Refocusing Where and How IT Value is Realized: An Empirical Investigation

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This study examines the direct and interaction effects of IT investments and IS department efficiency on different facets of firm performance. Specifically, measures for financial, sales, and intermediate firm performance are considered. IS budget is used as a measure of IT investment; asset turnover and labor productivity are used as intermediate performance measures; and sales per IS employee and income per IS employee are used as measures of IS department efficiency. Secondary sources were used to construct a database of 210 firms, which was used for statistical analysis. Our results suggest that: (i) IS budget is not related to financial firm performance, but is positively related to sales performance; (ii) The results for intermediate performance were mixed; (iii) IS efficiency had no impact on the relationship between IS budget and firm performance measures, except market share. Analysis of the results suggest that the effect of IT investments should be assessed simultaneously on both aggregate and intermediate performance. Furthermore, IS departments with “high” efficiency may be unable to better leverage each additional dollar spent on IT. This has significant implications for organizations considering radical downsizing and elimination of their IS departments, as in the process they could reduce their conversion effectiveness. Copyright © 1996 Elsevier Science Ltd

Key words—information systems, technology, productivity, cost benefit analysis, investment

1. INTRODUCTION

The 1990s has been labeled as the “information era” with Information Technology (IT) playing an increasing role in business organizations. IT provides new forms of customer service, new distribution channels, new information based products, improved productivity, and has the capacity to influence industry structure [8–10, 33]. The strategic value of IT is documented by case histories such as the American Airlines’ reservation system, American Hospital Supply’s order entry, Citibank’s automatic tellers, and Merrill Lynch’s consolidated accounting.

Past achievement is often used as a basis to rationalize increased IT spending. The common logic applied is that if selected organizations report extraordinary success in IT applications, then increased investment should positively impact firm performance. In the 1980s US businesses invested a staggering $1 trillion in IT; in 1992 alone the investment figure was in excess of $150 billion in constant 1987 dollars [7]. As a result investments in information technology today account for an increasing proportion of US capital stock. Investment in the service industry over the 18 year period from 1970 to 1988, has increased from 6.4% to 19.8% of the capital stock. During the same period the percentage increase in the manufacturing sector
has been from 1.6% to 10.6% of the capital stock [37].

Dramatic improvements in IT capabilities have been accompanied with increased IT investments. However, aggregate output statistics do not indicate that any benefits have been realized from investments in IT. Many studies have failed to provide evidence that IT investments leverage the value of the firm [15, 25, 42]. The often referred to “productivity paradox” has been appropriately described as the “clash of expectations and statistics” [5]. Top management today is increasingly questioning the efficacy of investments in IT. Lack of adequate evidence has prompted statements such as “No, computers do not boost productivity, at least most of the time,” which reflects a sentiment questioning the efficacy of IT investments [16, p. 13].

As an area of academic research the IT investment-performance linkage has numerous gaps [1, 25], and has often been criticized. Clemons and Kimbrough [10] comment that the literature largely relies on a common and perhaps overworked collection of examples. Recent studies [6, 22] have produced fresh evidence and put research in the area on a firmer foundation. However, by and far the analysis has been limited to measuring value of IT investments using aggregate firm performance measures such as sales, Return on Assets (ROA) and Return on Equity (ROE). Many researchers have already pointed out the shortcomings of using aggregate statistics in studying the effect of IT spending on firm performance [5, 32]. IT is put forth as having the necessary capabilities to transform archaic business processes [19]. The value of IT investments should then manifest as improvements in business processes. Accordingly activity performance measures should also be considered as dependent variables in evaluating business value of IT.

In this paper we examine the relationship between IT investment and firm performance. Our analysis is at the firm level, and data used in our analysis were collected from secondary sources. This level of analysis is appropriate as IT investment is first likely to demonstrate benefits at the firm level prior to influencing entire industry sectors [38]. The proposed conceptual model considers the relationship of IT investment with both aggregate and intermediate measures of firm performance. We expand existing conceptualization to simultaneously study the impact of IT investments on both aggregate and intermediate performance so as to better detect where performance is impacted by these investments.

Differences in value generated by IT may exist across organizations because of variations in IT investments or competence in leveraging IT investments. A significant competence in leveraging IT investments is the efficiency and effectiveness of the Information Systems (IS) department [42]. Focus on IS department efficiency has gained increasing attention with expanding IS budgets and inconsistent confirmation of payoffs. Some organizations have engaged in downsizing the number of IS employees by dramatically reducing or completely eliminating personnel charged with specific IS functions, and in extreme cases completely eliminating the entire IS department. In some cases services provided by the IS department have been restricted, and in others these functions have been outsourced to external service providers. The specific question that we are addressing is whether “high” efficiency IS departments are, in fact, able to better leverage each additional dollar spent on IT than “low” efficiency IS departments. Factors that influence the capability of an organization to leverage resources spent on IT have been labeled by Weill [42] as conversion effectiveness. Then, do high efficiency IS departments represent a higher level of conversion effectiveness?

In summary, the objectives of the study are:

- To examine the relationship of IT investment with both aggregate and intermediate performance of the firm.
- To examine whether “high” efficiency IS departments are able to leverage IT investments better than “low” efficiency IS departments.

The remainder of the paper is organized as follows; first, a survey of the current literature that examines the effect of IT investment on organizational performance is presented; this is followed by a description of our conceptual model. The sample, analytical procedures and results are then discussed. Finally, implications for practice and further research are presented.
2. SYNTHESIS OF IT INVESTMENT STUDIES

2.1. Economy and industry level studies

IT investment research at the economy and industry levels has concentrated on the overall impact of IT spending on productivity. Roach [35, 36] was among the first to identify the productivity shortfall of IT investments in the 1980s. In 1988, Loveman [27] provided further impetus to the productivity paradox with his macroeconomic study of lackluster productivity returns after nearly a decade of huge IT investments. Loveman’s [27] study of the manufacturing sector for the period 1978–1984 found no evidence that IT spending positively impacted productivity. He concluded that “the marginal dollar would best have been spent on non-IT inputs into production.” Morrison and Brendt [29] examined industry level data and found that investments in “high tech” capital were not leading to corresponding increases in measured output. The lack of evidence at the economy and industry level may be due to measurement issues. Most macro studies have relied on the Federal Government for data and the quality of these data is questionable for several reasons [5]. It has also been suggested that large changes in capital stock are required to see the impact of IT investments on economy wide returns. It is possible that the accumulated capital stock of IT investments is only now beginning to reach sufficient scale to impact performance. Besides measurement problems, lack of significant relationships may be due to lagged effects of learning and adjustment, redistribution and dissipation of profits, and mismanagement of IT [5].

2.2. Organization level studies

Studies undertaken at the firm level of analysis have examined the relationship of IT investment (or use) with some indicator(s) of financial performance (for example; operating costs, ROA, ROE, and Return on Investment (ROI). It is interesting to note that data used in these studies have typically been collected from the financial services industry (banking, insurance, and other financial services). Given the large proportion of revenues committed to IT by the financial services industry, it is not surprising that researchers have gravitated in this direction for data collection efforts. Using a sample of 2090 branches of California banks, Lucas [28] found that IT investment did not predict performance. His results indicated that system usage, and not extent of investment, was a better predictor of performance. In a study of 58 banking firms, Turner [40] found no significant relationships between IT expense, usage, and firm performance. Similar results were obtained by Banker and Kauffman [2]. In his study of the service sector firms, Strassman [39] found no correlation between IT spending and profitability.

In contrast, there are studies which have indicated a positive relationship between IT investment and firm performance. Bender [4] examined the relationship between the ratio of information processing expense to total operating expense and the ratio of operating expense to premium income in life insurance companies. He identified a parabolic relationship which led him to conclude that there is an optimum level of IT investment for organizations. Harris and Katz [21] used four year longitudinal data for 40 firms in the insurance industry and found that firms which showed maximum improvement in performance had a significantly higher proportion of operating expenses allocated to IT. They argued that firm performance is indicative of the extent to which the business processes of the firms are integrated and coordinated through technology.

More recently, Weill [42] examined the relationship between IT investment and firm performance in the valve manufacturing sector. A distinction between IT investments in strategic, informational and operational systems was made. The results suggest that heavy use of transactional IT investment is positively associated with strong firm performance in the short run. On the other hand, heavy use of strategic IT investment, while negatively associated with firm performance in the short run, was neutral in its impact in the long run.

Brynjolfsson and Hitt [6], in a multi-industry study of 380 large firms for the 1987–1991 period, found that IT investment made substantial and significant contributions to the firm’s output. They attributed their findings to the recency and the large size of the data set. Hitt and Brynjolfsson’s [22] subsequent analysis revealed that IT investments lead to increases in firm output productivity and consumer value, though not business performance. They argue
that gains from IT investments are translated into consumer welfare and, therefore, may not surface as improvements in business performance.

The issue of IT investment and firm performance is further complicated by the assertion that it is difficult to come up with a satisfactory confirmation of payoff, because computers are different from other types of investment. One of the explanations offered is that IT can increase product quality and variety, both of which are hard to quantify [5]. This has led researchers to suggest that there is a need to study the impact of IT investment on intermediate measures of firm performance [2, 3, 18]. Accordingly, Banker, Kauffman, and Morey [2] studied the impact of IT on sales and order management in Hardees fast food stores. IT improved efficiency by cutting down material costs, particularly in instances where the tasks supported by IT were complex. Barua, Kriebel and Mukopadhyay [3] studied the impact of IT investments on strategic business unit performance. They examined a two stage model which first incorporates the impact of IT investment on intermediate performance, and then the impact of intermediate performance on aggregate firm performance. Capacity utilization, inventory turnover, relative quality, relative price, and new products were used as measures of intermediate performance. ROA and market share were used as aggregate performance measures. IT capital was positively associated with all intermediate variables, except new products. Some of the associations between intermediate performance and aggregate performance were found to be negative.

2.3. Summary

Empirical studies on the impact of IT investment on firm performance have failed to produce consistent results. The problem of identifying the business value of IT investment is complicated by the fact that IT has an impact at several levels in the organization and only indirectly contributes to profitability. At all levels of analysis, exogenous factors and measurement problems can lead to contradictory or vague results. Another problem has been the identification of suitable techniques that give reliable results (for detailed reviews refer to [12] and [25]).

The results from these studies are not uniform. While some report little or negative impacts of IT investments, others have found significant positive impacts of IT on firm performance. In many of these studies dependent variables have been selected with limited rationalization as to why other performance variables were excluded. While there is no unanimity on the dependent variables that should be used, increasingly researchers suggest the use of multiple measures [43].

Besides financial performance, researchers have examined the impact of IT investments on intermediate firm performance. However, a limited number of studies [3, 30] have investigated the relationship between IT investments and the efficiency with which a firm utilizes its resources. IT is increasingly being applied to enhance business process performance, and therefore, it is here that significant impacts of IT should be found. Activity based measures such as asset turnover, inventory turnover and accounts receivable turnover reflect process management efficiency. Thus, activity based measures are an important category of intermediate performance measures that should be considered in IT value research.

3. THE CONCEPTUAL MODEL

Our model suggests that IT investments have an impact on firm performance, and that these impacts are moderated by the efficiency of IS departments (Fig. 1).

We propose two levels at which IT value can be assessed—firm aggregate performance and firm intermediate performance. While studying the impact of IT investment on firm performance, the model considers firm structure and process as a “black box” whose inputs and outputs are the only variables of interest. Aggregate firm performance is conceptualized as both firm financial and sales performance. IT investments can have differential impacts on firm profitability and firm sales or market share. In certain instances IT has reportedly enhanced market share and increased sales dollars, while in other cases it has merely improved firm income performance [14]. Accordingly, financial and sales performance are the two measures of firm aggregate performance considered here.

Accounting based measures such as ROA and ROE, which are used to gauge aggregate performance, may not give an accurate snapshot
of firm performance. They are influenced by lead and lagged effects, which include accounting adjustments of earlier and future investments. Qualitative evidence has been put forth that IT investments result in an improvement in intermediate performance measures like quality, service, productivity and cycle time. Some of the intermediate level performance measures may not manifest themselves in aggregate financial or market share measures of firm performance [13]. Kaplan [23] argues that assessments of high technology investments should not be based on aggregate accounting indicators at the firm level, and he suggests the use of qualitative and activity based measures instead.

Impact of IT can manifest at intermediate levels through improvements in productivity, quality and resource utilization. These intermediate level performance measures may, in the long and not necessarily in the short run, impact firm level performance measures like ROA and ROI [3]. However, there is inadequate theoretical justification to suggest that certain intermediate performance variables impact certain measures of aggregate performance. Exploring this relationship is beyond the scope of the present paper and we do not venture in this direction. Our conceptual framework focuses on the impact of IT investment on both aggregate and intermediate firm performance. This leads to the following hypotheses:

\[ H_1 : \text{There is a positive relationship between IT investments and aggregate firm performance.} \]

\[ H_2 : \text{There is a positive relationship between IT investments and intermediate firm performance.} \]

Impact of IT investment on firm performance is not only dependent on the level of IT investment, but also on contextual factors. IT can be deployed by firms at varying levels of sophistication, from localized exploitation to redefining the business scope for the firm [41]. Organizations that merely automate certain business processes are likely to gain limited benefits from IT. On the other hand, organizations that have the capability and vision to effectively deploy IT are likely to realize greater benefits from their investments. An organization's ability to effectively utilize IT investments has been termed as conversion effectiveness. Weill [42] defines conversion effectiveness in terms of organizational variables like top management commitment, user satisfaction, IT experience and internal political turbulence.

IS managers are also under significant pressure to increase the efficiency of their departments. Measures such as sales per IS employee and income per IS employee are now used to gauge the "business productivity" of the IS department. However, it remains to be seen whether "efficient" IS departments are better positioned to leverage each additional dollar spent on information technology. Alternatively a strategy focused on the creation of such efficiencies may erode the ability of IS departments to leverage IT input resources for the firm. This is a pertinent question as many

![Fig. 1. The conceptual framework.](image-url)
organizations, including IS organizations, are downsizing operations with an intent to improve efficiencies. While such initiatives can improve efficiencies, it is conceivable that in the process critical human resources and the organizational memory that they represent are lost. We specifically examine whether the efficiency of the IS department changes the relationship between IT investments and realized performance in organizations. In other words, does IS efficiency change the conversion effectiveness of the firm? This leads to the following hypotheses:

\[ H_3 : \text{The relationship between IT investment and aggregate firm performance is moderated by the efficiency of the IS department.} \]

\[ H_4 : \text{The relationship between IT investment and intermediate firm performance is moderated by the efficiency of the IS department.} \]

4. THE EMPIRICAL STUDY

4.1. Sample

Data for this study were obtained from secondary sources and represent several industries. Information Week (IW) selects the top 500 companies based on revenues and reports data on selected aspects of IT investment. Specifically, data on IS budget and number of IS employees were obtained from IW. Performance related data for these firms were obtained from Compustat for the financial year 1992–93. There was sample attrition due to missing data in the IW report and Compustat. We ended up with a usable sample of 210 firms, of which data on IS department efficiency was available for 205 firms.

By collapsing related industry categories, the firms were classified into 15 industries. These industries were further classified as manufacturing and service for the purpose of reporting descriptive data. As secondary data were used for the study there are concerns about data validity and reliability. Data collected by IW on IS budgets and related items are self-reported. The accuracy of self-reported data depends on the respondent's bias, understanding of the instrument, and accurate knowledge about the items. The method and instrument employed for data collection were unknown to us and to that extent cannot be factored into the analysis. However, the data from IW have been compared with data from International Data Group (IDG) which have been used in earlier IT investment studies [22, 34]. The annual spending reported by IW and IDG has been found comparable to that reported by the Bureau of Economic Analysis [26].

4.2. Measures

Table 1 presents a list of variables, their operational definitions, and sources from which data were obtained.

- IS budget is used as a measure of IT Investment. Both IS budget and IT capital have been used as measures of IS investment [20, 22]. Data on replacement cost of IT infrastructure published by IW in 1994 indicate that the average replacement costs of IT infrastructure are lower than IS budgets. Given the high rate of technology obsolescence, IS budget is an important facet of IT investment undertaken by an organization. Market value of past investments, while important, do not obviate the importance of current IS budgets in creating business value in a rapidly changing technological environment.
- Aggregate firm performance was conceptualized as financial and sales performance. The measures used were ROA [11], and ROE [22] for financial performance measures, and market share [3] and total sales for sales performance. Data on these variables were obtained from the Compustat database.
- Intermediate measures considered were asset turnover [17] and labor productivity [35]. Sales per employee is our measure of labor productivity, and asset turnover is measured as sales by average assets.
- IS department efficiency was assessed in terms of "business productivity". Two measures, sales per IS employee and income per IS employee, were used to assess the efficiency of the IS department.
Table 1. Variable definitions

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IS budget</td>
<td>Combined capital and operating budget of IS department directly under the control of the CIO</td>
<td>Information Week</td>
</tr>
<tr>
<td>IT investment</td>
<td>Natural logarithm of IS budget</td>
<td>Computed</td>
</tr>
<tr>
<td>Conversion effectiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IS department efficiency</td>
<td>Pre-tax income/number of IS employees</td>
<td>Computed</td>
</tr>
<tr>
<td>(based on income)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IS department efficiency</td>
<td>Sales/number of IS employees</td>
<td>Computed</td>
</tr>
<tr>
<td>(based on sales)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>15 industry classifications</td>
<td>Information Week</td>
</tr>
<tr>
<td>Organization size</td>
<td>Natural logarithm of total employees</td>
<td>Computed</td>
</tr>
<tr>
<td><strong>Firm financial performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return on Assets (ROA)</td>
<td>Pre-tax income/total assets</td>
<td>Compustat</td>
</tr>
<tr>
<td>Return on Equity (ROE)</td>
<td>Pre-tax income/total shareholder equity</td>
<td>Compustat</td>
</tr>
<tr>
<td><strong>Firm sales performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market share</td>
<td>Proportion of firm revenue to total sales generated by all firms belonging to the same SIC code. Natural logarithm used</td>
<td>Computed</td>
</tr>
<tr>
<td>Sales</td>
<td>Total sales. Natural logarithm used</td>
<td>Computed</td>
</tr>
<tr>
<td><strong>Firm intermediate performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset turnover</td>
<td>Sales by average assets for the year and previous year. Natural logarithm used</td>
<td>Compustat</td>
</tr>
<tr>
<td>Labor productivity</td>
<td>Sales per employee. Measured as sales/total employees. Natural logarithm used</td>
<td>Compustat Computed</td>
</tr>
</tbody>
</table>

*nThe full sample was divided into two subsamples that represented efficient and inefficient IS departments

4.3. Analysis

Given our two research questions, there were two phases to our statistical analysis. We first focused on testing the relationships between IS budget and firm performance. Subsequently, we examined whether these relationships were moderated by the efficiency of the IS department. We describe the statistical analysis undertaken under each of these phases.

Phase 1: Relationship between IS budget and firm performance. Measures of IS budget, organization size, sales, market share, asset turnover and labor productivity were positively skewed. Accordingly, natural logarithm transformations of these measures were used. Multiple regression was used to test the relationship between IS budget and each of the performance measures. The general form of the regression equation used was:

\[ \text{Performance} = \beta_0 + \beta_1 \text{Industry} + \beta_2 \text{Size} + \beta_3 \text{IT investment} + \epsilon \]

Industry and organization size were used as control variables, and were introduced first into the regression analyses. The residuals for all regression equations were normally distributed, except for those between IS budgets and ROA and ROE. Assumptions of homoskedasticity were also satisfied in all cases. Measures of ROE and ROA were negatively skewed and had positive kurtosis. Various transformations of these measures did not enhance the normality of their residuals. We decided to use partial correlation to test the relationship of IS budgets with ROA and ROE, because this technique does not require that the normality assumption be satisfied. Here, as with the earlier regression analyses, industry and size were used as control

Table 2. Regression results for IS budget (n = 210. Standardized estimates)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Financial performance (partial correlation)</th>
<th>Sales performance (multiple regression)</th>
<th>Intermediate performance (multiple regression)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS budget</td>
<td>n.s.</td>
<td>0.526**</td>
<td>n.s.</td>
</tr>
<tr>
<td>F value</td>
<td>n.s.</td>
<td>0.226**</td>
<td>0.67**</td>
</tr>
<tr>
<td>R²</td>
<td>n.s.</td>
<td>54.1**</td>
<td>58.9**</td>
</tr>
</tbody>
</table>

**P < 0.01; *P < 0.05
variables. The results of these analyses are summarized in Table 2.

Phase 2: Moderating effect of IS department efficiency. A subsampling methodology was used to examine if the relationships between IS budget and performance measures were moderated by IS department efficiency. The sample was partitioned into two subsamples that represented efficient and inefficient IS departments. An organization was classified as having an efficient IS department if its efficiency measure was greater than the sample mean, and was classified as inefficient otherwise. As in phase 1, and for the same reasons, we used partial correlation analysis to assess the association between IS budget and financial performance. For each of the two groups the effect of IS budget on performance was modeled as follows:

\[
\text{Performance} = \beta_0 + \beta_1 \text{Industry} + \beta_2 \text{Size} + \beta_3 \text{IT investment} + \epsilon
\]

A difference in \( \beta_3 \) for the two groups would suggest that the relationship between IS budget and a particular performance measure is moderated by IS department efficiency. A statistical comparison of the estimated IS budget coefficient for the two groups requires that residual normality and variance equality assumptions be satisfied [31]. No significant violations of these assumptions or homoskedasticity assumptions were observed. Table 3 summarizes results for the association between IS budget and performance measures, with sales per IS employee as a measure of IS department efficiency. Table 4 is a summary of the associations with income per IS employee as a measure of IS department efficiency.

| Table 3. Moderating effect of IS department efficiency based on sales per IS employee* (standardized estimates) |
|---|---|---|---|---|
| **Low efficiency IS departments: below mean subsample (n = 97)** | **Financial performance** | **Sales performance** | **Intermediate performance** |
|  | (partial correlation) | (multiple regression) | (multiple regression) |
| **Dependent/independent** | ROA | ROE | Sale | Market share | Asset turnover | Labor productivity |
| IS budget | n.s. | n.s. | 0.65** | 0.268* | n.s. | 0.994** |
| \( F \) | | | 58.47** | 7.48** | 47.7** | 21.2** |
| \( R^2 \) | | | 0.9 | 0.56 | 0.89 | 0.78 |
| **High efficiency IS departments: above mean subsample (n = 108)** | | | | | | |
| IS budget | n.s. | n.s. | 0.49** | n.s. | n.s. | 0.561** |
| \( F \) | | | 26.2** | 5.75** | 12.54** | 18.01** |
| \( R^2 \) | | | 0.81 | 0.48 | 0.68 | 0.75 |
| \( F \) test that \( \beta \) coefficients of IS budget for two groups is different |

*The full sample was divided into two subsamples that represented efficient and inefficient IS departments based on the mean value of IS department efficiency.

* \( P < 0.05; ** P < 0.01

| Table 4. Moderating effect of IS department efficiency based on income per IS employee* (standardized estimates) |
|---|---|---|---|---|
| **Low efficiency IS departments: below mean subsample (n = 100)** | **Financial performance** | **Sales performance** | **Intermediate performance** |
|  | (partial correlation) | (multiple regression) | (multiple regression) |
| **Dependent/independent** | ROA | ROE | Sale | Market share | Asset turnover | Labor productivity |
| IS budget | n.s. | n.s. | 0.69** | n.s. | n.s. | 0.988** |
| \( F \) | | | 36.3** | 5.96** | 23.4** | 13.8** |
| \( R^2 \) | | | 0.85 | 0.47 | 0.78 | 0.68 |
| **High efficiency IS departments: above mean subsample (n = 105)** | | | | | | |
| IS budget | n.s. | 0.21* | 0.49** | 0.20* | n.s. | 0.57** |
| \( F \) | | | 26.7** | 11.4** | 45.16** | 18.89** |
| \( R^2 \) | | | 0.83 | 0.67 | 0.89 | 0.77 |
| \( F \) test that \( \beta \) coefficients of IS budget for two groups is different |

*The full sample was divided into two subsamples that represented efficient and inefficient IS departments based on the mean value of IS department efficiency.

* \( P < 0.05; ** P < 0.01
It could be argued that the moderating relationship of IS department efficiency could be assessed using other analytical methods. Specifically, it could be contended that a variable that represents the interaction between IS budget and IS department efficiency be defined, and that this variable be included in the regression equations. This variable would typically be operationalized as a product of IS budget and IS department efficiency. The full sample could then be used to estimate the parameters of such a regression model. We believe that such an approach could pose problems for at least three reasons. First, since the measures of IS department efficiency used here are ratios, the semantic interpretation of a complex interaction term of the form \((a/b)^c\) is complicated. Second, the results of a regression analysis, and estimated parameters for complex interaction terms, are difficult to interpret. Third, the measures of firm performance, which are the dependent variables, include financial and sales information. It is critical to minimize the "definitional overlap" between dependent and independent variables. Our subsampling methodology is intuitively simple, does not pose the above problems, and yet is effective in addressing the question of a moderating effect that is being examined here.

5. RESULTS AND DISCUSSION

5.1. Descriptive statistics

Average revenues generated by the service sector are less than those generated by firms in the manufacturing sector (Fig. 2). However, firms in the service sector have larger IS organizations and IS budgets. The service sector allocated a higher proportion of its revenues to IS budgets by spending an average of 2.92% of its revenues compared to the 1.95% spent by the manufacturing sector. The average IS budget of service sector firms is greater than their manufacturing counterparts by $86 million. This confirms the trends observed at the economy level where the service sector has been historically spending a greater proportion of its resources on IT. Several of the industries in this sector operate in information intensive environments and IT is regarded as a key task technology [21]. The computers and telecommunications industry leads the service sector in funds committed to IS budgets, while the aerospace and automobiles industry, with an average budget size of $319 million, leads the manufacturing sector.

5.2. IS budget and firm performance

No statistically significant positive associations were observed between IS budget and the financial performance measures of ROA and ROE. IS budget was found to have significant positive associations with both measures of sales performance, which are sales and market share. IS budget was also positively related to one of the intermediate performance measures, labor productivity, but was not found to be related to asset turnover.

The lack of significant relationships between IS budget and financial performance measures such as ROA and ROE is consistent with earlier studies [22]. Hitt and Brynjolfsson [22] observe that the benefits of IT investment are distributed unevenly across organizations, and any accrued benefits may be passed on to the consumers. Their results suggest that even though IT may improve consumer welfare and increase firm output and value added it may not improve business performance. Our results indicate that not only are IT investments positively associated with increased output as measured by firm sales, they are also positively associated with firm market share. IT investments help firms improve their market position but on their own they are unlikely to result in improvements in financial performance measures such as ROA and ROE.

Labor productivity was found to be directly associated with IT investment. However, IT investments were not significantly associated with asset turnover. These results suggest that IT investments directed at automating existing processes, reducing manpower, and improving labor productivity are paying off. However, asset utilization does not seem to be enhanced with additional resources directed at IT. Strassman [38] has noted that the lack of relationship between IT investments and business performance measures of profitability can be traced to ineffective management processes and the lack of a linkage between IT and business strategy. The lack of relationship of IT investment with financial performance and asset utilization might be related. They might signify that organizations may not be using IT
to facilitate the reconceptualization and re-design of business processes.

As suggested by earlier studies, the results demonstrate the importance of evaluating intermediate measures of performance to study the relationship between IT investments and firm performance [3, 24]. IT investments seem to have a positive impact on one category of aggregate performance measures and one of the two intermediate performance measures. This supports the case for studying the impact of IT separately at the intermediate and aggregate levels of performance. The lack of data availability can sometimes impede the study of intermediate performance measures [2, 21]. Relating IT investment to firm performance need not ignore the intermediate processes if publicly available proxy measures of process performance such as asset turnover, inventory turnover and receivables turnover are used.

5.3. Moderating effect of IS department efficiency

5.3.1. Subsamples based on sales per IS employee. The significant associations of IS budget with sales and labor productivity are replicated for both subsamples. However, efficient IS departments do not show a
5.3.2. Subsamples based on income per IS employee. The significant associations between IS budget with sales and labor productivity are replicated for both groups. However, inefficient IS departments do not show a significant association between IS budget and market share, while a significant association is detected for efficient IS departments.

It can be concluded that:

- IS budget is related to sales, whether the IS department is efficient or inefficient.
- IS budget is positively associated with labor productivity, whether the IS department is efficient or inefficient.
- The relationship between IS budget and market share is moderated by the efficiency of the IS department. IS departments with high income per IS employee translate IT investments into market share improvements, while IS departments with low income per IS employees are unable to do so.
- IS departments that have high sales per IS employee are unable to translate additional dollars allocated towards IT into improvements in market share, on the other hand, are able to leverage the additional IT dollar towards improvements in market share.
- For both sales performance measures, the standardized coefficients for IS budget are lower for high efficiency IS departments than for low efficiency IS departments, even though they are not significantly different.

Why are efficient IS departments unable to improve the association between IT investments and firm performance? It could well be that internal efficiencies have been achieved by reducing the capability of the IS department, possibly because of radical, and not carefully thought out, downsizing. An alternate explanation is that a “ceiling effect” may exist for performance improvements that can be achieved through IT investments. Increases in internal productivity of IS organization may not be able to generate unlimited value from IT investments. Other factors such as the IT strategy alignment, user satisfaction, organizational decision making processes to justify IT investments may possibly show increasing marginal returns from IT investment. The results for market share suggest that assessing IS department efficiency based on income generation may be a better means of differentiating IS conversion effectiveness across organizations than measuring efficiency based on sales. Willcocks [44] suggests IT success should be measured in terms of profitability with measures like profits per employee. He argues that IT rarely reduces cost, but its value is in changing the cost structure of the organization.

Multi-faceted IS capabilities that constitute IS conversion effectiveness may not have the same effect on different measures of performance. A similar inference may be made about organizational capabilities. While some organizational capabilities might leverage IT investments to improve sales performance, different organizational capabilities might be required to improve financial or asset utilization performance. In a similar vein, Strassman [38] notes that while IT investments can result in improvements in labor efficiency, improvements in firm business performance require high quality management and redesign of management processes.

Our analysis provide partial support for the various hypotheses and suggests that: (i) activity based measures are a useful class of intermediate performance measures that are likely to be impacted by IT and accordingly should be considered in assessing IT value; (ii) both aggregate and intermediate performance measures should be used in assessing IT value; (iii) IS department efficiency may not constitute conversion effectiveness and may, in fact be detrimental to the organization’s ability to leverage IT investments; (iv) and that differing organizational capabilities may differentially impact the relationship between IT investments and various measures of performance.

6. CONCLUSIONS

6.1. Limitations

The data used in this study are cross-sectional in nature, and this prevents the modeling of lagged effects. Thus, inferences of causality should not be assumed, and the results are
indicative of the associative nature of relationships. Consistent with earlier studies, an assumption of linearity has also been made. It is recommended that non-linear models be explored in future IT value research.

IS budget as a measure of IT investment limits itself to IT expenses that are part of the annual budget and under the control of the IS department. More and more IS spending in the organizations is becoming invisible as IT become a part of divisional expenditures. The phenomenon of end-user computing is also changing the nature of IS jobs as users in the organization begin to perform IS functions that were once the domain of the central IS group. Measuring these invisible costs of IT is a complex exercise and one not undertaken by a majority of organizations. However, the significance of such measurement to IT value research is increasing.

6.2. Implications for research
A growing body of literature suggests that benefits from IT investments are negligible, if not negative. We have argued here for a re-evaluation of where benefits from IT investments are measured. Measures of intermediate variables need to be refined and researched. At present there is inadequate theory to suggest what these intermediate measures should be and how they relate to firm performance. There is a need to categorize different organizational capabilities based on how they influence the relationship between IT investment and different measures of performance. In the absence of a clear understanding of what intermediate performance measures need to be included and how they relate to aggregate measures of performance, it may be important to evaluate the performance effects of IT investments separately at intermediate and aggregate firm performance levels.

Modeling of organizational capabilities to leverage IT investments requires the study of multiple variables in the organizational and IS context. Future studies need to incorporate multiple measures of IS conversion effectiveness such as CIO reporting relationship, CIO tenure and background, and structure of the IS department. Other organization characteristics such as top management support, organization structure, and user involvement also need to be considered.

We have not differentiated between organizations based on how they use information technology. Some organizations may use IT to promote efficiency gains. Others may use IT to improve the effectiveness of core processes, such as customer service or product development. It would be useful to examine the moderating effect of IT strategy, business strategy, and organization characteristics on the relationship between IT investment and firm performance.

6.3. Implications for managers
Research and practice suggests that relying on outmoded, traditional, and accounting metrics to monitor returns on IT investments may be inadequate. Measurement of benefits should take place at multiple levels, including intermediate levels such as departments or business processes, and aggregate levels such as financial and sales performance. This is important as IT investments may show certain performance improvements, but may not show improvements in accounting based measures such as ROA and ROE.

Notwithstanding the phenomenon of end-user-computing, the IS department is likely to play a crucial role in the ability of the organization to leverage IT. The competence and productivity of IS staff will serve as a mediating factor in reducing the knowledge barriers in the application of IT for organizational transformation. The results suggest that an increased emphasis on IS department efficiency can reduce the ability of the organization to leverage resources expended on IT. This could be because of the ways in which such efficiencies are achieved. Managers need to carefully examine how IS department efficiency is being achieved and if critical conversion effectiveness capabilities are destroyed in the process. A detailed analysis of organizational context may be important to identify how organizational capabilities can be transformed to create value from IT investments.

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