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An Empirical Investigation of Economic Payoffs of E-Business and CRM Innovations

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Abstract

While the question of the benefits of e-business initiatives has been an issue in both the academic and business worlds, there has been little empirical research on the value created from such initiatives. Using Information Week's annual data set of innovative IT users, this study empirically examines the contribution of e-business initiatives to firm performance, measured by gross margin, revenue per employee, ROA, and ROE. The measure of e-business initiatives is constructed by combining e-business and CRM innovations. Data are analyzed for the full sample and for both the manufacturing and service industry sectors for the two years of 1999 and 2000. The results show that e-business and CRM innovations contribute to firm performance significantly. The results indicate that when firms deploy e-business technologies and practices early and creatively, namely when their e-business initiatives are innovative, they can generate significant economic returns.

Keywords: Innovative users of IT, e-business initiatives, e-business innovation, CRM innovation, firm performance

Introduction

Although the collapse of the dot-com boom at the turn of the twenty-first century has partly obscured the importance of e-business initiatives, traditional companies are still investing in information technology (IT) and e-business applications to improve their internal and external business processes. According to AMR Research (2002), companies continue to spend IT dollars in areas that increase revenues, including sales and customer management initiatives. E-business initiatives also aim to increase the efficiencies that come from streamlining internal processes and reducing overhead (AMR Research 2001).

Companies invest in IT or Internet-related technologies to support their e-business initiatives. However, companies tend to focus too much of their attention on technology. IT does not work in a vacuum, and managers must recognize the complementary nature of technology and business (Barua et al. 2001). Technology is not a substitute for effective business strategies and practices. As Rangan and Adner (2001) point out, in assessing e-business opportunities, companies must not let what is technologically feasible overshadow what is strategically desirable. In order to generate economic value from IT investments, companies have to understand the full implications of the strategic choices they are making and then develop desirable business processes and practices to complement their IT investments.

Using Information Week's annual data set of innovative IT users, this study empirically examines the economic payoffs generated from e-business initiatives, as measured by the combination of e-business and CRM innovations. Since 1998, Information Week has identified 500 companies each year as "innovative IT users." Information Week's selection of the companies was not determined by how much IT was purchased, namely the quantity of a company's IT investments, but by how companies use IT in their organizations, namely the quality of IT innovations (Weston 2000). The data set includes ratings for e-business and CRM innovations for each firm.

Previous Research on the Economic Returns of E-Business Initiatives

While the question of how many benefits are created by e-business and e-commerce initiatives has been an issue in both the academic and business worlds, few researchers have examined the economic value of such initiatives empirically.

Using event study methodology, Subramani and Walden (2001) empirically analyzed the impact of announcements of e-commerce initiatives on the returns to shareholders. Their findings show that e-commerce initiatives create positive cumulative abnormal returns to shareholders. The data used for their analysis were obtained during the period from October 1, 1998, to December 31, 1998. Although their study provides empirical evidence to support the expectation of significant future benefits to firms entering into e-commerce arrangements, the unique bull market of the period might have increased the positive returns associated with e-commerce announcements.

Barua et al. (2001) empirically examined the financial performance achieved by e-business initiatives using the data collected in September and October 2000. Their analysis was based on an e-business value model composed of e-business drivers, e-business operational excellence measures, and financial measures. Their findings show that companies with higher financial gains tend to have higher e-business operational excellence – that is, higher percentages of online revenues, procurement, and new customer acquisition. According to the authors, higher e-business operational excellence is achieved by e-business drivers such as processes related to customers and suppliers, IT applications oriented toward customers, suppliers and internal operations, systems integration, and e-business readiness with regard to customers and suppliers. They argue that in order to make e-business initiatives successful, managers must align business processes with e-business transformation and make complementary investments in process, technology and readiness.

More recently, Zhu and Kraemer (2002) empirically examined the relationship between e-commerce capabilities and firm performance in the manufacturing industry by developing an e-commerce metrics that measures e-commerce capabilities in four dimensions: information, transaction, customization, and supplier connection. They used data collected over a two-year period.[1] To determine the importance of complementary investments of business resources, they also examined the interaction effect of e-commerce capability and IT intensity on firm performance. Their analysis showed a significant relationship between e-commerce capability and measures of firm performance such as inventory turnover. Their results led them to argue that resource complementarity is important for the business value of e-commerce and that traditional firms need to enhance alignment between e-commerce capability and their existing IT infrastructure in order to reap the benefits of e-commerce.

According to Rangan and Adner (2001), technology and strategy are strong complements, but not substitutes. They argue that technology may provide growth opportunities, but that this may entail a loss of profitability. Hitt and Brynjolfsson (1996) argue that if a firm has access to unique IT, and other firms cannot easily replicate it, then the firm may earn higher profits from that access. They further argue that because there are relatively few IT investments that provide this kind of sustainable advantage, the size of IT investments does not necessarily lead to profit increases. In other words, IT is a strategic necessity, but not a source of competitive advantage (Clemons 1991). According to Hitt and Brynjolfsson (1996), a firm can, however, increase profits through the innovative use of IT. Innovative users of IT can raise existing barriers to entry or create new ones, thus increasing their profits.

As the above discussion shows, prior research generally emphasizes the complementarity of IT and business practices, and more specifically the importance of business processes and strategies. The same reasoning can be applied to the creation of value from e-business initiatives. E-business investments may be strategically necessary, but not sufficient for profit increases. In order to further elucidate this point of view, the present research focuses not on the amount of e-business investments, but on the quality of e-business technologies and business practices in order to determine their impact on the economic payoffs for e-business.

Data and Methodology

Data Sources and Variable Construction

This study uses two data sources: the Information Week 500 data set on innovative users of IT for the two years from 1999 to 2000 and the Compustat database. The IT innovation data were collected annually in a survey of senior IT executives on their organizational priorities and spending plans. Rather than being ranked by the amount of IT spending (how much companies spend on IT), Information Week rated companies by the quality of IT innovation (how companies use IT in their organizations), namely *technological, procedural, and organizational innovation* (Weston 2000). The data set includes various IT innovation categories, scored at three levels (gold, silver, and bronze) for each firm for the company's *early adoption and creative use of technologies and business practices* (Weston 2000). The ratings were made on a curve, with the highest third in each category receiving the

[1]The authors did not indicate for what two-year period the data were collected.

highest level (gold). The IT innovation categories include technology strategy, e-business (or e-business strategy), business practices, customer management (or customer knowledge), application development, and business processes/ERP.[2]

In this study, the category of e-business (or e-business strategy[3]) is used as a measure of e-business innovation. The category of customer management (or customer knowledge[4]) is used as a measure of CRM innovation. According to the definition provided by Information Week 500, e-business innovation refers to the early adoption and creative use of e-business technologies and practices (for example, the creation of e-marketplaces linked to customers and suppliers, or enterprise portals connected to other firms, and extranets). Likewise, CRM innovation refers to the early adoption and creative use of CRM technologies and practices (for example, use of CRM, personalization, customization, and e-business supply chains).

The measures of e-business and CRM innovations are qualitative explanatory variables evaluated by mutually exclusive levels of a quality (gold, silver, and bronze). One method of quantifying such variables is to construct artificial or dummy variables (Gujarati 1988). In the present study, a value of 1 is given to gold and a value of 0 is given to bronze.

The measure of e-business initiatives is constructed by combining e-business and CRM innovations in order to obtain continuous measures from the dummy variables of e-business and CRM innovations. The following process is used to construct the composite e-business initiatives measure: The numbers, 3, 2, and 1 are assigned to gold, silver, and bronze respectively. Then a composite e-business initiatives index is created by adding the numeric values of both e-business and CRM innovations.

Data items such as sales, cost of goods sold (COGS), ROA, ROE, and the number of employees are obtained from the Compustat database for the same firms included in the Information Week 500 data set. Multiple performance (or profitability) ratios such as gross margin, revenue per employee, ROA, and ROE are used as measures of business performance.

The sample includes 652 observations (259 manufacturing and 393 service firms) for the two years of 1999 and 2000. The sample statistics are shown in Table 1.

Methodology and the Model

To analyze the relationship between firm profitability and e-business initiatives, as measured by both e-business and CRM innovations, an analysis of the combined data set for two years is performed by using ordinary least squares (OLS) regression. Because there are high correlations among the independent variables, regressions are run separately for each independent variable (e-business innovation, CRM innovation, and the composite e-business initiatives index) to avoid the presence of multicollinearity.

Even though the ratio variables of gross margin, revenue per employee, ROA, ROE and qualitative index variables avoid the possible problem of heteroscedasticity, the total number of employees is used to control for differences in firm size.[5] In order to control for industry- and year-specific effects, dummy variables for each industry categorized by the North American Industry Classification System (NAICS) code and for each year are included.

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[2]The categories do not remain the same for the two years. The following is the list of the categories in each year: technology strategy, e-business strategy, business practices, and customer knowledge in 2000 and application development, e-business, customer management, and business process/ERP in 1999. The 1998 data set includes the category of e-business, but not the category of customer management or knowledge. Thus, this study does not include the 1998 data set.

[3] The category of e-business is used in 1999. It is replaced by the category of e-business strategy in the 2000 data set. In this study, the category of e-business strategy in 2000 is regarded as the same as the category of e-business in 1999.

[4] The category of customer management used in 1999 is replaced by the category of customer knowledge in 2000. In this study, the category of customer knowledge in 2000 is regarded as the same as the category of customer management in 1999.

[5]"Sales" is not used as a control variable because the dependent variables are derived from sales.

Table 1. Sample Statistics: Mean and Standard Deviation (1999 and 2000)

Variables	Manufacturing		Service		Full Sample	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
E-business Initiatives (composite)	4.20	1.33	4.01	1.43	4.08	1.40
E-business Innovation	2.12	.783	2.00	.835	2.05	.816
CRM Innovation	2.07	.795	2.01	.821	2.03	.810
Revenue per EMP	298.57	274.68	514.27	833.16	425.99	672.10
Gross Margin	.371	.174	.297	.206	.324	.205
ROA	.096	.097	.054	.112	.068	.130
ROE	.304	.757	.280	.885	.239	.540
Number of Observations	259		393		652	

The Model

The model measures the relationship between e-business initiatives and firm performance while controlling for firm size, industry and year.

$$PERF_{it} = \beta_0 + \beta_1 EBIZ_{it} + \beta_2 EMP_{it} + \beta_3 INDUSTRY_{it} + \beta_4 YEAR_{it} + \epsilon$$

where $EBIZ_{it}$ stands for e-business initiatives measured by the combined index of e-business and CRM innovations identified earlier. EMP_{it} denotes the total number of employees. $PERF_{it}$ represents performance (or profitability) measures that will be replaced in turn by each of the four performance variables – gross margin, revenue per employee, ROA, and ROE. $INDUSTRY_{it}$ and $YEAR_{it}$ denote dummy variables for industry and year. ϵ is the residual term with zero mean, which captures the net effect of all unspecified factors.

The model is estimated for the full sample and also for the manufacturing and service industry sectors separately in order to determine if the performance effect of e-business initiatives differs across the two industries.

Results

Results on Gross Margin

As shown in Table 2, the analysis of the relationship between gross margin and e-business initiatives shows that e-business initiatives are positively associated with gross margin.[6] This positive relationship is significant for both the manufacturing and service industries. The estimate is consistent with hypothesis H1 that there is a positive relationship between gross margin and e-business initiatives when they are innovative. The null hypothesis of zero effect can be rejected for the manufacturing industry at a .01 confidence level and for the service industry at a .05 confidence level. This result indicates that e-business innovation coupled with CRM innovation can contribute to gross margin. The individual analyses with e-business innovation and CRM innovation show similar results.

[6]The author also conducted the analysis with cost of goods sold. The results show that e-business initiatives are negatively associated with cost of goods sold, and the negative relationship is significant. Because gross margin is the ratio of sales minus cost of goods sold to sales, increases in gross margin imply decreases in cost of goods sold and vice versa.

Table 2. Regression Results on Gross Margin

	Manufacturing	Service	Full Sample
E-business initiatives (composite):	.125***[a] (3.184)[b]	.091** (2.492)	.062* (1.664)
E-business innovation	.134*** (2.709)	.050 (1.114)	.023 (.511)
CRM innovation	.128*** (2.575)	.126*** (2.820)	.092** (2.058)
EMP	-.039 (1.003)	-.089** (2.380)	-.032
Control Variables	Industry and Year	Industry and Year	Industry and Year
R^2	15.7%	24.7%	22.7%
Number of Observations	259	393	652

*** P < .01; ** P < .05; * P <.10

[a] These are standardized coefficients.

[b] The values in parentheses are t-statistics.

Results on Revenue per Employee

The analysis of the relationship between revenue per employee and e-business initiatives shows that the relationship between the two is positive and significant (Table 3). The estimate is consistent with hypothesis H2 that there is a positive relationship between revenue per employee and e-business initiatives when they are innovative. The null hypothesis of zero effect can be rejected for the manufacturing industry at a .05 confidence level and for the service industries at a .01 confidence level. This result indicates that e-business innovation coupled with CRM innovation can contribute to revenue per employee significantly. The individual analyses with e-business innovation and CRM innovation show similar results. The control variable of EMP (the number of employees) is not included in the analysis because the dependent variable is derived from EMP.

Table 3. Regression Results on Revenue per Employee

	Manufacturing	Service	Full Sample
E-business initiatives (composite):	.080**[a] (1.997)[b]	.105*** (2.824)	.116*** (2.927)
E-business innovation	.081 (1.624)	.114** (2.473)	.118** (2.409)
CRM innovation	.107** (2.095)	.115*** (2.614)	.127*** (2.699)
Control Variables	Industry and Year	Industry and Year	Industry and Year
R^2	13.9%	22.4%	12.6%
Number of Observations	259	387	646[c]

*** P < .01; ** P < .05; * P <.10

[a] These are standardized coefficients.

[b] The values in parentheses are t-statistics.

[c] Six outlier observations are excluded from the analysis.

Results on ROA

As shown in Table 4, the results show that e-business initiatives are positively associated with ROA. The positive relationship is marginally significant for both the manufacturing and service industries. The null hypothesis (H3) of zero effect can be rejected for both industries at a .10 confidence level. This indicates that e-business innovation coupled with CRM innovation can contribute to ROA. The individual analyses with e-business innovation and CRM innovation show similar results.

Table 4. Regression Results on ROA

	Manufacturing	Service	Full Sample
E-business initiatives (composite):	.072*[a] (1.744)[b]	.074* (1.831)	.047 (1.149)
E-business innovation	.034 (.665)	.025 (.509)	-.007 (.145)
CRM innovation	.125** (2.398)	.130** (2.575)	.110** (2.160)
EMP	.087** (2.112)	0.33 (.797)	.082** (2.003)
Control Variables	Industry and Year	Industry and Year	Industry and Year
R^2	8.9%	8.7%	8.7%
Number of Observations	259	389	648[c]

*** P < .01; ** P < .05; * P <.10

[a] These are standardized coefficients.

[b] The values in parentheses are t-statistics.

[c] Four outlier observations are excluded from the analysis.

Results on ROE

The analysis of the relationship between ROE and e-business initiatives shows that the relationship between the two is positive and significant (Table 5). The estimate is consistent with hypothesis H4 that there is a positive relationship between ROE and e-business initiatives when they are innovative. The null hypothesis of zero effect can be rejected for both the manufacturing and the service industries at a .05 confidence level. This result indicates that e-business innovation coupled with CRM innovation can contribute to ROE significantly. The individual analyses with e-business innovation and CRM innovation show similar results.

Table 5. Regression Results on ROE

	Manufacturing	Service	Full Sample
E-business initiatives (composite):	.082**[a] (1.947)[b]	.083** (1.984)	.094** (2.228)
E-business innovation	.060 (1.140)	.073 (1.423)	.095* (1.844)
CRM innovation	.093* (1.795)	.090* (1.736)	.114** (2.228)
EMP	.025 (.596)	.032 (.737)	.021 (.496)
Control Variables	Industry and Year	Industry and Year	Industry and Year
R^2	6.3%	2.6%	3.2%
Number of Observations	258	392	650[c]

*** P < .01; ** P < .05; * P <.10

[a] These are standardized coefficients.

[b] The values in parentheses are t-statistics.

[c] Two outlier observations are excluded from the analysis.

Discussion

This analysis of the relationship of e-business initiatives to firm performance shows that e-business and CRM innovations contribute to firm performance as measured by gross margin, revenue per employee, ROA[7] and ROE. The results imply that when e-business initiatives are innovative, namely when firms deploy e-business and CRM technologies and practices early and creatively, they can bring significant economic returns.

As Rangan and Adner (2001) state, a company may not be successful simply by being a first mover. To be profitable, companies should not only adopt e-business technologies early but also align their business processes and pursue business practices tailored to their technologies. When companies exploit e-marketplaces linked to customers and suppliers, enterprise portals, and extranets,

[7]The contribution is significant for gross margin, revenue per employee, and ROE, but marginal for ROA.

they can increase the effectiveness of this integration by employing CRM, personalization, customization, and e-business supply chains for quick and cost-efficient filling of customized orders. Companies have to evaluate how customer- and supplier-related processes align with e-business transformation, while encouraging the participation of suppliers, customers and internal constituents (Barua et al. 2001).

Limitations

This study uses secondary data from publicly available databases, including both qualitative and quantitative data. One weakness of the study is that the survey instrument used to collect the qualitative data on IT innovation, including e-business and CRM innovations, was designed by Information Week and could not be independently validated for reliability and construct validity.[8] However, their data provide a useful basis for empirical analyses. For instance, the examination of significant relationships between firm performance and e-business initiatives in terms of e-business and CRM innovations helps to elucidate the efficacy and nomological validity of these constructs (Zhu and Kraemer 2002).

Nomological validity examines the linkages specified by theory. If these linkages are found to be significant, despite variations in measurement, then the instrument may be said to be nomologically valid (Campbell 1960; Bagozzi 1980; Boudreau et al. 2001). The hypotheses developed in this paper allow us to examine the predicted relationships. The discovery of positive and significant relationships demonstrates the nomological validity of the measures employed for this study.

Although large-scale survey data such as the Information Week's annual data set used in this study may contain problems related to reliability and validity, they provide several advantages, such as providing a longitudinal database on various constructs not often available in other secondary data sources, better response rate, participation of knowledgeable industry analysts and executives, and corroboration through qualitative reports and case studies (Bharadwaj 2000). According to Bharadwaj (2000), other research disciplines such as management strategy and organization theory have a longer tradition of using large-scale publicly available (perceptual) survey data – e.g., Fortune magazine's annual survey of most admired corporations – compared to the IS literature, in which the use of such data has been scant. Bharadwaj (2000) has also used Information Week's annual data set of technology leaders from 1991 to 1994 to study the link between IT capability and firm performance. Her study was replicated and extended by Santhanam and Hartono (2003) with the same data source.

Conclusion

This study empirically analyzes the contribution of e-business initiatives to firm performance, measured by gross margin, revenue per employee, ROA, and ROE. E-business initiatives are measured by a combination of e-business and CRM innovations that indicate the early adoption and creative use of e-business and CRM technologies and practices. Data are analyzed for the full sample and for the manufacturing and service industry sectors for the two years from 1999 and 2000.

The results show that e-business initiatives (e-business and CRM innovations) contribute to firm performance significantly. The results indicate that firms can generate significant economic returns from their e-business when they deploy e-business technologies and practices early and creatively, namely when their e-business initiatives are innovative.

Contributions

The contributions of this research are twofold. First, it sheds light on how firms can improve the performance of their e-business initiatives by providing empirical evidence for the economic payoffs generated from e-business and CRM innovations. This research extends previous research on the value of e-business (or e-commerce) to firm performance by examining the impact of e-business initiatives in both the manufacturing and service industries. Since there has been little empirical research on e-business value, this study contributes to the e-business value literature.

[8]Although the survey instrument may lack academic rigor, it is probably relevant practically since the editing team of Information Week 500 has had experience in designing the instrument and collecting the data annually for more than 10 years. The editor of the Information Week 500 stated in the personal conversation with the author that the instrument was also field-tested by the editing team.

Future Research Directions

Although this study use fairly recent data (1999 and 2000), it would be interesting to see if results differ with more recent data. Since the Information Week 500 data are collected annually and publicly available, this study can be replicated with more recent data.

Although this study shows empirically the economic payoffs generated by innovative e-business initiatives, it does not address the issue of whether these benefits are sustainable over time. One reason is that the financial data are not publicly available yet, except the 2001 data. Future research can examine the sustainability of the economic benefits using more recent data when they become available.

This study does not consider the impact of a company's prior performance on the e-business and CRM innovation ratings. Since such perceptual ratings are likely to be subjected to a "performance halo effect" (Brown and Perry 1994; Bharadwaj 2000; Santhanam and Hartono 2003), future research should remove or adjust for the influence of a company's prior financial performance if it exists.[9]

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[9]However, according to the author's personal communication with the editor of Information Week 500, the survey was not biased to companies' prior financial performance.