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Abstract

Since its inception, e-commerce activity has seen remarkable projected growth figures. In response to this projected growth, many firms invested in e-commerce during the mid to late 1990s for any of a number of reasons, including the chance at a first-mover advantage and the ability to maintain a competitive position. The obvious question is, "Did firms that invested in e-commerce during the mid to late 1990s experience improvement in firm performance?" To answer this question, we analyze objective data such as Tobin's q and related financial performance measures for publicly listed firms that invested in e-commerce in 1997 or 1998. Our results provide empirical support to show that firms can achieve long term financial benefits from an investment in e-commerce. Also, our results align with prior findings that show improved shareholders wealth is associated with e-commerce announcements and that firm size is a factor in IT investments.

Introduction

Information technology (IT) continues to be actively employed by firms to achieve corporate goals. Some firms have invested in a variety of IT solutions such as enterprise resource planning (ERP) systems to support and enhance internal operations. Others, Wal-Mart and Hewlett Packard for example, have invested in IT systems that share information with suppliers and customers; resulting in improved communication within their supply chains. Still others have invested in IT to tap the potential of the Internet and the World Wide Web (Web). For example, some firms have set up websites to disseminate corporate information to current and potential stockholders, while other firms use websites to advertise and sell products and services.

Advances in IT—the development of the Web in particular—made e-commerce possible and changed the ways organizations conduct business and create value. In Drucker's (1999) words, e-commerce was a “totally new, totally unprecedented, totally unexpected development that created a new and distinct boom.” Whether they chose to invest in informational websites, in full-fledged e-commerce sites, or something in between, many businesses began opening their ‘virtual doors’ in the mid to late 1990s. While many of the first movers were purely online companies, traditional businesses quickly learned that an up-and-running website created opportunities for taking advantage of the Internet's exponential growth during this period.

To better understand the excitement these technologies were creating, it is important to look at the projections that businesses were seeing during the mid 1990s. Worldwide, fewer than 40 million people had access to the Internet at the end of 1996, but by the end of 2000 the projected number of Internet users was between 250 and 300 million (Computer Industry Almanac, 1997). Business-to-consumer (B2C) e-commerce revenue was projected to grow from \$2.4 billion in 1997 (Zapp, 2000) to \$26 billion by 2002 (Nichols, 1998). Business-to-business (B2B) e-commerce was projected to grow from \$5.6 billion in 1997 to \$268 billion by 2002 (Nichols, 1998). Given the potential growth of B2C and B2B revenue, many firms invested in e-commerce during the mid to late 1990s for a number of reasons that included gaining first-mover advantages and enhancing company competitiveness.

Based on perceptions of IT value, managers, consultants, and financial analysts assess a firm's potential abilities relative to its current IT resources and capabilities (Bharadwaj et al., 1999). Like most things in business, IT has evolved to where it is common practice for firms to employ e-commerce. In the late 1990s through 2001, we heard many reports about the ups and downs of e-commerce. For example, there were reports concerning the expectations of increased business as evidenced by the disastrous 1999 Christmas season in which many companies could not keep up with the demand for their products. There have also been studies reporting how e-commerce investment results in higher stock values (Subramani and Walden, 2001; Ferguson et al., 2005). However, while some firms achieved notable benefits, others experienced notable losses; there is still doubt if firms investing in e-commerce achieve higher financial performance after their investment. In other words, do firms, on average, benefit from an e-commerce investment? As an extension of the Subramani and

Walden (2001) study, this study seeks to answer two additional questions. First, did firms that invested in e-commerce during 1997 or 1998 experience improved firm financial performance? Second, if firms did achieve improved financial performance, what were the impacts and the time period over which these benefits were achieved?

To address these questions, we use longitudinal financial data of publicly listed firms making e-commerce announcements in 1997 and 1998. One may question the use of 1997 and 1998 data given that we are now in the 21st century. This time frame was chosen for a couple of reasons. It encompasses the time period studied by Subramani and Walden (2001), thus we can possibly confirm their results. Also, this time period represents a time when e-commerce investment was at a heightened pace (Subramani and Walden, 2001), and if e-commerce truly did impact financial performance, analysis is more likely to detect the impacts during this time.

Instead of analyzing abnormal stock returns as performed by Subramani and Walden (2001), we analyze objective data such as Tobin's q and other financial performance measures. We begin with a discussion of findings from prior studies that looked at the relationship between IT and firm performance and follow that with a discussion of prior studies about e-commerce initiatives and firm performance. We then present the methodology, sample statistics and our analyses and findings. We close the article with a discussion of overall findings, limitations of the study, and suggestions for future research.

IT and Firm Performance

Over the years, Information Systems researchers have studied the impacts of IT investments on firm performance. Unfortunately, the results are mixed. Bender's (1986) study found that IT investments equaling 15 to 25 percent of total expenses yielded the best firm performance. Other studies – Lucas's (1975) and Turner's (1983) - found no relationship between IT investments and firm performance. Lucas (1975) found that the usage of information systems instead of IT investment level was an indicator of firm performance. Turner (1983) found no relationship between firm performance and the relative proportion of resources allocated to IT investments.

Beyond these early studies, Dos Santos et al. (1993) addressed IT and firm performance by looking at the impact of an IT investment on the market value of a firm, specifically from the stockholder's perspective. Their study found no significant positive effects on the price per share after an IT investment announcement. However, the authors did find that firms making innovative IT investments involving the use of new technology or resulting in new products or services did have significant positive abnormal stock returns. In a similar study, Im et al. (2001) found no significant positive increase in stock price across all firms in their sample that made IT investment announcements. However, smaller firms and finance firms making announcements after 1991 did have significant positive stock price increases. Chatterjee et al. (2002) found significant evidence that positive abnormal returns and increased trading volume were associated with IT infrastructure investments. However, IT application announcements

did not generate the same increase in returns as IT infrastructure investments, nor did they generate an increase in trading volume.

In a study that combined samples from three previously mentioned studies, results indicate that not all types of IT investments lead to positive changes in stock price (Dehning et al., 2003). However, firms that made transformational IT investments or firms regarded as leaders in their industry did realize significant positive stock returns. Looking at these different results suggests that firms may achieve higher market value through IT investment, especially if the IT investment is considered leading edge for the industry. Also, smaller firms enjoy higher returns than larger firms, whose size may hinder their ability to embrace transformation (Dehning et al., 2003).

As an alternative to assessing impact on stock returns, Hitt and Brynjolfsson (1996) studied how IT spending impacted productivity, profitability and customer value. Their results provide evidence that IT spending may increase productivity and consumer value, but the same IT spending did not lead to "supranormal" business profits. Weill (1992) found a complex relationship between IT investment and firm performance, where transactional IT investments were associated with increased financial performance (sales growth, return on assets, and labor productivity). Strategic IT investments had mixed results and informational IT investments had no significant impact on firm performance (Weill, 1992).

The aforementioned studies looked at various types of IT investments, but others have focused on investment in specific types of IT. For example, several studies have addressed the impact of IT investment in ERP systems on market value and firm performance. One such study found that firms investing in ERP systems did enjoy positive abnormal stock returns (Hayes et al., 2001). Taking a longitudinal approach, Hunton et al. (2003) found that firms adopting ERP systems had higher ROA, ROI and asset turnover during a three-year time period than non-adopters. In accordance with these findings, Nicolaou's (2004) results indicated that firms adopting ERP systems achieved higher levels in multiple financial performance metrics such as ROI, ROA, Operating Return on Assets and Return on Sales when compared to non-adopting firms.

In the past few decades, the number of multi-national firms has increased as has the importance of supply chain management. As a consequence, firms have looked to IT for solutions in managing their operations. At first, firms began investing in net-enabled business transformations where IT and the Web were used to facilitate information sharing and financial transactions exchange (Straub and Watson, 2001). Eventually, the term "e-commerce" was coined and adopted. Now, e-commerce refers to IT applications that use the Internet to link firms and customers. Looking at the impact of e-business, specifically use of the Internet for conducting business in a supply chain, Zhu and Kraemer (2005) found a positive relationship between e-business use and firm performance within the retail industry.

E-commerce and Firm Performance

A number of researchers have addressed the impact of e-commerce on either market value or firm performance. For instance, Subramani and Walden (2001) found that e-commerce initiatives announced during the fourth quarter of 1998 signaled significant increases in stock value for the announcing firm. Dehning et al. (2003) conducted a variation of the Subramani and Walden study (2001) in which they compared abnormal returns for fourth quarter 2000 e-commerce initiatives to fourth quarter e-commerce initiatives conducted in 1998. Their study found a positive significant reaction to the e-commerce initiative announcements in 1998, but not in 2000. Another extension of Subramani and Walden's (2001) study found that investments in e-commerce increased shareholder wealth; also, positive cumulative excess returns were found with non-innovative investments, but were not found with innovative investments (Ferguson et al., 2005).

This paper differs from Subramani and Walden's (2001) study because we extend the time period of e-commerce announcements from one quarter to two years and we analyze longitudinal data for 3 years after the investment to study the long-term impact of e-commerce investments on firm performance. The investments being analyzed in this study qualify as innovative and transformational investments based, in part, on Drucker's (Subramani and Walden, 2001) view of e-commerce and in part on the fact that the time period in this study represents early stages of e-commerce adoption. While stock price is an element of a financial reporting for a firm, it measures stockholder perception of the impact of firm decisions on firm performance; it does not measure actual firm performance. For this reason, we chose to use financial metrics that minimize stock price's impact on performance and focus more on measuring the actual bottom line firm performance. In accordance with prior studies (Dehning et al., 2003; Dos Santos, 1993) and while making no distinction between innovative and transformational, we posit that firms investing in e-commerce do achieve higher firm performance.

Methodology

There are several approaches to study the relationships between firm activities and firm performance. One approach is the event study methodology proposed by Brown and Warner (1980; 1985). This method is based on the analysis of abnormal stock returns and the concept of market efficiency, which states that the full effects from a public announcement are felt within a small timeframe (i.e. two days). Other researchers have used this approach to study market value effects from IT investment announcements (Dos Santos et al., 1993; Im et al., 2001; Subramani and Walden, 2001). While this approach works well for understanding stockholder perception of the announcement's value; again we state, it does not address the actual changes in a firm's financial performance. As a result, other researchers employed a different approach using longitudinal financial data that chronologically encompasses the event date (Bharadwaj et al., 1986). In this study, we use this longitudinal approach to study the impact of e-commerce investment on financial performance, with particular

emphasis on Tobin's q . We also include traditional measures of financial performance such as sales, sales to assets, operating income, operating income to sales and operating income to assets.

Studying the relationship between firm activities and firm performance begins with the identification of firm activities related to the research question at hand. First, using public announcement information, we identified firms that have completed one of a list of activities during the specified time period. After identifying the sample firms, financial performance information for these firms was gathered for analysis. In the next section we provide the details on how our sample was identified along with descriptive information about our sample.

Sample Selection

Event data was generated from a search of public announcements for firms investing in e-commerce during 1997 and 1998. In this study, an event is defined as a firm's public announcement of its e-commerce investment. For example, an event is a firm's announcement of its new capability to handle electronic transactions via its website. Using the Guided News Search Option in LexisNexis, public announcements were identified using the key words, *launch, begin, or announce* in tandem with the key words, *electronic commerce, electronic business, web, B2B, B2C, e-commerce, e-business, online commerce, and .com*. Table 1 provides examples of public announcements used in this research.

Table 1: Announcement Examples
Roadway Express announces the introduction of an online version of its shipment rating application that will allow customers to receive instant rate quotes for shipments. Business Wire, 4-2-1997
APD announces the launch of its electronic commerce service which enables customers and prospects in the US to order the company's specialty gases and selected equipment. PR Newswire, 7-21-1997
Apple Computer, Inc launched The Apple Store for online sales of products via the internet. M2 Communications Presswire, 11-13-1997
AEOS launches its new interactive web site offering customers the chance to order on-line. PR Newswire, 12-3-1997
Akorn Launches First Full-Service Ophthalmic Website: Allows for Direct Purchases, Complete Product & Corporate Info. PR Newswire, 11-10-1998
Andrea Electronics Corporation launches new web site with features such as improved search capability, easier navigation throughout the site, improved online order features, updated news and press highlights and feedback capability, among other things. PR Newswire, 10-26-1998

To be included in the study, each announcement had to satisfy several criteria. First, the firm must be listed in the Compustat Annual Industrial File. Second, it must be clear from the announcement that the firm had made the investment; therefore announcements of firms' intent to invest were eliminated. Third, the announcement must indicate an investment enabling e-commerce for the firm, not announcing a new e-commerce software or hardware product for sale. It should be noted that a few firms had multiple announcements regarding e-commerce investments during the search time period. Since we are looking at the impact from e-commerce investments, the announcement with the earliest date was used.

A LexisNexis search yielded 117 firms that invested in B2B or B2C forms of e-commerce in either 1997 or 1998. Based on the percentages in Table 2, 40 firms made announcements in 1997 that met our criteria, while 77 firms made announcements in 1998. Over these two years, manufacturing, wholesale trade, and retail, along with information firms, accounted for 65 percent of the firms in our sample. During both 1997 and 1998, over 55 percent of the announcements were made in the first three quarters of the year.

Table 2.0: Sample Breakdown by Announcement Period and NAICS Code	
Announcement Period	%
1997	34%
1st Quarter	8%
2nd Quarter	28%
3rd Quarter	25%
4th Quarter	40%
1998	66%
1st Quarter	17%
2nd Quarter	26%
3rd Quarter	26%
4th Quarter	41%
Breakdown by NAICS Code	
Manufacturing	27%
Wholesale Trade and Retail	28%
Transportation and Warehousing	4%
Information	20%
Finance and Insurance	3%
Professional, Scientific, and Technical Services	3%
Administrative and Support and Waste Management and Remediation Services	6%
Accommodation and Food Services	3%
Miscellaneous	4%

Analysis Time Periods

Two time periods exist in our study and need further explanation. The first period is the time during which event data was collected, while the second is the length of time involved in our analysis. To identify the performance benefits from e-commerce investments, we chose a two year time period in which firms were making initial investments in e-commerce. With the aforementioned projected growth in B2C revenue and B2B commerce from 1997 to 2002 (Nichols, 1998; Zapf, 2000), firms were beginning to invest in e-commerce in the mid to late 1990s; thus we choose years 1997 and 1998 for our study. While several firms made e-commerce investments prior to 1997, we choose a later time period to better ensure an adequate number of firms meeting our criteria for statistical analysis.

The second time frame is a five year time period over which financial performance was analyzed. This includes the year of the announcement, the year preceding the announcement, and three years following the announcement. A three year time period was chosen because we recognize that it takes time for a firm to realize benefits from an e-commerce investment (Bharadwaj et al., 1999) and we needed to account for a possible time lag effect on firm performance. This time lag represents the time between the e-commerce investment (associated with the announcement date) and its impact on firm performance. Predictably, some firms may achieve financial benefits in a short time period—possibly the same year as the announcement—while others may experience longer time lags before there is an improvement in performance. For example, it may take more than a year for customers to be both informed and confident in the new e-commerce channel which can translate to a delay in increased sales. Since no consensus exists on what represents an adequate time lag, we take a conservative approach by choosing three years for the full effects from the investment to occur.

For each firm in our sample, the study uses five years of yearly financial information extracted from Compustat. The data was pooled across time by translating the calendar years to event years using the following convention. The announcement year was coded as time 0 then the prior year was coded as -1 while the following three years were coded as +1, +2, and +3. For example, an announcement made in 1997 would have 1997 coded as time 0 while 1996 is coded as time -1 and 1998 coded as +1.

To incorporate controls within our analysis, we identified a control firm to match each firm in our sample as has been done in prior studies (i.e., Hendricks and Singhal, 1997). The control firm was identified as 1) sharing the same 2 digit NAICS code and 2) having the closest (within +/- 30%) book value of assets at the end of the year when compared to the sample firm. The first condition controls for economic trends and industry effects while the second condition controls for effects of firm size.

Tobin's q Analysis

Tobin's q was first introduced by James Tobin as a predictor of a firm's future investments (Tobin, 1978; Turner, 1983). Since then, it has been used to study different phenomenon. For example, Lindberg and Ross (1981) used Tobin's q as a measure of monopoly power, specifically monopoly rents, of a firm, while Wernerfelt and Montgomery (1998) used it to study the importance of industry, focus and share effects in determining firm performance. Tobin's q represents the ratio of a firm's market value to the replacement cost of its assets. According to Wernerfelt and Montgomery (1998), Tobin's q incorporates a capital measure of firm rents thus it "implicitly uses the correct risk-adjusted discount rate, imputes equilibrium returns, and minimizes distortions due to tax laws and accounting conventions." This statement provides many of the reasons why Tobin's q is preferred over traditional accounting measures. Furthermore, Bharadwaj et al. (1999) found that IT expenditures were related and useful in explaining variance in Tobin's q , thus providing support for its use as a measure for studying the effects of e-commerce investment on firm performance.

Tobin's q has been measured in different ways. Wernerfelt and Montgomery (1998) described their measure of Tobin's q as, "the capital market value of the firm divided by the replacement value of its assets." Linderberg and Ross (1981) explicitly described their measure of Tobin's q based on ratio of market value to replacement cost. Their measure of market value equals the sum of market value of debt, common stock and preferred stock. Their measure of replacement cost equals the sum of total assets, replacement value of firm, and the replacement value of inventory minus historical value of the firm and historical value of inventory. Taking a different, yet simpler approach, Chung and Pruitt (1994) computed Tobin's q and found that their estimates had a .9315 correlation with Tobin's q values using Lindenberg and Ross's calculation (1981). Chung and Pruitt's (1994) method of computing Tobin's q was chosen for several reasons. First, Chung and Pruitt's (1994) method closely approximates the Tobin q values using the traditional approach by Lindenberg and Ross (1981). Second, it has the advantage of using information available in Compustat. Lastly, it requires fewer input fields thus reducing the likelihood of missing data. Chung and Pruitt (1994) approximate Tobin's q using the following formula:

$$\text{Tobin's } q = (\text{MVE} + \text{PS} + \text{DEBT}) / \text{TA}$$

where:

- MVE = (closing price of share at the end of the financial year) x (Number of common shares outstanding);
- PS = Liquidating value of the firm's outstanding stock;
- DEBT = (Current liabilities – Current assets) + (Book value of inventories) + (Long term debt); and
- TA = Book value of total assets.

While this calculation method requires fewer input values, there are still firms in our sample with missing data; thus resulting in the different number of observations per year in the data result tables. In keeping with similar studies (Hendricks and Singhal,

1997), a firm in our sample is still included in the analysis even though Tobin's q was not computed for all five years. Looking at the calculation, multiple explanations may exist for changes in Tobin's q . For example, if shareholders have a positive belief concerning the announcement then share price increases thus Tobin's q improves. Also, if the e-commerce investment has a positive impact on sales, then the book value of inventories may decrease, and additional revenue may be used to reduce long-term debt. Again, Tobin's q improves.

Results

The mean and median, along with the confidence intervals for Tobin's q are shown in Table 3. To control for possible effects of outliers, results are reported after trimming 2.5 percent of data in each tail. Next, the Wilcoxon signed-rank test statistic was used to test whether the mean percent change was significantly different from zero. Significance levels denoted in Table 3 are based on one-tailed tests. The negative mean values indicate that firms in our sample that invested in e-commerce had smaller Tobin's q values than the firms they were matched. However it is interesting to see that the difference was smaller in years 1 to 2 and 2 to 3 when compared to the years -1 to 0 and 0 to 1. Looking at the median values, we see that firms in the sample actually surpass the matched firms in terms of, performance with the transition from -12.53 percent in years -1 to 0 to 11.66 percent in years 2 to 3. However, the confidence intervals contain mostly negative percentages. Overall, the results are mixed with respect to gains in Tobin's q .

Table 3.0: Percentage Change in Tobin's Q					
% Change in Tobin's Q for B2B/B2C firms					
From/To				Confidence Interval	
Year	Obs	Mean	Median	Lower	Upper
-1 to 0	91	-13.83 ^d	-12.53	-53.13	25.46
0 to +1	94	-18.92	-0.27	-77.16	39.32
+1 to +2	83	-4.20	-2.19	-26.35	17.95
+2 to +3	70	-10.07	11.66	-53.08	32.95

Note: a, b, c and d denote, respectively, significant differences of mean from zero at the .01, .05, .10 and .15 levels for one-tailed tests.

To gain more insight, we compare the average change in Tobin's q difference between sample and control firms according to size. Using a sample mean of 16 thousand employees, we divided the sample into two groups, one representing small firms and the other representing large firms. Those firms missing this information were excluded from the analysis. Based on the results of another study (Dehning et al., 2003), we computed the mean changes for each group and checked to see if the mean change in Tobin's q for small firms would be greater than that of large firms. While there

are not significant differences between the means in Table 4, there are some interesting observations. For starters, large firms had larger Tobin's q values for years 0 to 1 and years 1 to 2 after the announcement while small firms swung from a negative Tobin's q of -10.34 percent in year 0 to 1 to increasing positive values of 1.06 percent and 8.30 percent in years 1 to 2 and 2 to 3, respectively. Unfortunately, large firms had lower Tobin's q values than their counterparts in years 2 to 3. The fact that large firms enjoyed higher values in the same year as the announcement while smaller firms did not achieve higher performance until a year after the announcement indicates that larger firms reap benefits faster than smaller firms.

From/To	Small Firms			Large Firms			T- Test *	
Year	Obs	Mean	Variance	Obs	Mean	Variance	t-statistic	P value
-1 to 0	66	-20.05	466.87	22	-10.79	48.55	-0.31	0.38
0 to +1	66	-10.34	813.54	23	17.92	130.70	-0.67	0.25
+1 to +2	59	1.06	205.40	22	12.48	30.77	-0.52	0.30
+2 to +3	46	8.30	176.09	18	-22.35	152.40	0.87	0.19

Note: T- tests are one-sided with $H_0 : \mu$ (small firms) $\geq \mu$ (large firms) and P-values are for one-sided tests.

Financial Performance Analysis

Per our earlier discussion, Tobin's q can change for many reasons; thus combining it with other financial measures provides more insight into how firm performance changes. In this study, we look at the effects of e-commerce technology investment on sales, assets and operating income. Looking at the means and median values in Table 5, we find differing results. The mean values indicate that the sample firms had 9.03 percent higher sales than the control firms in the year of the announcement followed by 6.16 percent lower sales in years 1 to 2 then 4.96 percent higher sales in years 2 to 3. Given the widening aspects of the confidence interval over the years, we also report the median values which indicate a lower value of 1.95 percent in the year of the announcement followed by increases of 4.41 percent and 7.39 percent in years 1 to 3 following the announcement. Looking at the percent difference in sales to assets, the means between sample and control firms are positive only in the year of the announcement then negative afterwards. In years 0 to 3, the confidence intervals widen and contain more negative values than positive ones. Also, the median values are negative for years 0 to 2 but positive at 1.15 percent in years 2 to 3. While the sales results are encouraging, the sales to assets results do not indicate any improvement from the investment, actually sales to assets performance dropped.

Table 5.0: Percentage Change in Sales and Sales/Assets										
From/To	% Change in Sales					% Change in Sales/Assets				
	Year	Obs	Mean	Median	Confidence Interval		Obs	Mean	Median	Confidence Interval
Lower					Upper	Lower				Upper
-1 to 0	89	12.56 ^a	5.57	3.26	21.86	89	1.20	2.56	-6.00	8.39
0 to +1	93	9.03 ^d	1.95	-7.91	25.97	93	8.93	-0.41	-12.42	14.21
+1 to +2	83	-6.16	4.41	-20.71	8.39	83	-12.77 ^d	-2.02	-26.52	0.99
+2 to +3	70	4.96 ^d	7.39	-10.16	11.15	70	-0.37	1.15	-13.07	12.32

Note: a, b, c and d denote, respectively, significant differences of mean from zero at the .01, .05, .10 and .15 levels for one-tailed tests.

The first panel in Table 6 indicates that firms had positive mean percent differences in operating income over the entire time frame but negative median values for years 1 to 3. On the positive side, we see the confidence interval contains predominantly more positive values than negative values, especially in years 1 to 2; thus providing some evidence that firms making B2B or B2C investments do achieve higher operating incomes. Given that the trend in operating income is primarily positive in the first panel, the explanation of the primarily negative results of operating income to assets in the second panel is that asset decreases were larger than the operating income increases. Blending these results concerning sales and operating income, we find interesting results in the percent differences in the operating income to sales data in the third panel of Table 6. Here we find that sample firms had positive mean values of 31.69 percent and 4.55 percent but negative median values of 9.79 percent and 0.96 percent, respectively, in years 1 to 2 and 2 to 3. Given the differing results, we note that the confidence intervals for these years have more positive values in the range than negative; thus providing evidence of financial gains in operating income to sales following the announcement. While the results are mixed, the sales and operating income results provide evidence that firms do benefit from e-commerce investments.

Table 6.0: Percentage Change in Operating Income, Operating Income to Sales and Operating Income to Assets					
% Change in Operating Income					
From/To				Confidence Interval	
Year	Obs	Mean	Median	Lower	Upper
-1 to 0	89	20.69 ^c	8.67	-6.77	48.16
0 to +1	92	15.39	9.15	-17.02	47.80
+1 to +2	82	67.35	-1.38	-1.71	136.40
+2 to +3	70	2.86	-1.43	-27.68	33.40
% Change in Operating Income/Assets					
From/To				Confidence Interval	
Year	Obs	Mean	Median	Lower	Upper
-1 to 0	89	18.70	3.23	-12.82	50.22
0 to +1	92	3.13	2.81	-25.02	31.29
+1 to +2	82	15.55	-2.85	-22.92	54.01
+2 to +3	70	-14.46	-0.67	-52.19	23.26
% Change in Operating Income/Sales					
From/To				Confidence Interval	
Year	Obs	Mean	Median	Lower	Upper
-1 to 0	88	15.81	2.30	-17.95	49.56
0 to +1	91	-7.61	0.00	-34.22	18.99
+1 to +2	81	31.69	-9.79	-24.09	87.48
+2 to +3	68	4.55	-0.96	-23.99	33.10
Note: a, b, c and d denote, respectively, significant differences of mean from zero at the .01, .05, .10 and .15 levels for one-tailed tests.					

Conclusions

In this study, we analyzed the percent difference of several financial measures between sample and control firms to address how e-commerce investment decisions impact firm performance. Although sample firms did close the gap between their lower performance and that of the control firms, additional analysis was performed that divided the sample based on the number of employees. These results indicate that both large and small firms in our sample had better percent improvements than their counterparts, but these gains happened at different times following their announcements. Specifically, large firms achieved their gains quickly, while there was a year time lag between announcement and gains for small firms. This result provides further evidence that a lag effect exists between investment and realized benefits from investment (Dehning et al., 2004).

With respect to other financial metrics, we find interesting results about sales. On a positive side, the sample firms did achieve a 9.03 percent larger increase in sales than the control firms in the year of the announcement. This result is not surprising given that a majority of the announcements (roughly 65 percent in both years) were made in the third and fourth quarters of the years, just in time to benefit from the holiday buying season. One possible explanation of the negative 6.16% difference in year 1 to 2 followed by the positive 4.96 percent difference may be the volume of product returns in January resulting from poor product presentation or information on the websites. Once firms were able to resolve these issues, the sample firm then enjoyed higher sales percentages than the control firm. Unfortunately, there is not a noticeable improvement in sales to assets. On a different note, the operating income results are favorable especially for year 1 to 2 following the announcement. However, the operating income to assets results are mixed. Given that both sales and operating income have encouraging results, while sales to assets and operating income to assets are not encouraging; sample firms did not achieve higher returns in terms of assets as compared to the control firms. However, sample firms did achieve better operating income to sales performance than control firms, especially in the year following the announcement.

While an accepted analysis methodology was employed, this approach does have its limitations. For instance, we did not exclude firms that had other public announcements during the time period in our study; thus confounding effects may exist. Fortunately, the use of a control firm matched with each sample firm according to NAICS code and assets does reduce potential confounding effects associated with such economic trends as the economic downturn during 2000 and 2001. Another important aspect to appreciate is that parametric tests, such as the Wilcoxon signed ranks test, are relatively weak in their ability to detect statistical differences. Thus, while there are few significant statistical Wilcoxon results, one can still draw useful inferences from the combined reporting of the means, medians, and confidence intervals. There is some evidence that firms did achieve long term financial benefits from investing in e-commerce.

Prior event studies showed improved shareholders wealth associated with e-commerce announcements (Ferguson et al., 2005; Subramani and Walden, 2001); but our Tobin's q results are mixed. As a study that considers potential gains in financial performance from e-commerce investments, specifically B2B and B2C, this is an important observation. "Why?" you may ask. Given that Tobin's q in this study represents the value of a firm, the results from this study indicate that, while a firm may achieve gains in shareholders' wealth, it may not necessarily achieve gains in its financial performance metrics. Drawing upon comments from productivity paradox studies by Brynjolfsson and Hitt (1993; 1996; and 1998), our results may be explained by knowing whether or not the e-commerce investment had characteristics that were unique to the firms. Another possible explanation is that firms in this sample could have had poor back end integration of the e-commerce tools, thereby negatively impacting any potential gains in firm performance (Zhu and Kraemer, 2005). On the other hand, firms investing in B2B or B2C did enjoy higher sales in the announcement year and

higher operating income in both the announcement year and the following year. In a different study, small firms investing in IT were found to achieve higher stock values than larger firms (Dehning et al., 2003); however our study indicates that while size may impact the time in which a firm achieves higher performance, large firms can still achieve higher performance in terms of Tobin's q .

With continuing advances in e-commerce technology, firms are investing in e-commerce and will continue to do so. Given this fact, more research is needed to identify those factors related to e-commerce investment that are associated with improved financial performance. As a starting point, Zhu and Kraemer (2005) identified several factors such as technology competence and financial commitment, as well as back-end and front-end integration capabilities as important requisites for e-business investment. Another related area of future research is identifying characteristics that predict when significant diminishing returns from e-commerce investment occur; thus identifying when one has tapped the full potential of the technology. For both of these extensions, one may perform case studies looking at the effect of investment on firm performance given access to observe and gather detailed information. It is a known fact that firms will continue to invest in IT in various evolving forms, however; it is not a guarantee that these investments will have a positive impact on firm performance. With that said, the focus of any e-commerce investment should be on fitting the software with the "best practices" process versus changing the process to fit the software.

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Note

The title graphic was made by Carole E. Scott

