A Moral Hazard Perspective on Environmental Uncertainty and IT Governance

Ling Xue  
*University of Scranton, xuel2@scranton.edu*

Gautam Ray  
*University of Minnesota, rayxx153@umn.edu*

Bin Gu  
*University of Texas at Austin, bin.gu@mccombs.utexas.edu*

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Gautam Ray  
University of Minnesota  
rayxx153@umn.edu

Bin Gu  
University of Texas at Austin  
bin.gu@mccombs.utexas.edu

ABSTRACT
Using a moral hazard model, this study examines the relationship between environmental uncertainty and the adoption of decentralized IT governance. We show that this relationship is determined by a trade-off between the need for processing local information and the concern on moral hazard. The trade-off results in an inverted-U-shaped relationship between environmental uncertainty and decentralization in IT governance. The increase in environmental uncertainty first increases and then decreases the likelihood of adopting decentralized IT governance, and thus decentralized IT governance is less likely to be adopted when the external environment is either highly stable or highly turbulent. We validate our analytical result using a sample of 455 business sites of Fortune 1000 companies. The empirical analysis provides evidence consistent with an inverted-U-shaped relationship between environmental uncertainty and decentralization in IT governance.

Keywords
IT governance, environmental uncertainty, moral hazard, agency theory

INTRODUCTION
IT governance refers to the organizational pattern of decision-making for IT-related activities, such as the management of IT infrastructure, IT principles, application development, service delivery, and IT investment (Sambamurthy and Zmud 1999; 2000; Weill and Ross 2005). A major focus of IS research on IT governance concerns with whether the decision authority regarding key IT-related activities should be delegated to business units or should they be centrally controlled by a corporate IT unit. As it is well recognized that there is no single best IT governance structure since IT needs to fit distinct organizational contexts and respond to diverse environments (e.g., Zmud 1984; Agarwal and Sambamurthy 2002), understanding how the choice of IT governance is influenced by various organizational and environmental contingency factors is important for designing effective IT organizational structure.

Prior research has studied a variety of organizational factors and environmental factors that influences IT governance. Organizational factors include: firm size (Ahituv et al. 1989; Brown and Magill 1994; Clark 1992; Ein-Dor and Segev 1982; Tavakolia 1989), corporate strategy (Brown and Magill 1994; Tavakolia 1989), and corporate governance structure (Ahituv et al. 1989; Brown and Magill 1994; Tavakolia 1989; Olson and Chervany 1980). External environmental factors include industry type and environmental turbulence (Brown and Magill 1994; Brown 1997; Hann and Weber 1996). The main argument here is that IT governance is a trade-off between cost-efficiency and the need for processing local information. When the potential benefits of cost-efficiency are large, firms are more like to adopt centralized IT governance. For example, it is well-accepted that centralized governance may be less cost-efficient in large, multidivisional corporations. As a result, large firms are more likely to adopt decentralized IT governance (Ein-Dor and Segev 1982). Also, the need for processing...
local information influences IT governance. As specialized knowledge about how to respond to the environment often resides with business units, organizations may decentralize IT governance to enable business units to better process external information. For example, it has been shown that decentralized IT governance is more likely to be adopted in organizations with decentralized corporate governance, as division units are more informed about their specific business processes (Brown and Magill 1994; Ein-Dor and Segev 1982; Tavakolian 1989). Likewise, firms with unrelated businesses are more likely to adopt decentralized IT governance (Boynton et al. 1994) due to the information asymmetry between the headquarters and business units.

Past research has hypothesized a positive relationship between environmental uncertainty and decentralization in IT governance (e.g., Allen and Boynton 1991). The rationale is that in uncertain environments, organizations tend to have increased needs for information processing (Galbraith 1973) and decentralized IT governance enables responsiveness by improving business units’ information processing capabilities (Allen and Boynton 1991). However, the results of empirical studies are mixed. For example, in a case study, Brown (1997) finds that unstable industry environment drives the organization to adopt decentralized governance in system development. On the other hand, Hann and Weber (1996) do not find significant empirical evidence that higher level of environmental uncertainty is associated with higher levels of delegation of IS decision rights to IS managers. Our research data on IT purchase decision at 455 business sites of Fortune 1000 companies shows a similar pattern. An analysis of the correlation between decentralization in IT purchasing decisions and environmental uncertainty reveals that firms tend to adopt centralized, rather than decentralized IT governance in more turbulent and complex business environments (the correlation table is in Section 3 of this paper).

The reason for these mixed empirical results, we argue, is that prior studies examining the relationship between environmental uncertainty and decentralization in IT governance overlook the potential moral hazard problem. While environmental uncertainty increases the value of decentralization from the perspective of information processing, it also exaggerates the moral hazard problem as it is harder for headquarters to monitor business units’ decisions in more uncertain environments. Thus the objective of this paper is to examine the relationship between environmental uncertainty and decentralization in IT governance, in the presence of moral hazard problem.

Drawing upon the agency theory, we build an analytical principal-agent model to illustrate two conflicting forces that environmental uncertainty exhibits. First, the model captures how environmental uncertainty drives the firm (the principal) to delegate IT decision rights to business units (the agent) in order to leverage business units’ information advantage. Second, the model captures how environmental uncertainty may amplify the agency cost associated with delegation of authority. The agency cost manifests itself as the business units’ discretionary investment that is not monitored by the headquarters (moral hazard). Considering these two forces, the model reveals that the relationship between environmental uncertainty and decentralization in IT governance is an inverted-U relationship. In either highly stable or highly uncertain environments, organizations tend to adopt more centralized IT governance. Decentralized IT governance is the optimal choice only when the level of environmental uncertainty is in an intermediate range. Our study also reveals that the net benefit of decentralization, i.e., the benefit of processing local information net of agency cost, first increases and then decreases with environmental uncertainty. That is, the relationship between the likelihood of adopting decentralized IT governance and environmental uncertainty exhibits an inverted-U-shaped relationship.

To confirm the implication of the analytical model, we conduct an empirical study to test the existence of an inverted-U-shaped relationship between environmental uncertainty and IT governance. We analyze a dataset capturing the IT purchasing decisions at 455 divisional sites of Fortune 1000 companies from year 2001 to 2005. The empirical analysis considers the probability that these sites adopt decentralized decision-making in IT purchasing. We find that sites in highly stable or highly uncertain business environments are more likely to adopt centralized decision-making in IT purchasing. Decentralized decision-making in IT purchasing is more likely to be adopted for sites in the business environments with intermediate uncertainty.

This research contributes to the IT governance research by illustrating a nonlinear relationship between environmental uncertainty and IT governance that has not been captured in the existing literature. Existing literature on IT governance largely recognizes the information advantage of local decision makers in unstable environments, and therefore focuses on the positive relationship between environmental uncertainty and decentralization. This research adopts the moral hazard perspective and provides new insights as an explanation for the discrepancy between prior theoretical prediction and empirical findings on the influence of environmental uncertainty on IT governance. The examination of this nonlinear relationship between environmental uncertainty and IT governance also follows the call of Sambamurthy and Zmud (1999) to study multiple effects of contingency factors on IT governance. Sambamurthy and Zmud (1999) note that existing literature on IT governance has focused on the singular effects of the contingency factors, and therefore they apply the theory of multiple contingencies to examine the interaction effects (e.g., amplifying, dampening, or overriding) between multiple
contingency factors. This paper takes another perspective and extends the research on IT governance by examining multiple conflicting forces (i.e., information processing versus agency cost) of the environmental uncertainty contingency factor.

The rest of this paper is organized as follows. Section 2 presents an analytical principal-agent model to illustrate the relationship between environmental uncertainty and decentralized IT governance. Section 3 describes the empirical study that tests the relationship between environmental uncertainty and decentralized IT governance. Section 4 concludes the paper and discusses directions for future research.

**THE ANALYTICAL MODEL**

We posit that the organization is comprised of a headquarter and a business unit. The headquarter is considered as the principal and the business unit is considered as the agent. The state of the world faced by the business unit is represented by an unknown random variable $\theta$. $\theta$ is drawn from a normal distribution with mean $\mu$ and variance $v$. Note that the value of $v$ captures the degree of environmental uncertainty. Both the principal and the agent can learn the state of the world. Specifically, the principal can observe a noisy signal $S$, which is normally distributed with mean $\theta$ and variance of $d$. The agent, in contrast, observes the value of $\theta$. Therefore, the term $d$ captures the degree of information asymmetry between different levels of management, or the degree of information advantage of the agent. The purpose of acquiring information about the state of the world is to assist IT investment decision at the business unit level. Suppose the IT investment is $I$, the payoff of the principal is represented as

$$U_p = \theta \sqrt{I} - I$$  \hspace{1cm} (3.1)

where the term $\theta \sqrt{I}$ is defined as the return of the IT investment. Note that (3.1) implies that the payoff of the principal is a concave function of the investment. This functional form has been used to model investment return in many other studies (e.g., Agrawal 1996). The principal’s objective is to maximize the profitability of IT investment. The payoff of the agent is represented as

$$U_a = \theta \sqrt{I} - I + a\sqrt{I} - (1 - a)I$$  \hspace{1cm} (3.2)

Note that compared with (3.1), the agent derives extra utility (captured by $al$) in making excess investment. Such private interest in excess investment can be explained from various perspectives, such as empire-building (Harris and Raviv 1998).

We first examine the case when the principal pursues centralized IT governance. In this case, the principal, rather than the agent, chooses the IT investment. The principal will choose an IT investment $I^c \in \max C(U_p)$ (the superscript $C$ denotes the case of centralization). Given the normal prior distribution of $\theta$ and the normal signal, the posterior distribution of $\theta$ is normal with mean $(vs + d\mu) / (v + d)$ and variance $vd / (v + d)$ (Cyert and DeGroot 1987). Therefore, given the signal observed by the principal, its expected payoff can be represented as

$$E(U_p) = E(\theta | S) \sqrt{I} - I.$$  \hspace{1cm} (3.3)

The principal’s expected payoff in the case of centralization can be represented as

$$E(U_p^{*}) = E \left[ \theta \left( \frac{1}{2} \frac{vs + d\mu}{v + d} \right) - \frac{1}{4} \left( \frac{vs + d\mu}{v + d} \right)^2 \right] = \frac{\mu^2}{4} + \frac{v^2}{4(v + d)}$$

Second, we examine the case when the principal pursues decentralized IT governance. In this case, the agent decides the level of IT investment. Since the agent maximizes its own payoff, the IT investment satisfies $I^d \in \max D(U_a)$ (the superscript $D$ denotes the case of decentralization). Also, since the agent always observes $\theta$, its payoff conditional on observing $\theta$ can be represented as $U_a = \theta \sqrt{I} - (1 - a)I$. The FOC $\partial U_a / \partial I = 0$ yields the optimal IT investment

$$I^d = \left[ \frac{\theta}{2(1 - a)} \right]^2$$

Therefore, the principal’s expected payoff in the case of decentralization can be represented as
Comparing (3.3) with (3.4), the principal will choose centralized IT governance when  \( E\left[U_r^c\right] \geq E\left[U_r^b\right] \), and choose decentralized IT governance if  \( E\left[U_r^c\right] < E\left[U_r^b\right] \). To help understand the trade-off between the need for information processing and the moral hazard problem, we can rewrite the principal’s expected payoff in the centralization case as

\[
E\left[U_r^c\right] = E\left(\frac{\theta^2}{2(1-a)} - \frac{\theta^2}{4(1-a)^2}\right) = \left(1 - \frac{2a}{1-a}\right)\left(\frac{\mu^2 + v}{4}\right)
\]  

(3.5)

and the principal’s expected payoff in the decentralization case as

\[
E\left[U_r^b\right] = \mu^2 + \frac{v}{4} - \left(\frac{a}{1-a}\right)^2 \left(\frac{\mu^2 + v}{4}\right)
\]  

(3.6)

Note that the first term in (3.5) and (3.6), \( \frac{\mu^2 + v}{4} \), represents the principal’s expected payoff if it always observes the state of the world \( \theta \) and adopts centralized IT governance. The second term in (3.5), \( \frac{\mu^2 + v}{4} \left(\frac{d}{v + d}\right) \), represents the cost of information disadvantage, i.e., the cost induced by the principal’s inability to always observe the state of the world. The second term in (3.6), \( \left(\frac{a}{1-a}\right)^2 \left(\frac{\mu^2 + v}{4}\right) \), represents the agency cost, i.e., the cost induced by the agent’s incentive to overinvest. The choice between centralization and decentralization can then be determined by the comparison between the cost of information disadvantage associated with centralization and the agency cost associated with decentralization. Proposition I summarizes the optimal solution for the principal (due to the page limit, the mathematic details of proof are not included in the paper but are available from the authors upon request).

**Proposition I.**

1) When the agent has too much private incentive to overinvest (\( a \geq \frac{1}{2} \)), the principal chooses centralized IT governance;  
2) When the agent has limited private incentive to overinvest (\( a < \frac{1}{2} \)), principal’s choice of IT governance depends on its information disadvantage and environmental uncertainty. When his information disadvantage is small (\( d \leq \frac{\mu^2 a}{1-4a(1-a)} \)), the principal chooses centralized IT governance. When his information disadvantage is significant (\( d > \frac{\mu^2 a}{1-4a(1-a)} \)), the principal’s choice of IT governance depends on environmental uncertainty \( v \):
   2.1) when environmental uncertainty is small (\( v \leq v^1 \)), the principal chooses centralized IT governance;  
   2.2) when environmental uncertainty is of an intermediate value, (\( v^1 < v < v^2 \)), the principal chooses decentralized IT governance;  
   2.3) when environmental uncertainty is large (\( v^2 \leq v \)), the principal chooses centralized IT governance.

Proposition I indicates that it is always optimal for the principal to centralize the IT governance when the agent has too much private incentive to overinvest or when it has little information disadvantage compared to the agent. In these two cases, the level of environmental uncertainty does not affect the principal’s decision. Therefore, we focus on the more interesting and relevant case illustrated by Proposition I.2.1-I.2.3 where the level of environmental uncertainty affects the principal’s decision.

As Proposition I.2.1 states, when the degree of environmental uncertainty (\( v \)) is small enough, the principal chooses centralized IT governance. This is consistent with the suggestion in prior literature that centralized IT governance is more likely to be adopted in stable environments (Allen and Boynton 1991). In this case, the cost of information disadvantage is smaller than the agency cost. The gain of decentralization, represented by \( E\left[U_r^c\right] - E\left[U_r^b\right] \), is negative and decentralization is dominated by centralization. However, as stated in Proposition I.2.3, in a highly uncertain environment where \( v \) is sufficiently large, it is also optimal for the principal to choose centralized IT governance. In this case, the agency cost is large enough to exceed the cost of information disadvantage. Proposition I.2.2 reveals that the principal chooses decentralized IT governance only when the environmental uncertainty is of an intermediate value, i.e. \( v^1 < v < v^2 \). The key
implication here is that when $v$ is large, the agency cost associated with decentralized IT governance can also be high and eventually offset the benefit of local information brought about by decentralization. Proposition II further characterizes the benefit of decentralization.

**Proposition II.** The gain of decentralization, defined by $E[U^D_f] - E[U^C_f]$, first increases and then decreases in environmental uncertainty $v$.

Proposition II indicates that there is an inverted-U-shaped relationship between the benefit of decentralization and environmental uncertainty. Using a numerical example with $a = 0.3$, $\mu = 1$, and $d = 2$, Figure 1 presents how the gain of decentralization changes with environmental uncertainty $v$. As Figure 1 illustrates, when $v < 0.26$, the gain of decentralization is negative since the cost of information disadvantage is lower than agency cost. In this case, it is optimal for the principal to choose centralization. When $v < 2.67$, the gain of decentralization is increasing in $v$. However, when $v$ exceeds 2.67, the gain of decentralization starts to decrease in $v$. When $v > 7.6$, the gain of decentralization is also negative. In this case, it is also optimal for the principal to adopt centralization. Only when $0.26 < v < 7.6$, the gain of decentralization is positive (since the cost of information disadvantage is higher than agency cost) and thus the principal finds it optimal to delegate decision-making to the agent.

![Figure 1. The Gain of Decentralization as a function of Uncertainty $v$](image)

**EMPIRICAL EVIDENCE**

To test the analytical result of an inverted-U-shaped relationship between environmental uncertainty and IT governance, we conduct an empirical study using a unique dataset on IT purchase decision at the business unit level. The data on IT governance is obtained from the *CI Technology Database*. This database contains information about the IT infrastructure in over 500,000 sites in the United States and Canada. The information in the database covers 10 key IT areas, including personal computing, systems and servers, networking, software, storage, and managed services. This database has been used in existing IS literature (e.g., Hitt 1999). *CI* database also records three types of IT decision at each business site: PC purchasing decision, server purchasing decision, and network purchasing decision. For each decision, the database indicates whether this decision is made by the headquarters (represented as “Parent”) or by the business units (represented as “Local”). In other words, the *CI* database captures the degree of centralization/decentralization in IT purchasing decision at the site-level. From this database, we build our data sample containing 455 business unit sites, all of which belong to Fortune 1000 companies. Since our measures of environmental uncertainty are based on data over a 5-year period from 2001 to 2005 (see below for details), we select those business unit sites with no significant change in their IT governance pattern within this 5-year period.

We also complement our dataset with two other data sources. First, we use *Compustat Segment* database to measure environmental uncertainty for each business site. Following strategy literature, we measure environmental uncertainty using three variables: dynamism, munificence, and complexity (details are provided below). Second, we measure the business relatedness between each site and its headquarters using industry date from the Bureau of Economic Analysis. Following prior
literature (e.g., Fan and Lang 2000), we measure the business relatedness using three variables: vertical relatedness ($StVI$), horizontal relatedness ($StHC$), and product market diversification ($StDiv$). Vertical relatedness captures the degree of vertical integration between the division and the headquarter in terms of buying and selling activities. Horizontal relatedness captures commonality between the division site’s and the headquarter site’s buying and selling processes. Product market diversification is measured by the difference between the division’s and the headquarter’s participation in different NAICS industries. These variables are used as control variables in our empirical model.

**Operationalization**

We use a binary variable $ITDec$ to indicate whether a business site adopts more centralized decision-making or more decentralized decision-making in IT purchasing. Since there are three types of IT purchase decision (i.e., PC, server, network) recorded for each site, if at least two decisions are made by local managers, we set $ITDec=1$, which means that the business site adopts a more decentralized decision-making in IT purchasing. Otherwise, if at least two decisions are made by the headquarter site, we set $ITDec=0$, which means that the business site adopts a more centralized decision-making in IT purchasing.

Following Keats and Hitt (1988), we measure 3 environmental variables: dynamism ($Dyn$), munificence ($Mun$), and complexity ($Cmpx$) (Keats and Hitt, 1988). Dynamism captures the uncertainty in demand, munificence captures the sales growth in an industry, and complexity captures the uncertainty caused by competition. Dynamism and munificence are measured using a two-step procedure. First, the natural logarithm of the total sales of four-digit NAICS industries is regressed against an index variable of years over a period of five years. Then the antilog of the standard error of the regression coefficient is used as the measure for dynamism, and the antilog of the regression coefficient is used as the measure for munificence. To measure complexity, we first run a regression of market shares of all firms in an industry against their market shares five years ago. Then the regression coefficient of the independent variable is taken as the measure of complexity.

We also have the following control variables. First, we use the ratio of IT employees to total employees as a control variable for the IT knowledge at the site-level. Second, we use the logarithm of the site’s total employee as a control variable for the site’s size. Table 2 presents the descriptive statistics of the key variables and correlation among them. As Table 1 illustrates, the degree of decentralization has a negative correlation with all of the three environmental factors. This suggests that more decentralized IT governance is not adopted in highly uncertain environments.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>$ITDec$</th>
<th>$StVI$</th>
<th>$StHC$</th>
<th>$StDiv$</th>
<th>$Dyn$</th>
<th>$Mun$</th>
<th>$Cmpx$</th>
<th>$ITEmp$</th>
<th>$StEmp$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ITDec$</td>
<td>1.66</td>
<td>0.47</td>
<td>1</td>
<td>-0.92</td>
<td>-0.53</td>
<td>0.07</td>
<td>-0.127*</td>
<td>-0.094*</td>
<td>-0.107*</td>
<td>-0.063</td>
<td>0.190**</td>
</tr>
<tr>
<td>$StVI$</td>
<td>0.08</td>
<td>0.11</td>
<td>-0.92</td>
<td>1</td>
<td>3.90**</td>
<td>-3.17**</td>
<td>0.406**</td>
<td>-0.261**</td>
<td>0.301</td>
<td>0.160**</td>
<td>-0.014</td>
</tr>
<tr>
<td>$StHC$</td>
<td>0.67</td>
<td>0.34</td>
<td>-0.53</td>
<td>3.90**</td>
<td>1</td>
<td>-7.56**</td>
<td>0.186*</td>
<td>0.042</td>
<td>0.096</td>
<td>0.010</td>
<td>0.047</td>
</tr>
<tr>
<td>$StDiv$</td>
<td>0.99</td>
<td>0.80</td>
<td>0.070</td>
<td>-3.17**</td>
<td>-7.56**</td>
<td>1</td>
<td>-2.04**</td>
<td>-0.074</td>
<td>-0.169**</td>
<td>0.077</td>
<td>-0.158**</td>
</tr>
<tr>
<td>$Dyn$</td>
<td>1.19</td>
<td>0.14</td>
<td>-1.27**</td>
<td>0.406**</td>
<td>0.186**</td>
<td>-2.04**</td>
<td>1</td>
<td>-0.405**</td>
<td>0.129**</td>
<td>0.088</td>
<td>0.041</td>
</tr>
<tr>
<td>$Mun$</td>
<td>0.96</td>
<td>0.20</td>
<td>-0.94**</td>
<td>-2.61**</td>
<td>0.042</td>
<td>-0.074</td>
<td>-4.05**</td>
<td>1</td>
<td>0.420**</td>
<td>-0.117**</td>
<td>0.028</td>
</tr>
<tr>
<td>$Cmpx$</td>
<td>0.96</td>
<td>0.66</td>
<td>-1.07**</td>
<td>0.031</td>
<td>0.96**</td>
<td>-1.69**</td>
<td>0.129**</td>
<td>0.420**</td>
<td>1</td>
<td>0.084</td>
<td>-0.004</td>
</tr>
<tr>
<td>$ITEmp$</td>
<td>0.18</td>
<td>0.12</td>
<td>-0.063</td>
<td>0.160**</td>
<td>0.010</td>
<td>0.077</td>
<td>0.088</td>
<td>-1.17**</td>
<td>0.084</td>
<td>1</td>
<td>-0.344**</td>
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<td>$StEmp$</td>
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<td>0.59</td>
<td>0.190**</td>
<td>-0.014</td>
<td>0.047</td>
<td>-1.58**</td>
<td>-0.041</td>
<td>0.028</td>
<td>-0.004</td>
<td>-0.344**</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1. Descriptive Statistics and Correlation Table

** $p < 0.01$ (2-tailed); * $p < 0.05$ (2-tailed); N=455

**The Inverted-U-Shaped Relationship**

We examine how environmental uncertainty influences decentralization in IT purchasing decisions. We use a series of binary logistic regression models to test the relationship between the environmental uncertainty and the adoption of decentralized IT governance at each business site. The logistic regression models are represented as follows,
Logit \( (P) = \beta_0 + \beta_1 Dyn_i + \beta_2 Mun_i + \beta_3 Cmpx_i + \beta_4 ITEmp_i + \beta_5 StVI_i + \beta_6 StHC_i \)
\[ + \beta_7 StDiv_i + \beta_8 StEmp_i + \beta_9 Unc_i^2 + e_i \] (4.2)
where \( P = \text{Prob}(ITDec_i = 1) \) and \( Unc = \{Dyn, Mun, Cmpx\} \). Note that the dependent variable \( ITDec \) is coded as a binary variable with value 0 (centralization) or 1 (decentralization). The logistic regression model basically captures how different organizational variables (such as \( StVI \) and \( ITEmp \)) and environmental variables (i.e., \( Dyn, Mun, Cmpx \)) influence the probability of adopting a more decentralized IT purchasing decision at each business site. By including a square term \( Unc^2 \) in the estimation model (4.2), we examine a nonlinear relationship between each environmental variable and the decentralization in IT purchasing decision. The results are presented in Table 2.

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficients</td>
<td>p-value</td>
<td>Coefficients</td>
</tr>
<tr>
<td>(Constant)</td>
<td>-11.435</td>
<td>6.421</td>
<td>-2.182</td>
</tr>
<tr>
<td>Dyn</td>
<td>22.637</td>
<td>.033</td>
<td>-.416</td>
</tr>
<tr>
<td>Mun</td>
<td>-2.773</td>
<td>.001</td>
<td>5.626</td>
</tr>
<tr>
<td>Cmpx</td>
<td>.039</td>
<td>.844</td>
<td>.035</td>
</tr>
<tr>
<td>ITEmp</td>
<td>-.107</td>
<td>.906</td>
<td>-.148</td>
</tr>
<tr>
<td>StVI</td>
<td>-1.919</td>
<td>.087</td>
<td>-2.371</td>
</tr>
<tr>
<td>StHC</td>
<td>.379</td>
<td>.444</td>
<td>.463</td>
</tr>
<tr>
<td>StDiv</td>
<td>.195</td>
<td>.352</td>
<td>.188</td>
</tr>
<tr>
<td>StEmp</td>
<td>.687</td>
<td>.001</td>
<td>.615</td>
</tr>
<tr>
<td>Dyn^2</td>
<td>-9.831</td>
<td>.019</td>
<td></td>
</tr>
<tr>
<td>Mun^2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cmpx^2</td>
<td>-3.993</td>
<td>.016</td>
<td></td>
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<tr>
<td>Pseudo-R^2</td>
<td>0.129</td>
<td>0.127</td>
<td>0.131</td>
</tr>
</tbody>
</table>

Table 2. Logistic Model Results

Note: 1. Dependent Variable: \( \text{Logit}(P) \); 2. \( N = 455 \); 3. ** \( p < 0.01 \); * \( p < 0.05 \); † \( p < 0.1 \).

As Table 2 indicates, for model 1, the coefficient of \( Dyn \) is positive and significant, and the coefficient of \( Dyn^2 \) is negative and significant. This suggests that the increase of dynamism first increases and then decreases the probability of adopting decentralized IT purchase decision, i.e., an inverted-U-shaped relationship. Also, for model 2, the coefficient of \( Mun \) is positive and significant, and the coefficient of \( Mun^2 \) is negative and significant. This suggests that the increase of munificence first increases and then decreases the probability of adopting decentralized IT purchase decision. For model 3, the coefficient of \( Cmpx^2 \) is negative and significant; the coefficient of \( Cmpx \), although insignificant, is still positive. Therefore, the results generally support the implication of our analytical model that the relationship between environmental uncertainty and the likelihood of adopting decentralized IT governance is an inverted-U-shaped relationship.

Figure 2 indicates an inverted-U-shaped relationship between the probability of decentralized IT purchasing decision and dynamism (with other independent variables at their mean values). When the absolute value of dynamism is small (i.e., \( Dyn < 1.16 \)), the probability of adopting decentralized IT purchase decision at a certain business site increases if dynamism increases. However, when the absolute value of dynamism is large (i.e., \( Dyn > 1.16 \)), the probability of adopting decentralized IT purchasing decision decreases in dynamism. Figure 3 shows a similar relationship between the probability of decentralized IT purchasing decision and munificence. The shapes of curves in Figure 2 and 3 are identical in nature to that in Figure 1. Therefore, the empirical study provides a general support for the implications of the theoretical model.
DISCUSSION AND CONCLUSION

Based on principal-agent theory, this study builds an analytical model to explain how environmental uncertainty influences the organization’s IT governance. The key insight of this model is that environmental uncertainty impacts IT governance through two countervailing forces. On one hand, organizations in highly uncertain environments tend to adopt decentralized IT governance to leverage local managers’ information advantage. On the other hand, highly unstable environments can induce managers to behave more strategically (the moral hazard problem) and exaggerate the agency cost. Therefore, the model suggests that decentralized IT governance may not be desirable in both the highly static environments and the highly uncertain environments. In highly static environments, the benefit of decentralization (i.e., the local managers’ information advantage) is not significant enough, and firms do not have strong need for responsiveness. Highly unstable environments, on the other hand, may induce more strategic behaviors by the agents. In this case, the agency cost can be very high and offset the benefit of decentralization. Moreover, the analysis suggests that as environmental uncertainty increases, the benefit of decentralization first increases and then decreases, exhibiting an inverted-U shape. Using a dataset of business sites, the empirical study in this paper confirms the key findings of the theoretical analysis.
This study calls for further consideration of the impact of the moral hazard problem and agency cost on IT governance. Hann and Weber (1996) find in their study that more delegation in decision-making is not associated with higher ex post agency cost. In their study, ex post agency cost refers to the cost of ensuring that the agent acts in accordance with the overall goals of the organization. In our study, agency cost is considered as economic loss (or inefficiency) caused by the strategic behaviors of the agent. Although the notion of agency cost in Hann and Weber (1996) is different from that in our study, their finding still provides an indirect support for our argument. Kahai, et. al. (2001) also find in their study on Fortune 1000 companies that the decision authority of IT management is more centralized than the allocation of IT resources. Their explanation is that organizations seek to centralize their decision-making on hardware and software to save costs and avoid unrestricted proliferation. Excess expenditure and unrestricted proliferation can also be considered as examples of the agency cost.

One limitation of this study is that the IT purchasing decision in this study is mainly about hardware infrastructure. The decision making about other aspects of IT, such as software management and project management, may have different features. For example, the adoption of ERP systems may require centralized governance of software management, even though the hardware purchasing decision can be decentralized. Future studies may focus on different aspects of IT governance and explore whether environmental factors have similar influences on those aspects. The second limitation is that we did not directly measure the extent of agency cost. One direction for future research is to directly measure the extent of agency cost and explicitly study whether agency cost tends to be higher in uncertain environments.

REFERENCES


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