IT Infrastructure Governance and IT Investment Performance: An Empirical Analysis

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The value of information technology (IT) investment comes increasingly from its ability to complement and enable business strategies and organizational capabilities. As a general purpose technology, however, IT could either a complement or a constraint. Making the right IT investment, particularly the right IT infrastructure investment could thus have far-reaching impact on a firm's IT investment performance. A necessary condition to make the right IT infrastructure investment is to ensure that a firm's IT infrastructure governance (ITIG) configuration is aligned with the firm's organizational structure and business strategies. In this study, we use a two-step approach to provide an empirical assessment of the impact of the ITIG alignment on IT investment performance. We first recognize that a key challenge is that the appropriate IT governance mode varies across both firms and business units within. We address the challenge by extending the multiple contingency theory for IT governance from the firm level to the business unit level. We use the business unit level multiple contingency theory to develop an empirical model to predict the appropriate ITIG configuration for each business unit and use the difference between the predicted and observed ITIG configurations to derive a multiple contingency theory based measure of *ITIG misalignment*. We then assess the relationship between ITIG misalignment and IT investment performance across a Fortune 1000 firm samples. We find that firms with high ITIG misalignment receive limited benefits from IT investments; whereas firms with low ITIG misalignment obtain about twice the value from their IT investments compared to firms with average ITIG misalignment.

Keyword: IT Infrastructure Governance, Business Value of IT, IT Investment, ROA Analysis, Tobin's q, Corporate Diversification

1. Introduction

Over the last three decades, IT investment has accounted for an increasing share of capital investments in businesses. Real investment in information technology increased from 30 percent of private nonresidential equipment and software investment in 1980 to 53 percent in 2008 (BEA 2009). Annual investment in information technology quadrupled during the same period from $130 billion to $560 billion (BEA 2009). IT investment not only accounts for a substantial portion of a firm's capital investment but also contributes significantly to the firm's overall risk (Dewan et al. 2007). Given the size and risk, how to make effective IT investment decisions has become one of the key challenges for business executives (Weill and Ross 2004).

A unique aspect of information technology that sets it apart from many other types of capital investment is that IT is a "general purpose technology" (Bresnahan and Trajtenberg 1995; Brynjolfsson and Hitt 2000). The value of such technology lies in its ability to enable new business strategies by transforming business processes and organizations. Extant information systems studies have identified a number of such corporate strategies and organizational capabilities, including corporate diversification (Dewan et al. 1998; Chari et al. 2007; Chari et al. 2008), decentralized organizational structure (Hitt and Brynjolfsson 1997; Hitt 1999; Brynjolfsson et al. 2002; Cron and Sobol 1983), workplace reorganization with skilled workers (Francalanci and Galal 1998; Bresnahan et al. 2000), flexible organizational capabilities (Banker, et. al. 2006; Kearns and Sabherwal 2006; Tanriverdi 2005; Bardhan et. al. 2007), and outsourcing and inter-firm integration capabilities (Rai et. al. 2006; Zhu and Kraemer. 2002; Aral and Weill 2007).

A less appreciated aspect of IT as a general purpose technology is that IT can also be "a constraint or inhibitor especially when the firm's IT infrastructure is inappropriate or inflexible" (Broadbent et al. 1999). This insight suggests that not all IT investments complement the business strategies and organizational capabilities identified in prior literature. Rather, generating business value from IT investments requires the *alignment* of two components: the development of appropriate business strategies and organizational capabilities, and "the deployment of an IT infrastructure that responds to and supports the chosen business strategy" (Henderson and Venkatraman 1992). This later element, however, has not received much attention in the literature on IT investment performance.[1]

IT infrastructure refers to IT assets such as computer networks, data architectures, and hardware and software platforms (Sambamurthy and Zmud 1999). IT infrastructure investment accounts for over 50 percent of all IT capital expenditure (Weill and Broadbent 1998) and provides the foundation for shared IT service, both across and within organizations (Aral and Weill 2007). Making the right IT infrastructure investment is especially important because the value of IT resides mainly in its ability to "generate returns from sharing and transferring IT assets across businesses; and facilitating coordination and control required to realize potential economies of scope in various assets and capabilities" (Chari et al. 2008). Empirical studies in the last decade consistently show that firms with capabilities to facilitate sharing and coordination obtain significantly more value from their IT investments (Bresnahan et al. 2000; Chari et al. 2007; Chari et al. 2008). Consequently, these firms invest more in information technology (Dewan et al. 1999).

For a firm to make the right IT infrastructure decision, it must adopt the appropriate IT infrastructure governance configuration (Sambamurthy and Zmud 1999). IT infrastructure governance is a key element of IT governance, which refers to "the decision rights and accountability framework to encourage desirable behavior in the use of IT" (Weill and Ross 2004). Different from corporate governance that focuses on the agency problem and emphasizes monitoring and incentive mechanisms (Jensen and Meckling 1976; Jensen and Meckling 1995), research on IT governance suggests that the allocation of decision rights is the primary mechanism for IT governance (Sambamurthy and Zmud 1999; Brown and Magill 1997). The difference is due to the unique nature of IT as a complement to business strategies and organizational capabilities (Hitt 1999), which often require coordination across multiple business units or divisions. In such cases, incentive and monitoring mechanisms are less effective, and allocation of decision rights becomes the primary tool of choice.

[1] One exception is Bardhan et al. (2007) that considers the alignment between information technology types and project environment and shows that the alignment has a significant impact on project performance.

Using sample data from Fortune 1000 companies, we analyze how the alignment between a firm's IT infrastructure governance (ITIG) and its organizational structure and business strategies influences the firm's IT investment performance. A key challenge in the analysis is that the appropriate ITIG configuration is determined by multiple contingency factors (Sambamurthy and Zmud 1999). Moreover, the appropriate ITIG configuration varies across not only firms but also business units within a firm. We develop a two-stage process for this analysis. In the first stage, we extend the multiple contingency theory of IT governance from the firm level to the business unit level and suggest that appropriate IT governance configuration choice for each business unit is determined by both firm level and business level contingency factors. We identify a comprehensive list of explanatory variables for the three sets of contingency factors proposed in the literature and use them to develop an empirical model for ITIG at the business unit level. We then use the regression model to identify the predicted ITIG configuration for each business unit and use the difference between the observed ITIG configuration and the predicted appropriate ITIG configuration as a proxy for the multiple-contingency theory based ITIG misalignment. In the second stage, we assess the effects of the ITIG misalignment measure on IT investment performance. Our analysis reveals that firms with high ITIG misalignment obtain limited benefits from their IT investment. On the other hand, firms with low or average ITIG misalignment obtain significant value from their IT investments – with the ones of low ITIG misalignment receiving about twice the value of those with average ITIG misalignment. Our results highlight the importance of aligning ITIG configuration with business strategies and environment and its influence on IT investment performance.

The remainder of the paper is organized as follows. The next section discusses the theoretical foundation of the study. After that, we extend the multiple contingency factor model of IT infrastructure governance from the firm level to the business unit level and develop a multiple contingency theory based measure of ITIG misalignment. We then assess the influence of ITIG misalignment on firms' IT investment performance. Finally, we conclude with implications and limitations.

2. Theoretical Foundation and Hypotheses Development

2.1. IT Infrastructure Governance

IT governance concerns both the vertical allocation of decision rights between corporate headquarters and business units, and the horizontal allocation of decision rights between IT and other functional departments (Weill and Ross 2004; Sambamurthy and Zmud 1999; Tiwana 2009). The direction of allocation varies for different aspects of IT governance. Tiwana (2009) shows that the allocation of decision rights for project management governance is mainly horizontal between IT and functional departments. On the other hand, the allocation of decision rights for ITIG is mainly vertical between corporate headquarter IS and business unit IS (Sambamurthy and Zmud 1999). As we focus on ITIG in this study, our analysis concerns the vertical allocation of decision rights.

Prior IT governance studies propose a multiple contingency theory for IT governance and identify a comprehensive list of contingency factors that influence IT governance configuration (Weill and Ross 2004; Sambamurthy and Zmud 1999). We recognize that the multiple contingency theory is, at its essence, a theory about the alignment between IT governance configuration and organizational capabilities and business strategies. The degree to which a firm's IT governance configuration meets the prediction from the multiple contingency theory, provides a natural measure of the alignment between the firm's IT governance configuration and its business strategies and organizational capabilities. One challenge in leveraging the multiple contingency theory to identify ITIG alignment is that, while the theory is developed at the firm level, the underlying theoretical arguments suggest that some of the contingency factors may vary significantly across business units within a firm. Such variations indicate that there may not be a single governance configuration that is applicable across all business units of a firm. Instead, a firm needs to consider the strategies and organizational capabilities of each business unit and determine the appropriate ITIG configuration for the business unit.

Sambamurthy and Zmud (1999) identify three categories of contingency factors for IT governance: corporate governance, economies of scope and absorptive capacity. Below we discuss the contingency factors within each category and extend each to the business unit level when applicable.

Corporate Governance

IT governance is influenced by corporate governance mode because of the complementarity between IT assets and organizational assets (Hitt 1999). As IT investments routinely require corresponding investments in organizational assets, alignment of the decision rights for both types of investments could significantly reduce coordination costs (Applegate et al. 1996; Brown and Magill 1994). As such, a firm with centralized corporate governance tends to have centralized IT governance while a firm with decentralized corporate governance tends to have decentralized IT governance. The alignment is especially important for IT infrastructure governance, whose main function is to provide a foundation for serving the business needs of the organization (Aral and Weill 2007). While a firm's corporate governance mode is often not observable to outside researchers, studies suggest that two factors influence a firm's choice of corporate governance mode. First, the choice of corporate governance mode is influenced by number of subsidiaries in a firm. In conglomerates with a large number of subsidiaries, the information processing capability of the headquarters is often insufficient for centralizing decisions from all the subsidiaries (Egelhoff 1982). Consequently, these firms are more likely to adopt decentralized corporate governance. Second, the choice of corporate governance mode is also influenced by the flatness of the organizational structure (Townsend et al. 1998). In flat organizations, decisions are delegated to business units that report directly to the headquarters (Townsend et al. 1998; Foss 2003; Rajan and Wulf 2006). As a result, business units get more decision-making authority. We, therefore, propose:

H1a: Firms with more subsidiaries are more likely to decentralize IT infrastructure governance to their business units.

H1b: Firms with a more flat organizational structure are more likely to decentralize IT infrastructure governance to their business units.

Prior studies on IT governance also suggest that firm size could influence a firm's IT governance. Firm size influences IT governance in two ways. On the one hand, large firms are more likely to have a large number of subsidiaries and diversified operations. As such, they may decentralize IT governance to business units to provide flexibility and responsiveness needed at the local level (Ein-Dor and Segev

1982; Sambamurthy and Zmud 1999; Xue et al. 2010). On the other hand, large firms are more likely to have the resources and the processes to obtain information from business units and centralize decision making. As such, they are more capable of centralizing IT governance to the headquarters (McElheran 2010). For example, a firm-level procurement of IT infrastructure can provide more bargaining power (over the IT vendors) than separate business unit level procurements (Turban, et al. 2006; Xue et al. 2010). A centrally provided IT infrastructure provides the common services to support business applications across different business units. Thus, centralization of IT infrastructure allows a firm the benefit of economy of scale and scope as the same IT infrastructure can be shared across different business units to reduce the unit cost of IT infrastructure for each business unit. The above argument suggests that, controlling for a firm's number of subsidiaries and diversification level, a large-sized firm is more likely to centralize IT infrastructure governance. We therefore propose

H2a: Larger firms are more likely to centralize IT infrastructure governance to the headquarters.

While prior studies on IT governance have considered size at the firm level, business unit size is known to have a more significant impact on the interactions between corporate headquarters and business units (Baiman et al. 1995; Cohen et al. 1987). In the case of IT infrastructure governance, corporate headquarters need to consider the trade-off between the additional infrastructure costs of allowing a business unit to make its own IT infrastructure decisions and the potential benefits of additional flexibility afforded to the business unit. The trade-off favors a more centralized IT infrastructure governance for a small business unit and a more decentralized one for a large business unit that can achieve scale economies on its own. We therefore propose

H2b: Firms are more likely to decentralize IT infrastructure governance to larger business units.

Economies of Scope

Economies of scope refer to the cost or revenue synergies within a multiunit firm that operates across related industries (Gurbaxani and Whang 1991; Dewan 1997; Hitt 1999; Chari et al. 2008). Knowledge and investments in one industry may benefit business operations in other related industries, thus reducing costs and increasing revenues. A firm's ability to leverage such knowledge across industries and business units could have a significant impact on IT governance configurations (Sambamurthy and Zmud 1999) and firm performance (Hitt 1999; Chari et al. 2008).

Sambamurthy and Zmud (1999) identify two forces of economies of scope that influence IT governance: diversification breadth and diversification mode. Diversification breadth refers to the market relatedness of business units within a firm. In related diversifications, firms diversify into related industries. Business units of these firms often share common bases of customers, production, or knowledge (Brown and Magill 1994). Synergies are thus stronger among these business units. As a result, firms are more likely to adopt centralized IT infrastructure governance to leverage the synergies across business units. On the other hand, firms engaging in unrelated diversification have fewer synergies across their business units and are thus more likely to decentralize IT infrastructure governance. We therefore propose:

H3a: Firms with more unrelated diversification (related diversification) are more (less) likely to decentralize IT infrastructure governance to their business units.

Another force of economies of scope identified by Sambamurthy and Zmud (1999) is diversification mode. Diversification mode refers to a firm's growth strategy (Amit et al. 1989; Simmonds 1990). Firms that grow through internal expansion are more knowledgeable about newly entered industries and, therefore, more likely to use centralized IT infrastructure governance to facilitate knowledge sharing across the firm. On the other hand, firms that grow through mergers and acquisitions are less knowledgeable about newly entered industries and are thus more likely to use decentralized IT infrastructure governance. This effect is stronger when firms grow into unrelated industries for which they have little prior knowledge. We therefore propose:

H3b: Firms that grow through acquisition into unrelated industries (related industries) are more (less) likely to decentralize IT infrastructure governance to their business units.

Finally, a firm's IT infrastructure governance decisions for a business unit also depend on the relationship between the business unit and the headquarters. A business unit that is closely related to a firm's main industry can benefit more from synergies with other related business units (Palich et al.

2000). Therefore, the headquarters is more likely to centralize IT infrastructure governance to facilitate the integration of the business unit with other related business units. On the other hand, a business unit unrelated to the firm's main industry has few synergies with other business units and little need to have compatible IT infrastructure. Hence, firms are more likely to decentralize IT infrastructure decisions to unrelated business units. We therefore propose:

H3c: Firms are more likely to decentralize IT infrastructure governance to business units in unrelated industries.

Absorptive Capacity

The third set of multiple contingency factors identified by Sambamurthy and Zmud (1999) is absorptive capacity, which refers to "the ability of firm's employees to develop relevant knowledge bases, recognize valuable external information, make appropriate decisions, and implement effective work processes and structures" (Sambamurthy and Zmud 1999, pp. 267).

Absorptive capacity often varies across business units within a firm. Sambamurthy and Zmud's definition indicates three factors that influence a business unit's absorptive capacity. First, a business unit requires technical knowledge to make IT infrastructure decisions. A business unit with more IT knowledge is thus more capable of making the right IT infrastructure decisions. In a study of project management governance, Tiwanan (2009) notes that technical expertise at a business function significantly influences the choice of governance mode. The same logic applies to IT infrastructure governance. A business unit's IT related knowledge plays a key role in its absorptive capacity, which in turn influences the IT infrastructure governance decision. We therefore propose:

H4a: Firms are more likely to decentralize IT infrastructure governance to business units with higher IT-related knowledge.

Second, a business unit's IT absorptive capacity depends not only on its IT-related knowledge but also on its ability to obtain valuable external information and understand the information flows in its business processes that coordinate activities within and across organizational boundaries (Sambamurthy and Zmud 1999; McElheran 2010). This is because IT is mainly used to support and facilitate intra-organizational and inter-organizational coordination of business operations. Making IT decisions thus requires broad engagement and understanding of information flow in the organization. We, therefore, propose:

H4b: Firms are more likely to decentralize IT infrastructure governance to business units with more information access.

Finally, a business unit's absorptive capacity is related to its IT infrastructure needs. Given a business unit's size, IT knowledge and information access, its capacity to make IT infrastructure decisions and implement effective work processes depends on the scale of its IT infrastructure needs. Everything else (e.g., business unit size, business unit relatedness, IT knowledge, and information access) being equal, a business unit faces more challenges in making decisions about and implementing large-scale IT infrastructure investments than in making decisions about and implementing small-scale IT infrastructure investments. For that reason, everything else being equal, a firm is less likely to decentralize IT infrastructure decisions to the business unit with more substantial IT infrastructure needs. We therefore propose:

H4c: Firms are less likely to decentralize IT infrastructure governance to business units with higher IT infrastructure needs.

2.2. IT Infrastructure Governance Misalignment and IT Investment Performance

While prior research on IT investment performance has emphasized the complementary relationship between information technology and business strategies and organizational changes, it has overlooked the subtlety that, as a general purpose technology, IT could either complement or constrain a firm's business operations and strategies. The impact of IT depends on its ability to facilitate information transmission and processes to support business operations and strategies (Basu and Jarnagin 2008; Chari et al. 2008; Henderson and Venkatraman 1992). We therefore propose that the alignment between ITIG configuration and a firm's business strategies and organizational capabilities affects a firm's IT investment performance. When a firm's ITIG is aligned with its business strategies and organizational capabilities, IT investments improve firm performance. On the other hand, a poor ITIG alignment reduces the effectiveness of a firm's IT investment. Following Bresnahan et al. (2000), we model this enabling relationship as a complementary relationship between ITIG alignment and IT investment and propose the following hypothesis:

H5: IT investment has a stronger positive impact on firm performance in firms with lower levels of IT infrastructure governance misalignment.

3. Data

We combine data from five main sources. First, we obtain data on IT resources and IT infrastructure governance from the *CI Technology Database*. This database contains detailed information about IT infrastructure in over 500,000 business establishments in the United States and Canada. Harte-Hanks maintains this database through over 7,000 phone-based interviews every month. The information in the database covers ten key IT areas, including personal computing, systems and servers, networking, software, storage, and managed services. Various versions of this database have been used in prior research in the IS literature (e.g., Zhu and Kraemer 2002; Forman 2005; Chen and Forman 2006; Xue et al. 2008).

The CI Technology Database identifies three levels of business establishments: branches, divisional headquarters, and corporate headquarters. Divisional headquarters represent business units, while corporate headquarters identify firms. Because ITIG concerns mainly the vertical allocation of decision rights between corporate headquarters and business units, we acquired data related to these two levels. The analysis of IT investment performance also requires financial data at the firm level, which restricts the scope of the research to public companies. Given the data needs, we acquire from Harte-Hanks data on all available Fortune 1000 companies and their business units between 2001 and 2005. The data contains information on IT assets at both the business unit and the firm levels. A unique aspect of the *CI* database is that it records three types of IT infrastructure purchasing decisions for each business unit: PC purchasing decisions, server purchasing decisions, and network purchasing decisions. For each decision, the database indicates whether the decision is made by the headquarters (represented as “Parent”) or by the business unit (represented as “Local”). The collection of the three infrastructure purchasing decision variables captures the degree of centralization/decentralization in the IT infrastructure governance configuration.

Second, to identity the diversification mode of a multiunit firm, we use the SDC Platinum Mergers and Acquisitions (M&A) database, which records all publicly announced M&A transactions. Each record contains detailed information about both sides of the transaction, their primary SIC codes, balance sheet information, and details on the M&A deal including the value and effective date.

Third, to identify the level of diversification breadth, we obtain segment data from Compustat Segments database, which identifies revenue, profit, and industry classification for each business segment of a firm.

Fourth, to identify corporate governance and organizational structure adopted by a multiunit firm, we use the Corporate Affiliations database from Lexis-Nexis, which documents detailed subsidiary relationships within a firm. In particular, the database records whether a subsidiary reports directly to the headquarters or to any other subsidiary. We use the subsidiary relationships to identify the number of subsidiaries and the flatness of organizational structure in a firm.

Finally, to analyze the impact of ITIG misalignment on IT investment performance, we obtain financial and performance data from the Compustat Fundamental Annual database. We use these financial data to identify and calculate Return on Assets (ROA), Tobin's *q*, Sales, Employees, Advertising Expenses, R&D Expenses, Market Share, Capital Investments and Debt-to-Equity Ratio.

4. Operationalization and Empirical Approach

4.1 Variables for the IT Infrastructure Governance Model

Dependent Variable

We use *IT Infrastructure Purchasing Decision* to measure the ITIG configuration at each business unit. As mentioned earlier, the *CI* database records three types of IT infrastructure purchasing decisions: PC purchasing decisions, server purchasing decisions, and network purchasing decisions. For each decision, the CI database indicates whether it is made by the headquarters or by the business unit. We use the fraction of the three IT purchase decisions made by the business unit to capture a business unit's ITIG configuration. If all three IT purchase decisions are made by the business unit, this measure takes the value of 1. If two of the three decisions are made by the business unit, the measure takes the value of 0.67. Other values are calculated accordingly. For cases in which we do not observe all three IT purchase decisions, the measure is calculated as the number of IT purchase decisions made by the business unit divided by the total number of IT purchase decisions observed[2].

Independent Variables

Corporate Subsidiaries. We measure the number of subsidiaries in a firm (denoted as *CorpSubs*) using data from the Corporate Affiliations database from Lexis-Nexis. We first construct the organizational structure of each firm using subsidiary relationships reported in the database. We then count the total number of subsidies that are either directly or indirectly controlled by a firm. We normalize the measure using its log value.

Organizational Structure. To assess the flatness of the organizational structure of a multiunit firm (denoted as *OrgStr*), we employ a measure similar to the *span of control* measure used by Collis et al. (2007) and Rajan and Wulf (2006). The measure again leverages the subsidiary relationships reported in the Corporate Affiliations database. For each firm, we measure the total number of subsidiaries that report directly to the headquarters. We then divide this number by the total number of subsidiaries of a firm reported in the database and take the consequent ratio as the measure of the firm's degree of flatness. A higher ratio indicates a more flat organization in which the span of the firm's headquarters is broader with more business units reporting directly to the headquarters. In these organizations, decision making authorities are more likely to be delegated to business units and divisional managers.

[2] We note that the decision process for purchase of different types of IT equipment could be different. In particular, PC purchases are relatively simple and can be more easily decentralized, while server and network purchases are often more complex. As such, mistakes in the allocation of PC purchase decision rights may not have as severe an impact as mistakes in the allocation of server and network purchase decision rights. To address the difference, we develop an alternative measure of *IT Infrastructure Purchasing Decision* using only server and network purchasing decisions. We find that the analytical results for both the IT governance model and IT performance model are qualitatively the same. For parsimony, the results are not reported in this manuscript but available from the authors upon request. We thank an anonymous reviewer for suggesting this alternative measure.

Corporate Size. The size of a firm (denoted as *CorpSize*) is measured by its total sales as reported in Compustat database. Given that firm sales are highly skewed, we use the log value of firm sales for normalization.

Business Unit Size. The size of a business unit (denoted as *BUSize*) is measured using the sales of the business unit as reported in the Harte-Hanks database. We use the log value of business unit size for normalization.

Diversification Breadth. We use entropy measures for diversification breadth. Hoskisson et al. (1993) shows that entropy measures capture corporate diversification better than a simple count of unique SIC codes. Entropy measures have also been widely used in prior IS studies on corporate diversification (Dewan et al. 1998; Chari et al. 2008). Following Dewan et al. (1998), we calculate unrelated diversification (denoted as *UnrelatedDiv*) by considering a firm's diversification at the two-digit NAICS[3] level. Specifically, the unrelated diversification of a firm is calculated as $\sum_{i=1}^{n} s_i ln\frac{1}{s_i}$, where s_i refers to the ratio of a firm's sales in two-digit NAICS industry group *i* to the firm's total sales. We definite related diversification (denoted as *RelatedDiv*) as the sum of diversification at the four-digit NAICS level within each two-digit NAICS group. Specifically, related diversification is calculated as $\sum_{j=1}^{m}\sum_{i=1}^{n_j} s_i^j ln\frac{s^j}{s_i^j}$, where s_i^j refers to the ratio of a firm's sales in four-digit NAICS industry *j* to the firm's sales in the two-digit NAICS industry group *i*.

Diversification Mode. The measure of diversification mode is derived using data from the SDC Platinum and Compustat databases based on an approach similar to Busija et al. (1997). We use the SDC Platinum Mergers and Acquisitions database to calculate the average annual value of mergers and acquisitions for each firm over the past five years. The ratio of average annual M&A value to the firm's annual operating income (obtained from Compustat) is taken as a measure of the firm's growth through M&A. A low ratio indicates that the firm grows mainly through internal expansion. A higher ratio

[3] The mixed use of NAICS and SIC codes for industry identification in various explanatory variables is due to data availability. The SDC database uses mainly SIC codes for industry identification while the Harte-Hanks data and Compustat segment data use mainly NAICS codes.

suggests that the firm enters new markets largely through mergers and acquisitions. To distinguish between related and unrelated acquisitions, we separate mergers and acquisitions in a firm's own industry (identified by the two-digit SIC industry reported in the SDC database for the firm) from those in different industries. We calculate related acquisitions (denoted as *RelatedAcquisition*) as the ratio of average annual M&A value in the same two-digit SIC industry to the firm's annual operating income, while unrelated acquisitions (denoted as *UnrelatedAcquisition*) is calculated as the ratio of average annual M&A value in different two-digit SIC industries to the firm's annual operating income.

Business Unit Relatedness. To assess business unit relatedness, we compare the industry in which a business unit resides with the primary industry of its headquarters. Variable *BURel* identifies the relationship between the two using a measure similar to Palepu (1985) on product market difference. If a business unit and its headquarters are in different two-digit NAICS industry groups, then *BURel*=0. If a business unit and its headquarters are in the same two-digit NAICS industry group but not the same four-digit NAICS industry, then *BURel*=1. If a business unit and its headquarters are in the same four-digit NAICS industry, then *BURel*=2. High relatedness indicates that the business unit focuses on markets similar to those of the headquarters.

Business Unit IT Knowledge. A business unit's IT knowledge (denoted as *BUITKnow*) is measured by the number of IT employees (Lichtenberg 1995). We normalize the measure by the total number of employees in the unit. A lower level of IT employees indicates that the business unit has less IT knowledge while a high level indicates that the business unit has more IT knowledge and thus higher capability in making IT infrastructure investment decisions and providing IT-related support for its business operations.

Business Unit Information Access. We measure business unit information access (denoted as *BUInfo*) using the number of network nodes reported in the CI database. Our approach is similar to that of McElheran (2010) who uses the presence of internet access at the business unit level to identify business units' information access. In our dataset, almost all business units have internet access. However, the degree of access differs significantly across business units. We calculate the ratio of the number of network nodes in a business unit to the total number of network nodes in the firm to measure the relative amount of information access the business unit has.

Business Unit IT Infrastructure Needs. We approximate a business unit's IT infrastructure needs (denoted as *BUITNeeds*) based on its IT assets using data from the CI database, which provides detailed information on IT assets and IT employees at the business unit level. We estimate the value of these IT resource using industry estimates of average IT resource prices. We obtain yearly PC prices from Gartner Dataquest Global PC Annual Forecast[4] and yearly server prices from IDC Worldwide Server Quarterly Tracker[5]. We adjust the nominal prices to real prices using the Bureau of Economic Analysis (BEA) price index for *Computers and Peripheral Equipment* (Lee and Barua 1999). Industry-average labor compensation is obtained from occupational compensation data reported by the Bureau of Labor Statistics (BLS), deflated by the Index of Total Compensation Cost. We then measure business unit IT assets by multiplying number of PCs, servers and IT employees by respective real prices. Following Hitt and Bryjolfsson (1996), IT assets for a business unit are calculated as the sum of PC and server capital plus three times the IT labor costs.

Industry Effect. Industry effect has been shown to influence the organizational structures and business strategies of a firm significantly (Mauri and Michaels 1998). It is, therefore, necessary to control for heterogeneity in the industry environment that is not observable to researchers. We use two-digit NAICS dummy variables to control for the industry effect.

4.2 Empirical Model of IT Governance

We employ the following regression model to identify the relationship between IT infrastructure governance configuration and multiple contingency factors.

$$\begin{aligned} ITDec_{it} = \alpha_0 &+ \alpha_1 CorpSubs_{it} + \alpha_2 OrgStr_{it} + \alpha_3 CorpSize_{it} + \alpha_4 BUSize_{it} \\ &+ \alpha_5 UnrelatedDiv_{it} + \alpha_6 RelatedDiv_{it} + \alpha_7 UnrelatedAcquisition_{it} \\ &+ \alpha_8 RelatedAcquisition_{it} + \alpha_9 BURel_{it} + \alpha_{10} BUITKnow_{it} + \alpha_{11} BUInfo_{it} \\ &+ \alpha_{12} BUITNeeds_{it} + \theta_{I(i)} + \lambda_t + \varepsilon_{it} \end{aligned}$$

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[4] We obtained PC price data from news releases by Gartner archived in the Dow Jones Factiva database.
[5] We obtained server price data from various newspaper articles that cite IDC Worldwide Server Quarterly Tracker from the Dow Jones Factiva database.

(1)

In the regression model above, a positive (negative) coefficient indicates that the corresponding independent variable increases (decreases) the chance that the business unit makes its own IT infrastructure investment decisions. Given H1a – H4c, we expect that seven of the contingency factors – number of subsidiaries (α_1), flatness of the organizational structure (α_2), business unit size (α_4), unrelated diversification (α_5), unrelated acquisition (α_7), business unit IT knowledge (α_{10}) and business unit information access (α_{11}) - to be positively associated with decentralized IT infrastructure governance. We expect the remaining five factors – corporate size (α_3), related diversification (α_6), related acquisition (α_8), business unit relatedness (α_9), and business unit IT needs (α_{12}) - to be negatively associated with decentralized IT infrastructure governance. The regression model also includes industry fixed effect and time fixed effect as control variables. We note further that ITIG misalignments across business units within a firm are likely to be correlated. To address the clustered correlation issue, we use a generalized estimating equation (GEE) regression model for the estimation of equation (1) (Liang and Zeger 1986).

4.3 Measure of IT Infrastructure Governance Misalignment

We use the result of equation (1) to identify the predicted ITIG configuration for a business unit based on multiple contingency theory. We then compare the predicted and actual ITIG configurations for each business unit and use the absolute value of standardized Pearson residual to measure ITIG misalignment for each business unit. The standardized Pearson residual identifies the difference between predicted and observed ITIG configurations and makes adjustments for variations in standard deviations of the difference (Harbin et al. 2007). The use of absolute value ensures that the misalignment measure is always positive, since deviation in either direction reflects misalignment. The value of the measure increases when a business unit deviates further from the prediction. A lower value of the measure suggests that the ITIG configuration for a business unit is closer to the multiple contingency theory based prediction for that business unit; while a higher value indicates poor choice on ITIG configuration.

Our approach of using a regression model to identify appropriate ITIG configuration needs more explanation. We recognize that the ITIG configuration for an individual business unit may not always be appropriate. If all firms strive to adopt appropriate ITIG configurations for their business units, however, the errors in ITIG configurations at individual business units are likely to be random. In this case, a regression analysis allows researchers to cancel out the random noises and obtain an approximation of the relationship between the appropriate ITIG configuration and the contingency factors.

Another concern of using a regression model to identify appropriate ITIG configuration is the possibility of missing variables related to ITIG that were not identified in prior studies. We address this concern as follows. First, we carefully choose a well-established theoretical model, the multi-contingency IT governance theory, as the foundation for our regression model. We then incorporate a comprehensive set of variables at both the firm level and the business unit level to capture the three categories of contingency factors identified in the multi-contingency theory. In this way, the predicted ITIG configurations from our regression model reflect the theory-suggested configurations. Second, we acknowledge that some of the differences between the predicted and observed ITIG configurations could be due to missing variables instead of misalignment. We note, however, that if such difference is caused by missing variables, it would suggest that some unobserved forces drive firms to make correct decisions on ITIG configuration. In this case, the difference would not have a negative influence on IT investment performance. On the other hand, if the difference between predicted and observed ITIG configurations is caused by misalignment, it would suggest that firms make mistakes in ITIG configuration. In this case, the difference would have a negative influence on IT investment performance. The noise in our ITIG misalignment measure thus biases against finding significant results. To the degree that our later analysis reveals a negative relationship between the difference and IT investment performance, it indicates that the difference measure reflects more information about ITIG misalignment. Finally, instead of using the Pearson residuals from the regression model as the measure for ITIG misalignment, an alternative approach is to identify the portion of the residuals due to known factors that contribute to ITIG misalignment and then use this portion as the measure for ITIG misalignment (see, e.g., Core et al. 1998;

Nyberg et al. 2010). This approach allows the exclusion of variations in ITIG configurations due to unobserved factors. Technically, this method requires regressing the Pearson residuals on these known factors and then using the predicted value as the measure for ITIG misalignment. We note that this approach is equivalent to 2SLS regression with these known factors as instruments for ITIG misalignments. We use this approach to address the potential missing variable issue in this study.

4.4 Variables for Measuring the Influence of IT Governance

Dependent Variables

We consider two measures of firm performance: Return on Assets (ROA) and Tobin's q. Return on assets identifies a firm's ability to generate profits from its assets. This measure has been widely used in prior studies (e.g., Hitt and Bryjolfsson 1996; Tanriverdi 2006; Kohli and Devaraj 2003). One drawback of the ROA measure is its narrow focus on firm profitability in the current fiscal year (Tanriverdi 2006; Smirlock et al. 1984). The impact of ITIG, however, could take years to materialize. To capture the long-term influence of ITIG, we also use Tobin's q as a measure of firm performance. Tobin's q is a forward-looking measure that reflects market expectations of future firm performance (Bharadwaj 2000; Berk et al. 1999).

Independent Variables

IT Infrastructure Governance Misalignment. The key independent variable in our analysis of IT investment performance is the multiple contingency theory based ITIG misalignment measure derived from the IT infrastructure governance model in the previous section. Since the objective of this study is to link ITIG misalignment with IT investment performance and we observe investment performance data at the firm level only, we aggregate ITIG misalignment measures from the business unit level to the firm level. We use a weighted average approach to aggregate ITIG misalignment with weight being the percentage of business unit sales over total firm sales. The weighted average approach captures the fact that ITIG misalignment in a large business unit has a more significant impact on the firm's performance.

IT Capital. The measurement of IT capital is similar to the measure of business unit IT needs in the IT infrastructure governance model. The main difference is that we calculate IT capital using firm level data instead of business unit level data. In addition, to standardize the measure of IT capital across firms, we divide IT capital by the total assets of a firm (Bharadwaj 2000).

Control Variables

Firm Size. Size not only influences a firm's choice of ITIG configuration, but also affects its financial performance. Economies of scale provide significant advantages to large firms in the form of lower costs. Firm size also affects internal coordination costs in a multiunit firm, as coordination costs increase exponentially with firm size. We measure firm size using two variables: logarithm of total number of employees and logarithm of total sales (Hart and Oulton 1996; Shalit and Sankar 1977).

Diversification Breadth. Similar to firm size, firm diversification also influences both a firm's choice of ITIG configurations and its financial performance. The persistence of diversification discount is well known in finance and strategy literatures, due possibly to inefficient resource allocations by the firm (Rajan et al. 2000). We therefore include diversification breadth as a control variable for the IT performance model. The calculation of firm diversification breadth is the same as the one used in the IT infrastructure governance model.

Other Control Variables. We also follow the existing literature (Hitt and Bryjolfsson 1996; Bharadwaj et al. 1999) to incorporate an extensive set of control variables that may affect a firm's performance. These variables include marketing and advertising expenditure, R&D expenditure, market share, capital investment, and debt-to-equity ratio.

Industry Effect. Industry effect has been shown to account for a majority of the variance in firm performance (Wernerfelt and Montgomery 1988). We, therefore, control for heterogeneity in industry environments using 2-digit NAICS dummy variables.

Table 2 presents a list of variables for the IT investment performance model, the data sources, and descriptive statistics.

4.4 Empirical Model for the Impact of ITIG Misalignment on IT Investment Performance

H5 suggests that ITIG misalignment has a negative moderating effect on the influence of IT capital on firm performance. The higher the misalignment between ITIG configuration and contingency factors on organizational structures and business strategies, the less business value a firm can generate from its IT assets. We use the following regression model to investigate the influence of ITIG misalignment on IT investment -performance.

$$ROA_{it} = \beta_0 + \beta_1 ITCapital_{it} + \beta_2 ITIGMisalignment_{it} + \beta_3 ITCapital_{it} \times ITIGMisalignment_{it} + \beta_4 Sales_{it} + \beta_5 Employee_{it} + \beta_6 Diversification_{it} + \beta_7 ADExp_{it} + \beta_8 RDExp_{it} + \beta_9 MarketShare_{it} + \beta_{10} CapitalInvestment_{it} + \beta_{11} DebtToEquityRatio_{it} + \mu_{I(i)} + \eta_t + \zeta_{it} \quad (2)$$

$$Tobin's\ q_{it} = \gamma_0 + \gamma_1 ITCapital_{it} + \gamma_2 ITIGMisalignment_{it} + \gamma_3 ITCapital_{it} \times ITIGMisalignment_{it} + \gamma_4 Sales_{it} + \gamma_5 Employee_{it} + \gamma_6 Diversification_{it} + \gamma_7 ADExp_{it} + \gamma_8 RDExp_{it} + \gamma_9 MarketShare_{it} + \gamma_{10} CapitalInvestment_{it} + \gamma_{11} DebtToEquityRatio_{it} + \upsilon_{I(i)} + \varphi_t + \xi_{it} \quad (3)$$

To estimate the above equations, we note that OLS regression could lead to biased results due to potential endogeneity between firm performance and ITIG misalignment. For example, high performing firms maybe more likely to adopt better ITIG practices, leading to reverse causality. Alternatively, factors unobserved by the researchers could affect both firm performance and ITIG misalignment. To address these concerns, we use an instrument variable approach. While prior studies have not considered instruments for ITIG misalignment specifically, we note that ITIG is a type of organizational control mechanism and that extant studies have identified factors contributing to the weaknesses in organizational control mechanisms. For example, the accounting literature on internal control weaknesses (e.g. Doyle et al. 2007) shows that complex and fast growing firms are more likely to have weaknesses in internal controls and organizational designs. We therefore use measures of organizational complexity and growth – number of subsidiaries, organizational flatness and acquisition activities – as instruments for ITIG misalignment.

We also note that the regression model could be subject to the influence of outliers, autocorrelation, and heteroskedasticity, resulting in biased OLS estimators. We take a two-step approach to address the problem. We first mitigate the influence of outliers by using robust regression (Huber 2003) to identify potential outliers and remove them from the regression analysis. We then perform a Durbin-Watson test and a White's test for autocorrelation and heteroscedasiticity respectively. The regression diagnostics indicate that the data are subject to both autocorrelation and heteroscedasiticity problems. To address the problem, we estimate the model using GMM with Newey-West autocorrelation and heteroscedasiticty resistant standard errors (Newey-West 1987). We also note that the regression model could be subject to multicollinearity among independent variables. To reduce multicollinearity, we centralize all variables and calculate the variance inflation factor (VIF) for each independent variable. We note that the VIF values are all below 10.

5. Results

5.1 Choice of IT Infrastructure Governance Configuration

Table 3 shows the estimation results of the IT governance model at the business unit level. The coefficients of nine out of the twelve explanatory variables in the model are significant. The signs of the coefficients are also consistent with the hypotheses. Specifically, the coefficient of the number of corporate subsidiaries is positive and significant, suggesting that a firm with a large number of subsidiaries is more likely to have a decentralized IT infrastructure governance configuration (H1a). The coefficient of organizational structure is also positive and significant ($p<0.01$), indicating that a firm with a flat organizational structure (i.e., more business units reporting directly to the headquarters) is more likely to adopt a decentralized IT infrastructure governance (H1b). The coefficients of corporate size and business unit are negative and positive respectively. The result suggests that, everything else being equal, larger firms are more likely to have the resources to centralize decision making on IT infrastructure for their business units (H2a). The same argument also applies at the business unit level. Large business units are more likely to have the resources to make their own IT infrastructure decisions. In such cases, a firm is more likely to delegate ITIG decision rights to a larger business unit (H2b). We also observe positive and significant coefficients on both unrelated diversification and unrelated acquisitions. This result suggests that firms diversifying into unrelated industries, especially those acquiring into unrelated industries, are more likely to adopt decentralized ITIG for their business units (H3a and H3b). The coefficient of relatedness is negative but insignificant, suggesting that firms lean towards adopting a centralized ITIG configuration for a business unit if it resides in the primary industry of the headquarters but the effect is not statistically significant (H3c). The coefficient of business unit IT knowledge and business unit information access are both positive and significant (H4a and H4b), indicating that a firm is more likely to adopt a decentralized ITIG configuration for a business unit with higher IT knowledge and more information access. Finally, the coefficient of business unit IT infrastructure needs is negative and significant, indicating that, given a business unit's IT knowledge and information access, its absorptive capacity of making IT infrastructure decisions depends on the scale of its IT infrastructure needs. It faces more resource and information constraints if the business unit has higher IT infrastructure needs. As a result, a firm is more likely to adopt a centralized ITIG configuration for a business unit with substantial IT infrastructure needs (H4c).

Overall, our results provide strong support for extending the multiple contingency theory of IT governance to the business unit level. We find that all three categories of contingency factors play a significant role in ITIG decisions, suggesting that the collective influence of the contingency factors determines the appropriate ITIG configuration for a business unit. Ignoring any of the factors may result in a misalignment between a firm's IT infrastructure governance and its business strategies and environment.

5.2 IT Infrastructure Governance Misalignment and IT Investment Performance

Table 4 presents the results of the IT investment performance model. The results show that IT capital has a significant impact on both the Tobin's q and ROA of a firm. These results indicate that, on average, IT capital has both substantial short-term and long-term influence on firm performance. These results are consistent with studies on the business value of IT investment (e.g. Bryjolfesson and Hitt 1996; Mithas et al. 2008). The coefficients of the interaction terms between ITIG misalignment and IT investment are negative and significant. The negative coefficients on the interaction terms suggest that, in firms with poor IT infrastructure governance (i.e. higher ITIG misalignment), IT investment has less influence on both short-term and long-term firm performance. Taken together, the results suggest that ITIG misalignment significantly reduces the influence of IT investment on firm performance, supporting H5 and suggesting that the alignment between IT infrastructure governance and a business unit's strategies and organizational structure could have a significant influence on a firm's IT investment performance. The analysis also shows that advertising is positively associated with a firm's short-term performance but that R&D's impact is negative. Moreover, we note that diversification breadth is negatively associated with a firm's short-term and long-term performance, indicating the presence of diversification discount (Rajan et al. 2000).

Comparing Column 1-3 and 4-6 in Table 4, we note that the instrument variable regressions have a noticeable impact on the scale of the coefficients. In particular, the coefficients of the interaction terms become more negative after using the instrument variable approach. The comparison also shows that the Newey-West standard errors are generally larger than the OLS standard errors, highlighting the importance of correcting for heteroskedasticity and auto-correlations.

To illustrate the magnitude of the influence of ITIG on IT investment performance, Table 5 calculates IT investment performance for firms with average ITIG misalignment, firms with ITIG misalignment one standard deviation below the average (i.e. firms with better than average IT infrastructure governance), and firms with ITIG misalignment one standard deviation above the average (i.e. firms with worse than average IT infrastructure governance), respectively.[6] The coefficients in the table represent the impact of IT investment on the two firm performance measures (ROA and Tobin's q)[7]. The coefficients are linear functions of the coefficient of IT capital and the coefficient of the interaction between IT capital and ITIG

[6] The mean and standard deviation of IT governance misalignment are 0.174 and 0.155 respectively.

[7] For example, Table 4 indicate that the impact of IT capital on Tobin's q with a given level of IT infrastructure governance misalignment is $\partial(Tobin's\ q)/\partial(IT\ Capital) = 1.63 - 9.20 \times ITIGMisalignment$. Given that the standard deviation of *ITIG misalignment* is 0.155 and that explanatory variables are centered, the impact of IT capital on firms with IT infrastructure governance misalignment one standard deviation below the average is therefore 3.06 $(= 1.63 - 9.20 \times (-0.155))$, while the impact of IT capital on firms with IT infrastructure governance misalignment one standard deviation above the average is 0.21. $(= 1.63 - 9.20 \times 155)$. The calculation for the impact of IT capital on ROA is derived with the same approach.

misalignment. Their standard deviations are derived from the covariance matrix of the instrument variable regression with Newey-West standard errors. The calculation shows that firms with poor ITIG alignment obtain no value from their IT investment in the short-term as measured by return on assets. Firms with good ITIG alignment obtain about twice the return from their IT investments compared to firms with average ITIG alignment. The result for the long-term firm performance measured by Tobin's *q* again indicates the importance of ITIG alignment. The calculation reveals that IT investment by firms with high and average ITIG alignment has a much more significant impact on market values than IT investment by firms with poor ITIG alignment. In addition, for firms with good ITIG alignment, the influence of their IT investment on market value is again about twice the influence of IT investment by firms with average ITIG alignment. These results provide evidence that a firm's ITIG alignment plays a significant role in enhancing its IT investment performance. Firms with good ITIG alignment obtain significantly more value from their IT investment than firms with poor ITIG alignment.

6. Discussion and Conclusions

The goal of this paper is to study how the alignment between IT infrastructure governance and a firm's organizational structure and business strategies influences its IT investment performance. We derive a multiple contingency theory based measure of IT infrastructure governance misalignment. We then propose a complementary relationship between ITIG alignment and IT investment and show that making the right choice on IT infrastructure governance is instrumental to enhancing a firm's IT investment performance.

6.1. Contributions

This research makes two contributions to IS research. First, studies conducted in the past decade have revealed that information systems are enablers. They complement organizational assets and business strategies to create value, but do not generate much value on their own. Subsequent studies focus on identifying complementary business strategies and organizational structures, but overlook the subtlety that IT is not necessarily a complement. As a general-purpose technology, IT can be either an enabler or a constraint to a firm's business strategies (Broadbent et al. 1999). In this study, we highlight the importance of alignment between IT, particularly IT infrastructure, and a firm's organizational structure and business strategies to assess how the alignment influences IT investment performance. Our analysis suggests that the alignment between IT infrastructure governance configuration and a firm's organizational structure and business strategies is crucial to a firm's ability to generate value from its IT investments. Second, we extend the multiple contingency theory of IT governance from the firm level to the business unit level. We show that many of the contingency factors vary across business units within a firm. As a result, there is not a single IT governance configuration that fits all firms or all business units within a firm. Our finding suggests that a firm must consider the unique characteristics of each business unit and develop the appropriate IT governance configuration for that business unit.

6.2 Implications for Practice

The findings of this study have a number of important implications for practice. First, our analysis reveals that IT infrastructure and the choice of IT infrastructure governance have a significant influence on a firm's IT investment performance. While IT infrastructure investment is often unglamorous, it provides the foundation for shared services in a firm and enables internal and external coordination (Aral and Weill 2007; Broadbent 1999). Because of this essential role, how the decision right on IT infrastructure is allocated between corporate headquarters and business units could have a profound impact on the effectiveness of a firm's IT investments. We make a first attempt to quantify the importance of the alignment between IT infrastructure and business strategies. Our results indicate to business executives that the alignment is essential to the success of IT investment. IT investments by firms with poor IT governance alignment provide less value, while firms with good IT governance alignment gain substantial benefits from their IT investments.

Second, our analysis reveals that IT infrastructure governance varies not only across firms but also across business units within a firm. This finding suggests that, while enabling internal and external sharing and coordination is an important motivation for IT infrastructure investments, a centralized IT infrastructure across all business units is not always the best choice. A firm needs to consider the characteristics of each business unit — especially its relatedness to the firm's primary industry, size, IT knowledge, information access and IT infrastructure needs — in determining the best IT infrastructure governance configuration for each business unit.

6.3 Limitations and Directions for Future Research

Our analysis also has a number of limitations. First, our focus is on IT infrastructure governance alignment. While IT infrastructure governance is an important element in overall IT governance, other aspects of IT governance are also indispensible (Sambamurthy and Zmud 1999; Tiwana 2009). Moreover, different aspects of IT governance are likely to complement each other in enabling a firm's business strategies and enhancing firm performance. Future research should consider examining the interactions between different aspects of IT governance and their impacts on IT investment performance. Second, our analysis focuses on the vertical allocation of IT decision rights between headquarters and business units. Tiwana (2009) suggests that the horizontal allocation of IT decision rights between business functions and IT functions also plays an important role in IT governance decisions, especially in project management governance. It would be valuable for future research to study the allocation of IT decision rights along both dimensions and to examine how the alignment on both dimensions influences IT investment performance. Third, we use the allocation of IT purchase decision rights between a business unit and the headquarters to determine each business unit's IT infrastructure governance configuration. This approach however oversimplifies the IT procurement process. In many firms, IT procurement involves decision making at multiple organizational levels. For example, the headquarters may determine vendors and negotiate firm-wide discounts while individual business units determine specific IT systems to acquire[8]. Due to data limitations, we are unable to observe these details in the IT procurement process. As a result, our multiple contingency theory based measure of IT infrastructure governance configuration is noisy. It will be beneficial for future studies to conduct a comprehensive

[8] We thank an anonymous reviewer for making this important observation.

analysis of IT procurement processes and their relationship with IT governance configuration. Fourth, the measure we derive – IT infrastructure governance misalignment – only considers the degree to which the IT infrastructure governance configurations adopted for each business unit deviates from the theoretical prediction of the multiple contingency model. It is important to note that the multi-contingency theory does not necessarily provide a perfect prediction of IT infrastructure governance configuration. As such, the misalignment measure is mainly a tool to assess the validity of the multi-contingency theory instead of an objective scale to precisely assess the extent of IT infrastructure governance misalignment. Further research is needed to develop a measure to more precisely assess the extent of IT governance misalignment. Fifth, our finding that IT infrastructure governance shall vary across business units based on their organizational structure and business strategies could have important implications for businesses. While we identify a number of business unit level contingencies based on the multiple contingency theory, more research is needed to provide a symmetric analysis of business unit level factors for IT infrastructure governance decisions. Sixth, we show that firms differ in IT infrastructure governance alignment, but our analysis does not address the cause for such variations. It could be related to senior management's IT knowledge, a firm's corporate governance or other organizational factors. We suggest that future studies identify what causes firms to deviate from adopting the appropriate IT infrastructure governance configurations. Finally, IT infrastructure governance is just one element in a firm's IT architecture (Sambamurthy and Zmud 2000; Agarwal and Sambamurthy 2002). Our analysis shows the value and importance of this element while leaving the important task of assessing other elements of IT architecture for future research.

References

Agarwal, R., V. Sambamurthy. 2002. Principles and models for organizing the IT function. *MIS Quarterly Executive* 1(1) 1-16

Amit, R., J. Livnat, P. Zarowin. 1989. The mode of corporate diversification: Internal ventures versus acquisitions *Managerial and Decision Economics* 10(2) 89-100

Applegate, L. M., F. W. McFarlan, J. L. McKenney. 1996. *Corporate Information Systems Management: Text and Cases, 4th Ed.* Richard D. Irwin, Chicago.

Aral, S. P. Weill, 2007. IT assets, organizational capabilities, and firm performance. *Organization Science* 18(5) 763-780

Aral, S., E. Brynjolfsson, D. J. Wu. 2006. Which came first, IT or productivity? The 'virtuous cycle' of investment and use in extended enterprise systems. *Proceedings of the 27th International Conference on Information Systems*, Milwaukee, WI, USA

Baiman, S., D. F. Larker, M. V. Rajan. 1995. Organizational design for business units. *Journal Accounting Research* 33(2) 205-229

Banker, R.D., I. R. Bardhan, S. Lin, H. Chang. 2006. Plant information systems, manufacturing capabilities and plant performance. *MIS Quarterly* 30(2) 315-337.

Bardhan, I. R., V. V. Krishnan, S. Lin. 2007. Project performance and the enabling role of information technology: An exploratory study on the role of alignment. *Manufacturing & Service Operations Management* 9(4) 579-595

Bardhan, I. R., J. Whitaker, S. Mithas. 2006. Information technology, production process outsourcing and manufacturing plant performance. *Journal of Management Information Systems* 23(2) 13-40

Barua, A., C. Kriebel, T. Mukhopadhyay. 1995. Information technology and business value: An analytic and empirical investigation. *Information Systems Research* 6(1) 3-23

Basu, A., C. Jarnagin. 2008. How to tap IT's hidden potential. *Wall Street Journal*, March 10, 2008

BEA. 2009. Investment in Private Fixed Assets, Equipment and Software, and Structure by Type. *Bureau of Economic Analysis Fixed Asset Table 2.7.* Retrieved from http://www.bea.gov/national/FA2004/TableView.asp?SelectedTable=51&ViewSeries=NO&Java=no&Request3Place=N&3Place=N&FromView=YES&Freq=Year&FirstYear=1985&LastYear=2008&3Place=N&Update=Update&JavaBox=no on September 10, 2009.

Berk, J. R.C. Green, V. Naik. 1999. Optimal investment, growth options, and security returns. *Journal of Finance* 54(5) 1553-1607

Bharadwaj, A. S. 2000. A resource-based perspective on information technology capability and firm performance: An empirical investigation. *MIS Quarterly* 24(1) 169-196

Bharadwaj, A. S., S. G. Bharadwaj, B. R. Konsynski. 1999. Information technology effects on firm performance as measured by Tobin's q. *Management Science* 45(7) 1008-1024

Bresnahan, T. F., E. Bryjolfsson, L. M. Hitt. 2000. Information technology, workplace organization, and the demand for skilled labor: Firm-level evidence. *Quarterly Journal of Economics* 117(1) 339-376

Bresnahan, T. F., M. Trajtenberg. 1995. General purpose technologies: 'Engines of growth'? *Journal of Econometrics* 65 83-108

Broadbent, M., P. Weill, D. S. Clair. 1999. The implications of information technology infrastructure for business process redesign. *MIS Quarterly* 23(2) 159-182

Brown, C. V., S. L. Magill. 1994. Alignment of the IS functions with the enterprise: Toward a model of antecents. *MIS Quarterly* 18(4) 371-403

Brynjolfsson, E., L. M. Hitt. 1996. Paradox lost? Firm-level evidence on the returns to information systems spending. *Management Science* 42(4) 541-558

Brynjolfsson, E., L. M. Hitt. 2000. Beyond computation: Information technology, organization transformation and business performance. *Journal of Economic Perspectives* 14(4) 23-48.

Brynjolfsson, E., T. W. Malone, V. Gurbaxani, A. Kambi. 1994. Does information technology lead to smaller firms. *Management Science* 40(2) 1628-1644

Busija, E. C., H. M. O'Neill, C. P. Zeithaml. 1997. Diversification strategy, entry mode, and performance: Evidence of choice and constraints. *Strategy Management Journal* 18(4) 321-327

Chari, M. D. R., Devaraj, S., David, P. 2007. International diversification and firm performance: Role of information technology investments. *Journal of World Business* 42(2) 184-197.

Chari, M. D. R., Devaraj, S., David, P. 2008. The impact of information technology investments and diversification strategies on firm performance. *Management Science* 54(1) 224-234.

Chen, P., C. Forman. 2006. Can vendors influence switching costs and compatibility in an environment with open standards? *MIS Quarterly* 30 541-562

Clemons, E., M. C. Row. 1991. Sustaining IT advantage: The role of structural differences. *MIS Quarterly* 15(3) 275-292

Collis, D., D. Young, M. Goold. 2007. The size, structure, and performance of corporate headquarters. *Strategic Management Journal* 28 383-405

Cohen, W. M., R. C. Levin, D. C. Mowery. 1987. Firm size and R&D intensity: A re-examination. *The Journal of Industrial Economics* 35 (4) 543-565.

Core, J. E., R. W. Holthausen, D. F. Larcker. 1999. Corporate governance, chief executive officer compensation, and firm performance. Journal of Financial Economics 51(3) 371-406.

Cron, W. L., M. G. Sobol. 1983. The relationship between computerization and performance: a strategy for maximizing the economic benefits of computerization. *Information & Management* 6 171-181

Devaraj, S., R. Kohli. 2000. Information technology payoff in the healthcare industry: A longitudinal study. *Journal of Management Information Systems* 16(4) 41–67.

Devaraj, S., R. Kohli 2003. Performance impacts of information technology: Is actual usage the missing link? *Management Science* 49(3) 273-289

Dewan, S., S. C. Michael, C. Min. 1998. Firm characteristics and investments in information technology: Scale and scope effects. *Information Systems Research* 9(3) 219-232.

Dewan, S., C. Min. 1997. The substitution of information technology for other factors of production: A firm level analysis. *Management Science* 43(12) 1660-1675

Dewan, S., C. Shi, V. Gurbaxani. 2007. Investigating the risk-return relationship of information technology investment: Firm-level empirical analysis. *Management Science* 53(12) 1829-1842

Dos Santos, B. L., K. G. Peffers, D. C. Mauer. 1993. The impact of information technology investment announcements on the market value of the firm. *Information Systems Research* 4(1) 1-23

Doyle, J., W. Ge, S. McVay. 2007. Determinants of weaknesses in internal control over financial reporting. *Journal of Accounting and Economics* 44 193-223.

Egelhoff, W. G. 1982. Strategy and structure in multinational corporations: an information-processing approach. *Administrative Science Quarterly* 27(3) 435-458

Ein-Dor, P., E. Segev. 1982. Organizational context and MIS structure: Some empirical evidence. *MIS Quarterly* 6(3) 55-68

Forman, C. 2005. The Corporate digital divide: Determinants of internet adoption. *Management Science* 51(4) 641-654

Foss, N. J. 2003. Selective intervention and internal hybrids: Interpreting and learning from the rise and decline of the Oticon spaghetti organization. *Organization Science* 14(3) 331-349

Francalanci, C., Galal, H. 1998. Information technology and worker composition: Determinants of productivity in the life insurance industry. *MIS Quarterly* 22(2) 227–241.

Gurbaxani, V., S. Whang. 1991. The impact of information systems on organizations and markets. *Communications of the ACM*. 34(1) 59-73

Hardin, J. W., J. M. Hilbe. 2007. *Generalized Linear Models and Extensions,* Second Edition. Stata Press, College Station, TX, USA.

Hart P. E., N. Oulton. 1996. Growth and Size of Firms. *The Economic Journal* 106(438) 1242-1252

Henderson, J., N. Venkatraman. 1992. Strategic alignment: A model for organizational transformation via information technology. In T. Kochan and M. Useem (eds.), *Transforming Organizations*, Oxford University Press, New York, 1992.

Hitt, L. 1999. Information technology and firm boundaries: Evidence from panel data. *Information Systems Research* 10(2) 134-149

Hitt, L. M., E. Brynjolfsson. 1996. Productivity, business profitability, and consumer surplus: Three different measures of information technology value. *MIS Quarterly* 20(2) 121-142

Hitt, L. M., E. Brynjolfsson. 1997. Information technology and internal firm organization: An exploratory analysis. *Journal of Management Information Systems* 14(2) 77-99

Hitt, L. M., D. J. Wu, X. Zhou. 2002. Investment in enterprise resource planning: Business impact and productivity measures. *Journal of Management Information Systems* 19(1) 71-98

Hoskisson, R. E., M. A. Hitt, R. A. Johnson, D. D. Moesel. 1993. Construct validity of an objective (entropy) categorical measure of diversification strategy. *Strategic Management Journal* 14(3) 215-235.

Huber, P. J. 2003. *Robust Statistics*. Wiley-Interscience. New York, NY.

Jensen, M. C., W. H. Meckling. 1976. Theory of the firm: Managerial behavior, agency costs, and ownership structure. *Journal of Financial Economics* 3(4) 305-360.

Jensen, M. C., W. H. Meckling. 1995. Specific and general knowledge, and organizational structure. *Journal of Applied Corporate Finance* 8(2) 4-18.

Kearns, G. S., R. Sabherwal. 2006. Strategic alignment between business and information technology: A knowledge-based view of behaviors, outcome, and consequences. *Journal of Management Information Systems* 23(3) 129-162

Kohli, R., S. Devaraj. 2003. Measuring information technology payoff: A meta-analysis of structural variables in firm-level empirical research. *Information Systems Research* 14(2) 127-145

Lee, B., A. Barua. 1999. An integrated assessment of productivity and efficiency impacts of information technology investments: Old data, new analysis and evidence. *Journal of Productivity Analysis* 12 21-43

Lichtenberg, F. R. 1995. The output contributions of computer equipment and personnel: A firm-level analysis. *Economics of Innovation and New Technology* 3(4) 201-217.

Loh, L. 1993. The economics and organization of information technology governance: Sourcing strategies for corporate information infrastructure. *Unpublished MIT Dissertation*. Available at http://dspace.mit.edu/handle/1721.1/12545.

Mauri, A. J., M. P. Michaels. 1998. Firm and industry effects within strategic management: An empirical examination. *Strategic Management Journal* 19(3) 211-219

McElheran, K. S. 2010. Delegation in multi-establishment firms: The locus of IT systems purchasing authority. *Harvard Business School working paper*.

Melville, N., K. Kraemer, V. Gurbaxani. 2004. Information technology and organizational performance: An integrative model of IT business value. *MIS Quarterly* 28(2) 283-322

Mithas, S., A. Tafti, I. Bardhan, J. M. Goh. 2008. Resolving the profitability paradox of information technology: Mechanisms and empirical evidence. *University of Maryland Working Paper*. Available at SSRN: http://ssrn.com/abstract=1000732.

Mukhopadhyay, T., S. Rajiv, K. Srinivasan. 1997. Information technology impact on process output and quality. *Management Science* 43(12) 1645–1659

Newey, W. K, K. D. West. 1987. A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica* 55(3) 703–708.

Nyberg, A. J., I. Fulmer, B. Gerhart, M. A. Carpenter. 2010. Agency theory revisited: CEO returns and shareholder interest alignment. *The Academy of Management Journal* 53(5) forthcoming.

Palepu, K. 1985. Diversification strategy, profit performance and the entropy measure. *Strategic Management Journal* 6 239- 255

Palich, L. E., L. B. Cardinal, C. C. Miller. 2000. Curvilinearity in the diversification-performance linkage: An examination of over three decades of research: *Strategic Management Journal* 21(2), 155-174

Rai, A., R. Patnayakuni, N. Seth. 2006. Firm performance impacts of digitally-enabled supply chain integration capabilities. *MIS Quarterly* 30(2) 225-246

Rajan, R. G., J. Wulf. 2006. The Flattening Firm: Evidence from Panel Data on the Changing Nature of Corporate Hierarchies. *The Review of Economics and Statistics* 88(4) 759-773.

Rajan, R. H. Servaes, L. Zingales. 2000. The cost of diversity: The diversification discount and inefficient Investment. *The Journal of Finance* 55(1) 35-80

Ross, J., C. Beath, D. Goodhue. 1996. Develop long-term competitiveness through IT assets. *Sloan Management Review* 38(1) 31–42.

Sambamurthy, V., R. W. Zmud. 1999. Arrangements for information technology governance: A theory of multiple contingencies. *MIS Quarterly* 23(2) 261-290

Sambamurthy, V., R. W. Zmud. 2000. Research commentary: The organizing logic for an enterprise's IT activities in the digital era – A prognosis of practice and a call for research. *Information Systems Research* 11(2) 105-114

Sambamurthy, V., A. Bharadwaj, V. Grover. 2003. Shaping agility through digital options: reconceptualizing the role of information technology in contemporary firms. *MIS Quarterly* 27(2) 237-263

Santhanam, R., E. Hartono. 2003. Issues in linking information technology capabilities to firm performance. *MIS Quarterly* 27(1) 125-153

Shalit, S. S., U. Sankar. 1977. The Measurement of Firm Size. *The Review of Economics and Statistics* 59(3) 290-298

Simmonds, P. G. 1990. The combined diversification breadth and mode dimensions and the performance of large diversified firms. *Strategic Management Journal* 11(5) 399-410

Smirlock, M., T. Gilligan, W. Marshall. 1984. Tobin's q and the Structure-Performance Relationship. *American Economic Review* 74(5) 1051-1060.

Straub, D., M. Limayem, E. Karahanna-Evaristo. 1995. Measuring system usage: Implications for IS theory testing. *Management Science* 41(8).

Tanriverdi, H. 2005. Information technology relatedness, knowledge management capability, and performance of multibusiness firms. *MIS Quarterly* 29(2) 311-334

Tanriverdi, H. 2006. Performance effects of information technology synergies in multibusiness firms. *MIS Quarterly* 30(1) 57-77

Tiwana, A. 2009. Governance-Knowledge Fit in Systems Development Projects. *Information Systems Research* 20(2) 180-197

Townsend, A. M., S. M. Demarie, A. R. Hendrickson. 1998. Virtual teams: Technology and the workplace of the future. *The Academy of Management Executive* 12(3) 17-29.

Turban, E., J. McKay, P. Marshall, J. Lee, and D. Viehland. 2006. *Electronic Commerce: A Managerial Perspective.* Pearson Prentice Hall

Venkatraman, N. 1989. The concept of fit in strategy research: Toward verbal and statistical correspondence. *Academy of Management Review* 14(3) 423–444.

Weill, P. 1992. The relationship between investment in information technology and firm performance: A study of the valve manufacturing sector. *Information Systems Research* 3(4) 307-333

Weill, P., J. Ross. 2004. *IT Governance: How Top Performers Manage IT Decision Rights for Superior Results*. Harvard Business School Press.

Wernerfelt, B., C. A. Montgomery. 1988. Tobin's q and the Importance of Focus in Firm Performance. *The American Economic Review* 78(1) 246-250

Xue, L, G. Ray, B. Gu. 2010. Environmental uncertainty and IT infrastructure governance: A moral hazard perspective. *Information Systems Research,* forthcoming

Xue, Y., H. Liang, W. R. Boulton. 2008. Information technology governance in information technology investment decision processes: The impact of investment characteristics, external environment, and internal context. *MIS Quarterly* 32(1) 67-96

Zhu, K. 2004. The complementarity of information technology infrastructure and e-commerce capability: A resource –based assessment of their business value. *Journal of Management Information Systems* 21(1) 167-202.

Zhu, K., K. L. Kraemer. 2002. e-Commerce metrics for net-enhanced organizations: Assessing the value of e-commerce to firm performance in the manufacturing sector. *Information Systems Research* 13(3) 275–295.

Table 1a: Summary Statistics for the IT Infrastructure Governance Model

Categories	Factors	Variable	Operationalization	Mean	S.D.	Data Source
IT Governance	IT Governance	IT Infrastructure Purchasing Decision	Fraction of purchase decisions made by the business unit	0.741	0.438	CI Database
Corporate Governance	Corporate Governance Mode	Corporate Subsidiaries	Log value of total number of divisions in a firm	3.296	1.347	Corporate Affiliations DB
		Organizational Structure	Ratio of number of divisions reporting directly to the headquarters to total number of divisions in a firm	0.604	0.284	Corporate Affiliations DB
	Firm Size	Corporate Size	Log value of firm revenue	8.782	1.270	Compustat Database
		Business Unit Size	Log value of business unit revenue	4.009	1.774	CI Database
Economies of Scope	Diversification Breadth	Related Diversification	Entropy measure of the sum of firm diversifications at the 4-digit NAICS level within each 2-digit NAICS level	0.133	0.255	Compustat Segment Database
		Unrelated Diversification	Entropy measure of firm diversification at the 2-digit NAICS level	0.276	0.415	Compustat Segment Database
	Diversification Mode	Related Acquisition	Ratio of the total amount of acquisitions in related industries (same 2-digit SIC) to firm revenue over 5 years	0.097	0.529	SDC Database
		Unrelated Acquisition	Ratio of the total amount of acquisitions in unrelated industries (different 2-digit SIC) to firm revenue over 5 years	0.056	0.152	SDC Database
	Exploitation Opportunities	Business Unit Relatedness	0 – the business unit and headquarters in different 2-digit NAICS code; 1 – same 2-digit but difference 4-digit NAICS code; 2 – same 4-digit NAICS code	0.992	0.800	CI Database
Absorptive Capabilities	IT Knowledge	Business Unit IT Knowledge	Ratio of IT employees to total employees in a business unit	0.074	0.125	CI Database
	Information Access	Business Unit Information Access	Ratio of number of internet nodes in a business unit to the total number of internet nodes in a firm	0.080	0.188	CI Database
	IT Needs	Business Unit IT Needs	Log value of business unit IT assets (PC and server expenditures plus 3 times IT labor cost)	3.987	2.906	CI Database

Table 1b: Summary Statistics for the IT Investment Performance Model

Factors	Operationalization	Mean	S.D.	Data Source
Return on Assets	Pretax operating income divided by total assets	0.079	0.115	Compustat Database
Tobin's Q	Tobin's Q measure as in Bharadwaj, et al. (1999)	1.693	1.062	
ITIG MisAlignment	Standardized Pearson residual from the IT infrastructure governance model.	0.174	0.155	N/A
IT Capital	Total PC and server expenditures plus 3 times IT labor cost (Hitt and Bryjolfsson 1996). The measure is standardized by total assets	0.037	0.737	CI Database
Diversification Breadth	Entropy measure of diversification at the 2-digit SIC level	0.371[9]	0.428	Compustat Segment Database
Number of Employees	Natural logarithm of number of employees in the firm	2.621	1.333	Compustat Database
Sales	Natural logarithm of firm sales (in US dollars)	8.349	1.142	
Advertising Expenditure	5-year rolling-average advertising expenditure divided by sales	0.010	0.025	
R&D Expenditure	5-year rolling-average R&D expenditure divided by sales	0.018	0.053	
Market Share	Sales divided by industry total sales at the 4-digit NAICS level	0.106	0.156	
Capital Investment	Total invested capital divided by total assets	0.287	0.224	
Debt-to-Equity Ratio	Total liability divided by total equity	2.968	26.002	

[9] The variable for total diversification is the same for the site level analysis and the firm level analysis. However, the mean and standard deviation of the variable are slightly different across the two levels of analysis because

Table 2a. Correlation Table for IT Infrastructure Governance Model Data

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. IT Infrastructure Purchase Decision	1.00												
2. Corporate Subsidiaries	0.00	1.00											
3. Organization Structure	-0.00	-0.64***	1.00										
4. Corporate Size	-0.11***	0.51***	-0.21***	1.00									
5. Business Unit Size	0.25***	0.11***	-0.10***	0.16***	1.00								
6. Unrelated Diversification	0.08***	0.41***	-0.13***	0.32***	0.03***	1.00							
7. Related Diversification	0.02**	0.26***	-0.08***	0.04***	-0.08***	0.17***	1.00						
8. Unrelated Acquisition	0.06***	0.04***	-0.03***	-0.17***	-0.03***	0.13***	0.04***	1.00					
9. Related Acquisition	0.01	-0.06***	0.06***	-0.19***	-0.03***	-0.03***	-0.01	0.11***	1.00				
10. Business Unit Relatedness	-0.06***	-0.18***	0.06***	-0.10***	0.04***	-0.26***	-0.05***	-0.06***	-0.00	1.00			
11. Business Unit IT Employees	0.07***	-0.02***	0.01	-0.04***	-0.04***	-0.01	0.04***	-0.01	0.00	-0.02***	1.00		
12. Business Unit Information Access	0.23***	-0.23***	0.13***	-0.21***	0.26***	-0.10***	-0.06***	0.02***	0.01**	-0.23***	0.12***	1.00	
13. Business Unit IT Needs	-0.26***	0.40***	-0.19***	0.30***	-0.58***	0.24***	0.13***	0.02***	-0.01	-0.16***	0.06***	-0.37***	1.00

Note: *** p<0.01; ** p<0.05; * p<0.10

Table 2b. Correlation Table for IT Investment Performance Model Data

	1	2	3	4	5	6	7	8	9	10	11	12
1 Return on Assets	1.00											
2 Tobin's Q	0.13***	1.00										
3 ITIG Misalignment	0.01	-0.05***	1.00									
4 IT Capital	-0.55***	0.34***	-0.01	1.00								
5 Diversification Breadth	-0.06***	-0.11***	0.05**	-0.02	1.00							
6 Number of Employee	0.22***	0.01	-0.01	-0.19***	0.13***	1.00						
7 Sales	0.21***	-0.04***	0.01	-0.23***	0.08***	0.73***	1.00					
8 Advertising Exp.	0.12***	0.21***	-0.10***	-0.01	-0.01	0.10***	0.05***	1.00				
9 R&D Expenditure	-0.03**	0.29***	-0.11***	0.00	-0.03*	-0.00	-0.05***	0.02	1.00			
10 Market Share	0.11***	0.06***	0.06***	-0.02	0.16***	0.31***	0.26***	0.08***	-0.08***	1.00		
11 Capital Investment	-0.00	-0.09***	-0.03*	-0.02	-0.02	0.01	0.02	-0.06***	-0.14***	-0.04*	1.00	
12 Debt/Equity Ratio	-0.01	-0.03**	-0.00	-0.01	-0.02	-0.01	0.01	-0.01	-0.03*	-0.03**	-0.02	1.00

Note: *** p<0.01; ** p<0.05; * p<0.10

Table 3. GEE Regression on IT Infrastructure Purchase Decision		
Corporate Subsidiaries	0.03*** (0.01)	H1a Supported
Organization Structure	0.10*** (0.03)	H1b Supported
Corporate Size	-0.05*** (0.01)	H2a Supported
Business Unit Size	0.05*** (0.00)	H2b Supported
Unrelated Diversification	0.10*** (0.01)	H3a Partially Supported
Related Diversification	0.02 (0.02)	
Unrelated Acquisitions	0.05* (0.03)	H3b Partially Supported
Related Acquisitions	-0.01 (0.02)	
Business Unit Relatedness	-0.01 (0.01)	H3c Not Supported
Business Unit IT Knowledge	0.30*** (0.03)	H4a Supported
Business Unit Information Access	0.22*** (0.02)	H4b Supported
Business Unit IT Needs	-0.02*** (0.00)	H4c Supported
YEAR 2001	-0.03*** (0.01)	
YEAR 2002	-0.03*** (0.01)	
YEAR 2003	-0.03*** (0.01)	
YEAR 2004	-0.03*** (0.01)	
2-digit industry dummy variables included		
Goodness of Fit		
R-square	20.27%	
N	11212	

Note: *** p<0.01; ** p<0.05; * p<0.10

	Table 4. IT Investment Performance Models						
	Return-on-Assets (ROA)			Tobin's Q			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
	OLS Model	2SLS Model	2SLS with Newey-West Std. Err.	OLS Model	2SLS Model	2SLS with Newey-West Std. Err.	VIFs
IT Capital	**0.79***** **(0.06)**	**0.66***** **(0.04)**	**0.67**** **(0.31)**	**2.98***** **(0.27)**	**1.62***** **(0.13)**	**1.63***** **(0.30)**	8.21
ITIG Misalignment	0.02 (0.01)	-0.08 (0.06)	0.04 (0.06)	0.04 (0.06)	-0.81* (0.47)	-0.02 (0.36)	1.83
ITIG Misalign ×IT Capital	**-2.04***** **(0.13)**	**-3.58***** **(0.16)**	**-3.64***** **(1.38)**	**-7.17***** **(0.69)**	**-9.03***** **(0.76)**	**-9.20***** **(1.78)**	8.02
Diversification Breadth	-0.01* (0.00)	-0.01* (0.00)	-0.01* (0.00)	-0.05* (0.03)	-0.05* (0.03)	-0.05 (0.03)	1.10
Sales	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.02 (0.02)	0.02 (0.02)	0.01 (0.02)	2.33
Number of Employees	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.02)	-0.00 (0.02)	-0.00 (0.02)	2.36
Advertising Expenses	0.15** (0.07)	0.10 (0.07)	0.19** (0.09)	-0.33 (0.52)	-0.79 (0.60)	-0.24 (0.74)	1.14
R&D Expenses	-0.17*** (0.03)	-0.18*** (0.03)	-0.15** (0.08)	-0.56** (0.25)	-0.76*** (0.27)	-0.57 (0.85)	1.36
Market Share	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.01 (0.07)	0.04 (0.08)	0.01 (0.06)	1.24
Capital Investment	-0.03*** (0.00)	-0.03*** (0.01)	-0.02* (0.01)	-0.18*** (0.07)	-0.22*** (0.07)	-0.12** (0.06)	1.05
Debt-to-Equity	-0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	1.01
Lag (ROA) / Lag (Tobin's Q)	0.15*** (0.01)	0.22*** (0.01)	0.22*** (0.07)	0.68*** (0.01)	0.69*** (0.01)	0.69*** (0.06)	1.33
Year Dummy 2001	-0.02*** (0.00)	-0.03*** (0.01)	-0.02** (0.00)	-0.09*** (0.03)	-0.17*** (0.05)	-0.09* (0.05)	2.67
Year Dummy 2002	-0.02*** (0.00)	-0.02*** (0.01)	-0.01* (0.00)	-0.18*** (0.03)	-0.24*** (0.05)	-0.17*** (0.04)	2.54
Year Dummy 2003	-0.01*** (0.00)	-0.02*** (0.01)	-0.01 (0.00)	0.09*** (0.03)	0.05 (0.05)	0.10** (0.04)	2.53
Year Dummy 2004	-0.00 (0.00)	-0.01 (0.01)	0.00 (0.00)	0.04 (0.03)	-0.03 (0.05)	0.04 (0.04)	2.56
2-digit industry fixed variables included							
R^2	53.15%	56.06%	55.78%	72.40%	72.86%	72.71%	
N	2283	2283	2283	2230	2226	2226	

Note: *** $p<0.01$; ** $p<0.05$; * $p<0.10$.

Table 5. IT Investment Performance Comparison		
	Impact on Return-on-Asset (ROA)	Impact on Tobin's Q
Firms with average IT infrastructure governance misalignment	0.67** (0.31)	1.63*** (0.30)
Firms with IT infrastructure governance misalignment one standard deviation below the average	1.23*** (0.52)	3.06*** (0.58)
Firms with IT infrastructure governance misalignment one standard deviation above the average	0.10 (0.10)	0.21*** (0.06)

Note: *** p<0.01; ** p<0.05; * p<0.10. Estimations are derived from estimated coefficients and variance-covariance matrix for models (3) and (6) in Table 4.