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IT internal control weaknesses and the market value of firms

John R. Kuhn
Stetson University, DeLand, Florida, USA, and
Bonnie Morris
Duquesne University, Pittsburgh, Pennsylvania, USA

Abstract

Purpose – With computer technology fast becoming the engine that drives productivity, IT systems have become more pervasive in the daily operations of many businesses. Large, as well as small, businesses in the USA now rely heavily on IT systems to function effectively and efficiently. However, past studies have shown CEOs do not always understand how reliant their business is on IT systems. To the authors' knowledge, no research has not yet examined if financial markets understand how IT affects the performance of businesses. The paper aims to discuss these issues.

Design/methodology/approach – In this study, the authors utilize the event study method to examine how financial markets interpret weaknesses in businesses IT systems. The authors examine this in the context of the Sarbanes-Oxley Act – Section 404 requirements and utilize the internal reporting requirement in the annual financial statement filing with the Securities Exchange Commission as a proxy to evaluate how the financial markets interpret IT weaknesses.

Findings – Using an event study, the authors show that the market does not necessarily understand and respond to the effects of IT weaknesses on overall financial performance of firms and thus challenge the efficient market hypothesis theory.

Originality/value – A second contribution is methodological in nature. IS researchers thus far have been using limited market benchmarks, statistical tests, and event windows in their respective event studies of market performance. This study shows shortcomings of that approach and the necessity of expanding usage of available event analysis tools. The authors show that using more than one market benchmark and statistical test across multiple time frames uncovers the effects that using a single benchmark and test over a single window would have overlooked.

Keywords Sarbanes-Oxley, Methodology, Event study, IT controls, Market value of firms

Paper type Research paper

1. Introduction

This study examines the impact of IT-related internal control weaknesses released to the Securities Exchange Commission (SEC) in the annual financial statements on the share prices of public companies. In the wake of financial scandals of Enron, WorldCom, and others in the early part of the twenty-first century, Congress passed the Public Company Accounting Reform and Investor Protection Act of 2002 (commonly referred to as the Sarbanes-Oxley (SOX) Act). Key sections of the act require management of firms and their auditors to assess internal controls over financial reporting and describe any material weaknesses in internal controls. Internal controls are policies and procedures intended to achieve the objectives of efficient and effective operations, reliable financial reporting, and compliance with laws and regulations. Because IT plays an ever-increasing role in organizations' operations, financial reporting, and compliance, IT-related controls are an important part of the overall set of internal controls. IT must establish and operate a governance process similar to that of the business process side to comply with SOX (Maurizio *et al.*, 2007).

Recent studies of internal control weaknesses support the notion that firms reporting internal control weaknesses are riskier, less mature in their processes, and in general financially less sound (Ashbaugh-Skaife *et al.*, 2007; Ogneva *et al.*, 2007) and report more misstatements of financial reports (Klamm and Watson, 2009). IT-related control

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weaknesses (ITCW) also lead to devastating losses from security breaches resulting in loss of confidentiality, integrity, and availability of IT assets (Ponemon, 2016). Reports of ITCW should result in a market reaction because they reflect increased risk of unintentional financial statement errors, of intentional acts by management to manipulate earnings, and of losses due to IT-related security events. Given this increase in risk, one would expect investors to punish the firms with reported ITCW with lower stock prices. Additionally, Weill and Ross (2005) reported firms with effective IT governance earned profits 20 percent higher than those pursuing similar strategies that do not have effective IT governance.

There is a significant body of research utilizing event study methodology to examine the market reaction to announcements or reports of a variety of IT investments (Jory *et al.*, 2010; Daniel *et al.*, 2009; Dewan *et al.*, 2007; Roztocki and Weistroffer, 2009; Tanriverdi and Ruefli, 2004; Dehning *et al.*, 2003; Im *et al.*, 2001; Hayes *et al.*, 2000; Dos Santos *et al.*, 1993), negative outcomes related to IT control failures (Benaroch, *et al.*, 2012; Acquisti *et al.*, 2006; Covusoglu *et al.*, 2004), and internal control weaknesses in general (without distinguishing between IT-related and non-ITCW) (Ittonen, 2010; Ashbaugh-Skaife *et al.*, 2009; Hammersley *et al.*, 2008; Ashbaugh-Skaife *et al.*, 2007; Ogneva *et al.*, 2007). What is missing in the literature is a study of the value of IT-related internal controls as perceived by the capital markets. This study addresses that gap in the literature through an event study that measures the market impact of reports of ITCW. The question addressed in this paper is: does the market understand the value of IT controls? More importantly, does the market differentiate between IT and non-IT internal control weaknesses? This is an important contribution because the reason to require reporting of internal control weaknesses is to alert the market of increased risk.

A second contribution is methodological in nature. IS researchers thus far have been using limited market benchmarks, statistical tests, and event windows in their respective event studies of market performance. This study shows the shortcomings of that approach and the necessity of expanding usage of available event analysis tools. By using more than one market benchmark and statistical test across multiple time frames, this study uncovers effects that using a single benchmark and test over a single window would have overlooked.

2. Background

Background on the SOX Act

The financial scandals of Enron, WorldCom, and others in the early part of the twenty-first century led to the passage of the Public Company Accounting Reform and Investor Protection Act of 2002 (commonly referred to as the SOX Act). The Act was passed as a measure to address the issues of corporate accountability and to stabilize the financial markets by restoring confidence in financial market processes. The law requires all SEC registrants and their auditors to independently report on the effectiveness of internal controls used to manage and handle financial reporting for a firm, including those related to IT. With a firm's IT systems being more interrelated with every facet of a firm's operations (Canada *et al.*, 2009), IT governance and auditing has now been brought to the forefront of every executive in charge of publicly reporting the financial results of their organization.

IT governance

Though IT often represents the most valuable and least understood set of assets, IT governance continues to be a challenge for key decision makers of many firms (Weill and Ross, 2005). Effective controls over IT systems are more critical in today's interconnected business environment. IT controls regulate IT applications, systems, platforms, environments and include access to systems, programs, and data; computer operations; and program development and change management. To comply with

Section 404 internal control assessment and reporting requirements, firms and auditors must construct a link between control objectives for financial reporting and control objectives for IT.

In 1992, the IT Governance Institute released the first version of the Control Objectives for Information and related Technology (COBIT), a framework of best practices and control objectives for the management of IT resources to provide information that firms need to achieve their objectives. Over time, COBIT has become the generally accepted internal control framework for IT. COBIT outlines two broad categories of IT internal controls, application and general. Application controls refer to those inside specific software systems that support business processes and financial reporting. For example, an accounts payable user role in SAP restricts access to only transactions necessary to process accounts payable functions, thus protecting against segregation of duties violations. General controls apply to all IS (i.e. the IT infrastructure) and are designed to ensure secure and uninterrupted operations. Examples include systems security, configuration management, data management, and operations. The vast majority of firms subject to SOX 404 requirements and their auditors choose to adopt COBIT as the approach for evaluating IT controls and reporting weaknesses in the 404 report.

Event studies and their application to IT and internal controls

A significant body of research in IT has utilized the event study methodology to examine the impact of a variety of IT-related activities on the market value of the firm. Chatterjee *et al.* (2001) examined the wealth effects of newly created CIO announcements. Agrawal *et al.* (2006) and Hayes *et al.* (2000) studied the market impact of outsourcing decisions and Daniel *et al.* (2009) looked at offshoring. The impact of e-commerce-related decisions was examined by Subramani and Walden (2001) and Dewan and Ren (2007). Dehning *et al.* (2003) studied the impact of "transformational information technology investments." Other researchers have examined the relationship of other aspects of IT investments and risk and return (Dewan *et al.*, 2007; Tanriverdi and Ruefli, 2004; Im *et al.*, 2001). In what may be the most relevant of IT investment to the current study, Jory *et al.* (2010) found that the stock market reacts favorable to firms that make IT investments related to SOX-related compliance. They also found that the results are stronger for companies that did not previously internal control weaknesses.

Other relevant studies utilized the event study methodology to examine the effect of IT control failures. Benaroch *et al.* (2012) refer to these as IT operational risk events. IT operational risk events include events that affect the confidentiality, integrity, or availability of IT assets. Benaroch *et al.* (2012) review 16 such studies including Acquisti *et al.* (2006) and Covusoglu *et al.* (2004). They note that the results are mixed, with nearly half the studies reviewed reporting no significant market reaction. Unlike other studies of IT operational risk events, Benaroch *et al.* (2012) linked the operational risk events to internal controls. They found that firms experiencing IT operational risk events suffer significant negative abnormal market returns and the negative returns were greatest for those firms who experienced events that compromised the availability of operational systems.

There are also event studies related to internal control weaknesses, in general, and to SOX compliance. Li *et al.* (2008) studied the market reaction to events surrounding the Sarbanes-Oxley Act of 2002. Ashbaugh-Skaife *et al.* (2009) and Beneish *et al.* (2008) found that internal control weaknesses resulted in significantly higher the cost of equity. Hammersley *et al.* (2008) found negative price reactions to the disclosure of internal control weaknesses. Ittonen (2010) found negative abnormal returns when management failed to identify or report the material weaknesses before the auditor.

The gap in the extant research that is addressed by this study is whether the market distinguishes between IT-related internal controls and non-IT-related internal controls: Is there a market reaction to reports of ITCW?

3. Theoretical foundation and development of hypotheses

This study draws on the efficient market hypothesis theory (EMH), a seminal theory well-established in capital markets research and it applies an event study research approach common to economics, accounting, finance, and IS.

EMH has provided the theoretical foundation for how capital markets function and are viewed for four decades. In its most basic form, the EMH asserts stock prices reflect information (Russel and Torbey, 2009) and investors act rationally. However, Malkiel and Fama (1970) distinguished between three forms of efficient market activity that evolved over time, each with its own staunch supporters. The first, referred to as the "strong" form, contends stock prices reflect all information, both public and private information; therefore, no one can earn excess returns since everyone has access to full information. The "weak" form claims that past stock prices and returns are reflected in current prices and can be used to identify over or undervalued firms to earn excess returns through the analysis of firm financial fundamentals as reported in the released financial statements but not through technical analysis (i.e. forecasting future through study of past market data) (Fama, 1991), whereas the "semi-strong" form implies stock prices rapidly adjust to include publicly available information such as financial statements, earnings statement dividend releases, mergers and acquisition announcements, and other publically available information from the market. Due to near-instantaneous incorporation of public information into stock prices, neither fundamental nor technical analysis can result in obtaining excess returns. Only by identifying private information can one gain an advantage over other market participants. This provides information which can be difficult to measure, difficult to obtain, and/or be viewed as illegal (i.e. insider trading). The semi-strong form of capital markets dominates empirical research but recent research utilizes the weak form as well (Russel and Torbey, 2009). Event studies, as we use and will be discussed shortly, rely on the assumption the market adjusts quickly to publicly released information, the core of the semi-strong EMH form.

In the market turmoil of the past few years, this theory has generated some doubt, and economists have shifted their allegiances to behavioral economics which provides insights into investor psychology. This theory relies on the belief that investors can be too confident in their own abilities and tend to follow trends as opposed to rational market models (MMs); this ultimately exaggerates the rise and fall of specific securities as well as the overall market. A third and emerging paradigm termed "adaptive markets hypothesis" (Lo, 2004) attempts to reconcile the two perspectives. The view suggests humans are neither fully rational nor just psychologically driven but instead, they make their best educated guesses and work by a trial and error approach. They follow the strategy that has worked for them before until it stops working. The market is not viewed as efficient but fiercely competitive and adaptive. As time and the environment changes, old strategies become obsolete and new strategies are needed. We argue the advent of SOX led to such a state of change and it is therefore important to examine market reactions to specific disclosures, in this case, IT control weaknesses.

Development of hypotheses

A significant body of research examined relationships of internal control weaknesses to corporate financial reporting, disclosures, and stock market effects (Ogneva *et al.*, 2007; Raghunandan and Rama, 2006; Doyle *et al.*, 2007a, b; Hammersley *et al.*, 2008; Li *et al.*, 2008). However, very little research to date explored the connection of IT governance and technology-based control weaknesses to overall firm performance, health, and shareholder value. Some related studies of note in the IS discipline include the Weill and Ross (2005) self-reported survey of IT governance design and firm profitability, asset utilization, and growth; the Canada *et al.* (2009) analysis of the effects of IT control weaknesses on the

fees charged by public accounting firms to their clients; the Ahuja *et al.* (2009) examination of the performance of IT governance efforts and key financial performance and health indicators (i.e. common accounting ratios); the Elbardan *et al.* (2015) development of a conceptual framework for how the internal audit function can respond to the implementation of ERP systems in light of increased corporate governance. No studies explicitly investigated the relationship of poor performing IT governance mechanisms and shareholder value. Therefore, opportunities exist to gain valuable insight into the relationship of IT controls to firm performance, health, and market value given the pervasiveness of IT throughout firms' business processes and the importance of IT to the generation of corporate financial statements.

Accounting-specific studies identified a correlation between poor stock price performance and the reporting of internal weaknesses, in general (Ittonen, 2010; Beneish *et al.*, 2008; Hammersley *et al.*, 2008; Li *et al.*, 2008), but not the specific relationship between IT governance deficiencies and market performance. This study addresses the void between the two research streams by analyzing whether the capital markets recognize and punish firms reporting IT internal control weaknesses with negative abnormal returns. First, a baseline was set for comparison by determining whether firms reporting any type of internal weakness experience worse stock price performance around the announcement of the weakness(es) through the filing of the annual report with the SEC than the broader market, as a whole. This leads to the first of three related hypotheses:

H1a. Firms reporting an internal control weakness will generate significant negative abnormal returns as compared to the market.

As noted by prior IT internal control weakness research (Ge and McVay, 2005; Carter *et al.*, 2012; Weill and Ross, 2005; Ahuja *et al.*, 2009), evidence shows a distinct and significant correlation between reported material IT weaknesses and poor financial performance and health relative to peer firms/competitors. Klamm and Watson (2009) found that firms with weak IT controls report more financial report misstatements than firms without IT-related weaknesses. In the Ahuja *et al.* (2009) study, firms reporting at least one IT weakness experienced a statistically significant worse financial condition and worse performance than a comparable set of firms reporting no internal control weaknesses: 49 percent lower current ratio (current assets over current liabilities), 25 percent higher debt ratio (total debt over total assets), 90 percent lower return on assets (ROA), and $1.23 lower earnings per share (EPS). Therefore, it is hypothesized that decisions by the investing community reflect awareness and effective information processing of this phenomena. The second sub-hypothesis analyzes whether the financial markets punish firms reporting material IT internal control weaknesses:

H1b. Firms reporting an IT internal control weakness will generate significant negative abnormal returns as compared to the market.

In order to adequately isolate and assign stock *H1b* price effects to weaknesses in IT governance, it was necessary to first determine if the effects are a result of merely the reporting of any type of internal control weakness or specifically those related to IT. Accounting research (Beneish *et al.*, 2008; Hammersley *et al.*, 2008; Li *et al.*, 2008) already identified a relationship between internal control weakness disclosure, in general, and poor stock price performance. For an appropriate comparison of firm market performance for IT weakness firms and non-IT weakness firms, it is necessary to determine the negative stock price effects for non-IT firms:

H1c. Firms reporting a non-IT internal control weakness will generate significant negative abnormal returns as compared to the market.

H1b provides evidence of whether the financial markets incorporate the reporting of IT governance weaknesses into investment decisions, but is this any different than the stock price effects for firms reporting only non-IT weaknesses? Are IT weaknesses treated any differently? In the Ahuja *et al.* (2009) study firms reporting at least one IT weakness experienced a statistically significant worse financial condition and worse performance than a comparable set of firms reporting only non-IT weaknesses: 24 percent lower current ratio (current assets over current liabilities), 17 percent lower debt ratio (opposite expectation), 56 percent lower ROA, and $0.40 lower EPS. Given the pervasiveness of technology in today's business environment and the poorer financial position/performance of IT weakness firms identified in recent research, the market is expected to evaluate IT weaknesses differently:

H2. Firms reporting an IT internal control weakness will generate a higher degree of significant negative abnormal returns as compared to firms reporting a non-IT internal control weakness.

4. Event study research methodology

The SOX requirement to publish internal control reports detailing the nature of material weaknesses commenced in 2004, resulting in financial statement and stock price data which can be used for empirical testing to quantify the relationship between IT controls and firm market value. The current study performs an event study examining the stock prices of firms in the time period surrounding an announcement of IT-related internal control weaknesses in the annual financial statements released to the SEC. Doing so uses the IT ICW announcement as a proxy for IT governance. Based on the EMH (Fama *et al.*, 1969), event studies provide researchers a robust tool to examine the strength of the correlation between individual firm events (e.g. release of critical information to the public) and the market value of the firm (McWilliams and Siegel, 1997). However, a great deal of debate exists in the financial domains, in both practice and academe, as to whether the stock markets are truly efficient and rational and whether any deviations are affecting broader market behavior (Thaler, 1999; Abarbanell and Bernard, 2000; Lee, 2001; Malkiel, 2003; Shiller, 2003). In this study, a baseline of firm performance and health based on accounting metrics is derived from a previous study (Ahuja *et al.*, 2009). Abnormal returns of firms reporting any type of internal control weakness are compared to the market return as a whole, firms reporting only IT weaknesses to the market, firms reporting only non-IT weaknesses to the market, and the abnormal returns of IT weakness firms to non-IT weakness firms. If the financial markets are truly efficient and rational then stock prices, which in theory reflect expectations of future firm earnings, should immediately incorporate released financial statement information. Stock prices and financial statement data should portray the same picture.

Event study methodology has been regularly used in the field of finance and accounting since the late 1960s (Fama *et al.*, 1969; Fama, 1991). Management research began to incorporate the methodology in the 1980s (Chatterjee, 1986), with IT research following shortly afterwards (Dos Santos *et al.*, 1993). Since 1993 various other IT studies have used the event study methodology (Hayes *et al.*, 2000; Im *et al.*, 2001; Subramani and Walden, 2001; Chatterjee *et al.*, 2001; Dehning *et al.*, 2003; Agrawal *et al.*, 2006; Dewan and Ren, 2007). As Dewan and Ren (2007) aptly note, the majority of IS event study research has concentrated on the wealth effects associated with specific technology initiatives. Their study being the exception, Dewan and Ren (2007) analyze both the wealth and risk effects associated with early electronic commerce initiatives and firm market value. This study extends the previous research in two ways. First, following Dewan and Ren's (2007) it focuses on risk, not the risk of IT investment in the traditional sense (e.g. investment in

electronic commerce), but rather the broader investment in IT controls and governance. Second, it delves into the methods of conducting event studies in IS research. It examines benchmarks, test statistics, and event windows employed in previous research and compare to best practices identified in quantitative methods research with the goal of investigating ways to improve on the event analysis method utilized in IS research thus far. Toward this goal, ten event studies published in premier IS journals were reviewed. Every single one of these studies utilized the MM with traditional parametric testing. Only one study (Chatterjee *et al.*, 2001) went further and compared MM results to the non-parametric Corrado's rank statistic test. In addition, these same studies examined very small event windows of fewer than 21 days. Limited windows are appropriate when sample sizes are small in order to retain sufficient power but can be relaxed with larger samples. Furthermore, most of the studies referenced MacKinlay (1997) to support various aspects of the research designs but none truly incorporated the trend analysis he advocated. Here, the cumulative abnormal returns (CARs) leading up to and surpassing the announcement of internal control weaknesses were examined. This improves researchers' ability to identify trends and patterns of market behavior that may differ pre- and post-event. In this specific study, the market significantly lowered stock returns for IT weakness firms (compared to both the market and non-IT firms) in the 21 days leading up to and including the event and that behavior discontinued post-event. Merely examining an equal sized window of days pre- and post-event may confound and hide these market behaviors.

5. Research model for IT control weakness reporting and market returns

This research study consists of three phases. First, firms reporting internal weaknesses in the 2004-2008 financial statements filed with the SEC were identified. Then, the firms were segregated into two groups, those reporting at least one IT-related internal control weakness (could be more than one, could be with other non-IT weaknesses) and those reporting only non-IT weaknesses. In the second phase, event studies were conducted to analyze the effects of releasing financial statements with internal control weaknesses on stock returns. Finally, comparison testing of stock returns for the two groups looking for different treatments by the market was performed.

Support for the proxy measure used to identify firms with internal control weaknesses is provided below. Why and how the event study methodology was used to analyze the data – specifically detailing the event used, the event window, measurement of abnormal returns (models and test statistics), and estimation window selected is then explained.

IT weakness measurement

To analyze IT weaknesses, a firms' internal control weaknesses as reported in financial statements filed with the SEC were identified. Internal control weakness reporting is used as a proxy of weakness in a firm's operation. By separating out the IT-related internal control weaknesses from the non-IT-related internal control weaknesses, it is possible to examine how financial markets treat IT weaknesses. Additionally, because internal control weaknesses are only reported to the financial markets through one document, the annual financial statement filing with the SEC, the internal control weakness announcement provides a solid proxy of what the market will do with IT and non-IT internal weaknesses.

The event and event window

As previously noted, SOX now requires all SEC registrants and their auditors to report on the effectiveness of internal controls over financial reporting, including those related to IT. Firms must report in their annual financial statement filings if management and/or their auditors found any weaknesses in internal controls over financial reporting. For the analysis

in this study, the events were separated into three groups: events where firms reported any type of internal control weakness, events where firms report at least one IT-related internal control weakness (even if also reporting non-IT weaknesses), and events where firms reported only non-IT-related internal control weaknesses.

Firms announce internal control weaknesses in two places of the annual filing with the SEC: Item 9 which includes management's report on internal control over financial reporting and in the auditor's independent report. As one of the changes occurring as a result of SOX, registrants must file within 75 days of the firm's fiscal year-end date (pre-SOX was 90 days) and this is the only place a firm must report identified control weaknesses. The subsequent annual report released to investors, investment analysts, etc., includes the same opinions on internal controls in addition to other pertinent firm information not included in the SEC filing. Therefore, the event for this study is defined as the annual financial statement filing date for the period examined. It should be noted, any subsequent filings for the same fiscal year (e.g. amended 10-K forms referred to as 10-KAs) were not included as an event. Subsequent filings generally result in the restatement of financials rather than revealing the identification of previously unreported internal control weakness in the original filing. The vast majority of internal control work by the external auditor occurs in the third quarter of a fiscal year in order to determine the level of comfort around controls which drives the amount of substantive testing necessary (i.e. weak controls = more tests of detail).

Choosing an event window is vitally important to the effectiveness of an event study. The window must be sufficiently long enough to capture the desired effect (i.e. the announcement of an internal control weakness). Using a small event window could miss the information leaked to the market through various means of signaling by the firm. Too large of an event window may result in the inclusion of unrelated effects from confounding announcements (e.g. mergers, stock-splits, analyst upgrades, etc.) that could influence any abnormal returns during the event window. This study used ± 20, ± 10, and ± 1 day event windows (i.e. X days before the event, the day of the event, and X days after the event). By looking at the 21 day window and the 3 day window surrounding the event (consistent with prior IS research, Chatterjee, 1986; Chatterjee *et al.*, 2001; Subramani and Walden, 2001), a full picture of the abnormal returns of the internal control weakness firms as compared to the rest of the market is captured while minimizing the effects of other events related to the firm that could possibly have taken place around the selected event date. Based on the power testing of event study sample sizes and event windows performed by MacKinlay (1997) and our large sample sizes (i.e. $>$ than 200) it is appropriate to include a longer event window. At first glance, one might wonder why days leading up to the event would and should be included in an event analysis. In a perfect world, no information related to the event comes to light until the event occurs (i.e. release of financial statements) and stock returns should not be affected prior to Day 0. However, information leakage does in fact happen, particularly related to financial statements (many investment analysts have direct access to firm executives and some firms hold periodic earnings conferences with investors and the media), thereby creating more of a reason to include a slightly longer event window. Therefore, the window is extended to 41 days which also allows us to perform trend analysis across time and analyze effects inside smaller windows leading up to and surpassing the event date (i.e. -20 to -10 day period, -10 to 0, 0 to $+10$, and$+10$ to $+20$).

Abnormal returns and estimation window

Event studies are used to measure abnormal returns. Abnormal returns to a firm are identified by comparing the firm's returns to the returns of a MM. As such, abnormal returns are a result of the consensus of a large number of investors. The abnormal returns signal the beliefs of the investors for what happens today will affect the results of the firm in the future. To calculate the effects of an event, it is necessary to calculate the normal return

of the market. The normal return acts as a baseline to determine the abnormal returns of the firms experiencing the event. An estimation window is used to determine what the normal return is for the market.

In calculating the CAR, an estimation period needs to be selected. Estimation periods typically range between 100 and 300 days (Peterson, 1989). A longer estimate period usually leads to a better estimate of the market's normal return since the standard error is lower (Cowan, 1992; Campbell *et al.*, 1997; Subramani and Walden, 2001). An estimated period of 255 days starting one day before the start of the event window (i.e. 21 days before the event date) was used. The event window is not included in the estimation period to prevent the event from influencing the normal performance model parameter estimate (Campbell *et al.*, 1997).

Three main benchmark models exist to compute daily abnormal returns: the MM, market adjusted returns (MAR) model, and comparison period mean adjusted abnormal returns (CPA) (Cowan, 2007; Baghai, 2009). The MM model is the most comprehensive procedure while MAR can be viewed as a more restrictive MM (MacKinlay, 1997). CPA is an alternative to both. It subtracts the mean return of the stock of the ith firm computed over the estimation period from its return on day t (Cowan, 2007). Researchers used these individually or in combination to provide a clearer, more exhaustive picture (Lease *et al.*, 1991; Hirschey and Richardson, 2002; Baghai, 2009). The main difference between MM and MAR is MM takes into account the risk factor of each firm (beta)[1] which may or not be appropriate for a particular study. Both models estimate what the return of the stock would have been if the event had not occurred. All three models are in the form of a regression formula, with the return of the stock being regressed against the return of the market index. The formulas for each model in calculating the abnormal returns are as follows (Cowan, 2007):

$$AR_{i,t} = R_{i,t} - \left(\alpha_i + \beta_i R_{m,t}\right) \text{(market model)}$$

$$AR_{i,t} = R_{i,t} - R_{m,t} \text{(market adjusted model)}$$

$$AR_{i,t} = R_{i,t} - R_i \text{(comparison period)}$$

where α_i and β_i are the coefficients for firm i; $AR_{i,t}$ the abnormal returns for firm i on day t; $R_{i,t}$ the returns to firm i on day t; $R_{m,t}$ the returns of the market on day t; and R_i the estimation period. The formula for calculating the CAR is as follows (McWilliams and Siegel, 1997):

$$CAR_{s,\tau} = \sum_{i=-\tau}^{\tau} AR_{s,i}$$

Brown and Warner (1980) show MAR performs as well as the more sophisticated MM model. Falk and Levy (1989) attribute the failing of MM to outperform MAR, not to the theoretical need for risk adjustment but rather to a poor definition and measurement of risk – possibly due to omitted variables, a market proxy effect, or some other specification errors. Larsen and Resnick (1999) find the combination of cross-sectional and bootstrapping statistical tests performs as well as, and sometimes better than, the traditional models (i.e. MM, MAR, CPA). Therefore, the EVENTUS system was used to analyze the abnormal market returns employing all three benchmark models tested normally as well as with a cross-sectional, bootstrapped test procedure.

EVENTUS reports both a parametric and non-parametric test statistic regardless of the model chosen. For parametric statistics, the data are assumed to be normally distributed,

whereas for non-parametric statistics, the assumption of normality is relaxed, as it is assumed that data are not drawn from a given probability distribution. The parametric test statistic is a Patell Z test (Patell, 1976) and the non-parametric test statistic is a generalized sign test (Cowan, 1992). The Patell Z test is a standardized abnormal return approach. It estimates a separate error for each security-event and then assumes cross-sectional independence between the events. The generalized sign test does not assume 0.5 for the positive abnormal returns as it adjusts the fraction of positive abnormal returns in the estimation period. The parametric test is more powerful under ideal conditions, but more sensitive to changes in the event window, changes in return variance, and low trading. Whereas, the generalized sign test accounts for these better deviations by taking into account the percentage of positive abnormal returns in the estimation period (Cowan, 1992). Since a standard event window based upon past literature (±20 day, ±10 day, ±1 day) was used and the stocks analyzed are highly traded on one of the major three US-based stock markets (NYSE, NASDAQ, and AMEX), only the Patell Z statistic and a cross-sectional, bootstrapped statistic were used. Numerous studies also used the Patell test (Linn and McConnell, 1983; Schipper and Smith, 1986; Haw *et al.*, 1990). The formula for the Patell Z statistic is as follows (Patell, 1976):

$$z_j = \frac{\sum_{t=T_{1_j}}^{T_{2_j}} \mathrm{SAR}_{jt}}{\left(L_j \frac{M_j-2}{M_j-4}\right)^{\frac{1}{2}}}.$$

where T_{1j} and T_{2j} are the two event dates specific to firm j; L_j the length of the event period in trading days; and SAR_{jt} the standardized abnormal return.

6. Data identification and collection

Firms started reporting internal control weaknesses with the 2004 financial statements. Using Audit Analytics, 1,788 instances of firms reporting internal control weaknesses between 2004 and 2007 (four years) were identified. After removing duplicates (i.e. subsidiary filings), the full population consisted of 1,642 records. Both COMPUSTAT and the Center for Research on Securities Prices (CRSP) databases were used to collect firm and stock market identifier information for the 1,642 records. Several firms reported more than once they had internal control weaknesses between 2004 and 2007. Therefore, for a unique event, the unique firm – fiscal-year identifier was used instead of just the firm as an identifier. Of the 1,642 unique firm – fiscal-year records pulled from Audit Analytics, CRSP found 1,426 firms that were traded on the NYSE, NASDAQ or the AMEX stock markets. CRSP removed 216 records because they did not have available trading data on the three stock markets. A sampling within the 216 firms showed these firms traded on over-the-counter bulletin boards. CRSP does not keep track of trading activity for firms trading on bulletin boards. Removing these firms from the sample is also supported theoretically, as bulletin board listings have a low volume of trading activity and low trading activity of a stock does not offer an efficient mechanism to analyze events (Fama *et al.*, 1969).

After identifying the records of firms reporting internal control weaknesses, the 1,426 records were loaded into EVENTUS to run an event analysis. The date on which the firm initially filed for the associated fiscal year was used as the event date. The market index was set to be equally weighted, with the estimation method being ordinary least squares. The estimate period settings were set to end before the start of the event window (i.e. 21 days before the event day), with the minimum estimation length being three days and the maximum estimation length being 255 days. All three benchmark models (MM, MAR, CPA) were run.

Using EVENTUS, separate analyses against the three models for all firms reporting internal control weaknesses (1,426 events), only firms reporting IT internal control weaknesses (276 events), and only firms reporting non-IT internal control weaknesses (1,150 events) were run. In running these separate analyses, events with insufficient trading data were eliminated from the analysis. In total, 64 events were removed in total at this stage by EVENTUS, of which 28 events were eliminated from the IT internal weakness group and 38 events were eliminated from the non-IT internal weakness group. This process left 1,360 total events with 248 events in the IT internal control weakness group and 1,112 events in the non-IT internal control weakness group. Table I shows the breakdown of the sample selection from initial identification in Audit Analytics to final records selected for use. In addition, Figure 1 breaks down the records by year and internal weakness classification (i.e. IT vs non-IT).

7. Event study results

Testing consists of several steps. First, the stock return effects of firms reporting internal weaknesses of any type, reporting at least one IT-related weakness, and reporting only non-IT weaknesses across several event windows using multiple testing techniques were analyzed. Second, the stock returns for the IT weakness firms were compared to the non-IT weakness firms. Finally, the results were examined collectively and additional analyses were performed across additional windows and for firms grouped at a more refined level.

Initial analysis

Through EVENTUS, the ±20, ±10, and ±1 day event windows for the various benchmark models with the standard Patell *Z* parametric and cross-sectional, bootstrapped statistics

	All ICW	IT ICW	Non-IT ICW
Records identified from audit analytics	1,788	379	1,409
Removal of records due to duplicates	(146)	(31)	(115)
	1,642	348	1,294
Removal of records due to firm not traded on NYSE, NASDAQ, or AMEX	(216)	(72)	(144)
	1,426	276	1,150
Removal of records due to lack of trading data	(67)	(28)	(32)
Total of sample used in event study analysis	1,359	248	1,112

Table I.
Sample selection

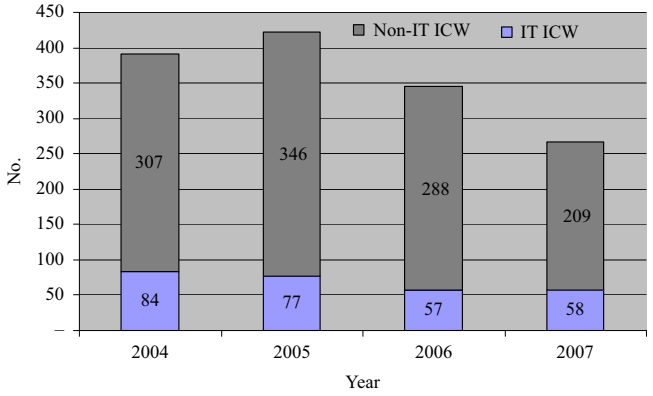

Figure 1.
Internal control weakness events

Source: Based upon fiscal year-end

were analyzed. The first hypothesis asserts firms reporting internal control weaknesses will experience negative stock returns in the time period surrounding the announcement. For *H1a* where all firms reporting weaknesses, regardless of weakness type were examined, the MM model reports 0.73 percent return over the market for the sample firms in the ± 20 day window, 0.41 percent for ± 10 days, and −0.17 percent for ± 1 day with no statistical significance for the Patell *Z* statistic and only significance at the 0.10 level for the cross-sectional (CSECT) bootstrapped statistic during ±20 days. This fails to support the hypothesis and contradicts previous research of both stock market and firm performance of firms reporting internal control weaknesses. The MAR and CPA models, on the other hand, strongly support the hypothesis. The MAR model reports −1.54 percent return below the market in the ±20 day window, −0.83 percent for ± 10 days, and −0.32 percent for ± 1 day with statistical significance for both the Patell *Z* statistic and CSECT across all windows. The CPA model reports −2.48 percent return below the market in the ±20 day window, −1.53 percent for ±10 days, and −0.36 percent for ±1 day with statistical significance for both the Patell *Z* statistic and CSECT across all windows. Table II presents the mean CARs estimated for all three windows.

H1b expects firms reporting IT weaknesses to experience negative stock returns compared to the market. The MM model reports 0.15 percent return over the market for the sample firms in the ±20 day window, 0.10 percent for ±10 days, and 0.48 percent for ±1 day with statistical significance for the Patell *Z* statistic at only the ±1 day window and no significance for CSECT. Once again, this fails to support the hypothesis and contradicts previous research of firm performance for firms reporting IT-related internal control weaknesses. Alternatively, the MAR and CPA models support the hypothesis. The MAR model reports −2.48 percent return below the market in the ±20 day window, −1.29 percent for ±10 days, and 0.36 percent for ±1 day with statistical significance for the Patell *Z* statistic during the ±20 and ±1 day windows and CSECT across the ±20 and ±10 day windows. The CPA model reports −3.15 percent return below the market in the ±20 day window, −1.84 percent for ±10 days, and 0.55 percent for ±1 day with statistical significance for the Patell *Z* statistic across all windows and CSECT across the ±20 and ±10 day windows. MAR and CPA support the hypothesis at the fringe of the event (±20 and ±10 days) but not immediately surrounding the release of financial statements containing information about the IT weakness (±1 day window). Table III presents the mean CARs estimated for all three windows.

Days	*n*	Mean CAR (%)	Patell *Z*	CSECT *t*
Market (MM) model, equally weighted index				
(± 20)	1,360	0.73	1.083	1.414****
(±10)	1,360	0.41	1.186	1.087
(±1)	1,358	−0.17	−0.506	−0.977
Market adjusted returns (MAR) model, equally weighted index				
(±20)	1,360	−1.54	−2.87**	−3.169***
(±10)	1,360	−0.83	−1.853*	−2.292*
(±1)	1,358	−0.32	−1.471****	−1.861*
Comparison period mean adjusted (CPA) model, equally weighted index				
(±20)	1,360	−2.48	−5.525***	−4.652***
(±10)	1,360	−1.53	4.938***	−4.018***
(±1)	1,358	−0.36	−2.437***	−1.988*

Notes: *,**,***,****Significant at 0.05, 0.01, 0.001 and 0.10 levels, respectively, using a one-tail test

Table II. CARs and test statistics for *H1a* (all weakness firms)

Days	n	Mean CAR (%)	Patell Z	CSECT t
Market (MM) model, equally weighted index				
(±20)	248	0.15	0.044	0.109
(±10)	248	0.10	0.160	0.119
(±1)	248	0.48	1.924*	1.137
Market adjusted returns (MAR) model, equally weighted index				
(±20)	248	−2.48	−1.884*	−1.945*
(±10)	248	−1.29	−1.280	−1.521***
(±1)	248	0.36	1.466***	0.879
Comparison period mean adjusted (CPA) model, equally weighted index				
(±20)	248	−3.15	−2.605**	−2.195*
(±10)	248	−1.84	−2.266*	−2.030*
(±1)	248	0.55	1.731*	1.243

Notes: *,**,***Significance at 0.05, 0.01 and 0.10 levels, respectively, using a one-tail test

Table III.
CARs and Test Statistics for *H1b* (IT weakness firms)

H1c anticipates firms reporting only non-IT weaknesses to experience negative stock returns compared to the market. The MM model reports 0.86 percent return over the market for the sample firms in the ±20 day window, 0.48 percent for ±10 days, and −0.31 percent for ±1 day with statistical significance for the Patell Z statistic during only the ±1 day window and significance for CSECT in the ±20 and ±1 day windows. These results fail to support the hypothesis and contradict previous research of firm performance for firms reporting IT-related internal control weaknesses for the ±20 and ±10 day windows; MM supports the hypothesis immediately surrounding the event (±1 day). The MAR and CPA models strongly support the hypothesis. The MAR model reports −1.33 percent return below the market in the ±20 day window, −0.72 percent for ±10 days, and −0.47 percent for ±1 day with statistical significance for both the Patell Z statistic and CSECT across all windows. The CPA model reports −2.33 percent return below the market in the ±20 day window, −1.46 percent for ±10 days, and −0.56 percent for ±1 day with statistical significance for both the Patell Z statistic and CSECT across all windows. MAR and CPA support the hypothesis for all windows. Table IV presents the mean CARs estimated for all three windows.

The results of the MM model fail to support the hypotheses and the MAR and CPA models strongly support *H1a* and *H1c* across all windows and *H1b* across the ±20 and ±10

Days	n	Mean CAR (%)	Patell Z	CSECT t
Market (MM) model, equally weighted index				
(±20)	1,112	0.86	1.178	1.551****
(±10)	1,112	0.48	1.237	1.142
(±1)	1,110	−0.31	−1.470****	−1.662*
Market adjusted returns (MAR) model, equally weighted index				
(±20)	1,112	−1.33	−2.284*	−2.548**
(±10)	1,112	−0.72	−1.445****	−1.814*
(±1)	1,110	−0.47	−2.320*	−2.507**
Comparison period mean adjusted (CPA) model, equally weighted index				
(±20)	1,112	−2.84	−4.880***	−4.101***
(±10)	1,112	−1.46	−4.390***	−3.480***
(±1)	1,110	−0.56	−3.513**	−2.858**

Notes: *,**,***,****Significant at 0.05, 0.01, 0.001 and 0.10 levels, respectively, using a one-tail test

Table IV.
CARs and test statistics for *H1c* (non-IT weakness firms)

day windows. The MM model directly contradicts previous research in accounting and IS literature regarding the stock market effects of reporting internal control weaknesses and overall financial health and performance of such firms while MAR and CPA consistently support extant work and expected market behavior. The sole exception lies in the reporting of IT weaknesses during the three-day window immediately surrounding release of the financial statements where stock returns of IT weakness firms outperform the market.

The second hypothesis asserts the pervasiveness of IT through business processes will result in IT weaknesses affecting the capital markets' view of such firms' earning potential more so than firms reporting only non-IT weaknesses. Subramani and Walden (2001) employed a student *t*-test to compare the mean CARs groups of interest of which also utilize. The results of the *t*-test shown in Table V using the MAR model show that IT weakness firms experience more negative abnormal returns than non-IT weakness firms for only the ±20 and ±10 day windows, but the difference is not statistically significant[2]. Furthermore, the stock returns of IT weakness firms outperform both the broader market and non-IT weakness firms during the three-day period around release of the financial statements. The surprising lack of statistically significant negative CARs for firms reporting IT weakness compared to non-IT firms combined with the observance of positive CARs (although weak significance) for the ±1 day window raises interesting questions about possible reasons. It is necessary to dig deeper into the market reaction to IT weakness announcements to possibly identify reasons for the observed market behavior.

Additional analyses

Test results fail to fully support the assertion that capital markets punish firms more severely for reporting IT weaknesses over traditional event windows. Following MacKinlay (1997), the stock return trend over a 41-day window for IT weakness and non-IT firms was examined. Rather than plot out the data points (cannot see statistical significance), the event studies were run over smaller windows: (−20, 0 and 0, +20 days) to isolate behavior pre-event and post-event to compare the CARs of the two groups via *t*-test. For IT weakness firms, the MAR model reports −3.30 percent return below the market in the (–20, 0) day window with statistical significance for both the Patell *Z* statistic and CSECT at the 0.01 level and a 0.84 percent return above market for the (0, +20) day window with no significance. The CPA model provides similar results. For non-IT weakness firms, the MAR model reports −0.86 percent return below the market in the (–20, 0) day window with statistical significance for both the Patell *Z* statistic and CSECT at the 0.05 level and a −0.68 percent return below market for the (0, +20) day window with significance for both Patell *Z* (0.10 level) and CSECT (0.05 level). The CPA model provides similar results. This clearly indicates the market punishes both types of groups leading up to and including the event day with IT weakness firms bearing the brunt. The direct opposite occurs on the event day and after where IT weakness firms neither outperform nor underperform the market but does appear to outperform non-IT weakness firms. Are the differences before and after the event between groups statistically significant? For the (−20, 0) day window, the −2.44 percent difference in the mean CARs using MAR is significant ($t = 2.640$, $p = 0.008$)

Event window	Mean CAR: IT events ($n = 248$) (%)	Mean CAR: non-IT events ($n = 1{,}112$)	Difference in mean CARs (IT – non-IT)	*t*-statistic
(±20)	−2.48	−1.33%	−1.15%	0.917
(±10)	−1.290	−0.722%	−0.568%	0.608
(±1)	0.365	−0.473	0.838%	−1.883*

Note: *$p < 0.10$

Table V.
Comparison of mean CARs between IT and non-IT internal control weakness events (MAR model)

supporting the notion IT weakness firms experience a greater decline in stock returns leading up to release of the financial statements. The CPA model provides similar results. For the (0, +20) day window, the 1.517 percent difference using MAR is not significant but very close ($t = -1.593$, $p = 0.111$) and is significant using CPA but barely ($t = -1.665$, $p = 0.096$). All in all, this additional trend analysis shows different treatment by the market pre- and post-event for IT weakness and non-IT firms. What could be the reasoning?

A possible explanation could lie in the inherent pervasiveness of IT in business processes as noted by Canada *et al.* (2009). IT problems can be costly, take a great deal of time to correct, indicate larger organizational issues, and directly affect a firm's ability to successfully and timely close their financial books, generate financial statements, and file annual reports with the SEC. Missing the SEC filing date historically signals to the market a firm is in distress and subsequently the firm experiences an instant drop in share price. Typically, firms announce they will miss the filing shortly before the deadline. One could assume IT firms filing late would experience a decline in share price right up to the point of actually filing, hence the significant negative abnormal returns leading up to the event date. Once the firms finally file, the market might be satisfied and discontinue driving down stock prices. That might explain the statistically significant positive CAR for IT weakness firms in comparison to both the market and non-IT firms after Day 0.

To examine this possible explanation, further analysis was done on the filing dates and returns for the IT and non-IT weakness firms. IT internal control weakness firms took 119 days to file on average as compared to 93 days to file for non-IT internal control weakness firms; note, the SEC deadline is 75 days after the end of a firm's fiscal year. The IT internal control weakness firms also exhibited a higher variation in the number of days to file as compared to the non-IT internal control weakness firms. The difference of means between the two groups for the days to file was 26 days ($t = 5.844$, $p < 0.001$) indicating the IT weakness firms filed significantly later than the non-IT firms (see Table VI for details). At first glance this provides promising evidence to support the proposed explanation. However, it seemed necessary to examine even further and compare the CARs for IT weakness late filers to the non-IT late filers. IT weakness firms experienced −3.00 percent return below market using MAR for the (−20, 0) day window and 1.29 percent for the (0, +20) day window – the first statistically significant for both the Patell Z statistic (0.01 level) and CSECT (0.01 level) and no significance for the latter window. Non-IT weakness firms experienced −1.56 percent return below market using MAR for the (−20, 0) day window and −0.89 percent for the (0, +20) day window – the first statistically significant for both the Patell Z statistic (0.10 level) and CSECT (0.01 level) and significance for only CSECT (0.10 level) for the latter window. CPA provides similar results. The percentages of the two groups align with the proposed explanation but unfortunately comparison of the mean CARs for the two groups failed to provide statistical significance thus relegating this explanation to an unsubstantiated conjecture.

Given the mixed results of this study relative to extant literature, some interesting questions related to the market assessment of IT governance arise: is it possible for the market to be efficient while incorporating IT weaknesses in firm valuations? Are market participants unable to comprehend how to deal with IT weaknesses? If so, why and how

Group	n	Mean days to file	SD
IT ICW events	249	118.63	87.781
Non-IT ICW events	1,113	92.60	56.733
t-statistic	5.84***		

Note: ***$p < 0.01$

Table VI.
Comparison of mean days to file

could this be changed? Does the market fundamentally not care about IT weaknesses? If not, should they? The study also implies that event study research in IS should expand the tools for analysis to include multiple benchmark methods, test statistics, and event windows.

8. Discussion of results and implications

This research study analyzed how capital markets react to the announcement of internal control weaknesses included in the financial statements filed annually with the SEC. Prior accounting and finance research identified a correlation between announcement of internal weaknesses and negative abnormal stock returns surrounding the announcement. In the first set of hypotheses, a baseline was set by first confirming the correlation between internal control weaknesses and stock returns by employing the event study methodology. Then, previous research was extended by analyzing two groups of firms (those reporting at least one IT weakness and those reporting only non-IT weaknesses) to determine if and how the market reacts to the two types of problems. Adhering to extant literature on event study methodology, multiple event windows (the broadest being 41 days) were examined using three benchmark methodologies (MM, MAR, CPA) and two statistical tests (Patell Z and cross-sectional, bootstrapped). The MM model failed to support any of the hypotheses in the first set (*H1a-H1c*) and directly contradicted recent research examining the same phenomena. The MAR and CPA models strongly support the view that internal control weaknesses, of any type (*H1a*), are correlated with negative abnormal stock returns across all three event windows examined. These two models provide support for the anticipation that IT weakness firms (*H1b*) would generate negative abnormal returns for the ± 20 days and ± 10 day windows but surprisingly not during the ± 1 day window. Like *H1a* results, the MAR and CPA models strongly support the assertion that non-IT weakness firms (*H1c*) would generate negative abnormal returns.

In the second hypothesis, the stock returns for the IT weakness firms were compared to the non-IT weakness firms to assess whether the market views IT governance issues more severely given recent research confirming firms reporting IT governance problems experience worse financial performance and health. Using the MAR and CPA models, the mean CARs for the two groups of firms were compared across the three event windows examined in the first set of hypotheses. The tests indicate that IT weakness firms experience more negative abnormal returns than non-IT weakness firms for only the ± 20 and ± 10 day windows, but the difference is not statistically significant. Ironically and contrary to expectations, the stock returns of IT weakness firms outperform both the broader market and non-IT weakness firms during the three-day period around release of the financial statements.

In the hopes of gaining insight into the lack of market effects for the announcement of IT weaknesses, the time period leading up to and including event day $(-20, 0)$ and the period including and after the event $(0, +20)$ were examined. Test results using the MAR and CPA models clearly identify negative abnormal returns for both groups leading up to the release of the financial statements and IT weakness firms experienced a statistically significant greater decline in returns than non-IT firms. The period following the announcement found no difference from the broader market for IT firms and significant underperformance by non-IT firms compared to the market. Relative to each other, non-IT firms marginally underperform the IT firms in this timeframe. The results indicate the market treats firms reporting IT weaknesses and only non-IT weaknesses differently before and after release of the financial statements. This prompted us to consider why this effect exists. IT processes permeate firms' business processes so when such problems exist they can be difficult, costly, and time-consuming to remedy and this also suggests larger organizational concerns. All of this can lead to firms not filing financial statements on time. The market would naturally revalue firms downward for not filing on time. Testing reveals that firms

reporting IT weaknesses filed, on average, 26 days later than non-IT firms (significantly different). Extracting out only the late filers from each of the two groups and comparing the mean CARs for the time before and after the event revealed IT firms filing late experienced more negative abnormal returns for the (−20, 0) window, but not statistically significant. As previously noted, the mixed results for the market reactions to the announcement of IT-related internal control weaknesses raise a variety of questions that are discussed below after considering the study's limitations.

This study tried to isolate the effects of firms announcing their internal control weaknesses. Given the annual financial statement filing is the only place and time where firms officially inform the public about identified internal control weaknesses, using the event study methodology seems to be an adequate method to analyze our hypotheses. However, it is nearly impossible to completely isolate the effects of control weaknesses on market perceptions since the financial statements contain a great deal of other information which might drive the results. Furthermore, this study is susceptible to the limitations that affect all event studies relying on market share prices. First, the imputation of abnormal returns to events is based on the assumption that markets are efficient (which is being questioned lately) and that the events were surprises and therefore unanticipated by the market (Subramani and Walden, 2001); information leakage happens. Our event windows were extended in the hopes of capturing such information dissemination. Second, the longer event study windows that were analyzed (i.e. ±20 and 10 days) risk lowering the power of the tests. This was mitigated by using large sample sizes as recommended by MacKinlay (1997). Related research employing the same approach reported consistent results supporting our research design and hypotheses (Beneish *et al.*, 2008; Hammersley *et al.*, 2008; Li *et al.*, 2008).

As previously mentioned, the results of the study raise some interesting questions for both practice and academe about the market and the use of event studies in IS research. First, let us discuss the market. Ardent opposition exists to all forms of the EMH, particularly by behavioral economics, finance, and accounting researchers. The 1980s saw a collection of research findings identifying anomalies in market performance that starkly contradicted any of the forms of EMH (Shiller, 2003). Shiller (1981) and LeRoy and Porter (1981) applied volatility tests to stock prices and bond markets, respectively, designed specifically to test for rationality. Both studies identified statistically significant fluctuations in prices not accounted for by the EMH. This research spawned additional volatility studies (West, 1988; Cochrane, 1991) confirming the results of these two studies which were summarily dismissed and criticized (Ackert and Smith, 1993). Ironically, Shiller (2003) admitted, through his own research and that of others, the price-dividend ratio (a fundamental analysis tool) is a strong forecaster of future changes in individual stock dividends. However, substantial unexplained bubbles in the market still exist. In the subsequent decade, a shift in focus occurred away from the econometric analysis on stock prices, dividends, and earnings toward an attempt at explaining the unexplained market anomalies through psychology and sociology approaches. The field of behavioral finance was born, setting up a distinct dichotomy in views of the nature of capital markets behavior continuing to this very day. This begs the question; could the market be inefficient when evaluating the impact of internal control weaknesses on future firm performance and financial health by mispricing stocks? Recent research and this study clearly show firms reporting control weaknesses experience significantly worse financial performance, health, and stock returns. Therefore, the financial statement data and stock return effects align supporting the EMH. Based on this, the question arises: is the market unable to comprehend how to interpret and value IT weaknesses or do they even care? The work of Weill and Ross (2005) and Ahuja *et al.* (2009) clearly showed a correlation between poor IT governance and poor financial performance and health in comparison to firms reporting no internal

control weaknesses and those reporting only non-IT weaknesses. The market should most definitely care. Given the fact financial performance suffers significantly yet the market fails to react accordingly, market participants simply may not be trained or experienced in the nuances of IT governance and its broader impact on firms' business processes and overall performance/health. IT weaknesses were rarely ever reported in auditor reports before SOX 404 requirements went into effect for accelerated filers in 2004 and only later include foreign registrants and smaller firms. This study was based on four early years of experience interpreting IT control weaknesses. Future research opportunities exist to identify why there is not a more consistent market reaction before and after announcement of IT weaknesses. Behavioral researchers might want to conduct an experiment with investment analysts presenting case scenarios with varying control weaknesses (even among IT) and financial statement data. A myriad of pertinent and valuable cross-discipline studies could be conducted.

This study also contributes by demonstrating the value of utilizing multiple market benchmarks, statistical tests, and windows in IS event studies. As mentioned before, quantitative methods research has called into question the efficacy of the MM benchmark method for event studies (Brown and Warner, 1980; Falk and Levy, 1989; Larsen and Resnick, 1999) and advocated the use of other methods. In response to this call, all three of the traditional methods (MM, MAR, CPA) along with both the traditional Patell Z test statistic and a cross-sectional, bootstrapped test procedure were used. This afforded an opportunity to compare and contrast results under varying methods. It was determined the MM model offered results in direct contradiction of current related research (not even confirming previous studies on market effects of announced internal control weakness) and our expectations while MAR and CPA provided consistent results. This should be of interest to IS researchers engaged in conducting, reviewing, or understanding the results of event studies. A review of ten event studies in premier IS journals found that every single one utilized the MM model with traditional parametric testing. Chatterjee *et al.* (2001) went a bit further and compared MM results to the non-parametric Corrado's rank statistic test. In addition, these same studies examined very small event windows, nothing beyond 21 days (±10). This is appropriate when sample sizes are small in order to retain sufficient power but can be relaxed with larger samples. Furthermore, most of the studies reference MacKinlay (1997) to support various aspects of their research designs but do not incorporate his trend analysis. By examining the CARs leading up to and surpassing the announcement of internal control weaknesses, this study was able to identify a trend where the market significantly lowered stock returns for IT weakness firms (compared to both the market and non-IT firms) in the 21 days leading up to and including the event. Without the trend analysis, it would not have been possible to identify this phenomenon. Based on the results and lessons from this event study, researchers are advised to include the use of multiple benchmark methods, statistical tests, and event windows looking for consistent results and potentially enlightening discoveries.

9. Conclusion

The purpose of this study was to examine the relationship between ITCW and firm performance in terms of abnormal market returns. The importance of this effort lies in the passage of the SOX Act of 2002 that now requires companies to report internal control weaknesses over financial reporting, including technology controls. The financial markets have never needed to evaluate the impact of IT on business to this extent before. Sufficient time has now passed to gather longitudinal data to examine how financial markets value IT governance, the major contribution of this study.

The second contribution is methodological in nature. IS researchers employing event study methodology thus far have primarily been relying upon only one benchmark,

one statistical test, and limited windows (in days) to examine market performance. This study discusses and presents empirical evidence of the shortcomings of that approach. This study shows that using more than one market benchmark and more than one statistical test across multiple time frames uncovers effects that using limited event study tools would have overlooked.

Using multiple event windows and three benchmark methodologies (MM, MAR, CPA), the findings of this event study confirm the correlation between internal control weaknesses and stock returns. The models strongly support the view that internal control weaknesses, of any type are correlated with negative abnormal stock returns across all three event windows examined. The models support the expectation that IT weakness firms would generate negative abnormal returns for the ±20 and ±10 days windows but surprisingly not during the ±1 day window. Further, strong support for the assertion that non-IT weakness firms would generate negative abnormal returns was found. This study also empirically examined whether firms reporting IT governance problems experience worse financial performance and health. Ironically and unexpectedly, the stock returns of IT weakness firms outperform both the broader market and non-IT weakness firms during the three-day period around release of the financial statements, raising critical questions about the markets' understanding of IT governance issues.

Our results indicate the market treats firms reporting IT weaknesses and non-IT weaknesses differently before and after release of the financial statements. While studies Weill and Ross (2005) and Ahuja *et al.* (2009) clearly demonstrate the relationship between poor IT governance and financial performance and health, the question becomes whether the markets are able and willing to interpret the value of IT in corporate governance. The finding that the markets fail to react to IT weaknesses suggests that IS researchers need to do a better job of educating the market participants of the impact of IT governance on firms' business processes and overall performance.

We should view this gap as an opportunity to identify and rectify the reasons why this is the case so that firms are motivated to govern IT with the seriousness that is warranted by its importance. Below, we discuss several research questions to which that this study leads us:

RQ1. First, given that the market responds favorably to the IT weaknesses, do managers see this as a cost center as opposed to an investment?

RQ2. Survey – what do managers think about IT in general? Why do not they think it is not important? What are the barriers that prevent managers from seeing this issue clearly? Are these barriers the same in service industry and manufacturing or are they different?

RQ3. Examine how these barriers can be managed. Are they real or perceived? Are they different for different industries and sizes? Ask managers what we IT researchers can do to communicate the importance of these.

RQ4. Examine the relationship between IT and business processes. While this relationship is assumed, it has not been systematically examined.

RQ5. Study long-term effects of IT weaknesses on business performance. We may be able to project a specific or a range of lag between IT weaknesses and effect on business performance. Also, we may be able to determine contingency variables that can influence this lag. For example, size and industry – that is it may show up immediately in smaller firms but after a lag of two to three years in established businesses.

RQ6. Study long-term effects of IT weaknesses on other weaknesses – similar to above.

Notes

1. For a further analysis and comparison of benchmark methods, see Cowan (2007).
2. Table V displays only the results for the MAR model. CPA model provides similar results.

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Corresponding author
John R. Kuhn can be contacted at: jrkuhn71@gmail.com