The Impact of Information Technology on the Performance of Diversified Firms

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Abstract

Diversification may increase economic benefits through more efficient utilization of business resources across multiple markets. However, the benefits of these scope economies are often not realized due to costs of coordinating resources in multiple markets. Information technology (IT) is widely used to achieve more efficient coordination by reducing the costs of coordinating business resources across multiple markets. Because of the need for coordination of business resources across multiple markets, diversification can increase the demand for IT. But does increased use of IT improve the performance of firms that are highly diversified? This research tackles this question by undertaking an empirical study of the impact of IT on the performance resulting from diversification, particularly related diversification. The empirical aspect of this subject has received little attention from previous information systems (IS) and economics research. This research also sheds light on the business value of IT by showing the importance of the complementarity of IT and diversification in firm performance, which has also received limited attention in prior IS research.

Keywords

Information technology, coordination, diversification, performance

1. Introduction

Firms diversify by extending the scope of their operations into multiple markets. A diversification strategy is pursued when firms have opportunities embedded in market structures and technology as well as opportunities for growth in the firm's basic business (Chandler 1977). In other words, firms diversify when they have consolidated their position in their base industry and hold underutilized resources usable in other sectors at low opportunity cost (Chandler 1962). Thus, diversification may increase economic benefits through more efficient utilization of business resources across multiple markets (Clarke 1985). However, the benefits of these scope economies are often not realized due to costs of coordinating resources in multiple markets (Montgomery 1994). Information technology (IT) is widely used to achieve more

efficient coordination by reducing the costs of coordinating business resources across multiple markets, thus leveraging the economic benefits of diversification.

Previous information systems (IS) research has examined the relationship between IT and diversification based on the speculation that IT can affect firm structure by reducing the costs of coordinating economic activities within and between firms (Dewan, Michael & Min 1998, Hitt 1999). After examining the relationship between IT and diversification, Dewan et al. (1998) found that diversified firms, especially in related lines of business, make greater investments in IT. They argue that their findings might reflect a greater need for coordination of assets within diversified firms. Hitt (1999) provides similar findings from his analysis of the link between IT and diversification: firms that were more diversified had a higher demand for IT capital. He also argues that increased use of IT is associated with a slight increase in diversification.

Diversification can increase the demand for IT because of the need for coordination of business resources across multiple markets. But does increased use of IT improve the performance of firms that are highly diversified? The answer is probably positive. However, few studies, including the prior research mentioned above, have provided empirical evidence to support this answer. This paper examines the performance impact of IT on diversified firms with the aim of providing empirical evidence for a link between the two.

2. Theoretical Background

2.1 Prior Research on Diversification and Its Performance

According to economics theory, a firm is a collection of physical, human and intangible resources capable of undertaking a number of separate activities. Some resources may be relatively product-specific. They are thus utilized to produce a particular good or service through one business line. Other resources, however, may have the potential to increase production of goods or services in multiple business lines. If such resources are insufficiently utilized in the firm's current operations, then it may be worthwhile to expand their use. In this case, the firm will use the resources by diversifying its operation into multiple markets (Caves, Porter, Spence & Scott 1980, Clarke 1985).

A firm can diversify its operations into related markets (e.g., TV and VCR or automobile and truck) in order to achieve economic benefits by sharing human or physical resources across markets. According to Hill (1988), firms pursue related diversification in order to realize economic benefits from the exploitation of the interrelationships between divisions, i.e., by sharing physical resources to achieve economies of scope and sharing marketing or technological know-how to realize economies of scale. When a firm pursues related diversification, however, achieving tangible economic benefits depends on increased coordination and communication among the different business lines (Hill & Hoskisson 1987, Hill 1994). Thus, when a firm pursues related diversification, it should consider the costs of coordinating resources, including the costs of information sharing, across related markets (Williamson 1975).

A firm can also diversify its operations into unrelated markets (e.g., TV and automobile) in order to realize economic benefits from the exploitation of an internal capital market. This is possible because capital can be more efficiently allocated in an internal market than in external markets. To achieve benefits from an internal capital market, the firm must establish operating autonomy and a monitoring apparatus, i.e., a system within which divisions can be held accountable for their performance. This facilitates least-cost behavior and the efficient allocation of capital resources within the firm (Hill 1988). However, firms pursuing related diversification cannot realize benefits from an internal capital market because the interrelationships between divisions require centralized decision-making in order to facilitate coordination between divisions. Because centralized decision-making makes it difficult to determine the efficiency of individual divisions, the firm increases the amount of information it processes in order to overcome this equivocality problem (Hill 1988). In the case of unrelated diversification, there are no interrelationships between divisions, i.e., sharing business resources such as managerial expertise and technical knowledge. Thus, unrelated diversification does not require as much coordination as related diversification (Hill & Hoskisson 1987, Hill 1994).

Many economics and business policy researchers have examined the performance of diversified firms (Rumelt 1974, 1982, Caves et al. 1980, Lecraw 1984, Montgomery 1985, 1994, Palepu 1985, Montgomery & Wernerfelt 1988, Wernerfelt & Montgomery 1988). The general conclusion from this previous research is that unrelated diversification has not led to improved firm performance. The researchers found that firms pursuing related diversification – that is, diversification built on firms' strengths in their basic activities – were, on average, more profitable than firms diversifying into unrelated areas. Wernerfelt and Montgomery (1988) explain the performance differences by pointing out the increased efficiency firms realize from transferring competencies to widely varying markets. Unrelated diversification may increase market-related risks, but it can achieve efficient capital management. On the other hand, related diversification can lead to higher corporate performance, when compared to unrelated diversification, by focusing on core organizational capabilities and by exploiting interrelationships between business lines, i.e., by sharing business resources. However, as mentioned earlier, the realization of economic benefits from related diversification is highly dependent on increased coordination and information processing across related businesses, i.e., whether or not special technologies, production skills, industry knowledge, distribution channels, input sources, and research facilities of one business are easily transferable and usable by the other.

2.2 Prior Research on IT and Diversification

IT is widely used to share information and coordinate business resources such as physical resources, managerial expertise, technical knowledge, and market information across multiple markets (Malone, Yates & Benjamin 1987, Gurbaxani & Whang 1991, Clemons, Reddi & Row 1993). By lowering the costs of sharing information and coordinating business resources, IT can enable scope economies and efficient utilization of business resources across multiple markets. After examining what types of firms make the largest investments in IT, Dewan et al. (1998) argue that diversification, particularly related diversification, is likely to increase a firm's demand for IT because the scope of the firm increases the need for coordination and information

processing. According to Hitt (1999), firms diversify into new product markets because IT makes it possible to coordinate diverse production activities. He also argues that increased diversification requires a higher demand for IT capital.

When firms diversify into related business lines by sharing business resources, scope economies inherent in these resources are often not realized due to the costs of coordinating the resources in multiple markets. Because IT reduces the costs of coordinating business resources and provides better means of coordination across multiple markets, firms pursuing related diversification may require increased IT investment. By the same reasoning, increased IT investment may facilitate diversification, particularly related diversification. A firm's IT investment can be the cause or the effect of its diversification. In other words, IT can complement a firm's diversification strategy or vice versa.

According to previous economics research, increased coordination and information sharing across related industries is critical for achieving the economic benefits of diversification. By focusing on the economic benefits of diversification that can be leveraged by IT, this research undertakes an empirical study of the impact of IT on the performance resulting from diversification, particularly related diversification. The empirical aspect of this subject has received little attention from previous IS and economics research. This study employs a more recent data set (1995-1997) than previous IS research (1988-1992 in Dewan et al.'s and 1987-1994 in Hitt's), and uses multiple diversification measures to increase the robustness of the empirical analysis, and to clearly distinguish the results for related diversification and unrelated diversification.

3. Data and Methodology

3.1 Data Sources

This study employs two data sources for the empirical analysis: a data set of IS budgets from 1995 to 1997, collected annually by Information Week, and the Compustat database.

From the Information Week data set, IT intensity is calculated by dividing the IS budget by selling and general administrative expenses. Multiple diversification indexes used in previous research are employed to capture different aspects of diversification: the Entropy index (Jacquemin & Berry 1979), the Concentric index (Caves et al. 1980; Montgomery & Wernerfelt 1988; Wernerfelt & Montgomery 1988), and the Hirschman-Herfindahl index.

Since the Entropy index distinguishes between related and unrelated diversification, the three separate sales-weighted entropy indexes (total diversification, related diversification, and unrelated diversification) can be obtained from the Compustat business segment data. The total diversification index is a weighted average of the sales shares of the different four-digit SIC code industries, where the weight for each industry is the logarithm of the inverse of its share. Related diversification measures the extent of diversification arising from operations in several industries of the same two-digit SIC code industry group. Unrelated diversification measures the extent of diversification arising from extending operations into different two-digit SIC code

industries. The sum of related diversification and unrelated diversification is a measure of total diversification.
The Concentric index measures the degree of distance or relatedness between industries. The weight is given based on industry sales shares. This value depends on the relations between the industries: the weight is zero if a firm's operations are in the four-digit SIC code industries within the same three-digit SIC code industries, one if they are in different three-digit SIC code industries but the same two-digit SIC code industries, two if they are in different two-digit SIC code industries. On the other hand, the Herfindahl index measures industry concentration. This index is defined as one minus the sum of squared shares of a firm's activities in different industries. It takes a value of zero when a firm is completely specialized in its primary industry, and (N-1)/N when a firm operates equally in all N industries.
As a measure of performance, we employ gross margin and performance ratios such as ROA and ROE.

3.2 Methodology

The basic methodology is to analyze the combined data set for three years (1995-1997) using an ordinary least squares (OLS) regression. To analyze the relationship between IT and the performance of diversified firms, the combined three-year sample is divided into three groups of the equal numbers based on the degree of diversification. Then OLS regressions are run for the two groups (high and low diversification). Since we use five diversification indexes (three Entropy, one Concentric, and one Herfindahl), the regressions are run for ten groups (two groups for each diversification index).
To increase the robustness of the study, a separate analysis is conducted with an interaction term of IT and diversification. This interaction term examines the impact of the association (or complementarity) of IT and diversification on firm performance. As in the other analysis, five diversification indexes are employed.

3.3 Model

The basic model measures the relationship between IT and gross margin, ROA or ROE, while controlling for industry- and year-specific effects. This model is run for two groups of samples: high and low diversification.

$$PERFt_{it} = \beta_0 + \beta_1 IT_{it} + \beta_2 INDUSTRY_{it} + \beta_3 YEAR_{it} + \varepsilon$$

where

$PERF_{it}$	= Gross margin, ROA, or ROE of the ith firm in year t
IT_{it}	= IT intensity (IS budget/selling, general, and administrative expenses) of the ith firm in year t
$INDUSTRY_{it}$	= A dummy for industry
$YEAR_{it}$	= A dummy for year
ε	= An error term with zero mean

Since this model employs performance ratio measures as dependent variables and IT intensity (instead of IS budget) as an explanatory variable, we do not employ firm size as a control variable. In order to control for industry- and year-specific effects, dummy variables for each industry categorized by the SIC code and for each year are included. The model is also run separately for the manufacturing and service industry sectors in order to determine if the performance impact of IT on diversified firms differs across sectors.
The model for an interaction term of IT and diversification is as follows:

$$PERFt_{it} = \beta_0 + \beta_1 IT_{it} + \beta_2 DIV_{it} + \beta_3 IT*DIV_{it} + \beta_4 INDUSTRY_{it} + \beta_5 YEAR_{it} + \varepsilon$$

where

$PERF_{it}$	= Gross margin, ROA, or ROE of the ith firm in year t
IT_{it}	= IT intensity (IS budget/selling, general, and administrative expenses) of the ith firm in year t
DIV_{it}	= Diversification index (Entropy, Concentric, and Herfindahl) of the ith firm in year t
$IT*DIV_{it}$	= IT intensity*diversification of the ith firm in year t
$INDUSTRY_{it}$	= A dummy for industry
$YEAR_{it}$	= A dummy for year
ε	= An error term with zero mean

The model includes a variable for diversification as a control variable, in addition to the interaction term, in order to estimate the coefficient of IT more accurately.

4. Expected Contributions

This research empirically examines the relationship between IT and the performance of diversified firms using multiple firm performance and diversification measures. The expected contributions of this research are twofold:

First, it provides empirical evidence for the impact of IT on the performance of diversified firms by focusing on the economic benefits of diversification that can be leveraged by IT, a subject that has received little attention in prior economics and IS research.

This research also sheds light on the business value of IT by showing the importance of the complementarity of IT and diversification in firm performance, which has also received limited attention in prior IS research. Most previous research on the value of IT to financial performance has shown IT's contribution to be minimal, negative, or mixed (Cron & Sobol 1983, Turner 1985, Bender 1986, Markus & Soh 1993, Rai, Patnayakuni & Patnayakuni 1997, Tam 1998). This may indicate that IT investments fail to improve financial performance for some firms, while others show marked improvement (Shin 2001). By grouping firms by extent of diversification and by using an interaction term of IT and diversification, this research demonstrates that the effect of IT on financial performance is not the same for all firms, but may depend on strategic choices such as diversification.

5. ECIS Presentation

The presentation of this research (in progress) will include the results obtained from the empirical analysis, discussion and implications of the findings. This research is currently under the stage of variable construction (multiple diversification indexes).

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