

Information Technology and Firm Boundaries: Impact on Risk-Return Profile

WISE 2006 Extended Abstract

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In this empirical study, we investigate the effects of IT investments on firm risk-return profile, emphasizing the complementarities between IT investments and firm boundary strategies; i.e., diversification and vertical integration. Our results are consistent with a strong moderating role of IT in leveraging firm boundary strategies on both the return and risk dimensions of firm financial performance — higher return and lower risk.

1. Introduction

IT investment has become the largest component of capital investment for most U.S. firms. Data from McKinsey Global Institute shows an average growth rate of 20.2% in IT investment from year 1995 to 2000 as compared to 2.5% growth in labor productivity of U.S. economy. The key question for individual firms is whether and how their growing IT investments can be translated into profits and competitive advantage — which was also the topic of intense debate surrounding the “Does IT Matter?” question posed by Carr (2003). While most IS researchers reject the claim in Carr (2003) that IT cannot provide competitive advantage, *how* IT investments can be combined with firm strategies to yield such advantage is still a rich open question, and one that motivates this work.

In this research, we examine how IT investments interact with the choice of firm boundaries — an important component of overall business strategy — in affecting firm financial performance. We consider both return and risk dimensions of financial performance, following the lead of emerging research in the IT investments literature (see e.g., Dewan, Shi and Gurbaxani 2006, Tanriverdi and Ruefli 2004) that highlight the importance of IT risk-return considerations. We address the following research questions: What are the direct and indirect (moderating) impacts of IT investments on firm performance? How do IT investments interact with firm boundaries in affecting the risk-return profile of the firm? How does the consideration of IT risk affect the estimation of IT returns?

Although risk and return are the two major dimensions of firm performance and they are interrelated, the risk consideration has been largely ignored in the IT business value literature. In fact, there has been ample anecdotal evidence suggesting that IT investments can be quite risky. Incorporating risk into the analysis would give us a more comprehensive understanding of the impact of IT on firm performance. Emerging IS research has been looking at the risk-return of IT investments. For example, Dewan et al (2005) investigate the relationship between IT risks and IT returns; Tanriverdi and Ruefli (2004) propose a conceptual model to study the impact of IT investments on the risk-return relations of firms. In this study, we conduct an empirical analysis to investigate the direct and indirect effects of IT investments on firm risk-return profile. Also, by emphasizing the moderating role of IT investments, we seek to understand how IT can be used to leverage other firm resources in creating competitive advantage. Specifically, we are focusing on resource allocations underlying the choice of firm boundaries, building on prior

work on IT and firm boundaries in the IS literature (Malone et al 1987, Gurbaxani and Whang 1991, Dewan et al 1998, Hitt 1999).

2. Theory and Hypotheses

Prior work in the IS literature has examined both the direct and moderating effects of IT investments on firm performance. While some studies posit a direct relationship between IT and firm performance, others have questioned the direct-effect argument and emphasized the complementarity between IT investments and other firm resources in achieving firm performance. For example, Powell and Dent-Micallef (1997) find that firms gain competitive advantage by using IT to leverage complementary human and business resources. Clemons and Row (1991) argue that IT can lead to sustainable competitive advantage when it is used to leverage structural differences between firms.

Building on prior work, we examine the complementarity between IT investments and firm boundary strategies (diversification and vertical integration), and how it affects financial performance on both the return and risk dimensions. Complementarities arise when firm resources are utilized in a mutually reinforcing manner (Ravichandran and Lertwongsatien 2005). In this study's research context, complementarities arise when IT is used to leverage firm boundary strategies in the way of coordinating activities among business units or in the value chain. Our research model is illustrated in Figure 1, which is followed by a brief development of our hypotheses.

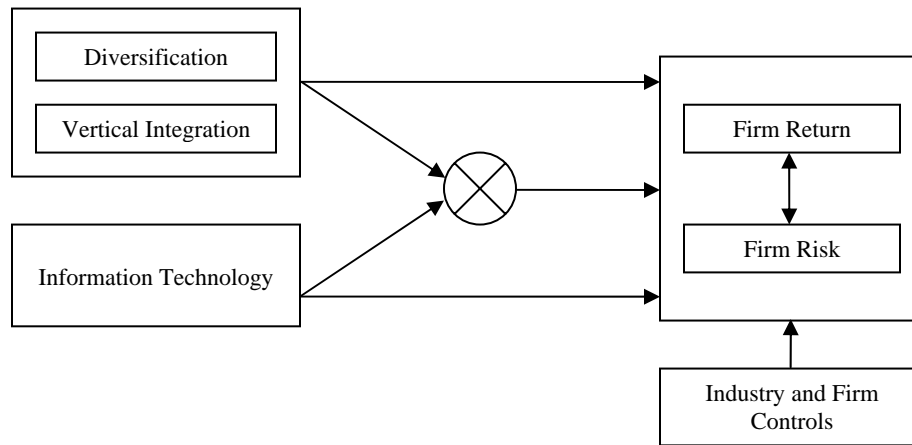


Figure 1: Research model relating firm boundaries, IT investment and risk-return performance

Diversification refers to the extent to which a firm operates in multiple lines of business. Firms diversify in response to excess capacity in resources or productive factors that cannot be efficiently sold in the market. Diversification increases internal coordination because it is associated with the sharing of such resources or productive factors across multiple lines of business or organizational units (Dewan et al. 1998). Moreover, the realization of synergistic gains can require interdivisional coordination by the corporate center (Jones and Hill 1988). The increased coordination demands for IT because IT can reduce the coordination costs (Malone et al 1987, Gurbaxani and Whang 1991, Dewan et al 1998, Hitt 1999). Moreover, diversified firms can use IT applications to exploit scale and scope economies in certain key strategic resources common to several lines of business or organizational units (Clemons and Row 1991). All of

these indicate that IT can be used to leverage firm diversification strategy in achieving better performance.

H1a: *The complementary effect between IT and firm diversification is positively associated with firm return.*

H1b: *The complementary effect between IT and firm diversification is negatively associated with firm risk.*

Vertical integration, which refers to the extent to which successive activities in a value chain are conducted within a firm, incurs more internal coordination and operations costs for the sake of external coordination (Gurbaxani and Whang 1991). Vertical integration is one of the most expensive strategies to coordinate because it is based on sequential interdependence where resource flows from one division to the next must be coordinated (Jones and Hill 1988). IT, however, can reduce the internal coordination costs and the operations costs induced by vertical integration strategies. For example, IT reduces the operations costs of a firm in the ways of intensified economies of scale in operation and increased degree of flexibility in production (Gurbaxani and Whang 1991). Porter and Millar (1985) relate IT to the value chain and argue that the main strategic purpose of IT is to coordinate activities in the chain. Complementary investment in IT with firm vertical integration decisions may confer competitive advantages.

H2a: *The complementary effect between IT and firm vertical integration is positively associated with firm return.*

H2b: *The complementary effect between IT and firm vertical integration is negatively associated with firm risk.*

3. Empirical Model and Data

Based on our theory and hypotheses, the empirical model specifications are as follows:

$$\begin{aligned} \text{Ret}_{it} = & \alpha_0 + \alpha_1 IT_{it} + \alpha_2 TD_{it} + \alpha_3 VI_{it} + \alpha_4 IT_{it} * TD_{it} + \alpha_5 IT_{it} * VI_{it} + \alpha_6 \text{Risk}_{it} + \alpha_7 K_{it} + \alpha_8 R \& D_{it} \\ & + \alpha_9 AD_{it} + \alpha_{10} \text{Size}_{it} + \alpha_{11} \text{Leverage}_{it} + \alpha_{12} \text{IndConc}_{it} + \alpha_{13} \text{IndCI}_{it} + \alpha_{14} \text{IndQ}_{it} + \alpha_{15} \text{IndReg}_{it} \quad (1) \\ & + (\text{Year}) + \varepsilon_{it} \end{aligned}$$

$$\begin{aligned} \text{Risk}_{it} = & \beta_0 + \beta_1 IT_{it} + \beta_2 TD_{it} + \beta_3 VI_{it} + \beta_4 IT_{it} * TD_{it} + \beta_5 IT_{it} * VI_{it} + \beta_6 \text{Ret}_{it} + \beta_7 K_{it} + \beta_8 R \& D_{it} \\ & + \beta_9 AD_{it} + \beta_{10} \text{Size}_{it} + \beta_{11} \text{Leverage}_{it} + \beta_{12} \text{IndConc}_{it} + \beta_{13} \text{IndCI}_{it} + \beta_{14} \text{IndQ}_{it} + \beta_{15} \text{IndReg}_{it} \quad (2) \\ & + (\text{Year}) + \varepsilon_{it}. \end{aligned}$$

The dependent variables Ret_{it} and Risk_{it} denote firm return and firm risk, measured by average and standard deviation of one-year quarterly ROA (accounting-based), and average and standard deviation of one-year monthly stock returns (market-based) following the IT investment of firm i in year t . Key independent variables include IT_{it} = IT capital stock, normalized by total assets; TD_{it} = entropy measure of total diversification; VI_{it} = vertical integration, measured by value-added/sales; Complementary effects are operationalized as the interaction terms $IT_{it} * TD_{it}$ and $IT_{it} * VI_{it}$. We include other five firm characteristics, four industry variables, and year dummies as controls. Following prior research, we put firm return, risk, and leverage as

endogenous variables and use 3SLS instead of OLS to estimate the regression models (1) and (2). Moreover, the Hausman specification test also suggests that 3SLS is preferred to OLS or 2SLS. As a benchmark, however, we still present results from OLS estimation.

We obtain firm-level IT stock data from the Computer Intelligence Infocorp (CII) database, which covers over 500 *Fortune 1000* firms during years 1987-1994. The Compustat database provides accounting data for our analysis, and the market-based data is obtained from CRSP. We deal with outliers by using the standard winsorization procedure, and discard the observations with missing values. The final sample consists of 3,100 firm years. Besides, we center the independent variables because both correlation matrix and multicollinearity test show a collinearity problem on the interaction terms.

4. Preliminary Empirical Results

Estimation results for the model based on accounting measure of firm return and risk are presented in Table 1 (only key variables shown). For the return model, IT does not affect firm return significantly. However, the interaction terms between IT and firm boundaries (IT*TD, IT*VI) have positive and significant impact. For the risk model, although IT significantly increases firm risk in the direct effect, it also reduces firm risk significantly through its interactions with firm boundaries. Coefficient estimates of other independent variables are consistent with prior literature. While analyses of market-based measure and robustness checks are in progress, our preliminary results are consistent with the results shown here. Put together, our results show that IT investments are associated with a strong complementarity with firm boundaries — not only in terms of increased firm returns, but also through reduced firm risk. We feel this is a new and meaningful contribution to the existing literature on the business value of IT.

Variable	Return Model		Risk Model	
	OLS	3SLS	OLS	3SLS
IT	0.038 (0.032)	-0.042 (0.034)	0.140 ^{***} (0.029)	0.148 ^{***} (0.031)
TD	-0.005 ^{***} (0.0004)	-0.004 ^{***} (0.0004)	-0.003 ^{***} (0.0004)	-0.001 ^{**} (0.0004)
VS	0.005 ^{***} (0.001)	0.008 ^{***} (0.001)	-0.002 [*] (0.001)	-0.005 ^{***} (0.001)
IT*TD	0.086 [*] (0.052)	0.186 ^{**} (0.055)	-0.140 ^{***} (0.047)	-0.224 ^{***} (0.050)
IT*VS	0.318 ^{**} (0.160)	0.600 ^{***} (0.169)	-0.382 ^{***} (0.144)	-0.664 ^{***} (0.153)
Adj. R ²	0.423	0.262 [†]	0.196	0.262 [†]

Notes: ^{***}, ^{**} and ^{*} denote significance at 1%, 5% and 10%, respectively, for two-tailed test.

[†] System weighted R² from 3SLS estimation. Standard errors are in parentheses.

Table 1: Estimation results for direct and indirect effects of IT on firm risk-return

5. Conclusions

Prior research in the IT business value literature has inconclusive findings on IT profitability. We seek to investigate the underlying mechanism by which IT can lead to competitive advantage, by focusing on the complementary effects between IT and firm boundaries. Our results confirm

such a complementarity, and show that it applies to both the return and risk dimensions of firm performance. Specifically, a new insight emerging from this research is that while IT investments by themselves are risky, strategic use of IT in leveraging firm resources can result in lower firm risk. These preliminary results and insights suggest the viability of this project, and we hope to present a more comprehensive analysis at WISE'06.

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