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Does Quality Still Pay? A Reexamination of the Relationship Between Effective Quality Management and Firm Performance

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Because of the changing competitive environment, quality might have lost some of its luster and emphasis in business. The research question we aim to address in this paper is: Does quality still pay in the new competitive environment? Using replication research, we re-examine the impact of an effective total quality management (TQM) program on a firm's operating performance in the new competitive environment. We use publicly available data for award-winning firms and adopt several control-firm-selection approaches in our event study. Based on data from more than 500 firms, we find that over a 10-year period—6 years before to 3 years after winning their first quality award—firms in our sample perform significantly better than control groups in various operating performance measures. Not only do award-winning firms have better results after receiving awards, they also have superior performance records before the award. Our results suggest that quality is still critical to achieving long-term competitive advantages, and firms who continuously improve their quality continue to reap rewards by way of sales and financial performances exceeding those of their competitors.

Key words: quality; total quality management; award; firm performance; event study
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1. Introduction

In response to increasing challenges from Japanese competitors, American companies recognized the importance of quality and began to implement formal total quality management (TQM) programs in the 1980s. The wide adoption of TQM programs in corporate America over the last two decades has led to significant quality improvements in many areas of the manufacturing and service sectors. As a result, in today's market, product or service quality is often treated by consumers as a given. As competition intensifies, organizations are required to continuously deliver and improve quality in order to remain competitive.

A major motivation for any business to implement a TQM program is the expectation that it will bring significant benefits. In the mid-1990s, Hendricks and Singhal performed some of the first studies that documented and quantified the value of a TQM program (Hendricks and Singhal 1996, 1997, 2001a, 2001b). In particular, using a sample of over 400 publicly traded companies from various industries that had won their first quality awards from 1983 to 1993, Hendricks and Singhal (1997) examined the impact of an effective TQM program on operating performance. The winning of quality awards was used as the proxy measure that a firm had implemented an effective quality management program. A group of control firms was selected to serve as benchmarks and to control for potential biases caused by industry-specific issues and economy-wide influences. These control firms were similar to the award winners in size and operated in the same industry but did not win quality awards. Overall, Hendricks and Singhal's (1997) results provided strong evidence that firms winning quality awards outperformed the control firms on several sales- and operating-income-based measures over a 10-year period, starting from 6 years before to 3 years after winning a quality award. For example, award winners had an average of 107% higher growth in operating income and 64% more sales than the control firms (Hendricks and Singhal 1997).

Drawing from data collected for firms that won quality awards between 1994 and 2003, this study aims to provide further evidence of the link between TQM and firm performance by replicating Hendricks and Singhal's (1997) study. Replication is common in scientific inquiries because one of the foundational components of the scientific method is the idea of reproducibility (Popper 1959). In order for a theory or an experiment to be considered valid, it should be replicated. Replication is also an integral part of the research process, particularly empirical research (Hubbard et al. 1998, Kaynak and Hartley 2008). A literature dominated by unreplicated findings is of

marginal value (Frohlich and Dixon 2006, Rosenthal and Rosnow 1984). Successful replication advances the development of a cumulative body of knowledge because it demonstrates that the original results were not obtained by chance and thus may be generalized with confidence. As Eden (2002, p. 841) pointed out, "The value of empirical management research is profoundly augmented if it enables its readers to infer credible scientific generalizations [that would be greatly aided by] a large number of high quality replication studies."

There are several motivating reasons for conducting this study. First, from a review of the business press and management literature, it can be argued that the competitive landscape shifted from the 1980s to 1990s and beyond. The 1980s could be characterized as the era during which quality was brought to the center of business. Evans and Lindsay (2011, p. 8) have discussed the U.S. quality revolution in the 1980s and stated that "The decade of the 1980s was a period of remarkable change and growing awareness of quality by consumers, industry, and government." However, in 1994, Sitkin et al. (1994) predicted that "the strategic focus of a firm may swing toward discovering new product domains for which novelty rather than reliability is the key to competiveness" (p. 545). The decline of TQM citations in the business literature starting in 1992 after a decade of dramatic increases reflected this shift of focus by businesses (Miller and Hartwick 2002), an indication that the business environment had changed significantly during the 1990s. Bettis and Hitt (1995) and Hitt et al. (1998) believed that a new competitive landscape had been emerging since the 1990s due to the technological revolution and increasing globalization. Volberda (1996, p. 359) wrote that "The globalization of markets, rapid technological change, shortening of product life cycles, and increasing aggressiveness of competitors have radically altered the ground rules for competing in the 1990s and beyond." In this "hypercompetitive" environment (D'Aveni 1994), firms faced significant market instability and uncertainty and thus needed to identify new capabilities to compete (Hitt et al. 1998). For example, Stalk and Hout (1990) suggested that the ability to manage time in production and new product development could be a powerful new source of competitive advantage. Hammer and Champy (1993) argued that the three Cs of competitive forces—consumers, competition, and change—created a new competitive landscape for businesses, forcing companies to reengineer their processes to become flexible and responsive. Fine (1998) pointed out that the ultimate source of a sustainable competitive advantage is a firm's ability to manage its supply chain. This shift of strategic focus provides an interesting context to examine the long-lasting value of an effective quality management program in the new competitive environment.

Second, Hendricks and Singhal's (1997) study has inspired significant research interest in using objective data to gauge the impact of TQM programs. However, most subsequent studies have been limited in scale and scope. For example, although Hendricks and Singhal (1997) included all award winners in their sample to reflect diverse, successful TQM programs, many subsequent studies focused only on winners of the Malcolm Baldrige National Quality Award (refer to as the Baldrige Award hereafter) (e.g., Jacob et al. 2004, Subedi and Maheshwari 2007) or government award winners (e.g., York and Miree 2004). As a result, the sample sizes in these studies were very small (e.g., 15 in Subedi and Maheshwari [2007], 17 in Przasnyski and Tai [2002], and 18 in Jacob et al. [2004]). Although Hendricks and Singhal (1997) used more than 10 different measures to examine different aspects of firm performance, such as sales, cost, and profitability, almost all subsequent studies adopted a much smaller set of performance measures. In addition, the time period examined in almost all of these studies overlapped that of Hendricks and Singhal's (1997) study. In this study, we aim to conduct more comprehensive and rigorous research to reexamine the link between effective TQM and firm performance.

Finally, when choosing control firms for the sample firms in their study, Hendricks and Singhal (1997) used matching criteria based on industry and firm size to control for potential industry- and economy-wide factors. However, they did not control for the difference in prior performance, which may confound the analysis and interpretation of the results, as discussed in Barber and Lyon (1996) and Hendricks et al. (2007). Barber and Lyon (1996) argued that matching with prior performance is critical in order to obtain well-specified test statistics and control for factors that may have nothing to do with the event under consideration. Without matching with prior performance, results can be inconclusive because it is unclear whether the observed abnormal performance is due to mean reversion or due to the event in question. Therefore, it is important to reexamine the TQM effect using the sample-matching method based on the prior performance of firms in addition to their size and industry. Furthermore, although Hendricks and Singhal (1997) used only a one-to-one matching method in selecting control firms, we perform a more comprehensive analysis based on both one-to-one and one-to-portfolio matching samples.

The next section provides a focused review of empirical studies using objective data on the economic gains from effective quality management programs. Section 3 states hypotheses. Sample selection

and methodology are detailed in section 4, and the empirical results are presented in section 5. Finally, the paper concludes with a discussion of the results, limitations, and future research directions.

2. Literature Review

Although there is ample empirical research within the TQM literature, much of it is based on surveys (Sila and Ebrahimpour 2002). Survey-based studies allow an in-depth examination of many organizational aspects of TQM implementation and help us to better understand the variations in the approach to TQM as well as its impact. However, a problem with self-reported survey data is the limited objectivity of the reported performance measures and common method variance because the respondent often reports both the effectiveness of the TQM program and the perceived improvement (e.g., Dow et al. 1999, Kaynak 2003). Thus, the reported benefits may not reveal the true magnitude of the performance impact of TQM. Although it is difficult to assess the effectiveness of TQM objectively because multiple dimensions are typically used in evaluating a TQM program and some of them are subjective, several proxy measures have been proposed as a means of assessing the effectiveness of TQM programs. The use of quality awards as a proxy for quality performance has become popular because of Hendricks and Singhal's (1997) work in which they discussed why quality awards represent reasonable evidence of effective TQM implementation. Indeed, it has been found that quality award models such as the Baldrige Award and the European Foundation for Quality Management Excellence Model effectively capture the key components of TQM (Bou-Llusar et al. 2009, Curkovic et al. 2000). An alternative proxy for TQM effectiveness is the use of quality certifications such as the well-known ISO 9000 certification (Corbett et al. 2005). In this section, we focus only on studies that rely exclusively on externally obtained firm performance data.

Of all the studies that used data from quality award winners, Hendricks and Singhal's (1997) study is the most prominent, and the results of this study have been featured in numerous business and trade publications such as *Business Week*, *Fortune*, *Quality Digest*, and *CIO Magazine* (Evans and Lindsay 2011). Because of this work, we have a better understanding of the relationship between TQM and financial results, and more importantly, we have a clearer idea of the magnitude of the benefits gained from TQM programs in the 1980s.

In a follow-up study, Hendricks and Singhal (2001a) provided a detailed analysis of how various firm characteristics affected TQM implementation and financial results. Using a sample of 435 award-winning firms, they examined the effect of firm size, capital intensity, firm diversification, award type, and the timing of TQM implementation. Their results suggest that, although TQM's impact was positive across a widespread spectrum of firms, the benefits from effective TQM implementations may vary with differing organizational characteristics.

Following Hendricks and Singhal (1997), several researchers reexamined the relationship between award winners and their operating and financial performance. York and Miree (2004) looked at Baldrige Award and certain state quality award winners before 1998 and found that award winners generally outperformed other firms in the same industry in various performance measures not only for the 5 years following their win but also in preceding years. Using a sample of 18 Baldrige Award winners from 1988 to 2002, Jacob et al. (2004) showed that award winners significantly outperformed industry benchmarks in terms of profitability and asset utilization. Subedi and Maheshwari (2007) analyzed a sample of 15 Baldrige Award winners from 1989 to 2003. Compared to a group of 30 control firms, the award-winning firms had better earnings and sales growth than the control firms. Hansson and Eriksson (2002) analyzed data from 17 award-winning companies in Sweden before 1999, and although the overall results suggest that the award winners outperformed the benchmark groups on most of the measures, the differences were mostly insignificant.

A number of studies also examined the stock performance of award-winning firms, focusing mostly on short-term performance during the days after the announcement of the quality award and found generally positive stock market reactions to quality award announcements. These studies include Hendricks and Singhal (1996), Adams et al. (1999), Przasnyski and Tai (2002), and Jacob et al. (2004). Furthermore, Hendricks and Singhal (2001b) examined the long-run stock performance of award-winning firms and found that award winners significantly outperformed control firms after winning the award.

Several researchers have studied the financial impact of firms that received a quality audit or certification. Easton and Jarrell (1998) examined the performance of 108 companies that implemented TQM programs between 1981 and 1991. They selected the firms in their sample based on the firms' serious efforts in implementing TQM programs as judged by the site visits of a former senior examiner for the Baldrige Award. They found that TQM firms, on average, had significantly better results in net-income-per-employee, operating-income-per-employee, and sales-per-employee than firms without TQM. Corbett et al. (2005) analyzed a sample of 554 ISO 9000 certified U.S. manufacturing firms and found that, within

3 years of receiving certification, these firms showed significant abnormal improvements in financial performance such as sales growth, return-on-assets, and return-on-sales relative to several carefully chosen control groups. Simmons and White (1999) reported a positive link between profitability and ISO 9000 certification for a sample of 36 certified electronic companies in the United States. Docking and Dowen (1999) found significant and positive abnormal stock market returns only for small firms, based on a sample of 252 North American companies that had received the ISO 9000 certification. Other studies that examined stock market returns on ISO 9000 certification include Lima et al. (2000) for Brazilian firms, Martinez-Costa and Martinez-Lorente (2003) for Spanish firms, and Sharma (2005) for Singaporean firms.

3. Hypotheses

Although the business environment of the 1990s and early 21st century may differ from that of the 1980s, the fundamental principles of TQM do not change over time. A perusal of the TQM literature from early to recent publications shows that the basic elements of a successful TQM program do not vary much across studies or over time. Although new developments, such as Six Sigma, continue to occur in quality management, the basic tenets and constructs remain unchanged (Zu et al. 2008). Powell (1995, p. 17) commented that, "Although different TQM proponents emphasize different features, an exhaustive review and integration of the TQM literature suggests that complete TQM programs tend to share 12 factors." Based on an extensive literature review, Sila (2007, p. 84) found that, "the TQM construct could be measured by seven general categories of practices." Sousa and Voss (2002) and Kaynak and Hartley (2008) also believed that there was substantial agreement on the set of quality management constructs and that these quality management practices had been well documented in the quality management literature. Indeed, these elements are similar to those promoted by prominent quality pioneers such as Crosby (1979), Deming (1986), and Juran (1988). As Sousa and Voss (2002, p. 94) discussed, "The agreement in the literature on what constitutes [T]QM indicates that [T]QM as a field has indeed matured and is laid down on solid definitional foundations."

Broadly speaking, TQM is an organization-wide effort to enhance the quality of products and services through continuous improvement and the participation of all employees. It is both an integrated management philosophy and a set of tools and practices for its implementation (Powell 1995). The key factors to a successful TQM program include leadership, customer focus, human resource management, strategic planning, supplier relationships, and information and process management (Flynn et al. 1994, 1995, Hackman and Wageman 1995, Kaynak 2003, Kaynak and Hartley 2008, Nair 2006, Powell 1995, Samson and Terziovski 1999, Sila 2007, Zu et al. 2008). Although the more recent Six Sigma movement does not change the underlying principles of TQM, it strengthens TQM efforts through a more rigorous and structured approach. As Schroeder et al. (2008) discussed, "Much of what is being done in Six Sigma is not entirely new with respect to prior quality tools or principles, but the deployment approach and emergent structure of Six Sigma are new." Zu et al. (2008) found that Six Sigma offers managers three additional practices (Six Sigma role structure, Six Sigma structured improvement procedure, and Six Sigma focus on metrics) that augment traditional TQM practices and provide new paths to quality improvement. Other studies that have examined how Six Sigma complements and strengthens TQM implementation effectiveness include Choo et al. (2007), Linderman et al. (2003, 2006), and Schroeder et al. (2005).

The TQM literature suggests that effective TQM practices improve financial and operational performance (Easton and Jarrell 1998, Hendricks and Singhal 1997, Kaynak 2003). As a firm gains a reputation for delivering quality products and services, more customers will seek its products and services, thus increasing the firm's market share and revenues. By adopting rigorous quality management techniques, a firm can reduce process variation, produce fewer defective products, and decrease operational costs. The focus on continuous improvement over the long run can enhance these benefits and therefore improve a firm's financial performance in terms of profitability and return on investment.

However, many researchers have argued that TQM has had diminishing effects on firm performance in the 1990s and beyond (Das et al. 2000, Lederer and Rhee 1995, Rust et al. 1995). Because of the increased awareness and emphasis on quality in corporate America during the 1980s, quality has been improved to such a degree that it may no longer be a differentiator in some industries, which leads firms to assume that the war for quality has been won (Garten 2000). In addition, although the competitive focus of the 1980s was mainly on quality, firms in the 1990s faced tremendous pressure to seek and develop new sources of competitive advantages due to changing business environments characterized by globalization, market uncertainty, and instability (Hitt et al. 1998, Rahman 2004). As a result, quality was not treated as a strategic priority by many businesses during the 1990s and the early 2000s (Garten 2000, Lee et al. 2006). However, losing the focus on quality as a key business driver can cost firms greatly. This is

evidenced by such anecdotal examples as Hudson Foods, which experienced a massive government-ordered recall of its beef products and closure of one of its plants (Janofsky 1997), and Abbott Laboratories, which had to pay a significant fine for failing to meet quality standards for medical kits (Gugliotta 1999).

Based on the above discussion, we believe that TQM remains an important differentiator despite the changing competitive environment. Thus, we propose the following propositions:

PROPOSITION 1. *An effective TQM program will lead to an increase in sales.*

PROPOSITION 2. *An effective TQM program will lead to a decrease in costs.*

PROPOSITION 3. *An effective TQM program will lead to an improvement in profitability.*

We used the same measures of sales, costs, and profit as Hendricks and Singhal (1997). For sales, we relied on three measures: net sales, sales-per-employee, and sales-per-dollar of asset. The primary cost measure was the cost-per-dollar sales, which is the total annual cost of goods sold plus general and administrative (G&A) and sales expenses divided by annual sales. The main measure of profitability was operating income before depreciation. In addition, we used three other profitability measures: operating income per employee, operating margin (measured as operating income per dollar of sales), and return on assets (measured as operating income per dollar of assets).

4. Data and Methodology

4.1. Sample Selection

The first step in the data collection process was to identify firms that had won quality awards between 1994 and 2003. The primary source for identifying such firms was Dow Jones Factiva, an online search database containing news sources such as *Wall Street Journal*, *Financial Times*, *Dow Jones and Reuters Newswires*, and *the Associated Press*. Although Hendricks and Singhal (1997) used only two sources in Factiva, i.e., PR Newswire and Business Wire, we elected to use the entire Factiva database to conduct our search. Using the same key words, "quality" and "award," as Hendricks and Singhal (1997), we performed a comprehensive search. We read every press release or article that contained a combination of the above keywords to identify firms that had actually won quality awards and to determine the timing of the award. The initial search produced 4798 firms.

Although Hendricks and Singhal (1997) also contacted a number of award providers directly to obtain the names of their award winners, we chose not to do so due to the concern of nonresponse bias or errors in the process. In addition, government-sponsored awards, including the Baldrige Award and state-level quality award programs, maintain websites that have complete information about award winners. In many cases, we found that a news report provided a complete list of all award recipients from a particular award giver. We examined several award givers via the Internet and verified that our search results were consistent.

The financial and accounting data for these firms were retrieved from COMPUSTAT. We included in our sample only those firms that had a minimum of 6 years of continuous data in COMPUSTAT. The 6-year requirement was used to reduce potential bias in the analysis, as discussed by Hendricks and Singhal (1997). Of the 4798 firms that resulted from our search, 785 firms were listed in the COMPUSTAT database, and of the 785 firms in the database, 501 had at least 6 years of continuous data.

Our sample firms represented a wide range of industries with 196 distinct four-digit Standard Industrial Classification (SIC) codes and 47 distinct two-digit codes. Table 1a depicts the distribution of the sample firms by year. Nearly 20% of the firms in the sample won an award in 1994. From 1995 to 1999, the percentage of firms in the sample varied from 5.4% to 9.2%. The lowest number occurred in year 2001 with 25 quality winners (nearly 5%). Table 1b reports several descriptive statistics for the 501 firms in the year before they received their quality award. It shows that the sample contained different-sized firms in terms of assets, sales, net income, market value, and number of employees.

We examined a firm's performance change over a 10-year period anchored around the year when the firm received its first award. The 10-year evalu-

Table 1a Sample Description of the 501 Quality Award Winners

The Distribution of the Quality Award Winners Over Years		
Year	Number of Firms	% of Firms
1994	98	19.56
1995	46	9.18
1996	33	6.59
1997	27	5.39
1998	43	8.58
1999	29	5.79
2000	60	11.98
2001	25	4.99
2002	77	15.37
2003	63	12.57
Total	501	100.00

Table 1b Selected Descriptive Statistics for the Sample

Measure	Mean	Median	Standard Deviation	Maximum	Minimum
Total Assets (Million $)	10356.4	931.4	47152.6	758800.0	0.5
Sales (Million $)	5841.6	1141.2	16142.5	218529.0	2.4
Net Income (Million $)	198.8	27.5	1007.8	7785.0	−8738.3
Market Value (Million $)	8732.5	919.4	35863.9	596475.8	1.8
Employed (thousands)	28.0	5.7	87.8	1383.0	0.02
Debt Ratio	0.41	0.42	0.19	0.94	0.01

ation period allowed a direct comparison with the results of Hendricks and Singhal (1997). Specifically, the evaluation period started 6 years before and ended 3 years after the award. To pool observations over time, we translated the calendar year to an event year for each firm and defined year 0 as the year the firm received the award, year ± 1 as the year after/before the award, year ± 2 as the second year after/before the award, and so on.

4.2. Control Firm Selection

In this study, we employed three different methods (referred to as Match 1, Match 2, and Match 3 in subsequent discussions) to choose control firms. Match 1 is the same one-to-one matching method used by Hendricks and Singhal (1997); that is, a single control firm was selected by matching its size and industry with each sample firm. Match 2 and Match 3 represent one-to-one and one-to-portfolio matching based on size, industry, and prior performance. In all cases, we used the year before the award year as the basis for determining control firms.

The Hendricks and Singhal (1997) approach to the selection of control firms was based on industry and size to control for potential industry- and economy-wide effects. For each sample award-winning firm, a control firm was chosen that satisfied the following requirements: (i) it had the same two-digit SIC code as the sample firm; (ii) it was closest in size as measured by the book value of assets at the year-end before the winning of the quality award, with the constraint that the ratio of the book value of assets of the control to that of the sample firm was less than a factor of 3; (iii) it had accounting data available for at least the same period as the sample firm; and (iv) it matched on fiscal year ending; that is, a control firm with a fiscal year-end in January–May (June–December) was matched with the sample firm whose fiscal year ended in January–May (June–December). Following this approach, we were able to find a control firm for 470 (94%) of the 501 award-winning firms in our database. Since Hendricks and Singhal (1997) found only a 72% match using the above criteria, they created two other control samples: one relaxed the condition of the matching fiscal year-end by allowing single-digit industry matching (matching 85% firms), and the other relaxed fiscal year-end matching as it related to the size requirement (matching 93% firms). Using these relaxed criteria, we were able to match 481 (96%) and 484 (96.6%) of all firms, respectively. For compatibility with Hendricks and Singhal (1997), we used the 481 matched sample and control firms in the subsequent analysis.

Although many earlier studies, including Hendricks and Singhal (1997), chose control firms based exclusively on industry and size, authors of recent studies have realized the importance of control for prior performance in selecting the control group. Barber and Lyon (1996) discussed the importance of selecting control firms with similar prior performance to reduce the confounding effect and to increase the power of the study, especially when the sample firms were better performers before receiving the quality awards. Therefore, we based our second method of selecting control firms on industry, size, and prior performance. That is, a control firm not only had to be in the same industry and of a similar size as the sample firm, but also must have had a similar performance to the sample firm before the award event. Following Lie (2001), Corbett et al. (2005), and Hendricks et al. (2007), we used the return on assets (ROA) as the measure of performance in choosing control firms. As discussed in Corbett et al. (2005) and Hendricks et al. (2007), although there is no single best way to choose control firms, the preferred method is to match firms by industry, ROA, and assets. Our matching sample selection consisted of the following steps:

(i) Inside the same two-digit industry of each sample firm, we identified control firms whose ROA was within 0.7 and 1.3 times the ROA of the sample firm and whose assets were within one-third to three times the assets of the sample firm.

(ii) In one-to-one matching (Match 2), we calculated for each firm the z-scores for ROA and assets and then computed the Euclidean distance in the two-dimensional space of z-scores (Corbett et al. 2005). The matching firm was the one whose Euclidean distance was closest to that of the sample firm.

(iii) In one-to-portfolio matching (Match 3), we selected all the firms identified in step (1) as the control firms.

(iv) When we could not identify any control firms for some of the sample firms, we removed the fiscal-year-end matching condition and

relaxed the two-digit SIC code restriction to a one-digit SIC, and then we repeated the procedure.

Through this process, we were able to match 458 (91.4%) firms out of the 501 sample firms.

4.3. Performance Measures and Calculations

We examined several aspects of operating performance, as in Hendricks and Singhal (1997). Specifically, the income-based measures include operating income and ratios of operating income to assets, to sales, and to the number of employees. The sales-based measures include total sales, and ratios of sales to assets and to the number of employees. Finally, the cost-based measure is the ratio of total cost to sales. Appendix A contains these measures along with their COMPUSTAT variables employed.

For each of these measures, we report two sets of results. The first set is the *annual* difference in the percentage change in performance between sample and control firms, referred to as the control-adjusted change hereafter. The second set is the percentage difference in performance between the sample and control firms over several long time intervals such as between years −6 and −1, −4 and −1, −1 and +1, −1 and +3, and −6 and +3. Hendricks and Singhal (1997) discussed the rationale in selecting these intervals. That is, the different intervals are necessary to account for the different patterns of change in performance across firms and the possibility that small and incremental improvements on an annual basis may add up to significant improvement over longer time periods. The calculation formula can be summarized as

$$\frac{PS_t - PS_{t-i}}{PS_{t-i}} - \frac{PC_t - PC_{t-i}}{PC_{t-i}},$$

where PS_t is the performance measure for the sample firm in year t, PC_t is the performance measure for the control firm in year t, $PS_{t\text{-}i}$ is the performance measure for the sample firm in year t-i, and $PC_{t\text{-}i}$ is the performance measure for the control firm in year t-i.

In each case, we calculated the mean and median for each performance measure. To control for the effect of potential outliers, the performance measures were trimmed symmetrically at the 2.5% level in each tail (see e.g., Hendricks and Singhal 1997). Even with the trimming, the data still may be asymmetric and outliers still may be an issue. For this reason, we report both parametric and nonparametric testing results. The parametric test is the t-test on whether the mean change is significantly different from zero. We used the Wilcoxon signed-rank (WSR) test to analyze whether the median of the changes was significantly different from zero. The results of all statistical tests were based on one-tailed tests.

5. Results

To provide a baseline comparison between our results and those in Hendricks and Singhal (1997), we first report and discuss the results using the one-to-one matching method based on industry and firm size. Then, we extend our discussion of the results to one-to-one and one-to-portfolio matching samples based on size, industry, and prior performance. Finally, we provide a comparison of key results between our study and Hendricks and Singhal (1997).

5.1. Results from One-to-One Matching of Control Firms Based on Industry and Size (Match 1)

Table 2 reports the mean and median percentage changes in operating-income-based measures. Panel A of the table gives the control-adjusted changes on an annual basis over the 10-year period, while Panel B shows the results of various longer intervals. The first part of Table 2 (Panel A) shows that, on an annual basis, both the mean and the median changes in operating income of the award-winning firms were higher than those of the control firms in eight out of the 10 years. The control-adjusted mean changes were positive and statistically significant in the following 2 years: −5 to −4 (10.63%, $p < 0.001$) and −1 to 0 (4.65%, $p = 0.023$). The median changes in these 2 years were also positive and significant. In addition, the mean changes were significant at the 10% level in years −2 to −1 (3.51%, $p = 0.085$) and −6 to −5 (4.41%, $p = 0.061$) with the median change significant only in year −2 to −1. On the other hand, over the 10-year period from years −6 to +3, the mean (median) control adjusted change in operating income was nearly 85% (39%). These changes were significant with p-values < 0.001. The mean changes were significant from years −1 to +1 ($p = 0.016$), −6 to −1 ($p = 0.084$), and −1 to +3 ($p = 0.055$). The median changes were significant from years −6 to −1 ($p < 0.001$), −1 to +1 ($p = 0.019$), and −4 to −1 ($p = 0.076$).

Our results for control-adjusted changes in operating income were similar to those reported by Hendricks and Singhal (1997). For example, on an annual basis, Hendricks and Singhal (1997) found positive control-adjusted mean (median) changes in 7 (8) out of the 10 years. The mean changes were statistically significant in 4 years, and the median changes were statistically significant in 2 years. In our results, we found positive mean and median changes in 9 out of the 10 years with the mean changes significant in 2 years and the median changes significant in 3 years. Over the 10-year period, the mean and median changes in operating

Table 2 Mean and Median Control Adjusted Percentage Changes in Operating Income-Based Measures with Control Firms Selected by Size and Industry (Match 1)

	% Change in Operating Income			% Change in Operating Income/Assets			% Change in Operating Income/Sales			% Change in Operating Income/Employees		
From Year	Obs	Mean	Median	Obs	Mean	Median	Obs	Mean	Median	Obs	Mean	Median
Panel A	Changes in Performance on an Annual Basis											
−7 to −6	369	2.55	−0.59	369	−1.38	−0.11	369	1.65	−0.76	342	−0.09	−0.33
−6 to −5	390	4.41[c]	1.07	390	0.25	−1.32	390	−0.77	−2.21	365	2.33	−1.11
−5 to −4	392	10.63[a]	7.03[a]	392	3.82[b]	0.14	392	3.14[b]	−0.70	367	5.88[a]	0.49
−4 to −3	391	2.78	2.85	391	2.11	2.48	390	1.84	2.57[c]	366	1.77	3.65
−3 to −2	384	1.60	1.74	384	−1.15	1.09	383	−0.42	1.98	358	−2.19	3.29
−2 to −1	380	3.51[c]	3.31[b]	380	1.52	1.27	380	0.85	1.25	352	3.90[c]	4.10[b]
−1 to 0	359	4.65[b]	3.11[b]	359	0.90	1.53	358	0.20	1.20	335	3.30[c]	2.30
0 to +1	350	1.53	2.74	350	−0.70	−1.88	349	−1.15	−0.46	326	1.41	1.16
+1 to +2	335	0.49	3.30	335	−3.12[c]	0.15	334	−0.76	−0.03	308	−2.15	0.98
+2 to +3	307	−0.66	0.07	307	−1.29	−0.80	307	−2.25[c]	−0.94	283	−2.67	1.43
Panel B	Changes in Performance Over Varying Time Periods											
−6 to −1	370	18.69[c]	29.46[a]	370	2.48	3.75	370	3.06	3.36	344	12.92[a]	7.18[b]
−4 to −1	374	5.33	8.88[c]	374	1.38	−0.07	373	1.04	0.68	346	2.46	6.26
−1 to +1	342	8.51[b]	7.11[b]	342	−1.79	−0.23	342	−2.55	0.32	315	1.21	2.91
−1 to +3	304	10.18[c]	7.74	304	−3.82	−4.89	304	−5.14[b]	−3.44	277	−1.98	0.91
−6 to +3	305	84.84[a]	39.24[a]	305	−2.22	1.14	305	−0.27	−0.84	283	10.07	6.30

Note: a, b, and c denote statistical significance at the 1%, 5%, and 10% levels.

income were positive and significant at the 1% level in both samples.

However, the results differ in several aspects. First, the magnitude of the positive mean or median changes was generally higher in Hendricks and Singhal's sample than in our sample. For example, Hendricks and Singhal (1997) reported an increase of 107% in mean and 48% in median operating income over the 10-year period, and in our sample, the corresponding mean and median changes were 85% and 39%, respectively. Second, while there were significant negative annual changes in Hendricks and Singhal's results, all changes in our study were essentially non-negative. Third, Hendricks and Singhal (1997) found that operating income started to improve significantly from year −1 onward, but no significant changes were found from years −6 to −1 and −4 to −1. However, we found significant changes in operating income from years −6 to −1 and −4 to −1, indicating that award-winning firms had better performance than control firms even before the award event.

The results for the other income-based measures in the rest of Table 2 show that there were less significant changes in these measures both annually and over a longer time frame. At the 5% level, there was only one significant result for the mean change in the ratio of operating income to assets from years −5 to −4 (3.82%, $p = 0.032$). There were two significant mean changes in the operating margin (i.e., the ratio of operating income to sales) at the 5% level from years −5 to −4 (3.14%, $p = 0.039$) and −1 to +3 (−5.14%, $p = 0.040$). In addition, there were two significant mean and median changes in the operating income per employee from years −5 to −4 (5.88%, $p = 0.007$) and −6 to −1 (12.92%, $p = 0.009$). Overall, these results were not as significant as those for the pure operating-income measure and those for the same measures in Hendricks and Singhal (1997).

Table 3 reports the percentage changes in three sales-based measures and one cost-based measure over a 1-year period (Panel A) and over longer time periods (Panel B). Panel A shows that the annual mean change in sales of the award-winning firms was higher than that of the control firms in each of the 10 years, while the annual median change in sales of the award-winning firms was higher than that of the control firms in nine out of the 10 years. The mean control-adjusted change was significant at the 1% level in the following 5 years: −6 to −5 ($p = 0.005$), −5 to −4 ($p < 0.001$), −3 to −2 ($p < 0.001$), −2 to −1 ($p = 0.002$), and −1 to 0 ($p < 0.001$). The change was significant at the 5% level from years 0 to +1 ($p = 0.032$) and significant at the 10% level from years +2 to +3 ($p = 0.053$). The median control-adjusted change was significant at the 1% level in the following 4 years: −6 to −5, −5 to −4, −3 to −2, and −2 to −1 and significant at the 5% level from years −1 to 0 and 0 to +1. Over the longer time intervals, Panel B shows that the mean (median) changes in sales were all positive and highly significant ($p \leq 0.003$). For example, over the 10-year period from years −6 to +3, the mean and median changes in sales of the sample firms were nearly 101% and 47%, respectively, higher than in the control firms. However, it is also important to note that the sample firms outperformed the control firms in changes in sales by almost 28% in the mean and

Table 3 Mean and Median Control Adjusted Percentage Changes in Sales and Cost-Based Measures with Control Firms Selected by Size and Industry (Match 1)

	% Change in Sales			% Change in Sales/Assets			% Change in Sales/Employees			% Change in Total Cost/Sales		
From Year	Obs	Mean	Median	Obs	Mean	Median	Obs	Mean	Median	Obs	Mean	Median
Panel A	Changes in Performance on an Annual Basis											
−7 to −6	431	0.78	−0.04	431	−1.82[b]	−1.30[c]	397	−2.14[b]	−0.51	431	−0.91[a]	−0.27[c]
−6 to −5	456	3.87[a]	2.93[a]	456	−0.22	−0.08	423	0.13	1.37	456	0.19	0.22
−5 to −4	456	6.06[a]	4.75[a]	456	1.55[b]	1.07	423	3.00[a]	0.78[b]	456	−0.12	0.21
−4 to −3	456	0.80	0.50	456	0.12	1.13	423	0.75	1.23	456	−0.49[b]	−0.37
−3 to −2	456	4.00[a]	2.08[a]	456	0.95	−0.31	423	−1.23[c]	−0.37	456	−0.13	−0.35
−2 to −1	456	3.38[a]	2.01[a]	456	−0.49	0.34	423	1.54[c]	0.79	456	−0.51[c]	−0.29[b]
−1 to 0	440	3.84[a]	0.72[b]	440	0.30	−0.60	409	2.38[a]	0.60	440	−0.19	−0.03
0 to +1	420	1.96[b]	2.87[b]	420	−0.49	−0.51	390	−0.81	−0.48	420	0.46[c]	0.34
+1 to +2	406	1.33	1.84	405	−2.42[a]	−1.44[c]	375	−1.43[c]	−0.50	406	0.33	0.02
+2 to +3	382	1.68[c]	1.00	382	0.38	0.09	350	−0.84	−0.98	382	0.13	0.11
Panel B	Changes in Performance Over Varying Time Periods											
−6 to −1	456	27.91[a]	21.94[a]	456	2.79[c]	1.43	423	6.43[a]	4.38[a]	456	−0.60	−0.26
−4 to −1	456	9.44[a]	9.81[a]	456	1.02	1.98	423	1.27	3.18	456	−0.84[b]	−0.28
−1 to +1	420	7.34[a]	3.30[a]	420	0.20	−0.57	390	1.89[c]	0.59	420	0.24	−0.06
−1 to +3	383	15.62[a]	8.78[a]	383	−1.99	−2.12	352	0.19	0.73	383	0.43	0.50
−6 to +3	383	100.96[a]	46.63[a]	383	0.54	0.19	352	8.06[b]	6.87[b]	383	−1.01[c]	−0.62

Note: a, b, and c denote statistical significance at the 1%, 5%, and 10% levels.

22% in the median from years −6 to −1. Therefore, the award-winning firms might have captured a larger market share than the control firms even before receiving the awards, an observation not found in Hendricks and Singhal (1997).

Results for the ratio of sales to assets and sales per employee were less significant than the results for changes in sales. There also were additional negative mean and median changes in these two ratios especially on an annual basis, although many of the changes were not statistically significant at the 5% level. Over the longer time intervals, none of the changes in the ratio of sales to assets was significant at the 5% level. The mean change in sales per employee was significant in the following years: −6 to −1 ($p = 0.003$), −1 to +1 ($p = 0.082$), and −6 to +3 ($p = 0.011$). The median changes in sales per employee were significant in two periods: −6 to −1 ($p = 0.004$) and −6 to +3 ($p = 0.033$).

Table 3 also gives the control-adjusted percentage changes in cost-per-dollar of sales. It shows that in 6 (5) out of the 10 years, the mean (median) changes in cost per dollar of sales of the sample firms were lower than those of the control firms. The mean changes were negative and significant in years −7 to −6 ($p = 0.001$), −4 to −3 ($p = 0.04$), and −2 to −1 ($p = 0.055$) while the median changes were negative and significant in the following years: −7 to −6 ($p = 0.054$) and −2 to −1 ($p = 0.042$). Note that there was also one positive and significant mean change from years 0 to +1 ($p = 0.068$). Over longer periods, Panel B of Table 3 shows that, from years −6 to +3, the mean change in cost-per-dollar of sales for the sample firms was 1.01% ($p = 0.072$) lower than that of the control firms. The mean change from years −4 to −1 was 0.84% ($p = 0.036$). None of the mean changes over other intervals and none of the median changes were significant at the 10% level.

Overall, our results were similar to those reported by Hendricks and Singhal (1997) on the three main measures of operating income, sales, and cost-per-dollar sales using the same control-firm selection criteria as used by Hendricks and Singhal. We further found that, in many cases, the sample firms showed a significant performance advantage over the control firms even before receiving the awards.

5.2. Results from One-to-One Matching of Control Firms Based on Industry, Size, and Performance (Match 2)

In this section, we report results after adjusting for the performance of the control firms selected based on firm size, industry, and ROA. As in the previous discussion, Panel A of the tables presents the mean and median percentage changes on an annual basis for the 10-year period starting at 6 years before and ending at 3 years after the award event, while Panel B gives the results on several selected longer time intervals.

Panel A of Table 4 reports the annual percentage changes in operating-income-based measures after adjusting for the performance of the control firms. The control-adjusted mean and median changes in operating income of the sample firms were positive in 8 of the 10 years. The mean changes were positive and significant in the following 3 years: −6 to −5

Table 4 Mean and Median Control Adjusted Percentage Changes in Operating Income-Based Measures with Control Firms Selected by Size, Industry, and Performance—One-to-One Matching (Match 2)

	% Change in Operating Income			% Change in Operating Income/Assets			% Change in Operating Income/Sales			% Change in Operating Income/Employees		
From Year	Obs	Mean	Median	Obs	Mean	Median	Obs	Mean	Median	Obs	Mean	Median
Panel A	Changes in Performance on an Annual Basis											
−7 to −6	345	−0.22	2.07	345	−1.71	−0.36	345	0.20	−0.16	291	1.18	−3.72
−6 to −5	374	5.59[b]	1.18	374	3.54[c]	−0.23	374	1.63	−0.54	325	5.65[b]	0.83
−5 to −4	372	5.06[b]	2.46	372	2.65	1.35	372	2.36	0.14	322	4.55[b]	1.35
−4 to −3	376	2.57	0.36	376	1.09	−1.22	375	0.74	−0.42	325	2.79	1.10
−3 to −2	378	1.87	0.66	378	−0.06	0.81	377	−0.80	−0.18	328	0.27	0.12
−2 to −1	387	6.11[a]	6.42[a]	387	3.74[b]	3.70[b]	386	4.69[a]	4.88[a]	336	3.80[c]	6.03[a]
−1 to 0	370	2.03	0.74	370	−0.30	1.69	369	−1.12	0.78	317	−1.05	−0.04
0 to +1	342	1.13	2.54	342	0.45	−0.83	342	0.24	−0.48	291	−2.13	−1.60
+1 to +2	321	−2.83	−1.40	321	−5.77[a]	−3.53[b]	320	−5.94[a]	−1.36[b]	270	−7.68[a]	−5.51[b]
+2 to +3	324	1.11	−1.62	324	0.03	0.15	323	−1.86	−1.56	272	−5.64[b]	0.84
Panel B	Changes in Performance Over Varying Time Periods											
−6 to −1	377	29.84[a]	18.16[a]	377	6.72[b]	1.20[c]	377	5.81[b]	1.63	329	15.84[a]	7.85[b]
−4 to −1	380	8.17[c]	9.24[b]	380	0.46	1.41	379	1.38	0.67	328	4.17	5.95
−1 to +1	351	3.06	2.77	351	−1.20	0.56	350	−1.11	−0.19	301	−3.25	2.14
−1 to +3	347	3.33	3.40	347	−3.19	−2.40	346	−7.57[a]	−6.88[b]	297	−13.98[a]	−7.42[c]
−6 to +3	332	13.85[a]	18.62[b]	332	−5.69[c]	−0.02	332	−9.01[b]	−4.02	286	−27.75[b]	−8.02

Note: a, b, and c denote statistical significance at the 1%, 5%, and 10% levels.

($p = 0.040$), −5 to −4 ($p = 0.036$), and −2 to −1 ($p = 0.006$). The median change was positive and significant only from years −2 to −1 ($p = 0.003$). Over the longer period, Panel B of the table shows that the control adjusted mean and median changes were all positive but significant only in years −6 to −1 ($p = 0.002$), −4 to −1 ($p = 0.061$), and −6 to +3 ($p = 0.007$). Over the 10-year period from years −6 to +3, the mean change was 13.85% and the median change was 18.62%. The results again show that the award-winning firms in our sample had strong, positive performance in operating income prior to the award year, even after controlling for prior performance. Compared to the results in Table 2, the magnitude of improvement was much lower when prior performance was controlled for.

The rest of Table 4 reports results for three income-based ratios. In general, on an annual basis, the mean and median changes in the ratio of operating income to assets, operating income per sales dollar, and operating income per employee were significant at the 5% level in 2–3 years, and there were approximately the same number of positive changes as negative ones. Over longer time periods, the mean and median changes in these measures from years −6 to −1 were positive and significant in almost all cases. However, the mean changes were negative and significant from years −6 to +3, although the median changes were not significant. These negative changes suggest that the sample firms may have experienced greater increases in assets, sales, and total number of employees than the growth of operating incomes during the 10-year period.

Table 5 reports the percentage changes in sales- and cost-based measures after adjusting for the performance of the control. Panel A shows that the mean and median changes in sales of the sample firms were higher than those of the control firms in 9 of the 10 years. The mean changes were positive and statistically significant at the 5% level in years −5 to −4, −3 to −2, −2 to −1, −1 to 0, and +1 to +2, and the median changes were positive and significant in 4 years, −5 to −4, −3 to −2, −1 to 0, and 0 to +1. Over longer periods, Panel B shows strong growth in sales for the sample firms. For example, from years −6 to +3, the mean change in sales of the sample firms was 55% and the median change was 21.6%, both significantly higher than those of the control firms. The results suggest that the sample firms had better sales results not only after but also before receiving the award. Table 5 also suggests that there were no significant mean or median control-adjusted changes in the ratio of sales to assets on an annual basis or in a longer time period. On the other hand, the mean and median changes in sales per employee were significant in several time periods with mixed positive and negative results. For example, both mean and median changes in sales per employee were positive and significant at the 1% level from years −6 to −1. They were negative and significant at the 10% level from years −1 to +3. These intermittent negative sales per employee may represent statistical quirks because we did not find the same negative values from sensitivity analyses with different sets of samples.

Table 5 (Panel A) also shows that the mean changes in cost-per-dollar of sales were negative in 5 of the

Table 5 Mean and Median Control Adjusted Percentage Changes in Sales and Cost-Based Measures with Control Firms Selected by Size, Industry, and Performance—One-to-One Matching (Match 2)

	% Change in Sales			% Change in Sales/Assets			% Change in Sales/Employees			% Change in Total Cost/Sales		
From Year	Obs	Mean	Median	Obs	Mean	Median	Obs	Mean	Median	Obs	Mean	Median
Panel A	Changes in Performance on an Annual Basis											
−7 to −6	409	−1.84	0.12	409	−0.83	0.48	341	−1.19	−0.60	409	−0.26	−0.02
−6 to −5	431	1.02	1.81	431	0.50	0.70	373	2.45[a]	2.11[b]	431	−0.09	0.09
−5 to −4	431	2.82[b]	2.96[b]	431	0.30	1.20	373	1.23	0.59	431	−0.37[c]	−0.20
−4 to −3	431	1.31	1.00	431	−0.58	0.72	373	0.94	0.93	431	0.17	0.17
−3 to −2	431	2.50[b]	2.92[b]	431	0.92	1.89	373	−1.06	0.75	431	0.40[c]	0.18
−2 to −1	431	2.27[b]	0.81	431	−0.26	−0.82	373	1.50[c]	1.85[b]	431	−0.46[c]	−0.73[a]
−1 to 0	417	3.48[a]	2.80[a]	417	1.27	0.75	358	2.01[b]	1.06	417	−0.23	−0.17
0 to +1	400	0.96	1.96[b]	400	−0.96	−0.82	341	−2.44[b]	−1.29[c]	400	0.31	0.18
+1 to +2	385	2.15[b]	0.59	384	−0.05	−0.24	325	−0.91	−0.11	385	0.91[a]	0.27[b]
+2 to +3	364	1.14	−0.72	364	1.09	1.79	307	−2.18[b]	0.27	364	0.06	0.33
Panel B	Changes in Performance Over Varying Time Periods											
−6 to −1	431	14.30[b]	12.43[b]	431	1.18	2.11	373	6.52[a]	7.75[a]	431	0.07	−0.32
−4 to −1	431	6.37[b]	5.09[b]	431	0.01	1.46	373	2.51[c]	2.60[c]	431	0.39	0.01
−1 to +1	400	4.12[b]	5.38[b]	400	0.17	0.32	342	−0.04	−0.21	400	−0.22	0.09
−1 to +3	365	12.67[a]	8.24[b]	365	0.66	1.45	311	−5.22[a]	−3.86[c]	365	1.00[b]	0.86[c]
−6 to +3	365	55.00[a]	21.61[a]	365	2.71	4.29	311	3.06	1.64	365	0.76	0.16

Note: a, b, and c denote statistical significance at the 1%, 5%, and 10% levels.

10 years, and the median changes were negative in 4 of the 10 years. The mean changes were negative and significant at the 10% level in the following 2 years: −5 to −4 ($p = 0.096$) and −2 to −1 ($p = 0.065$). However, there were positive and significant mean changes in these 2 years: −3 to −2 ($p = 0.098$) and +1 to +2 ($p = 0.007$). The significant median changes were from years −2 to −1 (−0.73%, $p = 0.009$) and +1 to +2 (0.27%, $p = 0.03$). Over the longer interval, we found in Panel B that the only significant mean and median changes in cost-per-dollar of sales appeared in years −1 to +3 with 1% ($p = 0.021$) for the mean and 0.86% for the median ($p = 0.053$).

5.3. Results from One-to-Portfolio Matching of Control Firms Based on Industry, Size, and Performance (Match 3)

Tables 6 and 7 depict the same abnormal return results as Tables 4 and 5, except here we used a portfolio of control firms that met the selection criteria and were close to the sample firms in terms of industry, size, and ROA. The number of control firms for

Table 6 Mean and Median Control Adjusted Percentage Changes in Operating Income-Based Measures with Control Firms Selected by Size, Industry, and Performance—One-to-Portfolio Matching (Match 3)

	% Change in Operating Income			% Change in Operating Income/Assets			% Change in Operating Income/Sales			% Change in Operating Income/Employees		
From Year	Obs	Mean	Median	Obs	Mean	Median	Obs	Mean	Median	Obs	Mean	Median
Panel A	Changes in Performance on an Annual Basis											
−7 to −6	359	7.90[a]	3.93[a]	340	0.37	0.40	326	−1.80	−1.63	315	−1.74	−1.97
−6 to −5	383	10.34[a]	3.62[a]	362	0.43	−0.26	359	−1.93	−1.60	346	0.54	−1.06
−5 to −4	382	8.88[a]	5.59[a]	373	3.21[c]	0.89	367	1.16	−1.45	353	3.52[c]	−0.30
−4 to −3	388	2.98[c]	1.35	379	−1.79	−0.77	376	−2.10[c]	−1.81	358	−1.67	−0.57
−3 to −2	385	5.79[a]	0.50	378	−0.08	−1.62	379	−4.33[a]	−3.52[a]	356	−1.12	−2.00
−2 to −1	392	9.07[a]	5.27[a]	389	−0.70	−3.52	387	−0.68	−3.64[b]	364	1.22	−1.30
−1 to 0	379	6.42[a]	5.20[a]	375	9.22[a]	7.59	376	10.17[a]	8.86[a]	348	12.06[a]	10.77[a]
0 to +1	357	1.74	3.43[c]	349	3.14[b]	4.53[a]	348	3.17[b]	4.59[a]	326	1.56	4.67[b]
+1 to +2	338	−0.16	0.68	334	−3.04[c]	0.41[a]	331	−1.13	0.06	311	−3.96[c]	0.57
+2 to +3	332	−2.87	−1.41	326	−0.14	−0.18	325	−0.92	−1.22	301	−4.56[c]	−2.02
Panel B	Changes in Performance Over Varying Time Periods											
−6 to −1	382	57.84[a]	19.38[a]	368	−7.79[a]	−9.79[a]	361	−13.42[a]	−14.40[a]	345	−3.86	−11.31[b]
−4 to −1	391	17.22[a]	7.70[a]	383	−6.42[a]	−7.91[a]	382	−10.69[a]	−10.78[a]	362	−6.17[b]	−8.13[a]
−1 to +1	363	7.26[a]	6.96[a]	362	11.67[a]	10.49[a]	358	12.15[a]	12.04[a]	337	13.12[a]	10.84[a]
−1 to +3	347	0.91	0.11	347	6.08[b]	6.81[b]	346	9.07[a]	8.60[a]	317	3.49	9.17[c]
−6 to +3	339	61.71[a]	21.94[b]	325	−4.25	1.40	319	−1.34	−1.97	304	−15.64[c]	−2.85

Note: a, b, and c denote statistical significance at the 1%, 5%, and 10% levels.

Table 7 Mean and Median Control Adjusted Percentage Changes in Sales and Cost-Based Measures with Control Firms Selected by Size, Industry, and Performance—One-to-Portfolio Matching (Match 3)

	% Change in Sales			% Change in Sales/Assets			% Change in Sales/Employees			% Change in Total Cost/Sales		
From Year	Obs	Mean	Median	Obs	Mean	Median	Obs	Mean	Median	Obs	Mean	Median
Panel A	Changes in Performance on an Annual Basis											
−7 to −6	409	4.59[a]	2.71[a]	409	0.00	0.37	375	−3.55[a]	−2.99[a]	409	0.10	0.28
−6 to −5	431	5.87[a]	3.19[a]	431	−0.27	−0.03	399	0.59	1.77	431	0.69[a]	0.15[c]
−5 to −4	431	6.31[a]	3.62[a]	431	0.57	−0.09	400	2.07[b]	0.78[c]	431	0.26	0.12
−4 to −3	431	3.27[a]	1.94[a]	431	−1.04[c]	0.31	400	1.11[c]	1.97	431	0.30[c]	0.18
−3 to −2	431	4.37[a]	2.93[a]	431	1.85[a]	1.10[b]	399	−0.72	1.13	431	1.04[a]	0.58[a]
−2 to −1	431	3.47[a]	1.80[b]	431	0.65	0.47	399	0.92	−0.17	431	0.67[a]	0.55[a]
−1 to 0	417	3.44[a]	2.49[a]	417	2.02[a]	1.19[b]	384	4.15[a]	2.66[a]	417	−1.61[a]	−1.34[a]
0 to +1	400	0.10	0.34	400	−0.18	−0.40	368	−0.61	0.08	400	−0.25	−0.67[a]
+1 to +2	385	1.38[c]	0.25	384	0.56	0.62	354	−1.15	−1.45	385	0.67[b]	0.19
+2 to +3	364	−0.72	−1.75	364	0.71	0.64	332	−1.02	0.04	364	0.14	0.1
Panel B	Changes in Performance Over Varying Time Periods											
−6 to −1	431	45.54[a]	19.80[a]	431	0.14	−1.53	399	4.04[b]	2.24	431	3.25[a]	2.19[a]
−4 to −1	431	15.12[a]	7.96[a]	431	0.92	0.95	400	1.65	1.21	431	2.28[a]	1.37[a]
−1 to +1	400	3.61[b]	3.15[c]	400	2.24[b]	1.79[b]	369	3.62[a]	3.49[a]	400	−2.13[a]	−1.70[a]
−1 to +3	365	8.43[b]	3.26	365	2.89[b]	2.57[c]	333	0.52	1.67	365	−1.40[a]	−1.33[a]
−6 to +3	365	97.07[a]	26.71[a]	365	1.24	−1.19	333	2.58	4.14	365	1.71[a]	0.32[c]

Note: a, b, and c denote statistical significance at the 1%, 5%, and 10% levels.

each sample firm ranged from 1 to 21 with the average portfolio size of 2.64. For one-to-portfolio matching, the average performance of all control firms was used in the analysis. The results of the statistical tests in these tables are quite similar to those in Tables 4 and 5, although the *p*-values are generally lower in Tables 6 and 7 than in the corresponding Tables 4 and 5, reflecting increased power in tests with portfolio-matching.

Overall, taking these results together, we found strong evidence that firms winning quality awards were more successful in improving their operating incomes and sales. The findings were mixed regarding the effectiveness of quality-award-winning firms in controlling cost and improving the ratios of operating income to several measures of firm size such as assets, sales, and number of employees. Once again, we found strong evidence that quality firms had better performance both before and after winning the award.

5.4. Comparison of the Key Results

We summarize our main results on the three primary measures of operating income, sales, and cost-per-dollar sales over several different time periods in Table 8 along with the corresponding results from Hendricks and Singhal (1997). Panel A reports the control-adjusted mean percentage changes, whereas Panel B shows the control-adjusted median percentage changes.

Overall, our results were similar to those in Hendricks and Singhal's (1997) study. That is, after receiving the award, sample firms experienced significant improvements in operating income and sales. However, there were several key differences in the results. First, although Hendricks and Singhal (1997) found almost no significant results for the firms before winning the awards, we found that award-winning firms had significantly better results before winning the awards. Second, Hendricks and Singhal (1997) found that over the 10-year period from years −6 to +3, the mean and median changes in the operating income for the award-winning firms were 107% and 48% higher than for the control firms. However, these numbers were 85% and 39% in our study when the control firms were chosen based on industry and size alone. For sales, Hendricks and Singhal (1997) reported a 64% (24%) increase in the mean (median) change for the sample firms. In our study, the mean (median) change in sales was 101% (47%) when using the same single-firm matching approach as Hendricks and Singhal (1997). Moreover, the mean change in sales was 55% and the median was 22% when single-firm matching was based on prior performance. Third, when control firms were selected based on prior performance (Match 2 and Match 3), the magnitude of these improvement results was generally smaller than when prior performance was not considered. This suggests that controlling for prior performance had a major impact on the magnitude of performance improvement. It also supports the theoretical argument in the event-study literature that without matching prior performance, the results may be biased toward sample firms. Finally, for the cost/sales ratio, our results were largely consistent with those of Hendricks and Singhal (1997) when the same single-firm matching method was used. From years

Table 8 Comparison of Key Results Between this Study and the Hendricks and Singhal Study

	% Change in Operating Income				% Change in Sales				% Change in Total Cost/Sales			
From Year	H&S	Match 1	Match 2	Match 3	H&S	Match 1	Match 2	Match 3	H&S	Match 1	Match 2	Match3
Panel A: Mean												
−6 to −1	10.41	18.69[c]	29.84[a]	57.84[a]	6.21	27.91[a]	14.30[b]	45.54[a]	0.27	−0.6	0.07	3.25[a]
−4 to −1	8.88	5.33	8.17[c]	17.22[a]	2.8	9.44[a]	6.37[b]	15.12[a]	−0.45	−0.84[b]	0.39	2.28[a]
−1 to +1	14.77[a]	8.51[b]	3.06	7.26[a]	6.26[a]	7.34[a]	4.12[b]	3.61[b]	−0.39	0.24	−0.22	−2.13[a]
−1 to +3	35.06[c]	10.18[c]	3.33	0.91	18.15[a]	15.62[a]	12.67[a]	8.43[b]	−0.94[c]	0.43	1.00[b]	−1.40[a]
−6 to +3	107.12[a]	84.84[a]	13.85[a]	61.71[a]	63.74[c]	100.96[a]	55.00[a]	97.07[a]	−1.27[c]	−1.01[c]	0.76	1.71[a]
Panel B: Median												
−6 to −1	0.56	29.46[a]	18.16[a]	19.38[a]	5.35	21.94[a]	12.43[b]	19.80[a]	−0.16	−0.26	−0.32	2.19[a]
−4 to −1	7.41	8.88[c]	9.24[b]	7.70[a]	2.92	9.81[a]	5.09[b]	7.96[a]	−0.27	−0.28	0.01	1.37[a]
−1 to +1	2.96[c]	7.11[b]	2.77	6.96[a]	2.52[b]	3.30[a]	5.38[b]	3.15[c]	0.24	−0.06	0.09	−1.70[a]
−1 to +3	22.93[a]	7.74	3.4	0.11	11.23[a]	8.78[a]	8.24[b]	3.26	−0.02	0.50	0.86[c]	−1.33[a]
−6 to +3	47.69[a]	39.24[a]	18.62[b]	21.94[b]	24.45[a]	46.63[a]	21.61[a]	26.71[a]	0.61	−0.62	0.16	0.32[c]

Note: H&S refers to Hendricks and Singhal (1997); Match 1 refers to the same one-to-one matching method as H&S, Match 2 refers to one-to-one matching with prior performance, and Match 3 refers to one-to-portfolio matching with prior performance; a, b, and c denote statistical significance at the 1%, 5%, and 10% levels.

−6 to +3, Hendricks and Singhal (1997) found that the mean change in cost-per-dollar of sales of the test sample was –1.27% (weakly significant at the 10% level), but the median change was 0.61% (not significant). These numbers were −1.01% for the mean change (weakly significant) and 0.62% for the median (not significant) in our study (Match 1). However, when also controlling for performance, our results differed somewhat from theirs. In one-to-one matching, most of the changes were not significant (Match 2). However, in one-to-portfolio matching (Match 3), the changes were mostly significant, but the signs were mixed. Because the magnitude of sales increases was greatly decreased when controlling for performance, the cost/sales ratio may increase even though costs might be reduced.

5.5. Results from the Sensitivity Analysis

We performed an extensive sensitivity analysis to address several potential issues in our study. First, in selecting the control group, we used a relatively wide band (within 0.7 and 1.3 ROA) for matching on performance in order to include more observations in our sample. We also ran our analyses by selecting the control firms within 0.9 and 1.1 times the ROA of the sample firms. The results were similar to those with wider control limits.[1]

Second, we used ROA as the measure of performance in choosing control firms. Although matching based on ROA is a widely accepted approach in the literature, we considered other performance measures such as operating income, return on sales, and sales turnover (sales over assets) as controls. The results did not change qualitatively from our main results reported earlier.

Third, one of the criteria that many government awards—especially the Baldrige National Quality Award—use in selecting winners is business results. For example, among the seven categories of criteria for the Baldrige Award, the Results category is one of the most emphasized with the largest number of points. The award examines a firm's performance and improvement in six areas—product, customer focus, financial and market, workforce focus, process effectiveness, and leadership. To address the concern that the Baldrige and state government awards may select firms that have superior financial performance, we ran the same analysis excluding firms that had won the Baldrige and state awards and the results were similar to those obtained with the whole sample.

Finally, some of the award winners in our sample might have received awards before 1994 and therefore could be included in Hendricks and Singhal's (1997) study. To identify these firms, we compared our sample firms with theirs and found 131 of the 501 firms were also award winners in their sample.[2] Interestingly, most of the Baldrige Award winners in our sample had received awards before. Using only the 370 firms that won their first quality awards during our study period, we reran the analysis and the results were again similar to the results for the whole sample. Once again, we found that the pre-award performances were still better even for the first-time award winners.

6. Discussion and Conclusion

This study provides further empirical evidence on TQM's long-lasting impact on firm performance. By replicating and extending Hendricks and Singhal's (1997) study using data mainly from the 1990s, we explore whether their results are still relevant. Our main findings are largely consistent with those found by Hendricks and Singhal (1997). That is, firms expe-

rienced significant improvement in several operating performance measures after winning quality awards. However, whereas Hendricks and Singhal (1997) did not find evidence of abnormal improvement in operating performance for firms before winning the awards, we have found that award-winning firms not only had better results after winning the awards but also superior performances before the award.

The differences between our results and those of Hendricks and Singhal (1997) can be attributed to several factors. First, while Hendricks and Singhal's sample consisted of firms that won their quality awards from 1983 to 1993, our sample contained firms that won their quality awards during the 10-year period from 1994 to 2003. As discussed previously, the business environment in the 1990s differed from that of the 1980s; consequently, the role of quality may be less dramatic in the latter period than in the former period. Companies that adopted and effectively implemented TQM programs in the 1980s were able to achieve considerably better business results and gain significant competitive advantages, as evidenced by the findings of Hendricks and Singhal (1997) that effective TQM implementers were similar in performance to their peers prior to the award year but much improved afterward. However, awards given in the 1990s were more likely to recognize continued TQM excellence instead of initial implementation.[3] Firms that stayed focused on TQM, as evidenced by winning awards in the 1990s, continued to outperform their peers both before and after the awards, which is a key difference between our results and those of Hendricks and Singhal (1997).

In addition, as quality continued to improve during the 1990s, enthusiasm about TQM began to fade (Garten 2000). This, coupled with increased competition in a globalized marketplace, made many companies believe that quality was no longer an advantage factor in the marketplace but a necessary condition for success (Evans and Lindsay 2011, Lee et al. 2006). Das et al. (2000) found that, in this highly dynamic and competitive environment, quality became a "routinized customer expectation" and performance benefits still accrued but at a decreasing rate. This may explain why our results were less dramatic in several performance improvements than those found by Hendricks and Singhal (1997). Another plausible explanation of the difference in post-award magnitude is that our control group for the 1990s consisted of firms that were more likely to have started or implemented TQM programs than control firms in Hendricks and Singhal's (1997) study during the 1980s, thus reducing the performance difference between award-winning firms and control firms.

Finally, we extended Hendricks and Singhal's approach for choosing control firms in carrying out the event study. Specifically, in Hendricks and Singhal's (1997) study, control firms were selected based on industry and size alone without considering pre-event firm performance. Because the goal of an event study is to evaluate whether the event contains information about a firm's future operating performance that is not a part of its historical performance trajectory without the event, matching on prior performance is critical to avoid potential biases in results or confounding factors that may have nothing to do with the event. As our results clearly show that matching on prior performance does have a major impact on the magnitude of performance change, this study provides further empirical support to the importance of matching on performance.

Our finding that award-winning firms experienced significant performance improvement before receiving awards suggests that awards do not "drive the bus," but rather that the desire for quality excellence is the primary motivator. In other words, the awards alone may not be important; they are simply recognition of a firm's effort to achieve higher quality and customer satisfaction. This suggests that it is the firm's own long-term quality improvement efforts that lead to superior performance results. The fact that many of the award-winning firms in our sample were also in Hendricks and Singhal's (1997) study seems to support this point. This is also consistent with the literature on operational capabilities that suggests that organizational learning is path-dependent: What a firm has done in the past tends to predict what it can do in the future (Corbett and Van Wassenhove 1993, Hayes et al. 2004, Kogut and Zander 1992, Rosenzweig and Roth 2004).

The results suggest that an effective TQM program continued to pay off in the 1990s and beyond despite changes in the business environment. Of course, quality can still be a differentiator for some industries. Even when quality no longer operates as a strategic differentiator and the focus is more on maintaining quality than using it to create a competitive edge, quality still remains one of the key dimensions that matter in the market. In general, consumers seek better quality and are loyal to organizations that consistently provide high-quality products and services; this explains why our study showed that award-winning firms' sales significantly and consistently outgrew those of the control firms over the 10-year period around the award. Furthermore, it is important to understand the role of quality as an order qualifier, the criterion that a company must meet in order to be considered by the market. If quality is not emphasized and quality management effort is not renewed over time, it will erode. A poor quality problem, such as a major product recall, can significantly affect consumer confidence and have a lasting nega-

tive effect on firm performance even after the problem has been fixed, as demonstrated by the Firestone tire fiasco a few years ago (O'Dell and Sanders 2000) and more recent product recalls by Mattel (Casey 2007). Therefore, quality should be consistently emphasized at the top management level, or a deterioration of quality will occur over time. As Garten (2000) commented, "If a CEO doesn't speak about it all the time, then it wanes."

As discussed previously, businesses in the 1990s and early 2000s might have shifted their competitive priority to other areas such as responsiveness and flexibility. Thus, an interesting question arises: is it possible for firms to compete on other dimensions without a quality foundation? Although there is a lack of direct evidence, our results appear to be consistent with the operation's competitive progression theory, which posits that sustainable competitive capabilities are built cumulatively from quality to delivery reliability to flexibility to cost leadership (Roth 1996). Although different sequences of cumulative capabilities have been observed in practice, quality has been consistently cited as the foundation of the development of cumulative capabilities (Ferdows and De Meyer 1990, Hall 1987, Nakane 1986, Schmenner and Swink 1998). In addition, the development sequence of these operational capabilities does not seem to work in reverse (Ferdows and De Meyer 1990). That is, quality provides a building block for firms to achieve other operational capabilities but not the other way around. Without a solid foundation in quality, it seems very difficult, if not impossible, for a firm to compete effectively on other dimensions such as delivery dependability, flexibility, responsiveness, and cost, especially over the long run. Those firms that continuously focus on quality improvement are rewarded with long-lasting advantages in the marketplace through a better capacity to develop competitive capabilities.

As in other similar studies, there are several limitations with this work. First, different types of quality awards were used, which could have affected firm performance differently because the awards varied in their evaluation criteria or standards and thus could have implied different levels of TQM implementation. Nonetheless, our results suggest that, overall, quality award winners, regardless of the award type, reap significant financial rewards both before and after the award. Second, we used company-wide financial data, whereas an award might be given to a unit or division of a large firm; this may result in an underestimation of the benefits from award-winning events. However, this is a common practice in this type of research due to the difficulty in obtaining unit-specific financial performance indicators. Third, our sample of award-winning firms was collected based on announcements or reports in the news media. It is possible that some firms might have received awards from sources that may not have been announced. Additionally, we were not able to find information about whether the control firms in our sample had effective TQM programs. Therefore, our results may not reflect the true magnitude of performance improvement for an effective TQM program. Finally, a firm might have won multiple awards from multiple sources. The number of awards as well as the nature of the award may indicate different levels of performance impact. However, only the first award was considered in this study, regardless of the award type. Because some of the award winners also appeared in Hendricks and Singhal's (1997) study, this overlap may indicate that the number of awards or award type may not be important. Rather, they are just evidence of continued long-term quality improvement.

Future research should address several of these limitations. For example, survey research methodology can be used to assess more accurately how awardees improve their operating and financial performance if awards are given only to the unit or division instead of to the whole organization. Survey data can be collected and analyzed from both the sample and control firms identified in this study to examine in depth their quality management programs, successful implementation elements, and key differences that impact their respective organizational performances. Due to the use of both subjective and objective data, such a study should provide better insight regarding the true impact of a successful TQM program. Future research can also study the changes of quality-award criteria and the impact of these changes on firm performance. Furthermore, we can study the impact of several organizational factors such as firm size, capital intensity, and firm type (service versus manufacturing) on performance improvement. Finally, longitudinal data analyses can be carried out to study the performance change of award-winning firms over time.

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Notes

[1]We do not include the sensitivity results here to save space. These results are available from the authors.
[2]We thank Vinod Singhal for sharing this information with us.

[3]Lee et al. (2006) and Evans and Lindsay (2011) discussed significant revisions of the Malcolm Baldrige National Quality Award criteria during the mid-1990s to emphasize continued performance excellence instead of quality assurance.

Appendix A

Measures and COMPUSTAT Variables

Performance Measures	COMPUSTAT Variables	Explanation
Operating Income	OIBDP	Operating income before depreciation
Operating Income/ Assets	OIBDP/AT	Operating income before depreciation divided by Total Assets
Operating Income/ Sales	OIBDP/SALE	Operating income before depreciation divided by Sales
Operating Income/ Employees	OIBDP/EMP	Operating income before depreciation divided by Employees
Sales	SALE	Net Sales
Sales/Assets	SALE/AT	Net Sales divided by Total Assets
Sales/ Employees	SALE/EMP	Net Sales divided by Employees
Total Cost/ Sales	(COGS +XSGA)/ SALE	Cost of Goods Sold plus Selling, General, and Administrative Expenses divided by Net Sales

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