META-STANDARDS AND ORDER-QUALIFIERS: AN EVENT STUDY OF THE IMPACT OF ISO 9000 CERTIFICATION ON THE MARKET VALUE OF A FIRM

By

Stephen John McGuire

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David M. Dilts

Craig M. Lewis

To the Big Easy, whose essence lives on in the hearts and souls of those I love.

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CHAPTER I

INTRODUCTION

ISO 9000 is a set of international meta-standards that provide management requirements for creating and maintaining company quality systems. Despite the prevalence of the standards, existing literature is sharply divided over whether ISO 9000 is ultimately good or bad for companies (Anderson, Daly, & Johnson, 1999; Beirão & Sarsfield Cabral, 2002; Corbett, Montes-Sancho, & Kirsch, 2005; Docking & Dowen, 1999; Hoyle, 1994; Huarng, Horng, & Chen, 1999; Huarng & Lee, 1995; Juran, 1995; Kanji, 1998; Lima, Resende, & Hasenclever, 2000; Martinez-Costa & Martinez-Lorente, 2003; Nicolau & Sellers, 2002; Subba Rao, Ragu-Nathan, & Solis, 1997; Uzumeri, 1997). For firms that voluntarily pursue certification, a common method to justify initial costs is the potential to create significant economic value through quality improvement in accordance with a set of international quality assurance standards (Anderson, et al., 1999). However, even articles in the popular press have cast doubt on this claim and have offered evidence that ISO 9000 is not a guarantee of product quality or market value for the firm (Milbank, 1994). Therefore, a question arises as to whether there is sufficient justification for a firm to pursue a program that carries with it no guarantee of external value despite often large up-front costs spent demonstrating to external auditors conformance to a set of minimum quality requirements. This thesis will shed light on this critical issue by determining if an ISO 9000 certification announcement has an impact on the market value of a firm.

Despite the confusion over the value of ISO 9000, the standard has evolved over the past eighteen years from a means to harmonize disparate European regulatory bodies into a global meta-standard in almost 150 countries (International Organization of Standardization, 2003; Zuckerman, 1994). Older versions of the standard actually delineated three separate quality certifications, ISO 9001, 9002, and 9003. ISO 9001:1994 was the most comprehensive of the three quality assurance models, ISO 9002:1994 was an abbreviated model available only to firms engaged in production and installation activities, and ISO 9003:1994 was the least comprehensive and available only to firms engaged in testing and final inspection activities (Ragothaman & Korte, 1999). On December 15, 2000, a revised set of standards known as ISO 9001:2000 was officially released and combined the three 1994 standards into one (Cianfrani, Tsiakals, & West, 2001). As ISO 9000 has spread worldwide, it has also become part of the global supply chain and is increasingly becoming a requirement for doing business particularly in Europe, where certification is a means of obtaining the CE Mark, a regulatory seal for products critical to public safety (Anderson, Daly, & Johnson, 1995). In the United States, the Department of Defense, Department of Energy, Food and Drug Administration, and the Federal Aviation Administration all have adopted varying degrees of ISO 9000 as a supplier requirement (Anderson, et al., 1995). Many firms have followed suit and demand that their suppliers become certified (Anderson, et al., 1999; Subba Rao, et al., 1997).

ISO 9000 is widely disseminated, but certification is by no means an easy or routine process for most firms. Implementation has been criticized as being time consuming and costly; collecting the documentation and completing the application very

often takes more than one year, and the required third-party audit may take several days to complete (Curkovic & Pagell, 1999). Companies incur costs for auditors, training, and the associated lost time due to the training requirements and interviews by both internal and third party auditors (Arnold, 1994; Cianfrani, et al., 2001). Because of the substantial required investment, the choice to implement ISO 9000 for many firms is not a decision to be taken lightly absent market or political pressures.

CHAPTER II

LITERATURE REVIEW

Criticism and Praise for ISO 9000

Past literature has heaped both exuberant praise and harsh criticism upon the ISO 9000 standards. Perhaps the most common criticism of the standard is the extensive documentation often associated with its implementation and the potential for certification to become "consultant-driven paperwork" (Huarng, et al., 1999, p. 1024). The certification process involves documenting the processes within a firm, and the risk of systemizing poor processes is often a concern (Australian Manufacturing Council, 1992). Furthermore, when a firm is pressured into attaining ISO 9000 registration, there is a possibility of short-term quality improvements for the certification process, but that performance could be the result of resource and effort loading that may be unsustainable. In such cases, certification is a "hollow achievement in the long run" (Terziovski, Samson, & Dow, 1997, p 4). The potential for only short-term improvement prompted Hoyle (1994) to state that ISO 9000 is only a beginning step to an effective quality program. Past empirical evidence suggests that ISO 9000 certified companies have a higher cost of quality and fewer new products than similar non-registered firms (Terziovski, et al., 1997). Similarly, Uzumeri (1997) suggests that a meta-standard like ISO 9000 might actually slow innovation within a firm.

Praise for ISO 9000 is rooted in some of the same parameters that also lead to its criticism. Systemization as a means to reduce process variation in a firm is a potential

benefit of ISO 9000 certification (Huarng & Lee, 1995). Extensive documentation can actually be beneficial (Anderson, et al., 1995, Beattie & Sohal, 1999), as such information can provide managers with detailed information about the processes of the firm, leading to fact-based decision making rather than assumptions that can introduce stochastic system behavior and associated risk (Arnold, 1994). While ISO 9000 is not a complete model of total quality management (TQM), the standard is compatible with TQM and can serve as a baseline for further quality initiatives (Arnold, 1994; Juran, 1995; Kanji, 1998).

Comparison of ISO 9000 and TQM

During the evolution of ISO 9000 as a worldwide meta-standard, much of the associated literature has addressed the similarities and differences between the ISO 9000 standards and the concepts of TQM. While there has been some disagreement to the extent of correlation between the concepts, there are a few points of consensus. ISO 9000 is not the same as or a substitute for TQM, even though there are some shared characteristics (Subba Rao, et al., 1997). ISO 9000 may best be described as either a subset or minimalist approach to TQM (Curkovic & Pagell, 1999; Hoyle, 1994; Kanji, 1998). Nicolau and Sellers (2002) state that certification is a guarantee of a minimum set of requirements, while Martinez-Costa and Martinez-Lorente (2003) describe registered firms as being in accordance with a generic norm. Docking and Dowen (1999) state that obtaining an ISO certificate is like getting a regulatory seal of approval on a process, not a product. Attaining certification may signal the achievement of meeting a specified standard, but the standard itself is not necessarily a signal of quality achievement.

Total quality management, on the other hand, emphasizes continuous improvement, not just meeting a baseline standard (Kanji, 1998). The ultimate goal of the concepts of TQM is providing an added economic value through what Deming (1986) calls "delighting the customer." TQM is associated with customer satisfaction, continuous improvement, fact-based decision-making, and people-centered management for the purposes of business excellence, not business standardization (Kanji, 1998). There is no single definition of total quality management, just as there is no one definition of quality because it is highly non-quantitative and changes over the course of time and business enterprise (Tobin, 1990). Many researchers have attempted to operationalize the construct of TQM, and a complete discussion of this body of work is beyond the scope of this paper. A few typical examples are included here for descriptive purposes. Samson and Terziovski (1999) provide a list of several key components of TQM: leadership, management of people, customer focus, use of information and analysis, process improvement, and strategic and quality learning. Easton and Jarrell (1998), in their study of the effects of TQM on business performance, identify key characteristics based on the criteria of the Malcolm Baldrige National Quality Award. Similarly, Hendricks and Singhal (1996, 1997b, 2001a, 2001b) use the winning of a quality award, whether from an independent source like the Baldrige or supplier awards, as a proxy for TQM implementation. Regardless of the constructs used to describe TQM, it is widely agreed the successful TQM implementation is associated with above average quality achievement.

Despite the disparate views in the literature between ISO 9000 and TQM, they are somewhat correlated and are not completely separate constructs. ISO 9000 may be

viewed as a first step of quality usually associated with accordance to technical specifications (Crosby, 1979), while TQM is a more robust and developed customer oriented approach (Deming, 1986). ISO 9000 certification can be used as a foundation for further quality improvement (Kanji, 1998). Even quality guru Joseph Juran (1995) does not dismiss ISO 9000 certification but states that firms must go beyond the minimum standard in order to be highly effective. However, a survey of 700 firms in a broad range of industries during that same year shows that only 7% see ISO 9000 as part of an overall TQM strategy (Taylor, 1995).

An alternative view consists of determining the difference between an order-winner and an order-qualifier (Hill, 1993). Hill states that qualifiers are the set of criteria that a firm must meet in order to be considered in the marketplace. Order-winners are those criteria that actually win orders or generate sales. Qualifiers are the set of minimum requirements that allow a firm to compete but do not guarantee market success, and order-winners are the separate criteria that determine success. Using an analogy from the sports world, the order-qualifiers for a hockey team would be the presence of 6 players, padding, and sticks. The order-winners would be teamwork, good communication and most importantly, the ability to score goals. In the realm of quality management, ISO 9000 certification would be an order-qualifier for effective quality, particularly in industry sectors with tight regulatory requirements. Being ISO 9000 certified allows a firm to compete within the market, but it is no guarantee of market success. The order-winners in this situation might be outstanding performance quality or delighting the customer, which do not guarantee but contribute greatly to added economic value and market success. Qualifiers are not necessarily less important than winners, but

they are fundamentally different. To offer qualifiers, a firm must only be as good as its competitors, but to offer winners, it must be better than the competition (Hill, 1993).

Financial Impact of TQM and ISO 9000

A few researchers have empirically observed the effects of total quality management on the financial performance of a firm. Using the winning of a quality award as a proxy for TQM implementation, Hendricks and Singhal (1996, 1997b, 2001a) published a series of studies that use the event study methodology to determine the impact of winning that award. In the short term around the announcement of winning an award, firms experience an abnormal increase in stock prices of about 0.6% and more pronounced reactions for smaller firms or firms that won awards from independent organizations like the Baldrige (Hendricks & Singhal, 1996). For long-term stock prices, award winning firms outperform a control group by about 40% in the five years following the award. In a ten year period ranging from six years before to three years after winning an award, award-wining firms have significantly higher operating income, sales growth, capital expenditures, asset growth, and employment growth than a control group (Hendricks & Singhal, 1997b). Smaller firms, more diversified companies, less capital intensive firms, and independent award winners exhibit higher changes in operating income (Hendricks & Singhal, 2001a). Instead of using quality awards, Easton and Jarrell (1998) developed a survey to identify firms that have implemented TQM and verified their findings with follow-up interviews. They report similar results of TQM firms outperforming a control group on both accounting variables and excess stock returns. Higher degrees of out performance were observed for more mature TQM

programs and manufacturing firms. Samson and Terziovski (1999) also used a carefully developed TQM construct and report that leadership, management of people, and customer focus are the strongest significant predictors of operational performance in 1200 Australian and New Zealand manufacturing organizations.

However, empirical observations on the financial impact of ISO 9000 certification have yielded inconsistent results. Past researchers have researched the impact of ISO 9000 registration on both stock price and accounting variables. With regard to accounting metrics, Corbett, et al. (2005) report that three years after certification, ISO 9000 registered firms exhibit a significant increase in return on assets, return on sales, intangible assets, sales growth, and the sales to assets ratio. Simmons and White (1999) observed a sample of 63 certified electronics companies and report higher profitability versus a non-certified control group but no significant difference in the sales to equity ratio. On the other hand, Lima, et al. (2000) using a similar methodology as Easton and Jarrell (1998) to determine the effects of ISO 9000 registration on both financial and stock price parameters, observed a significantly higher sales to assets ratio in their sample of 129 certified Brazilian firms. A caution with these results is that research that tests the impact of ISO 9000 certification on only accounting variables may be affected by the fact that accounting procedures are not uniform among all companies and are determined by each individual firm's financial officers (Benston, 1982; McWilliams & Siegel, 1997). Depending on each firm's accounting management techniques or on the relative extent of over-reporting earnings between certified and comparable firms, a conservative bias may be introduced into the results. It is important, then, to determine if improvements in the internal measures of production economics correspond to improvements in external

measures of firm performance, including shareholder value, that are more universal in nature.

Other empirical studies on the external financial effects of ISO 9000 registration have taken the form of event studies measuring the degree of abnormal stock price returns. Anderson, et al. (1995) found no significant positive wealth effect on the stock price of a sample of 221 American firms during a short term period centered on when the company's registration became official, while Docking and Dowen (1999), using a sample of 252 American firms who had achieved their first certificate observed significant positive abnormal stock prices only for smaller firms. Several smaller international studies with limited sample sizes also report conflicting results. In a sample of 30 Spanish companies, the stock market exhibited no abnormal reaction to the official ISO 9000 registration date (Martinez-Costa & Martinez-Lorente, 2003). However, whenever a Spanish firm publicly announced that it had received a quality certification based on ISO 9000[1], the market reaction was positive and significant (Nicolau & Sellers, 2002). Similarly, Beirão and Sarsfield Cabral (2002) report that for a sample of 13 Portuguese companies, the market favorably anticipates ISO 9000 certification announcements by 4 trading days.

Past TQM studies have observed firms that have shown above normal performance as judged by independent award criteria (Hendricks & Singhal, 1996; Hendricks & Singhal, 1997b; Hendricks & Singhal, 2001a), exceptional supply capabilities as evidenced by supplier awards (Hendricks & Singhal, 1996; Hendricks & Singhal, 1997b; Hendricks & Singhal, 2001a), or high TQM performance based upon

[1] Previously mentioned studies observed the market reaction during the official registration date. Subsequent studies mentioned in this chapter observe the reaction to a public news announcement, which is not necessarily concurrent with the official registration. For further details, see Chapter V.

rigorously developed academic constructs (Easton & Jarrell, 1998; Samson & Terziovski, 1999), but the market may perceive attainment of a minimum certification like ISO 9000, for which there is no guarantee of exceptional quality, quite differently. Overall, the existing literature is sharply divided over the overall effectiveness of ISO 9000. In particular, the economic impact of this global meta-standard is largely unknown with previous empirical analyses yielding inconclusive or conflicting results, largely due to structural or sample size limitations. Because of the continued debate over the correlation between ISO 9000 and the concepts of TQM, doubt remains as to whether the financial impact of each of these management approaches may be similar. Hence, there is a need for this study to provide a more rigorous and systematic approach then previous empirical studies in this area to clarify this issue.

CHAPTER III

HYPOTHESES

Market Expectations

The extent of the stock market's reaction to the attainment of an ISO 9000 certificate depends on the degree of change of the market's expectation of quality from the firm. Becoming ISO 9000 registered contains information about the quality processes at a particular site within a firm and confirms that, in the eyes of a third party observer, that firm's site has met a set of minimum requirements. Prior to registration, the market has developed a preconceived idea of the effectiveness of the firm's quality processes. Let P_1 be this initial assessment of the probability of an effective quality program, which is a function of many parameters, including the firm's reputation, size, industry, and the likelihood of attaining a quality certification like ISO 9000. This probability, particularly the reputation and likelihood of certification components, is formulated by signals such as newswire announcements pertaining to quality, quality initiatives in annual reports or government financial disclosures, or management emphasis on quality in shareholder or supplier meetings (Hendricks & Singhal, 1996; Spence, 1973). For the most part, these signals are self-reported and are difficult to verify by an impartial or external observer. After a firm announces ISO 9000 certification, the market incorporates this new information and reevaluates quality reputation of the firm and the effectiveness of the firm's quality programs. Let P_2 be this reassessed value for the probability that the firm has developed a set of effective quality processes. The market will continue to reassess

the effectiveness of the firm's quality program long after the ISO 9000 announcement as more information becomes available, such as further management discussions on quality or additional evidence of product quality (Garvin, 1991). Therefore, P_2 does not remain constant after registration.

In the short window centered on when the certification becomes known, the market reacts to the news that a site within a firm has been judged acceptable against a baseline standard. The change in probabilities is the result of a signal to the market and is expressed as $P_2 - P_1$ (Spence, 1973). There are several parameters that affect both the sign and the magnitude of this expression. A high initial quality reputation could result in a P_1 very close to 1, limiting the signaling potential of ISO 9000 certification and constraining the potential magnitude of the reaction. Prior anticipation of certification may affect the reaction in a similar manner, limiting the "surprise factor" and weakening certification's signaling potential. Subba Rao, et al. (1997) shed some light on this issue: based on an international survey of managers, the internal perceived benefits of ISO 9000 occur only after registration. They report no significant differences in the perceptions in managers of firms planning to become certified and firms with no certification plans, but significant perception differences between firms planning to become certified and registered firms. I am primarily concerned with the reaction to the attainment of the ISO 9000 meta-standard, and, as any reaction is likely to be positive, I assume $P_2 - P_1 > 0$.

Economic Value of Quality

Let V be the value of the future cash flows of the firm generated by an effective quality program (Hendricks & Singhal, 1996). This quantity can be divided into two

parts: conformance quality and performance quality. Let V_c be the value in implementing processes that improve conformance quality within a firm. Conformance quality is based upon Crosby's (1979) perception of quality as the degree of accordance of a product's design, manufacturing, or operational performance to a predetermined norm. Let V_p be the value in implementing processes that improve performance quality within a firm. Performance quality is based upon Deming's (1982) perception of quality in terms of operating parameters that lead to customer satisfaction. Therefore, $V = V_c + V_p$, and the sign and magnitude of V are dependent upon the signs and relative magnitudes of both V_c and V_p.

Conformance Quality

Within a particular product market, if different firms offer similar products at similar prices, the product with the highest conformance quality is likely to garner the greatest market share. It has been empirically verified that conformance quality and market share are positively correlated (Buzzell & Wiersema, 1981; Craig & Douglas, 1982; Phillips, Chang, & Buzzell, 1983). If one firm within a particular market has higher product conformance quality than its competitors, customers may be willing to pay a premium for the perception of added value (Viscusi, 1978). Thus, by maintaining the same market share, a firm with higher conformance quality could increase its revenues. Both situations suggest a positive correlation between conformance quality and revenue.

While the relation between conformance quality and revenue is relatively straightforward, there is disagreement over the effects of conformance quality on costs.

Juran and Gryna (1980) develop the concept of an ideal or optimal conformance level. Added preventative costs are used to offset the costs of failure up to a certain level of diminishing returns at which the preventative costs associated with improved conformance quality cannot be recouped by future reductions in the costs of failure. Empirical evidence supporting this concept of an optimal performance level includes Terziovski, et al.'s (1997) study reporting that ISO 9000 registered firms exhibited a higher cost of quality than non-registered firms. Conversely, other theories suggest that there is no point of diminishing returns and that the optimal level of conformance quality is zero defects (Crosby, 1979; Deming, 1982). No matter how much preventative costs must be spent to further improve conformance quality, they can still be recouped by later savings in reduced cost of failures. This theory is supported by empirical evidence that suggests that on average, R&D accounts for 12% of a project's costs, acquisition accounts for 28%, and operations and support account for 60% (Kerzner, 2003). Small increases in R&D costs for conformance quality improvement can result in huge savings during operations and support, when the cost of failure is realized. Despite the controversy over the optimal level of conformance, ISO 9000 is a management control system that has a strong potential to improve conformance quality and reduce quality costs (Anderson, et al., 1995). Conformance quality is associated with lower cost of quality and higher revenues, both of which lead to a positive V_c.

Performance Quality

The relation between improved performance quality and value creation is much more ambiguous than the relation between conformance quality and future expected cash

flows. Increases in performance quality are associated with direct increases in costs (Gale & Branch, 1982; Phillips, et al., 1983). The relation is particularly strong for differentiated product markets where quality is judged more in terms of performance rather than conformance. However, the effect of improved performance quality on revenues is unclear. While the market may accept higher prices for high performing goods (Viscusi, 1978), there is no strong evidence to suggest whether firm market share will change.

Higher performance quality leads to an increase in costs and might lead to an increase in revenues depending on the relative change in market share for a higher priced good, making it difficult to predict the sign of V_p. Despite the ambiguity, it is widely accepted that ISO 9000 is a better measure of conformance quality than performance quality (Anderson, et al., 1999). Even though it is difficult to predict the sign of V_p, because the benefits of ISO 9000 are more likely related to conformance than performance, the magnitude of V_p is very low compared to V_c ($|V_p| << |V_c|$). The sign and magnitude of V are dominated by V_c; therefore, if $V_c > 0$, then $V > 0$.

Market Reaction to Certification

The overall change in the firm's market value due to the attainment of ISO 9000 certification is $(P_2 - P_1)V$. This quantity is the reaction to the attainment of the standard, not the overall economic value of an effective quality program. Some of the value of the quality program will be incorporated prior to the event depending on the initial effectiveness of the program or the firm's existing quality certifications, and some of the value is incorporated after the certification announcement as more evidence concerning

the firm's product quality becomes available. Thus, the quantity $(P_2 - P_1)V$ is a lower bound on the overall market reaction (Hendricks & Singhal, 1996). The overall direction of the change in market value due to the certification announcement is therefore dependent upon the signs of V and $P_2 - P_1$, and the strength of the reaction is dependent upon their relative magnitudes. The predicted signs of $P_2 - P_1$ and V have been discussed previously; therefore, the market reaction to an announcement of ISO 9000 is predicted to be positive, leading to the first hypothesis:

H1. Firms announcing ISO 9000 certification experience an increase in their market value.

Risk and Asymmetric Information

The stock price of a firm is a reflection of the net present values of future expected cash flows. Quality is but one factor that could affect this value, but judgments about the quality capabilities of a firm are largely dependent upon internal processes that are extremely difficult to observe (Toffel, 2005). Investors must rely on scant or biased information on which to base their assessments of the firm. Claims of implementing TQM principles or other quality initiatives are very prevalent, but their scope and accuracy are very difficult if not impossible to verify (Akerlof, 1970; Anderson, et al., 1995; Nicolau & Sellers, 2002). As a result, an asymmetry of information develops concerning the quality processes within a firm even though such additional information could aid investors in their assessments of the company, leading to a change in the variance of the firm's stock returns and a change in its firm-specific, or idiosyncratic, risk (Hui, Leung, & Huang, 1993). Idiosyncratic risk is the element of risk that is attributable

to specifics of the particular firm after controlling for the risk of the overall market (Black & Scholes, 1973). While a construct of performance characteristics like those in the SCOR[2] model could aid investors, such information can be ambiguous or non-existent (Supply Chain Council, 2005; Wang, Huang, & Dismukes, 2004).

ISO 9000 certification is a formal, external signal of process quality control and contains information that the firm's internal processes conform to a specified standard. As such, ISO 9000 has the potential to reduce asymmetric information within the market, leading to a change in the idiosyncratic risk of a firm (Goetzmann & Massa, 2005; Kraus & Smith, 1989; Spence, 1973; Toffel, 2005). The direction of change is dependent upon how the market perceives adherence to a set of minimum requirements. If the market is convinced that ISO 9000 has the potential to improve quality within the firm, and that quality improvement will improve the firm's standing relative to other firms that face similar market risks, the idiosyncratic risk of that firm may decrease to reflect the perceived improvement in the firm's competitive position compared to the general market. However, attaining ISO 9000 certification may also impact the business risk of a firm (variance on the rate of return on assets), possibly signaling wealth transfers between bondholders and equityholders (Black & Scholes, 1973). There still may be a high degree of uncertainty of how the firm's internal processes actually affect quality, particularly as measured by performance characteristics, and theoretical and empirical work on the relation between quality and risk is rather limited (Hendricks & Singhal, 1996). Because of this limitation of the information content of ISO 9000 registration, a two-tailed hypothesis is more appropriate.

[2] Supply Chain Operations Reference

H2. Announcing ISO 9000 certification is associated with a change in idiosyncratic risk.

Effects of Moderating Variables

Hypothesis H1 concerns the overall market reaction to certification announcements. There may also be factors that moderate the strength of the reaction. These contingencies are worth evaluating because it is of great importance whether the theories relating conformance and performance quality to business performance are universal in nature or are dependent on additional factors. Specifically, there may be extenuating factors that affect the appropriateness of ISO 9000 as a meta-standard that has value creating potential within a firm. I empirically evaluate two of those potential factors: firm size and standard stringency.

Effect of Firm Size

Firm size has the potential to affect the extent of the market's reaction to ISO 9000 certification. The processes of large firms may be more resistant to change due to the presence of a significant management bureaucracy (Daft, 1995, Hendricks & Singhal, 2001a). This management inertia could result in less change between P_2 and P_1 for larger firms, thus moderating the extent of the market's reaction to certification. Additionally, large firms are more likely to have multiple sites that could potentially become ISO 9000 registered. Since the certification is usually site specific, the effects associated with the certification announcement may be diluted in large firms. Smaller firms may have more to gain in terms of reputation than larger firms, leading to a stronger signaling

component. Large firms also tend to get more media analyst coverage, so the market may have a better idea of the quality practices of large firms than of smaller ones. Thus, announcing certification may be less of a surprise for larger firms because most of the effects of implementing a quality program may have already been incorporated by the market. These factors suggest that $|P_2 - P_1|$ may be negatively correlated with firm size, which has been empirically verified by past event studies (Docking & Dowen, 1999; Hendricks & Singhal, 1996). The potential of firm size as a moderating variable leads to the third hypothesis:

H3. The market reaction to ISO 9000 certification announcements is more positive for small firms than for large firms.

Effect of Standard Stringency

Past empirical evidence has suggested that more stringent quality awards, such as independent awards like the Baldrige, have a greater impact the market value of a firm than supplier quality awards (Hendricks & Singhal, 1996). Interestingly, I have identified a dearth of literature concerning the economic impact of the ISO 9000:2000 standard, which was released in late 2000 and officially replaced the older 1994 series of standards on December 15, 2003 (ISO, 2003). The introduction of the ISO 9000:2000 series of standards has addressed some of the concerns levied by commentators like Juran (1995). The new standard has fewer requirements for documented procedures than the 1994 standards, potentially reducing the cost of quality and increasing the value of conformance quality V_c (Cianfrani, et al., 2001). The 2000 series of standards has a renewed emphasis on customer focus and continuous improvement, both of which are

more aligned with the concepts of TQM rather than conformance to a minimum standard (Cianfrani, et al., 2001, Terziovski, Power, & Sohal, 2003). The new standard may be more closely associated with creating economic value through performance quality V_p. Furthermore, by eliminating ISO 9002 and 9003, which were subsections of the ISO 9001:1994 standard, companies no longer can opt for a lower minimum requirement out of fear of failing to achieve certification. The market could potentially view ISO 9001:2000 as more stringent and thus in a more favorable light than ISO 9001:1994, ISO 9002:1994, and ISO 9003:1994[3]. These changes lead to Hypothesis 4:

H4. The market reaction to ISO 9000:2000 announcements is more positive than the reaction to ISO 9000:1994 announcements.

[3] ISO 9001:1994 is viewed as more stringent than both ISO 9002:1994 and ISO 9003:1994 (Anderson, et al., 1995; Ragothaman & Korte, 1999), but all three standards have been superseded by ISO 9001:2000. It is of little practical or management implication if there is any difference among the three 1994 standards since those certificates are no longer valid.

CHAPTER IV

SAMPLE SELECTION PROCEDURE AND DATA DESCRIPTION

I identified a sample of firms that had announced ISO 9000 series certification by searching full-text articles in the following databases: Business Wire, Dow Jones Business News, Dow Jones News Service, PR News, PR Newswire, Reuters News, and the Wall Street Journal. The search was conducted in February and March 2005 and covered the time period from 1999 to 2002. These years were purposefully chosen to ensure an adequate sample of firms who announced certification to the 1994 series of standards and to the 2000 series of standards. Keywords in the search were "ISO" and "certification." 2421 articles contained this combination of keywords. I read each of the articles and used the criteria listed in Appendix A to eliminate announcements (Docking & Dowen, 1999; Hendricks & Singhal, 1996; Hendricks & Singhal, 1997a; Hendricks & Singhal, 2003; Hendricks, Singhal, & Wiedman, 1995; Nicolau & Sellers, 2002).

The number of announcements eliminated by each criterion is presented in Table 1. Some announcements were eliminated by more than one criterion. If the announcement failed by criteria 1 through 5, no further information about the announcement was collected. 2136 announcements were eliminated by these five criteria, leaving 285 announcements in the preliminary sample. For each event in the preliminary sample, the following data were collected for classification:

- Company name
- 3 or 4 digit SIC code for the primary industry

- Announcement date
- Source for the announcement
- A description of the announcement, including the division or facility name
- Whether the certification was the first in the company, a renewal of an existing certificate, a certificate for a new site in a company that had achieved certification at other sites, or an upgrade from the 1994 series of standards to ISO 9001:2000
- Whether the certification was ISO 9001:1994, 9002:1994, 9003:1994, or 9001:2000.

Table 1. The Final Sample

Elimination Criterion	Announcements Eliminated
1. No Certificate Awarded	2136
2. Problem Pinpointing Event Date	
3. Not Traded on NYSE, NASDAQ, or AMEX	
4. Concurrent with Earnings Reports	
5. September 11 Terrorist Attacks	31
6. Insufficient Stock Information	28
7. Repeat Announcements	6
8. Articles in WSJ*	0
9. Insufficient Financial Data	24
10. Plans to Become Certified	9
11. Prior to Official Registration	7
12. After Publication in QSU Database	3
13. Unknown Classification	1
14. No Control Firm	7

*Three announcements in the sample mentioned other perhaps significant events at the same time as the ISO 9000 certification announcement. On April 7, 1999, the DII Group mentions a new large contract at the same time their Czech facility obtained ISO 9002 registration; on April 20, 1999, Thor Industries mentioned a new contract at the same time their Salina, KS facility was registered to ISO 9001:1994; and on November 7, 2000, MSC Software Corporation mentioned a new product at the same time they were ISO 9001:1994 registered. These announcements were included in the final sample because there was no other mention of any of them in another widely available public source, and they were judged not to be significant enough to warrant elimination from the sample.

After eliminating announcements where the above data were not available, the final sample consisted of 204 announcements. 112 announcements were made prior to the release of the ISO 9000:2000 series, but firms still announced certification to the 1994 series of standards for several months afterwards. 99 announcements were for ISO 9001:1994 certifications, 57 were for ISO 9002:1994 certifications, and 50 were for ISO 9001:2000 certifications. One announcement pertained to both a 9001:1994 and a 9002:1994 certification, and one announcement pertained to both a 9002:1994 and a 9001:2000 certification. I found no announcements for ISO 9003:1994 certifications. 33 announcements pertained to first time certifications within a company, 18 pertained to renewals of existing certifications, 10 pertained to upgrades from the 1994 series of standards to the 2000 series of standards, and 71 pertained to new facility certifications for firms that had previously certified other sites. Two announcements mentioned multiple certifications, and information about the certification history of the firm was not available for 74 of the announcements.

Table 2 presents descriptive statistics about the final sample. Panel A provides descriptive financial data taken from the fiscal year prior to the announcement. Four different measures of firm size (number of employees, total sales, total assets, and market value) are provided. Firms in the sample range from those with a few employees, less than $1 million in sales, less than $3 million in assets, and $1000 in total equity to those with over 300000 employees, over $100 billion in sales, over $700 billion in assets, and over $50 billion in total equity. Three measures of firm leverage (total debt, debt to equity ratio, and debt to asset ratio) are also included. One firm in the sample has no corporate debt, and the most levered firm has a total debt of over $600 billion. Slightly

more than half of the companies turned a profit in the fiscal year preceding the announcement. The highest profit reported is over $12 billion, while one company reported a loss of over $4 billion. Panel B provides an industry breakdown based on the primary SIC code of the firm. While the majority of the firms are manufacturers, the sample covers a wide range of industries. However, the sample does not contain any agricultural, mining, fishing, or public administration firms. The largest firms in terms of both total assets and market value are those in the financial services sector and include Citibank, Banc of America, AIG, and others. The smallest firms in the sample are medical devices manufacturers including Medstone International, Paradigm Medical Industries, and others.

Table 2. Descriptive Statistics on the 204 Announcements of Firms Attaining ISO 9000 Registration

Panel A. Financial Data

	Mean	Median	Standard Deviation	Maximum	Minimum
Total Sales (Million $)	5517.3	175.4	16618.0	128051.1	0.381
Total Assets (Million $)	24353.4	224.5	114371.6	700697.9	2.966
Total Debt (Million $)	21715.6	78.1	105745.6	625137.3	0.000
Market Value (Million $)	2742.6	124.0	9406.0	54135.3	0.001
Net Income (Loss) (Million $)	366.9	3.576	1518.5	12735	(4118.0)
Employees	20970	990	56236	323000	6
Debt/Equity Ratio	1.509	0.886	2.870	14.222	0.000
Debt Ratio [a]	0.471	0.483	0.247	1.311	0.042

[a] The debt ratio is defined as the total debt divided by the sum of total debt and the market value of equity.

Table 2. Descriptive statistics on the 204 announcements of firms attaining ISO 9000 registration *(continued)*

Panel B. Industry Breakdown [b]

Division	SIC Codes	Description	Announcements	Mean Assets (Million $)	Mean Market Value (Million $)
D	**2010-3999**	**Manufacturing**	**138**	**5527.4**	**1149.2**
	2010-2999	*Food, Furniture, Paper, and Chemicals*	*10*	*1331.2*	*535.4*
	3010-3569	*Rubber, Leather, Stone, Industrial Machinery*	*23*	*1857.1*	*963.4*
	3570-3699	*Computers, Electronics, and Communication*	*66*	*7885.1*	*1141.4*
	3710-3799	*Transportation Equipment*	*9*	*18250.6*	*5251.9*
	3810-3999	*Instrumentation and Medical Devices*	*30*	*736.4*	*282.7*
E	**4011-4971**	**Transportation, Communications, Electric, Gas, and Sanitary Services**	**16**	**8891.7**	**2597.9**
F	**5012-5199**	**Wholesale Trade**	**12**	**1780.4**	**490.5**
G	**5211-5999**	**Retail Trade**	**2**	**21509.4**	**4340.4**
H	**6011-6799**	**Finance, Insurance, & Real Estate**	**8**	**483770.3**	**35486.5**
I	**7011-8999**	**Services**	**28**	**4588.7**	**2173.8**

[b] No announcements were found for SIC Codes 0110-1799, and 9111-9999.

CHAPTER V

METHODOLOGY

Overview

I used the event study methodology to measure the shareholder's financial impact associated with the announcement of ISO 9000 certification. This approach is used to determine the effects of a particular event and isolate them from general market behavior (Brown & Warner, 1980; Brown & Warner, 1985). Any price change has two components: market- or industry-wide movements, and firm-specific or unique movements traceable to the content of the event, or in this case, the certification announcement. The firm-specific component is an adjusted return usually referred to as an "abnormal return" and is an estimate of the percent change in the stock price associated with that particular event. If a set of firms experience similar events, such as achieving ISO 9000 certification, then it is possible to calculate the average abnormal return on an event date for the entire set. Statistical tests can then be employed to determine the significance of any change or valuation impact of that type of event.

A major assumption associated with the event study methodology is that the market is efficient and can react to the information content of a certification announcement over a relatively short period of time (Brown & Warner, 1985; McWilliams & Siegel, 1997). Therefore, the study is strengthened if the event period or window is as small as possible and centered on the event (Barclay & Litzenberger, 1988; Brown & Warner, 1980; Dyckman, Philbrick, & Jens, 1984; McWilliams & Siegel,

1997). The possibility of abnormal returns being affected by an extenuating factor, such as dividend announcements, new products, or the signing of a new contract, is diminished because fewer contaminating events are likely to be present in a shorter event window (McWilliams & Siegel, 1997). In addition, the power of any statistical tests that are employed is increased regardless of the statistical significance of the abnormal returns (MacKinlay, 1997). These factors reduce the likelihood of Type I and II errors.

Event Date Specification

When dealing with events such as ISO 9000 certification, problems can arise when attempting to pinpoint the event date. Past studies have set the event date as the day the company's certification registration becomes official (Anderson, et al., 1995; Anderson, et al., 1999; Docking & Dowen, 1999; Martinez-Costa & Martinez-Lorente, 2003). The problem with this method is that investors may not be aware that the firm has achieved certification as soon as the registration becomes official. Since there is no real-time ISO 9000 registration database, in some instances the first time an investor may hear that a particular firm has been registered is when the next quarterly update to the ISO 9000 database becomes available, as many as 60 trading days. Specifying a 60-day event period dramatically weakens the effectiveness of the event study methodology. Instead, I use the date of first public announcement of official certification.

Despite the methodological advantages over the alternatives, specifying the event date as the day of the public announcement across the news wires is not perfect and requires a few controls to increase effectiveness. The company may announce that the firm has passed their final certification audit and has been recommended for certification,

even though it is illegal for a firm to state that it has achieved certification or is registered until the certification registration becomes official. Seven firms in the preliminary sample fit this criterion, and to avoid confusion and possible event date misspecification, they were removed from the final sample (Appendix A, criterion 11). There is also the possibility that the firm may wait to make an official announcement for a variety of reasons, including but not limited to: gathering information and approvals for the official press release or including the news as part of a larger announcement. If the wait is sufficiently long, the news may go public first by another means, such as company leaks or an appearance in the ISO 9000 registered company database. Three firms in the preliminary sample fit this criterion, and to avoid confusion and possible event date misspecification, they were removed from the final sample (Appendix A, criterion 12).

If an announcement contains no new information, then there will be no significant abnormal return because the news has already been incorporated into the price of the stock (MacKinlay, 1997). Therefore, if news of an ISO 9000 certification has been leaked to the market, there is the possibility that the stock price will change prior to an event window centered on the announcement of official certification. If it is known when the market first became aware of the certification, partial anticipation estimation models such as the one developed by Malatesta & Thompson (1985) can be used to isolate the effects of the leak. However, such information is difficult to obtain, so I attempted to control for the effects of news leaks within each of the firms in the sample. Any announcement containing information to the extent that the firm was pursuing certification was eliminated from the sample, along with subsequent announcements pertaining to that particular certification effort. Nine firms in the preliminary sample fit

this criterion, and to limit the effects of news leaks, they were removed from the final sample (Appendix A, criterion 10).

Considering the circumstances surrounding ISO 9000 certification announcements and the need to limit the effects of news leaks, I determined the exact event date by the time and date of the first public certification announcement by the newswires (Beirão & Sarsfield Cabral, 2002; Hendricks & Singhal, 1996; Hendricks & Singhal, 1997a; Hendricks & Singhal, 2003; Hendricks, et al., 1995; Nicolau & Sellers, 2002). If the announcement or newswire release was before the closing bell of the three major American stock markets (16:00 Eastern time), the event day is the same calendar day as the announcement date (197 announcements). If the announcement was made after the closing bell or on a day that the markets were closed, then the event day was specified as the next trading day after the calendar date of the announcement (7 announcements). While it is possible for investors to react to late afternoon and evening events due to after-hours trading, the method the Center for Research in Security Prices (CRSP) uses to calculate stock returns is based upon the closing price of the equity. Therefore, the valuation impact of the announcement is not captured until the returns of the following trading day are posted.

Calendar time was translated into a relative event time using the following procedure. The day of the certification event day is set at Day 0. The trading day after the event day is denoted Day +1, the subsequent trading day as Day +2, and so on. The trading day before the event day is denoted Day -1, the preceding trading day as Day -2, and so on. Weekends, holidays, and other days on which the market is closed are ignored. Because there is still the possibility of event date misspecification, I also

analyze the abnormal returns on Day -1 and Day +1 in addition to the event day (Day 0). If information is leaked prematurely, there may be an impact on Day -1. If the announcement is very late in the trading day (around 15:45), the full extent of the announcement may not be captured until Day +1. Even though there is some debate within the literature as to how quickly the market captures new information under the efficient market hypothesis (Dann, Myers, & Raab, 1977; McWilliams & Siegel, 1997; Mitchell & Netter, 1989), the overwhelming majority of the reaction should be captured between Day -1 and Day +1.

Calculating Abnormal Returns

Initially, three different commonly used models: the "Market Model," the "Mean Adjusted Returns Model," and the "Market Adjusted Returns Model," were used to estimate abnormal returns (Brown & Warner, 1985; McWilliams & Siegel, 1997). Later, in order to control for firm size and industry effects, two additional models were employed, the "Size and Industry Adjusted Returns Model" and the "Size and Industry Adjusted Market Model." Empirical studies have shown these two parameters could impact the magnitude of abnormal returns (Banz, 1981; Barber & Lyon, 1996; Fama & French, 1993; Reinganum, 1981).

The event study methodology consists of isolating abnormal returns from total returns, so a method is needed to estimate the expected return on a particular day. An estimation period (EstP) of 200 days was used in this study for statistical soundness and to reduce the effects of nonsynchronous data (Scholes & Williams, 1977). It is necessary to choose the location of the estimation period far enough away from the event to

eliminate any impact from the event itself but close enough to the event to reduce the effects of non-stationarity of the estimates. The estimation period in this study ended 10 trading days (two calendar weeks) before then event. The estimation period spans from Day -210 to Day -11. The models used to calculate the abnormal returns are summarized below; for a full description, see Brown and Warner (1985).

Market Model

The Market Model controls for the systematic risk of the equity and is a derivative of the Capital Asset Pricing Model (CAPM), which suggests (and has been empirically verified (Scholes & Williams, 1977)) that the return for a particular equity is directly proportional to the return of the general market. The return on a stock over a given time period is:

$$r_{it} = \alpha_i + \beta_i r_{mt} + \varepsilon_{it} \quad (1)$$

where r_{it} is the return for stock i on Day t, r_{mt} is the market return on Day t (the CRSP Equal-Weighted Index serves as the proxy for the general market in this study), α_i is the intercept of the regression for stock i; β_i is the constant of proportionality between stock i and the market return, also known as the equity beta; and ε_{it} is the error term for stock i on Day t. α_i is an estimate of the constant daily return for stock i, $\beta_i r_{mt}$ is the part of the return attributed to market-wide movements, and ε_{it} is the part of the price that cannot be attributed to the market (the firm-specific "abnormal return"). α_i, β_i, and the variance of the error term ε_{it} (henceforth denoted σ_e^2) are estimated using an ordinary least squares

regression over the estimation period.[4] By re-arranging Equation 1, the abnormal return for the Market Model can be expressed as:

$$A_{it} = r_{it} - \alpha_i - \beta_i r_{mt} \tag{2}$$

where A_{it} is the abnormal return for stock i on Day t.

Mean Adjusted Returns Model

While the Market Model is the preferred model for the estimation of abnormal returns because it captures the systematic risk of a firm, there is danger in using it exclusively. To increase the sensitivity of the study and strengthen its internal validity, I also calculated the abnormal return using other models to ensure that the choice of model does not drive the nature of the results (McWilliams & Siegel, 1997). One such model is the Mean Adjusted Returns Model:

$$A_{it} = r_{it} - \bar{r}_i , \tag{3}$$

$$\bar{r}_i = \left(\frac{1}{D_{est}} \right) \sum_{t \in EstP} r_{it} \tag{4}$$

where $\bar{r}_i$ is the mean of stock i's daily return during the estimation period, and D_{est} is the number of days in the estimation period.

Market Adjusted Returns Model

$$A_{it} = r_{it} - r_{mt} \tag{5}$$

[4] Brown and Warner (1985) and Dyckman, et al. (1984) have shown that the choice between the ordinary least squares regression and the Scholes and Williams (1977) procedure that controls for nonsynchronous data to estimate the equity beta has no significant impact on the calculated abnormal returns.

In this model, the market return is a benchmark and every firm in the sample has the same characteristics as the general market. There is no constant daily return for stock *i* ($\alpha_i = 0$) and each stock is assumed to have the same systematic risk as the general market ($\beta_i = 1$).

Size and Industry Adjusted Returns Model

This model controls for the effects of size and industry on the estimation of the abnormal returns. Empirical studies have shown that the magnitudes of abnormal returns for small firms are greater than those for large firms (Banz, 1981; Fama & French, 1993; Reinganum, 1981). It is also possible that abnormal returns could be affected by industry-wide movements relative to the market (Barber & Lyon, 1996).

$$A_{it} = r_{it} - r_{ct} \tag{6}$$

where r_{ct} is the return on Day *t* for a control firm similar in size and industry to the sample firm.

In order to identify a control firm, a list of all companies with the same three-digit SIC code as the sample firm was generated using the Hoover's database. Companies not meeting the following criteria were removed from consideration:

- Firms not publicly traded on the NYSE, NASDAQ, or AMEX at the time of the sample firm's ISO 9000 certification announcement
- Firms with insufficient stock information available through the CRSP database from Day -210 to Day +60 (approximately one calendar quarter after the announcement).

- Firms that announced ISO 9000 certification within two weeks of the sample firm.
- Firms that appeared in the final test sample.

If these four criteria eliminated all companies from the list, the procedure was repeated for a two-digit SIC code match. Of the companies that remained on the list, the control firm was specified as the one with the closest total sales to the sample firm for the year preceding the event date. No control firm has total sales less than 50% or greater than 200% of the sample firm. Control firms could not be found for seven firms, and they were not included in the final sample (Appendix A, criterion 14).

Size and Industry Adjusted Market Model

$$A_{it} = r_{it} - r_{ct} - \alpha_{is} - \beta_{is} r_{mt} \tag{7}$$

where α_{is} and β_{is} are the intercept and slopes estimated by an ordinary least squares regression of $r_{it} - r_{ct}$ with r_{mt} during EstP. This model adjusts for size, industry, and systematic risk.

Statistical Tests

The mean abnormal return on Day *t* is:

$$\overline{A}_t = \frac{1}{N} \sum_{t=1}^{N} A_{it} \tag{8}$$

where *N* is the number of samples with return observations on Day *t*. The cumulative abnormal return (CAR) over a given time period ($t_1, \ldots, t_2$) is the sum of the daily mean abnormal returns and is useful in determining the impact of the announcement over

multiple days, particularly if the announcement was made soon before the closing bell. The CAR is:

$$CAR(t_1, t_2) = \sum_{t=t_1}^{t=t_2} \overline{A}_t \tag{9}$$

There have been many proposed statistical tests for the distribution and independence of abnormal returns. Further information on many of these tests, including their theoretical underpinnings and empirical validation are available in the literature (Brown & Warner, 1980; Brown & Warner, 1985; Dyckman, et al., 1984). In this study, the null hypotheses states that abnormal returns for a stock *i* are independent of other stocks in the sample, have mean equal to zero, and have variance $\hat{S}_{\varepsilon i}^2$. When the analysis is expanded to cover more than one day (CARs), I also assume that there is no event clustering and that the abnormal returns are independent of the calendar time of the announcement. This assumption is reasonable because certification announcements for any company are not more likely to occur at one time of year versus another. The test statistic for any Day *t* is:

$$TS_t = \sum_{i=1}^{N} \frac{A_{it}}{\hat{S}_{\varepsilon i}\sqrt{N}} \tag{10}$$

where $\hat{S}_{\varepsilon i}$ is the estimated standard deviation. The test statistic for multiple days is:

$$TS_c = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} \frac{\sum_{t=t_1}^{t=t_2} A_{it}}{\sqrt{\sum_{t=t_1}^{t=t_2} \hat{S}_{\varepsilon i}^2}} \tag{11}$$

Equations 10 and 11 are t-test statistics used to determine the significance of the mean abnormal return.

To ensure that outliers are not driving the results, additional tests are employed (Dyckman, et al., 1984; MacKinlay, 1997; McWilliams & Siegel, 1997). In order to determine whether the median abnormal return is significantly different than zero, the Wilcoxon Signed Rank Test is used. Since the null hypothesis assumes that the abnormal returns are independent and normally distributed with a mean of zero, the probability of any return being greater than (or less than) zero is 0.5. To test whether or not the proportion of abnormal returns greater than (or less than) zero is significantly different from 50%, the Binomial Sign Test is used. Unlike the Wilcoxon Signed Rank Test, which accounts for the relative distance between each abnormal return and zero, the Binomial Sign Test only considers whether the return is positive or negative and does not consider its absolute value. Formulae and their derivations for these and other non-parametric statistics based on sign and/or rank are widely described in the literature (Hollander & Wolfe, 1973; Lehmann, 1975).

CHAPTER VI

RESULTS

Analysis of Abnormal Returns for Complete Sample of Firms

Table 3 is a summary of the abnormal returns calculated for the entire sample (N = 204) using the three primary models (Market, Mean Adjusted, and Market Adjusted Models). The table has the mean, median, and percent of positive abnormal returns for Days -1, 0 and +1, as well as the cumulative abnormal return for the day before and the day of the announcement (CAR(-1, 0)), and for the day of and the day after the announcement (CAR(0,+1)).[5]

Table 3. Abnormal Returns for the Complete Sample of 204 Announcements of ISO 9000 Certification*

	Day -1		Day 0		Day +1		CAR (-1,0)		CAR (0,+1)	
Market Model										
Mean	-0.25%	(0.25)	-0.02%	(0.48)	-0.15%	(0.33)	-0.26%	(0.27)	-0.17%	(0.37)
Median	-0.31%	(0.11)	-0.37%	(0.18)	-0.15%	(0.17)	-0.59%	**(0.05)**	-0.06%	(0.15)
% Positive	45.10%	(0.08)	45.10%	(0.08)	46.57%	(0.16)	45.59%	(0.10)	49.51%	(0.44)
Mean Adjusted Model										
Mean	-0.25%	(0.25)	0.07%	(0.43)	-0.25%	(0.24)	-0.18%	(0.34)	-0.19%	(0.36)
Median	-0.25%	(0.06)	-0.18%	(0.22)	-0.18%	(0.06)	-0.50%	(0.06)	-0.03%	(0.15)
% Positive	46.08%	(0.13)	45.59%	(0.10)	44.12%	**(0.05)**	45.10%	(0.08)	50.00%	(0.50)
Market Adjusted Model										
Mean	-0.22%	(0.27)	0.07%	(0.42)	-0.15%	(0.33)	-0.15%	(0.36)	-0.08%	(0.43)
Median	-0.27%	(0.08)	-0.28%	(0.29)	-0.09%	(0.18)	-0.53%	(0.08)	0.13%	(0.24)
% Positive	44.61%	(0.06)	44.61%	(0.06)	48.53%	(0.34)	43.63%	**(0.03)**	51.96%	(0.29)

*The Student T-test statistic tests if the mean is different from zero; Wilcoxon Signed Rank Test statistic tests if the median is different from zero; Binomial Sign Test statistic tests if the percentage of firms with a positive abnormal returns is different from 50%. One-tailed p-values are in parentheses.

[5] The Market Model results obtained for a post-event estimation period (Days +11 to +210) are very similar. I also calculated CAR(-1,+1), and those results are also similar to those reported here. For brevity and clarity, post-event estimation period Market Model and CAR(-1,+1) results are not reported here.

For the complete sample of announcements, while none of the mean abnormal returns are generally significantly different from zero at $\alpha = 0.05$[6], there are some exceptions. The CAR(-1,0) median abnormal return is significant and negative with only the Market Model ($p = 0.05$). Slightly less than half of all the returns were negative for all periods and in all three models, and the sign test was significant for the CAR(-1,0) Market Adjusted Model ($p = 0.03$) and the Day +1 Mean Adjusted Model ($p = 0.05$). Because the means and medians for each period and results of each model are relatively similar, there is no reason to suspect that neither the choice of models nor the presence of outliers is driving the results. The significant Wilcoxon and sign tests on Day +1 and CAR (-1,0) suggest that there might be some leakage of information and continued inspection of the entire event window is warranted.

Analysis of Change in Firm Risk

Even though there was no observed significant change in the market value of equity for the complete sample of firms, a change in the systematic risk could impact the rate at which future cash flows are discounted, leading to a change in the overall market value of the firm. Table 4 contains information about the performance of equity and asset betas (β_e and β_a, respectively) and the financial leverage during the periods before and after the ISO 9000 certification announcement. Following Hendricks and Singhal (1996), pre-announcement betas were measured during EstP (Days -210 to -11), and post-announcement betas were measured from Days +11 to +210 in order to ensure a similar basis for pre- and post-announcement parameter estimates. The pre-announcement debt

[6] For the remainder of this thesis, the level of statistical significance is set at $\alpha = 0.05$.

ratio is calculated using data from the most recent fiscal year completed before the announcement, and the post-announcement debt ratio is calculated using data from the first fiscal year completed after the announcement

Table 4. Measures of Equity and Asset Betas Before and After the Announcement of ISO 9000 Certification

	Pre-Announcement	Post-Announcement	Difference[a]	p-Value[b]
Mean β_e	1.27	1.30	0.03	0.63
Median β_e	1.10	1.19	0.05	0.40
% of Firms with Decrease in post-announcement β_e			46.57%	0.33
Mean β_a	0.75	0.75	0.01	0.90
Median β_a	0.49	0.50	0.01	0.99
% of Firms with Decrease in post-announcement β_a			47.55%	0.48
Mean Debt Ratio	0.471	0.474	0.003	0.71
Median Debt Ratio	0.483	0.483	-0.004	0.92
% of Firms with Decrease in post-announcement Debt Ratio			47.55%	0.40

[a] This is the average of the differences between pre-and post-announcement values, not the difference of the averages.

[b] The Student T-test statistic tests if the mean is different from zero; Wilcoxon Signed Rank Test statistic tests if the median is different from zero; Binomial Sign Test statistic tests if the percentage of firms with a decrease in post-announcement betas is different from 50%. All p-values are two-tailed.

The mean (median) equity beta increases from 1.27 (1.10) to 1.30 (1.19) for a mean (median) increase of 0.03 (0.05) after the announcement of ISO 9000 certification. 46.6% of the firms in the sample experienced a decrease in equity beta. A change in the equity beta from 1.27 to 1.30 implies that future cash flows will be discounted at a higher rate, leading to a reduction in the market value of equity. At a prime rate of 3% and a risk premium of 9%, the cost of equity would increase from 14.43% to 14.71%, or a 1.88% reduction in the value of a perpetuity with no growth. However, the mean (median) change in equity beta is not statistically different from zero ($p = 0.63$ ($p = 0.40$)), nor is the percentage of firms that experienced a decrease in equity beta different from 50% ($p = 0.33$).

Because financial leverage and equity risk are positively correlated, I also examine the debt ratio. The debt ratio is defined as the total debt of a firm divided by the sum of the total debt and the market value of equity. The mean (median) debt ratio changes from 0.471 (0.483) to 0.474 (0.483) for a mean (median) change of 0.003 (-0.004) after the announcement of ISO 9000 certification. 52.9% of the firms in the sample experienced a decrease in the debt ratio. The mean (median) change is not statistically different from zero (p = 0.71 (p = 0.92)), nor is the percentage of firms that experienced a decrease in the debt ratio different from 50% (p = 0.40).

Because a change in asset beta could also signal a change in equity beta, I also evaluated the performance of asset risk during the periods before and after an ISO 9000 certification announcement. However, because corporate debt is infrequently traded, returns on debt are difficult to find, and estimating future tax rates is difficult, direct measurements of asset betas are hard to make (Hendricks & Singhal, 1996). Instead, due to the relation between asset risk, equity risk, and financial leverage, asset betas can be indirectly computed based on leverage (Hamada, 1972).

$$\beta_a = \frac{\beta_e}{1 + D/E} \tag{12}$$

where D is the book value of total debt and E is the market value of equity. The mean (median) asset beta changes from 0.75 (0.49) to 0.75 (0.50) for an increase of 0.01 (0.01) after the announcement of ISO 9000 certification. 47.6% of the firms in the sample experienced a decrease in asset beta. The mean (median) change is not statistically different from zero (p = 0.90 (p = 0.99)), nor is the percentage of firms that experienced a decrease in asset beta different from 50% (p = 0.48). As expected, the behavior of the asset betas is very similar to the behavior of the equity betas.

In order to determine the impact of ISO 9000 certification on the idiosyncratic risk of a firm, I also calculated the variance of the rate of return on equity (σ_e^2), the variance of the rate of return on assets (σ_a^2), and the residual standard error from the Market Model (*Residual* σ) (see Table 5). Asset variances are calculated indirectly from the equity variances using Equation 13, while Equation 14 shows the relationship between asset variance and idiosyncratic risk.

$$\sigma_a = \frac{\sigma_e}{1 + D/E} \tag{13}$$

$$\sigma_i^2 = \sigma_a^2 - \sigma_m^2 \beta_a^{\,2} \tag{14}$$

where σ_i^2 is idiosyncratic risk and σ_m^2 is the variance of the market returns.

Pre- and post-announcement variances were measured using daily stock returns from Days -210 to -11 and Days +11 to +210, respectively, in order to ensure a similar basis for pre- and post-announcement parameter estimates.

Table 5. Measures of Variance Before and After the Announcement of ISO 9000 Certification

	Pre-Announcement	Post-Announcement	Difference[a]	p-Value[b]
Mean σ_e	0.0374	0.0380	0.0006	0.51
Median σ_e	0.0348	0.0338	-0.0012	0.72
% of Firms with Decrease in post-announcement σ_e			53.92%	0.26
Mean σ_a	0.0212	0.0213	0.0001	0.92
Median σ_a	0.0171	0.0164	-0.0003	0.47
% of Firms with Decrease in post-announcement σ_a			53.92%	0.26
Mean Residual σ	0.0492	0.0499	0.0007	0.58
Median Residual σ	0.0461	0.0439	-0.0014	0.65
% of Firms with Decrease in post-announcement Residual σ			55.39%	0.13

[a] This is the average of the differences between pre-and post-announcement values, not the difference of the averages.

[b] The Student T-test statistic tests if the mean is different from zero; Wilcoxon Signed Rank Test statistic tests if the median is different from zero; Binomial Sign Test statistic tests if the percentage of firms with a decrease in post-announcement betas is different from 50%. All p-values are two-tailed.

The mean (median) equity standard deviation changes from 0.0374 (0.0348) to 0.0380 (0.0348) for a change of 0.0006 (-0.0012) after the announcement of ISO 9000 certification. 53.9% of the firms in the sample experienced a decrease in equity standard deviation. The mean (median) asset standard deviation changes from 0.0212 (0.0171) to 0.0213 (0.0164) for a change of 0.0001 (-0.0003) after the announcement of ISO 9000 certification. 53.9% of the firms in the sample experienced a decrease in asset standard deviation. The mean (median) residual standard error changes from 0.0492 (0.0461) to 0.0499 (0.0439) for a change of 0.0007 (-0.0014) after the announcement of ISO 9000 certification. 55.4% of the firms in the sample experienced a decrease in equity standard deviation. As shown in Table 5, none of the differences in the pre-announcement and post-announcement values of these measures of risk are significantly different from zero.

Using an F-test, I determined that the cross-sectional variance of the residuals from the estimation period of the market model did not change significantly. During EstP the estimated standard deviation of residuals was 0.0237; during Days +11 to +210 the estimated standard deviation of residuals was 0.0256 (two-tailed $p = 0.56$).

Analysis of Impact of Moderating Variables

In order to determine firm size impact on abnormal returns, the full sample of 204 firms was split into two groups. A firm was classified as large if its average assets from the fiscal years immediately preceding and following the ISO 9000 certification announcement were above the median for the whole sample ($224,469,000); those with assets below the sample median were classified as small. Table 6 presents the abnormal returns for all models and event periods by large and small firms. The results for the

event day (Day 0) are particularly interesting, because the large firms' mean and median returns for every model are negative and statistically significant ($p \leq 0.03$). Anywhere from 39.2% to 42.2% of the large firm returns are less then zero, depending on the model used to generate the returns. In each case, the sign test is significantly different from 50% ($p \leq 0.06$). For small firms, only the Day –1 median from the Mean Adjusted Model is statistically different from zero ($p = 0.04$). The skewness of the Day 0 small firms is approximately equal to one for each of the return generating models. Anywhere from 2 to 4 of the 102 abnormal returns are greater than 15%, depending on the model that is used. Nonetheless, the large firm means, which range from -1.10% to -0.68%, and small

Table 6. Comparison of Large Firm to Small Firm Equity Abnormal Returns*

Panel A: Large Firms (N = 102)

N=102	Day -1		Day 0		Day +1		CAR (-1,0)		CAR (0,+1)	
Market Model										
Mean	0.02%	(0.47)	-0.68%	**(0.03)**	-0.09%	(0.39)	-0.66%	(0.08)	-0.77%	**(0.04)**
Median	-0.29%	(0.25)	-0.43%	**(0.03)**	-0.14%	(0.28)	-0.47%	**(0.04)**	-0.27%	**(0.04)**
% Positive	46.08%	(0.21)	42.16%	(0.06)	46.08%	(0.21)	43.14%	(0.08)	47.06%	(0.28)
Mean Adjusted Model										
Mean	0.20%	(0.29)	-0.68%	**(0.03)**	-0.09%	(0.39)	-0.48%	(0.16)	-0.77%	**(0.04)**
Median	-0.10%	(0.34)	-0.43%	**(0.03)**	-0.14%	(0.28)	-0.30%	(0.08)	-0.27%	**(0.04)**
% Positive	50.00%	(0.50)	42.16%	(0.06)	46.08%	(0.21)	43.14%	(0.08)	47.06%	(0.28)
Market Adjusted Model										
Mean	0.10%	(0.39)	-0.71%	**(0.03)**	-0.17%	(0.32)	-0.61%	(0.11)	-0.88%	**(0.03)**
Median	-0.28%	(0.20)	-0.50%	**(0.03)**	-0.09%	(0.23)	-0.78%	**(0.03)**	-0.48%	**(0.02)**
% Positive	46.08%	(0.21)	39.22%	**(0.01)**	48.04%	(0.35)	39.22%	**(0.01)**	47.06%	(0.28)
Size & Industry Adjusted Model										
Mean	-0.02%	(0.48)	-1.10%	**(0.005)**	0.21%	(0.33)	-1.13%	**(0.05)**	-0.89%	(0.07)
Median	-0.40%	(0.19)	-0.54%	**(0.01)**	-0.12%	(0.38)	-0.87%	**(0.02)**	-0.47%	(0.18)
% Positive	44.12%	(0.12)	42.16%	(0.06)	49.02%	(0.42)	43.14%	(0.08)	43.14%	(0.08)
Size & Industry Adjusted Market Model										
Mean	0.04%	(0.46)	-0.99%	**(0.01)**	0.41%	(0.19)	-0.95%	(0.07)	-0.58%	(0.17)
Median	-0.40%	(0.21)	-0.63%	**(0.02)**	0.11%	(0.22)	-0.85%	**(0.03)**	-0.11%	(0.30)
% Positive	45.10%	(0.16)	42.16%	(0.06)	50.98%	(0.42)	41.18%	**(0.04)**	50.00%	(0.50)

Table 6. Comparison of Large Firm to Small Firm Equity Abnormal Returns *(continued)*

Panel B. Small Firms (N = 102)

N=102	Day -1		Day 0		Day +1		CAR (-1,0)		CAR (0,+1)	
Market Model										
Mean	-0.52%	(0.22)	0.65%	(0.13)	-0.21%	(0.36)	0.13%	(0.43)	0.43%	(0.31)
Median	-0.32%	(0.15)	-0.14%	(0.32)	-0.17%	(0.22)	-0.70%	(0.27)	0.17%	(0.47)
% Positive	44.12%	(0.12)	48.04%	(0.35)	47.06%	(0.28)	48.04%	(0.35)	51.96%	(0.35)
Mean Adjusted Model										
Mean	-0.70%	(0.13)	0.65%	(0.13)	-0.21%	(0.36)	-0.05%	(0.47)	0.43%	(0.31)
Median	-0.36%	**(0.04)**	-0.14%	(0.32)	-0.17%	(0.22)	-0.88%	(0.20)	0.17%	(0.47)
% Positive	42.16%	(0.06)	48.04%	(0.35)	47.06%	(0.28)	43.14%	(0.08)	51.96%	(0.35)
Market Adjusted Model										
Mean	-0.53%	(0.20)	0.85%	(0.07)	-0.14%	(0.41)	0.32%	(0.32)	0.71%	(0.21)
Median	-0.25%	(0.12)	-0.03%	(0.16)	-0.11%	(0.27)	-0.39%	(0.40)	0.62%	(0.27)
% Positive	43.14%	(0.08)	50.00%	(0.50)	49.02%	(0.42)	48.04%	(0.35)	56.86%	(0.08)
Size & Industry Adjusted Model										
Mean	-0.82%	(0.15)	0.74%	(0.20)	0.55%	(0.25)	-0.08%	(0.47)	1.29%	(0.14)
Median	-1.07%	(0.21)	0.22%	(0.28)	0.51%	(0.26)	-0.24%	(0.48)	0.62%	(0.32)
% Positive	42.16%	(0.06)	50.98%	(0.42)	51.96%	(0.35)	49.02%	(0.42)	52.94%	(0.28)
Size & Industry Adjusted Market Model										
Mean	-0.82%	(0.16)	0.63%	(0.24)	0.55%	(0.24)	-0.19%	(0.43)	1.18%	(0.16)
Median	-0.89%	(0.26)	0.04%	(0.31)	0.84%	(0.27)	-0.36%	(0.46)	0.17%	(0.39)
% Positive	44.12%	(0.12)	50.00%	(0.50)	52.94%	(0.28)	48.04%	(0.35)	50.98%	(0.42)

*The Student T-test statistic tests if the mean is different from zero; Wilcoxon Signed Rank Test statistic tests if the median is different from zero; Binomial Sign Test statistic tests if the percentage of firms with a positive abnormal returns is different from 50%. One-tailed p-values are in parentheses.

firm means, which range from 0.63% to 0.85%, are significantly different from each other in a one-tailed t-test ($p \leq 0.05$).

The observed difference in the mean abnormal returns between the large and small firm sub-samples could be a result of the "small firm effect" documented by Banz (1981) and Reinganum (1981). Furthermore, industry-wide effects could be driving these results, particularly since the mean assets of firms within different industry sectors vary

widely.[7] To control for these factors, I also report the results from the Size and Industry Adjusted Model and the Size and Industry Adjusted Market Model in Table 6. For both the large and small firm sub-samples, these two models generate abnormal returns similar to the three primary models. The proportions of positive abnormal returns are also similar, suggesting that neither the "small firm effect" nor industry-wide market movements are the cause of the significantly less negative returns observed for small firms.

The negative abnormal returns observed for large firms could be the result of a shift in wealth from equityholders to bondholders due to a decrease in the variance of the rate of return of the firm's assets (Galai & Masulis, 1976). In this situation, measuring only the abnormal returns or the change in the market value of equity could be underestimating the total impact of the certification announcement on the market value of the firm. Conversely, in the case of the small firm sub-sample, the magnitude of the market reaction to ISO 9000 certification was only marginally positive. However, if the variance of the rate of return of the firm's assets remains unchanged, measuring only the change in the market value of equity always underestimates the impact of the announcement on the overall market value of the firm (Black & Scholes, 1973; Galai & Masulis, 1976). Table 7 shows the change in the variance of the rate of return of assets for the sub-samples. For large firms, the mean (median) reduction in the standard deviation of 0.0014 (0.0005) is statistically significant ($p = 0.005$ ($p = 0.02$)). Over 60% of the large firms experienced a reduction in asset variance, and the sign test is

[7] For example, the mean assets for the 8 finance firms in the sample is nearly $500 billion, or about 650 times the mean assets for the 30 instrumentation and medical device firms ($750 million). For a complete breakdown of firm size by industry sector, see Table 2.

significantly different from 50% (p = 0.02). For small firms, the mean (median) increase in the standard deviation of 0.0015 (0.0006) is not statistically significant from zero (p = 0.26 (p = 0.39)). Fewer than 50% of the small firms experienced an increase in asset variance, but the sign test is insignificant (p = 0.43).

Table 7. Measures of Variance in the Rate of Return on a Firm's Assets Before and After the Announcement of ISO 9000 Certification, Large and Small Firm Sub-Samples

	Pre-Announcement	Post-Announcement	Difference[a]	p-Value[b]
Large Firm Mean σ_a	0.0139	0.0126	-0.0014	**0.005**
Large Firm Median σ_a	0.0100	0.0101	-0.0005	**0.02**
% of Large Firms with Decrease in post-announcement σ_e			61.76%	**0.02**
Small Firm Mean σ_a	0.0285	0.0300	0.0015	0.26
Small Firm Median σ_a	0.0265	0.0279	0.0006	0.39
% of Small Firms with Decrease in post-announcement σ_a			46.08%	0.43

[a] This is the average of the differences between pre-and post-announcement values, not the difference of the averages.

[b] The Student T-test statistic tests if the mean is different from zero; Wilcoxon Signed Rank Test statistic tests if the median is different from zero; Binomial Sign Test statistic tests if the percentage of firms with a decrease in post-announcement betas is different from 50%. All p-values are two-tailed.

The results in Tables 6 and 7 suggest that large firms experience a decrease in the market value of equity after an ISO 9000 certification announcement as evidenced by significant negative Day 0 abnormal returns. That reduction is likely the result of a shift of wealth from equityholders to bondholders because of a decrease in the variance of the rate of return on assets. Therefore, the total impact of ISO 9000 certification announcements on the overall market value of large firms is tempered by that value shift and may be greater than the impact on the market value of equity. Small firms experience an increase in the market value of equity as evidenced by marginally significant positive abnormal returns. The increase in overall market value is likely larger because the asset variance of the firm does not significantly change. Neither the

"small firm effect" nor industry-wide market movements are driving the results. These outcomes suggest the announcement of ISO 9000 certification results in a more positive change in market value for small firms than for large firms. These findings are in concurrence with Docking and Dowen (1999), who observed significant increases in stock prices after ISO 9000 registration only for smaller firms.

Table 8 shows abnormal returns in sub-samples according to the standard to which the firm was certified, i.e., ISO 9001:1994, 9002:1994, and 9001:2000. None of the Day 0 or Day +1 means is significantly different from zero, but the Day -1 returns are worth further discussion. For announcements to the ISO 9001:1994 standard, the mean Day -1 abnormal returns range from -0.75% to -0.66% and the medians range from -0.82% to -0.73% depending on the model that is used. The means are marginally significant ($p \leq 0.10$), and the medians are statistically significant ($p \leq 0.04$). Fewer than 40% of the Day -1 abnormal returns are positive regardless of the model that is used, and the sign test is significantly different from 50% ($p \leq 0.02$). For announcements to the ISO 9002:1994 standard, none of the mean or median abnormal returns is significantly different from zero, nor is the percentage of positive returns significantly different from 50%. For announcements to the ISO 9001:2000 standard, the mean Day -1 abnormal returns range from 0.98% to 1.20% and are marginally significant ($p \leq 0.10$). The mean Day -1 abnormal returns for announcements to ISO 9001:2000 are significantly greater ($p \leq 0.03$) than the mean returns for announcements to the 1994 standards (both ISO 9001:1994 and ISO 9002:1994).

Table 8. Comparison of 2000 Standard to 1994 Standards Equity Abnormal Returns

Panel A: ISO 9001:1994 (N=99)

N=99	Day -1		Day 0		Day +1		CAR (-1,0)		CAR (0,+1)	
Market Model										
Mean	-0.75%	(0.09)	-0.04%	(0.47)	-0.49%	(0.17)	-0.79%	(0.11)	-0.53%	(0.25)
Median	-0.77%	**(0.04)**	-0.37%	(0.27)	-0.41%	(0.07)	-1.21%	**(0.02)**	-0.04%	(0.20)
% Positive	38.38%	**(0.01)**	43.43%	(0.10)	44.44%	(0.13)	39.39%	**(0.02)**	49.49%	(0.46)
Mean Adjusted Model										
Mean	-0.70%	(0.09)	-0.01%	(0.49)	-0.45%	(0.20)	-0.70%	(0.13)	-0.46%	(0.28)
Median	-0.73%	**(0.01)**	-0.36%	(0.22)	-0.45%	(0.06)	-0.76%	**(0.02)**	0.01%	(0.21)
% Positive	39.39%	**(0.02)**	40.40%	**(0.03)**	41.41%	**(0.04)**	41.41%	**(0.04)**	50.51%	(0.46)
Market Adjusted Model										
Mean	-0.66%	(0.10)	-0.01%	(0.49)	-0.44%	(0.20)	-0.67%	(0.13)	-0.45%	(0.28)
Median	-0.82%	**(0.02)**	-0.37%	(0.27)	-0.25%	(0.12)	-1.00%	**(0.02)**	0.04%	(0.26)
% Positive	37.37%	**(0.01)**	41.41%	**(0.04)**	46.46%	(0.24)	37.37%	**(0.01)**	50.51%	(0.46)

Panel B: ISO 9002:1994 (N=57)

Market Model										
Mean	-0.41%	(0.26)	0.16%	(0.41)	0.33%	(0.30)	-0.26%	(0.37)	0.49%	(0.31)
Median	-0.31%	(0.28)	-0.80%	(0.25)	-0.14%	(0.41)	-0.87%	(0.19)	-0.22%	(0.35)
% Positive	45.61%	(0.25)	45.61%	(0.25)	45.61%	(0.25)	42.11%	(0.12)	49.12%	(0.45)
Mean Adjusted Model										
Mean	-0.54%	(0.20)	0.30%	(0.33)	0.15%	(0.42)	-0.25%	(0.37)	0.45%	(0.34)
Median	0.02%	(0.32)	-0.02%	(0.40)	-0.13%	(0.21)	-1.30%	(0.13)	0.03%	(0.38)
% Positive	50.88%	(0.45)	49.12%	(0.45)	43.86%	(0.18)	42.11%	(0.12)	50.88%	(0.45)
Market Adjusted Model										
Mean	-0.65%	(0.16)	0.36%	(0.31)	0.44%	(0.26)	-0.29%	(0.35)	0.80%	(0.22)
Median	-0.06%	(0.20)	-0.27%	(0.38)	-0.12%	(0.49)	-1.72%	(0.12)	0.15%	(0.46)
% Positive	47.37%	(0.35)	45.61%	(0.25)	47.37%	(0.35)	43.86%	(0.18)	52.63%	(0.35)

Panel C: ISO 9001:2000 (N=50)

Market Model										
Mean	0.98%	(0.10)	0.00%	(0.50)	-0.16%	(0.40)	0.98%	(0.13)	-0.15%	(0.41)
Median	0.43%	(0.20)	-0.26%	(0.47)	0.00%	(0.47)	0.63%	(0.14)	-0.06%	(0.39)
% Positive	58.00%	(0.13)	48.00%	(0.39)	50.00%	(0.50)	62.00%	(0.04)	50.00%	(0.50)
Mean Adjusted Model										
Mean	0.99%	(0.09)	0.13%	(0.43)	-0.41%	(0.24)	1.11%	(0.12)	-0.29%	(0.34)
Median	0.10%	(0.24)	0.06%	(0.46)	-0.06%	(0.36)	0.33%	(0.14)	-0.13%	(0.28)
% Positive	56.00%	(0.20)	52.00%	(0.39)	48.00%	(0.39)	56.00%	(0.20)	48.00%	(0.39)
Market Adjusted Model										
Mean	1.20%	(0.06)	0.06%	(0.47)	-0.38%	(0.26)	1.25%	(0.08)	-0.32%	(0.31)
Median	0.08%	(0.14)	-0.01%	(0.41)	0.24%	(0.33)	0.38%	(0.09)	0.13%	(0.31)
% Positive	56.00%	(0.20)	50.00%	(0.50)	52.00%	(0.39)	56.00%	(0.20)	54.00%	(0.29)

Table 8. Comparison of 2000 Standard to 1994 Standards Equity Abnormal Returns *(continued)*

Panel D: T-Test For Equity of Means (1994 vs. 2000 Series Standards)										
	Day -1		**Day 0**		**Day +1**		**CAR(-1,0)**		**CAR(0,+1)**	
Market Model										
T-statistic	1.900	**(0.03)**	-0.047	(0.48)	0.031	(0.49)	1.584	(0.06)	-0.014	(0.49)
Mean Adjusted Model										
T-statistic	1.955	**(0.03)**	0.019	(0.49)	-0.259	(0.40)	1.559	(0.06)	-0.187	(0.43)
Market Adjusted Model										
T-statistic	2.223	**(0.02)**	-0.098	(0.46)	-0.383	(0.35)	1.772	**(0.04)**	-0.394	(0.35)

*The Student T-test statistic tests if the mean is different from zero; Wilcoxon Signed Rank Test statistic tests if the median is different from zero; Binomial Sign Test statistic tests if the percentage of firms with a positive abnormal returns is different from 50%. One-tailed p-values are in parentheses.

It may be possible that a correlation between firm size and certification standard could be driving these results (i.e., many large firms pursuing certification to the 1994 standards and many small firms pursuing certification to the 2000 standard). To determine if this was the case, I divided the firms into four sub-samples: large 1994 registered firms (N = 75), small 1994 registered firms (N = 80), large 2000 registered firms (N = 28), and small 2000 registered firms (N = 22). Table 9 contains the CAR(-1,0) for each of the five models.[8] The mean (median) abnormal returns for large firms announcing certification to the 1994 standards range from -1.72% (-1.32%) to -0.44% (-0.76%). The large 1994 means are statistically significant for the Size & Industry Adjusted Model ($p = 0.02$) and the Size & Industry Adjusted Market Model ($p = 0.03$), and the medians are statistically less than zero for all five models ($p \leq 0.05$). The mean (median) abnormal returns for small firms announcing certification to the 1994 standards range from -0.86% (-1.30%) to -0.43% (-0.91%). None of the small 1994

[8] I analyzed the results for each of the event periods, but the CAR (-1,0) results are worth further examination due to the statistical significance on Day 0 when the sample was divided by size and on Day -1 when the sample was divided by standard classification. For the sake of brevity, only the CAR (-1,0) results are reported hereafter.

means are statistically different from zero, and the median is statistically less than zero only for the Mean Adjusted Model (p = 0.05). This suggests that firm size alone is not driving the results for announcements to the 1994 standards. The market value of equity decreases for a firm announcing certification to the 1994 standards, but the change is tempered if the firm is small.[9]

The mean (median) abnormal return for large firms announcing certification to the 2000 standard ranges from –0.25% (-0.15%) to 0.83% (0.48%) and is not statistically different from zero for any of the five models. The mean (median) abnormal return for small firms announcing certification to the 2000 standard ranges from 2.22% (1.46%) to 3.04% (2.40%). None of the means is statistically different from zero, and only the median from the Market Adjusted Model is statistically significant (p = 0.05). Approximately two-thirds of all small firms experienced a positive reaction to the announcement of ISO 9001:2000 certification, and the sign tests for three of the five models are statistically significant (p = 0.04). The market value of equity increases for a firm announcing certification to the 2000 standard, but this reaction is tempered if the firm is large.[10] Statistical values are not necessarily predictive because of the small

[9] The mean (median) standard deviation of the rate of return on the firm's assets for large firms announcing certification to the 1994 standards decreases by 0.0005 (0.0003), which is insignificantly different from zero (p = 0.25 (0.35)). The mean (median) standard deviation of the rate of return on the firm's assets for small firms announcing certification to the 1994 standards increases by 0.0024 (0.0015), which is insignificantly different from zero (p = 0.14 (0.15)). Because there is a shift in the market value of equity but not in the asset variance, there may be a shift in wealth from equity holders to bondholders, and the total change in the market value of equity may underestimate the total impact on the overall market value of the firm (Black & Scholes, 1973; Galai & Masulis, 1976).

[10] The mean (median) standard deviation of the rate of return on the firm's assets for large firms announcing certification to ISO 9001:2000 decreases by 0.0038 (0.0025), which is significantly different from zero (p = 0.004 (0.005)). The mean (median) standard deviation of the rate of return on the firm's assets for small firms announcing certification to ISO 9001:2000 decreases by 0.0018 (0.0018), which is insignificantly different from zero (p = 0.18 (0.24)). Because there is an increase in the market value of equity and possibly a decrease in the asset variance, there may be a shift in wealth from equity holders to bondholders, and the total change in the market value of equity may underestimate the total impact on the overall market value of the firm (Black & Scholes, 1973; Galai & Masulis, 1976).

sample sizes related to ISO 9001:2000 certification. Nonetheless, I can safely assert that firm size alone is not driving the results for announcements related to the 2000 standard. I can also state that the market reaction to ISO 9001:2000 certification is significantly more positive than the reaction to ISO 9001:1994 or ISO 9002:1994.

Table 9. (CAR(-1,0)) for Firm Size and Standard Classification (1994 Standards and 2000 Standard)

	Market Model		Mean Adjusted Model		Market Adjusted Model		Size & Industry Adjusted Model		Size & Industry Adjusted Market Model	
Announcements by Large Firms to the 1994 Standards (N=75)										
Mean	-0.65%	(0.12)	-0.44%	(0.22)	-0.62%	(0.14)	-1.72%	**(0.02)**	-1.50%	**(0.03)**
Median	-0.87%	**(0.03)**	-0.76%	**(0.05)**	-1.27%	**(0.03)**	-1.32%	**(0.01)**	-1.07%	**(0.01)**
% Positive	38.67%	**(0.02)**	40.00%	**(0.04)**	36.00%	**(0.01)**	36.00%	**(0.01)**	36.00%	**(0.01)**
Announcements by Small Firms to the 1994 Standards (N=80)										
Mean	-0.54%	(0.25)	-0.63%	(0.21)	-0.43%	(0.28)	-0.85%	(0.26)	-0.86%	(0.26)
Median	-1.30%	(0.09)	-0.99%	**(0.05)**	-0.91%	(0.10)	-1.08%	(0.27)	-1.02%	(0.22)
% Positive	42.50%	(0.09)	43.75%	(0.13)	43.75%	(0.13)	43.75%	(0.13)	43.75%	(0.13)
Announcements by Large Firms to the 2000 Standard (N=28)										
Mean	-0.25%	(0.39)	-0.22%	(0.42)	-0.16%	(0.44)	0.77%	(0.26)	0.83%	(0.25)
Median	0.27%	(0.38)	-0.15%	(0.49)	-0.11%	(0.49)	0.48%	(0.24)	0.10%	(0.24)
% Positive	57.14%	(0.22)	46.43%	(0.35)	50.00%	(0.50)	64.29%	(0.07)	57.14%	(0.22)
Announcements by Small Firms to the 2000 Standard (N=22)										
Mean	2.55%	(0.34)	2.80%	(0.36)	3.04%	(0.38)	2.72%	(0.36)	2.22%	(0.32)
Median	1.46%	(0.12)	1.50%	(0.10)	2.02%	**(0.05)**	2.40%	(0.11)	2.12%	(0.13)
% Positive	68.18%	**(0.04)**	68.18%	**(0.04)**	63.64%	(0.10)	68.18%	**(0.04)**	63.64%	(0.10)

*The Student T-test statistic tests if the mean is different from zero; Wilcoxon Signed Rank Test statistic tests if the median is different from zero; Binomial Sign Test statistic tests if the percentage of firms with a positive abnormal returns is different from 50%. One-tailed p-values are in parentheses.

For added robustness, I also test the relations between abnormal returns on both size and standard classification using the following regression model:

$$A_i = \alpha_0 + \alpha_1 Size_i + \alpha_2 Class_i + \varepsilon_i \quad (15)$$

where A_i is the abnormal return of stock i. $Size_i$ is the natural logarithm of the average assets in the fiscal years preceding and during the announcement, and in accordance with H3, the term is predicted to be negative. $Class_i$ indicates the standard to which the firm was certified. This variable takes a value of 0 for firms certified to ISO 9001:1994 or ISO 9002:1994, and it takes a value of 1 for firms certified to ISO 9001:2000. ε_i is the random error term. Regressions were calculated for all five return-generating models.

The regression results are reported in Table 10. In accordance with H3 and H4, the coefficient for size is predicted to be negative, while the coefficient for classification is predicted to be positive. The model offers no evidence to support either H3 or H4; however, $Class_i$ is a binary, not a continuous variable, so the relationship may be stronger than predicted by the regression model. Furthermore, the intercept term is significantly different from zero in only one of the 25 regression models.

The results described above could be due to a poor fit of the regression model. In fact, only the Day -1 regression models are significant and only if industry effects are taken into account. The F-values for the Day -1 Size and Industry Adjusted Model and the Size and Industry Adjusted Market Model are significant at $\alpha = 0.05$, with values of 3.87 and 3.57, respectively. R^2 values for all 25 models are less that 4%, much less than would be expected for a well-fitting regression model, even for cross-sectional data such as these. Because the regression models are generally poor fits of the return data, there may be other factors that moderate the sign and magnitude of equity abnormal returns beside firm size and standard classification. While an exploratory analysis of such factors is beyond the scope of this paper, the topic is worthy of further study.

Table 10. Estimated Coefficients (t-statistics in parentheses) from Regressions of Event Period Abnormal Returns on Size and Standard Classification

Day -1											
Variable	**Predicted Sign**	**Market Model**		**Mean Adjusted Model**		**Market Adjusted Model**		**Size & Industry Adjusted Model**		**Size & Industry Adjusted Market Model**	
Intercept	?	-0.0137	(-1.48)	-0.0153	(-1.70)[a]	-0.0126	(-1.40)	-0.0188	(-1.64)	-0.0195	(-1.67)[a]
Size	-	0.0161	(1.87)[a]	0.0161	(1.93)[a]	0.0185	(2.23)[b]	0.0282	(2.65)[b]	0.0270	(2.50)[b]
Classification	+	0.0013	(0.88)	0.0015	(1.10)	0.0010	(0.73)	0.0013	(0.75)	0.0015	(0.86)
N		204		204		204		204		204	
Model F-value		2.18		2.54		2.79		3.87[a]		3.57[a]	
R^2		2.12%		2.46%		2.70%		3.70%		3.43%	
Day 0											
Variable	**Predicted Sign**	**Market Model**		**Mean Adjusted Model**		**Market Adjusted Model**		**Size & Industry Adjusted Model**		**Size & Industry Adjusted Market Model**	
Intercept	?	0.0114	(1.32)	0.0135	(1.52)	0.0146	(1.67)[a]	0.0103	(0.83)	0.0089	(0.72)
Size	-	0.0006	(0.07)	0.0012	(0.14)	0.0003	(0.03)	0.0015	(0.13)	-0.0003	(-0.02)
Classification	+	-0.0020	(-1.51)	-0.0023	(-1.65)[a]	-0.0024	(-1.79)[a]	-0.0021	(-1.12)	-0.0018	(-0.96)
N		204		204		204		204		204	
Model F-value		1.15		1.37		1.60		0.64		0.47	
R^2		1.13%		1.35%		1.57%		0.63%		0.46%	
Day +1											
Variable	**Predicted Sign**	**Market Model**		**Mean Adjusted Model**		**Market Adjusted Model**		**Size & Industry Adjusted Model**		**Size & Industry Adjusted Market Model**	
Intercept	?	-0.0036	(-0.42)	-0.0020	(-0.22)	-0.0029	(-0.34)	0.0029	(0.25)	0.0027	(0.24)
Size	-	-0.0001	(-0.01)[a]	-0.0021	(-0.25)	-0.0030	(-0.38)	0.0161	(1.49)	0.0159	(1.50)
Classification	+	0.0004	(0.28)	0.0000	(-0.01)	0.0004	(0.28)	-0.0005	(-0.29)	-0.0003	(-0.18)
N		204		204		204		204		204	
Model F-value		0.04		0.03		0.11		1.14		1.14	
R^2		0.04%		0.03%		0.11%		1.12%		1.12%	

Table 10. Estimated Coefficients (t-statistics in parentheses) from Regressions of Event Period Abnormal Returns on Size and Standard Classification (*continued)*

CAR(-1,0)											
Variable	**Predicted Sign**	**Market Model**		**Mean Adjusted Model**		**Market Adjusted Model**		**Size & Industry Adjusted Model**		**Size & Industry Adjusted Market Model**	
Intercept	?	-0.0024	(-0.22)	-0.0018	(-0.16)	0.0021	(0.20)	-0.0085	(-0.53)	-0.0105	(-0.65)
Size	-	0.0166	(1.68)	0.0173	(1.73)[a]	0.0188	(1.93)[a]	0.0297	(1.98)[a]	0.0267	(1.77)[a]
Classification	+	-0.0007	(-0.46)	-0.0007	(-0.45)	-0.0014	(-0.87)	-0.0008	(-0.33)	-0.0003	(-0.12)
N		204		204		204		204		204	
Model F-value		1.49		1.57		2.20		1.99		1.58	
R^2		1.46%		1.54%		2.14%		1.94%		1.54%	
CAR(0,+1)											
Variable	**Predicted Sign**	**Market Model**		**Mean Adjusted Model**		**Market Adjusted Model**		**Size & Industry Adjusted Model**		**Size & Industry Adjusted Market Model**	
Intercept	?	0.0077	(0.63)	0.0116	(0.91)	0.0117	(0.93)	0.0132	(0.78)	0.0117	(0.70)
Size	-	0.0005	(0.04)	-0.0009	(-0.08)	-0.0028	(-0.24)	0.0175	(1.12)	0.0156	(1.01)
Classification	+	-0.0016	(-0.86)	-0.0023	(-1.16)	-0.0020	(-1.06)	-0.0027	(-1.03)	-0.0021	(-0.83)
N		204		204		204		204		204	
Model F-value		0.37		0.68		0.60		1.13		0.83	
R^2		0.37%		0.67%		0.59%		1.11%		0.82%	

Significant at (a) $\alpha = 0.05$, (b) $\alpha = 0.01$

Dollar Change in the Market Value of Equity

Table 11 presents summary statistics for the actual dollar change in the market value of equity during the period surrounding an ISO 9000 certification announcement. The table presents results for the complete sample and the various sub-samples. Because I observed significant wealth effects on both Day –1 and Day 0, I computed the compounded abnormal return $CmAR_i(t_1,t_2)$ from the day before the announcement to the day of the announcement. This figure represents the total amount of money gained or lost by the shareholders of the firm assuming the shares were purchased at the Day -1 opening bell and sold at the Day 0 closing bell. The compounded abnormal return is:

$$CmAR_i(t_1,t_2) = \prod_{t=t_1}^{t_2}(1 + A_{it}) \tag{16}$$

where A_{it} is the abnormal return for stock i on Day t. For these calculations, I used the Market Model returns since they control for the systematic risk of the stock. The dollar change in the market value of equity $\$_i(t_1,t_2)$ is then:

$$\$_i(t_1,t_2) = [SO_{t_1-1}] \cdot [P_{t_1-1}] \cdot [CmAR(t_1,t_2)] \tag{17}$$

where SO_{t_1-1} is the number of shares outstanding on the day before the period of interest, P_{t_1-1} is the stock's closing price on the day before the period of interest.

The mean absolute change in market value may be misleading because the measure is heavily biased towards large or highly capitalized firms. For this reason, statistic tests were not performed on these measurements and are presented in Table 11 as purely descriptive. Outliers can and do in this case significantly impact the results. The total sample of firms lost $111.8 billion during the Day(-1,0) event period. However, almost 90% of this loss is attributed to one firm (Merisel), which is a large firm that

announced the extension of ISO 9001:1994 certification to a new facility.[11] Hence, these sub-samples are similarly skewed to the left. The median change in market value is likely a better indicator for these affected sub-samples.

Table 11. Dollar Change (in $1000s) in the Market Value of Equity Compounded from Day -1 to Day 0 (ISO 9000 Certification Announcement Day)

	N	Mean	Median	Standard Deviation	Maximum	Minimum
Complete Sample	204	-548,102	-404	7,081,237	7,008,576	-99,978,863
Large Firms	102	-1,096,491	-8,289	10,008,837	7,008,576	-99,978,863
Small Firms	102	287	-144	8,502	48,426	-40,809
ISO 9001:1994 Announcements	99	-989,514	-596	10,104,169	7,008,576	-99,978,863
ISO 9002:1994 Announcements	57	-250,693	259	1,543,013	4,466,597	-8,910,822
ISO 9001:2000 Announcements	50	8,958	-1,152	169,889	654,510	-664,274

Post-announcement Stock Price Performance

It is possible that the market could have a later reaction outside the event window because investors might not be aware of the certification until after the announcement (i.e., when it is published in a quarterly database of registered companies). It is also possible that the market could have over- or under-reacted to the announcement in the short-term (Hendricks & Singhal, 2003). To test if there are any abnormal returns that

[11] Three days after the announcement, the *Wall Street Journal* published a Business Brief that Merisel was cutting 400 jobs and expected a loss of $0.15 to $0.20 a share for the upcoming quarter. These losses were the result of restructuring plans that had been announced about two weeks prior to the certification announcement. It is possible that such a large loss could be late reaction to the unfavorable news of restructuring. The firm was not removed from the sample because only one article was published in the *Wall Street Journal* within a week of the certification announcement (Appendix A, Criterion 8). I note that if I drop this firm from this analysis, the mean (median) change in the market value of equity (in $1000s) is -58,295 (-396) for the complete sample, -117,457 (-7.844) for large firms, and 20,581 (-505) for ISO 9001:1994 firms.

occur after the event window, I also tested the stock price performance for 60 trading days after the announcement.[12]

All cumulative abnormal returns for this section are calculated using the Market Adjusted Model. The mean (median) 60 day cumulative abnormal return for the entire sample of firms is 7.95% (1.95%), The mean 60 day CAR is significantly greater than zero (two-tailed p = 0.006), but the median is only marginally significant (two-tailed p = 0.09). 52.9% of the returns are positive, which is insignificantly different from 50% (two-tailed p = 0.40). Since firm size or standard stringency may be driving the results, the analysis is repeated for both large firm and small firm sub-samples. For large firms, the mean (median) 60 day CAR is –2.51% (-0.33%), which is insignificantly different from zero (two-tailed p = 0.37 (0.72)). Exactly 50% of the large firm 60 day CARs are positive. For small firms, mean (median) 60 day CAR is 18.40% (3.41%), which is significantly greater than zero (two-tailed p = 0.0002 (0.006)). 55.9% of the returns are positive, which is insignificantly different from 50% (p = 0.24). For the sub-sample of firms announcing certification to the 1994 standards (N = 155), the mean (median) 60 day CAR is 11.82% (4.00%), which is significantly greater than zero (two-tailed p = 0.001 (0.008)). 58.1% of the returns are positive, which is marginally significantly different from 50% (two-tailed p = 0.05). For the sub-sample of firms announcing certification to ISO 9001:2000 (N = 50), the mean (median) 60 day CAR is

[12] 60 trading days is about one calendar quarter. During this time, a firm will have at least one quarterly earnings report and its ISO 9000 registration would have been published in the quarterly database of registered companies. Other than these practical concerns, there is no theoretical underpinning for the optimal time period to assess if the market has overreacted or underreacted to the announcement, and there is no guarantee that other factors could influence the results (Hendricks & Singhal, 2003).

-3.70% (-5.48%), which is insignificantly less than zero (two-tailed p = 0.42 (0.21)). 38.0% of the returns are positive, which is marginally significantly different from 50% (two-tailed p = 0.09).

The nature of these results suggests that outliers, particularly in the case of small firms, may be driving the results. Four firms were identified as having 60 day cumulative abnormal returns beyond the upper control limit of three sample standard deviations for the entire sample (122.41%).[13] The analysis was repeated with the four outliers removed. The mean (median) 60 day CAR for the trimmed sample (N = 200) is 5.01% (1.81%). The mean is statistically significant (two-tailed p = 0.05), but the median is insignificantly different from zero (two-tailed p = 0.20). 52.0% of the returns are positive, which is insignificantly different from 50% (two-tailed p = 0.57). For the trimmed sample of small firms (N = 98), the mean (median) 60 day CAR is 12.83% (2.47%), which is significantly greater than zero (two-tailed p = 0.002 (0.03)). 54.1% of the returns are positive, which is insignificantly different from 50% (two-tailed p = 0.42). For the trimmed sample of firms announcing certification to the 1994 standards (N = 151), the mean (median) 60 day CAR is 8.03% (3.90%), which is significantly greater than zero (two-tailed p = 0.007 (0.03)). 56.9% of the returns are positive, which is marginally significantly different from 50% (two-tailed p = 0.09). For the sub-sample of firms announcing certification to ISO 9001:2000 (N = 50), the mean (median) 60 day cumulative abnormal return is -3.70% (-5.48%), which is insignificantly less than zero (two-tailed p = 0.42 (0.21)). 38.0% of the returns are positive, which is marginally significantly different from 50% (two-tailed p = 0.09).

[13] The four firms are En Pointe Technologies, Emcore Corporation, Intelligroup, and AML Communications. Each of these firms was classified as small based on total assets.

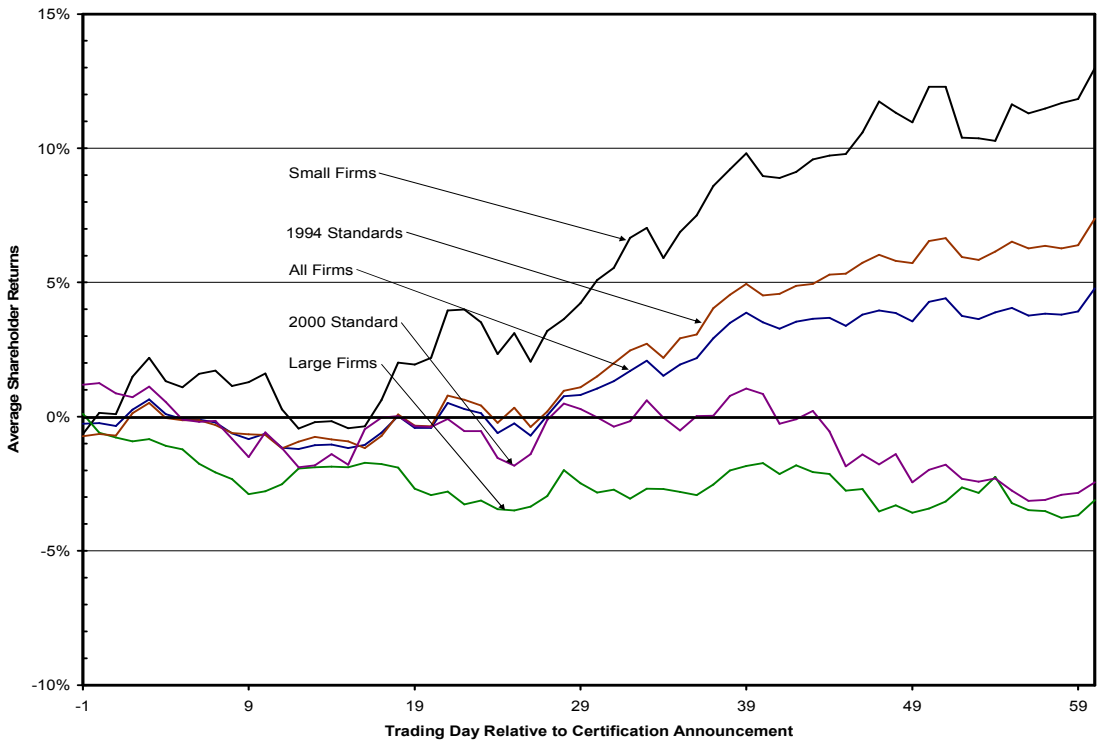

Figure 1. Mean Market Adjusted Shareholder Gain, Cumulated on a Daily Basis Starting on the Day Before the Announcement to 60 Days Later

Figure 1 shows the mean cumulative abnormal return (outliers trimmed) for the 60 day period following the announcement and the behavior of the stock price during the event period itself. Large firms and those announcing ISO 9001:2000 certification exhibit relatively flat abnormal returns in the calendar quarter following the announcement. Small firms and those announcing certification to the 1994 standards exhibit some positive gains in the second month following the announcement, but the levels of abnormal performance are relatively flat in the first and third months after the announcement. Because the other sub-samples exhibit such flat abnormal performance, it appears that small firms announcing certification to the 1994 standards are driving the

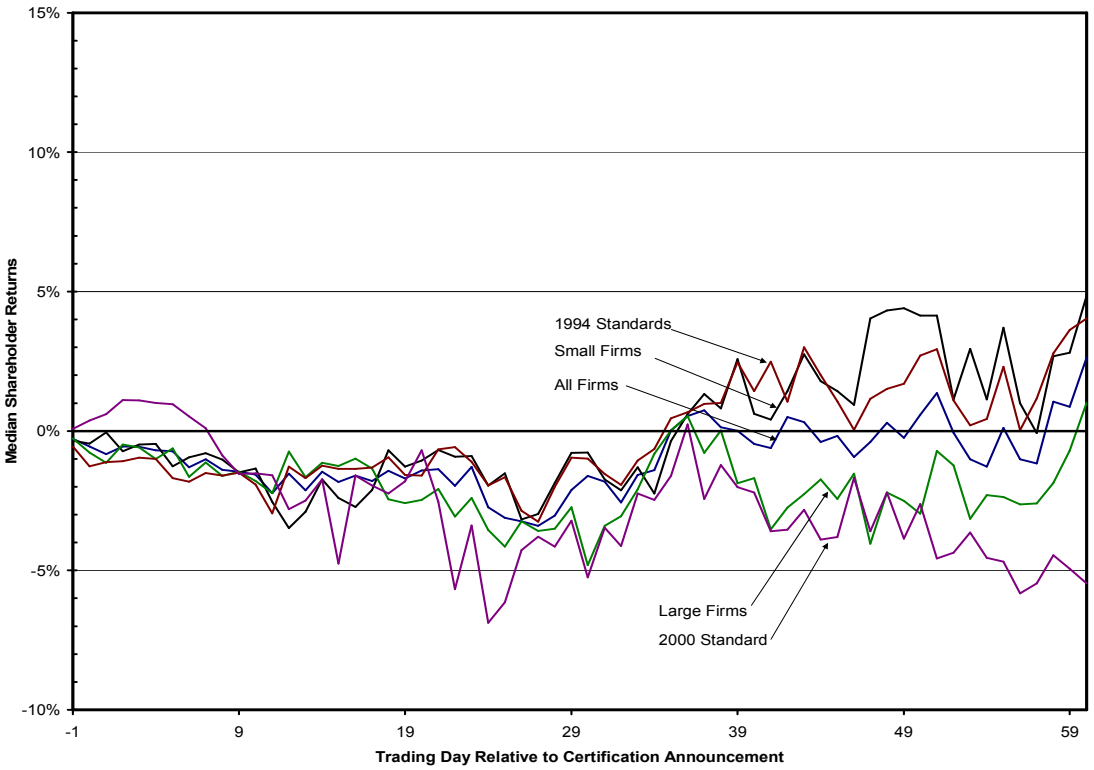

Figure 2. Median Market Adjusted Shareholder Gain, Cumulated on a Daily Basis Starting on the Day Before the Announcement to 60 Days Later

results for the complete sample of firms. Figure 2 depicts the median cumulative abnormal return (outliers trimmed) for the same 60 day time period. No trends are apparent for the medians of any of the sub-samples in the three months following the certification announcement, as the abnormal returns seem to fluctuate about zero.

To perform a sensitivity analysis and to determine if the choice of model is driving the nature of the results, I also compute the buy-and-hold abnormal return $BHAR_i(t_1,t_2)$ for the same 60 day period following the announcement.

$$BHAR_i(t_1,t_2) = \prod_{t=t_1}^{t_2}(1+r_{it}) - \prod_{t=t_1}^{t_2}(1+r_{ct}) \qquad (17)$$

where r_{it} is the return for stock i on Day t and r_{ct} is the Day t return for the control stock identified for the Size and Industry Adjusted Model. This quantity represents the abnormal percentage return on one dollar invested over the entire period of interest. For the entire sample with outliers trimmed (N = 200), the mean (median) buy-and-hold abnormal return is 9.35% (2.41%). The mean is marginally significant (two-tailed p = 0.06), while the median is insignificantly greater than zero (two-tailed p = 0.26). 52.5% of the buy-and-hold abnormal returns are positive, which is insignificantly different from 50% (two-tailed p = 0.48). For the sub-sample of large firms (N = 102), the mean (median) buy-and-hold abnormal return is –9.22% (0.21%), which is insignificantly different from zero (two-tailed p = 0.23 (0.60)). Exactly 50% of the large firm buy-and-hold abnormal returns are positive. For the sub-sample of small firms with outliers trimmed (N = 98), the mean (median) buy-and-hold abnormal return is 3.98% (4.71%), which is insignificantly different from zero (two-tailed p = 0.61 (0.38)). 54.9% of the small firm buy-and-hold abnormal returns are positive, which is insignificantly different from 50% (two-tailed p = 0.32). For the trimmed sample of firms announcing certification to the 1994 standards (N = 151), the mean (median) buy-and-hold abnormal return for the entire sample of firms is 4.21% (3.20%)**,** which is not significantly different from zero (two-tailed p = 0.26 (0.44)). 53.0% of the returns are positive, which is insignificantly different from 50% (two-tailed p = 0.46). For the sub-sample of firms announcing certification to ISO 9001:2000 (N = 50), the mean (median) buy-and-hold abnormal return for the entire sample of firms is 23.91% (3.83%)**,** which is insignificantly greater than zero (two-tailed p = 0.14 (0.34)). Exactly 50% of the buy-and-hold abnormal returns for firms announcing certification to ISO 9001:2000 are positive.

CHAPTER VII

DISCUSSION

Total Sample

When analyzing the complete sample of firms who had announced ISO 9000 certification, there were few statistically significant results. As shown in Table 3, only three out of the 45 tests were significant at $\alpha = 0.05$. Furthermore, there were significantly negative abnormal returns in only one out of these 45 tests (percentage of negative CAR(-1,0) from the Market Adjusted Model, $p = 0.03$). Overall, these results suggest that the market does not exhibit a strong positive reaction to an ISO 9000 certification announcement. The market value of firms in general does not significantly change; hence, I am unable to reject the null of H1.

Analysis of the risk parameters of the complete sample of firms yielded similarly statistically insignificant results. I was unable to detect any significant shifts (positive or negative) in equity beta, asset beta, debt leverage, equity variance, asset variance, or Market Model residuals. Overall, ISO 9000 certification announcements are not associated with a change in the systematic risk of a firm or its asset variance; therefore, there was no observable significant change in idiosyncratic risk and I am unable to reject the null of H2. Furthermore, there is scant evidence that certification announcements result in an exchange of wealth between bondholders and equityholders for the complete sample of firms.

Impact of Firm Size

There are statistically significant differences between large firms and small firms that announce ISO 9000 certification, particularly on the announcement date (Day 0). Both the mean and median large firm abnormal returns are significantly less than zero in all five models ($p \leq 0.03$), and the small firm means are slightly and marginally positive. I observe similar results for the three primary models and the two models that adjust for size and industry effects, suggesting that the statistically more positive abnormal returns are not due to the "small firm effect" described by Banz (1981) and Reinganum (1981). I also observe that large firms experience a significant decrease in asset variance after announcing ISO 9000 certification. Therefore, the reduction in the market value of equity may be the result of a shift of wealth from equityholders to bondholders and the impact of ISO 9000 certification announcements on the overall market value of large firms is not as negative as the impact on the market value of equity. I observe dissimilar behavior in small firms, for which ISO 9000 certification announcements lead to an insignificant increase in asset variance. The overall change in the market value of small firms is likely larger than the change in the market value of equity as the wealth of both bondholders and equityholders increases slightly. These results suggest that while the change in the overall market value of large firms might not be as negative as the change in the market value of equity, it is still less than the change in the overall market value of small firms. The results are similar to those reported by other researchers on the economic effects of quality awards and certifications (Docking & Dowen, 1999; Hendricks & Singhal, 1996). I can assert that ISO 9000 certification announcements

result in a more positive change in market value for small firms than for large firms, allowing a rejection of the null of H3.

There are several possible reasons for the differences in market value with respect to firm size. The media covers large firms more extensively than smaller firms, so the market may be able to better assess the quality practices of large firms. Certification, then, conveys little new information to the market causing a tempered reassessment of the firm's probability of implementing an effective quality program. Also, because ISO 9000 registration is usually site specific, announcing certification at just one site has the potential of affecting a greater proportion of a small firm's operations than those of a larger firm (Corbett, et al., 2005). For example, Citigroup appears four times in the sample because the company undertook an initiative in the late 1990s to get all of their call centers and data operation centers ISO 9002:1994 certified. The four CAR(-1,0) returns range from -1.5% to -4% regardless of the model used to estimate the abnormal returns.

Impact of Standard Stringency

Marginally statistically significant negative changes were observed in the market value of equity for firms announcing certification to ISO 9001:1994 ($p \leq 0.10$), insignificant negative changes for firms announcing certification to ISO 9002:1994 ($p \leq 0.16$), and marginally significant positive changes for firms announcing ISO 9001:2000 certification ($p \leq 0.10$). When I further divide the sample based on both the type of certification and firm size, I observe similar results. This suggests that while firm size may moderate the extent of the impact of the announcement on market value, it does

not drive the results with regards to the type of certification. My analysis suggests that the market reaction to ISO 9001:2000 announcements is more positive than the reaction to ISO 9001:1994 or ISO 9002:1994 announcements, allowing me to reject the null of H4.

The difference between the market perceptions of ISO 9001:2000 and the 1994 standards could be the result of several factors. The costs of certification could be lower for the newer standard due to fewer documentation requirements. In the sample, at least 10 of the 50 firms that announced ISO 9001:2000 certification had previously been certified to one of the 1994 standards.[14] It is possible that these firms could have merely made minor modifications to their applications to the 1994 standard, thus drastically reducing the up-front certification costs and increasing the value of conformance quality (higher V_c). In addition, the market may perceive the 2000 standard as more stringent than its 1994 predecessors. ISO 9001:2000 eliminated ISO 9002 and 9003, and with it eliminated the possibility that a firm could obtain ISO certification without adhering to all 20 quality elements of ISO 9001:1994 (Cianfrani, et al, 2001). Certification to the newer standard may be a stronger market signal of the probability that a firm's quality program is effective (higher P_2). These results closely pattern Hendricks & Singhal (1996, 2001a), who report that firms that win quality awards from independent sources fare better financially than firms that win supplier quality awards.

The marginally positive results for ISO 9001:2000 announcements could signal to the market a higher likelihood of performance quality. Because of the standards renewed focus on customer satisfaction and connections to the principles of TQM, the market may perceive ISO 9001:2000 as a possible order-winner rather than merely an order-qualifier

[14] The certification history of 19 of the 50 ISO 9001:2000 registered firms was not available.

(Hill, 1993). Because I observe a significant reduction in asset variance for large firms announcing ISO 9001:2000 certification, the overall impact on the market value of the firm could be greater than the marginally positive change in equity value due to a transfer of wealth from equityholders to bondholders (Black & Scholes, 1973; Galai & Masulis, 1976). These asset variance tests were performed to check for the impacts of a moderating variable: wealth shifts between equityholders and bondholders. The results in this study suggest that effect may be present, and it is important that future research in this area also conduct the same checks.

On the other hand, the market does not seem to react much to ISO 9002:1994 announcements, possibly because of the limited scope of the standard for only production and installation activities (Ragothaman & Korte, 1999). Because the sample frame includes the time during which the 1994 standards were replaced, the significantly negative results I observe for ISO 9001:1994 are possibly due to a market perception that firms were rushing to meet the old standard before the new one took effect. For example, Abaxis Corporation announced certification to ISO 9001:1994 on May 15, 2002 (exactly 17 months after the release of ISO 9001:2000) and exhibited Day -1 and 0 cumulative abnormal returns ranging from -8.74% to -4.31% depending on the model that was used. Furthermore, this ISO 9000 certificate was the firm's first. The reduction in market value for ISO 9001:1994 firms during the time period from 1999 to 2002 could also signal that the market perceived the soon to be obsolete standard as yet another meaningless management activity that brought about further operational restrictions. The market may not classify ISO 9001:1994 as even an order-qualifier, but rather a needless exercise in obtaining an unimportant sheet of paper.

Post-Announcement Stock Performance

I observe no apparent pattern in the median stock performance in the quarter after announcing an ISO 9000 certification for the complete sample of firms (two-tailed $p = 0.20$). On the other hand, the data presented in Figure 1 suggests that a few small firms that announced certification to one of the 1994 standards might be driving the significant mean cumulative abnormal returns for the complete sample, even with the four outliers trimmed. In fact, 17 small firms that announced ISO 9000:1994 certification exhibit a 60 day CAR of more than 50%, while none are below 50%. Eleven of these seventeen firms are part of SIC Industry Groups 357, 366, 367, or 737, which consist of high-technology manufacturing or services including computers and telecommunications. Because the sample frame coincides with the technology market "bubble" of the late 1990s, it is not surprising to see many high-performing companies in these industry sectors. It is likely that such high abnormal long-term performance from these eleven companies could be the result of industry-wide market movements and not directly attributable to ISO 9000 certification.

Furthermore, the mean and median buy-and-hold abnormal returns for all sub-samples are not different from zero at $\alpha = 0.05$, suggesting that the choice of the model has an impact on the significance of the results. Barber and Lyon (1997) suggest that one-to-one matching to a control firm (like the method used to calculate buy-and-hold abnormal returns) may be better specified than models based on a market portfolio (like the Market Adjusted Model CAR) because the latter leads to the presence of cross-sectional dependency and positively skewed abnormal returns.[15] Due to possible

[15] Cross-sectional dependency arises in the Market Adjusted CARs because the model assumes that the systematic equity risk of the firm is constant and always equal to the market risk ($\beta_e = 1$). Positively

industry-wide market effects and potential model misspecification, it is not possible to definitively state that the fluctuation in stock price during the post-announcement period is directly attributable to an ISO 9000 certification announcement. In this case, if there is any wealth effect associated with certification, the market captures most of the change close to the announcement itself.

skewed abnormal returns arise because the Market Adjusted CARs do not account for compounding, while the buy-and-hold abnormal returns do.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

In this thesis I have examined the abnormal stock market reaction for the dates surrounding an ISO 9000 certification announcement. Based on a sample of 204 firms of various sizes and industries that announced ISO 9000 certification from 1999 to 2002, I find no evidence that the stock market has any significant positive reaction. I also find that the announcement has little effect on the systematic risk or idiosyncratic risk of the firm, meaning future cash flows are not discounted at a different rate than before the announcement. However, I do find that the market value of equity for larger firms decreases by about 0.7%. While that decrease may be due in part to a shift in wealth from equityholders to bondholders, there is ample reason to suspect that financial justifications for the pursuance of ISO 9000 certification may be invalid. For smaller firms, I find that the market value of equity increases marginally, and the market value of corporate debt may also increase. This suggests that as firm size increases, managers may be less justified in using financial parameters to argue for pursuing quality certifications.

The financial effects of ISO 9000 certification were also dependent on standard stringency. For firms that announced certification to the 1994 series of standards, the market value of equity did not change much for ISO 9002 and decreased by about 0.7% for ISO 9001. While that decrease could be due in part from a shift in wealth from equityholders to bondholders, there is ample reason to believe that the older series of

standards did not reap financial rewards for those firms that attained them. For firms announcing ISO 9001:2000 certification, I find that the market value of equity increases despite a possible shift in wealth from equityholders to bondholders. Operations managers, then, are proper in using financial arguments to justify pursuing ISO 9000 certification. Should ISO announce in the future that the organization would expand the scope of their quality standards, managers ought to wait until the more stringent standards are released rather than rushing to obtain certification to the older standards before they become obsolete. These findings are summarized in Figure 3.

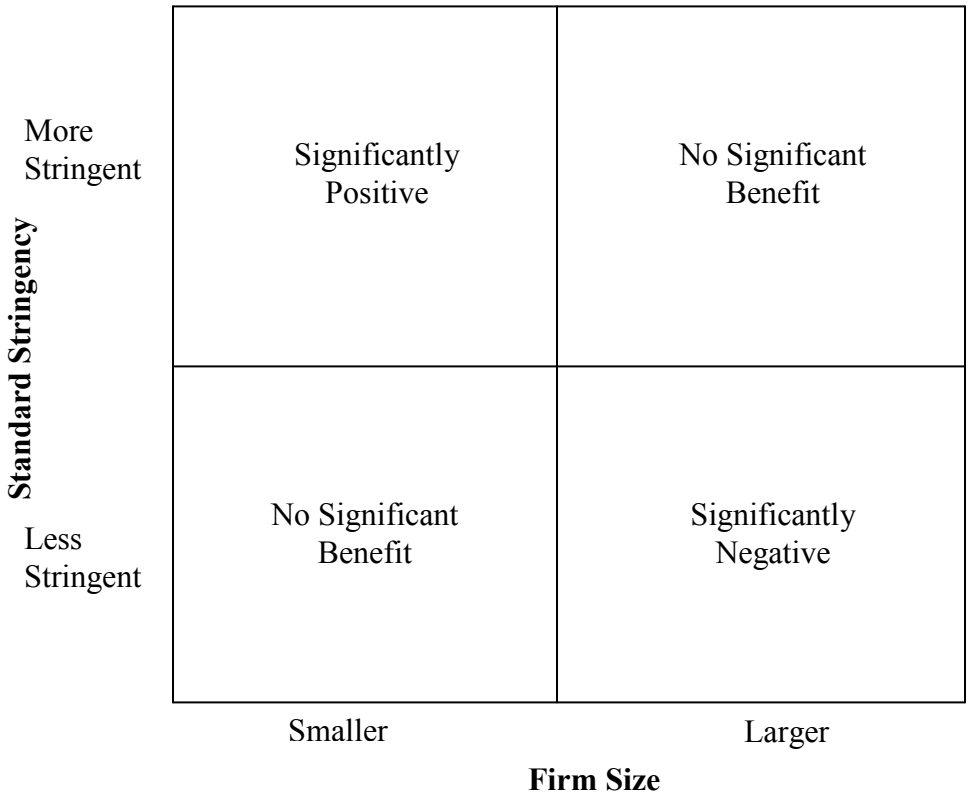

Figure 3. Financial Benefit of ISO 9000 Certification as a Function of Firm Size and Standard Stringency

In addition, I found evidence that small firms experienced an increase in the market value of equity in the calendar quarter following an announcement to the 1994 standards. However, it is not possible to attribute this performance solely to the certification announcement, as a large number of exceptionally well performing firms in this sub-sample are in the high technology sector. The "tech bubble" of the late 1990s could be skewing these results to the right, leading to the conclusion that industry-wide market movements could be an extenuating factor.

A limitation of this study is that it provides only a lower bound on the total economic value of ISO 9000. I examined only the impact of the actual attainment of the certificate on the market value of the firm's equity. It would be interesting to study the long-term financial impact of attaining ISO 9000 certification to determine the extent to which the market anticipates the certification and further reassesses the post-announcement operating performance of the firm. The methodology employed by Hendricks & Singhal (2001a, 2005) would be particularly helpful in this effort. Future research should also explore if the results I observe for this sample of American firms also apply internationally, particularly in the rapidly expanding Asian economies. Subsequent studies could document the reasons for the shift in wealth from equityholders to bondholders, and why this pattern was observed for certain groups of firms but not for others. Other research could explore the possibility of other as yet undetermined moderating variables, including firm reputation, market share, or company age. The impact of a firm's quality reputation on investors' pre- and post-announcement evaluations of the probability of an effective quality program is worth particular investigation. Additional avenues for future research stem from the conclusion that the

market perceives ISO 9001:2000 differently from its 1994 predecessors. It would also be interesting to evaluate the financial and operating performance of firms that were once ISO 9001:1994 or ISO 9002:1994 registered but who choose not to upgrade to the new standard and let their certificate expire. Corbett, et al. (2005) reported that ISO 9000:1994 firms exhibited better financial performance than non-certified firms as measured by several accounting and operating ratios, but my results suggest that these internal production economics measures might not necessarily be perceived by a firm's external stakeholders and incorporated as improvements in shareholder value. Since the results suggest that as ISO 9001:2000 is associated with positive changes in a firm's external market measurements, it would be of interest to examine if the standard has that same impact on internal measures of firm performance.

APPENDIX A

ANNOUNCEMENT EXCLUSION CRITERIA

Each of the criteria listed below was used to exclude announcements from the study sample:

1. Announcements not pertaining to the awarding of an ISO 9000 series certificate. In particular, many firms state on all company announcements that they are ISO 9000 certified. Announcements pertaining to the awarding of only ISO 14000 series certificates were also eliminated.
2. Announcements appearing in either non-daily or not real-time publications or any announcement for which there was a problem in pinpointing when the information contained within became public knowledge.
3. Announcements for firms not publicly traded on the New York Stock Exchange (NYSE), NASDAQ, or the American Stock Exchange (AMEX) at the time of the registration.
4. Announcements made at the same time as quarterly earnings reports because of the difficulty in separating the effects of the earnings news from the effects of the certification news (Bernard & Thomas, 1990).

5. Announcements made between September 10, 2001 and September 28, 2001, the time period during and immediately following the New York and Washington terrorist attacks and subsequent market closures.[16]
6. Announcements for firms with insufficient stock information available through the Center for Research in Security Prices (CRSP) database complied by the University of Chicago either during the event period or during a 210-day estimation period both before and after the announcement.
7. Repeat announcements on a later date in a different source about a firm receiving ISO 9000 series certification.
8. Announcements for firms with more than one published article in the Wall Street Journal in the period between 2 days before the announcement and 2 days after the announcement. Only announcements in the Wall Street Journal were considered to contaminate the sample because the most significant events for publicly traded firms are likely to be reported there (Hendricks & Singhal, 1997). I did not use subjective decisions to judge the importance of the articles.
9. Announcements for firms whose total assets, total sales, and total liabilities were not available for the fiscal years preceding and succeeding the announcement through either the Compustat, Bloomberg, or Hoover's databases or the firm's SEC filings (10-K).

[16] Hendricks and Singhal (1996) eliminate from their event study sample announcements made during the week of the October 1987 stock market crash. While obviously that event is too early to have any effect on the announcements in this study, both the stock market crash and the terrorist attacks are events that had a dramatic impact on all publicly traded equities. Rather than trying to account for the anomaly in our analysis, we simply remove the announcements from the sample. Special thanks Vinod Singhal from Georgia Tech for his comments concerning this issue.

10. Announcements stating that the firm plans to receive certification but has not been registered.
11. Announcements made before official certification has been granted. In particular, a few firms announced that they had been recommended for certification by their auditor but that the registration would not be official until a later date. To remove any ambiguities concerning specification of the event date, these announcements were eliminated from the sample.
12. Announcements made after the certification was published in the CEEM Information Services (Quality Systems Update, 2004) quarterly database of ISO 9000 registered companies. Announcements made on the news wires after this time are merely reporting news that has already been made public and disseminated throughout the market.
13. Announcements that did not specify which classification of ISO certification (9001:1994, 9002:1994, 9003:1994, or 9001:2000) the firm had achieved.
14. Announcements pertaining to firms for which no control firm could be identified. The control firm specification procedure is described in Chapter V.

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