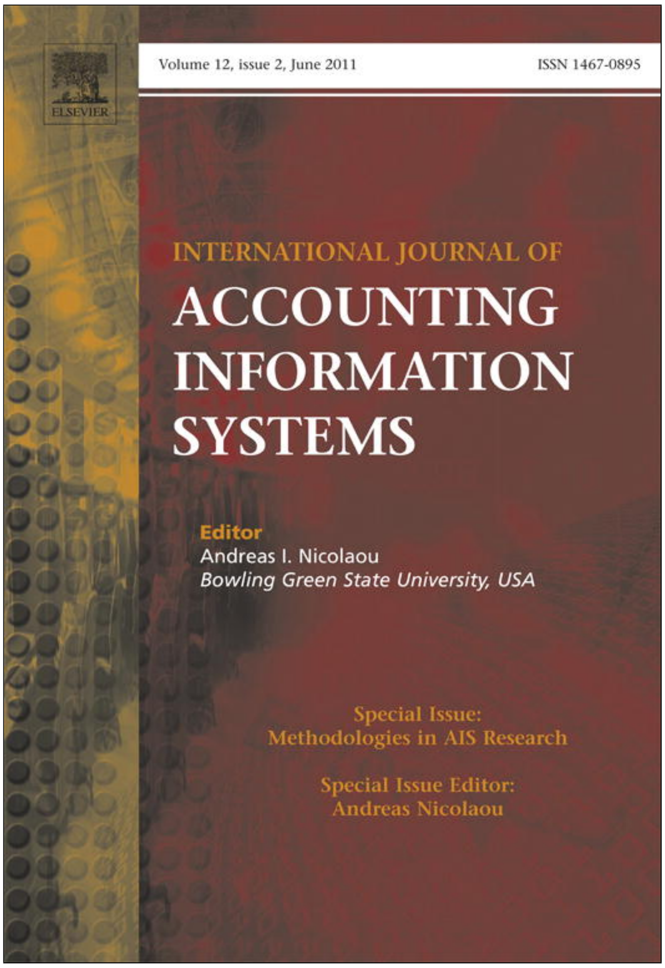
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Event study methodologies in information systems research

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ABSTRACT

Event studies are based on the theoretical framework of efficient capital markets and the notion that security prices include all information available to the market. As a result, announcements made by firms provide to market participants information that can be impounded into the market price. This paper investigates the use of event studies in information systems and accounting information systems research using a three-pronged approach. First, this paper provides a comprehensive survey of research that uses event study methodologies, where the events are announcements made by firms about issues related to information systems, e.g., announcements of the adoption of enterprise resource planning systems and of the effect of security breaches in firms' information systems. Second, this paper summarizes event study methodologies used in prior research, along with some of the key parameters and concerns associated with their implementation. Third, this paper provides remarks on key event study modeling issues, and it offers recommendations to researchers.

1. Introduction

Event studies have been a major focus of prior research because they provide a powerful setting to examine the informativeness of an event as assessed by market participants. An event study first requires identifying the event of interest, e.g., disclosure of the purchase of a particular type of software. After the event is defined, the period of time over which the stock price of the firm experiencing the event is determined. Then, the stock price changes beyond the "normal," or expected changes, in response to the event announcement, are examined to determine the extent to which the event changes the market participants' evaluation of the firm.

The notion of efficient capital markets (Fama, 1970) provides a strong theoretical foundation for this basic event study methodology. Fama (1991, p. 383) notes that "security prices fully reflect all available

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information". As new information is made available to the market, e.g., in the form of announcements about a firm's use of information technology, investors are expected to impound this information into the firm's stock price to capture the expected effect of the new information on the firm's value. As a result, the incremental effect of the information announcement on the value of the firm can be observed.

Event studies have been widely used in virtually all business and economics disciplines. Perhaps the first event study was published by Dolley (1933), who investigated the effect of stock splits on stock prices. The modern methodology of event studies was initiated by Ball and Brown (1968) and Fama et al. (1969), but the methodology has continued to evolve over time (MacKinlay, 1997).

MacKinlay (1997), Binder (1998), Kothari and Warner (2006), and others provide analyses of event studies in finance. In addition, Dehning et al. (2003a,b), Roztochi and Weistroffer (2008, 2009a,b), and others provide reviews of different aspects of the use of event studies in information systems. However, this paper focuses on methodological issues as they relate to the use of event studies in information systems. In addition, this paper updates the literature that uses event studies in the information systems research area. Further, this paper evaluates the research questions examined in prior studies, and analyzes the comparative limitations of alternative methodological approaches.

1.1. This paper scope: event studies and stock markets

At their most general level, event studies do not necessarily include or require stock market information. Instead, there could be a relationship between an event and a dependent variable. For example, Felcher et al. (2010) study the relationship between the event of "changing teachers" in a school and students' standardized test results. However, in this paper we assume that the event relates to an enterprise technology and the effect of the event is measured in a stock market response. Relating the effect of an event to a stock market response allows researchers to determine whether the event provides new, incremental information to stock market participants and the extent of the economic impact of the event on firm value.

1.2. Purpose of this paper

The purpose of this paper is to survey the literature on event study methodologies related to information systems, and investigate some of the key concerns with using event studies in information systems. In so doing, we analyze parameters associated with the methodology of over 50 information system event studies. Because the paper is primarily concerned with the methodology used in the event studies, we do not focus on the actual results or conclusions of the specific studies. A comprehensive set of references is provided at the end of the paper for the reader who wishes to further examine these research studies.

This paper proceeds as follows. Section 2 describes how event studies differ in information systems, in contrast to accounting and finance studies. Section 3 investigates the basic event study methodology, laying out six different steps. Section 4 examines the possibility that confounding events can occur during the event window. Section 5 discusses the importance of time-related issues, among these are stationarity and meta events occurring over time. Section 6 investigates the impact of firm size on event studies. Section 7 analyzes the question, "after the event, then what?," focusing on the analysis of future performance to determine whether the stock market is correct in its anticipation of the effect of the event. Section 8 analyzes limitations of an alternative market measure, and it describes why event studies are superior to an alternative approach to investigating the market response of technology adoption. Section 9 provides a summary of our key recommendations regarding event studies. Section 10 investigates the overall impact of information technology (IT) event studies, aggregating the results. Finally, Section 11 summarizes the paper, discusses its contributions, and provides potential extensions.

2. The difference between event studies in information systems and event studies in other settings

Event studies have been used in a wide range of settings, including accounting and finance (e.g., MacKinlay, 1997). As an example, in finance, researchers have used event studies to examine the market effect of mergers and acquisitions. Additional examples in accounting include whether accounting disclosures contain information, based on whether the stock market reacts to the disclosure of information events. In general, in virtually any discipline, the basic methodology remains the same: there is an event and a test to determine whether the stock market reacts to the event. However, the motivation and the theories used to generate expectations are likely to differ across disciplines.

The types of events and their motivations for information systems usually differ from those events used in accounting and finance. The events related to information systems typically relate to the adoption, implementation, purchase, or use of information systems technology. Generally, these event studies focus on all of the costs and benefits the technologies offer. For example, in their study of enterprise resource planning (ERP) systems, Hayes et al. (2001) discussed the increased benefits from increased firm efficiency and effectiveness that are manifested by increased financial performance and enhanced competitive position. However, they also investigated the extent to which other firm factors, including firm size and health, affected the market's response. As another example, in their investigation of radio frequency identification (RFID), Jeong and Lu (2008) found a greater market reaction in the manufacturing sector. Thus, one rationale is that the technology is a better "fit" in some circumstances.

Further, researchers have found that a firm's underlying strategy differentiates the adoption of information technology and the market reaction to the related announcement. For example, Dos Santos et al. (1993) found that more than just announcement of IT was important; instead what was required was an "innovative" use of technology. Accordingly, technology event studies may capture an additional "strategy" factor, as to how or why the firms are implementing the technology. Thus, there can be a "joint" "technology" and "strategy" component to the research questions in information systems. As another example, DeFond et al. (2010) investigate firms that implement knowledge management and implement it in a "superior" fashion.

There are additional potential strategic explanations that can be jointly explored with emerging technologies, including the following.

- *First mover:* Specifically, when a firm implements a technology, it generally follows strategy that has led to the implementation. For example, a firm may be a first mover or an early adopter, that is, the firm may be among the first to adopt the technology (Lieberman and Montgomery, 1988). That early adoption of the technology is likely to provide the firm a competitive advantage over firms that have not yet adopted. In this setting we would expect a significantly positive stock market reaction for early adopters, while a lower, negative, or no stock market reaction for late adopters.
- *Technology fit:* When a firm chooses to implement a technology, investors are likely to evaluate whether that technology aligns with the firm strategy, the management philosophy (O'Leary, 2010), or the firm capabilities. Does the technology "fit" with the particular firm's strategy, management philosophy, or firm capabilities? If the technology does fit, then we would expect a positive equity market reaction. If the technology does not fit, we likely would expect that the market reaction would be negative or insignificantly different from zero.
- *Competitive advantage (e.g., visibility):* Another underlying strategy for implementing a technology is that the adoption of the technology may facilitate the adopting firm's ability to compete. For example, RFID can provide the ability to increase "visibility" of goods in the supply chain, which may provide an improved ability to compete. If the technology is seen by the market as providing firms an increased ability to compete, we would expect a positive market reaction.
- *Cost/revenue specific motive (e.g., economies of scale):* An additional strategy is to suggest that adoption of technology will allow the organization to improve profitability, by affecting revenues and/or costs. For example, implementation of an ERP system may allow the adopting firm to generate "economies of scale" in its inventory. Unfortunately, many technologies such as ERP systems have broad ranging benefits. As a result, it may be difficult to know whether the market is responding to the ability to improve economies of scale or an effect different from profitability.
- *Change in way of doing business:* Another rationale is that the adoption of technology can lead to a change in the way that a company does business. For example, adoption of e-business technology could signal a change in the way a company does business, to include additional digitization.

Overall, firm characteristics, strategic rationales, and expectations provided as motivation for firms to adopt information systems technologies are likely to vary according to a wide range of motives, including those listed here. Further, in information systems, event research oftentimes can be couched in joint technology-strategy or technology-firm characteristic research questions.

3. Event methodology

MacKinlay (1997) outlined an event study methodology involving the following steps: (A) identification of the event of interest; (B) definition of the event window; (C) selection of the sample set of firms to be included in the analysis; (D) prediction of a "normal" return during the event window in the absence of the event; (E) estimation of the "abnormal" return within the event window, where the abnormal return is defined as the difference between the actual and predicted returns, without the event occurring; and (F) testing whether the abnormal return is statistically different from zero.

3.1. Identification of events of interest: information systems announcements

Firms or outside parties often make announcements about changes in the way they use information technology, which information technology vendors they plan to use, which information technology applications they implement, how they use information technology to change their processes, etc. As seen in Table 1, examples of announcements that have been previously studied include the impact of implementing activity-based costing systems, the outsourcing to application service providers, the impact of hiring a Chief Information Officer (CIO), the extension of the business to an e-business environment, the implementation of enterprise application integration, the impact of information technology outsourcing, the impact of information technology infrastructure changes, patent infringements, the impact of privacy breaches, the impact of security breaches, the impact of adopting RFID, the impact of recognizing software vulnerabilities.

Such announcements then serve to inform the market about firms' plans, successes, and failures. If the newly-disclosed information signal is seen as beneficial to the firm, a positive market response to the announcements is expected. Similarly, if the newly-disclosed information signal is seen as negative to the firm, a negative market response to the announcement is expected.

From a measurement perspective, researchers wish to narrow the announcement period (i.e., event window) to refine the information signal as precisely as possible to capture the stock market's response. Thus, in most cases researchers have used daily announcement period. However, in some cases (e.g., Filbeck et al., 2005) weekly announcement periods have been used.

3.2. Definition of the event window

The "event window" indicates the number of days before and after the announcement date over which the abnormal returns is accumulated. An event window is typically denoted [−x, +y], where x is the number of days before the announcement day and y is the number of days after the announcement day, and where the announcement day is typically denoted as " day 0". Including days before the announcement captures information leaks, whether from the press or internal users. Including days after the announcement captures the notion that it can take time for the information from the announcement to be received, understood, and acted on. As can be seen in Table 1, a wide range of event windows have been employed in event studies related to the adoption of information systems.

3.3. Sample selection: sources of announcements

The sample of firms is chosen based on the particular event of interest. The majority of information systems event studies appear to have used LexisNexis as the basis of finding the announcements, with particular mention given to Public Relations (PR) Newswire and Business Wire. This use of a common source of event information likely limits information asymmetries and inconsistencies about information technology announcements across different information system event studies. However, as noted in Table 1, LexisNexis was not the only source of announcements and other sources also were used.

3.4. Prediction of normal return: choice of estimation period

The significance of the stock price reaction during the event window is usually assessed relative to what is referred to as the normal return period. The normal return period is the usually a long window prior to the event window over which the variance of abnormal returns is estimated. As part of conducting an event study, the length of the estimation period must be specified. In addition, in cases where the loadings (i.e., betas) are used to predict normal (i.e., expected) returns, the estimation period required for predicting the normal returns needs to be established relative to the event window, requiring the researcher to answer the question "should the betas and the variance of the abnormal returns be estimated long before the event or immediately prior to the event?"

Unfortunately, the length of the estimation period is not without controversy, e.g., Pettengill (2001). This is further seen in Table 1, where researchers using event studies in information systems have used a wide range of dates, ranging from 120 business days (roughly six months) to 255 business days (roughly one year). Analysis of Table 1 also shows that studies use a period that varies from immediately prior to the event window over which abnormal returns are accumulated to 45 days prior to the event being investigated.

3.5. Cumulative abnormal returns

Event studies usually focus on examining cumulative abnormal return (CAR). CAR indicates the extent to which the market adjusts the firm's value in response to the new information signal obtained through the firm-related announcement. CARs are expected to be positive or negative depending on whether investors overall believe that the event will result in incremental positive or negative future cash flows. Typically, event studies employ a standard notation. For example, in the case of a window [−2, +2], the CAR is computed as follows:

$$CAR_{[-2\ +2]} = \sum_{t=-2}^{t=+2} \overline{AR_t} \tag{1}$$

where:

$$\overline{AR_t} = \frac{1}{N_t}\sum_{i=1}^{i=N_t} AR_{it};\ AR_{it} = R_{it} - E(R_{it});\ \text{and}\ t = (-2, -1, 0, +1, +2);$$

R_{it} is the return of the sample firm i on day t;

E(R_{it}) is the corresponding expected return (e.g., the market return from CRSP on day t; or the multiplication of market, Fama–French, or Fama–French–Carhart pre-event-period estimated betas with the CRSP daily factor returns during the event windows).

3.6. Statistical significance

Two t-statistics are frequently used to test the statistical significance of the CAR, one using the time-series mean abnormal returns as in Brown and Warner (1980, 1985), and the other using the calendar-time abnormal returns as in Jaffe (1974) and Mandelker (1974). The t-statistics using the time-series approach are computed as follows:

$$t = \sum_{t=-2}^{t=+2} \overline{AR_t} \Big/ \left(\sum_{t=-2}^{t=+2} S^2\left[\overline{AR_t}\right] \right)^{1/2} \tag{2}$$

where:

$$S^2\left[\overline{AR_t}\right] = \left(\sum_{t=-244}^{t=-6} \left[\overline{AR_t} - \overline{AAR}\right]^2 \right) \Big/ 238;\ \overline{AAR} = \sum_{t=-244}^{t=-6} \overline{AR_t} \Big/ 239.$$

This example uses 239 days (−244 through −6) in the estimation period to derive the standard deviation. In addition, the investigation typically restricts the analysis to firms with at least some minimum number of daily returns, such as 120 daily returns, in the estimation period. Because a portfolio average

Table 1
Information systems related event studies and some characteristics.

Researchers	Topic	Dates of announcements	Source of announcement	Number of announcements	CAR window	Normal return window
Acquisti et al. (2006)	Privacy	2000–2006	LexisNexis, Proquest	64		(−100,−8)
Aggarwal et al. (2006)	XML standards	1999–2003	LexisNexis	148	(−1,0)	(−255,−5) or (−105,−5)
Argawal et al. (2006)	E-business outsourcing	1999–2002	PR Newswire, Business Wire	96	(−1,1)	
Andoh-Baidoo and Osei-Bryson (2007)	Security breaches	1997–2003	LexisNexis – New York Times, Financial Times, Wall Street Journal, Washington Post, USA Today	41	(−1,1)	(−120,−2)
Anthony et al. (2006)	Website outages	1997–1999	Wall Street Journal, CD Net, ZD Net	19 firms and 89 outages	(−1,2)	(−240,−6)
Benbunan-Fich and Fich (2004)	E-business (web traffic)	1996–2001	LexisNexis, PR Newswire, Business Wire	283	(−1,1)	(−255,−10)
Benbunan-Fich and Fich (2005)	E-business (web presence)	1995–1999	PR News wire, Business Wire	77	(−1,1), (−3,3), (−5,5)	(−255, ?)
Campbell et al. (2003)	Security breaches	1995–2000	Wall Street Journal, New York Times, Washington Post, Financial Times, USA Today	43 firms	(−1,1)	(−121,−2)
Cavusoglu et al. (2004)	Security breaches	1996–2001	LexisNexis, Cd Net, ZD Net	66 Security Announcements	(0,1)	(−160,−1)
Chatterjee et al. (2001)	CIOs	1987–1998	LexisNexis	113	(−1,1)	(−300,−45)
Chatterjee et al. (2002)	IT infrastructure and applications	1992–1995	LexisNexis	112	(−2,2)	(−200, 10)
Cheng et al. (2007)	E-business channels	1997–2003	Taiwan Economic Journal	32	(−5,5)	120 Days
Daniel et al. (2009)	ICT outsourcing	January 1, 2000–July 1, 2005	LexisNexis	48	(0,0),(−1,0), (0,1), (−1,1)	(−230,−30)
Dardan et al. (2005)	E-business (e-commerce announcements)	1999–2000	PR Newswire, Business Wire	100 firms, 349 Announcements	(−1,1)	200 days
Dardan et al. (2006)	N/A					
Defond et al. (2010)	Knowledge management	2001–2008	Factiva, LexisNexis	247 Announcements	(−2,2)	(−244,−6)
Dehning et al. (2003a,b)	IT infrastructure and applications	1981–1996	Various	251, 355	(−1,1)	(−300,−45)
Dehning et al. (2004)	E-business (e-commerce Initiatives)	1998, 2000	LexisNexis, PR News Wire, Business Wire	542	(−10,10), (−5,5), (−1,1)	(−300,−45)
Dos Santos et al. (1993)	IT infrastructure and applications	1981–1988	PR Newswire PTS Prompt	97	(−1,0)	(−201,−1)
Ettredge and Richardson (2003)	Security (hacker attacks)	February 8–10, 2000	Keynote	4,275	(−1,1)	(−300,−45)

Ferguson et al. (2005)	E-business (e-commerce Investments)	January 1, 1988 to June 30, 2001	Australian Stock Exchange	232	(−1,1),(−5,5), (−10,10)	
Filbeck et al. (2005)	Supply chain	1995–2000	Inbound logistics, Warehouse Management, Logistics Management and Distribution Report, Supply Chain Management Review	52, 55, 140	(−1,1)	(−330,−70)
Florin et al. (2005)	IT outsourcing	1997–2002	LexisNexis	66	(−30,−1), (0,1), (2,250)	
Geyskens et al. (2002)	E-business (internet channel additions)			98 News Papers, 22 Firms	(0,1)	(−250,−30)
Hayes et al. (1999)	IT outsourcing	1990–1997	LexisNexis	78	(0,1)	
Hayes et al. (2000)	IT outsourcing	1990–1997	LexisNexis	76	(0,1)	(−201,−2)
Hayes et al. (2001)	Enterprise resource planning systems	1990–1998	LexisNexis	85–91	(0,1)	(−259,−60)
Hovav and D'Arcy (2003)	Security (denial of service attacks)	January 1, 1998–June 30, 2002	LexisNexis – Business News	23	(−1,0),−1,1), (−1,5), (−1,10), (−1,25)	(−201,−2)
Hovav and D'Arcy (2005)	Security (computer viruses)	January 1, 1988 to June 30, 2002	LexisNexis – Business News	110 announcements	(0,0), (0,1), (0,5), (0,10), (0,25)	(−201,−2)
Hunter (2003)	IT investment	1990–1997	Dow-Jones	150		
Im et al. (2001)	IT infrastructure and applications	1981–1996	PR Newswire, PTS Prompt and Business and Industry	238	(−1,0)	(−201,−1)
Jeong and Lu (2008)	Radio frequency identification (RFID)	2001–2006	LexisNexis – PR Newswire and Business Newswire		(−1,1)	(−201,−2)
Jeong and Stylianou (2010)	Application service providers	1998–2007	PR Newswire, Business Wire	268	(−1,1)	(−201,−2)
Kannan et al. (2007)	Security breaches	1997–2003	Wall Street Journal, New York Times, ZD Net and CNET	72 events	(−1,2), (−1,7), (−1,29)	
Khallaf and Skantz (2007)	CIOs	1987–2002	LexisNexis Wire Service	443	(−1,1)	
Koh et al. (2007)	IT outsourcing	1989–1999	LexisNexis	420	(−1,1)	(−255,−31)
Lim et al. (2007)	IT outsourcing	1990–2003	LexisNexis	335	(0,1)	(−255,46)
Lin et al. (2007)	E-business (e-service)	1999–2002	infowinnerPlus, ndndata.com Taiwan)	179	(−2,2)	
Loh and Venkatraman (1992)	Information outsourcing		LexisNexis	58 Outsourcing Aggrements	(−1,0), (−1,1), (−1.,2), (−1,3)	(−270,−70)
Masli et al. (2010)	Information technology excellence awards	1988–2007	CIO Magazine	373 Firms		
Meng and Lee (2007)	Value of IT in developing countries	1999–2002	Factiva (Business Wire, PR Newswire, Dow Jones Business News, Dow Jones International News, and WWW.p5w.net, www.stocknews.com.cn, finance.eastday.com, www.cs.com.cn, www.my5078.com	China 65, US 63	(0,2)	(−230,−30)
Nagm and Kautz (2008)	IT infrastructure and	1996–2006	Signal G (Australia)	217 Announcements	(−1,1), (−5,5)	(−205,−6)

(continued on next page)

Table 1 (*continued*)

Researchers	Topic	Dates of announcements	Source of announcement	Number of announcements	CAR window	Normal return window
	applications					
Oh et al. (2006a,b)	IT outsourcing	1995–2003	LexisNexis	192 Announcements	(−5,5)	(−230,−30)
Oh et al. (2006a,b)	IT investment	1985–1999	Prior Studies and LexisNexis	193 from prior studies and 158 from their own search	(−2,−1), (0,1), (2,3)	(−230,−30)
Peak et al. (2002)	IT outsourcing	N/A				
Raghu et al. (2008)	Patent infringement	1984–2002	LexisNexis news stories, LexisNexis case history database and NBER patent database	75 cases	(−1,0)	200 days
Ranganathan and Brown (2006)	Enterprise resource planning systems	1997–2001	LexisNexis Academic Universe database	116	(0,1)	(−246,−45)
Roztocki and Weistroffer (2006)	Activity-based costing		LexisNexis	3 Companies, 81 announcements	(−1,0)	(−201,−2)
Roztocki and Weistroffer (2007a)	Enterprise application integration	1998–2005	LexisNexis	81	(−1,0), (−1,1)	(−201,−2)
Rubin and Rubin (2007)	Business intelligence	1999–2004	PR Newswire	22 firms		
Subramani and Walden (2001)	E-commerce	10/1/1998–12/31/1998	PR Newswire, Business Wire, LexisNexis	251	(−10,10), (−5,5)	120 days
Telang and Wattal (2007)	Software vulnerability	January 1999–May 2004	Proquest and LexisNexis	147 vulnerabilities from 18 firms	(0,0)	(−175,−16)

abnormal return is used in the calculation of the standard deviation, the test statistic takes into account cross-sectional dependence in the abnormal returns.

4. Confounding events during the event window

Event studies are designed to capture the impact of a specific event. If another event occurs at roughly the same time of the event of interest, there would be a question as to what was the true cause of a change in market price. Accordingly, it is important to eliminate those announcements that may be tainted by another event or a set of events. As a result, a careful and thorough research design should investigate other announcements during the window of interest to determine whether there are any confounding events.

Confounding events might include capital events (stock splits and structural changes), damage suits, dividends, executive changes (Cannella and Hambrick, 1993), joint venture announcements (McConnell and Nantell, 1985), merger and acquisition activities (Morck and Yeung, 1992), and earnings announcements (Brown and Warner, 1985). Such types of events may influence the market price in conjunction with particular information systems announcement of concern.

In spite of considering potential confounding events by researchers, the longer the event window, the more difficult it is to ensure that these potential confounding events are controlled for. Further, Brown and Warner (1985) illustrate that a long event window severely reduces the power of the test statistic. Ultimately, this can lead to false inferences about the significance of an event. In addition, as noted by a number of observers, the use of a short window reduces the potential for a confounding event to interfere with the market's response. That is, shorter windows limit the impact of other news on the event of concern.

Unfortunately, based on our analysis of event research studies in information systems, in many cases it is unclear whether researchers have examined the possibility for confounding events. Further, in some cases, researchers may have unnecessarily employed long windows, in contrast to a preferred short window to eliminate confounding events.

Different approaches can be used to capture potential confounding events. For example, DeFond et al. (2010) use two methods to find and isolate the effect of such events. First, event data (such as filings of quarterly and annual financial statements, earnings announcements, and other firm's immediate announcements related to material events) about each sample firm can be gathered from the Securities and Exchange Commission (SEC) EDGAR filings around the event window. Second, news published about firms can be analyzed. A recommended potential source for identifying major news is the LexisNexis Academic database, Newswires and Press Releases section. The analysis can then take multiple stages, first with the SEC filing events removed, second with the news events removed, and third with all of the confounding events removed. Such an analysis can provide an investigation as to the robustness and causality of the evidence.

5. The importance of time

Not surprisingly, “time” plays an important role in event studies, through issues such as stationarity, importance of the particular time period, and meta events.

5.1. Stationarity

Information technology has changed rapidly over the past 30 years. For example, ERP systems from the mid 1990s are not the same as ERP systems in 2010. As a result, it is likely that the underlying processes related to technology and how investors view technology have changed over that time.

Accordingly, the stock market response data is not likely to be stationary over time. As a result, although some economic studies might use long time periods, they may be inappropriate in settings involving information systems. Thus, information systems researchers may need to break their data into different groups, where technology characteristics are similar.

A lack of stationarity can find results for one time period, but not another, or stronger in one period and weaker in another. For example Dehning et al. (2004) found that e-commerce announcements had a significantly greater impact in 1998 than in the fourth quarter of 2000. This can suggest that depending on the time periods analyzed, researchers may or may not find an effect from the information technology.

However, a non-stationarity condition generally biases against finding a result associated with an event. Accordingly, if researchers find statistically significant abnormal returns during the examined event window, this is evidence that the phenomenon of interest may be robust across the long time horizon.

5.2. Importance of the time period

Non-stationarities mean that relationships vary over time. As a result, the time period chosen for the event study also is important. For example, as noted by Dehning et al. (p. 56, 2004) “In 1998, business-to-business e-commerce initiatives, e-commerce initiatives with a tangible product, and e-commerce initiatives by pure-play internet firms were valued more than similar initiatives in 2000.” Prior to the “internet bubble,” the stock market apparently valued internet activities more favorably.

As another example, although the evidence is informal, one of the authors was part of a team of researchers that had examined RFID announcements as a potential event study. Unfortunately, the data over the time periods that were examined did not result in abnormal stock market returns. However, Jeong and Lu (2008) recently found a positive market reaction to RFID announcements. As a result, choosing the time periods can be critical. It is possible that as the market becomes more aware of the impact of the technology or as the technology progresses on its life cycle (e.g., O'Leary, 2008), a “no market reaction” can turn into a “market reaction” over time, or conversely.

This last concern also raises an important issue: if there is no market reaction to the event, does it mean that there was no effect, or is it simply a matter of finding the right time period to investigate?

5.3. “Meta events” during time period analyzed

As seen in Table 1, the data for information systems studies have been gathered over the time period 1981 to 2008. As a result, we might question whether there were any major events, independent of any specific firm that might have changed the stock market's reaction at different times, so called “meta events.” In particular, these events may limit the comparability of results that occur in different time periods. Further, these meta events may have contributed to Masli et al. (2010) finding that returns to IT have eroded since 1999.

For example, the so-called “Y2K” (year 2000) problem may have had the market responding to IT announcements in a manner that is inconsistent with today's market (e.g., Masli et al., 2010). At the time of Y2K, there were substantial concerns about corporate system failures and overall firm architectures not being ready to respond to the Y2K problem. As a result, in the mid 1990s ERP software was sold not only because it could facilitate improved processes and decision making, with corresponding business benefit, but in addition it was expected to help companies solve the dreaded Y2K problem. Thus, there were multiple sources of value to firms from ERP systems from the market's perspective. However, today's capital market is likely to not consider Y2K benefits because virtually all organizations have already solved that problem. Thus, any incremental benefit to firms would accrue only from non-Y2K sources.

Similarly, the “9/11” event may have generated market conditions for the stock market in 2001 that may not be applicable in today's capital market (Kannan et al., 2007). As an example, security concerns generally became more important immediately after the 9/11 event. Finally, as noted above, another potential set of events transpired with the internet bubble (Nagm and Kautz, 2008).

6. The importance of firm size

As noted by Kothari and Warner (2006), firms experiencing an event can have a non-random size and be from a non-random industry. For example, in the mid 1990s a typical implementer of an ERP system was both a manufacturing firm and generally a very large firm (e.g., O'Leary, 2000). Thus, announcements of ERP systems were likely from similar industries and of similar size. As a result, event studies can potentially capture substantial industry and firm size effects, which suggests that some event studies may be limited in their application to other settings. As further evidence, also as noted by Kothari and Warner (2006), individual firms' security variances and their abnormal return variances exhibit an inverse relationship to firm size and can vary systematically by industry.

7. After the event, then what? (relating stock market returns to accounting profits)

The stock market responds to event information because it anticipates a change in a firm's value. Accordingly, an important issue is whether the performance of a firm changes after the event. Thus, a complementary analysis to an event study could examine future performance to determine if the stock market's reaction to the event of interest is appropriate in terms of the event influencing future performance. Researchers (e.g., DeFond et al., 2010, and Masli et al., 2010) have taken multiple perspectives to investigate the post-event effect. This includes examining the firm's performance over a relatively long horizon subsequent to the event, relative to a matched group that did not experience the event in question, in order to determine if the adoption of the technology actually led to greater profitability. For example, Masli et al. (2010) compared future performance as measured by return on assets, return on sales, asset turnover, sales growth and Tobin's *q*.

One of the emerging controversial issues associated with comparing firms' performance is the development of the matched group. Mithas and Krishnan (2009) analyze propensity scores as a means of choosing the matching set of firms. However, few information systems studies have employed a propensity score approach to facilitate matching. In addition, DeFond et al. (2010) also suggested testing whether analysts substantially revise their earnings forecasts revisions of the firms subsequent to the event. Using the I/B/E/S database, the number of upward versus downward analyst forecast revisions are compared to determine whether there is a shift in analyst consensus earnings expectations after the event.

8. An alternative market measure to an event study

Hitt and Brynjolfsson (1996) and others have proposed a different market-based measure and approach to analyze the market impact of technology adoption. In particular, researchers have related information system developments to Tobin's *q*, which is defined as the ratio of market value to replacement value of assets. As an example, Bhardadwaj et al. (1999, p. 1017) found that "… the IT expenditure variable in the model increased the variance explained in *q* significantly. This indicates that the IT variable provides unique information in explaining variance in Tobin's *q*. Furthermore, after controlling for industry characteristics and other firm-specific variables, for all five years, expenditures in IT had a statistically significant positive association with Tobin's *q*."

Unfortunately, there are several limitations of Tobin's *q*. Over the past years, Tobin's *q* has been the subject of substantial research and analysis. Whereas event measures of market movement are closely tied to specific sets of events, researchers, such as Villalonga (2004) have found that *q* includes information about a wide range of intangibles beyond IT, including research and development, advertising, etc. Thus, to the extent that other intangibles are correlated with the variable(s) under consideration there can be substantial measurement error in the model. This can be particularly important when investigating particular information systems issues. For example, sales and advertising expenses are likely to be correlated with customer relationship management systems and other marketing systems.

The fact that *q* contains substantial amount of information from different sources also is apparent from the broad base of uses and explanations attributed to *q*. For example, *q* has been used as a measure of a firm's incentive to invest (Erickson and Whited, 2006), management's performance (Min and Prather, 2001), as a gauge of monopoly power (Lindenberg and Ross, 1981), and others. As a result, these multiple interpretations of *q* suggest that the *q* measure captures a broad base of information, in addition to the particular technology issues that are likely to be investigated when *q* is related to an information systems measure.

To the extent that information is correlated with the information systems issue under concern, it will result in measurement error and potential model misspecification. However, there are additional measurement issues associated with Tobin's *q*, beyond omitted correlated variables. For example, as noted by Dybvig and Warachka (2010), there is an endogeneity problem associated with *q*: under-investment lowers firm performance while increasing Tobin's *q*. Further, apparently the treatment of outliers is particularly critical when using Tobin's *q* (Subramanian, 2002).

In contrast, event studies provide a certain precision that is impossible to achieve using q. For example, in event studies, the detailed timing of a specific type of announcement, constituting a detailed event, is used to measure the stock market response to the precision of a specific day.

9. Remarks on modeling and recommendations to researchers

Events studies, which ultimately test for market efficiency, are joint tests of market efficiency and the model of expected returns used to estimate abnormal returns. There are several important issues about which the information systems researcher should decide when designing the research and setting up the model of expected returns. First, when appropriate, we recommend using daily, rather than monthly security returns data because such data allow more informative examination of the event of interest and more precise measurement of abnormal returns. Accordingly, we recommend that the researcher tries to accurately isolate the day or days during which the event (e.g., announcement of completing an ERP implementation; systems-related award announcement) is hypothesized to affect investor beliefs. We note that long-horizon event methods generally have serious limitations, and they are often unreliable and have low power. In fact, short-window tests represent the "cleanest evidence on market efficiency" (Fama, 1991), and they are especially powerful when the abnormal performance is concentrated in the event window (e.g., a precise implementation date is known).

Second, with respect to the award window selection when using a short-horizon event study, we recommend selecting a window of one day prior to the event until one day after the event, i.e., a [−1, +1] window. Such window allows focusing on the informative content of the event while allowing for leakage of information prior to the event and slightly belated response (because of, e.g., a technical reason) after the event. In cases when the event is announced prior to day 0 or there are theoretical reasons to hypothesize a more belated response, the researcher can select a [−2, +2] window, either as the main window for the event test or as an additional sensitivity test.

Third, with respect to the test-statistic used to conduct statistical inference with regards to the significance of the abnormal return, we note that in short-window event methods, the test-statistic is not highly sensitive to the benchmark model of abnormal returns or assumptions about the cross-sectional or time-series dependence of abnormal returns. This is in contrast to long-window event methods that are sensitive to different returns-related assumptions. In fact, Brown and Warner (1985) find that, when using daily, correcting for cross-correlation and auto-correlation generally had no significant impact on the inferences drawn, and they show that tests using daily returns and ignoring cross-sectional dependence can be well-specified and have higher power than tests which account for potential dependence. Accordingly, we recommend that using the cross-sectional test-statistic that does not control for cross-sectional correlation and auto-correlation can be appropriate and straightforward in many settings of short-event tests (Bartov et al., 2011).

Fourth, with respect to adjusting for risk and calculating abnormal returns, in short-window event studies, we recommend using either market, Fama–French-adjusted, or Fama–French–Carhart-adjusted returns, where Carhart refers to the Carhart (1997) momentum factor. The choice of the metric used to control for risk is not that important in such cases. This is because, in contrast to long-window event studies, the metric used to measure abnormal returns is typically straightforward and unimportant in short-window event studies, stemming from the fact that daily abnormal returns are about 0.05%. Therefore, even if risk factor loadings (i.e., betas) are severely misestimated, the error in estimating abnormal returns is small relative to abnormal returns of 0.5%–1.0%, or even higher, that are typically documented in short-window returns. In long-window event studies, however, the precision of the risk measurement becomes very important, yet adjusting for risk is problematic and it is unclear which expected return model is correct. Therefore, estimates of abnormal returns in such cases are highly sensitive to model choice (Kothari and Warner, 2006).

Fifth, when calculating average abnormal returns, it is possible to use either value-weighted or equally-weighted returns. When calculating equally-weighted average returns, as the name implies, every stock in the event portfolio receives the same weight, regardless how large or small the company is. In contrast, when calculating value-weighted average returns, each stock receives a weight which is usually based on the market value of equity on a specified day prior to the event. On one hand, because event studies often include extremely large companies that comprise a very large fraction of firms' total market of equity, weighting by market value of equity may misrepresent the magnitude of the event effects. On the other hand, equally-weighting may misrepresent the magnitude of the abnormal returns stemming from using stocks with extremely low market value of equity. Such stocks are usually illiquid and problematic (e.g., penny stocks). To balance these effects, we recommend using equally-weighted average abnormal returns after deleting extremely small stocks (usually firms with a stock price lower than $1 or $5, and a market value of equity lower than $10 million). As a sensitivity test, the researcher may repeat the analysis using value-weighted average abnormal returns.

Sixth, with respect to using cumulative or buy-and-hold abnormal returns (i.e., CAR or BHAR), we recommend using CAR in short-window event tests to be consistent with most prior literature, although using BHAR over a short-window is not likely to make a significant difference. In long-window event studies, the researcher can use either BHAR or the portfolio alpha (i.e., intercept) approaches. Both have low power and neither is immune to misspecification. Yet, the cutting-edge literature has made a gradual use in the portfolio alpha approach, and accordingly we provide below detailed information about this approach.

Specifically, a long-horizon event study may be needed because the event spans a long period or because the researcher wishes to examine whether the stock market fully reacts to an information signal over a short window. For example, an announcement of an ERP implementation may lead to a short-window abnormal return, yet this reaction may be incomplete, leading to the ability to detect abnormal returns over the longer horizon after the event date. To investigate such a possibility, a relatively clean and accurate way we recommend to use is the calendar-time portfolio test that focuses on the unexplained fraction of returns relative to a benchmark asset pricing model (Fama and French, 1993; Barth et al., 2010; Konchitchki, 2010). Such unexplained fraction captures abnormal returns, which are also denoted as Capital Asset Pricing Model (CAPM), Fama–French, or Fama–French–Carhart alphas (or intercepts).

To implement this test, we recommend using the portfolio-level or the firm-level approach, or both. Specifically, using the portfolio-level approach, the research design focuses on the intercepts from portfolios constructed based on a pre-determined conditioned variable, hereafter denoted as *CONDITIONED_VAR*. For example, a portfolio of all the firms that implemented an ERP system over the past twelve months, where portfolios are rebalanced annually based on the most recent twelve months. Another example is using ten portfolios based on grades for how successful was the ERP implementation. The estimated intercept from such a test permits testing the ability of the conditioning information of interest to explain systematic differences in the cross-section of stock returns, controlling for common risk factors. In particular, the test can examine whether the intercept for a portfolio of, for example, firms that implement an ERP system over the past twelve months is significantly positive or negative. Another examination that the test permits is in the case of several portfolios. In particular, whether the intercept for the low *CONDITIONED_VAR* portfolio is significantly different from the intercept for the high portfolio. The researcher can begin by constructing ten portfolios such that each period all firm-year observations with low (high) *CONDITIONED_VAR* are sorted into portfolio one (ten). The researcher can then calculate future monthly returns for each portfolio and estimate the following time-series equation at the portfolio level to obtain the portfolio intercepts:

$$R_{p,m} - R_{f,m} = \alpha_p + \beta_{p,MKTRF} \cdot MKTRF_m + \beta_{p,SMB} \cdot SMB_m + \beta_{p,HML} \cdot HML_m + \beta_{p,UMD} \cdot UMD_m + \varepsilon_{p,m}, \quad (3)$$

where $R_{p,m}$ is the portfolio return for portfolio p in month m; $R_{f,m}$ is the one-month Treasury bill rate; and $MKTRF_m$, SMB_m, HML_m, and UMD_m are the three Fama and French (1993) factor returns and the Carhart (1997) momentum factor return, where *MKTRF* is the excess return on the market, *SMB* and *HML* are respectively constructed based on market value of equity and the book-to-market ratio, and *UMD* is the momentum factor.

We recommend choosing conservatively a one-year time horizon to capture future abnormal performance. A one-year horizon is also consistent with prior research studies that examine future performance in similar settings (e.g., DeFond et al., 2010). While information systems may impact more than one year's future performance, it should impact at least one year. Also, the researcher can obtain monthly raw stock returns from the CRSP Monthly Stock File, as well as the monthly risk-free rate and the Fama–French and momentum factors from the Fama–French Portfolios and Factors dataset available through the Wharton Research Data Services (WRDS) or freely through Kenneth French's online data library.[2] If *CONDITIONED_VAR* requires information that becomes available only periodically (e.g., information from annual financial statement regarding the purchase or implementation of an information system), we recommend aligning firms'

[2] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

CONDITIONED_VAR on monthly returns accumulated over the twelve months beginning three months after the fiscal year-end, to allow for dissemination of annual reports information.

To the extent that *CONDITIONED_VAR* is fully priced by investors, abnormal returns, α_p, will be insignificantly different from zero. Alternatively, if investors do not fully account for the informative content of *CONDITIONED_VAR*, α_p is expected to be significantly different from zero.

Using the firm-level approach, the researcher can form ten portfolios each year such that firms with the lowest (highest) *CONDITIONED_VAR* are sorted into portfolio one (ten). Then, for each portfolio-year, the researcher should calculate mean abnormal returns, accumulated over the subsequent period (usually one year). As before, the researcher can align firms' annual amounts to monthly returns in the next 12 months beginning three months after the fiscal year-end. The examination of abnormal returns using this approach can be through several abnormal return metrics. These are returns adjusted for the value-weighted return on the market, for the Fama–French factors, and for the Fama–French and momentum factors. To obtain abnormal returns, the researcher can first calculate raw returns by annually compounding each firm's monthly returns. The market-adjusted return is calculated as the annually compounded raw return minus the annually compounded value-weighted return on all NYSE, AMEX, and NASDAQ stocks in CRSP. Alternatively, the researcher can estimate the following time-series equation for each firm:

$$R_{i,m} - R_{f,m} = \kappa_i + \beta_{i,MKTRF} MKTRF_m + \beta_{i,SMB} SMB_m + \beta_{i,HML} HML_m + \beta_{i,UMD} UMD_m + \varsigma_{i,m}. \quad (4)$$

Estimation of this equation over an estimation period (that can include, for example, the entire sample period) yields firm-specific loadings, or betas, $\beta_{i,MKTRF}$, $\beta_{i,SMB}$, $\beta_{i,HML}$, and $\beta_{i,UMD}$. We recommend adding all four factors when estimating the equations, such that the researcher can be comfortable that the abnormal returns do not stem from correlation with known risk factors. Finally, abnormal returns are obtained by subtracting from raw returns the product of a firm's betas and the respective factor returns, compounded annually.[3]

10. Does IT matter? Do IT event studies matter?

Although the purpose of this paper is to investigate the use of the event methodology in information systems, by bringing together a large number of these studies in a single setting it allows us to investigate another question. In particular, Carr (2003) investigates the question “Does IT Matter?” Based on the 50 or so IT event studies summarized in Table 1, it is clear that stock prices act as if IT does matter — at least the specific technologies investigated in those research papers. When taken in the aggregate, the studies summarized in Table 1 reveal that event studies have found that the introduction, use, etc. of technology “makes a difference.” In addition, the introduction of technology has shown to generate value to shareholders, as measured by the stock market response to technology-related news. Further, studies such as DeFond et al. (2010) also suggest that not only does the market recognize the difference; but that the technology also influences future performance of the adopting firms.

However, because there are a large number of documented instances of technology creating value, the incremental contribution of additional event studies that only examine the market response to the introduction of a new technology is in question. Perhaps future research in the use of event studies associated with IT will need to consider additional methodological, “strategic”, and other responses as discussed above, or provide further insight into issues such as that raised by Carr (2003). Finally, we believe that the impact of the technology on future performance will increasingly become an important part of the impact of technology introduction.

11. Summary, contributions, and extensions

This paper reviews and analyzes methodological features of event studies related to information systems announcements. In so doing, this paper provides a comparison of methodological parameters

[3] The firm-level test may lack power due to measurement errors in firm-specific factor betas and *CONDITIONED_VAR*. The portfolio test, in contrast, allows analyzing the variation in the cross-section of expected returns. That is, rather than using firm-specific intercepts that depend on unknown firm-level characteristics, the portfolio test conditions on a pre-determined characteristic — *CONDITIONED_VAR* — and then identifies whether any mispricing effects not explained by the factors vary with this characteristic. Thus, the portfolio test is less subject to this concern.

across a number of event studies in information systems that could be used to guide researchers. Further, this paper provides an updated literature survey on event studies in information systems, as well as it evaluates alternative research design choices and makes recommendations for researchers, thereby facilitating future event studies research using information systems-related events. In addition, this paper reviews some of the critical issues, and provides recommendations for researchers regarding the use of the event study methodology in information systems research. Further, this paper suggests that in some cases, research questions in information systems using event studies involve questions that are jointly an analysis of the impact of a technology and a strategy or firm characteristics.

This paper can be extended in a number of directions. Researchers can extend the analysis to other technologies not found as listed among the existing studies. Researchers can also investigate strategic motivations or firm characteristics that interact with technologies. Also, researchers can re-examine previous studies to determine if previous results are consistent with a more contemporary capital market structure. For example, if we were able to factor out Y2K effects, would there still be a positive abnormal return associated with ERP systems during the mid 1990s? Researchers can also investigate previous studies with different event study parameters (e.g., Table 1) to test whether similar results can be obtained.

Replication and extension of existing studies allows deep investigation of methodological issues in event studies, resulting in important findings. For example, as noted by Dehning et al. (2004) the choice of the event window can affect inferences made about the event of interest. Using data gathered from Subramani and Walden (2001) and additional data that they gathered allowed them to make formal hypotheses about the stationarity of the data, the corresponding impact of e-commerce announcements and, the affect of the length of the window. Future research could be extended in the same manner by using data from an existing study, extending that data and, investigating specific issues formally.

Finally, few of the event studies related to information systems announcements have examined future performance after the event under consideration (e.g., Masli et al., 2010). Thus, there has been limited tying of the market response to accounting measures of future performance. Accordingly, most of prior information systems event studies can be extended to include the analysis of future performance as summarized in this paper. Researchers initially have found that the impact of aggregate events such as the technology bubble may have changed the overall performance returns to IT (Masli et al., 2010). Additional key issues, such as the use of propensity scores (e.g., Mithas and Krishnan (2009) to match firms in order to compare performance, have only recently been used in information systems research. Future research might also examine previous studies to determine the extent to which using propensity scores as opposed to other approaches such as matching on size and industry results in alternative findings. Further, alternative approaches to analyzing future performance, such as analysts' forecasts (DeFond et al., 2010) also have not received much attention in the literature. Future research could examine the use of this approach in additional information systems research.

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References

Acquisti A, Friedman A, Telang R. Is there a cost to privacy breeches? An event study. Twenty Seventh International Conference on Information Systems, Workshop on the Economics of Information Security; 2006.

Aggarwal N, Dai Q, Walden EA. Do markets prefer open or proprietary standards for XML standardization? Int J Electron Commer 2006;11(1):117–36.

Andoh-Baidoo FK, Osei-Bryson K-M. Exploring the characteristics of Internet security breaches that impact the market value of breached firms. Expert Syst Appl 2007;32(3):703–25.

Anthony JH, Choi W, Grabski S. Market reaction to e-commerce impairments evidenced by website outages. Int J Acc Inf Syst 2006;7(2):60–78.

Argawal M, Kishore R, Rao H. Market reactions to E-Business outsourcing announcements. Inf Manage 2006;43:861–73.

Ball R, Brown B. An empirical evaluation of accounting numbers. J Acc Res 1968;6(2):159–78 Autumn.

Barth ME, Konchitchki Y, Landsman WR. Cost of capital and earnings transparency. Stanford University Graduate School of Business Research Paper No. 2015; 2010.

Bartov E, DeFond ML, Konchitchki Y. Capital market consequences of filing late 10-Qs and 10-Ks. Working paper. 2011.

Benbunan-Fich R, Fich EM. Effects of web traffic announcements on firm value. Int J Electron Commer 2004;8(4):161–81.

Benbunan-Fich R, Fich EM. Measuring the value of refining a web presence. J Electron Commer Organ 2005;3(1):35–52.
Bhardadwaj AS, Bharadwaj SG, Konsynski BR. IT effects on firm performance. Manage Sci 1999;45(6):1008-10024 June.
Binder J. The event study methodology since 1969. Rev Quant Finance Acc 1998:111–37 September.
Brown SJ, Warner JB. Measuring security price performance. J Financ Econ 1980;8:205–58.
Brown SJ, Warner JB. Using daily stock returns: the case of event studies. J Financ Econ 1985;14:3-31.
Campbell K, Gordon LA, Loeb MP, Zhou L. The economic cost of publicly announced information security breaches: empirical evidence from the stock market. J Comput Secur 2003;11(3):431–48.
Cannella A, Hambrick D. Effects of executive departures on the performance of acquired firms. Strateg Manage J 1993;14:137–52.
Carhart MM. On persistence in mutual fund performance. J Finance 1997;52(1):57–82.
Carr N. IT doesn't matter. Harv Bus Rev 2003:5-12 May.
Cavusoglu H, Mishra B, Raghunathan S. The effect of internet security breach announcements on market value: capital market reactions for breached firms and internet security developers. Int J Electron Commer 2004;9(1):69-104.
Chatterjee D, Richardson VJ, Zmud RW. Examining the shareholder wealth effects of announcements of newly created CIO positions. MIS Q 2001;25(1):43–70.
Chatterjee D, Pacini C, Sambamurthy V. The shareholder-wealth and trading-volume effects of information-technology infrastructure investments. J Manage Inf Syst 2002;19(2):7-42 Fall.
Cheng JM-S, Tsao S-M, Tsai W-H, Tu HH-J. Will echannel additions increase the financial performance of the firm?—the evidence from Taiwan. Ind Mark Manage 2007;36(1):50–7.
Daniel E, Kodwani D, Datta S. The impact of ICT enabled off shoring announcements on share prices. J Enterprise Inf Manage 2009;22(3):241–56.
Dardan M, Stylianou A, Dardan S. The valuation of ecommerce announcements during fluctuating financial markets. J Electron Commer Res 2005;6(4):312–26.
Dardan S, Stylianou A, Kumar R. The impact of customer-related IT investments on customer satisfaction and shareholder returns. J Comput Inf Syst 2006;47(2):100–11.
DeFond ML, Konchitchki Y, McMullin JL, O'Leary DE. Does superior knowledge management increase shareholder value? Paper presented at the American Accounting Association Annual Meeting, San Francisco, August; 2010.
Dehning B, Richardson V, Stratopolis T. Reviewing event studies in MIS: an application of the firm value framework. Proceedings of the 36th Hawaii International Conferences on System Sciences; 2003a.
Dehning B, Richardson V, Zmud R. The value relevance of announcements of transformational information technology investments. Manage Inf Syst Q 2003b;27(4):637–56 December.
Dehning B, Richardson VJ, Urbaczewski A, Wells JD. Reexamining the value relevance of ecommerce initiatives. J Manage Inf Syst 2004;21(1):55–82.
Dolley JC. Characteristics and procedure of common stock split-ups. Harv Bus Rev 1933;11:316–26 April.
Dos Santos B, Peffers K, Mauer D. The impact of information technology investment announcements on the market value of the firm. Inf Syst Res 1993;4(1):1-23.
Dybvig PH, Warachka M. Tobin's Q does not measure performance: theory, empirics, and alternative measures; 2010. November.
Erickson T, Whited T. On the accuracy of different measures of q. Financ Manage 2006 Autumn, 5–33.
Ettredge ML, Richardson VJ. Information transfer among internet firms: the case of hacker attacks. J Inf Syst 2003;17(2):71–82.
Fama E. Efficient capital markets: a review of theory and empirical work. J Finance 1970;25(2):383–417.
Fama E. Efficient capital markets II. J Finance 1991;46(5):1575–617.
Fama EF, French KR. Common risk factors in the returns of stocks and bonds. J Financ Econ 1993;33(1):3-56.
Fama E, Fisher L, Jensen M, Roll R. The adjustment of stock prices to new information. Int Econ Rev 1969;10(1):1-21 February.
Felcher, J. Song, J. and Poindexter, S., “School Reforms often overlook the instructors,” Los Angeles Times, Wednesday, December 22, 2010, p. A1 and A14.
Ferguson C, Finn F, Hall J. Electronic commerce investments, the resource-based view of the firm, and firm market value. Int J Acc Inf Syst 2005;6:5-29.
Filbeck G, Gorman R, Greenlee T, Speh T. The stock price reaction to supply chain management advertisements and company value. J Bus Logistics 2005;26(1):199–216.
Florin J, Bradford M, Pagach D. Information technology outsourcing and organizational restructuring: an explanation of their effects on firm value. J High Technol Res 2005;16:241–51.
Geyskens I, Gielens K, Dekimpe MG. The market valuation of internet channel additions. J Mark 2002;66(2):102–19.
Hayes D, Hunton J, Reck J. The Market's reaction to information systems outsourcing announcements. AMCIS; 1999.
Hayes D, Hunton J, Reck J. Information systems outsourcing announcements: investigating the market value of contract granting firms. J Inf Syst 2000;14(2):109–25 Fall.
Hayes D, Hunton J, Reck J. Market reaction to ERP implementation announcements. J Inf Syst 2001;15(1):3-18 Spring.
Hitt L, Brynjolfsson E. Productivity, business profitability, and consumer surplus: three different measures of information technology value. MIS Q 1996;20(2):121–42.
Hovav A, D'Arcy J. The impact of denial-of-service attack announcements on the market value of firms. Risk Manage Insur Rev 2003;6(2):97-121.
Hovav A, D'Arcy J. Capital market reaction to defective IT products: the case of computer viruses. Comput Secur 2005;24(5):409–24.
Hunter SD. Information technology, organizational learning, and the market value of the firm. J Inf Technol Theory Appl (JITTA) 2003;5(1):1-28.
Im K, Dow K, Grover V. Research report: A reexamination of IT investment and the market value of the firm — an event study methodology. Inf Syst Res 2001;12(1):103–17.
Jaffe JF. Special information and insider trading. J Bus 1974;47:410–28.
Jeong B, Lu Y. The impact of radio frequency identification investment announcements on the market value of the firm. J Theor Appl Electron Commer Res 2008;3(1):41–54 April.
Jeong B, Stylianou A. Market reaction to application service provider (ASP) adoption: an empirical investigation. Inf Manage 2010;47:176–87.
Kannan K, Rees J, Sridhar S. Market reactions to information security breach announcements: an empirical analysis. Int J Electron Commer 2007;12(1):69–91.

Khallaf A, Skantz TR. The effects of information technology expertise on the market value of a firm. J Inf Syst 2007;21(1):83-105.
Koh C, Ang S, Yeo G. Does IT outsourcing create value? SIGMIS-CPR-07; 2007. p. 87–91.
Konchitchki, Y. 2010. "Inflation and nominal financial reporting: implications for performance and stock prices, " The Accounting Review 2011 May.
Kothari S, Warner J. Econometrics of event studies. In: Espen Eckbo B, editor. Handbook of corporate finance: empirical corporate finance. Elsevier/North; 2006.
Lieberman MB, Montgomery DB. First mover advantages. Strateg Manage J 1988;9:41–58 Summer.
Lim, J., Richardson, V. and Zmud, R., Value implications of IT outsourcing contextual characteristics, April 2007, unpublished paper.
Lin J-SC, Jang W-Y, Chen K-J. Assessing the market valuation of e-service initiatives. Int J Serv Ind Manage 2007;18(3):224–45.
Lindenberg Eric B, Ross Stephen A. Tobin's q Ratio and Industrial Organization. J Bus 1981;54(1):1-32.
Loh L, Venkatraman N. Stock market reaction to information outsourcing. Working Paper. MIT; 1992. November.
MacKinlay C. Event studies in economics and finance. J Econ Lit 1997;35(1):13–39.
Mandelker G. Risk and return: the case of merging firms. J Financ Econ 1974;1:303–36.
Masli A, Richardson VJ, Sanchez JM, Smith R. Evidence from financial performance around information technology excellence awards. Presented at the International Symposium of Accounting Information Systems, Orlando, Florida, May, 2010; 2010.
McConnell J, Nantell T. Corporate combinations and common stock returns. The Journal of Finance 1985;XL(2):519–36 June.
Meng Z, Lee S-YT. The value of IT to firms in a developing country in the catch-up process: an empirical comparison of China and the United States. Decis Support Syst 2007;43(3):737–45.
Min J, Prather L. Tobin's q, agency conflicts and differential wealth effects. Glob Finance J 2001;12(2):267–83.
Mithas S, Krishnan MS. From association to causation via a potential outcomes approach. Inf Syst Res 2009;20:295–313.
Morck R, Yeung B. Internalization: an event study test. J Int Econ 1992;33(1–2):41–56 August.
Nagm F, Kautz K. The market value impact of IT investments announcements — an event study. J Inf Technol Theory Appl 2008;9(3): 61–79.
O'Leary DE. Enterprise resource planning systems: systems, life cycle, electronic commerce and risk. Cambridge, England: Cambridge University Press; 2000.
O'Leary DE. Gartner's hype cycle and information systems research issues. Int J Acc Inf Syst 2008;9:240–52.
O'Leary DE. The impact of manager philosophy on knowledge management systems. Intell Syst Acc Finance Manage 2010;17:111–26.
Oh W, Gallivan MJ, Kim JW. The market's perception on the transactional risks of information technology outsourcing announcements. J Manage Inf Syst 2006a;22(4):271–303.
Oh W, Kim JW, Richardson VJ. The moderating effect of context on the market reaction to IT investments. J Inf Syst 2006b;20(1): 19–44.A revised version of a paper presented at Proceedings of the International Conference on Information Systems, New Orleans LA, December 2001.
Peak DA, Windsor JC, Conover J. Risks and effects of IS/IT outsourcing: a security market assessment. J Inf Technol Cases Appl 2002;4 (1):6-33.
Pettengill GN, Clark JM. Estimating expected returns in an event study framework: evidence from the dartboard column. Q J Bus Econ 2001;40:3-21.
Raghu TS, Wo W, Mohan SB, Rao HR. Market reaction to patent infringement litigations in the information technology industry. Inf Syst Front 2008;10(1):61–75.
Ranganathan C, Brown CV. ERP investments and the market value of firms: toward an understanding of influential ERP project variables. Inf Syst Res 2006;17(2):145–61.
Roztochi N, Weistroffer H. Event studies in information systems research. AMCIS 2008, Toronto, Canada, August 14–17; 2008.
Roztochi N, Weistroffer H. Stock market reaction to information technology investments: towards an explanatory model. European Conference on Information Systems, Verona; 2009a.
Roztochi N, Weistroffer H. Event studies in information systems research: an updated review. AMCIS 2009, San Francisco, August 6–9; 2009b.
Roztocki N, Weistroffer HR. Stock price reaction to the investments in IT: relevance of cost management systems. Electron J Inf Syst Eval 2006;9(1):27–30.Published earlier in the Proceedings of the 15th European Conference on Information Systems (ECIS 2007), 1031–1040.
Roztocki N, Weistroffer HR. How do investments in enterprise application integration drive prices? Proceedings of the 40th Hawaii International Conference on System Sciences (HICSS); 2007.
Rubin E, Rubin A. The impact of business intelligence systems on stock return volitility. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1045581. November 30, 2007.
Subramani M, Walden E. "The impact of E-commerce announcements on the market value of firms", information systems research. Inf Syst Res 2001;12(2):135–54.
Subramanian G. The disappearing Delaware effect. Harvard Law School; 2002. 11/2002.
Telang R, Wattal S. An empirical analysis of the impact of software vulnerability announcements on firm stock price. IEEE Trans Software Eng 2007;33(8):544–57.
Villalonga B. Intangible resources, Tobin's *q*, and sustainability of performance differences. J Econ Behav Organ 2004;54(2):205-230.