AN EXAMINATION OF THE LONG-TERM BUSINESS VALUE OF SPECIFIC INVESTMENTS IN INFORMATION TECHNOLOGY USING REGRESSION DISCONTINUITY METHODOLOGY

A dissertation submitted to the Kent State University Graduate School of Management in partial fulfillment of the requirements for the degree of Doctor of Philosophy

by

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Chapter 1: Introduction

1.1 Motivation

Information systems (IS) researchers have questioned the added value of the billions of dollars spent by firms on information technology (IT) over the past thirty years (Carr, 2003). In spite of this uncertainty, IT spending steadily increased from 5% in 1965 to over 50% of capital expenditures by the late 1990s (Carr, 2003).

The results of studies that have examined the business value of information technology (BVIT) have been mixed. Early BVIT studies sought to explain the “productivity paradox,” the fact that intensive IT expenditures during the 1980’s did not appear to result in significant increases in firm productivity at that time (Brynjolfsson, 1993; Dos Santos, Peffers, & Mauer, 1993). Subsequent studies suggested that the effects of IT investments on firm productivity took much longer to realize. This was supported by research showing that many firms with substantial investments in IT reported significant increases in firm value after 1991 (Brynjolfsson & Hitt, 1996).

Later BVIT studies focused on firm and technology-specific characteristics to explain the valued added from investments in IT. For example, several researchers suggested that only small, healthy firms (regardless of industry type) (see Chatterjee, Richardson, & Zmud, 2001; Im, Dow, & Grover, 2001) would experience an increase in firm value as a result of IT investments (Hayes, Hunton, & Reck, 2000; Im, et al., 2001). When researchers examined type of industry more closely, it was found to make a
difference, especially when considering the strategic role of the technology within the firm and industry (Dehning, Richardson, & Zmud, 2003). Several BVIT researchers also suggested that the type of technology affected the impact of IT investments on the value of the firm (Chatterjee, Pacini, & Sambamurthy, 2002; Chatterjee, et al., 2001; Subramani & Walden, 2001). Technology focus was also examined, and researchers reported that both the specific characteristics of IT investments (Agrawal, Kishore, & Rao, 2006) and how those investments were implemented (Khallaf & Skantz, 2007; Oh, Kim, & Richardson, 2006) affected firm value. While some BVIT studies have examined the long-term effect of IT investments (using return on assets, return on investment and return on equity), these studies focused on overall and not specific investments in IT (Brynjolfsson & Hitt, 1996). These BVIT studies led some to examine whether the impact of IT investments is lagged over even longer periods of time (c.f. see Goeke, Faley, & Dow, 2009). Unlike prior long-term BVIT studies that focused on overall firm IT investments (i.e. IT budgets, IT spending), this dissertation compliments the current BVIT literature by examining the long-term effect of different, specific IT investments on firm value.

Different technologies have different cost-benefit / risk-return relationships. For example, if a firm invests in technology for technology’s sake (e.g. catching up to their competitors, following the “popular” crowd) they are less likely to realize long term benefits.
However, if investments in IT facilitate one or more of the firm’s specific long-term strategic objectives, these investments should lead to a meaningful increase in firm value. Thus, the research question posed in this dissertation is:

RQ: Do specific investments in IT affect the long-term market value of firms?

1.2 Research Approach

Researchers have examined the effect of announcements of IT investments by examining changes in short-term cumulative abnormal returns (CARs). One limitation of this approach is that it can capture the short-term effect but not the longer-term overall added value of these IT investments. Firms invest large amounts of capital on IT, and it is fair to question whether these firms receive their investment’s worth. This dissertation uses regression discontinuity methodology to address the question, “Do specific investments in IT contribute to firm value?”

The regression discontinuity methodology is a pre-post, two-group design that measures the causal and treatment effects within different groups (Campbell & Stanley, 1963). While this methodology has been and continues to be popular in the psychology and education literatures, it has only recently been adopted in the business literature (primarily in economics) as a way to examine the effect of a treatment on a group (Cook, 2008; G. Imbens & T. Lemieux, 2008; G. W. Imbens & T. Lemieux, 2008). One advantage of the regression discontinuity methodology is that it allows researchers to test the effect of a treatment even when program participants are not randomly assigned to
treatment and control groups (van der Klaauw, 2002). Because the regression discontinuity design allows researchers to examine discontinuities in the treatment groups when the treatment is applied, the average difference in outcomes between treatment and control groups provide a consistent estimate of the average treatment effect (Busse, Silva-Risso, & Zettelmeyer, 2006; Hahn, Todd, & Van der Klaauw, 2001; Imbens & Angrist, 1994).

The regression discontinuity design is used in this dissertation to examine the change in a firm’s long-term market value as a result of specific IT investments. Seven hundred and ninety eight IT investment announcements were collected from the period 1981-2006. Firm-level performance data prior to the announcement are assigned to the control group and data after the announcement are assigned to the treatment group. This permits a direct comparison of the change in the market model after the announcement to see how a specific IT investment affects the long-term market value of the firm.

### 1.3 Contribution

This dissertation contributes to the IS research in two meaningful ways. First, this dissertation uses the regression discontinuity design to examine the long-term effect of specific IT investments on firm performance. This approach addresses limitations of other event study methodologies, especially the small event-window. The regression discontinuity design, on the other hand, tests the effect of the event by
comparing the changes in regression lines before and after the event regardless of the duration of the event window.

The second contribution of this dissertation is that it examines the long-term impact of specific IT investments. As noted above, because of restrictions related to the methodologies used (e.g. inability to isolate the long term IT effect), most prior BVIT studies have focused on short-term event windows. Having a short-term focus provides researchers with only a partial explanation of the value of IT investments, and therefore may be misleading. For example, some IT investments might increase the short-term but not the long-term value of the firm (the reverse might also be true). Thus, examining both the short and long-term impact of IT investments on firm value is essential to better understanding the nomological network within which IT valuation exists. Only by examining the short and long-term impact of IT investments can we meaningfully understand the true impact of investments in IT on firm market value.

1.4 Organization of Dissertation

In Chapter 2, research on IT investments, IT value and IT investment research using the event study methodology is reviewed. The hypotheses that were tested in the dissertation based on economics, finance, and the previously reviewed IS research are also developed in Chapter 2. In Chapter 3, a model is proposed to test the effect of IT investments on a firm’s value derived from previous IS and financial economics research. Chapter 3 introduces the regression discontinuity design and describes how it
will be applied in this dissertation. Chapter 4 discusses the methodology and the results of the tested model. Chapter 5 concludes the dissertation with a discussion of the findings.
Chapter 2: Literature Review

This chapter is organized in three sections: first, the overall literature related to the business value of information technology (BVIT) is reviewed; second, the event study methodology related to BVIT is reviewed; and finally, the specific hypotheses that were examined in this dissertation are developed.

2.1 Business Value of Information Technology

2.1.1 Introduction

The BVIT literature focuses on whether the enormous investments in information technology (IT) over the past twenty years have had a significant effect on firm value (Carr, 2003). Organizational stakeholders (i.e. management, customers, shareholders, etc.) expect IT investments to reduce operating costs and/or increase revenues as well as lead to greater market share or competitive advantage. This is illustrated in Figure 2.1.
IT investments are expected to positively affect business outcomes important to firms either directly (first order effects) or indirectly (second order effects). Direct effects have a positive impact on major operational and financial business activities. Indirect effects are not as easily measurable. However they can have an impact on business operations. Unfortunately, the effects of IT investments are not always quickly apparent; they often take time to develop.

In this dissertation, the BVIT literature is reviewed in the following order: (1) the era of the productivity paradox (pre-1992), a time when researchers found very few significant changes in firm productivity in spite of the enormous investments firms were making in IT; (2) the post-productivity paradox era, a time when researchers began to find significant improvements in firm performance they attributed to earlier IT
investments; (3) the variety of methodologies that have been used to examine BVIT; and (4) the varied accounting metrics that have been used to study BVIT.

2.1.2 The Productivity Paradox – Pre 1992

The productivity paradox was coined to describe the inability of researchers to find productivity or financial gains in spite of the enormous IT investments made by firms during the 1960s, 1970s and 1980s. For example, IT spending by service firms tripled during this period of time while productivity decreased by 6% (Roach, 1991); no relationship appeared to exist between the service industry’s IT spending and the return on these investments either (Strassman, 1990).

Studies related to the productivity paradox also examined IT spending by manufacturing firms where results similar to those for service firms obtained. For example, Loveman (1994) examined the relationship between firm productivity and IT spending using the ratio of the contribution of IT capital to output and found the ratio remained flat over time. Barua, Kriebel, & Mukhopadhyay (1995) re-examined Loveman’s data using intermediate measures of productivity (e.g., capacity utilization, inventory turnover, quality, relative price and new product introduction). Although they found that firm productivity did improve on three of their measures, there was no improvement on return on sales and market share.

Brynjolfsson (1993) suggested four possible reasons for the productivity paradox, including: (1) there were no meaningful productivity gains, (2) the gains were time
lagged, (3) the scope of the technology in which firms invested was beyond their ability to use fully, and (4) problems related to accurately measuring productivity.

Brynjolfsson argued, for example, that the complexity of firms overall and the fact that different departments within a firm typically had idiosyncratic IT needs, meant that an investment in a single innovation would likely have little positive effect on firm productivity: investing heavily in a single firm-wide technology may not improve (and even may harm) departmental operations. Firms also may not realize the benefits of IT investments that are subject to a time delay.

For example, IT investments may take several months or even years to positively affect firm value due to the learning curve associated with the technology. Furthermore, firms may need to restructure their business processes to better fit the technology, which may take some time, and the scope of the technology may also create a problem, especially if the firm does not completely understand the likely impact of the technology or provide the training necessary to effectively use the technology. Finally, Brynjolsson posits that the inability of firms to measure productivity well due to the lack of accurate, quality-adjusted price deflators contributed to the productivity paradox (see also Stratopoulos & Dehning, 2000).

2.1.3 Post productivity paradox Studies – Post 1992

The productivity paradox seemed to disappear in the early 1990s as firms with major investments in IT realized measurable productivity increases (Brynjolfsson & Hitt, 1996). The widespread nature of these productivity gains suggested that the
productivity paradox may have been an illusion created by limitations inherent in the available data at that time. For example, many of the early BVIT studies used broadly based economic data unlike later studies that used firm-specific data. Firm-level data allowed researchers to capture more accurately firm and not just industry differences. While some early BVIT researchers (e.g. Barua, et al., 1995; Loveman, 1994) used firm-level data, their samples were so small (e.g., 20 firms) that this limited the generalizability of their findings.

Much of the literature from the third generation of BVIT research focused on better understanding the separate effects of IT investments on firm performance and productivity. Hitt and Brynjolfsson (1996) addressed this issue by testing the effect of IT investments on productivity, profitability, and consumer value. Surprisingly, they found that IT investments substantially improved productivity and increased consumer value, yet had only a marginal effect on profitability.

Building on the work of Hitt and Brynjolfsson (1996), other researchers found that investments in IT improved both production quality (Prattipati & Mensah, 1997; Thatcher & Oliver, 2001) and firm performance, especially when the IT investments were consistent with corporate strategy (Armstrong & Sambamurthy, 1999; Li & Ye, 1999). With respect to production quality, the benefits of investments in IT included higher production rates at a lower cost while improving the quality of the firm’s products and/or services (Thatcher & Oliver, 2001). With respect to corporate strategy, the benefits of IT investments were more likely to occur if management was actively
involved in the firm’s IT adoption (Armstrong & Sambamurthy, 1999), and management considered both internal (corporate operations and strategy) and external (competition) factors (Li & Ye, 1999).

2.1.4 Methodologies Used in the BVIT Literature

Several methodologies have been used to examine BVIT. Many of the early papers simply examined the impact of investment in technology through correlation analysis, interviews and surveys. Much of the early BVIT research examined the relationships between macro-level economic data (e.g. Bureau of Economic Analysis data) and industry productivity and profitability (Morrison, 1997; Siegel & Griliches 1991). This method allowed researchers to begin a primary examination of BVIT. A limitation of these studies is that most of them examined correlation analysis at a broad level (i.e. country wide, economy wide) (Brynjolfsson, 1993). In addition, while a simple approach was used, these studies argue a complex method would most likely be inappropriate since many governmental data are considered unreliable (Siegel & Griliches 1991).

To address weaknesses of these early correlational studies, researchers began to use interviews and surveys. The Interview and survey methodologies allowed the researchers to examine how IT was implemented and ultimately used by firms. These methodologies directed researchers to examine more specific components of the firm and how these components apply technology to their operations (Weill, 1992). In addition, many researchers modified their studies to capture specific productivity and
valuation measurement based on the discussions of the papers that used this methodology (Brynjolfsson & Hitt, 1996).

One of the most common methodologies used in the BVIT literature is the event study. The event study methodology is common in the accounting and finance literature capturing the market’s reaction to an event (Dos Santos, et al., 1993). The event that has been most commonly used in the BVIT literature is the firm’s announcement of investing in IT. A benefit of the event study methodology is that it focuses on a firm specific event. By capturing firm specific data it allows the researchers to isolate the IT effect and measure changes in profitability, productivity, and performance with the associated event.

2.1.5 Accounting metrics in BVIT studies

Many BVIT studies use accounting metrics to measure IT investing firms’ financial performance. Common metrics used in early BVIT studies included return on assets (ROA), return on equity (ROE), and return on investment (ROI) (Alpar & Kim, 1990; Hitt & Brynjolfsson, 1996; Li & Ye, 1999; Mahmood & Mann, 1993; Rai, Patnayakuni, & Patnayakuni, 1996; Tam, 1998; Weill, 1992). ROA, ROE, and ROI are measures of firm profitability (Alpar & Kim, 1990) that are highly correlated with alternative measures of profitability (Weill, 1992). BVIT studies typically examine changes in these variables after an IT investment to better determine the effect of the adoption. Early studies found little or no change in these ratios at the macro (i.e., industry) level (Alpar & Kim, 1990; Mahmood & Mann, 1993; Weill, 1992). However, as BVIT studies began to focus
on firm and technology specifics, some researchers reported positive changes in these profitability ratios (Hitt & Brynjolfsson, 1996; Li & Ye, 1999; Tam, 1998). Studies focusing on firm-specific characteristics (e.g., management structure, corporate strategy, competition, etc.) allowed researchers to better isolate and measure more concisely changes in ROA, ROE and ROI (Li & Ye, 1999). However, a weakness of these accounting metrics is that they only capture historical financial information (Mitra, 2005).

One response to this weakness has been the use of Tobins Q to capture the market value of the firm based on forward-looking, risk-adjusted factors. Overall, the more recent BVIT literature indicates that Tobins Q increases when firms boost IT spending (Bharadwaj, Bharadwaj, & Konsynski, 1999; Mitra, 2005).

While these accounting metrics are not the only ratios used in BVIT studies, they are the more commonly used ratios. The BVIT literature has also used several less common accounting and financial metrics including: risk (Dewan & Fei, 2007), earnings volatility (Kobelsky, Hunter, & Richardson, 2008) and analysts’ forecasts (Dehning, Pfeiffer, & Richardson, 2006). For example, VBIT research has shown that the risk premium increases due to IT investments (Dewan & Fei, 2007). Similarly, Dehning et al. (2006) report that investments in IT increase analysts’ forecasting error due to the increase in information risk associated with the IT’s characteristics. Kobelsky, Hunter, & Richardson (2008) also report that a firm’s growth, size and diversification strategy affect whether IT investments improve the earnings volatility of the firm.
2.2 The Use of Event Studies

The event study is one of the most popular methodologies used to examine BVIT because it allows researchers to directly examine the impact of IT investments on a larger scale, using multiple factors and firms. An event study is used to assess the stock market’s response to a specific event (e.g., a firm’s public announcement of an IT investment). Unlike accounting-based measures (which are often criticized as inadequate indicators of the true impact of IT investments on firm value - (McWilliams & Siegel, 1997), event studies can be used to evaluate a firm’s ability to successfully adapt to a changing environment (Brynjolfsson & Yang, 1997).

The objective of a BVIT event study is to examine the stock market’s response to the release of information about a firm’s IT investments (Im, et al., 2001). According to the semi-strong form of the efficient market hypothesis, a firm’s stock price reflects all publicly available information about the firm (Fama, 1970; Jensen, 1968; Watts & Zimmerman, 1986). Thus, the market value of a firm should reflect the added value of a firm’s announcement of an IT investment (Im, et al., 2001).

One of the earliest BVIT papers to use the event study methodology was by Dos Santos, Peffers, & Mauer (1993). While these authors did not find that IT investment announcements increased the market value of the firm (likely the result of using macro-level variables – (see Madhavan & Prescott, 1995; Xiang, 1993), their use of the event study methodology led to its increased use in the BVIT literature. For example, event...
studies have been used to examine the effect of a number of different firm characteristics on the value of the firm after an announcement of an IT investment. These characteristics include firm size (Im, et al., 2001), industry (Chatterjee, et al., 2002), and financial health (Hayes, et al., 2000). Results of these event studies suggest that smaller firms are more likely to be affected by IT investments (Dehning, et al., 2003; Hayes, et al., 2000; Im, et al., 2001; Oh, Kim, et al., 2006). On the other hand, industry affiliation does not seem to affect differentially the value of a firm after it announces investments in IT (Chatterjee, et al., 2002; Dehning, Richardson, & Stratopoulos, 2005; Im, et al., 2001). Finally, the value of healthy firms is also affected positively by announcements of IT investments (Hayes, et al., 2000).

Because not all technologies provide similar benefits or produce the same results, BVIT researchers have used event studies to examine the effect of announcements of investments in different types of technologies on the market value of firms. The technology announcements that have been examined include: (1) enterprise resource planning (ERP) investment announcements (Hayes, Hunton, & Reck, 2001; Ranganathan & Brown, 2006); (2) newly created Chief Information Officers (CIO) position announcements (Chatterjee, et al., 2001; Khallaf & Skantz, 2007); (3) electronic commerce (e-commerce) investment announcements (Dehning, Richardson, Urbaczewski, & Wells, 2004; Subramani & Walden, 2001); and (4) outsourcing investment announcements (Agrawal, et al., 2006; Hayes, et al., 2000).
ERP systems provide firms the capability of merging incongruent computer systems into a single integrated application that provides managers with a seamless flow of information. Although the expected functions are similar, ERP systems are designed specifically for individual firms. Early event studies have found that the announcement of investments in ERP systems increases a firm’s market value, especially for smaller, healthier firms (Hayes, et al., 2000). Investors appear to view mainstream ERP systems (Ranganathan & Brown, 2006) as integrated, value adding investments, that will increase the firm’s productivity if used correctly (Hayes, et al., 2001).

Early event study BVIT research also examined market reactions to the announcement of a new Chief Information Officer. Although the results of this research suggest that investors view the CIO position as value adding, the extent to which a new CIO increases firm value depends on the CIO’s qualifications and long-term strategic role (Chatterjee, et al., 2001; Khallaf & Skantz, 2007).

Announcements about e-commerce technology have also been examined for their impact on firm value because of the opportunities they provide to expand both a firm’s operations and marketing strategy. E-commerce requires large capital investments by firms, yet early on the benefits of e-commerce were not obvious. Overall, the market appears to view e-commerce as a value added activity, although the market prefers that firms invest in e-commerce that involves tangible goods and services (Subramani & Walden, 2001).
BVIT researchers have also used event studies to examine the effect of announcements of investments in IT outsourcing on firm value. Over the last twenty years, many firms have signed agreements to outsource all or portions of their IS-related activities. These agreements have resulted in large amounts of capital expenditures, and researchers are interested in understanding the market’s view of these agreements. Studies find that small firms increase in market value after IT outsourcing announcements (Hayes, et al., 2000). However, the change in market value depends on the integration of the IT outsourcing with corporate strategy, complexity of the outsourced technology and the speed of outsourcing integration (Agrawal, et al., 2006). Finally, the market may view the outsourcing contract negatively if it believes the firm is outsourcing proprietary technologies or has become too dependent on the outsourcing vendor (Oh, Kim, et al., 2006).

Finally, BVIT research has used event studies to examine whether the strategy a firm uses for investing in technology (i.e., IT strategic role) affects firm value. Dehning, Richardson, & Zmud (2003) implemented three different firm’s IT strategic roles: automate, informate, and transformate. Automate technologies replace human labor in order to automate business processes. Informate technologies provide information about business activities to either upper management or to employees across the firm to facilitate decision making. Transformate technologies redefine firm and industry processes and relationships.
IT strategic role has been examined in the BVIT literature at both the firm level (Armstrong & Sambamurthy, 1999) and the industry level (Chatterjee, et al., 2002). IT strategic role provides signals to the market about the expected impact IT will have on the firm and the firm’s ability to compete in its industry (Dehning, et al., 2003).

Not all IT strategic roles have the same impact. For example, transformate technologies radically change the firm’s business. While they are viewed as highly risky, transformate technologies also provide higher returns (Weill, 1992). Informate and automate technologies may enhance the firm’s competiveness through improvements in current business processes; however the benefits are only realized in the short term (Dehning, et al., 2003). These BVIT studies found that: (1) IT infrastructure investments generate larger abnormal returns than IT application investments and therefore provide greater growth and revenue opportunities for the firm (Chatterjee, et al., 2002) and (2) the IT strategic role of a firm help explain the stock market response to the IT investments. That is, IT investments that involve the transformate strategic role are associated with the largest cumulative abnormal returns (Dehning, et al., 2003). Table 2.1 provides a summary of BVIT studies that have used the event study methodology.

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<th>Primary Variables Examined</th>
<th>Summary of Findings</th>
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| Dos Santos, B., G. K. Peffers, et al. (1993) | • Firm’s Industry – financial vs. manufacturing  
• Innovation – innovative vs. non-innovative | No abnormal returns for full sample.  
Innovative IT investments present positive abnormal |
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<td>Chatterjee, D., V. J. Richardson, et al. (2001).</td>
<td>CIO hire - external vs. internal, IT transformative vs. non IT transformative, Time – 1995-1998 vs. other</td>
<td>Positive abnormal returns for the creation of CIO positions for firms within IT transformative industries.</td>
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| Dehning, B., V. J. Richardson, et al. (2003) | **Firm’s Industry** – financial vs. non-financial  
**Firm’s Industry** – IT producing vs. non IT producing | IT Strategic role help explains stock market response to IT investments. Largest positive abnormal returns for IT investment announcements with transformative strategic role for both industry and investment |
| Hunter, S. D. (2003) | IT investments – explorative vs. exploitative | No abnormal returns for either explorative or exploitative IT investments |
Outsourcing swiftness  
Outsourcing complexity | Positive abnormal returns for firms that incorporate as outsourcing as part of strategy and in a quick manner |
| Oh, M. J. Gallivan, et al. (2006) | Stock return volatility  
IT Strategic role  
Asset-specific IT resources  
Source of announcement  
Market to book ratio  
Firm size – small vs. large firms  
Firm’s industry – Financial vs. non-financial | General support for IT investments. However, if investment is too large or contains sensitive competitive information, investors view the investment negatively. |
CIO characteristics – new position | CIOs who have experience and education add value to the firm. |
2.3 Hypotheses Development

The hypotheses tested in this dissertation examine the effects of specific technology investments on firm value measured using the Capital Asset Pricing Model (CAPM). CAPM is used to price securities based on the relationship between risk and expected return: a firm’s returns are equal to the risk-free rate plus a risk premium based on the strength of the relationship between firm and market returns. Jensen (1968) modified the CAPM developed by Sharpe (1964) and Lintner (1965) in order to better capture the time series effects implied by the original model. Equation 1 illustrates the CAPM model in regression form based on Jensen’s modifications:

\[ R_{it} - R_{f} = \alpha_i + \beta_i(M - F) + \epsilon_{it} \]  
  \( \text{(Eq. 1)} \)

Where

- \( R_{it} = \) return for firm \( i \) at time \( t \),

| Nagm and Kautz (2008) | • CIO characteristics – graduate degree vs. non-graduate degree  
|:----------------------:|:-------------------------------------------------------------------------------------------------|
|                      | • Firm size – small vs. large firms  
|                      | • CIO appointment – internal vs. external  
|                      | • Time – Y2K period  
|                      | • Time – technology bubble  
|                      | • Time – post technology bubble  
|                      | • Firm size – small vs. large firms  
|                      | Positive abnormal returns for smaller firms and all time periods  

| Characteristics                                                                 |
|---------------------------------------------------------------------------------|----------------------------------|
| CIO characteristics – graduate degree vs. non-graduate degree                   |
| Firm size – small vs. large firms                                               |
| CIO appointment – internal vs. external                                          |
| Time – Y2K period                                                               |
| Time – technology bubble                                                        |
| Time – post technology bubble                                                   |
| Firm size – small vs. large firms                                               |
• \( R_{ft} \) = risk free rate at time \( t \),

• \( R_{Me} \) = market return at time \( t \).

• \( \beta_{IM} \) = captures the relative volatility of the individual firm’s rate of return compared to the market’s rate of return.

Jensen’s alpha helps investors better understand how well a portfolio has performed compared to the portfolio’s theoretical expected return. While Jensen originally applied his theory to mutual funds, it has been used to examine other types of portfolio performance. The CAPM model is risk adjusted, which means a portfolio’s return is solely based on the portfolio’s beta multiplied by the market’s return. In this case, Jensen’s alpha will be equal to zero. On the other hand, if the alpha is positive (or negative), the portfolio has earned excess returns above (or below) the market’s return (Ball & Kothari, 1989). Thus, investors who hold a portfolio with a positive Jensen’s alpha will increase their return without increasing their idiosyncratic risk (Mashruwala, Rajgopal, & Shevlin, 2006).

Firms that invest in technology may also gain a competitive advantage over their competitors by adopting technologies that fit well the firm’s long-term goals and mission. Although the technology itself (i.e. its processes, standards, skill sets, etc.) may be replicable by its competitors, the technology is much more difficult to imitate when the technology is matched with the specific needs of a particular firm (Chatterjee, et al., 2002).
Developing and implementing a successful technology investment can take a long time and involves a significant amount of capital, human and other resources. While the success of the investment may not be realized as quickly as expected or meet the original estimated budget, in the end most technology investments are deemed successful by their adopters. For example, the Standish Group (2009) reports that over time, more and more technology investments have been implemented successfully. Its survey of 9,236 projects reported that from 1994 to 2000, successful technology adoptions increased from 16% to 28% and challenged adoptions remained about the same (from 53% to 49%). The report defines a successful project as one that is completed on time and within budget with all expected technological features implemented. A challenged project is one that is completed later than expected, over budget, and with less than the expected technological features implemented. While it may be alarming that roughly half of all projects were over budget and delayed, even these projects were implemented with some degree of success. As noted by Compass (2009), most executives believe that in the end their firm’s technological investments improved firm performance, competitiveness, and cost management.

In the long run, investments in IT (even partially successful ones) should have a positive effect on firm value that would be reflected in Jensen’s alpha. Thus, if Jensen’s alpha increases after the announcement of an investment in technology, investors should perceive the IT investment as value adding. Thus, hypothesis one is:
H1: Firms that announce investments in information technology will experience a positive shift in the abnormal rate of return (i.e. a positive shift in the alpha coefficient).

The other component of the market model is beta. Beta can be thought of as the volatility of a firm’s return relative to the market’s return. More specifically, beta measures the sensitivity of the firm’s return to variation in the market’s return (Fama & French, 2004). Although investors perceive beta as a measure of risk, an increase in beta might also indicate that the firm attracts transient investors who trade aggressively within a short-term window and not that the firm is a riskier investment (Ke & Petroni, 2004).

Transient investors typically search for news announcements that suggest an increase in a stock’s momentum as a result of changes in firm growth due to development and expansion (Serwer, 1997) or changes in other important firm information including investments in IT (Bushee & Noe, 2000). For example, firms that invest in transformational technologies are often planning an overhaul of their business that leads to substantial future growth (Tanriverdi & Ruefli, 2004). And although firms that invest in informate and automate technologies will not likely experience a significant change in firm growth, these types of IT investments can lead to enhanced firm performance by improving business processes. Thus, we would expect IT investments to attract transient investors in the short-term while attracting other institutional investors in the long-term. Thus, hypothesis two is:
H2: Firms that announce investments in information technology will experience positive shifts in relative volatility (i.e. a positive shift in the beta coefficient).
Chapter 3: Research Design

3.1 Discussion of Regression Discontinuity

This section introduces the regression discontinuity methodology and describes its evolution and use. Several examples are provided to demonstrate the components of the method.

3.1.1 Regression Discontinuity Background

The regression discontinuity design (RDD), a pre-post two-group design that is used to measure the causal and treatment effects within different groups, is used to test the hypotheses in this dissertation. While RDD has had little exposure in the business literature, it has been used extensively in the psychology and education literatures. Interestingly, a number of recent studies in economics have used RDD as an alternative method for examining causal effects for non-experimental data (Cook, 2008; G. W. Imbens & T. Lemieux, 2008).

Thistlethwaite and Campbell (1960) argue that RDD is preferable to the ex-post design because RDD does not require the random assignment of subjects to experimental and control groups. The process of assigning subjects to groups depends on a subject’s score on a relevant assignment variable (Campbell & Stanley, 1963).

Researchers in economics have used RDD to assess the effect of social (Chen & van der Klaauw, 2008; Lalive, 2007; Lemieux & Milligan, 2008), economic, (Busse, et al., 2006) and financial policies (Huang, 2008) on important outcome variables. For example, Van der Klaauw (2002) examined the effect of financial aid offers on the
decision to attend a university. Van der Klaauw assigned students to either of two groups based on whether they accepted enrollment to a university. Whether students were offered financial aid is the dependent variable in this RDD analysis; the independent variables included each student’s enrollment decision and a ranking variable based on the student’s high school grade point average and SAT results.

Van der Klaauw found a discontinuous effect on student decisions to attend a university that were the result of either the size of the financial aid package or the student’s ineligibility for financial aid. Interestingly, Van der Klaauw noted that had he used OLS regression to examine the effect of financial aid on the decision to attend a university, the estimate effects would have been biased due to the variables used to control for endogeneity of the actual aid offers.

3.1.2 Regression Discontinuity Design – Another Example

In this study, the cutoff used to determine whether subjects are assigned to the treatment (i.e., control group) is the date of an announcement of a firm’s investment in a specific IT.

Busse, Silva-Risso, & Zettelmeyer (2006) used a similar approach to examine the effect of the timing of car manufacturer/dealer cash incentives on the final negotiated price of a car. The RDD model for their study is (Equation 2):
\[ P_{jt} = \lambda_j \text{CustCash}_{jt} + \lambda_k \text{DealCash}_{jt} + \beta_1 X_i + \beta_2 X_{jt} + \beta_3 \text{DealerComp}_{jt} + \mu_j + \tau_t + \epsilon_{jt}. \] (Eq. 2)

where:

- \( P_{jt} \) is the total price the customer paid for vehicle \( j \) at date \( t \).
- \( \text{Custcash} \) and \( \text{dealcash} \) are the amounts of customer and dealer cash available for vehicle \( j \) at date \( t \). All of these variables are unique because manufacturers typically make promotion decisions by nameplate, model, and model year (e.g. 1999 Pontiac Grand Am).
- \( X_i \) is the vector of the buyer’s individual and neighborhood customer characteristics including sex, race, income, education, employment type, and home ownership.
- \( X_{jt} \) is the vector of control variables defined by \( t \) (weekend, end of month, and end of year) since many dealers will try to up their sales record at the end of the period.
- \( \text{Dealercomp} \) measures how competitive the dealer is based on the number of competing dealers selling the same vehicle year and model within a ten-mile radius of the dealer. \( \mu_j \) is the vehicle fixed effects because manufacturers use similar parts and styles for different vehicles (i.e. body type, transmission, etc.) \( \tau_t \) is the week segment effect that contains the number of vehicles purchased on date \( t \).

Subjects were assigned to groups based on the timing of the manufacturer/dealer financial incentives (i.e., the week before and the week after the financial incentives were offered are the control and treatment groups, respectively). When \( \text{Custcash} \) equals zero, the surplus from the financial promotions is not passed through to the customer; when \( \text{Custcash} \) equals -1, the customer obtained the full rebate in the form of a lower price. Figure 3.1 illustrates the results of the Busse et al. RDD study.
These authors reported that customers paid a much lower price when a manufacturer incentive was offered (81% of the manufacturer incentive was passed through to the customer). On the other hand, when a dealer incentive was offered, only 31% of the dealer incentive was passed through to the customer. The authors suggested this was the result of information asymmetry because customers associate large marketing campaigns with manufacturer incentives while this is not the case with dealer incentives.

Busse et al. applied RDD because they wanted to measure differences in the final price of a car when promotions were offered versus when they were not (i.e., the discontinuity effect). However, this doesn’t necessarily mean the difference in price
between cars sold following a promotion and those sold prior to a promotion was equal to the size of the cash rebate. For example, a decrease in the price of car may be a result of product demand and not the promotion (Busse et al. tried to control for this outcome using $X_2$).

3.2 Regression Discontinuity Applied to BVIT

This dissertation uses RDD to examine the effect of firm announcements of specific information technology investments (i.e., the treatment) on the business valuation of the firm. This assumes that firms do not make investments in IT randomly (Kobelsky, Richardson, Smith, & Zmud, 2008).

RDD is the preferred methodology for this dissertation because it does not require strict statistical compliance (i.e. sample size) except for a clearly, defined cutoff between the control group and the treatment group for the assignment variable (Battistin & Rettore, 2002). In addition, the assignment variable does not have to be correlated with the dependent variable and more than one assignment variable can be used (Shadish, Cook, & Campbell, 2002). Finally, RDD does not require the sample to randomize the assignment of IT investing firms to treatment and control groups (like OLS where we assume the sample is randomly collected) (Campbell & Stanley, 1963). These firms likely share similar characteristics, including large financial resources, high institutional investor followings and complex operations (Dehning, et al., 2006; Khallaf & Skantz, 2007).
The requirements to use RDD are quite simple. First, the cutoff point must be clearly defined. In this study, the cutoff point is the date of the IT investment announcement. Second, the cutoff point must clearly separate the data into two groups: control and treatment groups. For this study, the control group is the time prior to the IT announcement and the treatment group is the time after the IT announcement. Third, when selecting the cutoff point, there cannot be any contemporaneous factors associated with the cutoff score. For example, when the firm announces an investment in IT there cannot be an earnings or dividend announcement on the same date. Finally, both the treatment and control groups must have complete sets of data.

While prior studies have typically used a small event window (often ten to forty days) to capture the firm’s CAR, this study uses RDD to capture the firm’s CAR using a long-term event window. RDD is acceptable under these circumstances as long as there are no discontinuous changes in the firm’s behavior (e.g. the firm’s industry membership changes as a result of the IT investment).

### 3.2.1 Regression Discontinuity Model for this Study

This study estimates the impact of IT investment announcements on the business value of the firm using the CAPM model in regression form based on Jensen’s modifications (Equation 3):\[ H_{it} - H_{ft} = \alpha_i + \beta_i \left( H_{it} - H_{ft} \right) + e_{it} \] (Eq. 3)
Where

- \( R_{lt} \) = return for firm \( l \) at time \( t \),
- \( R_{ft} \) = risk free rate at time \( t \),
- \( R_{Mt} \) = market return at time \( t \).
- \( \alpha_t \) is Jensen’s alpha, a risk adjusted performance measurement capturing excess returns,
- \( \beta_M \) = captures the relative volatility of the individual firm’s rate of return compared to the market’s rate of return.

IT investment announcements were grouped based on the specific type of IT as well as other firm and performance-related characteristics. The grouping criteria are described below.

3.2.2 Additional Control Variables

The IT literature suggests that not all technologies are equal and that different technologies provide different financial benefits to a firm. This section describes the individual technologies and IT strategies that are used in this study.

**IT Strategic Role.** IT Strategic Role is applied to the firm. These strategic roles include automate, informate, or transformate. To code the IT strategic role for each announcement, three recognized scholars in the area of IT strategy were independently asked to indicate the role that IT served in the particular announcement – whether automate, informate, or transformate using the coding rules established by Dehning et
al. (2003). The inter-rater reliability was 0.83, and all differences were reconciled as a group.

3.2.3 Performance Metrics

This section describes the performance metrics used to group the IT investment announcements for testing. The performance metrics described below are often used to measure the short-term effect of IT investments. However, these metrics were used in this study to determine whether firms that show a short-term benefit from IT investments maintain the benefit over a longer period of time.

Return on Sales (ROS) – ROS is net income (before interest and taxes) divided by sales. This ratio is used to evaluate the firm’s operating efficiency. Investors use ROS to assess how much profit the firm generates per dollar of sales.

Return on Assets (ROA) – ROA equals net income divided by total assets. It signals to investors how well the firm’s assets are managed to generate profits.

Return on Equity (ROE) – ROE is net income divided by shareholders equity and is expressed as a percentage. ROE tells investors how well shareholder investments are managed by the firm to generate profits.

3.2.4 Firm Characteristics

Finally, IT investment announcements are grouped based on firm characteristics. Firm characteristics will likely have an effect on the results because not all firms that make investments in IT share similar firm characteristics. These characteristics have
often been used as control variables in prior research studies and are used similarly in this study.

Size – Size is defined as the natural log of the firm’s total assets for the year of the IT investment announcement. The inclusion of size as a control variable has produced mixed results in prior studies. For example, while Im et al. (2001) reported that small firms are much more sensitive to IT investments, their results were not replicated in other studies.

Industry – Whether the firm is a member of the financial industry is examined for the sake of consistency. This was done in spite of the fact that prior studies have not found that being a member of the financial industry affects a firm’s return (Chatterjee, et al., 2002; Davis, Dehning, & Stratopoulos, 2003; Dos Santos, et al., 1993; Im, et al., 2001; Oh, Gallivan, & Kim, 2006). Thus, if the firm is a member of the financial industry it is coded as a “1”; otherwise it is coded as “0”.

Quick Ratio (slack) – The quick ratio equals the firm’s current assets less any inventories, divided by the firm’s current liabilities. The quick ratio is a proxy for slack.
Chapter 4: Results

4.1 Collection of IT investment announcements

The IT investment announcements used in this dissertation included 238 announcements collected by Im et al. (2001), 96 announcements collected by Chatterjee et al. (2001), 112 additional unique announcements collected by Chatterjee et al. (2002), 150 announcements collected by Hunter (2003), and 85 ERP announcements that were collected by Hayes et al. (2001). After both duplicate and non-locatable announcements were removed, a total of 532 existing IT investment announcements remained.

A total of 287 additional IT investment announcements were collected using the procedure described by Im et al. (2001): using pre-selected keywords, the Lexis Nexus and Business and Industry databases were searched for IT investment announcements during the period 1982-2007. The pre-selected keywords included: hardware, software, ecommerce, chief investment officer, enterprise resource planning (ERP), infrastructure, and IT outsourcing. The additional requirements for the inclusion of the 287 new announcements were:

- The firms investing in IT were traded only on the NYSE, NASDAQ, and AMEX.

- No potentially confounding events took place within three days surrounding the announcement period (e.g. earnings, dividends, mergers/acquisition, etc.)
• Financial information about the IT investing firms was available from CRSP and Compustat.

Table 4.1 provides a summary of the announcements by source and Table 4.2 provides a summary of the announcements by year. After duplicate and non-locatable announcements were removed, the combined total of usable existing and new IT investment announcements was 810.

Table 4.1: Number of IT investment Announcements by Source

<table>
<thead>
<tr>
<th>Source</th>
<th>Number of announcements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chatterjee et al. (2002)</td>
<td>112</td>
</tr>
<tr>
<td>Hayes et al. 2001</td>
<td>85</td>
</tr>
<tr>
<td>Im et al. (2001)</td>
<td>238</td>
</tr>
<tr>
<td>Hunter (2003)</td>
<td>150</td>
</tr>
<tr>
<td>Chatterjee et al. (2001)</td>
<td>96</td>
</tr>
<tr>
<td>Additional Collected</td>
<td>287</td>
</tr>
<tr>
<td>Less Duplicates and non-locatable announcements</td>
<td>(158)</td>
</tr>
<tr>
<td>Total Usable IT Investment Announcements</td>
<td>810</td>
</tr>
</tbody>
</table>

Table 4.2: Number of usable IT investment Announcements by Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
<th>Year</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>5</td>
<td>1995</td>
<td>88</td>
</tr>
<tr>
<td>1983</td>
<td>1</td>
<td>1996</td>
<td>69</td>
</tr>
<tr>
<td>1984</td>
<td>3</td>
<td>1997</td>
<td>85</td>
</tr>
<tr>
<td>1985</td>
<td>26</td>
<td>1998</td>
<td>59</td>
</tr>
<tr>
<td>1986</td>
<td>11</td>
<td>1999</td>
<td>22</td>
</tr>
<tr>
<td>1987</td>
<td>17</td>
<td>2000</td>
<td>49</td>
</tr>
<tr>
<td>1988</td>
<td>17</td>
<td>2001</td>
<td>32</td>
</tr>
<tr>
<td>1989</td>
<td>18</td>
<td>2002</td>
<td>35</td>
</tr>
<tr>
<td>1990</td>
<td>22</td>
<td>2003</td>
<td>25</td>
</tr>
<tr>
<td>1991</td>
<td>21</td>
<td>2004</td>
<td>13</td>
</tr>
</tbody>
</table>
Daily firm and market returns were collected from the CRSP database. The one-month Treasury bill rate was used as the risk-free rate. Each firm’s financial and other characteristics were taken from the Research Insight Compustat database.

### 4.2 Summary Statistics

Table 4.3 presents descriptive statistics for the study variables. As indicated, the average firm return is smaller than the average market return and firm returns vary slightly more than market returns (standard deviation of firm return = .0298; market return = .0071). Thus, it appears that alpha and beta did not change much across the time period surrounding the IT investment announcement. The average size of the firms included in the study is large: average firm sales = $14.0 billion; average number of employees = 75,000; average (median) total assets = $9.4 ($0.669) billion and average (median) total debt = $10.2 ($1.01) billion.
Table 4.3. Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Returns</td>
<td>388574</td>
<td>0.0007</td>
<td>(0.0002)</td>
<td>0.0298</td>
<td>(0.5786)</td>
<td>1.0000</td>
</tr>
<tr>
<td>Market Return</td>
<td>388574</td>
<td>0.0011</td>
<td>0.0016</td>
<td>0.0071</td>
<td>(0.1039)</td>
<td>0.0693</td>
</tr>
<tr>
<td>Alpha_{\text{pre}}</td>
<td>810</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0016</td>
<td>(0.0069)</td>
<td>0.0150</td>
</tr>
<tr>
<td>Alpha_{\text{post}}</td>
<td>810</td>
<td>0.0002</td>
<td>0.0002</td>
<td>0.0030</td>
<td>(0.0600)</td>
<td>0.0271</td>
</tr>
<tr>
<td>Beta_{\text{pre}}</td>
<td>810</td>
<td>1.0664</td>
<td>1.0400</td>
<td>0.5441</td>
<td>(0.8700)</td>
<td>3.5100</td>
</tr>
<tr>
<td>Beta_{\text{post}}</td>
<td>810</td>
<td>1.0427</td>
<td>1.0000</td>
<td>0.5377</td>
<td>(1.1100)</td>
<td>5.3800</td>
</tr>
<tr>
<td>Size (Total Assets)</td>
<td>810</td>
<td>9,406.77</td>
<td>669.14</td>
<td>29,227.70</td>
<td>0.25</td>
<td>457,951.34</td>
</tr>
<tr>
<td>Sales</td>
<td>810</td>
<td>14,002.50</td>
<td>4,836.48</td>
<td>25,981.99</td>
<td>9.55</td>
<td>265,906.00</td>
</tr>
<tr>
<td>Return on Assets</td>
<td>810</td>
<td>0.3355</td>
<td>0.2641</td>
<td>2.9402</td>
<td>(49.2400)</td>
<td>13.1791</td>
</tr>
<tr>
<td>Return on Equity</td>
<td>810</td>
<td>0.0518</td>
<td>0.1208</td>
<td>3.0942</td>
<td>(73.9466)</td>
<td>0.9572</td>
</tr>
<tr>
<td>Return on Sales</td>
<td>810</td>
<td>0.0215</td>
<td>0.0415</td>
<td>0.2391</td>
<td>(2.9969)</td>
<td>0.9572</td>
</tr>
<tr>
<td>Quick Ratio</td>
<td>810</td>
<td>1.2527</td>
<td>0.9645</td>
<td>1.2208</td>
<td>0.0770</td>
<td>14.6776</td>
</tr>
<tr>
<td>Employees</td>
<td>810</td>
<td>75.38</td>
<td>23.35</td>
<td>145.41</td>
<td>0.06</td>
<td>825.00</td>
</tr>
<tr>
<td>Total Debt</td>
<td>810</td>
<td>10249.67</td>
<td>1010.83</td>
<td>30895.25</td>
<td>0</td>
<td>276440</td>
</tr>
<tr>
<td>Debt to Equity</td>
<td>810</td>
<td>1.9093</td>
<td>0.6807</td>
<td>7.0171</td>
<td>0</td>
<td>151.3740</td>
</tr>
</tbody>
</table>

- Firm return: calculated return for the individual firm from event date \( i \) to date \( t \) less the risk free rate,
- Market return: calculated return for the market from event date \( i \) to date \( t \) less the risk free rate,
- Size (Total Assets): Total assets of the firm, in millions,
- Sales: Total sales in millions,
- Return on Assets: Net income divided by total assets,
- Return on Equity: Net income divided by shareholders equity,
- Return on Sales: Net income divided by sales,
- Quick Ratio: Current assets less any inventories, divided by the firm’s current liabilities,
- Employees: Number of employees for the firm, in thousands,
- Total Debt: Total debt in millions,
- Debt to equity: Total debt divided by total shareholders’ equity

### 4.3 Regression Discontinuity Analysis

#### 4.3.1 Hypothesis Testing

The general linear model (GLM) was used to analyze the shifts in alpha and beta related to firm announcements of IT investments (see Equation 4).
\[ R_{it} - R_{ft} = \alpha_i + \beta_1 \left( R_{mt} - R_{ft} \right) + \beta_2 \left[ \left( R_{mt} - R_{ft} \right) \times \text{prepost} \right] + \beta_3 \text{prepost} + e_{it} \]  
(Eq. 4)

The dependent variable in this analysis is the firm’s daily return adjusted for the daily risk-free rate \((R_{it} - R_{ft})\). The independent variables are the market’s daily return adjusted for the daily risk-free rate \((R_{mt} - R_{ft})\) henceforth labeled as \(\text{market}\), a timing variable (\(\text{prepost}\)), signified as a 1 if the observation occurred after the event date and a zero if before, and an interaction term \([\left( R_{mt} - R_{ft} \right) \times \text{prepost}]\) involving adjusted market returns and the timing variable.

The results of the regression discontinuity analysis are presented in Table 4.4: \(\alpha_i\) is the Jensen’s alpha for the overall model and \(\beta_1\) the overall model’s beta. The alpha and beta shifts, \(\beta_3\) and \(\beta_2\), respectively, measure the changes in alpha and beta at the post-IT investment announcement discontinuity point.

Table 4.4: Results of the Regression Discontinuity Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>T-value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.0006</td>
<td>-9.48</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Market ((\beta_1))</td>
<td>1.1853</td>
<td>124.35</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Prepost ((\beta_3))</td>
<td>0.0002</td>
<td>2.07</td>
<td>0.0386</td>
</tr>
<tr>
<td>Market*Prepost ((\beta_2))</td>
<td>0.0472</td>
<td>3.62</td>
<td>0.0003</td>
</tr>
</tbody>
</table>

Note: \(n=388,574\), \(R^2 = .0827\), \(F = 11547.20\), \(p<.0001\)
According to Hypothesis One, there will be a positive shift in a firm’s alpha after the firm announces an investment in IT. As indicated in Table 4.4, there is a small, positive alpha shift ($\beta_{3it}$, $p = .0386$) after an IT investment announcement that supports Hypothesis One. This suggests that investors can increase their returns by investing in firms that invest in IT even though this would have only a small effect on the size of their portfolios.

According to Hypothesis Two, there will be a positive shift in a firm’s beta after the firm announces an IT investment ($\beta_{2it}$). As shown in Table 4.4, the model supports a positive beta shift after the IT investment announcement ($\beta_{2it}$, $p = .00003$). Thus, although investors who invest in firms that invest in IT would increase their risk, over the long term in a growing market investor returns would also increase.

4.3.2 Additional Analyses

Additional analyses, including the timing of the announcement (pre or post productivity paradox), firm size, IT intensity and IT strategic role, were performed to determine the effect of these variables on the observed alpha and beta shifts in the overall model. The following sections describe these additional analyses.

*Timing of the IT Investment Announcement (Pre or Post Productivity Paradox)*

The existing BVIT literature suggests that firms did not benefit from IT investment investments until after 1992 (Brynjolfsson & Hitt, 1996). This phenomenon
was labeled the “productivity paradox”. It is important to examine the productivity paradox because IT investment announcements prior to 1992 may reduce the size and significance of alpha and beta shifts after 1992. To test for the productivity paradox affect, firms are classified as pre and post 1992 by the year of the announcement.

Table 4.5 presents the results of the regression discontinuity analysis of IT investment announcements made pre (Panel A) and post (Panel B) 1992. Pre-Productivity Paradox results indicate that neither alpha nor beta shifts occurred prior to 1992 (p = .0592 and .1851 respectively). The Post-Productivity Paradox results indicate there were positive shifts in both alpha (.0647, p <.0001) and beta (.0003, p = .0085) after 1992. The post-1992 increase in alpha suggests that the returns of investors who invest in firms that announced investments in IT after 1992 will increase (Brynjolfsson & Hitt, 1996). However, the magnitude of the increase will be very small. The post 1992 increase in beta suggests IT investment announcements attract more investor types, such as transient investors (Ke & Petroni, 2004).

Table 4.5: Results of Regression Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>T -value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.0001</td>
<td>-0.74</td>
<td>0.4597</td>
</tr>
<tr>
<td>Market (β1)</td>
<td>1.3313</td>
<td>75.97</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Prepost (β3)</td>
<td>-0.0003</td>
<td>-1.89</td>
<td>0.0592</td>
</tr>
<tr>
<td>Market*Prepost (β2)</td>
<td>-0.0327</td>
<td>-1.33</td>
<td>0.1851</td>
</tr>
</tbody>
</table>

Note: n=68,586, R² = .1421, F = 3787.80, p<.0001

Panel B: Productivity Paradox – Post
<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>T-value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.0007</td>
<td>-9.43</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Market (β1)</td>
<td>1.1552</td>
<td>105.22</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Prepost (β3)</td>
<td>0.0003</td>
<td>2.63</td>
<td>0.0085</td>
</tr>
<tr>
<td>Market *Prepost (β2)</td>
<td>0.0647</td>
<td>4.33</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Note: n=319,988, $R^2 = .0750$, $F = 8539.71$, $p<.0001$

**Firm Size**

Prior BVIT studies have also examined the effect of firm size on shifts in alpha and beta. For example, Im et al. (2001) and Dehning et al. (2003) reported that small firms often have lower stock prices and higher volatility than large firms because small firms have the ability to incorporate technology quickly. On the other hand, results reported by Chatterjee et al. (2002) and Oh et al (2006) did not support a firm-size effect.

Firm size is defined as the total asset value of the firm at the time of its IT investment announcement. The median asset value of the firms in the study ($670 million) was used to differentiate between large and small firms. The regression discontinuity results for firm size are presented in Panels A and B in Table 4.6. These results suggest that firms with total assets above $670 million experience a positive alpha shift ($p = .0493$) while firms with total assets below $670 million experience a positive beta shift ($p = .0002$). The results for firms with total assets below $670 million are not unexpected because small firms tend to be more volatile (Bushee & Noe, 2000; Im, et al., 2001). In additions, investors may believe smaller firms will generate greater
future cash flows from their IT investments than larger firms will (Nagm & Kautz, 2008).

The positive alpha shift for firms with total assets above $670 million suggests that the returns of investors who invest in large firms that invest in IT will increase. However, the magnitude of the increase will be small.

Table 4.6: Results of Regression Analysis

Panel A: Small Firms

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>T–value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.0005</td>
<td>-5.66</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Market (β1)</td>
<td>1.2465</td>
<td>81.75</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Prepost (β3)</td>
<td>0.0002</td>
<td>1.29</td>
<td>0.1973</td>
</tr>
<tr>
<td>Market *Prepost (β2)</td>
<td>0.0764</td>
<td>3.71</td>
<td>0.0002</td>
</tr>
</tbody>
</table>

Note: n=191,268, R² = .0713, F = 5261.57, p<.0001

Panel B: Large Firms

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>T–value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.0006</td>
<td>-8.98</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Market (β1)</td>
<td>1.1152</td>
<td>104.93</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Prepost (β3)</td>
<td>0.0002</td>
<td>1.97</td>
<td>0.0493</td>
</tr>
<tr>
<td>Market *Prepost (β2)</td>
<td>0.0005</td>
<td>0.03</td>
<td>0.9724</td>
</tr>
</tbody>
</table>

Note: n=197,306, R² = .1135, F = 7629.49, p<.0001

**IT Intensive Firms**

Mittal & Nault (2009) note that some firms are more IT intensive in their operations due to the nature of their business and industry; as IT intensive firms have a greater need to maintain industry standards and competitiveness. The IT Intensity of firms can be estimated based on the business sector in which the firm is classified.
Absent several exceptions (e.g., firms in the chemical and petroleum or the electrical and controlling equipment industries), manufacturing firms are generally considered low in IT intensity (Mittal & Nault, 2009). Firms are classified as highly IT intensive by their SIC code and membership in the following industries: transportation, retail, financial and service. All remaining industries are classified as low IT intensive. Table 4.7 presents the study results for low and high IT Intensive firms.

Table 4.7: Results of Regression Analysis

<table>
<thead>
<tr>
<th>Panel A: IT Intensive Firms - Low</th>
<th>Variable</th>
<th>Estimate</th>
<th>T-value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intercept</td>
<td>-0.0005</td>
<td>-4.62</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Market (β1)</td>
<td>1.1764</td>
<td>74.6</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Prepost (β3)</td>
<td>0.0001</td>
<td>0.61</td>
<td>0.5399</td>
</tr>
<tr>
<td></td>
<td>Market *Prepost (β2)</td>
<td>0.0097</td>
<td>0.46</td>
<td>0.6481</td>
</tr>
</tbody>
</table>

Note: n=128,961, R² = .0890, F = 4141.03, p<.0001

<table>
<thead>
<tr>
<th>Panel B: IT Intensive Firms - High</th>
<th>Variable</th>
<th>Estimate</th>
<th>T-value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intercept</td>
<td>-0.0001</td>
<td>-8.37</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Market (β1)</td>
<td>1.1907</td>
<td>99.4</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td></td>
<td>Prepost (β3)</td>
<td>0.0002</td>
<td>2.03</td>
<td>0.0421</td>
</tr>
<tr>
<td></td>
<td>Market *Prepost (β2)</td>
<td>0.0720</td>
<td>4.36</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Note: n=259,613, R² = .0794, F = 7399.35, p<.0001

The results show that high IT intensive firms experience both significant alpha and beta shifts, although low IT intensive firms experience no effect. The beta shift suggests that high IT intensive firms may attract greater numbers of transient investors than firms low
in IT intensity (Ke & Petroni, 2004; Oh, Gallivan, et al., 2006; Oh, Kim, et al., 2006). The significant Jensen’s alpha suggests that the returns of investors who invest in firms high in IT intensity will increase. However, once again, the magnitude of the increase will be small.

**IT Strategic Role**

In general, investments in IT are made to help firms better meet their strategic business objectives. Thus, investments in IT must be consistent with the business outcomes the firm wants to achieve if it wants to improve its performance (Byrd, Lewis, & Bryan, 2006). This is consistent with the findings of Dehning et al. (2003) that a firm’s IT strategic role differentially impacts a firm’s market value.

IT investment announcements were classified based on the firm’s IT strategic role using the three IT strategic roles conceptualized by Schein (1992) and Zuboff (1988), and later updated by Dehning et al. (2003) and Dehning et al. (2005). According to these authors, there are three IT strategic roles: automate, informate and transformate.

Table 8 presents the results of the regression discontinuity analysis.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>T-value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.0004</td>
<td>-3.71</td>
<td>0.0002</td>
</tr>
<tr>
<td>Market (β1)</td>
<td>1.2463</td>
<td>69.65</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Prepost (β3)</td>
<td>-0.0001</td>
<td>-0.52</td>
<td>0.5999</td>
</tr>
<tr>
<td>Market *Prepost (β2)</td>
<td>-0.0724</td>
<td>-2.97</td>
<td>0.003</td>
</tr>
</tbody>
</table>

*Note: n=78,729, R² = .112, F = 3289.48 p<.0001*
Panel B: ITA - Informate IT Investment Announcement

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>T-value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.0007</td>
<td>-8.43</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Market (β1)</td>
<td>1.1330</td>
<td>94.18</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Prepost (β3)</td>
<td>0.0002</td>
<td>2.1</td>
<td>0.036</td>
</tr>
<tr>
<td>Market *Prepost (β2)</td>
<td>0.0584</td>
<td>3.5</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

Note: n=216,384, R^2 = .0832, F = 6505.92, p<.0001

Panel C: ITA - Transformate IT Investment Announcement

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>T-value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.0005</td>
<td>-3.2</td>
<td>0.0014</td>
</tr>
<tr>
<td>Market (β1)</td>
<td>1.2584</td>
<td>52.95</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Prepost (β3)</td>
<td>0.0003</td>
<td>1.31</td>
<td>0.19</td>
</tr>
<tr>
<td>Market *Prepost (β2)</td>
<td>0.0814</td>
<td>2.57</td>
<td>0.0103</td>
</tr>
</tbody>
</table>

Note: n=88,389, R^2 = .0737, F = 2294.71, p<.0001

Panel A shows the regression discontinuity results for firms that invest in automate information technologies. These firms experienced a negative beta shift which was unexpected (-0.0724, p = .003). This negative beta shift may be due to the fact that firms investing in automate information technologies are often less attractive, low growth firms in the manufacturing sector where the automate technology has a minimal impact on firm performance (Busse, et al., 2006; Dehning, et al., 2005; Dehning, et al., 2003; Oh & Pinsonneault, 2007).

Panel B presents the results for informate information technologies that are designed to improve the up-flow (employee to manager) and down-flow (manager to
employee) of information within the firm. The improved distribution of information is expected to improve the overall decision making process (Sunil & Jonathan, 2007).

The results show that firms investing in informate information technologies experience both positive alpha (.0002, p = .0360) and positive beta shifts (.0584, p = .0005). The positive beta shift for informate investing firms may be the result of an increase in transient investors who are attracted to firms that implement technologies that increase the flow of information throughout the firm (Bushee & Noe, 2000). Although the positive alpha shift suggests that investor returns will increase, once again, the increase will have only a small impact on the investor’s portfolio, suggesting investors may view the benefits as short lived (Stratopoulos & Dehning, 2000).

Transformate technologies are expected to provide long-term benefits through the implementation of technologies that enhance business operations. This might include, for example, a new inventory system or a new business line that gives the firm a meaningful advantage over its competitors. However, transformate technologies are considered very risky because of uncertainties about the costs and the dollar value of future benefits associated with these technologies. Moreover, it upsets the status quo (Tanriverdi & Ruefli, 2004).

Panel C shows the results of the regression discontinuity analysis for firms that implement transformate information technologies. The results suggest that investments in transformate technologies produce a positive beta shift (.0813, p = .0003). In fact, transformate technologies produced the largest beta shift among the three IT strategic
roles. The positive beta shift may be a result of transient investors who are attracted to high-risk investments that have the potential for significant long-term growth (Dehning, et al., 2005) and higher risk (Ke & Petroni, 2004).
Chapter 5: Discussion

5.1 Key Findings

Several interesting findings emerged from this study. First, prior to a firm’s IT investment announcement, the average firm’s Jensen’s alpha is -.0006 (suggesting investors would realize a 0.06% reduction in their returns if they invested in the firm rather than the market). Second, prior to its IT investment announcement the average firm is riskier than the market, as indicated by the average firm beta of 1.18 (suggesting that the average firm is 18% more volatile than the market). Following a firm’s IT Investment announcement, however, both alpha and beta shifted positively (alpha shifted by 0.0002, p=0.0386, while beta shifted by 0.0472, p=.0003). These results support the finding that in general, IT investments positively affect the value of the firm.

Because the average firm’s alpha increased after its IT announcement, investors benefited long term from the firm’s IT investment through an increase in their excess returns. Unlike earlier short-term event studies that found no overall effect on firm value (Dos Santos, et al., 1993; Im, et al., 2001; Oh, Kim, et al., 2006), the current results suggest that IT adds value in the long term. Given the fact that investments in IT can take years to implement successfully (Armstrong & Sambamurthy, 1999; Bharadwaj, et al., 1999), it should not be surprising that the related financial benefits are also more likely to materialize in the long term rather than short term.
The overall positive beta shift suggests firms that invest in IT are perceived as riskier investments over the long-term. However, during the time period examined in this study (1982-2007) the market displayed bull characteristics [(when stock prices are rising or are expected to rise based on optimism, investor confidence and expectations that strong results will continue (Ritter & Warr, 2002)]. Investors’ expected returns increase during a bull market, which is likely due to an increase in risk because of bloated investor expectations. On the other hand, this beta increase may indicate an attraction of a different type of investor: transient investors. Transient investors are attracted to firms that display expansion and growth characteristics and to stocks that have a change in momentum. IT investments provide firms these opportunities, and as observed in the beta shift, it appears transient investors are attracted to IT investing firms.

Another possible explanation for the positive beta shift is that an IT investment increases a firm’s leverage (represented by d/e). Equation 5 represents the structure of the firm’s beta based on the cost of capital model (Brealey, Myers, & Marcus, 2007).

\[
\beta_{\text{firm}} = \beta_{\text{industry}} + \left[ (1 + \frac{d}{e}) \times (1 - t) \right]
\]  
(Eq 5.)

Where d = firm debt, e = firm equity, and t = marginal tax rate.

As firms invest in technology, risk increases as a result of the uncertainty associated with the future benefits of IT investments (Dehning, et al., 2006). Moreover, firms often fund their large capital purchases through additional borrowing.
borrowing increases, a firm’s cost of capital will increase as a result of the increase in beta. Thus, as a firm invests in IT, its debt increases over time, which in turn increases the firm’s beta.

To better understand the long-term benefits of IT investments, this study examined the alpha and beta shifts for the influence of time, firm, and technology characteristics. Early studies examining the affect of IT investments on firm value did not find any until after 1992 and, has been termed the “productivity paradox” (Brynjolfsson, 1993; Brynjolfsson & Hitt, 1996). This study tests alpha and beta shifts for the productivity paradox. During the productivity paradox (prior to 1992), IT investing firms display a negative Jensen’s alpha shift (‐.0003; p<.0592) while after the productivity paradox these firms display a positive alpha shift (.0003; p<.0085). This alpha shift suggests that investors did not view IT investments as value adding until after 1992. On the other hand, the pre-productivity paradox beta shift was not significant while the post-productivity paradox beta shift was positive (.0647; p<<.0001). This is likely due to the fact that transient investors invested more heavily in IT investing firms after 1992.

The current study also examined the effect of firm size on a firm’s return. These results showed that large firms display a positive alpha shift (.0002; p<.0493) while small firms display a positive beta shift (.0764; p<.0002). The positive alpha shift suggests that investors view IT investments by large firms as value adding. The positive beta shift for small firms was not unexpected as small firms tend to have higher, more volatile growth
rates, more internal changes and often display greater stock momentum, all of which increase investor perceptions of risk (Oh, Kim, et al., 2006). In fact, these are the same characteristics that attract transient investors, who are interested in the short-term potential associated with more volatile, smaller firms (Tanriverdi & Ruefli, 2004).

Next, the current study examined the effect of a firm’s IT intensity on the firm’s return. These results showed that only high IT-intensive firms had both positive alpha (.0002; p<.0421) and beta (.0720; p<.0001) shifts. The positive alpha shift suggests that the market views IT investments as an important investment-related consideration, yet the positive beta shift suggests that high IT-intensive firms are also viewed as riskier investments.

Finally, automate, informate and transformate IT strategic roles were examined for their effects on a firm’s return. While an alpha shift was not found for firms with an Automate IT strategic role, a negative beta shift (-0.0724; p<.003) was found. In fact, firms with an Automate strategic role were the only firms to exhibit a negative beta shift, which suggests that the market views Automate IT investments as less risky. This is likely due to the fact that investors believe that Automate IT investments have little impact on a firm’s growth and this decreases the volatility of the firm’s return. As a result, firms that invest in Automate IT are also unlikely to attract transient investors.

Firms that invest in Informate IT exhibit both positive alpha (0.0002; p<0.036) and beta (0.0584; p<0.0005) shifts, which is consistent with the results of prior research. Investments in Informate IT are expected to increase the quantity and quality of the
flow of information, which is expected to improve decision-making firm wide. This apparently attracts both non-transient investors who believe that investments in Informate IT positively impact firm growth (Verrecchia, 2001) and transient investors who believe Informate IT investments increase the volatility of a firm’s return (Bushee & Noe, 2000).

Interestingly, firms that invest in Transformate IT did not exhibit a shift in their Jensen’s alpha but did exhibit a positive beta shift (0.0814; p<0.0103) that was the largest beta shift reported in this study. It appears that investors view Transformate IT investments as quite risky. This may be because Tranformate IT investments attempt to completely re-engineer a firm’s business processes/operations, a risky endeavor under most any circumstances. The increase in risk associated with Transformate IT investments also likely attracts transient investors.

5.2 Implications for Theory

Earlier BVIT studies that examined the impact of investment announcements on firm value tended to produce non-significant results. The results reported in the current study suggest that these non-significant results are due to the short event-windows used in these earlier studies. Studies with short-term event windows provided a starting point to examining BVIT, yet a change in the short term value of a firm does not necessarily suggest its IT investments added value. For example, if a firm is installing a new inventory tracking system (and they believe it will take up to five months to be fully operational), the firm will not realize financial benefits until after the five-month period.
The value adding effect would not show up until after the installation period. In this example, using a long-term event window would more likely capture the firm’s change in market value because the event window would extend beyond the investment period.

The findings of this study show that IT investments do cause alpha and beta shifts after the IT Investment announcement. Thus, this study’s results support findings reported in the finance and accounting literatures that press releases can affect the market value of a firm by possibly providing investors with a better idea of a firm’s current and future operations and strategy. On the other hand, these press releases also appear to attract more transient investors. The attraction of transient investors likely suggests the market believes the IT investing firm is serious about its potential for growth and expansion.

Finally, this study introduces the regression discontinuity design methodology as an acceptable method for examining the long-term effects of IT investment announcements. Among its many advantages, RDD allows researchers to better assess the impact of IT investments absent many of the statistical constraints associated with other techniques (e.g., assumptions related to randomization). Thus, we can come to a better understanding of the BVIT phenomenon using RDD by expanding the reach of this research beyond the typical five-day event window. Moreover, the current research suggests that researchers should be able to more easily apply the RDD methodology to the study of other important business phenomenon.
5.3 Implications for Practice

The primary managerial implication of the current research is that IT investment announcements do matter to investors. Investments in IT are viewed as a major component of a firm’s operations; investors view IT investments as necessary for a firm’s success. However, not all IT investments have equal effects nor do all firms benefit from IT investments equally.

For average, individual investors, the small alpha shifts reported in this study would likely have little major impact on their portfolios. On the other hand, large investors (e.g., managed funds and institutional investors) are likely to experience a material change in the overall value of their portfolios. Even if an alpha shift is positive and small, institutional investors would add dollars to their portfolios while individual investors would add pennies, at most. One interesting note about this study is the post announcement window start ten days after. Thus, even if the investor did not invest until days after the announcement he would still see an increase in his portfolio.

The results of this study also show that IT investment announcements have a greater effect on beta than alpha. Both individual and institutional investors may capitalize on the change in beta to grow their portfolios. For example, investors would see significant growth in their portfolios during a bull market if they traded based on the IT Investment announcements. However, institutional investors are more likely to trade on this information because they have access to the necessary financial and human
resources to accomplish this successfully. Thus, a substantial portion of the portfolio growth would go to institutional investors.

5.4 Limitations

There is always the possibility the current results were driven by contemporaneous variables that influence market movements not attributable to the IT announcements. The current study controls for the effects of a number of important variables that influence market movements by examining the IT announcements using the Fama-French 3 factor model\(^1\). The results of this analysis were consistent with the market model.

As noted earlier, due care was also taken to isolate the IT announcements from other firm-specific events (e.g. earnings, dividends and/or acquisition announcements). Finally, a case can be made that the large sample size covering a substantial time period would most likely result in any contemporaneous firm effects being randomized across the sample firms without any material impact on the results.

Another potential limitation is that not all IT investment announcements during the time period examined were included in the analyses. The likelihood is small that IT announcements were either systematically excluded or enough were excluded to change the study results. The robustness of the study results also attests to this fact.

\(^1\) Because the CAPM oversimplifies the market by comparing excess investor returns to the market using only beta, the Fama-French 3 factor model was used to control for the impact of important variables that influence the market’s movements including differences between small and large cap stocks and value and growth stocks.
Another possible study limitation is that the results reported above took place during a bull market where stock prices typically increase and investors are euphoric. During a bear market, however, stock prices decrease and investor pessimism increases (as occurred over the last 20 years in Japan). As a result, transient investors are less likely to invest during a bear market because stock prices are not increasing.

One last potential limitation deals with how the IT strategic role of each investment was determined. Unfortunately, not all IT Investment announcements can be discretely classified as automate, informate, or transformate based on the description contained in a firm’s it announcement. For example, an investment in an ERP is clearly a transformational investment, yet it still exhibits properties of both automate and informate IT strategies. This can be seen in the announcement of an ERP implementation shown in Appendix A, which would be classified as a transformate IT strategy using the criteria employed in the current study. Nonetheless, ERP systems include characteristics of automate IT strategic role such as automated online requisitioning processes. This announcement also includes characteristics of the informate IT strategic role such as those that improve the flow and availability of information throughout the firm. Thus, this IT investment announcement includes characteristics of all three IT strategic roles – automate, informate, and transformate. The same is true of many of the IT investment announcements used in other studies that examine IT Strategic Role. As such, it is reasonable to conclude that very few IT investment announcements can be uniquely classified unidimensionally. Thus, it is
important to determine where each IT investment announcement falls within the nomological network within which IT Strategic Role exists. Figure 5.1 presents one possible multidimensional classification scheme for determining the IT strategic role of investment announcements.

Figure 5.1 – Multidimensional ITA Classification Example

5.5 Conclusions and Future Research Directions

This study used regression discontinuity methodology to examine long-term shifts in alpha and beta following the announcement of specific IT investments. The analysis of 810 IT investment announcements showed that IT investments result in positive shifts in both alpha and beta overall. Additional analyses showed that positive alpha shifts occurred for high IT-intensive firms, larger firms, firms that invest in
informate technologies and firms investing in IT after 1992. There were also positive beta shifts for small firms, high IT-intensive firms and firms that invest in informate and transformate technologies. Only firms that invest in automate technologies displayed negative beta shifts.

These results show that investors who invest in firms that adopt IT increase their portfolio returns. However, not all investors have the resources needed to invest wisely in IT investing firms. Thus, this raises the question of “Who is investing in IT investing firms?”

Future researchers can address this question using both experimental and market data. For example, experimental data can be used to compare the investment results of expert and novice investors. Using market data, researchers should be able to examine the buying/selling of the stock of IT investing firms surrounding an IT investment announcement. This examination should provide additional support for prior studies’ conclusions that IT investment announcements matter. This research should also provide practical insight about the types of investors who profit from investing in IT investing firms.

Another question that should be addressed in future research is “Does the timing or informational content of IT investment announcements affect investor behavior?” Because IT investment announcements are selectively written and released, it would appear that the management of IT investing firms believes they do. This
examination could be best accomplished using content-analytic methods such as those developed in the behavioral sciences (Asquith, Mikhail, & Au, 2005).
APPENDIX A

Sample IT Announcement

LAS VEGAS, March 23, 1998 /PRNewswire/ -- Oracle Corp. today announced that Sierra Health Services, Inc. has selected Oracle to replace its financial and human resources systems and meet year 2000 requirements... Sierra's payroll, general ledger, inventory, and purchasing systems were previously provided by three different vendors. Oracle will improve integration, resulting in operational efficiency, more accurate information and better decision support... Sierra also will use Oracle Web Server, and Oracle Financial Analyzer and Oracle Discoverer(TM) tools. Besides closing its books more efficiently each quarter with Oracle Financials, Sierra will implement Web Server for online requisitioning, enabling management to receive financial reports and drill down to details electronically as it moves to a paperless environment. Instead of running a series of paper reports to gain summary-level information, the data will be available on a PC with the push of a button. Sierra plans to Web-enable its applications via Oracle's Network Computing Architecture(TM). Oracle's Express line of OLAP tools will enhance Sierra's ability to analyze costs as it grows in size. Sierra, which won a managed-care contract for 600,000 beneficiaries in Northeast and Mid-Atlantic states as part of the U.S. Defense Department's Civilian Health and Medical Program of the Uniformed Services (CHAMPUS) program, already faces additional volume requirements that exceed the capacity of its existing system...
References


