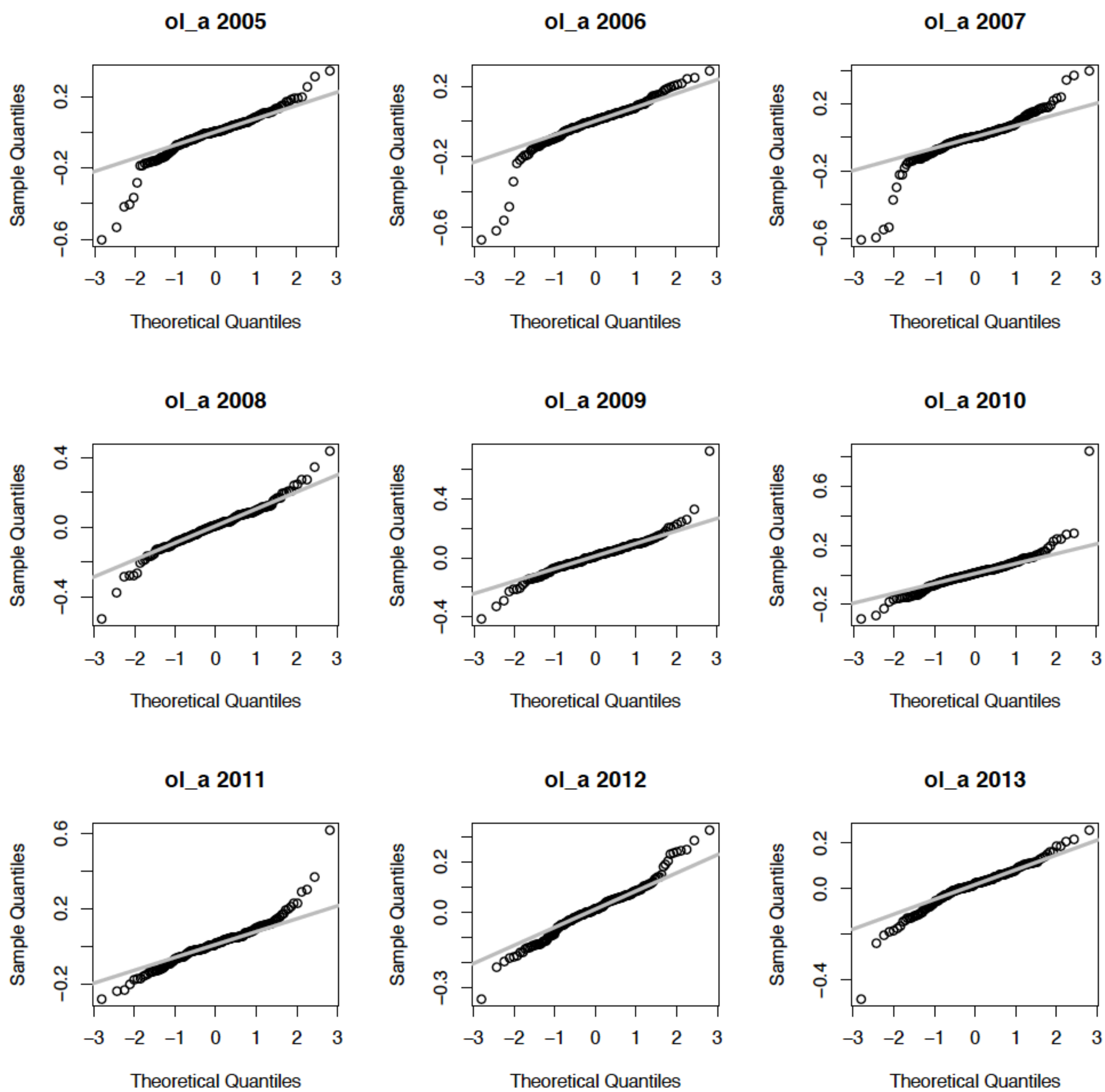
B.1. Q-Q Plots for ROA



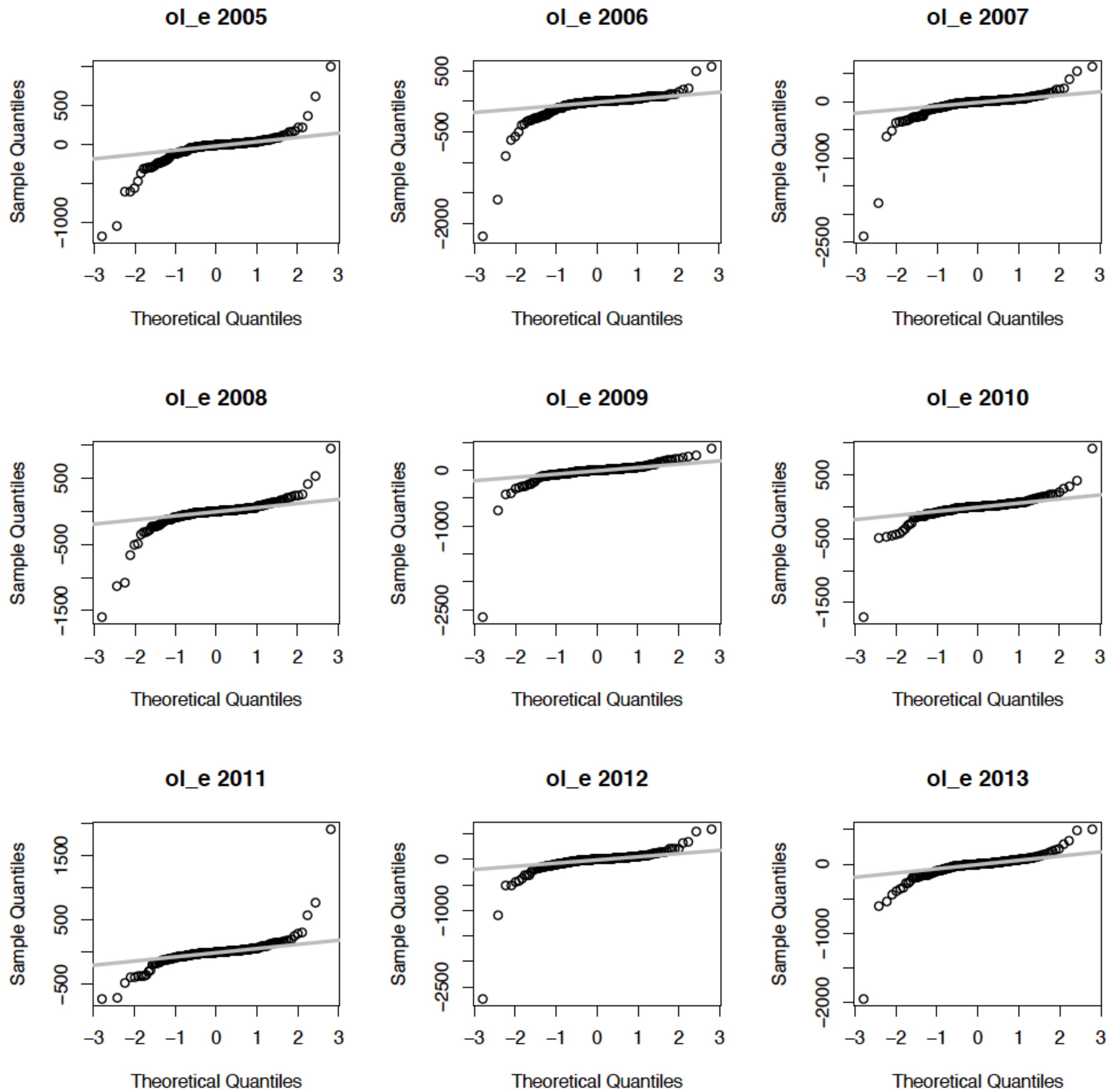
B.2. Q-Q Plots for ROS



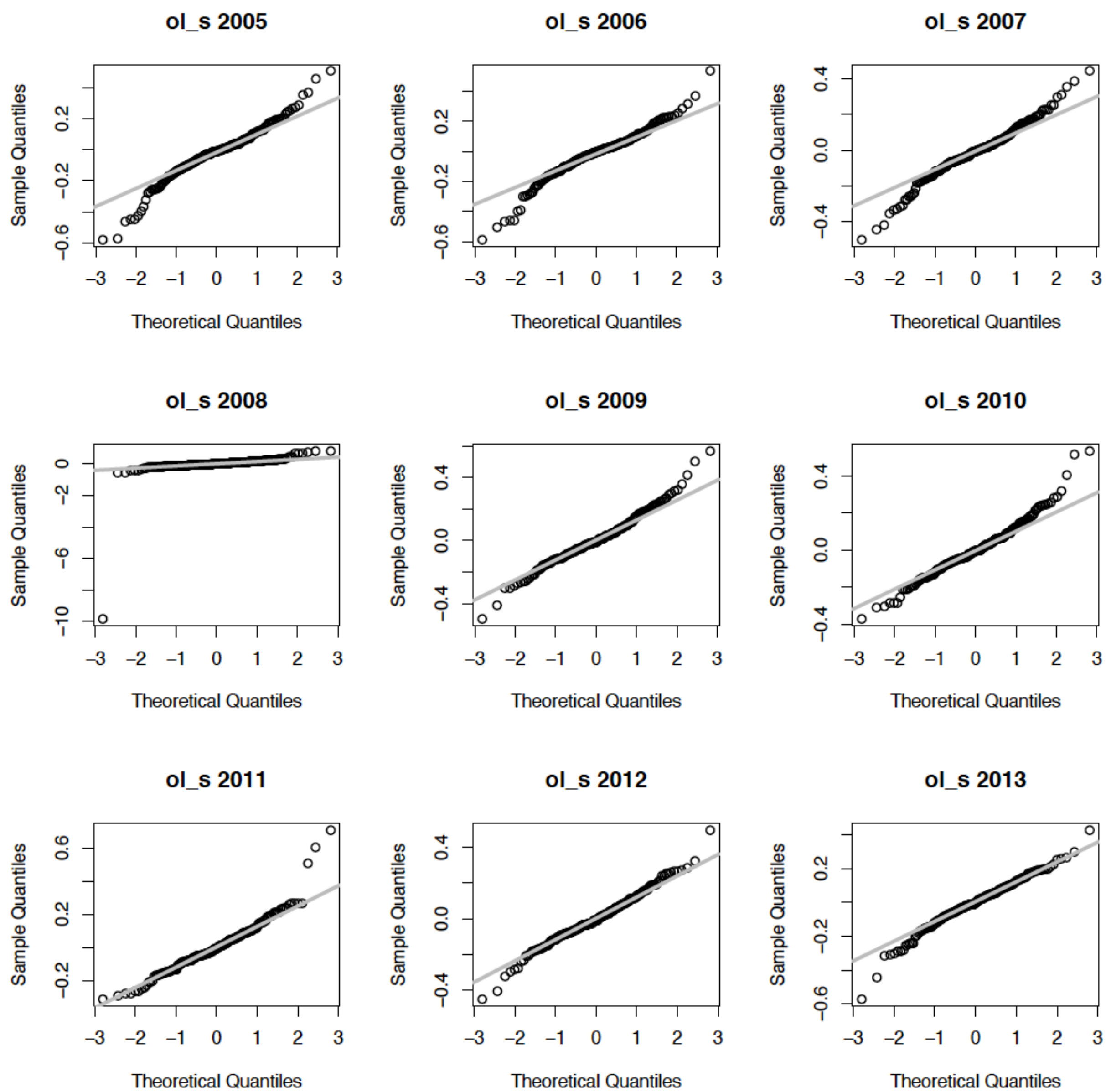
B.3. Q-Q Plots for OI/A



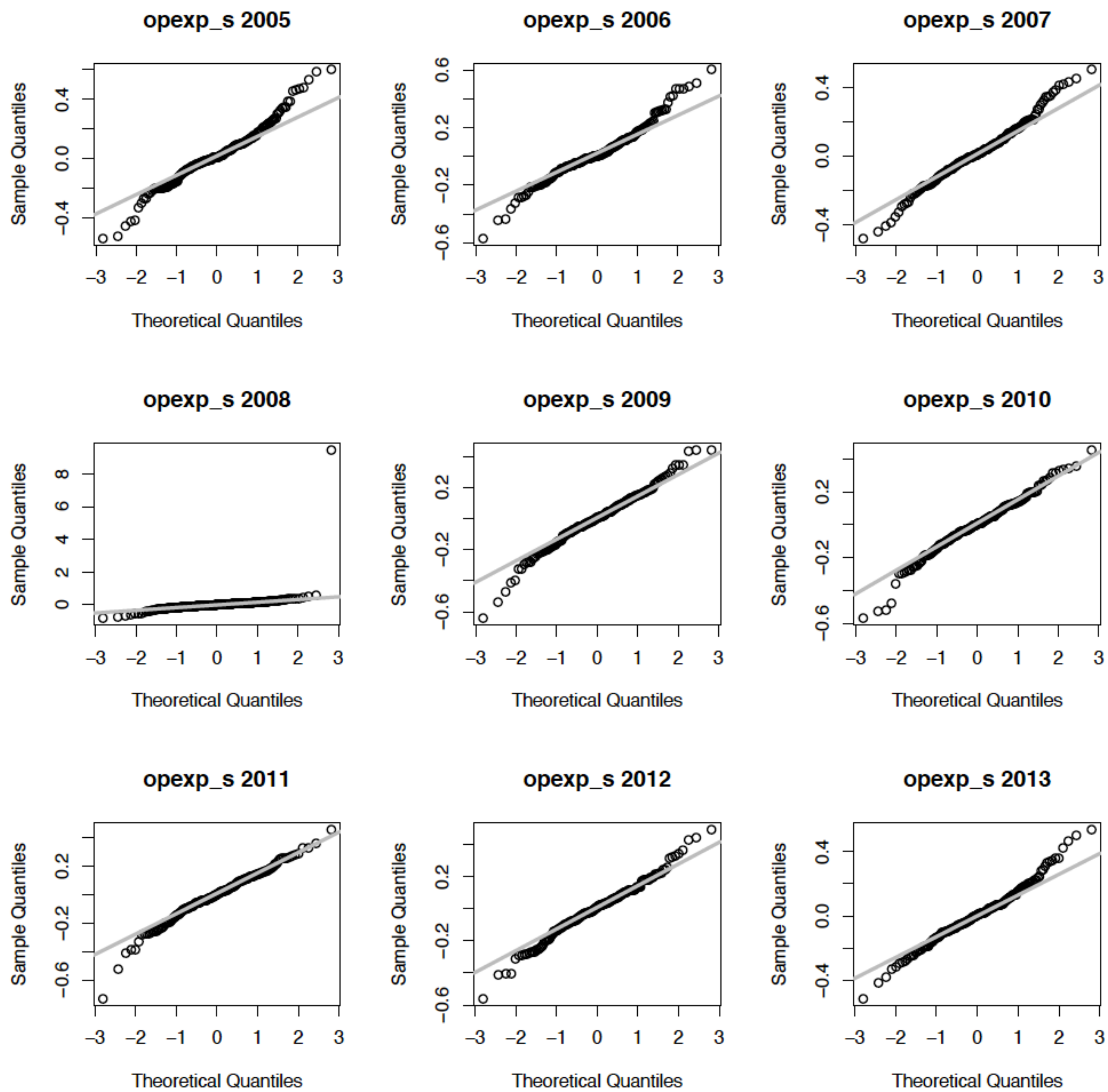
B.4. Q-Q Plots for OI/E



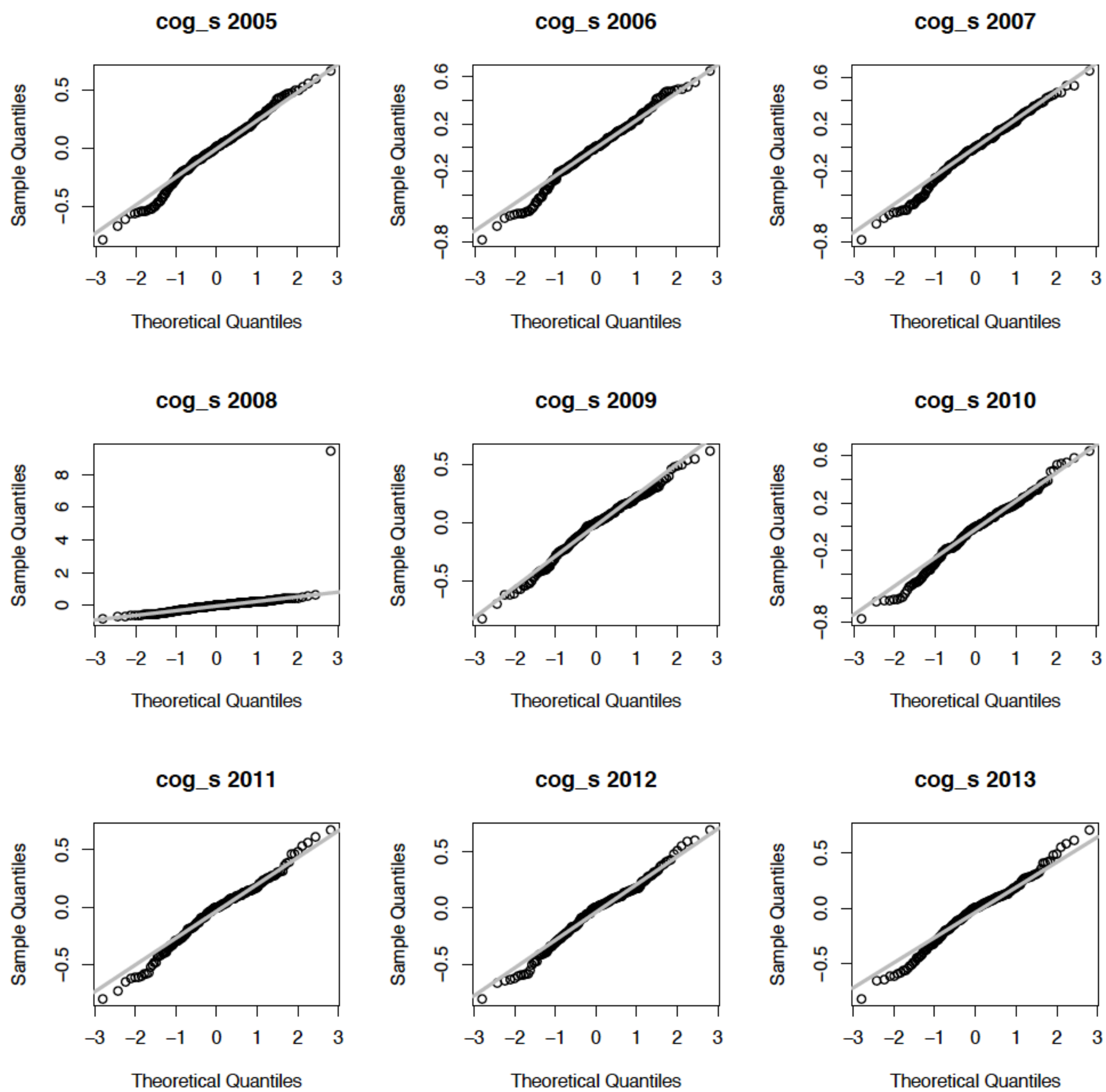
B.5. Q-Q Plots for OI/S



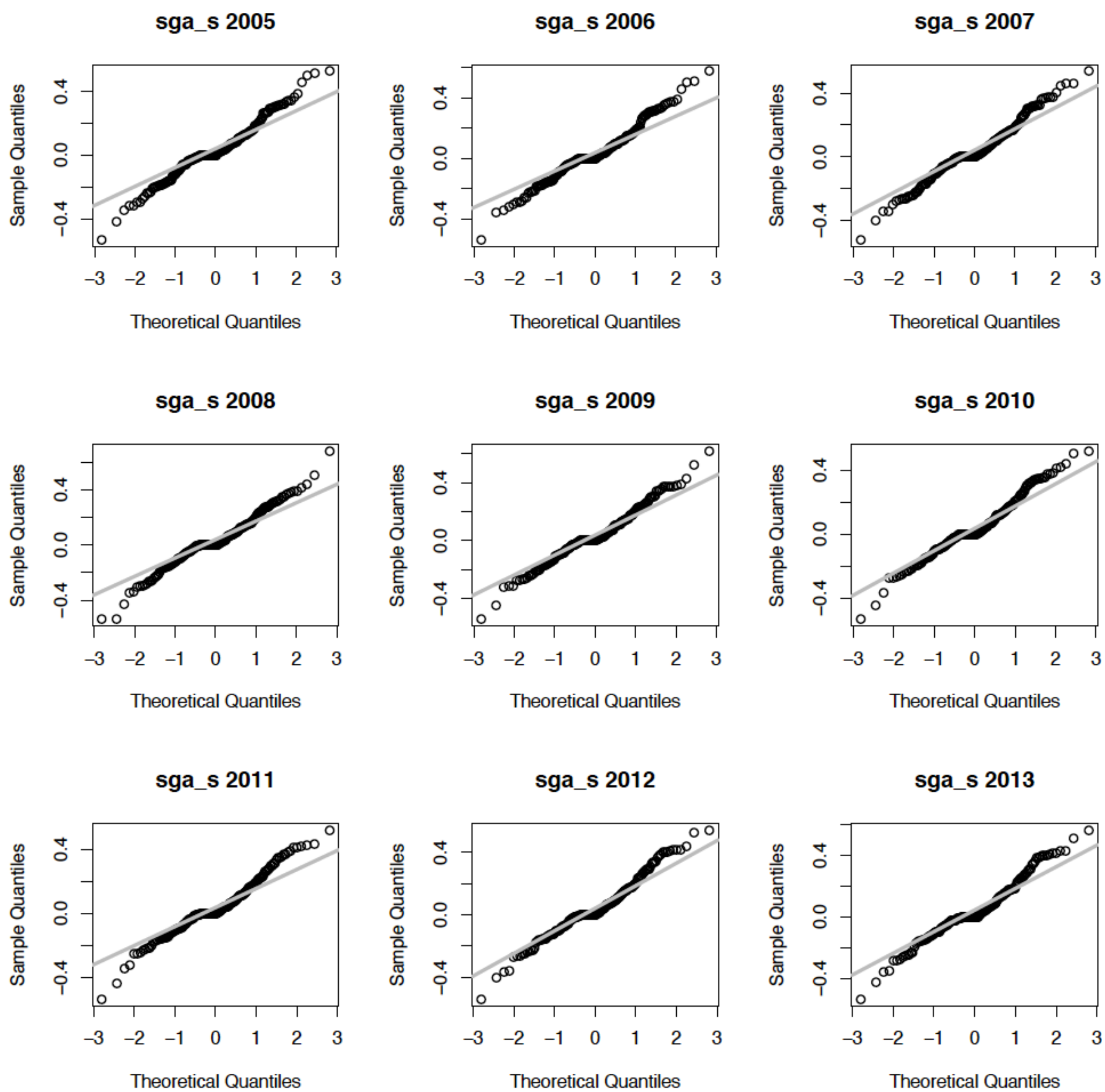
B.6. Q-Q Plots for OPEXP/S



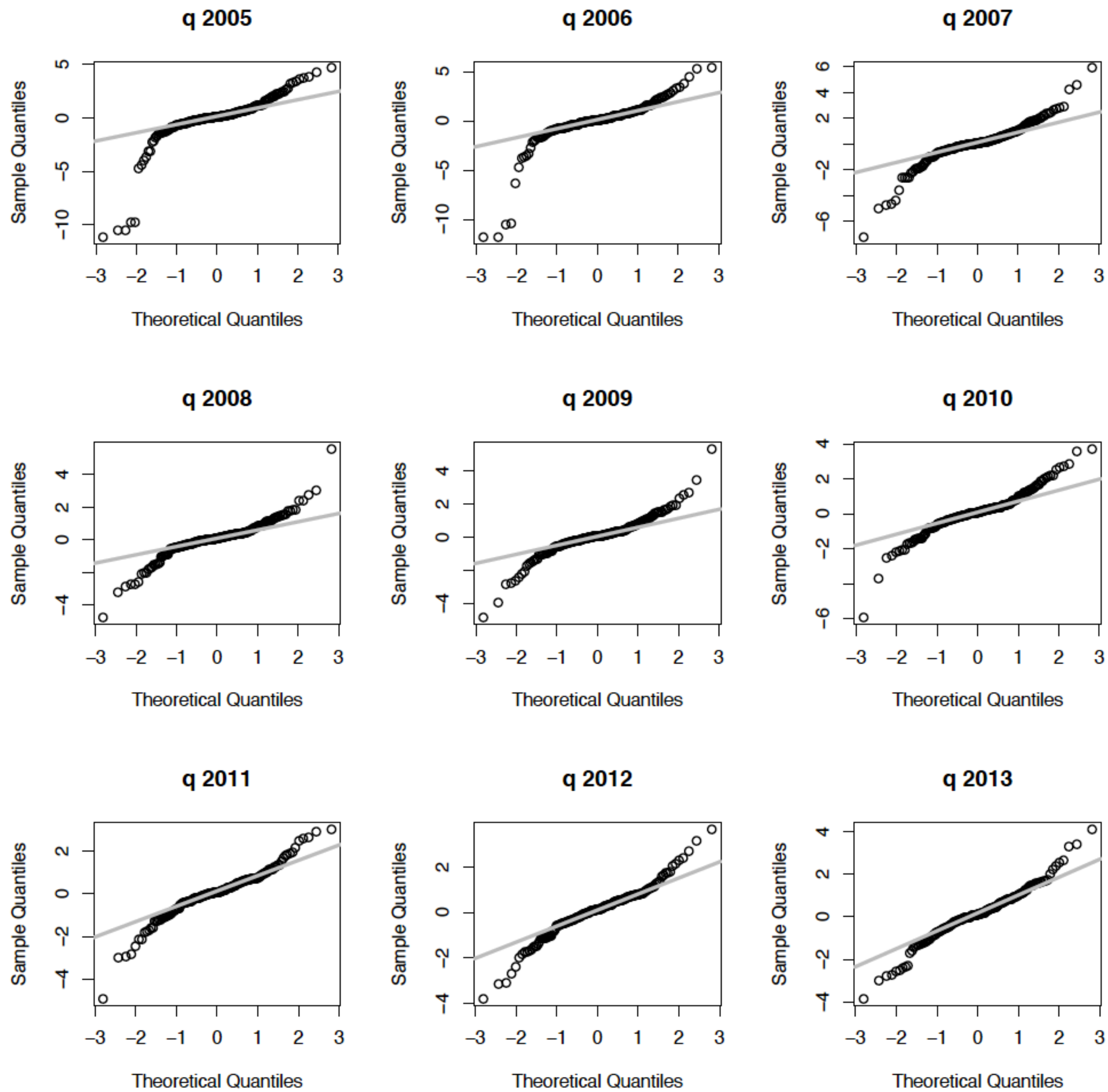
B.7. Q-Q Plots for COG/S



B.8. Q-Q Plots for SGA/S



B.9. Q-Q Plots for Tobin's Q



APPENDIX C. Standard Industrial Classification (SIC) Division Codes

A. Division A: Agriculture, Forestry, And Fishing Major Group 01: Agricultural Production Crops Major Group 02: Agriculture production livestock and animal specialties Major Group 07: Agricultural Services Major Group 08: Forestry Major Group 09: Fishing, hunting, and trapping
B. Division B: Mining Major Group 10: Metal Mining Major Group 12: Coal Mining Major Group 13: Oil And Gas Extraction Major Group 14: Mining And Quarrying Of Nonmetallic Minerals, Except Fuels
C. Division C: Construction Major Group 15: Building Construction General Contractors And Operative Builders Major Group 16: Heavy Construction Other Than Building Construction Contractors Major Group 17: Construction Special Trade Contractors
D. Division D: Manufacturing Major Group 20: Food And Kindred Products Major Group 21: Tobacco Products Major Group 22: Textile Mill Products Major Group 23: Apparel And Other Finished Products Made From Fabrics And Similar Materials Major Group 24: Lumber And Wood Products, Except Furniture

Major Group 25: Furniture And Fixtures

Major Group 26: Paper And Allied Products

Major Group 27: Printing, Publishing, And Allied Industries

Major Group 28: Chemicals And Allied Products

Major Group 29: Petroleum Refining And Related Industries

Major Group 30: Rubber And Miscellaneous Plastics Products

Major Group 31: Leather And Leather Products

Major Group 32: Stone, Clay, Glass, And Concrete Products

Major Group 33: Primary Metal Industries

Major Group 34: Fabricated Metal Products, Except Machinery And Transportation Equipment

Major Group 35: Industrial And Commercial Machinery And Computer Equipment

Major Group 36: Electronic And Other Electrical Equipment And Components, Except Computer Equipment

Major Group 37: Transportation Equipment

Major Group 38: Measuring, Analyzing, And Controlling Instruments; Photographic, Medical And Optical Goods; Watches And Clocks

Major Group 39: Miscellaneous Manufacturing Industries

E. Division E: Transportation, Communications, Electric, Gas, And Sanitary Services

Major Group 40: Railroad Transportation

Major Group 41: Local And Suburban Transit And Interurban Highway Passenger Transportation

Major Group 42: Motor Freight Transportation And Warehousing

Major Group 43: United States Postal Service

Major Group 44: Water Transportation

Major Group 45: Transportation By Air

Major Group 46: Pipelines, Except Natural Gas

Major Group 47: Transportation Services

Major Group 48: Communications

Major Group 49: Electric, Gas, And Sanitary Services

F. Division F: Wholesale Trade

Major Group 50: Wholesale Trade-durable Goods

Major Group 51: Wholesale Trade-non-durable Goods

G. Division G: Retail Trade

Major Group 52: Building Materials, Hardware, Garden Supply, And Mobile Home Dealers

Major Group 53: General Merchandise Stores

Major Group 54: Food Stores

Major Group 55: Automotive Dealers And Gasoline Service Stations

Major Group 56: Apparel And Accessory Stores

Major Group 57: Home Furniture, Furnishings, And Equipment Stores

Major Group 58: Eating And Drinking Places

Major Group 59: Miscellaneous Retail

H. Division H: Finance, Insurance, And Real Estate

Major Group 60: Depository Institutions

Major Group 61: Non-depository Credit Institutions

Major Group 62: Security And Commodity Brokers, Dealers, Exchanges, And Services

Major Group 63: Insurance Carriers

Major Group 64: Insurance Agents, Brokers, And Service

Major Group 65: Real Estate

Major Group 67: Holding And Other Investment Offices

I. Division I: Services

Major Group 70: Hotels, Rooming Houses, Camps, And Other Lodging Places

Major Group 72: Personal Services

Major Group 73: Business Services

Major Group 75: Automotive Repair, Services, And Parking

Major Group 76: Miscellaneous Repair Services

Major Group 78: Motion Pictures

Major Group 79: Amusement And Recreation Services

Major Group 80: Health Services

Major Group 81: Legal Services

Major Group 82: Educational Services

Major Group 83: Social Services

Major Group 84: Museums, Art Galleries, And Botanical And Zoological Gardens

Major Group 86: Membership Organizations

Major Group 87: Engineering, Accounting, Research, Management, And Related Services

Major Group 88: Private Households

Major Group 89: Miscellaneous Services

J. Division J: Public Administration

Major Group 91: Executive, Legislative, And General Government, Except Finance

Major Group 92: Justice, Public Order, And Safety

Major Group 93: Public Finance, Taxation, And Monetary Policy

Major Group 94: Administration Of Human Resource Programs

Major Group 95: Administration Of Environmental Quality And Housing Programs

Major Group 96: Administration Of Economic Programs

Major Group 97: National Security And International Affairs

Major Group 99: Nonclassifiable Establishments

* *Sources:* United States Department of Labor

APPENDIX D. The results of Wilcoxson tests using key elements of financial ratios

Elements	Groups	2005				2006				2007			
		Mean	**Median**	**Z**	**P**	**Mean**	**Median**	**Z**	**P**	**Mean**	**Median**	**Z**	**P**
AT	IT_AGG$_{Low}$	53557.304	3993.734	287	0.063	57420.898	4031.533	289	0.067	65403.687	4473.274	283	0.089
	Control$_{AL}$	85917.076	3365.657			108040.289	4520.000			120604.448	4369.614		
	IT_AGG$_{Med}$	21213.154	5773.000	1293	0.487	24602.791	6173.000	1310	0.545	27035.384	6242.573	1302	0.518
	Control$_{AM}$	28312.189	7157.405			30520.153	8397.265			31249.954	9102.747		
	IT_AGG$_{High}$	33284.883	9165.526	2374	0.857	33640.244	9449.459	2127	0.291	35157.879	12086.700	2100	0.321
	Control$_{AH}$	37258.438	11003.838			41754.115	11586.050			47404.197	12458.100		
COG	IT_AGG$_{Low}$	0.632	0.672	483	0.504	0.622	0.660	477	0.555	0.630	0.646	460	0.510
	Control$_{AL}$	0.607	0.646			0.607	0.652			0.615	0.651		
	IT_AGG$_{Med}$	0.605	0.646	1165	0.171	0.603	0.635	1171	0.181	0.609	0.630	1136	0.128
	Control$_{AM}$	0.661	0.696			0.659	0.701			0.669	0.694		
	IT_AGG$_{High}$	0.670	0.720	2613	0.508	0.664	0.719	2582	0.580	0.661	0.702	2430	0.849
	Control$_{AH}$	0.658	0.709			0.651	0.704			0.659	0.718		
EBIT	IT_AGG$_{Low}$	1796.515	369.072	212	0.004	2520.061	329.665	258	0.025	2287.897	294.255	285	0.094
	Control$_{AL}$	3295.329	434.549			4502.569	401.200			4539.923	299.748		
	IT_AGG$_{Med}$	1723.939	456.148	1422	0.989	1934.670	573.814	1339	0.652	2132.454	608.584	1403	0.910
	Control$_{AM}$	1611.667	531.844			1804.980	655.891			2051.266	661.000		
	IT_AGG$_{High}$	1770.414	860.350	2316	0.699	2202.382	1003.713	2438	0.966	2329.381	1154.100	2276	0.719
	Control$_{AH}$	2188.207	949.000			2550.997	985.250			2960.144	1181.000		
EMP	IT_AGG$_{Low}$	21.225	12.800	424	0.644	20.943	13.800	383	0.863	19.482	14.479	374	0.740
	Control$_{AL}$	20.305	5.631			22.406	5.542			25.298	5.600		
	IT_AGG$_{Med}$	33.665	13.722	1581	0.298	35.338	14.000	1413	0.580	36.244	13.300	1500	0.546
	Control$_{AM}$	34.524	14.668			36.410	16.145			37.473	17.914		
	IT_AGG$_{High}$	55.665	26.750	2385	0.567	58.807	28.600	2293	0.963	60.470	28.800	2300	0.801
	Control$_{AH}$	57.734	26.027			59.170	26.334			59.177	25.548		

Elements	Groups	2008				2009				2010			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
AT	IT_AGG$_{Low}$	57413.810	4547.325	317	0.216	55477.720	4465.100	268	0.090	55070.879	3946.200	243	0.065
	Control$_{AL}$	109901.387	4588.416			96460.138	4863.724			104731.552	4593.706		
	IT_AGG$_{Med}$	27475.365	6469.399	1356	0.718	28159.697	6900.973	1219	0.471	30021.537	6776.646	1060	0.155
	Control$_{AM}$	30464.685	8818.800			35761.824	8675.160			41281.631	8744.167		
	IT_AGG$_{High}$	33766.605	11317.480	2217	0.567	37373.798	11134.000	2255	0.663	39235.091	11172.000	2251	0.653
	Control$_{AH}$	44062.464	12125.200			46310.552	12575.273			50611.073	13070.800		
COG	IT_AGG$_{Low}$	0.871	0.651	410	1.000	0.643	0.668	420	0.684	0.596	0.624	327	0.537
	Control$_{AL}$	0.654	0.665			0.631	0.651			0.623	0.648		
	IT_AGG$_{Med}$	0.615	0.633	946	0.012	0.610	0.617	995	0.051	0.594	0.617	1023	0.103
	Control$_{AM}$	0.715	0.728			0.686	0.715			0.665	0.718		
	IT_AGG$_{High}$	0.680	0.727	2315	0.826	0.666	0.695	2310	0.812	0.657	0.695	2259	0.674
	Control$_{AH}$	0.698	0.733			0.684	0.724			0.674	0.708		
EBIT	IT_AGG$_{Low}$	−983.258	333.412	358	0.493	1174.367	297.331	368	0.767	1626.668	411.514	364	0.931
	Control$_{AL}$	1733.302	192.740			1429.194	313.700			2575.550	396.818		
	IT_AGG$_{Med}$	1694.084	486.000	1549	0.514	1669.078	467.105	1361	0.956	1916.345	605.308	1185	0.471
	Control$_{AM}$	1395.674	464.806			1342.143	432.000			1931.083	604.300		
	IT_AGG$_{High}$	1976.569	846.314	2472	0.732	1866.156	724.795	2368	0.977	2450.327	1022.598	2368	0.977
	Control$_{AH}$	1982.279	729.700			1826.500	620.573			2389.100	1016.613		
EMP	IT_AGG$_{Low}$	18.932	13.607	437	0.521	17.025	12.700	379	0.480	16.308	10.600	354	0.750
	Control$_{AL}$	23.581	5.200			22.087	5.190			21.742	4.437		
	IT_AGG$_{Med}$	36.848	15.000	1604	0.346	36.227	15.050	1472	0.268	37.994	15.000	1476	0.258
	Control$_{AM}$	38.325	17.200			37.948	14.730			39.315	16.350		
	IT_AGG$_{High}$	62.578	29.150	2195	0.974	61.120	27.700	2113	0.919	60.997	26.800	2093	0.600
	Control$_{AH}$	59.929	29.865			56.643	29.250			59.697	30.578		

Elements	Groups	2011				2012				2013			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
AT	IT_AGG$_{Low}$	53626.706	3924.103	242	0.101	50690.023	3739.497	241	0.097	49976.286	4103.000	235	0.080
	Control$_{AL}$	111239.566	5469.000			109653.061	5278.000			105376.389	6168.028		
	IT_AGG$_{Med}$	33562.479	7219.143	1067	0.403	35836.121	8042.793	1038	0.411	39033.831	8315.000	1008	0.415
	Control$_{AM}$	43157.747	9154.671			43845.467	9316.228			45663.921	10056.739		
	IT_AGG$_{High}$	41772.017	13292.500	2302	0.926	44924.645	12748.000	2335	0.981	46422.932	13208.449	2084	0.577
	Control$_{AH}$	53748.227	12907.300			55305.039	15681.055			57670.458	16428.276		
COG	IT_AGG$_{Low}$	0.610	0.608	340	0.870	0.604	0.619	322	0.665	0.605	0.615	326	0.709
	Control$_{AL}$	0.621	0.654			0.626	0.659			0.624	0.646		
	IT_AGG$_{Med}$	0.607	0.638	912	0.078	0.605	0.610	963	0.201	0.600	0.617	956	0.341
	Control$_{AM}$	0.687	0.723			0.670	0.718			0.659	0.707		
	IT_AGG$_{High}$	0.663	0.700	2109	0.527	0.660	0.705	2066	0.428	0.652	0.722	1980	0.537
	Control$_{AH}$	0.683	0.731			0.687	0.719			0.675	0.709		
EBIT	IT_AGG$_{Low}$	1482.111	463.777	355	0.964	1543.806	476.000	368	0.811	1528.943	436.000	327	0.720
	Control$_{AL}$	2920.936	444.023			2595.242	451.854			2656.587	475.500		
	IT_AGG$_{Med}$	2090.306	697.600	1190	0.919	2253.019	678.550	1189	0.925	2600.810	793.919	1183	0.623
	Control$_{AM}$	1860.333	698.000			1860.075	678.565			1997.883	902.900		
	IT_AGG$_{High}$	2512.429	1142.000	2415	0.752	2326.570	1047.789	2425	0.724	2889.137	1133.500	2303	0.654
	Control$_{AH}$	2429.406	961.361			2160.404	1089.700			2359.861	1229.087		
EMP	IT_AGG$_{Low}$	16.971	10.000	364	0.636	17.393	11.300	361	0.669	17.376	9.075	358	0.704
	Control$_{AL}$	21.931	5.051			22.493	5.800			22.304	6.350		
	IT_AGG$_{Med}$	41.321	17.500	1408	0.152	41.944	17.000	1362	0.102	44.623	18.300	1431	0.038
	Control$_{AM}$	37.980	15.000			38.421	14.880			38.291	15.520		
	IT_AGG$_{High}$	62.738	27.650	2217	0.955	63.891	28.200	2240	0.979	62.523	30.400	2057	0.825
	Control$_{AH}$	61.268	32.100			62.313	31.700			57.438	31.340		

Elements	Groups	2005				2006				2007			
		Mean	**Median**	**Z**	**P**	**Mean**	**Median**	**Z**	**P**	**Mean**	**Median**	**Z**	**P**
NI	IT_AGG$_{Low}$	329.318	138.817	228	0.008	811.073	134.213	200	0.002	616.991	130.742	305	0.162
	Control$_{AL}$	1358.608	206.339			1559.950	255.691			828.215	105.766		
	IT_AGG$_{Med}$	1066.093	254.655	1402	0.905	1258.602	358.806	1372	0.782	1477.632	332.300	1469	0.818
	Control$_{AM}$	974.925	307.892			1013.625	359.700			1177.851	356.978		
	IT_AGG$_{High}$	946.824	541.639	2611	0.512	1413.236	581.240	2693	0.344	625.246	615.578	2239	0.622
	Control$_{AH}$	1083.446	527.634			1161.501	568.080			1458.326	544.600		
SALE	IT_AGG$_{Low}$	9218.636	3283.653	244	0.015	9644.837	3191.700	228	0.008	10153.798	4028.260	310	0.183
	Control$_{AL}$	10642.879	3502.000			12513.810	3516.000			13999.494	3317.144		
	IT_AGG$_{Med}$	13008.638	5673.000	1238	0.325	14323.315	6142.000	1180	0.197	16071.596	6034.249	1282	0.452
	Control$_{AM}$	12889.297	5292.782			14678.125	5979.000			15305.144	6821.061		
	IT_AGG$_{High}$	15522.365	7702.878	2512	0.761	16840.260	8951.750	2155	0.339	18255.489	9734.856	1846	0.057
	Control$_{AH}$	16274.619	7768.852			18442.943	8233.971			20973.862	9411.497		
XOPR	IT_AGG$_{Low}$	7102.285	2604.600	387	0.581	6790.559	2352.337	378	0.504	7512.823	3085.800	392	0.816
	Control$_{AL}$	6922.385	2386.124			7546.987	3011.000			8926.631	2896.452		
	IT_AGG$_{Med}$	10730.844	4296.841	1356	0.718	11788.268	4786.000	1187	0.210	13248.309	5404.000	1342	0.663
	Control$_{AM}$	10539.331	4183.078			12009.795	4868.571			12381.467	5565.769		
	IT_AGG$_{High}$	12854.627	6421.343	2585	0.573	13704.835	6855.333	2351	0.793	14846.600	6997.632	1870	0.069
	Control$_{AH}$	13115.925	5509.450			14802.842	6001.190			16828.042	7620.000		
XSGA	IT_AGG$_{Low}$	625.440	423.020	255	0.875	692.193	434.500	218	0.400	722.860	445.254	210	0.468
	Control$_{AL}$	744.072	426.465			874.143	359.300			1011.121	440.050		
	IT_AGG$_{Med}$	3388.974	1204.000	808	0.052	3753.561	1284.000	761	0.077	4104.523	1361.913	776	0.054
	Control$_{AM}$	2523.262	675.200			2832.966	875.031			2979.900	1035.406		
	IT_AGG$_{High}$	3063.065	989.894	1084	0.943	3372.362	1066.254	1108	0.819	3770.899	1302.300	1071	0.669
	Control$_{AH}$	2709.285	1229.000			2901.779	1401.000			3321.374	1453.000		

Elements	Groups	2008				2009				2010			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
NI	IT_AGG_{Low}	−3072.623	59.694	312	0.192	332.405	148.469	425	0.634	633.936	228.497	340	0.667
	$Control_{AL}$	−701.483	58.685			283.844	48.967			1259.689	125.103		
	IT_AGG_{Med}	554.891	196.000	1654	0.228	1070.905	251.000	1406	0.762	1144.040	335.921	1195	0.506
	$Control_{AM}$	505.844	211.995			694.867	211.923			1248.435	368.911		
	IT_AGG_{High}	542.360	200.593	2514	0.622	2217.990	461.271	2703	0.241	1405.141	606.000	2444	0.809
	$Control_{AH}$	288.495	293.673			786.177	360.830			1366.748	507.800		
SALE	IT_AGG_{Low}	6801.694	4024.020	313	0.197	8482.838	3516.000	333	0.435	8507.891	3253.613	307	0.365
	$Control_{AL}$	11939.731	3360.265			10732.677	2879.042			12012.290	3105.344		
	IT_AGG_{Med}	15840.448	6263.054	1501	0.690	15271.367	5412.623	1456	0.564	16479.594	5883.602	1266	0.790
	$Control_{AM}$	14864.612	6110.840			14160.487	5201.279			16064.326	6336.156		
	IT_AGG_{High}	18316.195	9329.000	2327	0.860	17305.897	8867.100	2029	0.212	18807.670	8927.700	2128	0.372
	$Control_{AH}$	21089.735	9653.000			18672.746	9229.000			20720.959	9779.000		
XOPR	IT_AGG_{Low}	7398.317	2903.480	357	0.485	6922.131	2819.029	352	0.605	6498.513	1852.842	285	0.220
	$Control_{AL}$	9643.121	2981.150			8697.494	2476.655			8802.836	2702.026		
	IT_AGG_{Med}	13423.791	5494.959	1378	0.806	12901.652	4807.321	1327	0.899	13861.170	4937.495	1247	0.709
	$Control_{AM}$	12613.059	5310.098			11959.416	4497.247			13242.039	5194.550		
	IT_AGG_{High}	15229.468	7527.900	2293	0.765	14319.812	6742.800	2140	0.396	15173.578	7614.519	2214	0.560
	$Control_{AH}$	17801.197	8382.836			15642.656	6783.529			17153.341	7298.661		
XSGA	IT_AGG_{Low}	782.603	596.773	249	0.992	747.342	494.897	239	0.870	757.303	517.942	239	0.903
	$Control_{AL}$	1067.038	432.597			1048.289	410.574			1078.953	477.031		
	IT_AGG_{Med}	4109.258	1332.084	836	0.056	3991.472	1331.011	701	0.150	4190.623	1292.436	742	0.116
	$Control_{AM}$	2982.042	806.140			3148.238	827.537			3193.511	793.695		
	IT_AGG_{High}	3858.724	1220.500	1066	0.694	3845.170	1178.000	1078	0.634	4062.254	1135.000	1081	0.620
	$Control_{AH}$	3318.740	1631.836			3168.785	1274.000			3253.411	1314.000		

Elements	Groups	2011				2012				2013			
		Mean	**Median**	**Z**	**P**	**Mean**	**Median**	**Z**	**P**	**Mean**	**Median**	**Z**	**P**
NI	IT_AGG$_{Low}$	835.538	142.800	345	0.929	293.668	125.622	253	0.141	639.298	124.200	259	0.167
	Control$_{AL}$	1300.213	90.450			1070.794	184.000			1429.277	213.720		
	IT_AGG$_{Med}$	1340.039	367.661	1348	0.403	1364.655	394.688	1215	0.800	1933.569	431.554	1190	0.592
	Control$_{AM}$	1102.512	196.251			1083.116	325.114			1251.482	397.190		
	IT_AGG$_{High}$	1436.249	609.211	2683	0.195	1108.863	530.511	2633	0.266	1713.490	626.750	2426	0.358
	Control$_{AH}$	1227.278	521.650			903.776	524.501			1148.588	560.000		
SALE	IT_AGG$_{Low}$	8594.272	3454.537	294	0.394	8701.454	4072.330	284	0.316	8910.079	3373.898	274	0.249
	Control$_{AL}$	13276.709	3024.000			13845.508	3431.712			14282.736	4103.776		
	IT_AGG$_{Med}$	18122.623	7178.000	1252	0.792	18842.248	8384.806	1283	0.503	20256.243	9560.647	1238	0.399
	Control$_{AM}$	17333.551	7213.000			17436.746	6543.251			17522.496	7332.068		
	IT_AGG$_{High}$	20047.849	10198.250	2202	0.647	20920.891	10175.062	2297	0.911	20470.290	10624.450	2211	0.924
	Control$_{AH}$	23039.053	10359.005			23282.157	11165.807			22410.932	10696.210		
XOPR	IT_AGG$_{Low}$	6728.560	2225.500	261	0.177	6650.786	2601.100	248	0.121	6863.559	2193.000	243	0.104
	Control$_{AL}$	9629.138	2766.984			10451.342	3189.693			10762.467	3484.518		
	IT_AGG$_{Med}$	15289.805	5888.000	1211	0.986	15824.194	7136.632	1197	0.886	16851.686	7827.122	1223	0.455
	Control$_{AM}$	14638.726	5761.132			14764.406	5779.000			14716.593	5654.400		
	IT_AGG$_{High}$	16347.287	7946.775	2202	0.647	17365.683	8355.791	2334	0.984	16324.244	8540.243	2270	0.748
	Control$_{AH}$	19370.629	8933.300			19866.807	8840.472			18760.393	9086.000		
XSGA	IT_AGG$_{Low}$	740.006	454.874	239	0.903	728.577	423.173	200	0.717	746.456	414.300	182	0.455
	Control$_{AL}$	1216.822	486.316			1388.859	512.867			1525.034	548.038		
	IT_AGG$_{Med}$	4547.690	1449.867	637	0.099	4700.166	1604.814	625	0.132	4936.781	1594.703	597	0.137
	Control$_{AM}$	3458.550	829.842			3458.918	867.225			3476.216	944.326		
	IT_AGG$_{High}$	4289.031	1235.950	1133	0.536	4493.570	1382.500	1160	0.424	4115.500	1462.800	991	0.578
	Control$_{AH}$	3449.606	1309.000			3456.234	1426.372			3603.944	1440.720		

Elements	Groups	2005				2006				2007			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
AT	IT_CON$_{Low}$	47496.922	6662.333	811	0.446	52119.591	6522.250	803	0.412	58852.328	6682.900	770	0.387
	Control$_{CL}$	67875.951	6933.292			83701.409	7874.968			92094.386	9036.344		
	IT_CON$_{Med}$	23183.134	4850.838	1187	0.604	25890.660	5227.000	1181	0.580	27954.913	5796.179	1217	0.729
	Control$_{CM}$	26620.192	5274.000			29161.152	6968.600			30107.537	7593.779		
	IT_CON$_{High}$	30758.274	8735.000	1542	0.363	30491.539	9019.300	1350	0.075	31671.090	11296.581	1307	0.069
	Control$_{CH}$	40177.717	10529.000			44795.666	11144.390			51157.654	12281.550		
COG	IT_CON$_{Low}$	0.598	0.636	896	0.892	0.589	0.629	878	0.788	0.595	0.614	871	0.919
	Control$_{CL}$	0.606	0.654			0.607	0.659			0.610	0.649		
	IT_CON$_{Med}$	0.621	0.659	1001	0.113	0.618	0.648	1012	0.128	0.624	0.652	950	0.061
	Control$_{CM}$	0.690	0.735			0.684	0.723			0.700	0.722		
	IT_CON$_{High}$	0.686	0.724	2068	0.141	0.681	0.730	2058	0.153	0.678	0.713	1944	0.263
	Control$_{CH}$	0.646	0.695			0.640	0.701			0.647	0.702		
EBIT	IT_CON$_{Low}$	2520.287	549.337	803	0.412	3192.890	544.900	816	0.468	3170.385	609.300	800	0.524
	Control$_{CL}$	3002.580	647.337			3962.902	695.610			4249.708	797.324		
	IT_CON$_{Med}$	1284.119	408.492	1206	0.682	1498.915	497.600	1233	0.799	1617.634	535.900	1302	0.893
	Control$_{CM}$	1513.089	396.900			1709.602	417.845			1788.445	429.535		
	IT_CON$_{High}$	1615.222	745.396	1509	0.289	2003.131	956.800	1559	0.405	2140.185	1056.921	1462	0.269
	Control$_{CH}$	2202.936	949.000			2540.009	921.000			2986.140	1177.300		
EMP	IT_CON$_{Low}$	37.387	17.200	929	0.572	37.668	17.377	806	0.874	36.941	16.750	786	0.925
	Control$_{CL}$	36.551	10.400			39.479	11.132			41.253	14.313		
	IT_CON$_{Med}$	26.229	13.722	1386	0.287	27.631	14.326	1257	0.463	28.391	13.608	1310	0.404
	Control$_{CM}$	35.303	9.860			37.670	12.000			37.645	9.665		
	IT_CON$_{High}$	57.361	25.554	1727	0.609	61.075	27.050	1699	0.858	63.236	26.926	1742	0.703
	Control$_{CH}$	52.520	26.027			53.195	26.334			53.947	26.404		

Elements	Groups	2008				2009				2010			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
AT	IT_CON$_{Low}$	53039.416	7166.000	817	0.610	54188.575	7969.000	732	0.341	54407.382	6927.700	685	0.263
	Control$_{CL}$	84536.972	8361.000			75764.051	8922.300			81822.597	9415.300		
	IT_CON$_{Med}$	27572.355	5281.000	1315	0.834	28062.843	5902.087	1205	0.990	29767.647	6237.146	1050	0.454
	Control$_{CM}$	29753.930	7202.500			34984.230	7314.791			40291.077	7487.607		
	IT_CON$_{High}$	31043.936	10764.861	1381	0.139	33722.852	10077.664	1417	0.189	35788.136	10066.149	1394	0.156
	Control$_{CH}$	47009.214	11939.711			49468.967	12419.187			54361.820	12889.914		
COG	IT_CON$_{Low}$	0.761	0.626	808	0.564	0.605	0.622	794	0.637	0.569	0.603	657	0.179
	Control$_{CL}$	0.640	0.679			0.629	0.659			0.621	0.679		
	IT_CON$_{Med}$	0.639	0.652	831	0.011	0.630	0.645	888	0.056	0.614	0.656	875	0.069
	Control$_{CM}$	0.747	0.762			0.714	0.741			0.697	0.729		
	IT_CON$_{High}$	0.691	0.733	1773	0.743	0.679	0.702	1784	0.705	0.671	0.701	1798	0.657
	Control$_{CH}$	0.692	0.726			0.675	0.711			0.660	0.694		
EBIT	IT_CON$_{Low}$	469.566	487.000	829	0.675	1927.940	498.946	849	0.963	2403.772	656.000	781	0.721
	Control$_{CL}$	2218.164	632.239			1634.829	450.500			2808.041	732.450		
	IT_CON$_{Med}$	1357.950	422.100	1465	0.285	1360.911	444.500	1233	0.881	1618.501	585.296	1161	0.944
	Control$_{CM}$	1166.297	350.294			1278.298	379.000			1669.827	513.467		
	IT_CON$_{High}$	1894.321	659.500	1698	0.989	1743.131	681.148	1647	0.803	2321.937	927.260	1613	0.684
	Control$_{CH}$	1861.097	688.769			1803.205	668.339			2378.598	989.641		
EMP	IT_CON$_{Low}$	35.692	16.600	853	0.985	34.533	16.150	774	0.980	34.202	15.800	715	0.648
	Control$_{CL}$	40.679	12.900			40.264	19.341			41.249	17.500		
	IT_CON$_{Med}$	29.420	15.000	1469	0.186	28.572	15.050	1343	0.130	30.374	15.000	1382	0.078
	Control$_{CM}$	36.644	9.679			33.620	7.685			35.037	7.628		
	IT_CON$_{High}$	65.848	27.276	1613	0.876	64.124	26.112	1545	0.986	64.017	25.269	1525	0.650
	Control$_{CH}$	56.286	29.899			54.787	29.600			57.610	31.178		

Elements	Groups	2011				2012				2013			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
AT	IT_CON_{Low}	54081.340	7353.300	671	0.302	52388.047	7488.550	662	0.269	52626.097	7834.400	638	0.193
	$Control_{CL}$	86368.197	9243.000			85805.943	8752.871			83716.974	9431.473		
	IT_CON_{Med}	32814.865	7071.000	1049	0.881	35135.510	7439.771	1030	0.949	37397.134	8208.914	944	0.664
	$Control_{CM}$	43819.644	7491.800			44794.917	7862.750			47567.438	8876.800		
	IT_CON_{High}	38871.502	10886.805	1454	0.332	42503.083	11170.282	1494	0.434	44621.063	12043.000	1361	0.286
	$Control_{CH}$	56403.487	12876.600			57727.546	15218.000			59424.468	16284.000		
COG	IT_CON_{Low}	0.581	0.597	665	0.280	0.578	0.594	653	0.239	0.578	0.587	663	0.273
	$Control_{CL}$	0.623	0.662			0.626	0.679			0.619	0.648		
	IT_CON_{Med}	0.628	0.656	793	0.068	0.625	0.659	815	0.133	0.619	0.644	801	0.220
	$Control_{CM}$	0.719	0.747			0.703	0.731			0.697	0.734		
	IT_CON_{High}	0.676	0.707	1638	0.933	0.673	0.714	1616	0.987	0.665	0.723	1542	0.839
	$Control_{CH}$	0.670	0.711			0.674	0.708			0.660	0.689		
EBIT	IT_CON_{Low}	2429.251	738.550	790	0.951	2588.206	735.150	839	0.741	2763.496	788.267	804	0.964
	$Control_{CL}$	2999.622	746.457			2788.820	760.200			2863.771	910.298		
	IT_CON_{Med}	1708.957	674.400	1115	0.784	1810.470	658.599	1076	0.812	2033.214	793.919	1048	0.619
	$Control_{CM}$	1743.201	600.900			1745.049	495.216			1852.400	651.293		
	IT_CON_{High}	2384.471	1013.000	1692	0.884	2134.163	935.000	1685	0.910	2779.187	982.700	1571	0.881
	$Control_{CH}$	2325.601	892.528			2000.627	1089.700			2235.912	1167.044		
EMP	IT_CON_{Low}	35.596	16.300	728	0.728	35.106	15.350	731	0.747	35.890	14.550	743	0.824
	$Control_{CL}$	43.576	18.721			43.923	19.100			43.205	10.702		
	IT_CON_{Med}	32.953	16.900	1300	0.046	34.057	17.000	1247	0.031	36.011	18.000	1294	0.012
	$Control_{CM}$	32.565	7.927			33.793	9.670			34.127	9.936		
	IT_CON_{High}	66.152	26.200	1636	0.941	67.603	26.057	1661	0.846	66.267	27.950	1501	0.690
	$Control_{CH}$	58.607	32.250			59.132	31.950			53.232	31.500		

Elements	Groups	2005				2006				2007			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
NI	IT_CON_{Low}	1079.801	253.550	821	0.491	1741.283	269.933	753	0.234	1561.086	307.143	812	0.584
	$Control_{CL}$	1450.262	316.450			1678.328	412.262			1384.249	421.000		
	IT_CON_{Med}	748.449	253.259	1188	0.608	925.047	318.571	1274	0.984	1076.197	303.772	1423	0.408
	$Control_{CM}$	870.789	226.491			899.063	266.566			919.348	257.483		
	IT_CON_{High}	823.131	512.972	1715	0.901	1156.517	515.447	1731	0.958	337.034	576.747	1411	0.180
	$Control_{CH}$	1038.051	494.467			1075.587	564.259			1414.398	543.300		
SALE	IT_CON_{Low}	14356.541	5409.859	562	0.009	15537.669	6174.618	527	0.004	17307.908	6407.300	601	0.032
	$Control_{CL}$	16053.469	5570.007			18654.134	5607.283			19743.521	5328.600		
	IT_CON_{Med}	10301.610	4579.000	1126	0.385	11104.648	5174.000	1115	0.352	11996.501	5860.000	1214	0.716
	$Control_{CM}$	10241.883	4887.193			11795.114	5605.752			12935.102	6013.000		
	IT_CON_{High}	15445.746	6991.823	1926	0.407	16859.546	8881.500	1616	0.566	18407.146	9120.428	1383	0.142
	$Control_{CH}$	15754.049	7553.000			17646.180	7786.942			20232.563	9242.949		
XOPR	IT_CON_{Low}	11170.825	3934.596	703	0.119	11634.239	4483.439	635	0.040	13341.915	5095.503	703	0.171
	$Control_{CL}$	12304.738	3734.326			13815.776	4137.650			14638.360	4431.836		
	IT_CON_{Med}	8656.225	3681.650	1215	0.720	9223.104	4073.730	1119	0.364	9948.737	4764.738	1169	0.534
	$Control_{CM}$	8236.230	4183.078			9536.337	4868.571			10507.370	5565.769		
	IT_CON_{High}	12902.638	5850.718	2075	0.132	13888.098	6796.265	1880	0.535	15130.768	6918.316	1502	0.358
	$Control_{CH}$	12488.815	5423.900			13913.412	5888.730			15954.986	6950.006		
XSGA	IT_CON_{Low}	2514.459	655.913	618	0.764	2768.998	681.033	584	0.972	2990.565	743.700	578	0.887
	$Control_{CL}$	1984.135	540.868			2250.981	592.251			2395.900	594.642		
	IT_CON_{Med}	2489.000	955.319	628	0.027	2723.092	1135.328	576	0.060	2998.827	1060.818	568	0.076
	$Control_{CM}$	1700.214	675.200			1926.655	791.713			2129.128	867.060		
	IT_CON_{High}	2926.360	879.002	763	0.778	3259.421	1011.054	787	0.932	3693.521	1089.200	761	0.877
	$Control_{CH}$	2858.828	1122.432			3014.981	1401.000			3463.154	1420.500		

Elements	Groups	2008				2009				2010			
		Mean	**Median**	**Z**	**P**	**Mean**	**Median**	**Z**	**P**	**Mean**	**Median**	**Z**	**P**
NI	IT_CON$_{Low}$	−1421.779	119.774	769	0.383	988.725	202.742	886	0.816	1284.409	350.053	701	0.321
	Control$_{CL}$	3.952	141.472			485.718	92.500			1672.978	382.147		
	IT_CON$_{Med}$	354.819	189.978	1513	0.179	829.745	209.200	1291	0.620	914.219	312.295	1251	0.636
	Control$_{CM}$	365.091	144.100			715.376	211.923			967.570	221.599		
	IT_CON$_{High}$	366.020	191.043	1761	0.785	2337.640	446.636	1944	0.263	1309.523	583.791	1671	0.890
	Control$_{CH}$	142.785	282.492			738.070	330.918			1331.409	507.800		
SALE	IT_CON$_{Low}$	14191.517	6336.200	679	0.121	15033.836	5155.000	659	0.129	16212.008	5759.200	607	0.082
	Control$_{CL}$	18601.325	5263.900			16218.483	4845.310			18264.789	5438.582		
	IT_CON$_{Med}$	12148.854	5948.000	1298	0.911	11933.285	5047.000	1309	0.546	12624.938	5883.602	1165	0.963
	Control$_{CM}$	13170.940	5808.000			12635.202	4834.268			14398.586	5837.292		
	IT_CON$_{High}$	18742.733	9052.750	1822	0.579	17426.261	8440.550	1565	0.530	18921.883	8864.450	1636	0.764
	Control$_{CH}$	19579.568	9296.701			17695.676	8978.181			19546.765	9697.500		
XOPR	IT_CON$_{Low}$	12891.521	4910.429	726	0.232	12261.613	4333.500	644	0.102	12904.210	4104.200	577	0.048
	Control$_{CL}$	15571.806	4530.709			13754.901	4060.000			14600.732	4300.088		
	IT_CON$_{Med}$	10332.262	4880.000	1119	0.364	10149.676	4432.000	1181	0.876	10573.261	4659.500	1085	0.593
	Control$_{CM}$	11314.441	5437.070			10639.360	4497.247			11991.381	4846.658		
	IT_CON$_{High}$	15680.305	7410.450	1865	0.451	14503.711	6735.900	1705	0.989	15393.452	7232.410	1781	0.715
	Control$_{CH}$	16297.056	7878.818			14605.819	6645.265			15904.305	7128.336		
XSGA	IT_CON$_{Low}$	3047.826	889.250	612	0.618	3053.354	868.934	597	0.733	3362.792	938.500	605	0.488
	Control$_{CL}$	2404.059	590.737			2395.879	565.200			2510.085	579.500		
	IT_CON$_{Med}$	3018.006	965.419	617	0.083	2854.627	892.878	514	0.166	2993.159	992.464	538	0.167
	Control$_{CM}$	2239.129	798.689			2344.902	759.500			2386.813	729.100		
	IT_CON$_{High}$	3806.847	1143.100	764	0.857	3795.643	1086.900	771	0.809	3931.801	1098.900	764	0.857
	Control$_{CH}$	3400.719	1570.376			3242.729	1266.090			3337.081	1190.840		

Elements	Groups	2011				2012				2013			
		Mean	Median	Z	P	Mean	Median	Z	P	Mean	Median	Z	P
NI	IT_CON$_{Low}$	1481.363	275.996	789	0.945	1338.885	303.955	727	0.565	1914.584	293.949	773	0.842
	Control$_{CL}$	1532.840	338.250			1365.193	273.491			1674.960	439.592		
	IT_CON$_{Med}$	1078.477	394.682	1231	0.302	973.188	351.613	1025	0.923	1386.568	431.554	955	0.883
	Control$_{CM}$	1032.680	225.266			1009.364	277.450			1107.712	358.350		
	IT_CON$_{High}$	1335.805	548.000	1944	0.183	899.402	469.000	1895	0.271	1515.199	517.000	1748	0.303
	Control$_{CH}$	1099.218	511.000			728.194	446.700			1023.382	518.472		
SALE	IT_CON$_{Low}$	16725.234	5894.600	587	0.086	16890.290	5677.000	609	0.124	17349.686	5613.750	624	0.157
	Control$_{CL}$	20470.896	6539.837			21347.744	6660.500			21423.879	6541.000		
	IT_CON$_{Med}$	14113.989	7178.000	1143	0.647	14776.530	7535.293	1145	0.485	15857.273	7959.894	1098	0.396
	Control$_{CM}$	16024.382	6125.718			16117.995	5454.750			16547.809	5865.598		
	IT_CON$_{High}$	20234.817	9879.500	1712	0.810	21235.532	10128.223	1762	0.634	20765.290	10480.300	1661	0.550
	Control$_{CH}$	21124.042	10325.000			21062.275	10893.778			19787.965	10391.457		
XOPR	IT_CON$_{Low}$	13389.837	4792.600	523	0.025	13352.239	4592.500	490	0.012	13637.024	4369.968	550	0.043
	Control$_{CL}$	16539.430	4910.418			17562.194	5242.018			17525.971	5337.571		
	IT_CON$_{Med}$	11918.825	5329.871	1084	0.943	12447.740	5818.122	1122	0.586	13272.394	6350.089	1102	0.381
	Control$_{CM}$	13603.025	5459.100			13726.494	4927.500			14031.674	5259.226		
	IT_CON$_{High}$	16651.089	7911.000	1754	0.661	17837.643	7495.400	1821	0.451	16679.233	8089.504	1743	0.314
	Control$_{CH}$	17475.628	8280.631			17727.336	8637.000			16189.806	8478.050		
XSGA	IT_CON$_{Low}$	3397.220	1019.611	540	0.806	3361.594	913.185	465	0.733	3393.963	794.056	464	0.724
	Control$_{CL}$	2826.715	621.900			3015.339	744.290			3020.740	809.800		
	IT_CON$_{Med}$	3331.513	1195.000	498	0.065	3505.172	1138.000	508	0.046	3724.067	1233.694	480	0.053
	Control$_{CM}$	2447.841	730.000			2394.573	790.100			2473.369	796.300		
	IT_CON$_{High}$	4183.357	1190.200	814	0.716	4444.614	1253.550	830	0.618	4007.179	1384.345	681	0.870
	Control$_{CH}$	3511.068	1251.636			3497.849	1339.305			3667.693	1413.567		

Jin Ho Kim
Strome College of Business
Old Dominion University
Norfolk, VA 23529
jkim013@odu.edu

EDUCATION

Ph.D. in Information Technology, ABD (Expect) May 2020
Old Dominion University, Strome College of Business, Norfolk, VA
M.B.A. May 2011
University of Minnesota, Carlson School of Management, Minneapolis, MN
B.S. in Computer Science and Engineering February 1999
Hanyang University, Ansan, Republic of Korea

REFEREED JOURNAL PUBLICATIONS

1. **Kim, J. H.**, & Chen, W. (2018). Research Topic Analysis in Engineering Management Using a Latent Dirichlet Allocation Model. *Journal of Industrial Integration and Management*, 3(4), 1850016.
2. **Kim, J. H.** (2017). A Survey of IoT Security: Risks, Requirements, Trends, and Key Technologies. *Journal of Industrial Integration and Management*, 2(2), 1750008.
3. **Kim, J. H.** (2017). A Review of Cyber-Physical System Research Relevant to the Emerging IT Trends: Industry 4.0, IoT, Big Data, and Cloud Computing. *Journal of Industrial Integration and Management*, 2(3), 1750011.

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1. **Kim, J. H.**, Lu, Y. (2019). Information Communication Technology and Global Logistics Performance. *Americas Conference on Information Systems (AMCIS)* Cancun, Mexico, August 2019.