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Investments in Web Technologies and Firm Value Effects

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ABSTRACT

This research examines whether investments in web technologies in the mid and late 1990s increased the value of the firm. Although the link between IT investments and shareholders' wealth has not been conclusively proven, recent evidence suggests that IT infrastructure investments are more closely associated with firm value increases than applications investments. We argue that early investments in web technologies, signaled by the initial deployment of a commercial web site, are more comparable to IT infrastructure investments, due to the potential of the web presence to become a platform for firm growth and revenue creation. The introduction of a commercial web site provides the launching pad to support complementary innovations in business processes and products or services, which are likely to affect the locus of value creation in many firms. Using the event study methodology and a sample of over three hundred announcements, we investigate the payoff of establishing a new commercial web presence in the late 1990s. Our results suggest that early investments in web technologies produced significant increases in firm value, and we believe this illustrates the potential of the Internet to change the locus of value creation.

Keywords


INTRODUCTION

In the 1990s, many commercial organizations began to take advantage of the Internet as a commercial medium by investing in web technologies. According to a survey of 100 commerce sites conducted by Gartner Group, companies initially spent an average of $750,000 for the baseline technology to enable web-based commerce (Wilder, 1998). Investment categories included web servers and specialized business-oriented server software. The first signal of such investments was the introduction of a new web presence, which required additional outlays depending upon the type of site. A study by Forrester Research reports web site development costs ranging from about $100,000 for a promotional site to almost $600,000 for a transaction site (Tedesco, 1996). However, other accounts from this period estimate average web site development expenses to be approximately $1 million (Global Finance, 1999).

From an investment perspective, initial web site deployments are more comparable to IT infrastructure improvements than to the development of applications due to the potential of a web presence to evolve into a platform for firm growth and revenue creation. For many companies, establishing a commercial web presence was the first formal step towards exploiting their newly acquired web technologies and exploring the potential of the Internet as a business environment.

Although recent empirical literature suggests that IT infrastructure investments and e-commerce initiatives have positive effects on firm value (Chatterjee et al. 2002a; Subramani and Walden, 2001), to our knowledge, the link between investments in web technologies specifically and firm value has not been explicitly addressed. This research fills this gap by studying the shareholders' wealth effects of early investments in web technologies signaled by the establishment of a commercial web presence. Our results suggest that financial markets anticipated positive returns for firms investing in web technologies.

LITERATURE REVIEW AND HYPOTHESES

The first visible step of the firm’s investment in web technologies was the introduction of a new corporate web site. In the late 1990s, companies began to leverage their existing IT infrastructure and to make more IT investments to harness the power of the Web. Although commercial web sites were developed for a variety of reasons ranging from the promotion of goods or services to the support of transactions, the deployment of a new site signaled a change in the strategic and operational activities of the firm and the readiness of their web-based IT investments. A web presence could eventually become the foundation for the deployment of more advanced web-based capabilities and complementary innovations. These innovations, in turn, could radically change the locus of value creation in many firms. New web sites hint at potential shifts in the locus of value creation, rather than actual changes (Davern and Kauffman, 2000).
The launch of a new commercial web site was usually announced by a press release. According to the signaling literature (e.g. Heil and Robertson, 1991), such announcements constitute a low-cost mechanism to inform different stakeholders (customers, employees, competitors, investors, industry experts and analysts) about the projects, intentions or future planned actions of the firm. These announcements are also associated with greater veracity because, unlike advertising, they are often subject to disclosure requirements and public scrutiny, which further enhances their perceived accuracy and believability (Calantone and Schatzel, 2000).

Because of its potential to affect the performance of the firm, a newly deployed web site exhibits some of the key characteristics of an IT infrastructure investment, particularly in terms of purpose and scope. The purpose of a new web site is not only to deliver business functionality but also to provide a platform for the deployment of current and future applications. Such platform offers option-like opportunities to leverage the competitive advantages associated with the new business environment. The scope of a typical IT application is constrained to one business process, product or function. In contrast, the scope of a web presence is usually broader, as it spans different business processes, products and functions, ranging from the static presentation of product catalogs to interactive features and virtual community networking (Chatterjee et al. 2002b). Investments made in building an IT structure with these general-purpose and broad-scope characteristics are likely to increase the value of the firm (Chatterjee et al. 2002a).

The empirical evidence to date has not proven conclusively the link between IT investments and firm value. For example, Dos Santos et al. (1993) and Im et al. (2001) conclude that on average IT investments do not increase the value of the firms upon their disclosure. However, Chatterjee et al. (2002a) find that investments in IT infrastructure produce larger increases on firm value than investments in IT applications. They argue that the value of the firm increases when IT investments are made in platforms for growth and revenue generation.

In addition to signaling investments in web technologies, the initial deployment of a commercial web site is also evidence of an IT innovation. Although Dos Santos et al. (1993) report that IT investments do not affect shareholders’ wealth, they find empirical support for the idea that innovative IT investments positively affect firm value. Indeed, a new web presence is an example of Swanson’s (1994) Type III innovation due to its potential integration into the core business processes and its potential to impact financial performance.

The deployment of a new commercial web site lays the foundation for the beginning and future expansion of the firm’s online operations. Like many other e-commerce announcements, the availability of a new web presence is also expected to increase the value of the firm. For example, Subramani and Walden (2001) report significant stock price increases for 251 e-commerce announcements about new B2C initiatives during the last quarter of 1998. It is not known however, whether different types of e-commerce announcements generate market reactions of different magnitude. Other analysis of e-commerce related events in the late 1990s have reported mixed shareholder wealth results. For example, Benbunan-Fich and Fich (2004a) found positive stock price changes of about 5% on the announcement of web traffic milestones in the late 1990s, while Benbunan-Fich and Fich (2004b) found no significant changes attributable to the completion of web site redesign initiatives. It seems that financial markets are able to distinguish among different IT investments and e-commerce events as signals of change in the locus of value creation. Table 1 summarizes these studies.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Type of investment (sample size)</th>
<th>Time Period</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dos Santos et al. (1993)</td>
<td>IT investments (97)</td>
<td>1981-1988</td>
<td>No excess returns, only significant for innovative IT investments</td>
</tr>
<tr>
<td>Im et al. (2001)</td>
<td>IT investments (238)</td>
<td>1981-1996</td>
<td>No excess returns</td>
</tr>
<tr>
<td>Chatterjee et al. (2002a)</td>
<td>IT investments (112)</td>
<td>1992-1995</td>
<td>Significant excess returns, Infrastructure &gt; applications</td>
</tr>
</tbody>
</table>

Table 1. Summary of Event Studies

The initial launch of a commercial web site signals the firm's investment in an innovative platform to support the growth of the e-commerce activities. The theory and the empirical evidence to date on innovative IT investments, IT infrastructure investments and e-commerce announcements suggests that an initiative with these characteristics is expected to increase the value of the firm. Therefore, we hypothesize that:
H1: Investments in web technologies will produce firm value increases.

Top management support has been found to be very important for IT projects in general (Jarvenpaa and Ives, 1991), and for the adoption and assimilation of IT innovations (Chatterjee et al. 2002b). In fact, in a study of the determinants of the corporate adoption of web technologies, Kambil et al. (2000) find that senior management support is the most important factor to explain the presence of a web site in the 1996-1997 period. Hence, in publicly traded companies, a good indicator of top management involvement with web technologies is the establishment of a corporate web presence by the parent company. This event would provide a strong signal, not only to external constituencies, but also to internal stakeholders, divisions and sub-units, about the importance of web technologies. Therefore, we would expect that:

H2: Investments in web technologies at the corporate level will result in larger firm value increases than investments at the subsidiary level.

Kambil et al. (2000) also report that firms with technology leadership and rich in resources are more likely to establish an early web presence in the mid 1990s. Early deployment of a new web site indicates the firm’s intention to capitalize on the commercial possibilities of the Internet by reaping first-mover advantages such as strategic positioning, technological leadership or learning curve gains. Early adopters are often able to secure a competitive advantage and strategic benefits, as in the case of early airline reservation systems and ATMs (Chatterjee et al. 2002b; Porter and Millar, 1985; Dos Santos and Peffers, 1995). These pioneers are also able gain learning curve advantages as they learn how to use the technology before their competitors do. However, in order to transform these gains into real competitive advantages, early adopters must be able to keep what has been learned proprietary to the organization. This condition of inimitability can be difficult to achieve in an e-commerce environment characterized by weak intellectual property rights protection, technological interdependence and rapid rates of innovation (Mellahi and Johnson, 2000).

Early movers in e-commerce are likely to enjoy other intangible benefits such as strong brand recognition, but face larger investment requirements and risks than its successors. In contrast, followers may be able to adopt more efficient processes and technologies and reduce their own investment requirements as well as their risks (Boulden and Christen, 2001). Despite the potential benefits for followers, financial markets initially unaware of the particular characteristics of the e-commerce medium are likely to assign a premium to pioneer adopters of web technologies. By establishing a web presence early, these pioneers indicate their willingness to invest in new technologies, their advanced technical expertise ("know how"), and their readiness to exploit new opportunities in the changing marketplace ahead of their competitors. Thus, we hypothesize that:

H3: Early adopters of web technologies will experience significantly larger firm value increases than late adopters will.

Web technologies can be considered general-purpose technologies with tangible and intangible benefits (Brynjolfsson and Hitt, 2000) ranging from cost savings and operational efficiencies to new business opportunities and competitive advantages. Web sites in particular, have the potential to change how business is transacted and where value is created, not only at the firm level but also at the industry level, and change the basis of competition in many industries. Porter and Millar (1985) theorize that firms with high information intensity in their processes and/or their products are expected to experience more competitive advantages and derive more benefits from IT investments than other firms. Although any type of firm may benefit from cost savings and operational efficiencies due to the availability of a web presence, service firms such as those in retail, financial, publishing, etc. may experience comparatively more advantages than manufacturing firms, because of the degree of information intensity in the process and in the product. The latter are constrained by the need to distribute/deliver physical products to complete a business transaction, while the former may completely deliver their offerings online (Palmer and Griffith, 1998). Based on these conjectures, we hypothesize:

H4: Service firms will experience larger valuation increases than manufacturing firms due to investments in web technologies.

RESEARCH METHODS AND DATA

To analyze the firm value effects of early investments in web technologies and initial deployment of commercial web sites, we use the event study methodology. This methodology is based on the efficient market hypothesis (Fama et al. 1969), according to which financial markets process publicly available information to assess current firm performance and to adjust the expectations of future achievements. At any given time, the stock price of a publicly traded firm reflects all the available information about the firm's current and future profit potential. Thus, any news resulting from an unexpected event or any additional information that may affect the firm's current and future earnings will produce changes in the stock price to reflect the new assessment of the value of the firm. The amount of change in the price of a security after an event, compared with its pre-event price, would reflect the market's unbiased estimation of the economic value of the new information (Brown and
Warner, 1985). Furthermore, the magnitude of this difference provides a quantifiable measure of the impact of the announcement on firm value.

In order to assess whether an announcement affects the stock price of a firm, we estimate what the expected stock price would have been had the event not taken place. Abnormal stock returns (also called excess returns) are then computed by subtracting raw returns around the event date from the market model expected returns. If the difference between the expected stock return and the actual return earned by the firm is significant then it can be concluded that the announcement had an effect on the market valuation of the firm. The market model is estimated for each firm using daily returns from an estimation period previous to the date of the event, defined as day 0. In our case, the estimation period includes 255 days, from day -300 to day -46, with 0 being the date of the event.

For each firm, the abnormal returns are added up over an event window to produce the Cumulative Abnormal Returns (CARs) for that firm. Consistent with prior event studies in IS (Dos Santos et al. 1993; Subramani and Walden, 2001), we study the CARs on the (-1, +1) event window. Positive CARs are expected when most market participants perceive that the event would result in significant future cash flows. Conversely, negative CARs are expected when most investors believe that the new information would have a detrimental effect on firm value. Overall, the CARs are assumed to measure the average effect of the event on the value of the firms in the sample. Therefore, if significant one can infer that the event had a noteworthy impact on the value of the firms. This inference depends upon the following assumptions: (1) markets are efficient; (2) the event was not anticipated by the market and (3) there were no confounding effects during the event window (McWilliams and Siegel, 1997).

Data Collection

To assemble a sample of firms that invest in web technologies and signal their readiness with a new commercial web presence, we use the Lexis/Nexis data retrieval system. We search for press releases with the following keywords (launch OR new) AND (web site OR website), in the 1994-1999 period. We impose two additional selection criteria to the thousands of announcements retrieved by this search strategy. First, we focus only on articles released via PR Newswire or Business Wire due to the widespread distribution of such announcements. Second, we retain only those articles referring to public companies trading in the major stock exchanges (AMEX, NYSE, NASDAQ) for which trading data was available via CRSP. These two additional filtering mechanisms reduce the sample to about one thousand articles.

The selected announcements are coded depending upon the level of the deployment (parent vs. subsidiary) and the type of site (general, product related, or service-specific). Product and service-specific web presence creation are analyzed in a separate paper. We focus here on announcements of general-purpose web sites. Duplicated announcements referring to the introduction of the same web site are eliminated and mixed press releases dealing with several news items are filtered out. In addition, each of the articles in the original sample is checked for the presence of simultaneous but separate press releases about other events such as management or board changes, earnings or dividend announcements, which are likely to affect the value of the firm. In these cases it may be difficult to attribute firm value changes solely to the launch of a new web presence. This "contamination" check is done for the three-day window surrounding the announcement date (the day before, the day after, and the day of the announcement). A total of 381 announcements do not experience a simultaneous event, but trading data was not available (or not enough) for 7 firms. Therefore, the final sample size for the event study is 374 observations. Table 2 shows the distribution of announcements per year.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Original Sample</td>
<td>4</td>
<td>54</td>
<td>120</td>
<td>89</td>
<td>91</td>
<td>135</td>
<td>493</td>
</tr>
<tr>
<td>minus Contaminated</td>
<td>2</td>
<td>14</td>
<td>21</td>
<td>19</td>
<td>17</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>minus Mixed</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>minus Trading data insufficient</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Final Sample</td>
<td>1</td>
<td>36</td>
<td>94</td>
<td>64</td>
<td>65</td>
<td>114</td>
<td>374</td>
</tr>
</tbody>
</table>

Table 2. Distribution of announcements per year

ANALYSIS AND RESULTS

We apply the standard event study methodology to the full sample to test H1. The results for the day of the announcement (day=0) and the three-day window (-1, +1) are shown in Table 3. This analysis confirms that the announcement of a new web presence by a publicly traded company has positive and significant effects on the value of the firm. Companies making such announcements experience significant abnormal returns of 0.76% the day of the announcement (at p<.001), and significant CARs of almost 1% in the days surrounding the announcement (p<.01). Although the proportion of firms experiencing
abnormal returns on the day of the announcement is not significantly different from what would have been expected based on the estimation period ($Z = 0.518$), the proportion on the three-day window is significantly higher ($Z = 2.801$). Therefore, H1 is supported.

<table>
<thead>
<tr>
<th>Window</th>
<th>CAR</th>
<th>Positive: Negative</th>
<th>t</th>
<th>Gen. Sign Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.76%</td>
<td>176:198</td>
<td>3.346***</td>
<td>0.518</td>
</tr>
<tr>
<td>(-1,+1)</td>
<td>0.98%</td>
<td>198:176</td>
<td>2.492**</td>
<td>2.801**</td>
</tr>
</tbody>
</table>

Significance levels: ** $p<.01$, *** $p<.001$, using a 1-tail test.

Table 3. Event study results for the full sample

Table 4 shows the cross-sectional analyses of the sample to test H2, H3 and H4.

In order to test H2, we separate the sample according to the parent vs. subsidiary coding of each article. When analyzed independently, the CARs in each sub-sample are positive and significant at $p<.05$. Although their magnitude appears to be different (0.85% vs. 1.82%), a t-test of the difference is not significant ($t=0.68$). In both cases the proportion of firms experiencing positive CARs is greater than the number of firms experiencing positive returns in the estimation period, according to the generalized sign $Z$ test.

We test H3 by dividing the sample according to the date of the press release into two sub-samples. Companies making announcements in the first three years of the period (1994-1996) are considered "early adopters", while those in the second half are considered "late adopters." Interestingly and contrary to H3, firms in the early adopter category do not experience significant CARs, while those in the "late adopter" group do exhibit positive CARs of the order of 1.41%, which are significant at $p<.01$. Although a t-test of the difference between these two samples is not significant ($t=1.49$), there is a tendency for firms with abnormal returns to cluster in the later years of the period.

Finally, to test H4, the sample is divided according to the two-digit SIC code of the firms, into manufacturing (codes between 20 and 39) and service (codes in the 40 to 87 range). According to the results, only manufacturing firms experience CARs, which are significant at $p<.05$, while the CARs of service firms are not significantly different from zero. Also in this case, a t-test of the difference in CARs between the sub-samples is not significant ($t=-0.53$). Despite the tendency of manufacturing firms to exhibit positive abnormal returns due to the establishment of a web presence, the magnitude of the difference between manufacturing CARs and service CARs is not large enough to be detected by the t-test.

**Discussion**

Our findings suggest that investments in web technologies, signaled by the initial deployment of a corporate web site, increase the value of firm. Contrary to H2, firm-value adjustments are not sensitive to the level at which the web presence is established, as both levels—parent and subsidiary—have positive firm value effects, which are not significantly different from each other. Other analyses by year of deployment (H3) and industry (H4) find no significant differences between the sub-sample CARs. Therefore, the data does not support any of the cross-sectional hypotheses.
Interestingly, in the chronological analysis, most of the firms experiencing abnormal returns are those introducing a new web presence in the later part of the period ("late adopters"). Several arguments may explain this finding. First, it is possible that early adopters were mostly deploying informational web sites with little transactional capabilities, or that due to the novelty of web technologies investors could not yet appreciate the potential changes in the locus of value creation when the first web sites were introduced. As web technologies evolved and more firms incorporated sophisticated functionality, the potential of a web presence to improve firm performance could be better appreciated by investors, or perhaps better leveraged by the firms. Second, it is also possible that financial markets recognized the risks associated with being a pioneer in a highly technological and dynamic environment, and rewarded instead the followers, who adopted newer web technologies and faced lower risks.

Finally, the results of the industry-based analysis of the sample seem to suggest that manufacturing firms tend to benefit more from establishing a new web presence than service firms do. It is possible that some manufacturing firms sent a stronger and more surprising signal about their commitment to e-commerce when deploying their web presence for the first time, than service firms, for which investing in web technologies was an expected move.

Limitations

There are two main sources of limitations in this study: one relative to the sample and the source of the data, and the other related to the event study methodology. First, the use of press releases as the source to identify the companies that launched new sites during the period under study may introduce some selection bias. Only companies that announce a new web presence through PR News wires or Business Wires are selected when, in fact, many more companies may have done the same but did not issue a press release to that effect or used a different medium to communicate the news. In addition, our selection of keywords may have also introduced a selection bias. Only companies using the words “new” or “launch” in the text of their announcements were extracted from Lexis/Nexis and included in the original sample.

Shortcomings of the event study method include the fact that stock prices are naturally noisy and therefore an event of interest must generate a reaction significant enough to be detected above the normal background noise of the stock market. A second limitation of the methodology deals with the issue of the true event date. For some events it is very difficult to pinpoint exactly when the actual information became publicly available. In some instances information may leak out of its source before it officially becomes public knowledge or the news may have been released after the end of the trading day. Therefore, it is important to analyze the excess returns in a window of time around the event date, as we did. Despite these limitations, event studies offer an unbiased estimation of the economic value of an announcement. Due to its particular characteristics, this methodology captures the tangible and intangible benefits associated with the firm’s investments in web technologies.

CONCLUSION

This research provides empirical evidence of the positive firm value effects attributable to the firm's investment in web technologies. Our findings are consistent with other e-commerce event studies, but since we focus on web creation announcements exclusively, the evidence presented here allows us to estimate the extent to which firm value increases with the establishment of a new web presence. Our findings are also in line with recent studies in IT investments, which suggest that infrastructure investments increase firm value while investments in IT applications do not. Although a new web presence is technically an application, it signals successful investments in web technologies and presents a platform with the potential to change the locus of value creation and facilitate a host of complementary innovations. Therefore, it is more comparable to IT infrastructure investments. Our results confirm this notion. Deployments of new web sites, unlike other IT investments in applications, increase the value of the firm. As organizations continually deploy new web sites to support and expand their online activities, the analysis of the shareholder's wealth effects of these initiatives may have important implications for the allocation of resources and IT investment decisions.

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