THE USEFULNESS OF GOODWILL IMPAIRMENT UNDER SFAS NO. 142 IN REFLECTING THE RELATIVE EFFICIENCY OF FIRMS

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INTRODUCTION

1.1 Motivation and Summary

Goodwill as a proportion of assets acquired in business combinations has been growing in recent years, resulting in an increased demand for more useful information about goodwill.[1] Before the recent changes in accounting standards, goodwill was viewed as a depreciating asset and systematically amortized over an arbitrary ceiling of 40 years. Prior studies examine the effect of goodwill amortization on the usefulness of earnings and find that goodwill amortization is not value relevant (Moehrle et al. 2001; Jennings et al. 2001). The Financial Accounting Standards Board (FASB) acknowledges that users of financial statements do not consider goodwill amortization in making investment and credit decisions, and entities ignore goodwill amortization in evaluating the performance of management (SFAS No. 142, Appendix B, par B90). These findings suggest that eliminating goodwill amortization should not reduce the usefulness of earnings. In addition, as previous standards provided little guidance about how to determine and measure the write-offs of goodwill when the values decrease, the accounting for voluntary goodwill write-offs was not consistent or comparable, and

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[1] Goodwill is an important component of a firm's value, representing approximately 20 percent of the total assets of business combinations that occurred between 1990 and 1994 (Henning et al. 2004). The percentage of goodwill to the purchase price for the acquisitions that occurred from 1997 to 2002 is approximately 68 percent, which is larger relative to the acquisitions over 1990-1994 (Long 2005).

information usefulness was questionable.

In June 2001, the FASB issued Statement of Financial Accounting Standard (SFAS) No. 142, *Goodwill and Other Intangible Assets* (FASB 2001b), which provides more specific guidance for determining the amount and timing of goodwill impairment recognition. This standard changes the accounting for goodwill from an amortization method to an impairment testing approach. SFAS No. 142 requires goodwill to be tested for impairment under a two-step process: (1) to identify potential impairment, and (2) to measure the amount of impairment loss. The argument for SFAS No. 142 is that previous practice of goodwill amortization did not reflect the economic change of a firm's value because accounting earnings were burdened with periodic goodwill amortization expenses. However, acquiring entities are willing to pay for goodwill presumably due to the assumption that net assets acquired will yield more than the purchase price. The acquiring entities pay a premium for an opportunity to improve profitability from an acquired entity, to create value from synergy, and to achieve economies of scale. Therefore, the argument can be made that goodwill should be viewed as a valuable economic resource and should not be systematically amortized. However, goodwill should remain until it is impaired under the criteria of SFAS No. 142.

The FASB expects that SFAS No. 142 will improve financial reporting by providing users with a better understanding of the underlying economic value of goodwill and enhancing their ability to assess firms' future profitability and cash flows (SFAS No. 142, Summary). The implementation of SFAS No. 142 leads to a main research question whether or not the standard provides information about a firm's economic performance. This study focuses on the periods subsequent to the initial adoption of SFAS No. 142 and

addresses the following questions: (1) Is an impairment firm relatively less efficient than a non-impairment firm in the year of impairment recognition? (2) How does the relative efficiency of a firm change over time when a firm reports goodwill impairment versus no impairment each year? (3) Is relative efficiency a determinant of goodwill impairment? (4) What is the predictive ability of relative efficiency with respect to a goodwill impairment decision? This study selects three industries--durable manufacturers, computers, and services--for the analysis. These industries have the largest number of firms with goodwill impairment losses and, thus, provide sufficient impairment observations. The research questions are examined in the following two parts.

The first part, "Goodwill impairment and relative efficiency of firms", examines whether or not goodwill impairment under SFAS No. 142 improves financial reporting and disclosures by better reflecting a firm's underlying relative efficiency. A firm's relative efficiency is measured by using Data Envelopment Analysis (DEA). DEA allows an aggregation of several financial measures into a meaningful measure of firm performance. Each industry is analyzed individually to mitigate the effect of industry differences. Therefore, the results better capture economic environment and industry characteristics. First, using a cross-sectional analysis, this study compares the relative efficiency of impairment firms in the year of goodwill impairment recognition to that of non-impairment firms in the same year. Second, this study investigates the relative efficiency of firms over time. A longitudinal analysis is useful because it explains how relative efficiency changes over time when firms recognize goodwill impairment or do not have impairment in each year. The linkage between goodwill impairment and

relative efficiency provides an opportunity for the additional analysis in the second part of this study.

The second part, "The determinant and predictive ability of relative efficiency on goodwill impairment under SFAS No. 142", examines the importance of a firm's relative efficiency in determining the percentage and the decision of goodwill impairment recognition. After obtaining firms' relative efficiency scores by each industry, this study performs the analyses on combined industries to increase the sample size. This study uses a Tobit regression to analyze the determinants of the percentage of goodwill impairment and uses a logistic regression to analyze the likelihood of a goodwill impairment decision, after controlling for managerial reporting incentives. In addition, this study examines the predictive ability of relative efficiency with respect to a goodwill impairment decision by using a logistic regression and a multivariate discriminant analysis (MDA).

1.2 Contribution

This study contributes to the extant literature in several ways. First, it contributes to the literature regarding asset write-downs (e.g. Strong and Meyer 1987; Francis et al. 1996; Segal 2003; Zang 2003; Riedl 2004). Prior research does not include relative efficiency as a determinant of goodwill impairment. To my knowledge, this research is the first attempt to explore the linkage between goodwill impairment and a firm's relative efficiency and will thus provide evidence regarding potential benefits of SFAS No. 142 in conveying information about a firm's underlying economic value. Further, the linkage between goodwill impairment and a decline in efficiency can explain why goodwill

impairment conveys information about a firm's equity valuation and future performance. Second, this study extends the relative efficiency literature (e.g. Bowlin 1995, 1999; Seiford and Zhu 1999; Zhu 2000; Luo 2003) by applying the DEA technique to measure a firm's overall relative efficiency and to assess the implementation of the accounting standard in reflecting the effect of relative efficiency. Finally, this study contributes to the literature on goodwill impairment prediction models (e.g. Hayn and Hughes 2006) by examining the predictive ability of relative efficiency in determining goodwill impairment. Although the objective of this study is not to construct a prediction model for goodwill impairment, the results from this study provide an avenue for future research to incorporate an overall measure of firm performance into the prediction model. The inclusion of a firm's relative efficiency measure will help financial statement users to better assess the likelihood of goodwill impairment decisions.

The results from this study are of interest to investors, auditors, and standard setters. Investors benefits from the ability to determine a goodwill impairment loss. If an impairment loss signals a decrease in firm efficiency, it will help investors to be aware of a decline in the value of their investment in an impairment firm. Auditors are responsible for expressing an opinion on the fairness of financial statements in material respects. Therefore, auditors will be able to assess whether goodwill should be kept in financial statements or should be written down as goodwill impairment. Finally, to standard setters, results from this study provide empirical evidence on the implication of SFAS No. 142 after its initial adoption. The evidence helps to indicate whether or not the standard has improved financial reporting by reflecting the underlying economics of

goodwill so that financial statement users are better able to assess the subsequent performance of firms.

The remainder of this study is organized as follows. Chapter 2 provides the background of SFAS No. 142. Chapter 3 discusses a performance measurement. Chapter 4 presents the first part, "Goodwill impairment and relative efficiency of firms". Chapter 5 provides the second part, "The determinant and predictive ability of relative efficiency on goodwill impairment under SFAS No. 142". The final chapter offers a summary.

CHAPTER 2

BACKGROUND OF SFAS NO. 142

Prior to SFAS No. 142, goodwill was viewed as a depreciating asset. It was systematically amortized over its expected economic useful life, which was not more than 40 years, according to Accounting Principles Board (APB) Opinion No. 17, *Intangible Assets* (AICPA 1970). However, APB No. 17 did not provide any guidance for when and how to measure the existence of goodwill impairment. SFAS No. 121, *Accounting for the Impairment of Long-Lived Assets and for Long-Lived Assets to Be Disposed Of* (FASB 1995), was used as a rough guide for goodwill impairment testing although its objective was for other long-lived asset impairment testing.[2] This standard offered management discretion in deciding the timing of the impairment test.

In June 2001, the FASB issued SFAS No. 141, *Business Combinations*, and SFAS No. 142, *Goodwill and Other intangible Assets* (FASB 2001a, 2001b). SFAS No. 141 eliminates the pooling-of-interest method and requires all business combinations after June 2001 to comply with the purchase accounting method. SFAS No. 142 changes accounting for goodwill from an amortization method to an impairment testing approach. Goodwill is no longer viewed as a depreciating asset but represents the expectation of

[2] SFAS No. 121 was superseded by SFAS No. 144, *Accounting for the Impairment or Disposal of Long-Lived Assets* (FASB 2001c), in August 2001.

benefits arising from synergies due to an integration of the acquired and acquiring entities. The standard is more specific on three main issues: (1) what level of reporting unit to test for goodwill impairment, (2) when to test for impairment, and (3) how to measure the amount of goodwill impairment.

First, SFAS No. 142 requires that a goodwill impairment test be performed at a level of "reporting unit".[3] The amount of goodwill assigned to a reporting unit is based on the expected benefits arising from synergies of the business combinations although other assets or liabilities of the acquired entity may not be allocated to that reporting unit (SFAS No. 142, par 34). The reason is that estimated cash flows are generated at this level for planning purposes and can be used to determine the fair value of a reporting unit. Further, the lower the level of a reporting unit is, the lower is the likelihood that a firm can offset goodwill impairment from one reporting unit with unrecognized internally developed goodwill from another reporting unit. Second, SFAS No. 142 requires goodwill to be tested for impairment at least annually and at the same time each year to eliminate the effect of timing manipulation. In addition, the goodwill impairment test can be performed between annual tests if events or certain circumstances indicate that the fair value of a reporting unit is likely to be lower than its carrying amount.[4] Finally, the

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[3] The reporting unit is an operating segment (as currently reported under SFAS No. 131, *Disclosures about Segments of an Enterprise and Related Information*), or one level below an operating segment (referred to as a component). A component of reporting segment is a reporting unit if its discrete financial information is available and segment management regularly reviews the operating results. However, two or more components of an operating segment can be aggregated as a single reporting unit if the components have similar economic characteristics (SFAS No. 142, par. 30, 31).

[4] Examples of such events or circumstances include: (1) a significant adverse change in legal factors or in the business climate, (2) an adverse action or assessment by a regulator, (3) unanticipated competition, (4) a loss of key personnel, (5) a reporting unit or a significant portion of a reporting unit is more likely to be sold or disposed of, (6) the testing for recoverability under SFAS No. 121 of a significant asset group within a reporting unit, and (7) recognition of a goodwill impairment loss in the financial statements of a subsidiary that is a component of a reporting unit (SFAS No. 142, par. 28).

FASB provides specific guidelines on how to measure the amount of goodwill impairment.

The goodwill impairment test is performed in a two-step process. The first step is to identify potential goodwill impairment and the second step is to measure the amount of impairment loss.

Step 1: The fair value of a reporting unit is compared with its carrying amount, including goodwill. If the fair value of a reporting unit is less than its carrying amount, this indicates potential goodwill impairment, thereby necessitating the next step (SFAS No. 142, par. 19).

Step 2: The "implied fair value" of the reporting unit goodwill is compared with the carrying amount of goodwill.[5] If the implied fair value of goodwill is less than its carrying amount of the reporting unit goodwill, the difference between these amounts is charged as an impairment loss to the income statement (SFAS No. 142, par. 20).

The fair value of a reporting unit is the amount at which a unit as a whole could be bought or sold in a current transaction between willing parties. In determining the fair value of a reporting unit, FASB states that quoted market prices are the best evidence of the fair value, if available, but need not be representative of the fair value of a reporting unit as a whole. This is because a substantial value may arise from synergies and other benefits from a controlled entity (SFAS No. 142, par 23). An acquiring entity is willing

[5] To calculate implied fair value of goodwill, an entity must allocate the fair value of a reporting unit to all of the assets and liabilities of that unit (including any unrecognized intangible assets) as if the reporting unit had been acquired in a business combination. The implied fair value of goodwill is the excess of the fair value of a reporting unit over the amount allocated to its assets and liabilities (SFAS No. 142, par. 21).

to pay a higher price for the controlling interest in an acquired entity than the amount that an investor would pay for securities without the controlling interest (SFAS No. 142, par B154). The controlling interest allows an acquiring entity to access all resources and make strategic decisions on policies and directions of an acquired entity. Moreover, an acquiring entity can obtain benefits from an increase in supply chain and coordination from an acquired entity. The economy of scale synergies are typical parts of the controlling interest benefits. Therefore, the fair value of a reporting unit may exceed its market capitalization. SFAS No. 142 notes that if a quoted market price is not available, a present value of future cash flows might be the best available technique. To estimate future cash flows, an entity needs to incorporate assumptions that available for market participants to estimate fair value or uses its own assumptions if that information is unavailable (SFAS No. 142, par 24).[6] SFAS No. 142 also allows using other valuation techniques (e.g. multiples of earnings or revenues) or similar performance measures when the fair value of an entity with the comparable operations and economic characteristics is obtainable (SFAS No. 142, par 25).

Another issue to be considered is that goodwill impairment under SFAS No. 142 and long-lived asset impairment under SFAS No. 144, *Accounting for the Impairment or Disposal of Long-Lived Assets* (FASB 2001c), may be tested for impairment at the same time. In this situation, SFAS No. 142 notes that the other asset (or asset group) will be tested for impairment before goodwill. If the asset (or asset group) is impaired, the

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[6] Assumptions are required to determine the present value of future cash flows, for example, the several scenarios of business conditions, the probability of occurrence, the discount rate, and the risk adjustment factors. Statement of Financial Accounting Concepts No. 7, *Using Cash Flow Information and Present Value in Accounting Measurements*, provides guidance for using cash flows to determine the fair value of assets (FASB 2000).

impairment loss will be recognized prior to goodwill being tested for impairment (SFAS No. 142, par. 29). Therefore, the values of assets on the balance sheet at the date of goodwill impairment test are the lower amount of fair values or carrying values of these assets. After adjusting for the long-lived asset impairment, the carrying values of these assets will be included in estimating the fair value of a reporting unit for the purpose of goodwill impairment test.

According to SFAS No. 144, a long-lived asset impairment loss will be recognized only if (1) the carrying amount of a long-lived asset is *not recoverable*, and (2) exceeds its fair value (SFAS No. 144, par 7). SFAS No. 144 requires a long-lived asset to be tested for recoverability whenever events or circumstances indicate that the carrying amount of an asset may not be recoverable.[7] The carrying amount of a long-lived asset is not recoverable if it exceeds the sum of *undiscounted* cash flows from the use and disposition of the asset. Although the fair value of a long-lived asset is less than its carrying amount, firms may not recognize the long-lived asset impairment loss if the sum of *undiscounted* cash flows still exceeds its carrying amount. Therefore, firms are able to avoid achieving the threshold for the long-lived asset impairment test.

On the contrary, when performing a goodwill impairment test, a firm that has a decrease in the fair value of long-lived assets is more likely to exhibit deterioration in the

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[7] The examples of such events or changes in circumstances are: (1) a significant decrease in the market price of a long-lived asset (asset group); (2) a significant adverse change in the extent or manner in which a long-lived asset (asset group) is being used or in its physical condition; (3) a significant adverse change in legal factors or in the business climate, including an adverse action or assessment by a regulator; (4) an accumulation of costs significantly in excess of the amount originally expected for the acquisition or construction of a long-lived asset (asset group); (5) a current-period operating or cash flow loss, a history of operating or cash flow losses or forecast that demonstrates continuing losses associated with the use of a long-lived assets (asset group); and (6) a current expectation that, more likely than not, a long-lived asset (asset group) will be sold or otherwise disposed of significantly before the end of its estimated useful life (SFAS No. 144, par 8).

fair value of a reporting unit. This is because the reporting unit's cash flows, which are generated from long-lived assets, also reduce as a result of poor operations. Unlike SFAS No. 144, SFAS No. 142 does not require a recoverability test to assess the sum of undiscounted cash flows in determining goodwill impairment. Instead, SFAS No. 142 applies *present value* techniques to measure the fair value of a reporting unit and requires annual assessment for goodwill impairment. Therefore, a firm is less likely to avoid achieving the threshold for a goodwill impairment test. As a result, the goodwill impairment loss should be able to reflect a decrease in firm performance. In addition, the goodwill impairment loss can also reflect a decline in the fair values of other long-lived assets in the reporting unit that may not be noticeable if there are no disclosures of fixed asset impairment losses. An example of goodwill impairment test under SFAS No. 142 and its relation with SFAS No. 144 are further discussed in Appendix A.

The FASB expects that changes in SFAS No. 142 will improve financial reporting as follows:

> *The new standard will improve financial reporting because the financial statements of entities that acquire goodwill and other intangible assets will better reflect the "underlying economics" of those assets. As a result, financial statement users will be better able to understand the investments made in those assets and the subsequent performance of those investments. The enhanced disclosures about goodwill and intangible assets subsequent to their acquisition also will provide users with a better understanding of the expectations about and changes in those assets over time, thereby improving their ability to assess future profitability and cash flows* (SFAS 142, Summary).

The adoption of SFAS No. 142 is effective for fiscal years beginning after December 15, 2001. Early adoption is permitted for entities with fiscal years beginning after March 15, 2001. However, subsequent recovery of a goodwill impairment loss is not allowed. The amount of the transitional goodwill impairment loss is recorded as "the

effect of a change in accounting principle" and presented in the income statement between the captions extraordinary items and net income.[8] After the transitional period, the goodwill impairment loss is presented as a separate line item of the continuing operations in the income statement (SFAS No. 142, par. 43, and 56).

[8] An entity has six months from the date of initial adoption of SFAS No. 142 to complete the first step of transitional goodwill impairment test. However, amounts used in the transitional goodwill impairment test are measured at the beginning of the year of initial application (SFAS No. 142, par. 55).

CHAPTER 3

PERFORMANCE MEASUREMENT

3.1 Linkage between Goodwill Impairment and Firm Performance

An acquiring entity is willing to pay for goodwill because it believes that the net assets acquired are worth more than the purchase price. The value of goodwill is originated from the value of combining entities. For instance, an entity obtains potential acquisition gains from an improvement of management efficiency by well-managed bidders (Lang et. al 1989), synergistic gains from economies of scale (Bradley et al. 1988), and financial synergy benefits from internal financing versus external financing advantages (Nielsen and Melicher 1973). Synergy goodwill is the value created by a business combination that may result from more efficient management, economies of scale, integration of resources, the improvement in production techniques, and the redeployment of assets to more profitable uses. This concept is consistent with the evidence of synergistic gains from corporate acquisitions (Bradley et al. 1988). In other words, corporate acquisitions create synergistic gains resulting in better uses of resources. Firms that use resources more efficiently are seen as efficient firms.

SFAS No. 142 requires managers to test goodwill for impairment at the reporting unit level. However, management estimates and assumptions are subjective and information regarding each reporting unit is usually unobtainable. Although SFAS No.

142 allows a reporting unit to be the same as a business segment under SFAS No. 131, in practice, many companies have a number of reporting units greater than a number of reportable segments. In addition, Watt (2003) argues that synergies imply joint costs and benefits so the allocation of joint costs and benefits for valuation purposes is arbitrary. "If there are significant synergies at all among the units, then there is no meaningful way to allocate future cash flows, value, and goodwill among units" (p. 218). Therefore, assessing performance at the firm level is more relevant than at the reporting unit level when goodwill is assigned to multiple reporting units.

Goodwill is viewed as an asset by the market and the decline in the value of goodwill is used by investors to value the firm as a whole (Hayn and Hughes 2006). Therefore, goodwill represents the value and performance of an entire entity. However, goodwill does not have a set of cash flows uniquely associated with it. "Instead, the cash flows associated with acquired goodwill usually are intermingled with those associated with internally generated goodwill and other assets because entities generally enter into business combinations to reduce costs and achieve synergies, which entails integrating the acquired entity with the acquiring entity" (SFAS No. 142, Appendix B, par B84). To assess goodwill for impairment, a firm is allowed to use present value techniques in measuring the fair value of a reporting unit. Because a firm needs to make assumptions based on past and current performance when estimating future cash flows, firm performance is an important indicator in determining a goodwill impairment loss.

Efficiency is a measure of firm performance and is defined as the ratio of the output(s) that a firm produces to the input(s) that it uses (Coelli et al. 1998, p.1-3). Larger values of this ratio are related with a better performance. This study defines

efficiency as a measure of financial performance, which is generated from business operations, and uses accounting data to estimate the performance measure. Cash flows generated from business operations indicate how well firms use several resources as inputs (e.g. cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) to generate outputs (e.g. sales; income before extraordinary items; and operating cash flows). Thus, a measure of efficiency can be used to evaluate the performance of combined entities. A decline in the value of goodwill reported as goodwill impairment should reflect the deterioration of firm performance. Because a measure of performance is a relative concept, or so-called relative efficiency, it is measured relative to the performance of another firm or relative to its performance at different points in time.

3.2 Measuring Relative Efficiency by Data Envelopment Analysis

This study assesses firm performance and estimates the relative efficiency of impairment and non-impairment firms by using Data Envelopment Analysis (DEA). DEA is a frontier estimation technique that uses linear approximation to map the envelope of the input-output data. Each firm within a given industry is considered as a decision making unit (DMU). The efficient frontier line indicates the performance of the best DMUs and measures the efficiency of other DMUs by deviations from it (Cooper et al. 2000).

Figure 1 is a simple example to illustrate the relative efficiency concept. Following Farrell (1957), the two-input and single-output production process is

demonstrated under conditions of constant returns to scale for simplification.[9] The production function is usually represented as $y = f(x_1, x_2)$; where y is an output; and x_1, x_2 are two inputs. An isoquant QQ shows all combinations of two inputs that efficient firms can use to produce a unit of output. The efficiency of each firm is measured relative to the isoquant. *Technical efficiency* is defined as the maximum output attainable from each level of inputs or the minimum inputs used for a given level of output. Firms A, B, C are technically efficient because they are located on the isoquant. Firm D is off the isoquant so it is not technically efficient. The technical efficiency of firm D is the ratio of optimal input use (OD') to actual input use (OD).

In Farrell (1957), all firms in the sample are assumed to have the same technology and have the same frontier. However, impairment and non-impairment firms may have different objective functions and employ different best practice frontiers. To allow this possibility, this study partitions the pooled sample into the subsamples of impairment and non-impairment firms. Following Fizel and Nunnikhoven (1992), Figure 2 illustrates how to obtain the technical efficiency index relative to the pooled frontier and the subsample frontier. QQ represents the frontier isoquant from the pooled sample, whereas Q^*Q^* represents the frontier for the impairment subsample. Considering firm D, the technical efficiency relative to the pooled frontier is called an *overall efficiency index* (EI), which is equal to OD'/OD. The efficiency of each firm calculated relative to its separate group's frontier is called a *within-group index* (EI_w). For instance, the technical

9 Returns to scale (RTS) is a long-run concept which reflects the degree of proportional increase in all inputs that increases outputs. In constant RTS, a proportional increase in all inputs results in the same proportional increase in outputs. Variable RTS can be increasing and decreasing RTS. Increasing (Decreasing) RTS occurs when a proportional increase in all inputs results in a greater (smaller) proportional increase in outputs (Coelli et al. 1998, p. 18).

efficiency index of firm D relative to its own group is equal to OD"/OD. A *between-group index* (EI_b), which captures the difference in the frontiers of the two subsamples is calculated as the ratio of the overall efficiency index to the within-group efficiency index such that $EI_b = EI/ EI_w$.

To examine differences between two subsamples, this study starts by testing whether each subsample shares a common production frontier. Following Fizel and Nunnikhoven (1992), EI and EI_w are compared for each subsample. If there are no significant differences between the pooled and within-group indices, a Wilcoxon rank sum test will be conducted on the overall efficiency indices (EI vs. EI). A Wilcoxon rank sum test is suggested because the theoretical distribution of efficiency scores in DEA is usually unknown (Cooper et al. 2000, p.200-202). This method is used to examine the differences between the two groups, assuming that the subsamples share the common production frontier. However, if EI and EI_w are significantly different, suggesting that the subsample has a frontier different from the pooled frontier, a Wilcoxon rank sum test will be conducted on the between-group indices (EI_b vs. EI_b). The differences in relative efficiency between these two subsamples will indicate which subsample is more efficient than the other.[10]

This study relaxes the restriction of constant returns to scale and allows for variable returns to scale by using the Banker-Charnes-Cooper (BCC) model (Banker et al. 1984). Impairment and non-impairment firms may possess different returns to scale properties. For example, impairment firms may exhibit decreasing returns to scale

[10] This method has also been used in the study of Burnett and Hansen (2005) to test for the differences in relative efficiency between Phase-One and Non-Phase-One plants in cross-sectional and longitudinal analyses.

because management cannot utilize assets efficiently to generate revenues, profits, and cash flows. Although the results of different DEA models are relatively robust (Ahn et al. 1988), the BCC model is more flexible and can accommodate the translation in variance.[11] The input-oriented BCC model for n DMUs, m outputs, and s inputs is shown as follows:

$$\text{Min } \varepsilon$$

Subject to:

$$\begin{aligned} &\sum_{i=1}^{n} w_i O_{ij} \geq O_{kj,}, j = 1,2,...., m \\ &\sum_{i=1}^{n} w_i I_{ir} \leq \varepsilon I_{kr}, r = 1,2,..., s \\ &\sum_{i=1}^{n} w_i = 1 \end{aligned} \tag{1}$$

where:

ε = DEA scores;
O_{ij} = Output j for DMU i;
I_{ir} = Input r for DMU i;
O_{kj} = Output j for DMU k (target DMU);
I_{kr} = Input r for DMU k (target DMU);
w_i = Weight assigned by DEA;

The BCC model selects a set of weights to minimize ε. The hypothetical composite DMU is constructed based on outputs and inputs for all DMUs. The constraints require the composite DMU to use fewer inputs to produce the greater or the same outputs as the target DMU. In this case, the composite DMU is more efficient than

[11] Translation invariance means that translating the original input or output variables results in a new problem that has the same optimal solution.

the target DMU and the target DMU is defined as relative inefficiency ($\varepsilon < 1$). The value of ε in the objective function falls in between 0 and 1. If $\varepsilon = 1$, the composite DMU is not more efficient than the target DMU, indicating that the target DMU is on the efficient frontier.

CHAPTER 4

GOODWILL IMPAIRMENT AND RELATIVE EFFICIENCY OF FIRMS

4.1 INTRODUCTION

This chapter examines the underlying economics of goodwill impairment. SFAS No. 142 was issued in 2001, which eliminates the goodwill amortization method and requires goodwill to be tested for impairment annually or whenever events or circumstances indicate the potential for impairment. The standard provides more specific guidance in determining the timing and measuring the amount of goodwill impairment loss. The objective of SFAS No. 142 is to improve financial reporting transparency such that financial statements will better reflect the underlying economics of assets acquired, including goodwill. As a result, the users of financial statements will better understand the changes in those assets over time, thereby improving their ability to assess future profitability and cash flows (SFAS No. 142, Summary).

Relevance and *reliability* are the two primary qualitative characteristics of accounting information (Statement of Financial Accounting Concepts No. 2, *Qualitative Characteristics of Accounting Information* (FASB 1980). Accounting information is relevant when it has predictive value, feedback value, and timeliness. Because historical accounting increases a gap between market values and book values, accounting information under the historical-oriented model becomes less relevant. SFAS No. 142 is one of the several accounting standards that have been recently moved toward the fair

value accounting model.[12] Accounting information is reliable when it achieves characteristics of verifiability, neutrality, and representational faithfulness. The FASB concludes that the nonamortization of goodwill together with the impairment testing is consistent with the concept of *representational faithfulness*, as stated in FASB Concepts Statement No. 2.[13]

Recently, studies of goodwill have revealed the impact of changes in the goodwill accounting rules on the stock market during the initial adoption period. Prior research finds that stock return effects of goodwill impairment announcements are negative. The results indicate that these announcements are useful because they convey information of a decline in the future performance of firms to market participants (Segal 2003; Li et al. 2005; Long 2005; Shough 2005). Prior literature examining determinants of goodwill impairment documents that the impairment is the result of two main factors--the deterioration of economic conditions and reporting incentives for write-off decisions. Segal (2003) and Li et al. (2005) find that goodwill impairment under SFAS No. 142 results from the deterioration of economic conditions subsequent to the acquisition, while several other studies suggest that managerial reporting incentives are important factors in determining goodwill impairment (Beatty and Weber 2006; Guler 2006). Previous research uses a firm's historical performance, industry trends, and stock market performance to proxy for economic factors.

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12 Examples of such accounting standards are SFAS No. 133, *Accounting for Derivatives Instruments and Hedging Activity* and SFAS No. 159, *The Fair Value Option for Financial Assets and Financial Liabilities*, which will become effective after November 15, 2007.

13 Representational faithfulness is correspondence or agreement between a measure or description and the phenomenon it purports to represent. In accounting, the phenomena to be represented are economic resources and obligations and the transactions and events that change those resources and obligations (CON No. 2, par 63).

Prior research focuses on the initial adoption because SFAS No. 142 offers management incentives to manage earnings by allowing the transitional impairment losses to be reported as "the effect of a change in accounting principle" and presented between captions of extraordinary items and net income (SFAS No. 142, par 56). This "below-the-line" item motivates firms to recognize the goodwill impairment losses in the adoption year rather than deferring the impairment and reporting them in later years as expenses in continuing operations. In addition, the goodwill impairment losses subsequent to the initial adoption period have been under-investigated because of limited data availability. However, the data have become available recently since SFAS No. 142 was implemented in 2002. There are several concerns about the implementation of SFAS No. 142 because subjectivity is inherent in the goodwill impairment test, such as identifying a reporting unit, allocating assets, liabilities, and goodwill to a reporting unit, and calculating the fair value of a reporting unit. As shown in the 2002 annual report of AOL Time Warner Inc, the company notes that "the determination of impairment of goodwill and other intangible assets requires significant judgment and estimates".[14] Due to subjectivity and complexity of the implementation of SFAS No. 142, it is interesting to examine whether or not the standard has achieved its merit in reflecting the underlying economic reasons for goodwill impairment recognition, the primary objective of this standard.

Drawing upon prior literature examining the relation between goodwill impairment and determinants of impairment *during* the initial adoption of SFAS No. 142,

[14] In 2002, AOL Time Warner Inc reports $54.2 billion charge for goodwill impairment as a cumulative effect of an accounting change and records an additional charge of $45.5 billion as a part of operating income.

this study extends prior research by focusing on goodwill impairment *after* the initial adoption period. The purpose of this study is to examine the usefulness of SFAS No. 142 whether the implementation of this standard achieves the FASB's objective such that goodwill impairment reflects the underlying economics of goodwill. Goodwill is a valuable economic resource and the valuation of goodwill is important information for evaluating the level and uncertainty of a firm's future cash flows (Hayn and Hughes 2006). Goodwill represents benefits from a business combination due to a value created by combining synergies, saving from economies of scale, an ability to obtain controlling interest, a possibility to achieve profitability, and an increase in market shares (Nielsen and Melicher 1973; Bradley et al. 1988; Lang et. al 1989). Goodwill does not generate cash flows on its own but is associated with other assets in business operations. Therefore, a decrease in the value of goodwill reported as goodwill impairment should reflect a decline in firm performance and efficiency. Unlike prior studies that use several accounting data and stock returns to proxy for firm performance, this study takes advantage of Data Envelopment Analysis (DEA) in capturing a firm's overall relative efficiency. DEA aggregates multiple financial measures into a single measure of firm performance and efficiency.

This study applies DEA technique to measure a firm's relative efficiency by comparing efficiency of a firm with other firms in the same period and with similar firms over different periods. Data are obtained from three selected industries--durable manufacturers, computers, and services. For a cross-sectional analysis, the empirical results show that impairment firms are relatively less efficient than non-impairment firms in the year of goodwill impairment recognition, consistent with the prediction that

impairment firms are likely to use economic resources less efficiently than non-impairment firms. For a longitudinal analysis, this study examines changes in the relative efficiency of impairment versus non-impairment firms over time. The results indicate a significant increase in relative efficiency from year *t* to *t+1* for firms that report goodwill impairment in year *t*, but do not have goodwill impairment in year *t+1*. This study finds partial evidence supporting a decrease in relative efficiency from year *t* to *t+1* for firms that do not have goodwill impairment in year *t*, but report impairment in year *t+1*. However, the results show no significant changes in the relative efficiency of firms that report goodwill impairment in two consecutive years. A plausible explanation is that impairment firms may have a gradual decline in relative efficiency additional to the decline in efficiency from the prior year of impairment recognition. Therefore, the changes in relative efficiency from the prior year are not significant enough to indicate any differences between these two periods. Overall, these findings show that goodwill impairment under SFAS No. 142 reflects a decrease in relative efficiency, the underlying economic reason for goodwill impairment.

This study contributes to the prior literature in the following ways. First, this study is the first to examine the usefulness of goodwill impairment under SFAS No. 142 by assessing the relative efficiency of firms instead of applying the market-based approach. The results of this study extend the literature by providing further insight into the underlying economic reasons for the association between goodwill impairment and stock prices (e.g. Segal 2003; Zang 2003; Li et al. 2005; Long 2005). The association between goodwill impairment and the relative efficiency of firms helps to explain why goodwill impairment conveys information about firms' equity valuations and provides

users of financial statements with a better understanding of the underlying economic value of goodwill. Second, this study contributes to the relative efficiency literature (e.g. Bowlin 1995, 1999; Seiford and Zhu 1999; Zhu 2000) by applying the DEA technique to test the implementation of an accounting standard in reflecting the underlying economics of goodwill impairment. Finally, the evidence supporting this study helps investors and other users of financial statements to determine potential goodwill impairment by including a measure of firm performance. This study also provides the FASB with empirical evidence on the implication of SFAS No. 142 whether or not goodwill impairment recognition is consistent with the concept of representational faithfulness.

The remainder of this chapter is organized as follows. Section 4.2 reviews the related literature. Section 4.3 discusses hypothesis development. Section 4.4 describes research design. Section 4.5 contains empirical results and Section 4.6 presents the sensitivity analysis. The final section offers the conclusion.

4.2 LITERATURE REVIEW

4.2.1 Nature of Goodwill

At the date of acquisition, SFAS No. 142 requires a combined entity to record the target firm's identifiable and non-identifiable net assets at their fair values. The excess of acquisition price over the fair values of the acquired entity's net assets is recorded as goodwill. The FASB defines goodwill as *the excess of the cost of an entity over the net of the amounts assigned to assets acquired and liabilities assumed* (SFAS No. 141, par. 43). Previous studies (Henning et al. 2000; Long 2005) decompose goodwill into three components--going-concern, synergy, and residual components--using the framework

provided by Johnson and Petrone (1998).[15] Henning et al. (2000) find that, for the sample period of 1990-1994, going-concern, synergy, and residual components of goodwill represent about 20, 50, and 30 percents of recognized goodwill, respectively. According to the FASB, going-concern and synergy components of goodwill are described as "core goodwill" that meets the FASB's definition of assets in FASB Concepts Statement No. 6.[16, 17] Going-concern goodwill represents the preexisting goodwill that was either internally generated by the acquired entity or acquired by it in past business combinations. Synergy goodwill reflects the excess value created by combining the entities (SFAS No. 141, Appendix B, par B105). Residual goodwill is not conceptually part of goodwill but it represents a measurement error or a gain/loss to the acquiring entity. It may also occur after acquisitions when the combined entity cannot achieve the expected benefits due to a decline in firm performance and efficiency.

Henning et al. (2000) and Long (2005) conclude that market values have a significant positive association with the going-concern and synergy components, but a

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15 Henning et al. (2000) measure components of goodwill as follows: Going-concern component is calculated as the difference between the target's pre-acquisition market value measured six days prior to the acquisition and the target's fair market value of assets. Synergy component is calculated as the combined cumulative abnormal returns to the target and the acquirer for the 11 days of the acquisition announcement. Residual component is calculated as the purchase price less the sum of the fair value of the target's net assets, the going-concern component, and the synergy component.

16 The FASB describes three components as follows: (1) *Going-concern goodwill* relates to the acquired entity and represents the ability of a business to earn a higher rate of return on an assembled collection of net assets than would be expected if those net assets were acquired separately. That value arises from the synergies of net assets of the business and from other benefits (e.g. the ability to earn monopoly profits and barriers to market entry); (2) *Synergy goodwill* reflects the fair value of the expected synergies from combining the acquiring entity's and acquired entity's net assets and businesses; (3) *Residual goodwill* represents the overvaluation of the amount paid due to errors in valuing acquired entity and the overpayment (if the price is driven up in the course of bidding) or underpayment (in a case of distress sale or fire sale) by the acquiring entity (SFAS No. 141, Appendix B, par. B102).

17 FASB Concepts Statement No. 6, *Elements of Financial Statements* (FASB 1985) defines assets as probable future economic benefits obtained or controlled by a particular entity as a result of past transactions or events.

significant negative association with the residual component of goodwill. In addition, the coefficient of the synergy component has the highest magnitude compared to the other two components of goodwill and is greater than one, suggesting that investors value this synergy goodwill more than other components. During the initial adoption of SFAS No. 142, Long (2005) finds a positive association between the transitional goodwill impairment loss and the residual goodwill, suggesting that the transitional impairment loss has already captured the overpayment in past acquisitions. The transitional impairment loss is also positively associated with the synergy goodwill, indicating that the synergy component becomes impaired after the acquisition period. This may be caused by a decline in firm performance. The synergy goodwill is the largest component of goodwill, which represents about half of the total amount of goodwill (Long 2005).

4.2.2 Literature on Goodwill Impairment

Goodwill is recorded as an asset because it is expected to generate future economic benefits. Prior studies find a strong positive association between equity values and goodwill, suggesting that investors value the amount of goodwill as a valuable economic resource (Jennings et al. 1996; Henning et al. 2000). Accounting for goodwill after the initial recognition has been debated among researchers and regulators for a long time. An important question is whether goodwill should be amortized over its expected useful life or whether it should be tested for impairment. Under the previous accounting standard, firms were forced to record goodwill amortization even though they were able to enhance the value of goodwill as could be seen by an increase in an ability to generate future operating profits. On the other hand, firms that experience a significant decline in

the value of goodwill were able to hide the decrease by estimating the number of years over which goodwill is amortized. Hall (1993) finds that managers consider economic consequences in deciding the length of goodwill amortization period. The FASB acknowledges that not all goodwill declines in value or if the value of goodwill decreases, the reduction rarely follows a straight-line basis (SFAS No. 142, Appendix B, par B79). Thus, the amortization method achieves the acceptable level of reliability but does not reflect the economic changes in the value of goodwill, thereby reducing the level of relevance. Prior studies focus on how accounting for goodwill amortization affects the usefulness of financial statements. The findings suggest that goodwill amortization disclosure is not useful to investors (Jennings et al. 1996; Jennings et al. 2001; Moehrle et al. 2001). Therefore, eliminating goodwill amortization from income statements may reduce a source of noise in earnings measurement and not reduce the usefulness of earnings.

In general, prior studies on asset write-offs, including goodwill before the issuance of SFAS No. 142, conclude that the asset write-offs are value relevant and have negative valuation effects (Elliott and Shaw 1988; Bartov et al. 1998; Hirschey and Richardson 2002, 2003). Hirschey and Richardson (2002, 2003) find that information effects tied to goodwill write-off announcements are materially negative, on the order of -2 to -3 percent of the stock price. They also find negative information effects of -40 percent in the one-year pre-announcement period and -11 percent by the end of the one-year post-announcement period. These results suggest that investors partially anticipate goodwill write-offs and underreact to the write-off announcements. Moreover, Elliott

and Shaw (1988) document that analysts reduce their forecasts of year-ahead earnings after asset write-off announcements.

Previous studies examine the announcements of goodwill impairment losses under SFAS No. 142 and find that these disclosures convey useful information to users of financial statements (e.g. investors and analysts). The stock market responds negatively to the transitional impairment loss under SFAS No. 142 (Segal 2003; Zang 2003; Li et al. 2005; Long 2005; Shough 2005). Li et al. (2005) examine the goodwill impairment sample from January 2002 to March 2003 and find significantly negative three-day stock returns (day -1 to +1) surrounding the impairment announcements. However, comparing goodwill impairment under pre- and post-SFAS No. 142, Segal (2003) finds no evidence that the market reaction to goodwill impairment is more negative under SFAS No. 142. In addition, prior studies find that financial analysts revise their earnings forecast downward upon the announcement of goodwill impairment loss (Zang 2003; Li et al. 2005). The evidence indicates that the transitional goodwill impairment loss provides meaningful information about the future performance of a firm. However, market-based studies provide only indirect evidence about the relation between goodwill and a firm's future operating performance. This study extends the value relevance literature by providing further insight on the underlying economic reasons for the association between goodwill impairment and stock prices.

Goodwill impairment may arise from the overpayment at the time of acquisition or from the subsequent poor performance. Prior research documents that the transitional goodwill impairment is positively associated with the indicator of overpayment (Li et al. 2005; Long 2005), but negatively associated with the past stock returns and financial

performance of a firm (Segal 2003; Li et al. 2005; Long 2005). Long (2005) measures the overpayment as the residual component of goodwill and finds that the goodwill impairment loss in the adoption year captures over two thirds of the overpayment cumulated across past acquisitions. These results indicate that although firms should write off the overpayment from the amount of goodwill after the acquisition periods, they tend to delay the negative effect of the impairment loss until they are required to do so by SFAS No. 142. Because the transitional impairment loss has already captured the overpayment accumulated over the past years and a catch-up adjustment to reflect a decline in the economic value of goodwill, this offers a research opportunity to examine the extent to which post-SFAS No. 142 goodwill impairment reflects a deterioration of a firm's underlying economic value.

4.2.3 Literature on Relative Efficiency

Measuring efficiency has been increasingly important since the 1980s as corporations are focusing more on improving their performance by increasing their efficiency. Further, there have been changes in legislative and management policies in many industries over the past decades and the changes have affected the financial condition and performance of firms. Prior studies assess the performance of firms in specific industries. For example, Bowlin (1995) examines the financial condition of the defense industrial base relative to the Standard & Poors (S&P) 500.

Data Envelopment Analysis (DEA), a nonparametric analysis, is a widely accepted method used to assess the relative efficiency of firms. DEA has been applied in non-profit organizations such as hospital and health care (Grosskopf and Valdmanis

1987; Nyman and Bricker 1989; Fizel and Nunnikhoven 1992), the banking industry (Miller and Noulas 1996; Leong et al. 2003), and the computer industry (Thore 1996; Thore et al. 1996). Moreover, DEA has been used to compare the productivity growth, technical progress, and efficiency change in industrialized countries (Fare et al. 1994). DEA has also been used to assess the financial performance of the defense industry (Bowlin 1995, 1999), large banks (Seiford and Zhu 1999; Luo 2003), and the Fortune 500 companies (Zhu 2000).

DEA has several characteristics that make it attractive to measure relative efficiency. First, DEA allows evaluating efficiency when multiple outputs and inputs need to be considered. In this setting, firms use several resources (inputs) to produce multiple financial terms (outputs) that can capture the operating efficiency and ability to generate future cash flows, which are a major concern in making a goodwill impairment decision. Thus, DEA combines several financial measures into a meaningful measure of overall performance (Bowlin 1999). Second, the DEA model is pareto optimal so any input variable reductions or output variable changes can be affected without worsening other model variables (Bowlin 1999). Third, DEA does not require a weight to be attached to each input and output, and does not require a priori specification of functional forms as needed in a regression analysis (Cooper et al. 2000, p.4). Finally, firms on the DEA frontier are the best performing firms and can be used as the benchmark for measuring the efficiency of other firms. Therefore, DEA allows this study to achieve the objective of comparing the relative efficiency between impairment and non-impairment firms in the pooled sample as well as partitioning the pooled sample into subsamples when they have different production frontiers.

4.3 HYPOTHESES DEVELOPMENT

4.3.1 Cross-Sectional Analysis

Business combinations after the adoption of SFAS No. 141 and 142 are expected to report the initial goodwill recognition more accurately than prior acquisitions. This is because SFAS No. 141 requires an acquiring entity to make every effort to: (1) measure the purchase consideration accurately; (2) record net assets acquired at fair values rather than their carrying amount; and (3) recognize all acquired intangible assets, to avoid subsuming the write-up of net assets acquired and the residual component into the amount initially recognized as goodwill (SFAS No. 141, Appendix B, par. B106). Thus, the residual component of goodwill is likely to represent a smaller portion of recognized goodwill. In addition, Long (2005) finds that the transitional goodwill impairment loss, which captures over two thirds of the overpayment cumulated across past acquisitions and a catch-up adjustment for a decline in the economic value of goodwill, has already adjusted the amount of goodwill to reflect its current economic value. The evidence suggests an opportunity to examine whether goodwill impairment after the initial adoption can signal a decline in a firm's relative efficiency, which is an alternative approach to assess the usefulness of goodwill impairment under SFAS No. 142.

This study directly examines whether or not the recognition of goodwill impairment loss after the initial adoption of SFAS No. 142 can convey a decline in a firm's underlying economic performance. Investors view the amount of purchased goodwill as a valuable economic resource, which can be seen by a strong positive association between equity values and goodwill (Jennings et al. 1996; Henning et al. 2000). Prior studies show that the largest component of goodwill is the synergy goodwill

(Henning et al. 2000; Long 2005), which represents the value created by business combinations resulting from more efficient uses of resources (Bradley et al. 1988). Goodwill represents the present value of a stream of expected future cash flows (Jennings et al. 1996). However, goodwill does not have a unique set of cash flows associated with it. Instead, cash flows associated with goodwill are mixed with those associated with other assets. Thus, goodwill impairment provides a signal of important changes in the value of goodwill and a firm's future earnings potential (Hirschey and Richardson 2003). Impairment firms are more likely to use their economic resources less efficiently than non-impairment firms. Moreover, these firms are likely to have poor performance, decline in efficiency, low profitability, and negative net cash flows. Therefore, the first hypothesis stated in the alternative form is:

H1: Impairment firms are relatively less efficient than non-impairment firms in the year of goodwill impairment recognition after the initial adoption of SFAS 142.

4.3.2 Longitudinal Analysis

This study examines changes in the relative efficiency of impairment and non-impairment firms over time. Goodwill impairment is presumably related to a decline in the relative efficiency of firms. Firms are more likely to have lower relative efficiency in the year of goodwill impairment reporting than in the year of no impairment reporting. Moreover, firms that report goodwill impairment in two consecutive years are more likely to have an additional decline in relative efficiency in the second year of goodwill impairment. The disclosure of goodwill impairment will be useful if it can reflect the deterioration of a firm's underlying economic value so that financial statement users will be able to understand the subsequent performance of a firm and make better decisions.

Therefore, a longitudinal analysis provides further evidence on the merit of SFAS No. 142 to standard setters and other users of financial statements.

A longitudinal analysis is conducted on each two consecutive years based on four possible scenarios. The first scenario is that impairment firms may report goodwill impairment losses in two consecutive years. If SFAS No. 142 provides information about firm performance, the impairment losses recognized in the second year of impairment should reflect an additional decline in relative efficiency. Thus, the relative efficiency of firms in the second year of goodwill impairment is likely to be lower than that in the first year of goodwill impairment $(EFF_t > EFF_{t+1})$.

Regarding the second and third scenarios, firms reporting goodwill impairment in this year (year t) may not have goodwill impairment in the next year (year $t+1$), or vice versa. If SFAS No. 142 is properly applied and achieves its objective, the disclosures of goodwill impairment losses should convey the underlying economics of goodwill on a timely manner. Therefore, the relative efficiency of firms in the year of impairment reporting is likely to be lower than that in the year of no impairment reporting. For the second scenario, if firms report impairment losses in this year, but do not have impairment losses in the next year, the relative efficiency of firms in the next year is likely to be as least equal to or higher than that in this year $(EFF_t \leq EFF_{t+1})$. For the third scenario, if firms report no impairment losses in this year, but have impairment losses in the next year, the relative efficiency of firms in the next year is likely to be lower than that in this year $(EFF_t > EFF_{t+1})$.

For the final scenario, this study compares the relative efficiency of firms that do not report goodwill impairment in both years. In this case, this study predicts to find no

significant differences in relative efficiency between this year and the next year ($EFF_t = EFF_{t+1}$).

4.4 RESEARCH DESIGN

4.4.1 Data and Sample Selection

The sample is restricted to firms on *Compustat* that are publicly traded in the U.S. for the fiscal years 2002-2005. The adoption of SFAS No. 142 is effective for fiscal years beginning after December 15, 2001. Thus, the first effective fiscal year is 2002.[18] The diagram of effective date for the SFAS No. 142 implementation is shown in Figure 3. This study restricts the sample to firms with fiscal years ended December 31 to eliminate the effect of an early adoption that is permitted to firms with fiscal years beginning after March 15, 2001. The impairment sample of 2002-2005 reports goodwill impairment losses as required by SFAS No. 142.

Table 4.1 shows the breakdown of impairment observations by industry.[19] The initial sample starts with 13,957 firm-year observations having goodwill balances at the beginning or at the ending of each fiscal year during the periods of 2002-2005. Firms with no goodwill impairment and missing data are eliminated. This study also restricts the sample to firms with fiscal years ended December 31. The sample selection method

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[18] For the first effective fiscal year of 2002, this study excludes firms that record only transitional goodwill impairment losses as cumulative effects of a change in accounting principle because the transitional impairment losses may represent the overpayment during the acquisition periods or the poor efficiency of firms in the past years before SFAS No. 142 was adopted but firms delayed goodwill impairment recognition.

[19] Industry membership is determined by using the industry classification as shown in the study of Barth et al. (1998), which classified firms into 14 industries. The classification of Barth et al. (1998) provides this study with enough observations to perform an analysis for each selected industry rather than using the classification of two-digit SIC code.

results in an impairment sample of 914 firm-year observations from 2002-2005 across 14 industries. The durable manufacturing industry has the largest number of impairment observations (210 firm-year observations), following by the computer industry (180 firm-year observations), and the service industry (124 firm-year observations). Therefore, the final sample firms are selected from these three industries because each of them provides sufficient observations with goodwill impairment. In addition, due to the nature of rapid growth and high technology business, these industries have been considered to be very active in mergers and acquisitions and have a large number of firms recognizing goodwill impairment losses after the adoption of SFAS No. 142. Finally, the durable manufacturers, computers, and services provide 514 firm-year observations with goodwill impairment losses, representing about 56 percent of the total impairment observations from all industries.

The amount of goodwill impairment reported by *Compustat* is verified by comparing with firms' 10K reports.[20] Forty-two observations that have no 10K filings or have incorrect amount of goodwill impairment reported by *Compustat* are eliminated. Data for the control sample of firms that report goodwill on the balance sheet but no goodwill impairment losses over the entire period of study are collected. Control firms defined as non-impairment observations are matched by *SIZE* and the same two-digit SIC code as the sample firms in the same period. *SIZE* is the beginning total assets. The relative efficiency of firms can be influenced by firm size because large firms are likely to have higher relative efficiency than small firms due to economies of scale. On the other hand, large firms can experience more mergers and acquisitions than small firms so

[20] *Compustat* sometimes includes the amount of other intangible asset impairment or the amount of long-lived asset impairment in the amount of goodwill impairment.

they may exhibit greater likelihood of goodwill impairment. Moreover, firms in different industries are subject to different economic conditions. Thus, matching by firm size and industry will reduce size effects and industry-specific factors and allow making a more precise analysis about the effect of the relative efficiency.[21] Finally, 27 observations from the initial sample are excluded because they have no firms matched on size and industry. As shown in Table 4.2, the sample selection results in the final sample of 445 firm-year impairment observations, which include 173, 161, and 111 observations from durable manufacturers, computers, and services, respectively.

Table 4.3 presents the sample and matched control observations classified by industry and year. The impairment sample consists of firms with goodwill impairment losses in at least one year during 2002-2005, while the control sample has no goodwill impairment losses over the entire period. Durable manufacturers and computers have the largest number of impairment firms presented in 2002 as opposed to 2003-2005. However, impairment firms are almost evenly distributed across four years for the service industry.

4.4.2 Variables for DEA Model

This study uses financial performance measures as proxies for the relative efficiency of firms. Bowlin (1995) suggests two factors to be considered in selecting the input and output variables: (1) the production function nature of the DEA model

[21] I obtain additional disclosures of possible reasons for goodwill impairment by reviewing firms' 10K and 10Q filings. If the goodwill impairment loss is caused by an overpayment, the impairment observation and the matched control sample will be eliminated from the overall sample. However, after reviewing the 10K and 10Q filing, I do not find any disclosures indicating the overpayment as a rationale for goodwill impairment. Examples of goodwill impairment disclosures are shown in Appendix B.

indicating what firms produce in financial terms; and (2) the financial analysis nature of the research, which suggests using financial ratios to measure the financial performance of firms.[22] In this study, the financial performance measure is acceptable because what firms are attempting to produce in financial terms reflect the operating efficiency and ability to generate future cash flows, which are major concerns when making an impairment decision. Moreover, DEA allows assessing multiple measures of the financial performance simultaneously and constructing a single performance measure. Thus, it eliminates intercorrelations among variables and contradictions that may result from including multiple performance variables in the model.

To calculate DEA scores, five input variables (i.e. cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets, including goodwill) and three output variables (i.e. net sales; income before extraordinary items; and operating cash flows) are primarily selected. Although the selection of input and output variables can be subjective, the variables in this study, in part, are widely used for evaluating firm performance as described in previous research (Bowlin 1995; Bowlin 1999; Seiford and Zhu 1999; Zhu 2000; Luo 2003).[23] These variables are selected because they can represent what firms are attempting to produce in terms of financial measures as well as capture important financial ratios, such as profitability, return on assets, asset turnover, and cash-return on assets. In addition, DEA can provide information additional to that offered by the traditional ratio analysis (Feroz et al. 2003).

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[22] Financial terms that a firm attempts to produce are, for instance, market shares, profitability, liquidity, and market values. These factors are considered as outputs produced by using input variables (e.g. plant and equipment, capital, and personnel).

[23] Summary of input/output variables from prior studies is shown in Appendix C. Market value and stock prices are not included as output variables in this study because they incorporate many events or circumstances that can be affected by the wide economy and market, which are uncontrollable by firms.

Variable descriptions are presented in Table 4.4. Input variables are resources used to generate outputs. Cost of goods sold *(COGS)* and selling, general, and administrative expenses *(SG&A)* measure the amount of resources consumed to produce outputs. Current assets *(CA)*, fixed assets *(FA)*, and intangible assets *(INTAN)* represent economic resources available to generate sales, net income, and operating cash flows. Output variables measure outcomes of business operations, which can be used to assess the financial performance in terms of revenues, profitability, and cash generating ability. Net sales *(S)* captures market share and represents the original output of firms. Income before extraordinary items *(IB)* measures profitability and how efficiently firms use their resources to generate profits. Operating cash flows *(OCF)* is used to assess the financial performance in terms of cash generating ability. This model represents how efficiently a firm can utilize its resources to generate outputs in financial terms.

A concern of this study is that any changes in a set of input/output variables may affect the robustness of results. For instance, adding various sets of input/output variables in the DEA model may result in different relative efficiency scores leading to inconsistent inferential statistics. Thus, several combinations of input/output variables are implemented to ensure that the conclusion is robust. Cost of goods sold and selling, general, and administrative expenses are combined as a single input variable called operating Expenses *(OE)*. Moreover, total assets *(TA)* is used as a single input variable to represent current assets, fixed assets, and intangible assets. This study starts with a simple model--two inputs (operating expenses and total assets) and a single output (sales). Then, this study introduces several combinations of input/output variables in the model. Table 4.5 shows eight combinations of input/output variables in the DEA model.

Models 2 and 3 have the same inputs as model 1 but have more output variables. Operating cash flows is added to model 2 and income before extraordinary items is further included in model 3. Models 4, 5, and 6 have four input variables (operating expenses, current assets, fixed assets, and intangible assets) and have three different combinations of output variables similar to models 1, 2, and 3. Operating expenses is then disaggregated into cost of goods sold and selling, general, and administrative expenses for models 7 and 8. The robustness check of including various input/output variables in the DEA model is further discussed in the empirical result section.

DEA requires all variables to be greater than zero (Charnes et al. 1978). However, income before extraordinary items and operating cash flows may have negative values. These negative values are handled by adding a constant to the specific output of each DMU. The constant is obtained by finding the minimum values of the particular variable and adding its absolute values to all DMUs so that all firms have positive values for that particular variable (Bowlin 1999).[24] Although the issue of negative values can be resolved, the DEA model with sales as the single output variable is more attractive in the sense that it does not have any negative values so there is no need for an adjustment.

4.4.3 Cross-Sectional Analysis

A cross-sectional analysis is used to address the differences between the relative efficiency of impairment and non-impairment firms. This analysis is conducted within each industry from 2002-2005. First, the samples of impairment and non-impairment

[24] This method is suitable because the BCC model allows for translation invariance, meaning that translating the original input or output variables results in a new problem that has the same optimal solution.

firms are pooled together each year and the overall efficiency indices (EI) are calculated for all firms. Second, this study partitions the pooled sample into the subsamples of impairment versus non-impairment firms and calculates the within-group indices (EI_w) and the between-group indices (EI_b). Then, the test for differences in relative efficiency between the overall efficiency indices and the within-group indices (EI vs. EI_w) is used to determine whether the subsample frontiers are different from the pooled frontier. Finally, to assess differences in relative efficiency between impairment and non-impairment firms, a Wilcoxon rank sum test will be conducted on the overall efficiency indices of each subsample (EI vs. EI) if both subsamples share the common frontiers of the pooled sample. On the other hand, if subsample frontiers are different from the pooled frontier, a Wilcoxon rank sum test will be analyzed on the between-group indices (EI_b vs. EI_b) to determine which subsample is more efficient than the other. Overall, results finding that impairment firms have lower relative efficiency than non-impairment firms and the differences are statistically significant will support hypothesis 1.

4.4.4 Longitudinal Analysis

To assess the relative efficiency of firms over time, this study traces each sample firm to a subsequent year by using the method of Fizel and Nunnikhoven (1992). Within each industry, DMUs in year *t* and *t+1* are pooled together and classified into four groups--(1) firms with impairment in year *t* and *t+1*; (2) firms with impairment in year *t*, but without impairment in year *t+1*; (3) firms without impairment in year *t*, but with impairment in year *t+1*; and (4) firms without impairment in both years. Then, the overall efficiency indices (EI) are calculated for all DMUs in each group, which is

considered as the pooled sample. Second, the pooled sample in each group is partitioned into subsamples of year *t* versus year *t+1*. Then, the within-group indices (EI_w) and the between-group indices (EI_b) are calculated for each subsample. Finally, the Wilcoxon rank sum test is used to examine whether there are significant differences in relative efficiency between these two periods.

The analysis starts by assessing whether each subperiod frontier is different from the pooled frontier. The test for differences in relative efficiency between the overall efficiency indices and the within-group indices (EI vs. EI_w) for each subperiod is conducted for this purpose. Then, to determine which subsample period is more efficient than the other, the Wilcoxon rank sum test conducted on the overall efficiency indices (EI vs. EI) will be applied if the subsample frontiers are not different from the pooled frontier, otherwise the between-group index test (EI_b vs. EI_b) will be used. The test for significant differences in relative efficiency between the subsamples of period *t* and *t+1* is similar to the approach discussed in the cross-sectional analysis.

4.5 EMPIRICAL RESULTS

4.5.1 Descriptive Statistics

Table 4.6 provides descriptive statistics for the impairment and non-impairment samples by industry. Panels A, B, and C of Table 4.6 report descriptive statistics for durable manufacturers, computers, and services, respectively. Descriptive statistics of input and output variables indicate that non-impairment firms use slightly higher inputs and produce greater outputs than impairment firms. However, mean differences are not statistically significant, except for the difference in income before extraordinary items.

The means of income before extraordinary items are $-21.11, $-110.67, and $-101.22 million for impairment firms as opposed to $66.81, $14.94, and $75.81 million for non-impairment firms in the durable manufacturers, computers, and services, respectively. The differences are statistically significant at the 1 percent level (t-statistics of 3.98, 3.11, and 4.98, respectively), indicating that impairment firms are less profitable than non-impairment firms for all three industries. The median differences of income before extraordinary items are also statistically significant at the 1 percent level (z-statistics of 9.34, 9.01, and 8.44, respectively), consistent with the results of mean differences. In addition, non-impairment firms have lower amount of selling, general, and administrative expenses than impairment firms in the service industry and the mean difference is statistically significant at the 5 percent level (t-statistic of 2.09). Moreover, the median differences indicate that non-impairment firms have significantly higher cash flow from operations than impairment firms for all three industries (z-statistics of 3.54, 8.37, and 1.74). Overall, the descriptive statistics of an individual input/output variable, in part, reveal the differences in financial performance between impairment and non-impairment firms.

Regarding descriptive statistics for the size of goodwill, the service industry has the largest amount of goodwill for impairment firms ($450.73 million in mean, $53.14 million in median), following by the durable manufacturing industry ($208.78 million in mean, $15.28 million in median) and the computer industry ($118.36 million in mean, $11.65 million in median). For the impairment sample, the amount of goodwill, on average, represents 28, 17, and 24 percents of total assets in the services, durable manufacturers, and computers, respectively. In Panel A of Table 4.6, results of the

durable manufacturing industry show that the goodwill balance of impairment firms is $208.78 million, which is not significantly different from that of non-impairment firms ($290.66 million). The mean (median) of goodwill to total assets is 17 percent (13 percent), which is the same for both impairment and non-impairment samples. Therefore, there are no significant differences in size of goodwill for this industry.

Panel B of Table 4.6 indicates that there are significant differences in size of goodwill between impairment and non-impairment firms for the computer industry. The goodwill balance of impairment firms, on average, is $118.36 million, which is statistically greater than that of non-impairment firms ($46.56 million) (t-statistic of 1.81). Moreover, impairment firms have a larger percentage of goodwill to total assets (24 percent) than non-impairment firms (14 percent) (t-statistic of 4.94). The median differences also indicate that impairment firms have a higher amount of goodwill and a larger percentage of goodwill to total assets than non-impairment firms (z-statistics of 2.78 and 4.29), consistent with the results of mean differences.

In Panel C of Table 4.6, results of the service industry show that goodwill balances of impairment firms ($450.73 million in mean, $53.14 million in median) and non-impairment firms ($381.50 million in mean, $32.94 million in median) are not statistically different. However, the percentage of goodwill to total assets of impairment firms is 28 percent, which is significantly greater than that of non-impairment firms (21 percent) (t-statistic of 2.62). The median differences also support that impairment firms have a larger percentage of goodwill to total assets (z-statistic of 3.08). Overall, the durable manufacturing industry is the only one having no significant differences in size of goodwill between impairment and non-impairment firms.

In addition to having the largest amount of goodwill, the service industry also has the largest amount of impairment loss ($102.63 million), following by the computer industry ($65.4 million) and the durable manufacturing industry ($28.77 million). The proportion of impairment loss to goodwill of the service industry is 80 percent, which is also the largest percentage relative to the computer industry (69 percent) and the durable manufacturing industry (65 percent). However, the service industry has the lowest proportion of goodwill impairment loss to total assets (19 percent), in comparison with 33 percent of the computer industry and 24 percent of the durable manufacturing industry. Because the computer industry has the highest percentage of impairment loss to total assets, the amount of goodwill impairment loss appears to be more important to overall firms' values in this industry than in other two industries.

4.5.2 Results of Cross-Sectional Analysis

4.5.2.1 Pooled Cross-Sectional Analysis

Table 4.7 presents the results of Wilcoxon rank sum test used to examine whether or not the differences in efficiency arise because impairment and non-impairment firms have different frontiers. First, impairment and non-impairment firms are pooled across the period of 2002-2005 and the overall indices are calculated. Then, the within-group indices are estimated separately for each subsample of impairment and non-impairment. Finally, the Wilcoxon rank sum test is used to compare differences between the overall indices and the within-group indices for each subsample. If the differences are statistically significant, this study will use the between-group indices to compare the

differences in relative efficiency between impairment and non-impairment firms, otherwise the overall indices will be used.

This study tests the validity of the DEA model by incorporating eight combinations of input/output variables into the model. The results are robust across different DEA models. Panels A and B of Table 4.7 show the results of the durable manufacturers and computers. In general, the frontiers of the impairment and non-impairment subsamples are statistically different from the pooled frontier, suggesting that these two subsamples do not share a common production function. However, only model 4 for both industries and model 6 for the computer industry have the frontier of impairment subsample shifted away from the pooled frontier, but there is no shift in the frontier of non-impairment subsample. The results suggest that impairment firms are more likely to be relatively less efficient than non-impairment firms.

Panel C of Table 4.7 presents the results of the service industry. For all models, the frontier of the impairment subsample is statistically different from the pooled frontier, which immediately suggests that impairment firms are less efficient than the non-impairment firms. However, model 7 also has the frontier of the non-impairment subsample shifted out from the pooled frontier. Therefore, a further analysis is needed to examine which subsample is more efficient than the other.

Panels A, B, and C of Table 4.8 provide the results of the pooled cross-sectional analysis examining the differences between impairment and non-impairment firms for the durable manufacturing, computer, and service industries, respectively. Because at least one frontier of the two subsamples is statistically different from the pooled frontier as previously discussed, this study uses the between-group indices to assess the differences

between impairment and non-impairment firms. Overall, the results indicate that impairment firms are less efficient than non-impairment firms and the differences are statistically significant at the 1 percent level for all three industries. These findings strongly support the first hypothesis that impairment firms are relatively less efficient than non-impairment firms in the year of goodwill impairment recognition. Most importantly, the results are consistent across all models, indicating that including different sets of input/output variables in the DEA model does not affect the inferential statistics in this study.

4.5.2.2 Cross-Sectional Analysis by Year

Tables 4.9, 4.10, and 4.11, report the results of the cross-sectional analysis examining the differences between impairment and non-impairment firms by year and industry. Because the empirical results are robust across various input/output variables in the DEA model, this study reports only the results from model 7, which have five inputs (i.e. cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and a single output (sales). This model is selected because it does not have to adjust for negative values that incur when the model includes income before extraordinary items and operating cash flows. Moreover, the inclusion of multiple input variables in the model helps to estimate the relative efficiency of firms more accurately.

Table 4.9 presents the results of the cross-sectional analysis by year for the durable manufacturing industry. Panel A of Table 4.9 reports the frequencies and summary statistics of the efficiency scores for impairment and non-impairment firms on a

yearly basis. Although approximately 50 percent of firms appear on the efficiency frontier (the efficiency scores equal to 1), non-impairment firms dominate the high efficiency score deciles more than impairment firms. These results are similar for the overall indices, within-group indices, and between-group indices. Further, the mean efficiency scores indicate that impairment firms are slightly less efficient than non-impairment firms in every year. Panel B of Table 4.9 compares the overall indices with the within-group indices for each subsample to assess whether the subsample frontiers of impairment and non-impairment firms are different from the pooled frontier. The results reveal that, except for 2004, at least one frontier of the impairment and non-impairment subsamples is shifted out from the pooled frontier. Therefore, to assess differences in relative efficiency between these two subsamples, this study uses the between-group index test in 2002, 2003, and 2005 as opposed to the overall index test in 2004. The findings from Panel C of Table 4.9 support the prediction that impairment firms are relatively less efficient than non-impairment firms and the differences are statistically significant in 2002, 2004, and 2005.

Table 4.10 and Table 4.11 provide the results of the cross-sectional analysis by year for the computer and service industries. The frequencies and summary statistics of the efficiency scores for impairment and non-impairment firms are reported on a yearly basis in Panel A of both Tables. Similar to the manufacturing industry, non-impairment firms in the computer and service industries dominate the high efficiency score deciles, whereas several impairment firms scatter over the low efficiency score deciles. In addition, impairment firms have lower mean efficiency scores than non-impairment firms. In Panel B of Tables 4.10 and 4.11, this study examines whether impairment and

non-impairment subsamples share a common production function. The results mostly indicate a shift in the frontier of the impairment subsample from the pooled frontier, suggesting the use of a between-group index test to assess differences in relative efficiency between these two subsamples. However, no frontiers of the two subsamples are statistically different from the pooled frontier for the computer industry in 2004 and for the service industry in 2005. These findings indicate the use of an overall index test for the cross-sectional analysis in these particular years as shown in Panel C. In Panel C of Table 4.10, results of the computer industry indicate that the relative efficiency of impairment firms is statistically lower than that of non-impairment firms in 2002 and 2003 at the 1 percent significant level. In Panel C of Table 4.11, results of the service industry show that impairment firms are relatively less efficient than non-impairment firms in 2002, 2003, and 2004. The differences are also statistically significant at the 1 percent level. These findings are mostly consistent with the main results of the pooled cross-sectional analysis as presented in Table 4.8.

Overall, the results of the cross-section analysis show statistically significant differences in relative efficiency between impairment and non-impairment firms. The results indicate that impairment firms are relatively less efficient than non-impairment firms in the period of goodwill impairment recognition, supporting hypothesis 1.

4.5.3 Results of Longitudinal Analysis

4.5.3.1 Pooled Longitudinal Analysis

This section examines changes in the relative efficiency of impairment and control samples across time. The impairment samples in year t and $t+1$ are pooled

together within each industry and classified into four groups--(1) firms having goodwill impairment in two consecutive years, (2) firms having impairment in year *t*, but no impairment in year *t+1*, (3) firms having no impairment in year *t*, but impairment in year *t+1*, and (4) firms having no impairment in both years. The control samples in year *t* and *t+1* are also pooled together. The impairment and control samples are required to have goodwill balances and other data available in every two-year analysis.

Table 4.12 presents the sample distribution by industry and year. For all industries, about 50 percent of the impairment sample reports goodwill impairment either in year *t* or year *t+1* (the second and third groups). However, the impairment sample recognizing goodwill impairment in two consecutive years (the first group) is relatively small, approximately 10 percent of the total impairment sample. For all three industries, the total impairment and control samples are almost evenly distributed over each two-year period (2002 vs. 2003, 2003 vs. 2004, and 2004 vs. 2005).

Table 4.13 presents the results of the pooled longitudinal analysis for three industries. The impairment samples in each two-year period are pooled together across time within each group to perform the pooled longitudinal analysis. A similar approach is applied to the control sample. Table 4.13, Panel A examines whether each period frontier is statistically different from the pooled frontier. For all industries, the subsample frontiers of the first group, which have goodwill impairment in both years, are not different from the pooled frontier, suggesting the use of an overall index test to examine the differences between year *t* and *t+1*. For the second group, the frontier in year *t* of having goodwill impairment recognition is shifted out from the pooled frontier, while the frontier in year *t+1* of having no impairment is not statistically different from

the pooled frontier. These results indicate that the relative efficiency in year *t* of goodwill impairment is likely to be lower than that in year *t+1* of no impairment. However, the results of the third and the forth groups as well as the results of the control sample are mixed across industries. In conclusion, if this study finds statistically significant differences between the overall indices and within-group indices, the between-group index test is used for the analysis in Panel B, otherwise the overall group index test is applied.

Table 4.13, Panel B presents the results of the rank sum test used to examine differences in relative efficiency between year *t* and *t+1* by each subgroup. First, the results show no significant differences in relative efficiency between year *t* and *t+1* for firms reporting goodwill impairment in both years (the first group), indicating that a second year of impairment loss does not reflect an additional decline in relative efficiency. A possible explanation is that firms are likely to have a major decline in relative efficiency in the first year of impairment recognition. Thus, any changes in relative efficiency from the prior year are not significant enough to indicate the differences between these two periods. Interestingly, this study finds that firms reporting goodwill impairment in year *t*, but no impairment in year *t+1* (the second group) have an increase in relative efficiency over time for all three industries. The significant changes in relative efficiency strongly support the prediction that firms are relatively more efficient in the period of no impairment recognition (year *t+1*) than in the period of goodwill impairment reporting (year *t*).

On the other hand, the results of the pooled longitudinal analysis for the third and fourth groups are mixed across industries. For the impairment sample that does not have

goodwill impairment in year *t*, but reports impairment in year *t+1* (the third group), the results of the durable manufacturing industry indicate an increase in relative efficiency from year *t* to *t+1*. These findings contradict the prediction. In addition, the results of the computer industry show no significant differences in relative efficiency between year *t* and *t+1*. Therefore, the individual two-year longitudinal analysis is needed for further explanations. However, for the service industry, the results are consistent with the prediction that firms are relatively less efficient in the period of impairment recognition (year *t+1*) than in the period of no goodwill impairment (year *t*), and these findings are statistically significant at the 1 percent level.

This study predicts that there will be no significant differences in relative efficiency between two periods of no goodwill impairment recognition (the fourth group). However, for durable manufacturers, the impairment sample in group 4 exhibits a decline in relative efficiency in the second year of no impairment recognition. Because firms classified into this group do not have goodwill impairment losses in the two particular years but are allowed to have impairment recognition in any other years, a decline in relative efficiency can be a signal of potential goodwill impairment. These findings suggest that a measure of relative efficiency can be used to determine the likelihood of goodwill impairment in the near future. Finally, the results of the control sample show no significant differences in relative efficiency between year *t* and *t+1* for non-impairment firms in every industry.

In summary, the results of the pooled longitudinal analysis strongly support an increase in relative efficiency from year *t* to *t+1* for firms that report goodwill impairment losses in year *t*, but no impairment losses in year *t+1*. These findings are

consistent across all three industries. However, the evidence only supports a decline in relative efficiency from year *t* to *t+1* for firms that have no impairment in year *t*, but recognize goodwill impairment in year *t+1* in the service industry.

4.5.3.2 Longitudinal Analysis by Two Years

This section discusses the results of the longitudinal analysis by two years to further analyze changes in the relative efficiency of impairment and non-impairment firms over time. Tables 4.14, 4.15, and 4.16 present the results of the rank sum tests for durable manufacturers, computers, and services, respectively. First, the impairment samples in 2002 vs. 2003 are pooled together to calculate the overall indices. Then, the pooled samples are partitioned into two subsamples of 2002 and 2003 to estimate the within-group indices and the between-group indices. The control samples in 2002 vs. 2003 are also pooled together for this analysis. A similar approach is performed on the analysis in 2003 vs. 2004 and in 2004 vs. 2005. Panel A of Tables 4.14, 4.15, and 4.16 presents the results of Wilcoxon rank sum test, which is used to examine whether each subperiod frontiers and the pooled frontiers differ. The between-group index test is used to assess differences between two periods if the subperiod frontiers are shifted out from the pooled frontier. However, the overall index test is applied if the subperiod frontiers are not statistically different from the pooled frontier.

Panel B of Tables 4.14, 4.15, 4.16 reports the results of the rank sum test used to examine the changes in relative efficiency between two periods when impairment firms exhibit four different scenarios of having goodwill impairment in every two-year analysis. Table 4.14, Panel B presents the results of Wilcoxon rank sum test for the

durable manufacturing industry. Consistent with the pooled longitudinal analysis, the results show no significant changes in relative efficiency between each two-year analysis for firms that report goodwill impairment in both years (the first group). Moreover, the results consistently indicate a significant increase in relative efficiency from year *t* to *t+1* for firms that report goodwill impairment in year *t*, but do not have impairment in year *t+1* (the second group), except for the results in the 2004 vs. 2005 analysis.

For each two-year analysis, this study reports no significant differences in relative efficiency scores between firms that do not have goodwill impairment in year *t*, but have impairment in year *t+1* (the third group). However, these findings are different from the results of the pooled longitudinal analysis that indicate an increase in relative efficiency from year *t* to *t+1*, contrary to the prediction. The two-year longitudinal analysis provides more detailed pictures in every period. Therefore, it suggests a better explanation regarding the changes in relative efficiency of the third group in comparison with the results of the pooled longitudinal analysis. Nonetheless, this study is unable to find evidence supporting the prediction that the relative efficiency in year *t+1* of impairment is lower than that in year *t* of no impairment. A plausible explanation is that the relative efficiency in year *t+1* may be lower than in year *t* for the analyses of 2003 vs. 2004 and 2004 vs. 2005. However, a decline in relative efficiency can be eliminated by an increase in efficiency resulting from an industry effect. Results of the control sample in the same periods also show an increase in relative efficiency from year *t* to *t+1*, supporting the argument that the industry improvement has an impact on the changes in relative efficiency over time.

Finally, the results of the fourth group show a decline in relative efficiency in the second year of no goodwill impairment recognition for the periods of 2002 vs. 2003. These results suggest that firms in this group are likely to have goodwill impairment in the near future, consistent with evidence from the pooled longitudinal analysis. In contrast, the Wilcoxon rank sum test for the differences in relative efficiency between 2003 vs. 2004 indicates an increase in relative efficiency in the second year of no goodwill impairment reporting. These opposite results can be explained by the industry effect, which can also be seen from an increase in the relative efficiency of the control sample in the analysis of 2003 vs. 2004.

Table 4.15, Panel B reports the results of Wilcoxon rank sum test for the computer industry. The analysis of the first and second groups provides similar results to the findings in the durable manufacturing industry. For the first group, the results show no significant differences in relative efficiency between each two-year analysis for firms that have goodwill impairment in both years. For the second group, the results indicate a significant increase in relative efficiency from year *t* to *t+1* for firms that report goodwill impairment in year *t*, but do not have impairment in year *t+1* for every two-year analysis. These results are consistent with the prediction. For the third group, the results show an increase in relative efficiency from 2002 to 2003 for firms that do not have goodwill impairment in 2002, but have impairment in 2003, which contradicts the prediction. The increase in relative efficiency is possibly explained by an industry improvement. The results of the control sample having no impairment in 2002 and 2003 also indicate an increase in relative efficiency, which supports the industry improvement effect. Finally,

for the fourth group, the results show no significant changes in the relative efficiency of firms that have no impairment in every two-year analysis.

Table 4.16, Panel B reports the results of Wilcoxon rank sum test for the service industry. Results of the first two groups in this industry are similar to those in the durable manufacturers and computers. For the first group, the results of the rank sum test indicate no significant differences in relative efficiency between each two-year analysis. For the second group, except for the results in 2002 and 2003, this study consistently finds an increase in relative efficiency from year *t* to *t+1* for firms that have goodwill impairment in year *t*, but do not have impairment in year *t+1*. For the third group, the rank sum tests show a slight decline in relative efficiency from year *t* to year *t+1* when non-impairment firms in year *t* exhibit goodwill impairment recognition in year *t+1*. However, the differences are not statistically significant. Finally, the results of the fourth group and the control sample indicate no significant differences in relative efficiency over time for every two-year analysis.

In summary, this study finds no significant changes in relative efficiency from year *t* to *t+1* for firms that have impairment in two consecutive years. The results suggest that the second year of impairment recognition does not provide information regarding an additional decline in relative efficiency. Interestingly, the results of the two-year longitudinal analysis indicate a significant increase in relative efficiency from year *t* to *t+1* for firms that have goodwill impairment in year *t*, but do not have impairment in year *t+1*, consistent with the prediction. These findings are similar to the results of the pooled longitudinal analysis and are consistent across all three industries. On the other hand, the two-year longitudinal analysis is not able to provide evidence to support a

decline in relative efficiency from year *t* to *t+1* for firms that do not have goodwill impairment in year *t*, but report impairment in year *t+1*. A possible explanation is that a decrease in relative efficiency is offset by an increase in relative efficiency resulting from an industry improvement. Finally, results show no significant differences in the relative efficiency of the sample firms that report no goodwill impairment in both consecutive years.

Overall, the results of the cross-sectional analysis strongly support the prediction that impairment firms are relatively less efficient than non-impairment firms in the year of goodwill impairment recognition. However, the longitudinal analysis provides evidence partially supporting the prediction that firms are relatively less efficient in the year of goodwill impairment recognition than in the year of no impairment. An alternative explanation is that management is responsible for preparing financial reporting and disclosures so managers are able to manage firm performance across time. Therefore, when this study examines changes in relative efficiency over time, results can be affected by management's manipulation of firm performance. On the other hand, the cross-sectional analysis compares the relative efficiency of impairment firms to that of non-impairment firms in the same industry. Because management is unable to manage the performance of other firms, the cross-sectional analysis provides evidence that is more clear and consistent with the prediction.

4.6 SENSITIVITY ANALYSIS

Because goodwill impairment under SFAS No. 142 and fixed asset impairment under SFAS No. 144 can be recognized during the same period, a concern has been

raised as to whether or not a decline in the relative efficiency of firms is attributed to fixed asset impairment rather than goodwill impairment. This study checks the robustness of research results by excluding the impairment firms and the matched control firms, which have fixed asset impairment, from the pooled cross-sectional analysis. Therefore, the sensitivity analysis is only conducted on the sample with goodwill impairment. The reduced sample consists of 210, 214, and 134 observations from durable manufacturers, computers, and services, respectively.

Table 4.17 presents the results of the pooled cross-sectional analysis. Panel A reports frequencies and summary statistics of the efficiency scores for impairment and non-impairment firms in each industry. For all three industries, non-impairment firms appear on the efficiency frontier and dominate the high efficiency score deciles more than impairment firms. In addition, impairment firms have lower mean efficiency scores than non-impairment firms, consistent with the main results.

Table 4.17, Panel B compares the within-group indices with the overall indices to examine differences in the relative efficiency of each subsample frontiers from the pooled frontier. The results indicate that the impairment samples have frontiers shifted out from the pooled frontier for all three industries. Thus, this study uses the between-group index test to compare differences in relative efficiency between impairment and non-impairment firms. Findings from Table 4.17, Panel C strongly support the main results in Table 4.8 that impairment firms are relatively less efficient than non-impairment firms in the year of impairment recognition. These results are consistent across all three industries.

4.7 CONCLUSION

This study examines the usefulness of goodwill impairment after the initial adoption of SFAS No. 142 by assessing the relative efficiency of firms rather than using the market-based study. Data Envelopment Analysis is used to measure firm performance because it allows an aggregation of several financial measures into a single performance measure. Eight combinations of input/output variables are included in the DEA model to ensure that results are robust across different models.

The results of the cross-sectional analysis strongly support the hypothesis that impairment firms are relatively less efficient than non-impairment firms in the year of goodwill impairment reporting. These findings are consistent across different DEA models for all three selected industries--durable manufacturers, computers, and services. This study, then, examines changes in the relative efficiency of impairment and non-impairment firms over time. The results of the longitudinal analysis indicate an increase in relative efficiency from year *t* to *t+1* for firms that have impairment in this year, but no impairment in the next year. However, the longitudinal analysis provides evidence partially supporting a decline in relative efficiency from year *t* to *t+1* for firms that do not have impairment in this year, but report goodwill impairment in the next year. The plausible explanation is that managers are able to manage the financial reporting and performance of their firms over time, while they are unable to manipulate the financial performance of other firms in the same industry. Therefore, measuring the performance of a firm relative to other firms (the cross-sectional analysis) provides better evidence to support the prediction as opposed to measuring the performance of a firm relative to its performance at different points in time (the longitudinal analysis). Overall, the results

indicate that goodwill impairment under SFAS No. 142 can reflect the decline in the relative efficiency of firms; therefore, the implementation of this standard achieves the FASB's objective.

CHAPTER 5

THE DETERMINANT AND PREDICTIVE ABILITY OF RELATIVE EFFICIENCY ON GOODWILL IMPAIRMENT UNDER SFAS NO. 142

5.1 INTRODUCTION

Goodwill has become an important component of a firm's value. It represents approximately 20 percent of the total assets of business combinations that occurred between 1990 and 1994 (Henning et al. 2004) and the proportion of goodwill to purchase price for the acquisitions that occurred from 1997 to 2002 is approximately 68 percent (Long 2005). The FASB responded to the demand for more useful information about goodwill from financial statement users by issuing SFAS No. 142, *Goodwill and Other Intangible Assets*, in June 2001. SFAS No. 142 provides more specific guidance to determine the timing and to measure the amount of goodwill impairment. The primary objective of this standard is to improve financial reporting so that financial statements will better reflect the underlying economic value of goodwill and other intangible assets (SFAS No. 142, Summary).

However, the implementation of SFAS No. 142 involves subjective assumptions and estimates in determining reporting units, allocating goodwill and other net assets to reporting units, and measuring the fair value of reporting units.[25] These difficulties call

[25] The FASB allows several methods to calculate the fair value of a reporting unit such as market capitalization, discounted cash flow, multiple of earnings, and residual income valuation.

for management's potential opportunistic behavior in making a goodwill impairment decision. Because future cash flows are unlikely to be verifiable and the valuation based on them may be manipulated, the FASB's adoption of SFAS No. 142 may lead to an increase in fraudulent financial reporting that emerges from the FASB moves toward the firm valuation as reflected in SFAS No. 142 (Watts 2003). In a recent study, Beatty and Weber (2006) examine factors affecting managers' decisions to recognize goodwill impairment *during* the adoption period by focusing on the trade-off between recording goodwill impairment charges "below the line" and recording uncertain future impairment charges "above the line." Beatty and Weber (2006) provide evidence that managerial incentives affect managers' accounting choices that relate to the trade-off between the timing and the presentation of goodwill impairment recognition when SFAS No. 142 was adopted. Moreover, Guler (2006) examines goodwill impairment decisions in the years after the adoption of SFAS No. 142. The results reveal that the managers' choice to recognize goodwill impairment losses is attributable to managers' in-the-money stock option holdings and the corporate governance.

Motivated by this debate, the first objective of this chapter is to examine whether or not goodwill impairment under SFAS No. 142 reflects the underlying economics of goodwill, thereby achieving the FASB's objective. Specifically, this study focuses on the role of a firm's underlying relative efficiency as a determinant of goodwill impairment. Unlike Beatty and Weber's (2006) study, this study examines factors affecting a goodwill impairment decision *after* the adoption of SFAS No. 142. Because goodwill impairment losses during the transitional period are presented as a cumulative effect of a change in accounting principle, SFAS No. 142 offers management incentives for making

impairment decisions. However, the determinants of goodwill impairment may change after the adoption period due to the absence of such incentives from the initial implementation. Additionally, unlike the study of Guler (2006) that examines the roles of managers' in-the-money stock option holdings and corporate governance, this study analyzes the role of firm efficiency in determining goodwill impairment in the years subsequent to the initial adoption of SFAS No. 142.

This study uses a Tobit regression to examine factors affecting the percentage of goodwill impairment and a logistic regression to analyze factors affecting the likelihood of a goodwill impairment decision. In general, firms recognize asset write-offs during a period of economic difficulty, and write-off firms are likely to have lower performances than other firms in the same industries (Elliott and Shaw 1988). Therefore, a firm's relative efficiency is expected to have a negative association with the percentage of goodwill impairment and the likelihood of a goodwill impairment decision, after controlling for reporting incentive factors. This study is unique because the performance of impairment firms is calculated relative to non-impairment firms within the same industry by using Data Envelopment Analysis (DEA). The advantage of DEA is that it aggregates several financial measures into a single measure of firm performance and efficiency. This eliminates concerns regarding intercorrelations and contradictions among variables resulting from the inclusion of multiple performance variables in the model.

Overall, the results strongly support the hypothesis that firms are more likely to report goodwill impairment losses and recognize higher percentages of goodwill impairment losses when their lagged relative efficiency is low, after controlling for the

effects of managerial reporting incentives. Moreover, the weighted exogenous sample maximum likelihood (WESML) used to account for the choice-based sample bias provides evidence similar to the results of Tobit and logistic regressions. The inferences are not sensitive to the choices of various input/output variables in the DEA model. In addition, the findings are consistent with the main results after this study applies a conditional logistic regression to account for the matched sample design and includes a variable to control for a reportable segment.

The second objective of this chapter is to assess the ability to determine goodwill impairment independently from the management decision by using measures of a decline in relative efficiency. In particular, this study examines whether or not a decrease in relative efficiency of firms in prior years can signal potential goodwill impairment under SFAS No. 142. In a related study, Hayn and Hughes (2006) develop a goodwill write-off prediction model that incorporates acquisition characteristics and measures of the acquired entity's postacquisition performance. However, this study differs from the study of Hayn and Hughes (2006) in the following ways. First, the objective of this study is to examine the predictive ability of a decline in relative efficiency with respect to the likelihood of a goodwill impairment decision, whereas the study of Hayn and Hughes (2006) aims at developing a goodwill write-off prediction model. Second, the sample in their primary analysis has goodwill write-offs *before* the adoption of SFAS No. 142, and only 56 write-offs occur subsequent to the adoption of this standard. In contrast, the sample in this study consists of firms having goodwill impairment in the *post*-SFAS No. 142 period, which provides more relevant evidence on the implication of this standard *after* the initial adoption. Third, this study measures the performance at the firm level

relative to other firms in the same industry, while Hayn and Hughes (2006) use available segment data to capture the performance of segments to which goodwill is assigned. Finally, this study applies DEA technique to estimate the overall relative efficiency of firms instead of including several performance measures as shown in the study of Hayn and Hughes (2006).

This study uses a logistic regression and a multivariate discriminant analysis (MDA) to assess the predictive ability of a decline in relative efficiency in determining potential goodwill impairment. First, this study applies a logistic regression to assess the likelihood of a goodwill impairment decision. The results indicate that the likelihood of goodwill impairment in year *t* is positively associated with an indicator variable of a decline in relative efficiency from year *t-2* to *t-1* and a history of goodwill impairment reporting from year *t-3* to *t-1*. However, the likelihood of goodwill impairment in year *t* is negatively associated with a percent change in relative efficiency from year *t-2* to *t-1* and from year *t-3* to *t-1*. Empirical evidence suggests that these variables can be used to determine potential goodwill impairment.

Second, this study applies similar variables in the logistic regression to the MDA and uses this method to classify firms as impairment or non-impairment. Resubstitution and cross-validation methods are used to assess classification accuracy. The results show that the model including a percent change in relative efficiency from year *t-3* to *t-1* correctly predicts more than 50 percent of the actual impairment and provides the total classification error of 35.32 percent, which is the lowest error rate. These findings suggest that a decline in relative efficiency is an important factor in determining potential goodwill impairment. Moreover, adding information regarding a change in relative

efficiency from the past years produces better results than including only information from year *t-2* to *t-1*.

This study contributes to the related literature in the following ways. First, this study extends the literature regarding asset write-offs (e.g. Strong and Meyer 1987; Francis et al. 1996; Riedl 2004) and determinants of goodwill impairment under SFAS No. 142 (e.g. Segal 2003; Beatty and Weber 2006; Guler 2006). To my knowledge, this study is the first attempt to analyze the relation between goodwill impairment and a firm's relative efficiency, the underlying economics for goodwill impairment. Second, this study contributes to the relative efficiency literature (e.g. Bowlin 1995, 1999; Seiford and Zhu 1999) by using the DEA technique to measure the performance of firms and assessing the implication of SFAS No. 142. Finally, this study extends the literature regarding the bankruptcy (e.g. Altman 1968; Ohlson 1980) and goodwill impairment prediction models (e.g. Hayn and Hughes 2006). The evidence supporting this study helps investors and other users of financial statements to determine potential goodwill impairment by considering the overall measure of firm performance.

The remainder of this chapter is organized as follows. Section 5.2 reviews the related literature. Section 5.3 develops hypotheses. Section 5.4 discusses research design. Section 5.5 contains empirical results. Section 5.6 provides sensitivity analysis and the final section concludes.

5.2 LITERATURE REVIEW

5.2.1 Determinants of Goodwill Impairment

Prior literature examining the determinants of asset impairment concludes that the impairment loss resulted from two main factors--reporting incentives and the deterioration of economic conditions. Prior to the specific guidance on accounting for asset write-offs, Francis et al. (1996) point out that managers have incentives to manage earnings by recognizing impairment only when it provides advantages to them. Francis et al. (1996) conclude that incentives play a substantial role in explaining more discretionary asset write-off items, such as goodwill write-offs and restructuring charges over the 1989-1992 periods. Strong and Meyer (1987) find that the most important indicator of the asset-write-down decision is a change in senior management. Moreover, Riedl (2004) reveals that asset write-offs under SFAS No. 121 have a weaker association with economic factors but a higher association with "big bath" reporting behavior.

On the other hand, other studies suggest that managers recognize the impairment loss to reflect a decrease in the values of assets due to the poor performance of firms, the changes in the economic environment, or the changes in management strategies. Elliott and Shaw (1988) find that asset write-off firms tend to underperform other firms in the same industry during the three years leading up to and including the year of write-offs in terms of the market performance, return on assets, and return on equity. They also conclude that the write-off firms have dividend decreases and bond rating downgrades compared to other industrial firms, indicating that asset write-offs occur during the period of economic difficulty. Finally, Rees et al. (1996) find that managers recognize asset impairment in years when earnings are low, relative to the industry.

After the initial adoption of SFAS No. 142, several recent papers document that management's discretion still has an impact on the initial goodwill impairment decision. This is because the standard allows the initial impairment loss to be recorded as the effect of a change in accounting principle, not affecting income numbers. Zang (2003) finds that the initial goodwill impairment loss is larger when there has been recent management turnover because new managers tend to take a "big bath." However, the initial goodwill impairment loss is smaller for firms that are highly levered so they can avoid violating debt covenants. Segal (2003) examines the determinants of goodwill impairment before and after SFAS No. 142 and finds evidence of a lower association with incentive variables but no evidence of a higher association with economic variables under SFAS No. 142.[26] Moreover, Jordan and Clark (2003) find evidence of "big bath" earnings management among the Fortune 100 companies during the initial adoption period of SFAS No. 142. Beatty and Weber (2006) examine the adoption decision of SFAS No. 142 by focusing on the trade-off between recording goodwill impairment losses below the line and recording future impairment losses above the line. They conclude that firms accelerate the initial goodwill impairment charges when their income from continuing operations has a higher stock market multiple or they have recent management turnover. However, firms' debt contracting, compensation incentives, and exchange delisting requirements affect management decisions to delay impairment recognition during the transitional period. Finally, Guler (2006) reveals that the likelihood of recognizing the impairment losses subsequent to the adoption period significantly decreases when

[26] Incentive variables are proxies for factors associated with management incentives to record goodwill impairment (e.g. management turnover, debt covenant violations, unexpectedly low (high) performance). Economic variables are proxies for a poor historical firm performance and a decline in industry trend (e.g. changes in sales and in industry ROA).

managers have in-the-money stock option holdings, but it significantly increases when firms have stronger corporate governance.[27]

In summary, most of these recent studies were conducted using data from the initial adoption period because post-SFAS No. 142 data were not available at that time. In addition, the adoption period was investigated in great detail because the standard allows the transitional goodwill impairment loss to be recorded as the effect of a change in accounting principle. This offers incentives for the management to exercise discretion in reporting the transitional impairment. However, this study aims at examining the implication of SFAS No. 142 after the transitional period because data have recently become available. Moreover, the management has no incentives to report goodwill impairment above-the-line or below-the-line item in income statements as allowed during the initial adoption period. Drawing upon the results from chapter 4, which show that impairment firms are relatively less efficient than non-impairment firms during the year of goodwill impairment recognition, this chapter further examines whether or not the relative efficiency is a determinant of goodwill impairment losses, after controlling for other confounding factors.

5.2.2 Predictive Ability of Relative Efficiency

This study applies the literature on bankruptcy prediction models as guidance in discussing the prediction of goodwill impairment. Prior research on the bankruptcy prediction model uses several financial ratios to predict bankruptcy. Altman (1968) employs a multiple discriminant analysis and a set of financial ratios in constructing the

[27] Guler (2006) measures corporate governance by the percentage of outside directors, percentage of outside directors' ownership, number of busy directors, and separation of CEO and Chair titles.

Altman's Z score. These financial ratios include working capital to total assets, retained earnings to total assets, earnings before interest and taxes to total assets, market value equity to book value of total debt, and sales to total assets. Results indicate a decline in financial ratios as bankruptcy approached, and the prediction model accurately predicts the failure up to two years prior to bankruptcy. Ohlson (1980) includes nine variables used to capture firm leverage, liquidity, and performance in the prediction model, and uses a logistic analysis to predict corporate failure. Finally, Zmijewski (1984) uses three variables--net income to total assets (return on assets), total debt to total assets (leverage), and current assets to current liabilities (liquidity)--to estimate financial distress prediction models.

In a recent study regarding the prediction of goodwill impairment, Hayn and Hughes (2006) develop a write-off prediction model that incorporates acquisition characteristics and measures of the acquired entity's subsequent performance of acquisitions made over the years from 1988 to 1998.[28] Four performance indicators, which are used to measure the performance of segments to which the goodwill is assigned, are operating income to identifiable assets, a change in ROA from the previous year, operating losses, and the percentage change in sales. Results indicate that the predictive power of their write-off prediction model is modest and much weaker than that of the bankruptcy prediction model, which measures the performance at the firm level. In addition, the modest predictive power is not mainly due to the subsequent performance of the acquired entity, but rather due to the acquisition characteristics. These results are

[28] Measures of acquisition indicators are payment of significant premium, number of bidders, the percentage of the acquisition cost assigned to goodwill, and use of acquiring firm's stock as the primary model of consideration.

surprising and contradict bankruptcy prediction model literature, which indicates that performance indicators are powerful predictors of financial distress. According to Hayn and Hughes (2006), plausible explanations for the contradiction are the limited number of performance indicators that can be computed from segment data and the low quality of the available segment disclosures.

The purpose of this study is not to develop a predictive model of goodwill impairment, but to employ financial performance measures in prior years to identify potential goodwill impairment. Unlike prior research, which uses several performance indicators, this study develops an overall measure of firm performance by using DEA technique to combine several input/output variables. DEA has been widely used to assess performance in many industries, such as non-profit organizations, the banking industry, and the defense industrial business (e.g. Grosskopf and Valdmanis 1987; Fizel and Nunnikhoven 1992; Miller and Noulas 1996; Bowlin 1999; Leong et al. 2003). DEA is a robust and flexible methodology for financial performance evaluation because it is able to assess multiple variables simultaneously and capture possible interactions between variables (Bowlin 1995). Moreover, DEA offers information additional to that provided by a traditional ratio analysis (Feroz et al. 2003).

5.3 HYPOTHESES DEVELOPMENT

5.3.1 Determinants of Goodwill Impairment

Prior research concludes that the recognition of asset write-offs is determined by economic factors and managerial reporting incentives. Asset write-offs can signal a decrease in a firm's ability to generate future earnings, and management appropriately

reports the information (e.g. Elliott and Shaw 1988; Rees et al. 1996). On the other hand, the write-offs can be results of management acting opportunistically to improve future earnings (e.g. Strong and Meyer 1987; Beatty and Weber 2006).[29] Therefore, the FASB issued SFAS No. 142 to improve financial reporting quality and reduce management's opportunistic behavior on goodwill impairment decisions. The FASB expects that the standard will help financial statements to better reflect the underlying economics of goodwill. However, Guler (2006) still finds evidence of the roles of managers' stock option holdings and board of directors' characteristics in managers' choice to report goodwill impairment. Thus, the usefulness of SFAS No. 142 after the initial adoption period remains debatable.

Motivated by the above debate, this study takes an alternative view to examine the extent to which goodwill impairment losses under SFAS No. 142 can be identified by the underlying economics of goodwill. To assess goodwill for impairment, the FASB requires using the fair value approach to identify the value of a reporting unit. Market capitalization can represent the fair value of a reporting unit if it is available and a firm has only one reporting unit. However, the fair value of a reporting unit may be greater than the market capitalization due to synergies and other benefits from a controlled entity. When market value is not available, SFAS No. 142 allows using other valuation techniques (e.g. the present value of future cash flows and the multiples of earnings or revenues), which require assumptions and estimates based on past and current

[29] Management acts opportunistically to improve future earnings by recording goodwill impairment when a firm has recent management turnover. However, management tends to delay goodwill impairment recognition due to debt contracting constraint, compensation incentives, and exchange delisting requirements.

performance. Therefore, the recognition of goodwill impairment losses is inevitably determined by a firm performance.

Prior studies find that the goodwill impairment loss has some evidence of delayed recognition and is associated with firm past performance (Li et al. 2005; Long 2005; Hayn and Hughes 2006). Firms experiencing relatively low efficiency, compared to other firms in the same industry, are likely to have a decrease in goodwill values, which will be reported as goodwill impairment losses. Thus, relative efficiency can be used as a measure of firm performance, an underlying economic reason for a decline in goodwill value. Moreover, the economic linkage between goodwill impairment and firm performance suggests that, after controlling for other incentive variables, goodwill impairment loss is likely to have a negative association with lagged relative efficiency. In other words, inefficient firms are more likely to report goodwill impairment losses in the near future. The hypothesis stated in an alternative form is as follows:

H2: Goodwill impairment loss under SFAS No. 142 is negatively associated with lagged relative efficiency.

5.3.2 Predictive Ability of Relative Efficiency

The second objective of this chapter is to assess the predictive ability of a firm's past performance on the likelihood of a goodwill impairment decision. Because a firm reporting asset write-offs is likely to experience lower performance than other firms in the same industries (Elliott and Shaw 1988), it is interesting to examine whether or not an indicator of a decline in a firm's past performance can be a factor that attributes to the recognition of goodwill impairment in the near future. Therefore, a decline in firm performance over the past years is expected to indicate the likelihood of a goodwill

impairment decision. Nonetheless, this study does not intend to develop a prediction model for goodwill impairment, as in the study of Hayn and Hughes (2006).

5.4 RESEARCH DESIGN

5.4.1 Data and Sample Selection

Sample firms obtained from *Compustat* are publicly traded companies in the U.S. during the fiscal years 2002-2005. The initial sample starts with the selected impairment sample from chapter 4 that consists of 173 firms from durable manufacturers, 161 firms from computers, and 111 firms from services. As previously discussed, the impairment sample is matched with control firms that have no goodwill impairment for the entire period of study based on size, the same two-digit SIC code, and the same year. Then, the additional restrictions are imposed. Observations are required to have stock returns and sufficient information to calculate lagged relative efficiency for the analysis of determinants of goodwill impairment.[30] Therefore, the final sample is reduced to 384 firm-year observations--172 firms from the durable manufacturers, 118 firms from the computers, and 94 firms from the services. The sample period becomes 2003-2005 because the 2002 data are needed to estimate lagged relative efficiency for 2003.

For the analysis of a predictive ability of relative efficiency with respect to a goodwill impairment decision, observations are required to have adequate information to compute lagged relative efficiency up to the three-year lag. The decline in efficiency from the past three years is considered because goodwill impairment losses lag behind

[30] To calculate lagged relative efficiency, information about assets (e.g. current assets, fixed assets, intangible assets, total assets) at the beginning and ending periods of the previous year are needed to calculate the average balances of these variables. Thus, these observations need to take place within the past two years.

the economic impairment of goodwill by an average of three to four years (Hayn and Hughes 2006). Therefore, the sample period becomes 2004-2005. The final sample is reduced to 252 firm-year observations, consisting of 124 firms from the durable manufacturers, 66 firms from the computers, and 62 firms from the services.

For all observations, firms' 10K filings to the US Securities and Exchange Commission (SEC) are reviewed to obtain additional goodwill impairment disclosures and to ensure that the amount of goodwill impairment provided by *Compustat* is correct.[31] In addition, information about changes in chief executive officers over the past two years is hand-collected from firms' proxy statements.

5.4.2 Relative Efficiency Measure

Because financial ratios and performance indicators are important factors in indicating the financial distress and bankruptcy (e.g. Altman 1968; Ohlson 1980; Zmijewski 1984), this study uses financial performance measures as proxies for the relative efficiency of firms, an indicator of goodwill impairment. However, this study is unique in a way that it applies DEA technique to include several input/output variables and construct a single performance measure.[32] Therefore, it mitigates intercorrelations and contradictions among variables that may incur from including multiple performance measures in the model.

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[31] *Compustat* sometimes combines the impairment amount of other intangible assets or the long-lived assets into the amount of goodwill impairment. In this case, this study includes only the amount of goodwill impairment for the analysis.

[32] This study uses the Banker-Charnes-Cooper (BCC) model for the DEA analysis to allow for variable returns to scale.

Regarding the robustness check among various DEA models in chapter 4, the inferences are not sensitive to the choices of different input/output variables in the DEA model. This study reports primary results from the DEA model, which has five input variables (i.e. cost of goods sold, selling, general, and administrative expenses, current assets, fixed assets, and intangible assets) and a single output variable (sales). A reason for selecting this combination of input/output variables is that all variables in this model do not have negative values. Therefore, this study does not have to make an adjustment for the relative efficiency measurement.

Market values the amount of goodwill as an asset, a valuable economic resource (Henning et al. 2000), so the decline in value of goodwill should reflect a deterioration of a firm value. This study measures the relative efficiency at the firm level because evaluating goodwill for impairment by each reporting unit is unlikely to perform due to unavailable information. Although SFAS No. 142 mentions that a reporting unit can be an operating segment, in practices, several reporting units are combined to represent a component of an operating segment. The combination of reporting units leads to lower quality of disclosures than those provided at the firm level (Hayn and Hughes 2006). Moreover, the problem of disclosure quality still exists even a reporting unit is the same as an operating segment.[33] Hayn and Hughes (2006) also note that "when goodwill is allocated across reporting units, the unique subsequent performance of the acquired entity is no longer clearly defined and can no longer be traced". Moreover, Watt (2003) argues that synergies imply joint costs and benefits so it is arbitrary to allocate future cash flows

[33] Givoly et al. (1999) find that segment data reported under SFAS No. 14, *Financial Reporting for Segments of a Business Enterprise*, have lower quality data than firm-level data due to the need to assign joint costs to the firm's segments.

and goodwill among units. Therefore, this study uses available information to measure performance at the firm level as opposed to at the reporting unit level.

5.4.3 Empirical Models

5.4.3.1 Determinants of Goodwill Impairment

Prior research concludes that economic factors and reporting incentives are two major determinants of goodwill impairment reporting (e.g. Segal 2003; Zang 2003; Li et al. 2005; Long 2005). This study applies Tobit and logistic regressions for the analysis.[34] First, this study uses a Tobit model to examine the association between the percentage of goodwill impairment and the determinants of goodwill impairment. The Tobit model is a censored regression where observations on the dependent variable (y) are censored at a certain point, but the explanatory variables are observed for all observations (Maddala 1991).[35] Second, this study uses a logistic regression to examine firms' decisions to recognize goodwill impairment. The logistic regression is appropriate because the decision to report goodwill impairment is a dichotomous choice. The Tobit and logistic models are specified as follows:

Tobit regression

$$IMP\%_{it} = \beta_0 + \beta_1 EFF_{i,t-1} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{it} + \beta_4 BATH_{it} + \beta_5 SMOOTH_{it} + \beta_6 SM\_INCREASE_{it} + \beta_7 SIZE_{i,t-1} + \beta_8 LEV_{i,t-1} + \varepsilon_{it} \quad (2)$$

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34 Tobit and logistic regressions are used because this study examines both the percentage of goodwill impairment that is reported and the decision to recognize goodwill impairment.

35 In this study, the dependent variable is the percentage of goodwill impairment, which can also be seen as the percentage change in the value of goodwill. Since U.S. GAAP does not allow for the recognition of an increase in goodwill values, but only allow for the recognition of a decrease in goodwill values (i.e. goodwill impairment), the dependent variable is censored at zero where the values of goodwill increase.

Logistic regression

$$IMPAIR_{it} = \beta_0 + \beta_1 EFF_{i,t-1} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{it} + \beta_4 BATH_{it} + \beta_5 SMOOTH_{it} + \beta_6 SM\_INCREASE_{it} + \beta_7 SIZE_{i,t-1} + \beta_8 LEV_{i,t-1} + \varepsilon_{it} \quad (3)$$

where:

$IMP\%_{it}$ Firm *i*'s reported pre-tax goodwill impairment (measured as a positive sign) for year *t*, divided by goodwill at the end of year *t-1* for impairment firms, and 0 for non-impairment firms;

$IMPAIR_{it}$ A dichotomous variable equal to 1 if firm *i* reports goodwill impairment for the fiscal year *t,* and 0 otherwise;

Proxies for Economic Factors

$EFF_{i,t-1}$ (-) Firm *i*'s relative efficiency scores for the fiscal year *t-1*;

$RET_{i,t-1}$ (-) Firm *i*'s stock returns over the fiscal year *t-1*;

Proxies for Reporting Incentives

CEO_{it} (+) A dichotomous variable equal to 1 if firm *i* has a change in CEO in the year of impairment reporting, and 0 otherwise;

$BATH_{it}$ (-) A proxy for "unexpectedly low" earnings, equal to a *decrease* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the decrease is *below* the median of *negative* values of this variable, and 0 otherwise;

$SMOOTH_{it}$ (+) A proxy for "unexpectedly high" earnings, equal to an *increase* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the increase is *above* the median of *positive* values of this variable, and 0 otherwise;

$SM\_INCREASE_{it}$ (-) A dichotomous variable equal to 1 when the difference in net income before goodwill impairment between year *t* and *t-1*,

scaled by market value of equity at the end of year *t-1*, falls in the interval [0.00, 0.02), and 0 otherwise.[36]

Control Variables

$SIZE_{i,t-1}$ (?)	Firm *i*'s log of total assets at the end of year *t-1*;
$LEV_{i,t-1}$ (?)	Total debts divided by total assets at the end of year *t-1*.

Proxies for Economic Factors

Goodwill impairment is negatively associated with a firm's historical financial performance and past stock performance (Segal 2003; Li et al. 2005; Long 2005). The relative efficiency variable is a proxy for firm overall performance, which eliminates intercorrelations and contradictions among variables resulting from the inclusion of several performance variables in the model. This variable is calculated by using the Banker-Charnes-Cooper (BCC) model to measure the performance of a firm relative to other firms within the same industry and year. According to prior research, goodwill impairment before the adoption of SFAS No. 142 shows some evidence of delayed recognition and is associated with firm past performance. Therefore, lagged relative efficiency ($EFF_{i,t-1}$) is included to examine the extent to which the relative efficiency in a year prior to goodwill impairment reporting is a determinant of goodwill impairment. $EFF_{i,t-1}$ is predicted to be negatively associated with goodwill impairment, after controlling for other confounding variables. Results finding a significant negative association between $EFF_{i,t-1}$ and goodwill impairment will, thus, support hypothesis 2. Moreover, prior research finds that firms with poor stock performance in prior periods are

[36] Market value of equity is a firm's price per share (*Compustat* item 199) multiplied by the number of shares outstanding (*Compustat* item 25) measured at the end of year *t-1*.

likely to have asset write-offs (Elliott and Shaw 1988; Francis et al. 1996; Long 2005). Therefore, this study includes lagged stock returns ($RET_{i,t-1}$) as a proxy for the stock performance over a year prior to the impairment announcement. The goodwill impairment loss is also predicted to be negatively associated with lagged stock returns.

Proxies for Reporting Incentives

Incentive factors are used to measure management incentives in making the goodwill impairment decision. Prior studies find that new management has incentives to clear the deck to improve firm future performance and blame the previous management (Strong and Meyer 1987; Segal 2003; Zang 2003; Riedl 2004). Therefore, CEO_{it} is included to capture a change in chief executive officer (CEO) in the year of goodwill impairment reporting. A positive association between goodwill impairment and the CEO turnover is expected.

Current year's earnings performance such as when earnings are *unexpectedly low* or *unexpectedly high* may also affect the goodwill impairment decision. Management is likely to record goodwill impairment when earnings are unexpectedly low under the "big bath" hypothesis (Walsh et al. 1991; Zucca and Campbell 1992). On the other hand, management tends to reduce earnings volatility, particularly in the period of unusual increases in earnings or when earnings are unexpectedly high, under the "income smoothing" hypothesis (Moses 1987; Trueman and Titman 1988). The reduction of earnings volatility when earnings are unexpectedly high may lead to an increase in goodwill impairment losses. Prior research distinguishes between these two effects on asset write-offs by including separate variables to measure *unexpectedly low* versus *unexpectedly high* earnings performance (Francis et al. 1996; Segal 2003; Riedl 2004).

Segal (2003) finds evidence supporting the big bath and smoothing hypotheses in the period before the adoption of SFAS No. 142, but only finds evidence supporting the big bath hypothesis after the adoption of this standard. Following Riedl (2004), earnings performance is considered to be poor when a decrease in net income before goodwill impairment from year *t-1* to *t*, divided by total assets at the end of *t-1*, is below the median of negative values of this variable, and 0 otherwise. Earnings performance is considered to be good when an increase in net income before goodwill impairment from year *t-1* to *t*, divided by total assets at the end of *t-1*, is above the median of positive values of this variable, and 0 otherwise. Thus, this study includes $BATH_{it}$ ($SMOOTH_{it}$) to proxy for the *unexpectedly low* (*unexpectedly high*) earnings performance. Goodwill impairment is predicted to be negatively associated with $BATH_{it}$, but positively associated with $SMOOTH_{it}$.

Studies on earnings management find that managers attempt to avoid reporting earnings decreases, small losses, and negative earnings surprises at the earnings announcement (Burgstahler and Dichev 1997; Matsumoto 2002). Burgstahler and Dichev (1997) find that the distribution of earnings shows unusually low frequencies of small decreases in earnings and small losses but unusually high frequencies of small increases in earnings and small positive profits. These findings indicate that firms manage earnings to avoid earnings decreases and losses. Following Ashbaugh et al. (2003), this study includes a measure of small earnings increases ($SM\_INCREASE_{it}$) as defined to be in the range [0.00, 0.02) to capture the small increase in earnings from the prior year deviated from the benchmark of zero. Goodwill impairment is predicted to be

negatively associated with $SM\_INCREASE_{it}$ because firms that report small earnings increases try to reduce the amount of goodwill impairment.

Control Variables

In addition to economic factors and reporting incentives, this study includes control variables to measure the size and risk of firms. $SIZE_{i,t-1}$ is a control variable to assess the extent to which large firms may experience more mergers and acquisitions than small firms and may have the different likelihood of a goodwill impairment loss. Elliott and Shaw (1988) find that write-off firms are larger in terms of revenues and assets. On the other hand, large firms may gain benefits from economies of scale and more efficient uses of resources, resulting in the lower amount of goodwill impairment. Finally, leverage ($LEV_{i,t-1}$) is a control variable to measure the risk of firms. High risk firms are likely to report the large amount of goodwill impairment. On the other hand, highly leveraged firms may try to avoid violations of debt covenants by reducing the effect from goodwill impairment losses (Zang 2003; Beatty and Weber 2006). Therefore, this study does not predict any signs for the size and leverage variables.

Using Tobit and logistic regressions, however, raises a concern of choice-based sample bias. The choice-based sample bias results when the sample of impairment firms is identified first, and then the control sample is selected from non-impairment firms, resulting in a nonrandom sample. The probability of a firm entering the sample is larger than the population probability, which causes the constant and all of the coefficients to be asymptotically biased and inconsistent. This problem occurs for most specifications of the selection probability type model such as logistic and probit models (Zmijewski 1984).

Zmijewski (1984) addresses the problem of the choice-based sample bias and suggests using a weighted exogenous sample maximum likelihood (WESML) to account for this problem. The WESML procedure provides asymptotically consistent parameter estimates and is the least complex method in comparison with other techniques, such as a conditional maximum likelihood and full information concentrated maximum likelihood (Zmijewski 1984).

The concept of WESML is to weight the log-likelihood function by the ratio of the population frequency rate to the sample frequency rate to adjust for the choice-based sample bias.[37] This study applies the WESML estimation procedure as discussed by Zmijewski (1984). Impairment and non-impairment observations collected in equal proportions are adjusted by the probability of goodwill impairment in the population. According to data available in *Compustat*, the proportion of firms reporting goodwill impairment losses is approximately 10 percent over the periods of 2003-2005 for these three selected industries.[38] Therefore, the weight of firms reporting goodwill impairment in the population is set to be 10 percent for the WESML estimation.

5.4.3.2 Predictive Ability of Relative Efficiency

Logistic Regression

Following the bankruptcy prediction model literature (Ohlson 1980; Zmijewski 1984), this study applies a logistic regression for which the dependent variable is a

[37] The WESML estimator requires that the true population proportions be known. Then, the estimator is obtained by maximizing the weighted log-likelihood (Greene 2003, p. 673).

[38] There are 226, 179, and 116 firms that report goodwill impairment from the total population of 2,367, 1,744, and 1,206 firms during the periods of 2003-2005 for the durable manufacturing, computer, and service industries, respectively.

dichotomous variable indicating whether firms report either goodwill impairment or no impairment. The logistic regression model uses an indicator of a decline in relative efficiency and other explanatory variables in the past years to determine the likelihood of a goodwill impairment decision. The logistic model is specified as follows:

$$IMPAIR_{it} = \beta_0 + \beta_1 DecEFF_{i,t-1} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{i,t-1} + \beta_4 MKBK_{i,t-1} + \beta_5 LEV_{i,t-1} + \varepsilon_i \quad (4.1)$$

where:

$IMPAIR_{it}$	A dichotomous variable equal to 1 if a firm reports a goodwill impairment in year *t*, and 0 otherwise;
$DecEFF_{i,t-1}$ (+)	A dichotomous variable equal to 1 when there is a decline in firm *i*'s relative efficiency scores from year *t-2* to *t-1*, and 0 otherwise;
$RET_{i,t-1}$ (-)	Firm *i*'s stock returns over the fiscal year *t-1*;
$CEO_{i,t-1}$ (+)	A dichotomous variable equal to 1 if firm *i* has a change in CEO in a year prior to impairment reporting (year *t-1*), and 0 otherwise;
$MKBK_{i,t-1}$ (-)	Market to book ratio at the end of year *t-1*;
$LEV_{i,t-1}$ (?)	Total debts divided by total assets at the end of year *t-1*.

Instead of using $DecEFF_{i,t-1}$ variable as shown in model (4.1), this study further includes several measurements of a decline in the relative efficiency of firms up to the past three years (i.e. $DecEFF\_Hist_{i,t-3}$, $\%ChgEFF_{i,t-1}$, $\%ChgEFF_{i,t-2}$, and $\%ChgEFF_{i,t-3}$). These variables are included because goodwill impairment losses lag behind the economic impairment of goodwill by an average of three to four years (Hayn and Hughes 2006). Therefore, the logistic models are shown as follows:

$$IMPAIR_{it} = \beta_0 + \beta_1 DecEFF\_Hist_{i,t-3} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{i,t-1} + \beta_4 MKBK_{i,t-1} + \beta_5 LEV_{i,t-1} + \varepsilon_i \quad (4.2)$$

$$IMPAIR_{it} = \beta_0 + \beta_1 \%ChgEFF_{i,t-1} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{i,t-1} + \beta_4 MKBK_{i,t-1} + \beta_5 LEV_{i,t-1} + \varepsilon_i \quad (4.3)$$

$$IMPAIR_{it} = \beta_0 + \beta_1 \%ChgEFF_{i,t-2} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{i,t-1} + \beta_4 MKBK_{i,t-1} + \beta_5 LEV_{i,t-1} + \varepsilon_i \quad (4.4)$$

$$IMPAIR_{it} = \beta_0 + \beta_1 \%ChgEFF_{i,t-3} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{i,t-1} + \beta_4 MKBK_{i,t-1} + \beta_5 LEV_{i,t-1} + \varepsilon_i \quad (4.5)$$

where variables are as defined above, and;

$DecEFF\_Hist_{i,t-3}$ (+) Number of years in which firm *i* has a decline in relative efficiency from year *t-3* to *t-1* prior to goodwill impairment recognition;

$\%ChgEFF_{i,t-1}$ (-) A percent change in relative efficiency scores from year *t-2* to *t-1*;

$\%ChgEFF_{i,t-2}$ (-) A percent change in relative efficiency scores from year *t-3* to *t-2*;

$\%ChgEFF_{i,t-3}$ (-) A percent change in relative efficiency scores from year *t-3* to *t-1*;

The explanatory variables are proxies for two main factors--economic reasons and reporting incentives. Write-off firms appear to underperform other firms in the same industry during the years prior to the write-offs announcement (Elliott and Shaw 1988; Francis et al. 1996; Long 2005). The relative efficiency and stock return variables are used to measure the past operating and stock market performance of firms. Firms with a history of low efficiency and low stock returns are more likely to report goodwill impairment losses. Therefore, a goodwill impairment decision is predicted to have a positive association with proxies for an indicator of a decline in efficiency ($DecEFF_{i,t-1}$ and $DecEFF\_Hist_{i,t-3}$), but a negative association with a percentage change in relative efficiency from the prior years ($\%ChgEFF_{i,t-1}$, $\%ChgEFF_{i,t-2}$, and $\%ChgEFF_{i,t-3}$). In addition, a goodwill impairment decision is predicted to be negatively associated with lagged stock returns ($RET_{i,t-1}$).

Regarding the reporting incentive variables, CEO turnover in a year prior to goodwill impairment announcement is more likely to increase the likelihood of an impairment decision because new management has incentives to clear the deck and blame the previous CEO (Strong and Meyer 1987; Segal 2003; Zang 2003; Riedl 2004). Therefore, a goodwill impairment decision is expected to have a positive association with

$CEO_{i,t-1}$. Market to book ratio ($MKBK_{i,t-1}$) is used to measure firm growth. Growth firms that have high market to book ratio are less likely to have goodwill impairment charges because the potential valuation effects of reporting losses or earnings declines are relatively high for these firms. Thus, a goodwill impairment decision is expected to be negatively associated with $MKBK_{i,t-1}$. Finally, highly leveraged firms are unwilling to report goodwill impairment charges so that they can avoid potential violations of debt covenants (Zang 2003; Beatty and Weber 2006). The recognition of impairment losses will reduce the book value of goodwill and increase the debt-to-equity ratio that may exceed the thresholds stipulated by debt covenants. In contrast, the variable $LEV_{i,t-1}$ is also a proxy for the economic difficulty and financial problem. Firms that have high leverage ratio are seen as high risk firms, which face an obstacle in obtaining external sources of financing. This problem can lead to the lack of sufficient funding. These firms are more likely to become less efficient, resulting in a decision to take goodwill impairment charges. Therefore, this study does not predict a sign for $LEV_{i,t-1.}$

Multivariate Discriminant Analysis (MDA)

Prior studies use MDA to develop bankruptcy prediction models (Altman 1968; Altman et al. 1977). MDA is a classification analysis that can be used to discriminate between at least two categories. However, MDA has some disadvantages in that it requires the variance-covariance matrices of the predictors to be identical and normally distributed for both groups (Ohlson 1980). Nonetheless, Ohlson (1980) notes that a violation of these assumptions is unimportant if the only objective of the model is to develop a discriminating device. Moreover, Kuruppu et al. (2003) note that MDA provides better accuracy in predicting company liquidation than a logit model developed

from the same data. Therefore, this study uses MDA to distinguish between impairment and non-impairment firms and applies similar variables in the logistic regression models (4.1) to (4.5) to MDA.

This study estimates the probability of correct classification by using resubstitution and cross-validation methods. The first method applies a discriminant rule to the data used to develop the rule so the probabilities of correct classification are overestimated. The second method also known as Lachenbruch or jackknifing procedure removes one observation from the data set, develops discriminant rule based on the remaining data, and applies it to the observation not used in developing the model. This procedure is repeated for each observation to evaluate the model accuracy. The cross-validation method provides unbiased estimates for the true probabilities of classification (Johnson 1998, p. 220-221).

5.5 EMPIRICAL RESULTS

5.5.1 Descriptive Statistics

Table 5.1 reports descriptive statistics for the goodwill impairment sample. These data are hand-collected from firms'10K filings to provide further insight into the properties of impairment firms. Panel A of Table 5.1 shows a description of circumstances leading to goodwill impairment. A decline in the operating performance of firms, changes in strategies, and reorganization are primary reasons for recognizing goodwill impairment. These circumstances represent 46.9 percent of the total impairment samples. Other possible circumstances are an economy downturn (4.7 percent), a decline in stock prices (2.6 percent), an adverse change in legal action (1.0

percent), an unanticipated competition (0.5 percent), and a loss of key personnel (4.7 percent). Approximately 16 percent of the impairment firms disclose a combination of reasons leading to goodwill impairment recognition. However, 23.4 percent of the impairment firms do not provide any rationale for goodwill impairment charges.

Panel B of Table 5.1 provides methods of determining the fair value of a reporting unit. Approximately 59 percent of the impairment firms use a present value of future cash flows when determining the fair value of reporting units, suggesting that impairment firms need to make assumptions and estimations based on past and current performance. Other fair value techniques include market capitalization (3.6 percent), multiples of earnings (1.6 percent), and a combination of fair value methods (25 percent). Panel C of Table 5.1 reports the quarterly distribution of goodwill impairment. The majority of goodwill impairment losses are reported in the fourth quarter, consistent with prior research (e.g. Elliott and Shaw 1988). The proportion of firms reporting goodwill impairment in the fourth quarter represents approximately 64 percent of the total impairment firms. Finally, Panel D of Table 5.1 shows that the majority of impairment firms (72.9 percent) have multiple reportable segments, suggesting that impairment firms are likely to have more complex organizational structures.

Table 5.2 contains descriptive statistics for the determinants of goodwill impairment classified by impairment and non-impairment samples. Consistent with prior research, goodwill impairment firms exhibit poorer financial performance when compared to non-impairment firms. The mean of $EFF_{i,t-1}$ for impairment firms is 0.93 as opposed to 0.97 for non-impairment firms, and the difference is statistically significant (t-statistic of 3.89). Impairment firms also have a significantly lower mean of $RET_{i,t-1}$ than

non-impairment firms (t-statistic of 3.08). The median differences also indicate that impairment firms have lower financial and stock market performances than non-impairment firms (z-statistics of 3.48 and 4.28).

Regarding variables related to managerial reporting incentives, the mean and median differences as reported by t-statistics and z-statistics show that impairment firms have significantly higher rates of CEO turnover (t-statistic of 3.83, z-statistic of 3.76), more unexpected low earnings ($BATH_{it}$) (t-statistic of 2.42, z-statistic of 3.15), and lower small earnings increases ($SM\_INCREASE_{it}$) (t-statistic of 3.56, z-statistic of 3.51). These results indicate that firms are more likely to report goodwill impairment when they have a change in CEO or encounter an unexpected low performance. On the contrary, firms are less likely to report goodwill impairment when they experience small earnings increases.

Regarding the control variables, impairment and non-impairment firms are not significantly different in size because they are matched by size and industry. However, impairment firms have higher leverage ($LEV_{i,t-1}$) than non-impairment firms. The mean difference is statistically significant at the 5 percent level (t-statistic of 2.01), but there is no difference in median. The amount of goodwill, on average, represents 23 percent of total assets, which is significantly greater than the amount of goodwill to total assets for non-impairment firms (t-statistic of 1.95). Finally, for the impairment firms, the amount of goodwill impairment loss, on average, represents 66 percent of goodwill and 16 percent of total assets.

Table 5.3 reports descriptive statistics for the variables used to distinguish between impairment and non-impairment firms for the predictive ability analysis. The results show that impairment firms are likely to have a more decline in relative efficiency

from year *t-2* to *t-1* ($DecEFF_{i,t-1}$) (t-statistic of 2.63, z-statistic of 2.60), a longer history of goodwill impairment from year *t-3* to *t-1* ($DecEFF\_Hist_{i,t-3}$) (t-statistic of 2.81, z-statistic of 1.94), and a lower percent change in relative efficiency from year *t-3* to *t-1* ($\%ChgEFF_{i,t-3}$) (t-statistic of 2.53, z-statistic of 3.59) than non-impairment firms. Both mean and median differences of these variables are statistically significant at least at the 10 percent level. However, descriptive statistics show only differences in the median of variables used to measure a percent change in relative efficiency from year *t-2* to *t-1* ($\%ChgEFF_{i,t-1}$) and from year *t-3* to *t-2* ($\%ChgEFF_{i,t-2}$).

Regarding other explanatory variables, impairment firms have lower stock returns ($RET_{i,t-1}$) (t-statistic of 2.96, z-statistic of 3.91) and higher rate of CEO turnover in the year prior to goodwill impairment recognition ($CEO_{i,t-1}$) (t-statistic of 2.91, z-statistic of 2.87). Impairment firms also have higher leverage ($LEV_{i,t-1}$) than non-impairment firms, but only the mean difference is statistically significant (t-statistic of 2.11). Moreover, impairment firms have lower market to book ratio ($MKBK_{i,t-1}$) than non-impairment firms, but only the median difference is statistically significant (z-statistic of 4.28).

Table 5.4 presents Pearson correlations for the determinants of goodwill impairment. Table 5.5 reports Pearson correlations for variables used in the predictive ability analysis. The results from both tables indicate that proxies for the relative efficiency ($EFF_{i,t-1}$, $DecEFF_{i,t-1}$, $DecEFF\_Hist_{i,t-3}$, $\%ChgEFF_{i,t-1}$, $\%ChgEFF_{i,t-2}$, and $\%ChgEFF_{i,t-3}$) are not highly correlated with other variables. However, Table 5.5 shows that these relative efficiency variables are highly correlated with one another. The largest correlation coefficient is 0.80 (p-value < 0.0001), which measures the correlation between $DecEFF_{i,t-1}$ and $DecEFF\_Hist_{i,t-3}$. Therefore, the relative efficiency variables are

separately included in the model to prevent multicollinearity problem.[39] Except for a high correlation between the relative efficiency variables, the correlation coefficients between any other two variables are lower than 0.35 in absolute values, so no other variables are highly correlated with each other.

5.5.2 Determinants of Goodwill Impairment

Table 5.6 presents the main results of a Tobit regression used to examine determinants of the percentage of goodwill impairment and a logistic regression used to examine the likelihood of a decision to recognize goodwill impairment. The first analysis shown in this table is a Tobit regression. This study examines if the estimation results have a heteroskedasticity problem by estimating the model that allows for heteroskedasticity and the model that assumes no heteroskedasticity. The likelihood ratio test for the null hypothesis that the model is homeskedastic is rejected at the 1 percent significant level, suggesting a presence of heteroskedasticity. Therefore, the estimated Tobit regression that accounted for heteroskedasticity is used for the analysis.

Results in Table 5.6 show that $EFF_{i,t-1}$ is significantly negative, as predicted (t-statistic of -4.07), indicating that firms having low lagged efficiency relative to other firms in the same industry are likely to report a higher amount of goodwill impairment. This finding strongly supports hypothesis 2. The results also show a significantly negative association between $RET_{i,t-1}$ and the percentage of goodwill impairment (t-statistic of -1.91), suggesting that firms with low past stock performance are likely to report a higher percentage of goodwill impairment.

[39] Correlation coefficients that higher than 0.8 in absolute values may indicate multicollinearity problem (Kennnedy 1998, p. 187).

For the reporting incentive variables, CEO_{it} is significantly positive (t-statistic of 2.80) and $SM\_INCREASE_{it}$ is significantly negative, as predicted (t-statistic of -1.79). These results indicate that firms having a change in CEO are more likely to report a higher amount of goodwill impairment, while firms with small earnings increases try to reduce the amount of goodwill impairment losses to avoid earnings decreases and losses. However, $BATH_{it}$ and $SMOOTH_{it}$ are not significantly associated with the percentage of goodwill impairment.

Regarding the control variables, results show that $SIZE_{it}$ is not statistically significant because impairment and non-impairment firms are matched by size. However, results show that $LEV_{i,t-1}$ is significantly positive (t-statistic of 1.79). Thus, firms having higher leverage are more likely to report larger amount of goodwill impairment losses, suggesting that high risk firms face economic difficulty and are more prone to a decline in firm performance.

In addition, the relative efficiency variable measured in the same period of goodwill impairment reporting (EFF_t) is further included in the Tobit regression to check whether the lagged relative efficiency variable remains significant. The results (untabulated) are qualitatively similar to the results from the original Tobit model. The coefficient of $EFF_{i,t-1}$ is -2.19 and significantly associated with the percentage of goodwill impairment (t-statistic of -2.37). However, the variable EFF_t is not statistically significant. The results suggest that the lagged relative efficiency measure has more explanatory power and outperforms the current relative efficiency measure. Thus, the past performance of firms is an important determinant of goodwill impairment.

The second analysis, which follows the Tobit regression, is a logistic regression. The logistic regression used to examine the likelihood of a goodwill impairment decision provides similar results to those discussed in the Tobit analysis. Table 5.6 reports the coefficient estimates, marginal effects, and z-statistics of each variable. The psudo R square is 11 percent and the likelihood ratio chi-square is significant at the 1 percent level, indicating that the model is valid.[40] Consistent with results of the Tobit regression, the variable $EFF_{i,t-1}$ has a significantly negative association with the likelihood of a goodwill impairment decision (z-statistic of -3.48). The marginal effect on $EFF_{i,t-1}$ indicates that having a reduction of the relative efficiency score in year *t-1* increases the likelihood of recognizing goodwill impairment losses by 1.23 times. These findings strongly support the hypothesis that low lagged relative efficiency is an important indicator used in decisions to take goodwill impairment charges. A difference between the results of Tobit and logistic analyses is that the proxy for $BATH_{it}$ becomes significantly negative (t-statistic of -1.89) in the logistic analysis.

The last column reports results of the WESML coefficients for the logistic regression. The WESML procedure is used to adjust for the choice-based sample bias as discussed by Zmijewski (1984). Although the WESML procedure provides consistent estimators, they are less efficient (Maddala 1991). The results of WESML estimation are qualitatively similar to the results of logistic regression. Most importantly, the variable $EFF_{i,t-1}$ remains significantly negative, as predicted (t-statistic of -2.63), suggesting that

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40 This study examines if the estimation results of the logistic regression have heteroskedasticity problem by estimating the model that allows for heteroskedasticity and the model that assumes no heteroskedasticity. The likelihood ratio test for the null hypothesis that the model is homeskedastic is not rejected at the 1 percent significant level. Therefore, the heteroskedaticity is not an issue in the logistic analysis.

the negative association between $EFF_{i,t-1}$ and the likelihood of goodwill impairment recognition holds after adjusting for the choice-based sample bias. The only difference from the results of logistic regression is that the coefficient of $LEV_{i,t-1}$ becomes insignificant in the WESML estimation.

To eliminate the effects of extreme observations, this study also winsorizes the top and bottom 1 percentile of continuous variables and reexamines the Tobit and logistic regressions. Results (untabulated) provide similar inferences to the main results without winsorization. The percentage of goodwill impairment loss and the likelihood of goodwill impairment recognition remain negatively associated with lagged relative efficiency.

Finally, other measure of firm performance is included in the Tobit and logistic regressions to compare with the relative efficiency measure. Because prior studies (Elliott and Shaw 1988; Francis et al. 1996; Rees et al. 1996) use return on assets (ROA) to assess firm performance, this study includes ROA in the models as another performance measure. The ROA variable is calculated in the same year of goodwill impairment reporting.[41] The results of Tobit regression (untabulated) indicate that both coefficients of ROA (-0.48) and lagged relative efficiency (-2.18) are negatively significant (t-statistics of -5.93 and -4.19), but the coefficient of lagged relative efficiency is larger in magnitude. Instead of using current year ROA, this study includes lagged ROA in the model. The results show that lagged ROA becomes insignificant, but lagged relative efficiency remains negatively significant (t-statistic of -3.78). The logistic regression also provides similar inferences as the Tobit regression. These findings

[41] Return on assets is an operating income after depreciation (*Compustat* item 178) divided by total assets (*Compustat* item 6) measured at the end of year *t*.

suggest that lagged relative efficiency is a better measure of firm performance than ROA and should be used to determine potential goodwill impairment.

Overall, Tobit regression, logistic regression, and WESML estimation provide similar results, supporting the hypothesis that firms having low lagged efficiency relative to other firms in the same industry are more likely to record goodwill impairment and report a higher amount of goodwill impairment. These results remain consistent after controlling for managerial reporting incentives and other confounding variables.

5.5.3 Predictive Ability of Relative Efficiency

This section uses a logistic regression and a discriminant analysis to assess the possibility of including several relative efficiency measures and other controlling variables in years prior to goodwill impairment recognition to identify potential goodwill impairment. Table 5.7 reports results of the logistic regression. An indicator of a decline in relative efficiency from year *t-2* to *t-1* ($DecEFF_{i,t-1}$) is included in model (4.1) and the number of years in which firms report a decline in relative efficiency from year *t-3* to *t-1* ($DecEFF\_Hist_{i,t-3}$) is included in model (4.2). Results show that the likelihood of goodwill impairment in year *t* is positively associated with $DecEFF_{i,t-1}$ and $DecEFF\_Hist_{i,t-3}$ (Wald Chi-squares of 4.45 and 4.36, respectively). This study also includes measures of a percent change in relative efficiency from year *t-2* to *t-1* ($\%ChgEFF_{i,t-1}$), from year *t-3* to *t-2*, ($\%ChgEFF_{i,t-2}$), and from year *t-3* to *t-1* ($\%ChgEFF_{i,t-3}$) in models (4.3), (4.4), and (4.5), respectively. The results show that $\%ChgEFF_{i,t-2}$ and $\%ChgEFF_{i,t-3}$ are negatively significant (Wald Chi-squares of 2.16 and 4.14). However, $\%ChgEFF_{i,t-1}$ is not statistically significant. The coefficient of

$\%ChgEFF_{i,t-3}$ has the largest magnitude compared to efficiency measures in other models, suggesting that model (4.5) provides the best performance indicator for goodwill impairment.

For all models, the likelihood of goodwill impairment in year t is negatively associated with $RET_{i,t-1}$, but positively associated with $CEO_{i,t-1}$ and $LEV_{i,t-1}$. These findings suggest that the likelihood of a goodwill impairment decision increases when firms have lower past stock returns, higher CEO turnover in the year prior to goodwill impairment reporting, and higher leverage. In summary, the findings suggest that these variables ($DecEFF_{i,t-1}$, $DecEFF\_Hist_{i,t-3}$, $\%ChgEFF_{i,t-2}$, and $\%ChgEFF_{i,t-3}$) can be used to determine potential goodwill impairment.

Table 5.8 presents the results of the discriminant analysis using the same variables that are specified for the logistic regression to assess the predictive ability of the relative efficiency measures. This study uses resubstitution and cross-validation methods to assess classification accuracy. In Panel A of Table 5.8, using the resubstitution method, this study finds that non-impairment firms are correctly classified 73.02 percent of the time, while impairment firms are correctly classified 53.97 percent of the time. Using the cross-validation method, the classification accuracy of non-impairment firms is 72.22 percent, whereas the classification accuracy of impairment firms is 53.17 percent, which is slightly lower than the results of resubstitution method. The total classification error is 37.30 percent. In general, the cross-validation method provides unbiased estimates (Johnson 1998), so it should be used to assess classification accuracy. In Panel B of Table 5.8, instead of using the $DecEFF_{i,t-1}$ variable, this study includes $DecEFF\_Hist_{i,t-3}$, which measures the number of years in which a firm has a decline in efficiency from year

t-3 to *t-1*. The discriminant analysis shows the total classification error of 41.67 percent, which is slightly higher than the total error in Panel A.

In Panels C, D, and E of Table 5.8, this study adds information about a percent change in relative efficiency from year *t-2* to *t-1* ($\%ChgEFF_{i,t-1}$), from year *t-3* to *t-2* ($\%ChgEFF_{i,t-2}$), and from year *t-3* to *t-1* ($\%ChgEFF_{i,t-3}$) in the analysis instead of using an indicator variable of a decline in efficiency, or a history of a decline in efficiency. In Panel E, the MDA model that includes the variable $\%ChgEFF_{i,t-3}$ produces better results than the models that include the variables $\%ChgEFF_{i,t-1}$ and $\%ChgEFF_{i,t-2}$ in Panels C and D. The model in Panel E correctly predicts 53.17 percent of the actual impairment and 76.19 percent of the actual non-impairment. In addition, the total classification error reduces to 35.32 percent, which is the lowest error rate compared to other models from Panels A to D. Finally, in Panel F of Table 5.8, the results of the discriminant analysis excluding the measure of relative efficiency show that the model correctly predicts only 43.65 percent of the actual impairment, which is the lowest classification accuracy. The total classification error is 39.29 percent.

In conclusion, the model including the variable $\%ChgEFF_{i,t-3}$ provides the best result for classification accuracy. The linear discriminant function of this model is as follows:

$$Z = -0.21 - 1.66\%ChgEFF_{i,t-3} - 0.18RET_{i,t-1} + 1.17CEO_{i,t-1} - 0.001MKBK_{i,t-1} + 0.81LEV_{i,t-1} \quad (5)$$

where other variables are as defined above; and Z is an overall index. If Z is greater than zero, a firm will be classified as an impairment firm; otherwise it will be classified as a non-impairment firm.

Overall, the results of this study suggest that a decline in relative efficiency at the firm level can be used to determine future goodwill impairment. Moreover, adding information about a percent change in relative efficiency from year *t-3* to *t-1* helps to improve classification accuracy.

5.6 SENSITIVITY ANALYSIS

This section provides sensitivity analyses to check the robustness of research results. The sensitivity analyses are performed by examining whether the results are sensitive to the choices of different input/output variables in the DEA model. Moreover, this study applies a conditional logistic regression to the matched sample, and includes one reportable segment in the model as a control variable.

5.6.1 Choices of Input/Output Variables

A concern has been raised as to whether the results remain consistent if the choices of input/output variables in the DEA model are different. Therefore, this study reruns the Tobit regression, logistic regression, and WESML estimation on two additional DEA models. Table 5.9, Panel A reports results of the DEA model having four input variables (operating expenses; current assets; fixed assets; intangible assets) and a single output variable (sales), while Panel B presents results of the DEA model having two input variables (operating expenses; total assets) and three output variables (sales; operating cash flows; income before extraordinary items). These two DEA models produce results that are qualitatively similar to the findings presented in Table 5.6. Most importantly, the percentage of goodwill impairment losses and the likelihood

of a goodwill impairment decision remain negatively associated with the lagged relative efficiency, after controlling for other reporting incentive and control variables.

5.6.2 Conditional Logistic Regression

The second sensitivity analysis is performed to take into account matching variables' effects because this study selects the control sample by matching on size and the same two-digit SIC code. A conditional logistic regression, which provides consistent estimates, is used to analyze the pair-wise differenced data between the sample and matched control. The conditional logistic regression is a no-intercept logit regression of pair-wise differences in the dependent variable upon pair-wise differences of the independent variables (Cram et al. 2007).[42]

Table 5.10 contains results of the conditional logistic regression applying on three different DEA models.[43] Findings in Table 5.10 are qualitatively similar to the main results of the logistic regression presented in Table 5.6. The likelihood of goodwill impairment recognition is negatively associated with lagged relative efficiency, indicating that impairment firms have poor past performance and low efficiency. In addition, the likelihood of goodwill impairment recognition is positively associated with CEO_{it} and $LEV_{i,t-1}$, but it is negatively associated with $RET_{i,t-1}$, $BATH_{it}$, and $SM\_INCREASE_{it}$, consistent with the main results. Only difference from the results of

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42 Another method to account for the matching variables' effects is a logit analysis of pooled, non-differenced data that includes a dummy variable for each pairing without an overall intercept (Cram et al. 2007).

43 *DEA model 1* has five inputs (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; intangible assets) and a single output (sales). *DEA model 2* has four inputs (operating expenses; current assets; fixed assets; and intangible assets) and a single output (sales). *DEA model 3* has two inputs (operating expenses; total assets) and three outputs (sales; operating cash flows; income before extraordinary items).

the logistic regression is that the proxy for $SIZE_{it}$ becomes negatively significant in the conditional logistic regression. These findings suggest that small firms are likely to recognize higher goodwill impairment losses because they are less likely to achieve economies of scale, as opposed to large firms. The statistically significance in size suggests that impairment and non-impairment firms are not perfectly matched by size and the differences are revealed when using the conditional logistic analysis. Overall, the results are robust across various DEA models.

5.6.3 Control for Reportable Segment

The third sensitivity analysis is undertaken to control for a reportable segment. This study measures relative efficiency at the firm level, while the FASB requires that goodwill impairment is assessed at the reporting unit level. Thus, there is a concern that managers of firms with multiple reporting units can exercise their discretion on goodwill allocation. Managers can offset poor performance of one reporting unit with good performance of another reporting unit, leading to no goodwill impairment recognition. On the other hand, managers do not manipulate performance of reporting units, but appropriately report goodwill impairment losses when there is a deterioration of firm performance. In general, firms with complex organizational structures and operations are likely to have multiple reporting units. These firms need to put greater effort to achieve the optimal resource allocation and coordination among various units. Therefore, firms that have multiple reporting units are more likely to report goodwill impairment losses when their operations are inefficient.

The number of reporting units is typically not disclosed in financial statements. However, Beatty and Weber (2006) argue that single-segment firms tend to have one reporting unit. They include a dichotomous variable to proxy for one reporting unit. This variable equals to 1 for single-segment firms and 0 for multiple segment firms. Following Beatty and Weber (2006), this study includes the variable $OneSEG_{it}$ to control for firms that have one reportable segment and reruns the Tobit regression, logistic regression, and WESML estimation. Descriptive statistics (not tabulated) show that impairment firms are more likely to have multiple reportable segments, whereas non-impairment firms are more likely to have a single reportable segment. The mean of $OneSEG_{it}$ for impairment firms is 0.27 compared to 0.52 for non-impairment firms and the difference is statistically significant at the 1 percent level (t-statistic of 5.17).

Table 5.11 presents results of the Tobit regression, logistic regression, and WESML estimation including a control variable for one segment. The results in Table 5.11 are qualitatively similar to those findings shown in Table 5.6, after including a control variable for one reportable segment. The percentage of goodwill impairment and the likelihood of goodwill impairment recognition are negatively associated with the variable $OneSEG_{it}$, consistent with the results in Beatty and Weber (2006). These findings indicate that firms having one reportable segment are less likely to recognize goodwill impairment losses than firms having multiple segments. The results run counter to the argument that firms with multiple reportable segments try to hide their poor performance from one segment with good performance from other segments.

5.7 CONCLUSION

This study examines the role of the relative efficiency of firms in determining the percentage of goodwill impairment and the decision to recognize goodwill impairment charges in the years subsequent to the adoption of SFAS No. 142. This study applies DEA technique to estimate a firm's relative efficiency. Relative efficiency is a measure of a firm's overall performance, the underlying economics for goodwill impairment decision. The results show that firms having low lagged relative efficiency are more likely to have goodwill impairment charges and report higher amount of goodwill impairment losses, after controlling for managerial reporting incentives and other confounding variables. The results suggest that relative efficiency is an important determinant of goodwill impairment. The inferences are robust to the choice of various input/output variables in the DEA model. Moreover, the findings are consistent after applying a conditional logistic regression to account for the matched sample design and after controlling for a reportable segment.

This study also assesses the ability of including several proxies for a decline in relative efficiency in the past years to determine the likelihood of a goodwill impairment decision. Moreover, a discriminant analysis is used to distinguish between impairment and non-impairment firms. Results of logistic regressions show that an indicator variable of a decline in relative efficiency and a history of goodwill impairment reporting are positively associated with the likelihood of goodwill impairment in year *t*. Moreover, the variables measured a percent change in relative efficiency from year *t-3* to *t-2* and from year *t-3* to *t-1* are negatively associated with the likelihood of goodwill impairment in year *t*. The results suggest that these variables can be used to determine potential

goodwill impairment. Applying similar variables to the discriminant analysis, the model correctly predicts more than 50 percent of the actual impairment with the best total error rate of 35.32 percent. These findings provide opportunity for future research to include the measure of a firm's overall performance in the prediction model of goodwill impairment.

CHAPTER 6

SUMMARY

This study examines the implementation of SFAS No. 142 after the initial adoption period to assess whether the standard achieves its objective to improve the quality of financial reporting. The FASB expects that financial statements of firms that acquire goodwill and other intangible assets will better reflect the underlying economics of those assets (SFAS No. 142, Summary). This study takes advantages of Data Envelopment Analysis (DEA) to measure firm performance and efficiency, the underlying economic determinant of goodwill impairment. The DEA aggregates several financial measures into a meaningful measure of overall performance. This method reduces intercorrelations and contradictions among variables that occur from including multiple variables in the model.

First, this study examines the usefulness of goodwill impairment under SFAS No. 142 by assessing whether the impairment loss signals a decline in relative efficiency, rather than applying the market-based study. The results of the cross-sectional analysis strongly support the hypothesis that impairment firms are relatively less efficient than non-impairment firms in the year of goodwill impairment recognition. These findings are robust across different DEA models. The results of the longitudinal analysis show a significantly increase in relative efficiency from year *t* to *t+1* for firms that have goodwill impairment in this year, but no impairment in the next year. However, evidence of the

longitudinal analysis partially supports a decline in relative efficiency from year *t* to *t+1* for firms that do not have goodwill impairment in this year, but have impairment in the next year. The plausible explanation is that managers are able to manipulate performance of their firms over time, but they are unable to manage performance of other comparable firms. Therefore, the cross-sectional analysis provides stronger evidence to support the hypothesis than the longitudinal analysis. Overall, the results indicate that goodwill impairment under SFAS No. 142 can reflect the decline in a firm's relative efficiency as compared to other firms in the same industry.

Second, this study examines the role of relative efficiency of firms in determining the percentage of goodwill impairment and the decision to recognize goodwill impairment. The results indicate that firms having low lagged relative efficiency are more likely to recognize goodwill impairment charges and report higher amount of goodwill impairment losses, after controlling for managerial reporting incentives. These findings are consistent among the choices of various input/output variables in the DEA model, after applying a conditional logistic regression to account for the matched sample design, and after controlling for a reportable segment. In addition, a decline in relative efficiency in the past years can be used to determine potential goodwill impairment and discriminate between impairment and non-impairment firms.

The results of this study extend the literature on value relevance (e.g. Hirschey and Richardson 2002, 2003; Segal 2003; Li et al. 2005) by providing evidence on the underlying economics for the association between goodwill impairment and stock prices. This study also contributes to the literature on asset write-downs (e.g. Segal 2003; Beatty and Weber 2006; Guler 2006) by including a firm's relative efficiency as one of the

determinants for goodwill impairment. This study provides evidence on the implication of SFAS No. 142 after the initial adoption period. Although prior studies conclude that reporting incentives and economic conditions are major factors for goodwill impairment, this study provides evidence that goodwill impairment under SFAS No. 142 can reflect the underlying economics of goodwill, thereby achieving the objective of this standard. The relation between goodwill impairment and a firm's relative efficiency helps financial statement users to understand the underlying economics for goodwill impairment. The results also provide an avenue for future research to incorporate an overall measure of firm performance in the goodwill impairment prediction model.

However, the analysis is subject to some limitations. First, the study assesses the relative efficiency of firms based solely on financial performance measures that may lack a comprehensive view of the overall measure of firm efficiency. Non-financial measures (e.g. quality of services, new product success rate, and customer satisfaction rate) are also important measures of firm efficiency. Thus, including non-financial performance measures as proxies for the relative efficiency of firms will be beneficial to future research. Another limitation is that although the FASB requires the goodwill impairment test to be performed at the reporting unit level, all variables in the study are measured at the firm level because reporting unit performance data are unavailable. Consequently, the performance of a firm as a whole can be different from the performance of a reporting unit that reports goodwill impairment. Therefore, including the measure of relative efficiency at the reporting unit level will be fruitful for future research and provide a better perspective on this analysis.

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APPENDIXES

APPENDIX A

ACCOUNTING FOR GOODWILL IMPAIRMENT UNDER SFAS NO. 142

This section provides discussions and an example of the accounting for goodwill impairment. For the purpose of testing goodwill for impairment, *acquired assets and assumed liabilities* will be assigned to a reporting unit as of the acquisition date if both of the following criteria are met: (1) the asset or liability relate to the operations of a reporting unit; and (2) the asset or liability will be considered in determining the fair value of a reporting unit (SFAS No. 142, par. 32). *Goodwill* acquired in a business combination will also be assigned to one or more reporting units as of the acquisition date. The amount of goodwill assigned to reporting units is based on the expected benefits obtained from synergies resulting from business combinations although other assets or liabilities of the acquired entity may not be allocated to that reporting unit (SFAS No. 142, par. 34).

The accounting for goodwill impairment under SFAS No. 142 is illustrated in the following example. Assume that a company has two reporting units (Unit A and B). The values of the identifiable net assets (acquired assets and assumed liabilities), the amount of goodwill, and the fair value of reporting units recorded at the date of impairment test are presented as follows:

	Reporting Unit A	*Reporting Unit B*
Identifiable net assets:		
Current assets	50	250
Long-lived assets	200	350
Less Liabilities	(100)	(400)
	150	200
Goodwill	200	400
Carrying value of reporting unit	350	600
FV of reporting unit	250	450

The goodwill impairment test is performed at the reporting unit level under a two-step process. The first step is to identify potential impairment by comparing the fair value of a reporting unit with the carrying value of a reporting unit, including goodwill. The second step is to measure the amount of impairment loss by comparing the implied fair value of reporting unit goodwill with the carrying amount of that goodwill. The *implied fair value of goodwill* is calculated by allocating the fair value of a reporting unit to all assets and liabilities of that unit (including any unrecognized intangible assets), as if the reporting unit had been acquired in a business combination. The excess of the fair value of a reporting unit over the amount assigned to its assets and liabilities is the implied fair value of goodwill (SFAS No. 142. par. 21). The example of the two-step goodwill impairment process is shown as follows:

	Reporting Unit A	*Reporting Unit B*
Two-Step Process		
Step 1: To identify potential impairment		
FV of reporting unit	250	450
Carrying value of reporting unit (BV)	350	600
FV < Carrying value of reporting unit	(100)	(150)
Step 2: To measure the amount of impairment loss		
FV of reporting unit	250	450
Assign to: FV of current assets	(50)	(250)
FV of long-lived assets	(200)	(430)
FV of liabilities	120	400
Implied FV of goodwill	120	170
Carrying value of goodwill	200	400
Goodwill impairment loss	80 (200-120=80)	230 (400-170=230)

In this example, the fair values of reporting units A and B are below the carrying values of reporting units in the first step; therefore, the second step is required. After allocating the fair values of each reporting unit to all of the assets and liabilities in that reporting unit, this company has the implied fair value of goodwill less than the carrying amount of goodwill. Therefore, goodwill impairment loss is recognized as the total amount of $310. The amount of impairment loss is the difference between the carrying amount of goodwill and the implied fair value of goodwill.

SFAS No. 142 and SFAS No. 144 Comparison

This section compares SFAS No. 142 with SFAS No. 144 regarding the criteria of *when* to test and *how* to measure the impairment loss. SFAS No. 144, superseded SFAS No. 121, and addresses the accounting for long-lived assets to be held and used, to be

disposed of other than by sale, and to be disposed of by sale. SFAS No. 144 requires long-lived asset (asset group) to be tested for recoverability whenever events or changes in circumstances indicate that its carrying amount may not be recoverable.[44] The following table compares the examples of circumstances that indicate potential goodwill impairment under SFAS No. 142 as opposed to circumstances that indicate the potential long-lived asset impairment under SFAS No. 144.

SFAS No. 142 (SFAS No. 142, par 28)	**SFAS No. 144** (SFAS No. 144, par 8)
1. Significant adverse change in legal factors or in the business climate 2. Adverse action or assessment by a regulator 3. Reporting unit is more likely to be sold or disposed of 4. Unanticipated competition 5. Loss of key personnel 6. Testing for recoverability under SFAS 121 (SFAS 144 now) of a significant asset group within a reporting unit 7. Recognition of goodwill impairment loss of a subsidiary that is a component of a reporting unit	1. Significant adverse change in legal factors or in the business climate 2. Adverse action or assessment by a regulator 3. Long-lived asset is more likely to be sold or disposed of 4. Decrease in market price of a long-lived asset 5. Adverse change in the extent in which a long-lived asset is being used or in physical condition 6. Accumulation of costs in excess of the amount originally expected for the acquisition or construction 7. Current-period operating or cash flow loss, a history of operating or cash flow losses, or a forecast of continuing losses

The first three events that trigger goodwill impairment test under SFAS No. 142 are similar to events indicating that the carrying amount of long-lived assets may not be recoverable under SFAS No. 144. More importantly, the test for recoverability under

44 If a long-lived asset (or assets) is part of a group that includes other assets and liabilities, the unit of accounting for the long-lived asset is its group. An *asset group* represents the lowest level for which identifiable cash flows are largely independent of the cash flows of other groups of assets and liabilities (SFAS 144, par 4).

SFAS No. 144 is one of the circumstances that require goodwill to be tested for impairment. Therefore, firms that have long-lived asset impairment may report goodwill impairment during the same period.

Unlike the two-step process of goodwill impairment test in SFAS No. 142, SFAS No. 144 requires that an impairment loss will be recognized only if the carrying amount of a long-lived asset is *not recoverable* and *exceeds its fair value*. The recoverability test is an additional step, which requires assessing the sum of *undiscounted* cash flows as a threshold for the impairment test. If the carrying amount of a long-lived asset exceeds the sum of the undiscounted cash flows from the asset, the carrying amount of a long-lived asset will not be recoverable. Then, an impairment loss is measured as the difference between the carrying amount of a long-lived asset and its fair value (SFAS No. 144, par7). The recoverability test offers a possibility to avoid achieving the threshold for long-lived asset impairment test when the carrying amount of a long-lived asset is greater than its fair value, but still lower than the sum of the undiscounted cash flows.

On the other hand, SFAS No. 142 applies *present values* techniques to measure fair value of reporting unit; therefore, firms are less likely to avoid achieving the threshold for goodwill impairment test. Although a firm with a decline in the fair value of long-lived assets is able to avoid recording fixed asset impairment, the fair value of a reporting unit is more likely to decrease due to a reduction in benefits from these assets, resulting in goodwill impairment recognition. Therefore, goodwill impairment loss provides an overall picture of a decrease in the fair value of a reporting unit, which reflects a deterioration of the fair value other assets in the reporting unit as well.

When a reporting unit (or a portion of reporting unit that constitutes a business) is to be disposed of in its entirely, goodwill of that reporting unit should be included in the carrying amount of the reporting unit when determines the gain or loss on disposal. The amount of goodwill in the carrying amount of unit to be disposed of should be based on the relative fair values of the business to be disposed of and the portion of the reporting unit that will be retained (SFAS No. 142, par. 39).

APPENDIX B

GOODWILL IMPAIRMENT DISCLOSURES

The objective of this section is to obtain additional disclosures of possible circumstances leading to goodwill impairment. There is a concern that the relationship between goodwill impairment losses and firms' relative efficiency will not hold when the major component of goodwill is the residual goodwill, which becomes impaired. The FASB noted that going-concern and synergy components of goodwill are conceptually part of goodwill, whereas residual component of goodwill is not conceptually part of goodwill. Residual goodwill represents a measurement error in valuing the acquired entity, or an overpayment (e.g. if the price is driven up in the course of bidding) or underpayment (e.g. a distress sale or fire sale) by the acquiring entity (SFAS No. 141, Appendix B, par. B102, B105).

To identify reasons for goodwill impairment loss, firms' 10K and 10Q filings are reviewed to obtain additional goodwill impairment disclosures from notes to financial statement. The impairment observation and the matched control sample will be eliminated from the final sample if there are disclosures indicate that an overpayment is a circumstance leading to goodwill impairment recognition. This method is appropriate since SFAS No. 142 requires impairment firms to disclose a description of the facts and circumstances leading to the impairment in the notes to the financial statements (SFAS

No. 142, par. 47). The examples of disclosures regarding goodwill impairment loss are shown as follows:

Excerpt from Intermet Corporation – 2003 Annual Report

*"…**Due to the erosion of the profitability of the Light Metals reporting unit, and the revision of our forecast as a result of the changing market conditions, our estimated discounted cash flows from the Light Metals reporting unit decreased significantly as compared to our impairment tests performed in 2002.** Based on the first step analysis, we determined that the carrying value of the Light Metals reporting unit was in excess of its fair value as of November 30, 2003. Accordingly, we were required to perform the second step analysis on the Light Metals reporting unit to determine the amount of the impairment. The second step analysis indicated that the pre-tax goodwill impairment charge was **$**51.1 million, which was reported as "Goodwill Impairment Charge" in the accompanying statements of operations in 2003."*

Excerpt from Inter Corporation – 2003 Annual report

*"… The Wireless Communications and Computing Group (WCCG) business, comprised primarily of flash memory products and cellular baseband chipsets, has not performed as management had expected. **In the fourth quarter of 2003, it became apparent that WCCG was now expected to grow more slowly than previously projected. A slower-than-expected rollout of products and slower-than-expected customer acceptance of our products in the baseband chipset business, as well as a delay in the transition to next-generation phone networks, have pushed out the forecasts for sales into high-end data cell phones. These factors resulted in lower growth expectations for the reporting unit and triggered the goodwill impairment.** The impairment review requires a two-step process. The first step of the review compares the fair value of the reporting units with substantial goodwill against their aggregate carrying values, including goodwill. The company estimated the fair value of the WCCG and ICG reporting units using the income method of valuation, which includes the use of estimated discounted cash flows. Based on the comparison, the carrying value of the WCCG reporting unit exceeded the fair value. Accordingly, the company performed the second step of the test, comparing the implied fair value of the WCCG reporting unit's goodwill with the carrying amount of that goodwill. Based on this assessment, the company recorded a non-cash impairment charge of **$**611 million, which is included as a component of operating income in the "all other" category for segment reporting purposes."*

Excerpt from Movie Gallery Inc – 2005 Annual report

*"Goodwill is tested at a reporting unit level. Our reporting units for this purpose are Movie Gallery and Hollywood Video (our Game Crazy segment has no goodwill). Goodwill is impaired if the fair value of a reporting unit is less than the carrying value of its assets. **The estimated fair value of each of the reporting units was computed using***

the present value of estimated future cash flows, which included the impact of trends in the business and industry noted in 2005, and considering market prices of our debt and equity securities, including the accelerated decline in the in-store rental industry, increased competition in the video sell-through markets and the growth of the on-line movie rental segment in which we do not have a presence. *Impairments of goodwill were recorded for the Movie Gallery and Hollywood reporting units in the amounts of $161.7 million and $361.2 million, respectively.*

The first step of the goodwill impairment test compares the book value of the reporting units to their estimated fair values. The estimated fair values of the reporting units are computed using the present value of estimated future cash flows. This analysis utilizes a multi-year forecast of estimated cash flows and a terminal value at the end of the cash flow period. The forecast period growth assumptions consist of internal projections that are based on our budget and long-range strategic plan. The discount rate used at the testing date is our weighted-average cost of capital, modified as necessary to reconcile the sum of the enterprise values of our reporting units to the market value of our debt and equity securities outstanding. If fair values of the reporting units do not exceed their carrying values then the second step must be performed to quantify the amount of the impairment.

The second step of the goodwill impairment test compares the implied fair value of goodwill to the book value of goodwill for each reporting unit. To determine the implied fair value of goodwill, we allocated the estimated fair value of each reporting unit to the estimated fair value of the existing tangible assets and liabilities, as well as existing identified intangible assets and previously unidentified intangible assets. The estimated implied fair value of goodwill was compared to its respective carrying value and any excess carrying value was recorded as a goodwill impairment charge to operating income.

In the first step of the impairment test the fair value of both the Movie Gallery and Hollywood Video reporting units were lower than their carrying values, and therefore the goodwill of those reporting units was impaired.

The second step of the impairment test indicated that the implied fair value of goodwill for the Movie Gallery reporting unit was completely impaired, and therefore a goodwill impairment charge was recorded for $161.7 million. The implied fair value of goodwill for the Hollywood Video reporting unit was $118.4 million, and therefore a goodwill impairment charge was recorded for $361.2 million."

APPENDIX C

SUMMARY OF INPUT/OUTPUT VARIABLES FROM PRIOR STUDIES

Studies	Input Variables	Output Variables
Bowlin (1995)	Total assets Stockholders' equity Plant and equipment Employees	Net income Cash flow from operations Net sales End-of-year market value of equity
Bowlin (1999)	Operating expenses Identifiable assets	Operating profit Operating cash flows Sales
Seiford and Zhu (1999) Zhu (2000)	*Stage 1* Employees Assets Stockholders' equity	*Stage 1* Revenues Profits
	Stage 2 Revenues Profits	*Stage 2* Market value Total return to investors Earnings per share
Luo (2003)	*Stage 1* Employees Total assets Stockholders' equity	*Stage 1* Revenues Profits
	Stage 2 Revenues Profits	*Stage 2* Market value Stock price Earnings per share

APPENDIX D

LIST OF SAMPLE FIRMS

Panel A: Durable Manufacturers

Id	YR	Impairment Firms	SIC	No Impairment Firms	SIC
1	2002	CHANNELL COMMERCIAL CORP	3089	CLARION TECHNOLOGIES INC	3089
2	2002	CONSOLIDATED CONTAINR CO	3089	APTARGROUP INC	3089
3	2002	EAGLE BUILDING TECH INC	3270	AMERICAN STONE INDUSTRS INC	3281
4	2002	U S CONCRETE INC	3270	JARDEN CORP	3221
5	2002	FIBERCORE INC	3357	NIAGARA CORP	3310
6	2002	INTERNATIONAL WIRE GROUP	3357	GIBRALTAR INDUSTRIES INC	3310
7	2002	ACME UNITED CORP	3420	NORTH AMER GALV & COATINGS	3470
8	2002	MPM TECHNOLOGIES INC	3564	JMAR TECHNOLOGIES INC	3559
9	2002	QUIPP INC	3559	PARAGON TECHNOLOGIES INC	3530
10	2002	VEECO INSTRUMENTS INC	3559	IDEX CORP	3561
11	2002	TIGER TELEMATICS INC	3663	COGNITRONICS CORP	3661
12	2002	DISTINCTIVE DEVICES INC	3661	ELECTR TELE-COMMUNCTN	3661
13	2002	TPC LIQUIDATION	3661	HOME DIRECTOR INC	3669
14	2002	DIGITAL ANGEL CORP	3669	CIRCUIT RESEARCH LABS INC	3663
15	2002	PUBLICARD INC	3690	EMRISE CORP	3640
16	2002	PORTA SYSTEMS CORP	3661	SOCKET COMMUNICATIONS INC	3663
17	2002	NCT GROUP INC	3651	FIBERSTARS INC	3640
18	2002	DIGITAL VIDEO SYSTEMS IN	3651	NUMEREX CORP -CL A	3669
19	2002	COM21 INC	3661	ASTRONICS CORP	3640
20	2002	MAXWELL TECHNOLOGIES INC	3612	LIFELINE SYSTEMS INC	3663
21	2002	VYYO INC	3663	COMMUNICATIONS SYSTEMS INC	3661
22	2002	WAVE WIRELESS CORP	3663	UNIVERSAL ELECTRONICS INC	3651
23	2002	SL INDUSTRIES INC	3620	EXCEL TECHNOLOGY INC	3690
24	2002	CARRIER ACCESS CORP	3661	FRANKLIN ELECTRIC CO INC	3621
25	2002	NMS COMMUNICATIONS CORP	3661	NATIONAL PRESTO INDS INC	3634
26	2002	KOMAG INC	3695	BALDOR ELECTRIC CO	3621
27	2002	STANDARD MOTOR PRODS	3690	GENLYTE GROUP INC	3640
28	2002	SONICWALL INC	3663	MCDATA CORP -CL A	3669
29	2002	ARRIS GROUP INC	3663	REGAL-BELOIT CORP	3621
30	2002	ZAP	3790	UNIVERSAL AUTOMOTIVE INDS	3714
31	2002	LMI AEROSPACE INC	3728	MARINE PRODUCTS CORP	3730
32	2002	NATIONAL R V HOLDINGS IN	3716	R & B INC	3714
33	2002	MCDERMOTT INTL INC	3730	AMERICAN AXLE & MFG HLDGS	3714
34	2002	ANTARES PHARMA INC	3841	EP MEDSYSTEMS INC	3845
35	2002	PARADIGM MEDICAL INDS IN	3845	ORBIT INTERNATIONAL CP	3812
36	2002	ELECTRIC CITY CORP	3825	CARDIAC SCIENCE CORP	3845

Id	YR	Impairment Firms	SIC	No Impairment Firms	SIC
37	2002	BICO INC	3845	ENDOLOGIX INC	3841
38	2002	AETRIUM INC	3825	IRIS INTERNATIONAL INC	3826
39	2002	ENDOCARE INC	3841	BADGER METER INC	3824
40	2002	MDI INC	3861	SUNRISE TELECOM INC	3825
41	2002	CRYOLIFE INC	3842	ARTHROCARE CORP	3845
42	2002	NANOMETRICS INC	3829	TOLLGRADE COMMUNICATIONS INC	3825
43	2002	IXIA	3825	RUDOLPH TECHNOLOGIES INC	3823
44	2002	SEQUENOM INC	3826	OAKLEY INC	3851
45	2002	INFOCUS CORP	3861	MINE SAFETY APPLIANCES CO	3842
46	2002	TERADYNE INC	3825	STRYKER CORP	3842
47	2002	GABRIEL TECHNOLOGIES COR	3990	ACTION PRODUCTS INTL INC	3944
48	2002	DECRANE AIRCRAFT HLDGS I	3728	WABASH NATIONAL CORP	3715
49	2002	MILACRON INC	3559	DENTSPLY INTERNATL INC	3843
50	2002	WHIRLPOOL CORP	3630	COOPER INDUSTRIES LTD	3640
51	2002	PROGRESSIVE GAMING INTL	3990	MIDDLETON DOLL CO	3942
52	2003	LEXINGTON PRECISION CORP	3060	MICROTEK MEDICAL HLDGS INC	3089
53	2003	CONSTAR INTERNATIONAL IN	3080	BPC HOLDING CORP	3089
54	2003	BARRY (R G) CORP	3140	ROCKY SHOES & BOOTS INC	3140
55	2003	LIQUIDMETAL TECHNOLOGIES	3310	NIAGARA CORP	3310
56	2003	WOLVERINE TUBE INC	3350	GIBRALTAR INDUSTRIES INC	3310
57	2003	LONE STAR TECHNOLOGIES	3317	COMMSCOPE INC	3357
58	2003	WHX CORP	3330	HARSCO CORP	3390
59	2003	OLIN CORP	3350	OM GROUP INC	3341
60	2003	POWERCOLD CORP	3585	PARAGON TECHNOLOGIES INC	3530
61	2003	SHUMATE INDUSTRIES INC	3533	REINHOLD INDUSTRIES -CL A	3555
62	2003	QUIPP INC	3559	CECO ENVIRONMENTAL CORP	3564
63	2003	T-3 ENERGY SERVICES INC	3533	ALAMO GROUP INC	3523
64	2003	NN INC	3562	WATER PIK TECHNOLOGIES INC	3569
65	2003	MESTEK INC	3585	KADANT INC	3550
66	2003	ASTEC INDUSTRIES INC	3531	GARDNER DENVER INC	3560
67	2003	MILACRON INC	3559	IDEX CORP	3561
68	2003	TECUMSEH PRODUCTS CO -C	3585	COOPER CAMERON CORP	3533
69	2003	TEREX CORP	3531	BRUNSWICK CORP	3510
70	2003	ILLINOIS TOOL WORKS	3540	INGERSOLL-RAND CO LTD	3560
71	2003	SAFARI ASSOCIATES INC	3669	ISECURETRAC CORP	3669
72	2003	AXESSTEL INC	3663	VIEWCAST.COM INC	3663
73	2003	DIGITAL ANGEL CORP	3669	ASTRONICS CORP	3640
74	2003	PECO II INC	3612	UNIVERSAL ELECTRONICS INC	3651
75	2003	NMS COMMUNICATIONS CORP	3661	HARMONIC INC	3663
76	2003	POWERWAVE TECHNOLOGIES I	3663	TELEDYNE TECHNOLOGIES INC	3663
77	2003	ZAP	3790	PORTEC RAIL PRODUCTS INC	3743
78	2003	CONRAD INDUSTRIES INC	3730	MARINE PRODUCTS CORP	3730
79	2003	DECRANE AIRCRAFT HLDGS I	3728	MONACO COACH CORP	3711
80	2003	TRIMAS CORP	3790	FEDERAL SIGNAL CORP	3711
81	2003	UNION TANK CAR CO	3743	BORGWARNER INC	3714
82	2003	FEDERAL-MOGUL CORP	3714	EATON CORP	3714
83	2003	HOMELAND SECURITY NETWRK	3812	TRESTLE HOLDINGS INC	3826
84	2003	AMERICAN MEDICAL TECHNOL	3845	EP MEDSYSTEMS INC	3845
85	2003	ZEVEX INTERNATIONAL INC	3845	BIOJECT MEDICAL TECHNOL	3841

Id	YR	Impairment Firms	SIC	No Impairment Firms	SIC
86	2003	MDI INC	3861	K-TRON INTERNATIONAL INC	3823
87	2003	TRANSGENOMIC INC	3826	MERIT MEDICAL SYSTEMS INC	3841
88	2003	X-RITE INC	3861	KYPHON INC	3841
89	2003	IXIA	3825	RUDOLPH TECHNOLOGIES INC	3823
90	2003	THERMO ELECTRON CORP	3826	PERKINELMER INC	3826
91	2003	LEVCOR INTERNATIONAL INC	3960	ACTION PRODUCTS INTL INC	3944
92	2004	THERMOVIEW INDUSTRIES IN	3089	UFP TECHNOLOGIES INC	3086
93	2004	ARMSTRONG HOLDINGS INC	3089	COOPER TIRE & RUBBER CO	3011
94	2004	K-SWISS INC -CL A	3140	DECKERS OUTDOOR CORP	3100
95	2004	SUPER VISION INTL INC -	3357	METALICO INC	3341
96	2004	TITAN INTERNATIONAL INC	3312	BRUSH ENGINEERED MATERIALS	3330
97	2004	GENERAL CABLE CORP/DE	3350	CENTURY ALUMINUM CO	3350
98	2004	MUELLER INDUSTRIES	3350	OM GROUP INC	3341
99	2004	DRESSER INC	3490	SILGAN HOLDINGS INC	3411
100	2004	TOWER AUTOMOTIVE INC	3460	SNAP-ON INC	3420
101	2004	QUIPP INC	3559	CECO ENVIRONMENTAL CORP	3564
102	2004	KAYDON CORP	3562	GARDNER DENVER INC	3560
103	2004	LENNOX INTERNATIONAL INC	3585	COOPER CAMERON CORP	3533
104	2004	ILLINOIS TOOL WORKS	3540	INGERSOLL-RAND CO LTD	3560
105	2004	TIGER TELEMATICS INC	3663	LEGEND MOBILE INC	3663
106	2004	SLS INTERNATIONAL INC	3651	SENTRY TECHNOLOGY CORP	3669
107	2004	NCT GROUP INC	3651	CIRCUIT RESEARCH LABS INC	3663
108	2004	PECO II INC	3612	LOJACK CORP	3669
109	2004	ROCKFORD CORP	3651	UNIVERSAL ELECTRONICS INC	3651
110	2004	TELEX COMMUNICATIONS INC	3651	LAMSON & SESSIONS CO	3640
111	2004	DSP GROUP INC	3663	INTER-TEL INC -SER A	3661
112	2004	APPLICA INC	3634	BALDOR ELECTRIC CO	3621
113	2004	STANDARD MOTOR PRODS	3690	REGAL-BELOIT CORP	3621
114	2004	CHECKPOINT SYSTEMS INC	3669	GENLYTE GROUP INC	3640
115	2004	TELEFLEX INC	3620	AMERICAN POWER CONVERSION CP	3620
116	2004	MAYTAG CORP	3630	COOPER INDUSTRIES LTD	3640
117	2004	SPX CORP	3612	L-3 COMMUNICATIONS HLDGS INC	3663
118	2004	IMPCO TECHNOLOGIES INC	3714	SUPREME INDUSTRIES INC	3713
119	2004	FEDERAL-MOGUL CORP	3714	EATON CORP	3714
120	2004	UNIVEC INC	3841	TRESTLE HOLDINGS INC	3826
121	2004	SPECTRX INC	3845	CYTOMEDIX INC	3841
122	2004	TRANSGENOMIC INC	3826	ATRION CORP	3841
123	2004	ENDOCARE INC	3841	FARO TECHNOLOGIES INC	3829
124	2004	NEWPORT CORP	3821	FLIR SYSTEMS INC	3812
125	2004	TRANS-INDUSTRIES INC	3990	GAMING PARTNERS INTL CORP	3944
126	2004	ESCALADE INC	3949	CROSS (A.T.) & CO -CL A	3950
127	2004	EXX INC -CL A	3621	WJ COMMUNICATIONS INC	3663
128	2004	T-3 ENERGY SERVICES INC	3533	3D SYSTEMS CORP	3559
129	2005	NORTH AMER TECHNOL GROUP	3089	UFP TECHNOLOGIES INC	3086
130	2005	FOAMEX INTERNATIONAL INC	3086	WEST PHARMACEUTICAL SVSC INC	3060
131	2005	GRAHAM PACKAGING HLDGS C	3089	COOPER TIRE & RUBBER CO	3011
132	2005	MADDEN STEVEN LTD	3140	DECKERS OUTDOOR CORP	3100
133	2005	LIBBEY INC	3220	CERADYNE INC	3290
134	2005	TARPON INDUSTRIES INC	3317	DYNAMIC MATERIALS CORP	3390

Id	YR	Impairment Firms	SIC	No Impairment Firms	SIC
135	2005	MMI PRODUCTS INC	3310	BRUSH ENGINEERED MATERIALS	3330
136	2005	BELDEN CDT INC	3357	OM GROUP INC	3341
137	2005	TECUMSEH PRODUCTS CO -C	3585	COOPER CAMERON CORP	3533
138	2005	AMERICAN STANDARD COS IN	3585	CUMMINS INC	3510
139	2005	ITT INDUSTRIES INC	3561	BAKER HUGHES INC	3533
140	2005	ILLINOIS TOOL WORKS	3540	INGERSOLL-RAND CO LTD	3560
141	2005	PUBLICARD INC	3690	ISECURETRAC CORP	3669
142	2005	VODAVI TECHNOLOGY INC	3661	VASCO DATA SEC INTL INC	3669
143	2005	TERABEAM INC	3663	MEDIS TECHNOLOGIES LTD	3690
144	2005	EXX INC -CL A	3621	AXSYS TECHNOLOGIES INC	3640
145	2005	DIGITAL ANGEL CORP	3669	COMMUNICATIONS SYSTEMS INC	3661
146	2005	AROTECH CORP	3690	AIRSPAN NETWORKS INC	3663
147	2005	ZHONE TECHNOLOGIES INC	3661	KINETEK INC	3621
148	2005	REMY INTL INC	3690	TELEDYNE TECHNOLOGIES INC	3663
149	2005	MAYTAG CORP	3630	TELLABS INC	3661
150	2005	SPX CORP	3612	L-3 COMMUNICATIONS HLDGS INC	3663
151	2005	TRINITY INDUSTRIES	3743	AMERICAN AXLE & MFG HLDGS	3714
152	2005	ELECTRIC CITY CORP	3825	TRESTLE HOLDINGS INC	3826
153	2005	MED-DESIGN CORP	3841	PHOTOMEDEX INC	3845
154	2005	WORLD HEART CORP	3845	UTAH MEDICAL PRODUCTS INC	3845
155	2005	CIPHERGEN BIOSYSTEMS INC	3826	RAE SYSTEMS INC	3829
156	2005	SONIC INNOVATIONS INC	3842	YOUNG INNOVATIONS INC	3843
157	2005	OCCULOGIX INC	3845	AMERICAN MEDICAL SYSTMS HLDS	3842
158	2005	LEVCOR INTERNATIONAL INC	3960	DATREK MILLER INTL INC	3949
159	2005	K2 INC	3949	HASBRO INC	3944
160	2005	CHECKPOINT SYSTEMS INC	3669	GENLYTE GROUP INC	3640
161	2005	T-3 ENERGY SERVICES INC	3533	3D SYSTEMS CORP	3559
162	2005	FEDERAL-MOGUL CORP	3714	EATON CORP	3714
163	2005	BOYDS COLLECTION LTD	3942	NAUTILUS INC	3949
164	2005	CTI INDUSTRIES CORP	3060	CORE MOLDING TECHNOLOGIES	3089
165	2005	DANA CORP	3714	GOODRICH CORP	3728
166	2005	DAYTON SUPERIOR CORP	3440	RTI INTL METALS INC	3490
167	2005	MICROFIELD GROUP INC	3640	SENTRY TECHNOLOGY CORP	3669
168	2005	PTS INC	3949	ACTION PRODUCTS INTL INC	3944
169	2005	TEKELEC	3663	BALDOR ELECTRIC CO	3621
170	2005	TEREX CORP	3531	AGCO CORP	3523
171	2005	UTSTARCOM INC	3669	COOPER INDUSTRIES LTD	3640
172	2005	ZAP	3790	COACH INDUSTRIES GROUP INC	3711
173	2005	PARADIGM MEDICAL INDS IN	3845	QUALMARK CORP	3829

Panel B: Computers

Id	YR	Impairment Firms	SIC	No Impairment Firms	SIC
1	2002	SOFTNET TECHNOLOGY CORP	3571	CAMBEX CORP	3572
2	2002	STORAGE COMPUTER CORP	3577	TRANSACT TECHNOLOGIES	3577
3	2002	IMMERSION CORP	3577	SAFENET INC	3577
4	2002	SCM MICROSYSTEMS INC	3577	ECHELON CORP	3576
5	2002	MRV COMMUNICATIONS INC	3576	ELECTRONICS FOR IMAGI	3576
6	2002	QUICKLOGIC CORP	3674	SIRENZA MICRODEVICES	3674
7	2002	PCD INC	3678	PLX TECHNOLOGY INC	3674
8	2002	SILICON IMAGE INC	3674	MONOLITHIC SYS TECHNO	3674
9	2002	CENTILLIUM COMMUNICATION	3674	DIODES INC	3674
10	2002	SILICON LABORATORIES INC	3674	ADVANCED POWER TECHNO	3674
11	2002	SIPEX CORP	3674	NORTECH SYSTEMS INC	3679
12	2002	BEL FUSE INC	3677	TTM TECHNOLOGIES INC	3672
13	2002	KEY COMPONENTS LLC	3677	PIXELWORKS INC	3674
14	2002	MICROTUNE INC	3674	VICOR CORP	3679
15	2002	ANADIGICS INC	3674	ACTEL CORP	3674
16	2002	ARTESYN TECHNOLOGIES INC	3679	ZORAN CORP	3674
17	2002	DDI CORP	3672	AMIS HOLDINGS INC	3674
18	2002	TRANSWITCH CORP	3674	CTS CORP	3670
19	2002	TRIQUINT SEMICONDUCTOR I	3674	AMPHENOL CORP	3678
20	2002	CYPRESS SEMICONDUCTOR CO	3674	LATTICE SEMICONDUCTOR	3674
21	2002	AMKOR TECHNOLOGY INC	3674	FAIRCHILD SEMICONDUCT	3674
22	2002	BROADCOM CORP -CL A	3674	VISHAY INTERTECHNOLOG	3670
23	2002	AXTIVE CORP	7372	LION INC	7370
24	2002	NEW MEXICO SOFTWARE INC	7372	VITALSTREAM HOLDINGS	7370
25	2002	NEXT GENERATION TECH HLD	7372	KINTERA INC	7372
26	2002	GUARDIAN TECHNLGS INTL I	7373	SIBONEY CORP	7372
27	2002	DIGITAL FUSION INC	7370	MAI SYSTEMS CORP	7373
28	2002	MEDIAVEST INC	7370	EBIX INC	7372
29	2002	INNOVATIVE SOFTWARE TECH	7372	KNOVA SOFTWARE INC	7372
30	2002	VERTEL CORP	7372	MERGE TECHNOLOGIES IN	7373
31	2002	INSIGHTFUL CORP	7372	D A CONSULTING GROUP	7370
32	2002	LOYALTYPOINT INC	7370	DOCUMENT SCIENCES COR	7372
33	2002	NESTOR INC	7373	SEGUE SOFTWARE INC	7372
34	2002	VIANET TECHNOLOGIES INC	7373	APPLIX INC	7372
35	2002	EUROWEB INTERNATIONAL CO	7370	ANALEX CORP	7370
36	2002	WORLDGATE COMMUNICATIONS	7373	OPEN SOLUTIONS INC	7372
37	2002	FASTNET CORP	7370	ERESEARCHTECHNOLOGY I	7372
38	2002	INTRUSION INC	7372	PRIVATE BUSINESS INC	7372
39	2002	SAGENT TECHNOLOGY INC	7372	DATALINK CORP	7373
40	2002	NEXPRISE INC	7372	LIONBRIDGE TECHNOLOGI	7372
41	2002	HEALTHAXIS INC	7374	INFOCROSSING INC	7374
42	2002	VIEWPOINT CORP	7372	SYNPLICITY INC	7372
43	2002	TUMBLEWEED COMMUNICATION	7372	TRIPOS INC	7372
44	2002	ITA HOLDINGS INC	7373	PDF SOLUTIONS INC	7373
45	2002	I-MANY INC	7372	AMICAS INC	7372
46	2002	EDGEWATER TECHNOLOGY INC	7370	RAINDANCE COMMUNICATI	7370
47	2002	BSQUARE CORP	7372	ACTUATE CORP	7372
48	2002	VERTICALNET INC	7372	PEGASYSTEMS INC	7372
49	2002	IVILLAGE INC	7370	QUADRAMED CORP	7372
50	2002	CAPTARIS INC	7372	NUANCE COMMUNICATIONS	7372
51	2002	CLARUS CORP	7372	COGNIZANT TECH SOLUTI	7370
52	2002	KANA SOFTWARE INC	7372	SYNTEL INC	7370
53	2002	APPLIED DIGITAL SOLUTION	7373	MIDWAY GAMES INC	7372

Id	YR	Impairment Firms	SIC	No Impairment Firms	SIC
54	2002	EASYLINK SERVICES CP -C	7370	RENAISSANCE LEARNING	7372
55	2002	SONUS NETWORKS INC	7373	DENDRITE INTERNATIONA	7372
56	2002	METASOLV INC	7372	MANTECH INTL CORP	7373
57	2002	VIA NET.WORKS INC	7370	CRITICAL PATH INC	7370
58	2002	ANSWERTHINK INC	7370	ECLIPSYS CORP	7373
59	2002	QUOVADX INC	7372	COVANSYS CORP	7371
60	2002	IGATE CORP	7371	SPSS INC	7372
61	2002	VITRIA TECHNOLOGY INC	7372	ACCELRYS INC	7372
62	2002	PRICELINE.COM INC	7370	NEOFORMA INC	7374
63	2002	TRIZETTO GROUP INC	7372	MEDQUIST INC	7374
64	2002	INTERWOVEN INC	7372	NATIONAL INSTRUMENTS	7372
65	2002	SAPIENT CORP	7372	INTERNET SECURITY SYS	7372
66	2002	VIGNETTE CORP	7372	KEANE INC	7371
67	2002	INFOSPACE INC	7370	PEROT SYSTEMS CORP	7373
68	2002	SYBASE INC	7372	MERCURY INTERACTIVE C	7372
69	2002	VERISIGN INC	7372	UNISYS CORP	7373
70	2002	CORNING INC	3679	TEXAS INSTRUMENTS INC	3674
71	2002	EPRESENCE INC	7370	COSTAR GROUP INC	7370
72	2003	INTELLI-CHECK INC	3579	GLOBAL EPOINT INC	3571
73	2003	DIGITAL LIFESTYLES GROUP	3571	TRANSACT TECHNOLOGIES	3577
74	2003	MRV COMMUNICATIONS INC	3576	ECHELON CORP	3576
75	2003	RAMTRON INTERNATIONAL CO	3674	SIRENZA MICRODEVICES	3674
76	2003	REPTRON ELECTRONICS INC	3672	SUNTRON CORP	3672
77	2003	KEY COMPONENTS LLC	3677	TTM TECHNOLOGIES INC	3672
78	2003	DDI CORP	3672	PIXELWORKS INC	3674
79	2003	BROADCOM CORP -CL A	3674	FAIRCHILD SEMICONDUCT	3674
80	2003	VERIDICOM INTERNATIONAL	7372	SECURED SERVICES INC	7373
81	2003	SAFE TECHNOLOGIES INTL	7370	LION INC	7370
82	2003	MAXIMUM DYNAMICS INC	7372	VITALSTREAM HOLDINGS	7370
83	2003	AXTIVE CORP	7372	CHINA MOBILITY SOLUTI	7370
84	2003	MEDLINK INTERNATIONAL IN	7370	ADSTAR INC	7370
85	2003	VANTAGEMED CORP	7372	A D A M INC	7372
86	2003	INSIGHTFUL CORP	7372	SEGUE SOFTWARE INC	7372
87	2003	IPIX CORP	7373	TELTRONICS INC	7373
88	2003	ASA INTERNATIONAL LTD	7373	INNODATA ISOGEN INC	7374
89	2003	EUROWEB INTERNATIONAL CO	7370	DOCUMENT SCIENCES COR	7372
90	2003	LOUDEYE CORP	7370	GSE SYSTEMS INC	7372
91	2003	VERSO TECHNOLOGIES INC	7373	THESTREET.COM	7370
92	2003	BSQUARE CORP	7372	DATALINK CORP	7373
93	2003	I-MANY INC	7372	TECHTEAM GLOBAL INC	7370
94	2003	IVILLAGE INC	7370	CRITICAL PATH INC	7370
95	2003	APPLIED DIGITAL SOLUTION	7373	AMICAS INC	7372
96	2003	METASOLV INC	7372	BLACKBAUD INC	7372
97	2003	RADIANT SYSTEMS INC	7373	NYFIX INC	7373
98	2003	VIA NET.WORKS INC	7370	RENAISSANCE LEARNING	7372
99	2003	IGATE CORP	7371	SYNTEL INC	7370
100	2003	ENTRUST INC	7372	DENDRITE INTERNATIONA	7372
101	2003	ASIAINFO HOLDINGS INC	7372	VALUECLICK INC	7370
102	2003	S1 CORP	7373	INFORMATICA CORP	7372
103	2003	VERISIGN INC	7372	MCAFEE INC	7372
104	2003	INCENTRA SOLUTIONS INC	7372	UNITED SYSTEMS TECHNO	7372
105	2003	724 SOLUTIONS INC	7372	LIONBRIDGE TECHNOLOGI	7372
106	2004	SOFTNET TECHNOLOGY CORP	3571	GLOBAL EPOINT INC	3571
107	2004	RELIABILITY INC	3674	PHOTONIC PRODUCTS GRO	3679
108	2004	ACACIA RESEARCH-CONSOLID	3674	PLX TECHNOLOGY INC	3674
109	2004	THREE-FIVE SYSTEMS INC	3674	SUNTRON CORP	3672

Id	YR	Impairment Firms	SIC	No Impairment Firms	SIC
110	2004	ESS TECHNOLOGY INC	3674	SILICON STORAGE TECHN	3674
111	2004	STONERIDGE INC	3679	ZORAN CORP	3674
112	2004	CORNING INC	3679	TEXAS INSTRUMENTS INC	3674
113	2004	SPORTSNUTS INC	7370	VITALSTREAM HOLDINGS	7370
114	2004	WIZZARD SOFTWARE CORP	7372	PRESCIENT APPLIED INT	7373
115	2004	NEW MEXICO SOFTWARE INC	7372	WIDEPOINT CORP	7370
116	2004	BRIGHTSTAR INFO TECH GRP	7370	SIBONEY CORP	7372
117	2004	INCENTRA SOLUTIONS INC	7372	SECURED SERVICES INC	7373
118	2004	PRACTICEXPERT INC	7373	CIMNET INC	7372
119	2004	LEVEL 8 SYSTEMS INC	7371	HEALTHGATE DATA CORP	7370
120	2004	VANTAGEMED CORP	7372	LION INC	7370
121	2004	AXTIVE CORP	7372	A D A M INC	7372
122	2004	FIRSTWAVE TECHNOLOGIES I	7372	HEALTH GRADES INC	7370
123	2004	VIA NET.WORKS INC	7370	SECURE COMPUTING CORP	7372
124	2004	INTRADO INC	7374	NYFIX INC	7373
125	2004	LIGHTBRIDGE INC	7374	ANSYS INC	7372
126	2004	CNET NETWORKS INC	7370	DIGITAL INSIGHT CORP	7370
127	2004	MASTERCARD INC	7374	SABRE HOLDINGS CORP	7373
128	2004	INTERMEC INC	3577	ELECTRONICS FOR IMAGI	3576
129	2005	REPTRON ELECTRONICS INC	3672	ADVANCED POWER TECHNO	3674
130	2005	ACACIA RESEARCH-CONSOLID	3674	SUNPOWER CORP	3674
131	2005	ESS TECHNOLOGY INC	3674	VICOR CORP	3679
132	2005	DDI CORP	3672	ACTEL CORP	3674
133	2005	TECHNITROL INC	3679	AMIS HOLDINGS INC	3674
134	2005	ADVANCED MICRO DEVICES	3674	FREESCALE SEMICONDUCT	3674
135	2005	WIZZARD SOFTWARE CORP	7372	CIMETRIX INC	7372
136	2005	ONELINK CORP	7374	CATUITY INC	7371
137	2005	FIRSTWAVE TECHNOLOGIES I	7372	SIBONEY CORP	7372
138	2005	AMERICAN EDUCATION CORP	7372	MAKEMUSIC INC	7372
139	2005	INCENTRA SOLUTIONS INC	7372	HEALTHSTREAM INC	7370
140	2005	VIEWPOINT CORP	7372	ONLINE RESOURCES CORP	7374
141	2005	TECHNOLOGY SOLUTIONS CO	7373	CORILLIAN CORP	7372
142	2005	ANALYSTS INTERNATIONAL C	7371	ACTUATE CORP	7372
143	2005	APPLIED DIGITAL SOLUTION	7373	SECURE COMPUTING CORP	7372
144	2005	SAFLINK CORP	7373	WEBMD HEALTH HOLDINGS	7370
145	2005	PROXYMED INC	7374	KANBAY INTERNATIONAL	7373
146	2005	INTERNET CAP GROUP INC	7370	ALTIRIS INC	7372
147	2005	ASIAINFO HOLDINGS INC	7372	ECLIPSYS CORP	7373
148	2005	JDA SOFTWARE GROUP INC	7372	DENDRITE INTERNATIONA	7372
149	2005	BROADVISION INC	7373	SUPPORTSOFT INC	7372
150	2005	INNOVATIVE SOFTWARE TECH	7372	CIMNET INC	7372
151	2005	PRACTICEXPERT INC	7373	ADSTAR INC	7370
152	2005	VERIDICOM INTERNATIONAL	7372	LION INC	7370
153	2005	AAVID THERMAL TECHNOLOGI	3679	SUNTRON CORP	3672
154	2005	CYBER DEFENSE SYSTEMS IN	7372	HYPERSPACE COMM INC	7372
155	2005	IDI GLOBAL INC	7370	A CONSULTING TEAM INC	7370
156	2005	IMAGEWARE SYSTEMS INC	7373	A D A M INC	7372
157	2005	IMMEDIATEK INC	7372	BITSTREAM INC -CL A	7372
158	2005	JUNIPER GROUP INC	7370	WIDEPOINT CORP	7370
159	2005	ZANETT INC	7370	APPLIX INC	7372
160	2005	RAMTRON INTERNATIONAL CO	3674	LOGICVISION INC	3674
161	2005	SOFTNET TECHNOLOGY CORP	3571	FOCUS ENHANCEMENTS IN	3576

Panel C: Services

Id	YR	Impairment Firms	SIC	No Impairment Firms	SIC
1	2002	MARRIOTT INTL INC	7011	HILTON HOTELS CORP	7011
2	2002	ALDERWOODS GROUP INC	7200	CARRIAGE SERVICES INC	7200
3	2002	RCM TECHNOLOGIES INC	7363	HEALTHCARE SERVICES GROUP	7340
4	2002	UNIVERSAL ACCESS GLOBAL HLD	7389	MEDICAL STAFFNG NTWRK HLDGS	7363
5	2002	VALASSIS COMMUNICATIONS INC	7310	KINETIC CONCEPTS INC	7350
6	2002	PROTECTION ONE INC	7380	CONVERGYS CORP	7389
7	2002	SPHERION CORP	7363	INTERPOOL INC	7359
8	2002	HANOVER COMPRESSOR CO	7359	WESCO FINANCIAL CORP	7359
9	2002	UNITED RENTALS INC	7350	CROWN CASTLE INTL CORP	7359
10	2002	INTERPUBLIC GROUP OF COS	7311	OMNICOM GROUP	7311
11	2002	MIDAS INC	7500	STANDARD PARKING CORP	7500
12	2002	CINEMARK USA INC -CL A	7830	REGAL ENTERTAINMENT GROUP	7830
13	2002	EMERGENT GROUP INC	8090	MIRACOR DIAGNOSTICS INC	8071
14	2002	NOVAMED INC	8011	ODYSSEY HEALTHCARE INC	8050
15	2002	CHEMED CORP	8082	NATIONAL HEALTHCARE CORP	8051
16	2002	SUN HEALTHCARE GROUP INC	8051	APRIA HEALTHCARE GROUP INC	8082
17	2002	EVCI CAREER COLLEGES INC	8200	CONCORDE CAREER COLLEGES IN	8200
18	2002	NEW HORIZONS WORLDWIDE INC	8200	GP STRATEGIES CP	8200
19	2002	THINKPATH INC	8711	INDUSTRIAL SERVICES AMER IN	8742
20	2002	OPINION RESEARCH CORP	8700	EXPONENT INC	8742
21	2002	MANAGEMENT NETWORK GROUP IN	8742	ARBITRON INC	8700
22	2002	META GROUP INC	8700	AMERICAN DENTAL PARTNERS IN	8741
23	2002	DISCOVERY PARTNERS INTL INC	8731	AMBASSADORS INTERNATIONL IN	8741
24	2002	KENDLE INTERNATIONAL INC	8731	PER-SE TECHNOLOGIES INC	8741
25	2002	COMFORCE CORP	8742	DIGITAS INC	8742
26	2002	DECODE GENETICS INC	8731	MAXYGEN INC	8731
27	2003	DIALOG GROUP	7310	ACCUFACTS PRE-EMPLOYMENT SC	7389
28	2003	BUTLER INTERNATIONAL INC	7363	IPAYMENT INC	7389
29	2003	ON ASSIGNMENT INC	7363	UNIVERSAL HOSPITAL SERVICES	7350
30	2003	HUDSON HIGHLAND GROUP INC	7361	AARON RENTS INC	7359
31	2003	HANOVER COMPRESSOR CO	7359	R H DONNELLEY CORP	7310
32	2003	UNITED RENTALS INC	7350	LAMAR ADVERTISING CO -CL A	7310
33	2003	INTERPUBLIC GROUP OF COS	7311	OMNICOM GROUP	7311
34	2003	MACE SECURITY INTL INC	7500	STANDARD PARKING CORP	7500
35	2003	MIDAS INC	7500	DOLLAR THRIFTY AUTOMOTIVE G	7510
36	2003	AVENUE ENTERTAINMENT GRP IN	7812	SECURED DIGITAL APPLICATION	7812
37	2003	BLOCKBUSTER INC	7841	REGAL ENTERTAINMENT GROUP	7830
38	2003	DOVER MOTORSPORTS INC	7948	MAJESTIC STAR CASINO LLC	7990
39	2003	PINNACLE ENTERTAINMENT INC	7990	PENN NATIONAL GAMING INC	7990
40	2003	MAGNA ENTERTAINMENT CORP	7948	AMERISTAR CASINOS INC	7990
41	2003	STATION CASINOS INC	7990	WESTWOOD ONE INC	7900
42	2003	HARRAHS ENTERTAINMENT INC	7990	SIX FLAGS INC	7996
43	2003	PACER HEALTH CORP	8093	METROPOLITAN HLTH NTWRKS IN	8011
44	2003	NEW YORK HEALTH CARE INC	8082	BIO IMAGING TECHNOLOGIES IN	8071
45	2003	CHEMED CORP	8082	NATIONAL HEALTHCARE CORP	8051
46	2003	ALLIANCE IMAGING INC	8071	PEDIATRIX MEDICAL GROUP INC	8060
47	2003	HEALTHSOUTH CORP	8060	TRIAD HOSPITALS INC	8062
48	2003	TENET HEALTHCARE CORP	8062	HCA INC	8062
49	2003	THEGLOBE.COM INC	8742	ESSEX CORP	8711
50	2003	ELOYALTY CORP	8742	MTC TECHNOLOGIES INC	8711
51	2003	OPINION RESEARCH CORP	8700	EXPONENT INC	8742
52	2003	MANAGEMENT NETWORK GROUP IN	8742	AMBASSADORS INTERNATIONL IN	8741
53	2003	COMFORCE CORP	8742	ARBITRON INC	8700

Id	YR	Impairment Firms	SIC	No Impairment Firms	SIC
54	2003	PRG-SCHULTZ INTL INC	8721	AAIPHARMA INC	8731
55	2003	MAGELLAN HEALTH SERVICES IN	8741	PHARMACEUTICAL PROD DEV INC	8731
56	2003	CHAMPNSHIP AUTO RACING TEAM	7948	WHEELING ISLAND GAMING INC	7990
57	2004	SRI/SURGICAL EXPRESS INC	7200	TRM CORP	7200
58	2004	MONARCH STAFFING INC	7361	VILLAGE EDOCS INC	7389
59	2004	SPAR GROUP INC	7389	KENEXA CORP	7361
60	2004	PRECIS INC	7389	NATIONAL RESEARCH CORP	7389
61	2004	MIVA INC	7310	ARBINET-THEXCHANGE INC	7389
62	2004	DIGITAL GENERATION SYS INC	7310	BARRETT BUSINESS SVCS INC	7363
63	2004	RCM TECHNOLOGIES INC	7363	PORTFOLIO RECOVRY ASSOC INC	7320
64	2004	EMAK WORLDWIDE INC	7310	APAC CUSTOMER SERVICES INC	7389
65	2004	ON ASSIGNMENT INC	7363	ICT GROUP INC	7389
66	2004	COMPUTER HORIZONS CORP	7363	IPASS INC	7389
67	2004	SITEL CORP	7389	CDI CORP	7363
68	2004	TEAM HEALTH INC	7363	HARTE HANKS INC	7331
69	2004	UNITED RENTALS INC	7350	MANPOWER INC/WI	7363
70	2004	INTERPUBLIC GROUP OF COS	7311	OMNICOM GROUP	7311
71	2004	MACE SECURITY INTL INC	7500	STANDARD PARKING CORP	7500
72	2004	MAGIC LANTERN GROUP INC	7812	POINT.360	7819
73	2004	BLOCKBUSTER INC	7841	DREAMWORKS ANIMATION INC	7812
74	2004	DISCOVERY HOLDING CO	7812	REGAL ENTERTAINMENT GROUP	7830
75	2004	TOWN SPORTS INTL HOLDINGS	7997	CHURCHILL DOWNS INC	7948
76	2004	BALLY TOTAL FITNESS HLDG CP	7990	WESTWOOD ONE INC	7900
77	2004	U S PHYSICAL THERAPY INC	8000	MEDTOX SCIENTIFIC INC	8071
78	2004	RADIOLOGIX INC	8093	AMERICAN HOMEPATIENT INC	8082
79	2004	HANGER ORTHOPEDIC GRP	8093	PEDIATRIX MEDICAL GROUP INC	8060
80	2004	TENET HEALTHCARE CORP	8062	HCA INC	8062
81	2004	PRINCETON REVIEW INC	8200	LINCOLN EDUCATIONAL SERVICE	8200
82	2004	ALBANY MOLECULAR RESH INC	8731	CBIZ INC	8721
83	2004	GARTNER INC	8700	COVANCE INC	8731
84	2004	BEARINGPOINT INC	8742	CORRECTIONS CORP AMER	8744
85	2004	MANAGEMENT NETWORK GROUP IN	8742	STONEPATH GROUP INC	8742
86	2005	GREAT WOLF RESORTS INC	7011	MORGANS HOTEL GROUP CO	7011
87	2005	PRECIS INC	7389	MEDIALINK WORLDWIDE INC	7380
88	2005	DIGITAL GENERATION SYS INC	7310	INTERSECTIONS INC	7320
89	2005	EMAK WORLDWIDE INC	7310	COMPUDYNE CORP	7381
90	2005	REWARDS NETWORKS INC	7389	MEDICAL STAFFNG NTWRK HLDGS	7363
91	2005	MIVA INC	7310	CDI CORP	7363
92	2005	SOURCECORP INC	7389	CROSS COUNTRY HEALTHCARE IN	7363
93	2005	RENT-A-CENTER INC	7359	DUN & BRADSTREET CORP	7320
94	2005	INTERPUBLIC GROUP OF COS	7311	OMNICOM GROUP	7311
95	2005	MOVIE GALLERY INC	7841	READING INTL INC -CL A	7830
96	2005	CINEMARK USA INC -CL A	7830	DREAMWORKS ANIMATION INC	7812
97	2005	BLOCKBUSTER INC	7841	REGAL ENTERTAINMENT GROUP	7830
98	2005	U S PHYSICAL THERAPY INC	8000	MEDTOX SCIENTIFIC INC	8071
99	2005	I-TRAX INC	8000	OSTEOTECH INC	8090
100	2005	RADIOLOGIX INC	8093	OPTION CARE INC	8093
101	2005	QUEST DIAGNOSTICS INC	8071	COMMUNITY HEALTH SYSTEMS IN	8062
102	2005	GREENFIELD ONLINE INC	8700	ESSEX CORP	8711
103	2005	NANOGEN INC	8731	AMERICAN DENTAL PARTNERS IN	8741
104	2005	LECG CORP	8742	SYMYX TECHNOLOGIES INC	8731
105	2005	PDI INC	8742	MAXYGEN INC	8731
106	2005	SFBC INTERNATIONAL INC	8731	DIGITAS INC	8742
107	2005	OPINION RESEARCH CORP	8700	NUVELO INC	8731
108	2005	PRG-SCHULTZ INTL INC	8721	GEVITY HR INC	8741
109	2005	THINKPATH INC	8711	COMMONWEALTH BIOTECHNOLOGIE	8731

Id	YR	Impairment Firms	SIC	No Impairment Firms	SIC
110	2005	HOOPER HOLMES INC	8090	AMERICAN HOMEPATIENT INC	8082
111	2005	MSX INTERNATIONAL INC	7363	ARBINET-THEXCHANGE INC	7389

APPENDIX E

TABLE 4.1
Industry Distribution of Impairment Observations (2002-2005)

Industry	Primary SIC Code	Total Firm-year Obs.	Impairment Firm-year Obs.	%
1. Mining and Construction	1000-1999, excluding 1300-1399	250	20	8.00%
2. Food	2000-2111	361	15	4.16%
3. Textiles and Printing & Publications	2200-2780	730	44	6.03%
4. Chemicals	2800-2824, 2840-2899	369	29	7.86%
5. Pharmaceuticals	2830-2836	531	28	5.27%
6. Extractive Industries	2900-2999, 1300-1399	336	14	4.17%
7. Durable Manufacturers	3000-3999, excluding 3570-3579 and 3670-3679	3,332	210	6.30%
8. Computers	7370-7379, 3570-3579, 3670-3679	2,418	180	7.44%
9. Transportation	4000-4899	952	82	8.61%
10. Utilities	4900-4999	205	15	7.32%
11. Retail	5000-5999	1,550	65	4.19%
12. Financial Institutions	6000-6411	917	72	7.85%
13.Insurance and Real Estate	6500-6999	293	16	5.46%
14. Services	7000-8999, excluding 7370-7379	1,713	124	7.24%
Total		13,957	914	
Selected Industries				
Durable Manufacturers	3000-3999, excluding 3570-3579 and 3670-3679	3,332	210	
Computers	7370-7379, 3570-3579, 3670-3679	2,418	180	
Services	7000-8999, excluding 7370-7379	1,713	124	
Total		7,463	514	
Percentage of selected industries to all industries		53.47%	56.24%	

Note:
1. Industry membership is determined by using the industry classification as shown in the study of Barth et al. (1998), which classified firms into 14 industries. Observations shown in this table have goodwill balances at the beginning or at the ending of the fiscal year greater than zero.

TABLE 4.2
Sample Selection

Selection Procedure	Firm-year Observations
Available observations with goodwill balances from *Compustat* database over 2002-2005 for durable manufacturer, computer, and service industries	7,463
Observations deleted due to	
- No goodwill impairment	6,160
- Missing data	473
- Non-December 31 fiscal year-end	316
	514
Less:	
- No 10K report or not actually goodwill impairment	42
- No control firms with a match on size and industry	27
The final sample	445
Impairment observations classified by industry	
- Durable Manufacturers	173
- Computers	161
- Services	111
Total	445

Note:
1. The final impairment sample is matched with firms having no goodwill impairment over the entire period of 2002-2005. The matched control has the same two-digit SIC code, similar size (total assets at the beginning of year *t*), and belongs to the same year.

TABLE 4.3
Sample Distribution by Industry (Cross-Sectional Analysis)

Description	2002	2003	2004	2005	Total Firm-Year Obs.
Panel A: Durable Manufacturers					
Impairment firms in year *t*	51	40	37	45	173
Non-impairment firms in year *t*	51	40	37	45	173
Total	102	80	74	90	346
Panel B: Computers					
Impairment firms in year *t*	71	34	23	33	161
Non-impairment firms in year *t*	71	34	23	33	161
Total	142	68	46	66	322
Panel C: Services					
Impairment firms in year *t*	26	30	29	26	111
Non-impairment firms in year *t*	26	30	29	26	111
Total	52	60	58	52	222

TABLE 4.4
Input/Output Variables in the DEA Model

Variable	Description (*Compustat* item)
Inputs	
Cost of goods sold *(COGS)*	All costs directly allocated by the company to the production (Item 41)
Selling, general and administrative expenses *(SG&A)*	All expenses of operation incurred in the regular course of business pertaining to the securing of operating income (Item 189)
Current assets *(CA)*	Cash or other assets that are expected to be realized in cash or used in the production of revenue within the next 12 months (Item 4)
Fixed assets *(FA)*	Cost, less accumulated depreciation, of tangible fixed property used in the production of revenue (Item 8)
Intangible assets *(INTAN)*	Value of intangible assets, including goodwill (Item 33)
Outputs	
Sales (*S*)	Net sales in income statements (Item 12)
Income before extraordinary items (*IB*)	Income of a company (Item 18) after all expenses, including special items, income taxes, and minority interest. This item does not include discontinued operations or extraordinary items.
Operating cash flows (*OCF*)	Change in cash from all items classified in the operating activities section on statement of cash flows (Item 308)

Note:

1. Current assets, fixed assets, and intangible assets are average balances calculated by adding the beginning balances to the ending balances of the fiscal year and dividing by two.

TABLE 4.5
Combinations of Input/Output Variables in the DEA Model

DEA Model	Input Variable	Output Variable
Model 1	*OE, TA*	*S*
Model 2	*OE, TA*	*S, OCF*
Model 3	*OE, TA*	*S, OCF, IB*
Model 4	*OE, CA, FA, INTAN*	*S*
Model 5	*OE, CA, FA, INTAN*	*S, OCF*
Model 6	*OE, CA, FA, INTAN*	*S, OCF, IB*
Model 7	*COGS, SG&A, CA, FA, INTAN*	*S*
Model 8	*COGS, SG&A, CA, FA, INTAN*	*S, OCF, IB*

Variable definitions:

1. Input variables: *COGS* is cost of goods sold; *SG&A* is selling, general, and administrative expenses; *OE* is operating expenses, equaling to cost of goods sold plus selling, general and administrative expenses; *CA* is current assets; *FA* is fixed assets; *INTAN* is intangible assets; *TA* is total assets;.
2. Output variables: *S* is sales; *OCF* is operating cash flows; *IB* is income before extraordinary items.

TABLE 4.6
Descriptive Statistics

Panel A: Durable Manufacturers

	Impairment			Non-Impairment			Mean Differences	Median Differences
Variable	Mean	Median	S.D.	Mean	Median	S.D.	|t-stat|	|z-stat|
(Impairment N=173, Non-Impairment N=173)								
Inputs ($million)								
COGS	792.62	71.84	1689	806.32	106.67	1675	0.08	1.40
SG&A	166.72	33.74	364	192.34	46.39	376	0.64	1.18
OE	952.26	104.54	2010	998.62	164.48	1995	0.18	0.97
CA	456.78	71.79	908	470.59	100.69	886	0.14	1.18
FA	231.50	20.74	506	219.87	26.25	419	0.23	0.75
INTAN	229.14	15.26	585	361.49	24.03	953	1.56	0.97
TA	1062.57	138.53	2231	1134.64	148.79	2285	0.30	0.32
Outputs ($million)								
S	1063.92	110.15	2315	1145.53	182.28	2291	0.33	1.40
IB	-21.11	-11.16	236	66.81	8.13	169	3.98***	9.34***
OCF	66.03	-0.12	240	100.92	11.64	210	1.44	3.54***
Size of Goodwill and Impairment								
Goodwill ($million)	208.78	15.28	509.18	290.66	13.01	775.02	1.16	0.32
Goodwill/Total assets	0.17	0.13	0.16	0.17	0.13	0.16	0.17	0.11
Impairment ($million)	28.77	4.53	60.17					
Impairment/Goodwill	0.69	0.40	2.66					
Impairment/Total assets	0.24	0.03	1.13					

TABLE 4.6 (Continued)

Panel B: Computers

Variable	Impairment Mean	Impairment Median	Impairment S.D.	Non-Impairment Mean	Non-Impairment Median	Non-Impairment S.D.	Mean Differences |t-stat|	Median Differences |z-stat|
(Impairment N=161, Non-Impairment N=161)								
Inputs ($million)								
COGS	126.66	24.92	345	190.61	26.06	644	1.11	0.11
SG&A	85.84	23.61	237	114.68	27.07	386	0.81	0.11
OE	212.50	58.49	548	305.29	77.78	1015	1.02	0.78
CA	174.02	39.52	502	249.62	47.06	910	0.92	0.78
FA	106.92	4.56	538	110.93	6.17	552	0.07	1.22
INTAN	101.83	11.12	373	65.65	7.96	173	1.12	1.00
TA	434.04	86.56	1481	505.17	96.14	1890	0.38	0.11
Outputs ($million)								
S	229.73	43.72	667	372.24	75.14	1352	1.20	1.67*
IB	-110.67	-16.53	487	14.94	0.08	160	3.11***	9.01***
OCF	16.89	-1.64	151	59.88	4.05	311	1.58	8.37***
Size of Goodwill and Impairment								
Goodwill ($million)	118.36	11.65	482.82	46.56	2.86	137.75	1.81*	2.78***
Goodwill/Total assets	0.24	0.16	0.21	0.14	0.08	0.15	4.94***	4.29***
Impairment ($million)	65.40	5.53	376.35					
Impairment/Goodwill	0.65	0.59	0.52					
Impairment/Total assets	0.33	0.09	1.41					

TABLE 4.6 (Continued)

Panel C: Services

Variable	Impairment Mean	Impairment Median	Impairment S.D.	Non-Impairment Mean	Non-Impairment Median	Non-Impairment S.D.	Mean Differences |t-stat|	Median Differences |z-stat|
(Impairment N =111, Non-Impairment N=111)								
Inputs								
COGS	859.30	178.42	1805	1099.71	234.00	3057	0.71	0.94
SG&A	207.10	48.65	528	91.33	34.10	248	2.09**	1.47
OE	1066.41	243.18	2039	1191.03	312.97	3130	0.35	0.94
CA	525.89	89.04	1412	560.00	101.64	1450	0.18	0.67
FA	425.52	36.37	969	530.88	32.68	1600	0.59	0.13
INTAN	433.62	56.00	845	443.38	57.12	1134	0.07	0.13
TA	1527.68	244.30	2991	1666.78	254.52	3837	0.30	0.13
Outputs								
S	1228.16	286.66	2286	1415.72	340.57	3647	0.46	1.47
IB	-101.22	-21.25	303	75.81	10.46	220	4.98***	8.44***
OCF	110.41	14.57	260	166.70	24.40	410	1.22	1.74*
Size of Goodwill and Impairment								
Goodwill ($million)	450.73	53.14	882.60	381.50	32.94	1047	0.53	1.21
Goodwill/Total assets	0.28	0.27	0.19	0.21	0.14	0.2	2.62***	3.08***
Impairment ($million)	102.63	15.78	250.99					
Impairment/Goodwill	0.80	0.28	3.07					
Impairment/Assets	0.19	0.06	0.49					

TABLE 4.6 (Continued)

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level (two-tailed), respectively. The t-statistics for mean differences and z-statistics for median differences are reported in absolute values.
2. Input variable definitions: *COGS* is cost of goods sold; *SG&A* is selling, general, and administrative expenses; *OE* is operating expenses, equaling to cost of goods sold plus selling, general and administrative expenses; *CA* is current assets; *FA* is fixed assets; *INTAN* is intangible assets; *TA* is total assets. *CA, FA, INTAN,* and *TA* are average balances calculated by adding the beginning balances to the ending balances of the fiscal year and dividing by two.
3. Output variable definitions: *S* is sales; *OCF* is operating cash flows; *IB* is income before extraordinary items.
4. Impairment loss is the pre-tax goodwill impairment recognized in the fiscal year.
5. Goodwill and total assts are measured at the beginning balance of the fiscal year.

TABLE 4.7
Pooled Cross-Sectional Analysis (Relative Efficiency Scores Based on Overall Index vs. Within-Group Index)

Difference in Distribution		Wilcoxon Mean Score: Impairment Overall Index	Impairment Within-Group Index	Impairment Wilcoxon Z-Score		Non-Impairment Overall Index	Non-Impairment Within-Group Index	Non-Impairment Wilcoxon Z-Score	
Panel A: Durable Manufacturers (N = 346)									
Model 1	Inputs: OE, AT Outputs: S	163.97	183.03	1.77	*	163.51	183.49	1.86	*
Model 2	Inputs: OE, AT Outputs: S, OCF	162.53	184.47	2.04	**	162.37	184.63	2.07	**
Model 3	Inputs: OE, AT Outputs: S, OCF, IB	161.27	185.73	2.28	**	162.96	184.04	1.96	**
Model 4	Inputs: OE, CA, FA, INTAN Outputs: S	145.76	201.24	5.17	***	164.85	182.15	1.61	
Model 5	Inputs: OE, CA, FA, INTAN Outputs: S, OCF	164.09	182.91	1.75	*	158.57	188.43	2.79	***
Model 6	Inputs: OE, CA, FA, INTAN Outputs: S, OCF, IB	163.50	183.50	1.86	*	158.47	188.53	2.82	***
Model 7	Inputs: COGS, SGA, CA, FA, INTAN Outputs: S	160.17	186.83	2.50	**	158.75	188.25	2.77	***
Model 8	Inputs: COGS, SGA, CA, FA, INTAN Outputs: S, OCF, IB	157.80	189.20	2.95	***	157.32	189.68	3.07	***

TABLE 4.7 (Continued)

Difference in Distribution		Wilcoxon Mean Score: Impairment Overall Index	Impairment Within-Group Index	Impairment Wilcoxon Z-Score	Non-Impairment Overall Index	Non-Impairment Within-Group Index	Non-Impairment Wilcoxon Z-Score
Panel B: Computers (N=322)							
Model 1	Inputs: OE, AT Outputs: S	152.99	170.01	1.64 *	151.33	171.67	1.96 **
Model 2	Inputs: OE, AT Outputs: S, OCF	151.40	171.60	1.95 *	152.38	170.62	1.76 *
Model 3	Inputs: OE, AT Outputs: S, OCF, IB	150.63	172.40	2.09 **	152.86	170.14	1.67 *
Model 4	Inputs: OE, CA, FA, INTAN Outputs: S	151.83	171.17	1.87 *	153.33	169.67	1.58
Model 5	Inputs: OE, CA, FA, INTAN Outputs: S, OCF	150.34	172.66	2.15 **	152.81	170.19	1.69 *
Model 6	Inputs: OE, CA, FA, INTAN Outputs: S, OCF, IB	149.92	173.08	2.24 **	153.11	169.89	1.63
Model 7	Inputs: COGS, SGA, CA, FA, INTAN Outputs: S	141.85	181.15	3.81 ***	151.61	171.39	1.94 *
Model 8	Inputs: COGS, SGA, CA, FA, INTAN Outputs: S, OCF, IB	139.34	183.66	4.33 ***	151.52	171.48	1.98 **

TABLE 4.7 (Continued)

Difference in Distribution		Wilcoxon Mean Score: Impairment Overall Index	Impairment Within-Group Index	Impairment Wilcoxon Z-Score	Non-Impairment Overall Index	Non-Impairment Within-Group Index	Non-Impairment Wilcoxon Z-Score
Panel C: Services (N=222)							
Model 1	Inputs: OE, AT Outputs: S	97.29	125.71	3.30 ***	106.91	116.09	1.06
Model 2	Inputs: OE, AT Outputs: S, OCF	97.92	125.09	3.15 ***	106.60	116.40	1.14
Model 3	Inputs: OE, AT Outputs: S, OCF, IB	94.92	128.08	3.86 ***	108.11	114.89	0.79
Model 4	Inputs: OE, CA, FA, INTAN Outputs: S	84.29	138.71	6.33 ***	107.63	115.37	0.90
Model 5	Inputs: OE, CA, FA, INTAN Outputs: S, OCF	88.39	134.61	5.40 ***	107.89	115.11	0.86
Model 6	Inputs: OE, CA, FA, INTAN Outputs: S, OCF, IB	87.12	135.89	5.73 ***	108.55	114.45	0.71
Model 7	Inputs: COGS, SGA, CA, FA, INTAN Outputs: S	89.87	133.13	5.09 ***	104.42	118.58	1.71 *
Model 8	Inputs: COGS, SGA, CA, FA, INTAN Outputs: S, OCF, IB	89.96	133.04	5.14 ***	106.32	116.68	1.32

TABLE 4.7 (Continued)

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level (two-tailed), respectively. The null hypothesis assumes that the expected rank sums of the overall indices and the within-group indices are the same. Wilcoxon Z-cores are two-sided tests.
2. Input variable definitions: *COGS* is cost of goods sold; *SG&A* is selling, general, and administrative expenses; *OE* is operating expenses, equaling to cost of goods sold plus selling, general and administrative expenses; *CA* is current assets; *FA* is fixed assets; *INTAN* is intangible assets; *TA* is total assets. *CA, FA, INTAN*, and *TA* are average balances calculated by adding the beginning balances to the ending balances of the fiscal year and dividing by two.
3. Output variable definitions: *S* is sales; *OCF* is operating cash flows; *IB* is income before extraordinary items.

TABLE 4.8
Pooled Cross-Sectional Analysis (Impairment vs. Non-Impairment)

Difference in Distribution		Wilcoxon Mean Score: Impairment (EI_b)	Wilcoxon Mean Score: Non-Impairment (EI_b)	Wilcoxon Z-Score	
Panel A: Durable Manufacturers (N=346)					
Model 1	Inputs: OE, AT Outputs: S	147.07	199.93	4.91	***
Model 2	Inputs: OE, AT Outputs: S, OCF	143.36	203.64	5.61	***
Model 3	Inputs: OE, AT Outputs: S, OCF, IB	134.54	212.46	7.25	***
Model 4	Inputs: OE, CA, FA, INTAN Outputs: S	138.29	208.71	6.55	***
Model 5	Inputs: OE, CA, FA, INTAN Outputs: S, OCF	157.49	189.51	2.98	***
Model 6	Inputs: OE, CA, FA, INTAN Outputs: S, OCF, IB	152.77	194.23	3.87	***
Model 7	Inputs: COGS, SGA, CA, FA, INTAN Outputs: S	146.03	200.97	5.13	***
Model 8	Inputs: COGS, SGA, CA, FA, INTAN Outputs: S, OCF, IB	143.64	203.36	5.60	***

TABLE 4.8 (Continued)

Difference in Distribution		Wilcoxon Mean Score: Impairment (EI_b)	Wilcoxon Mean Score: Non-Impairment (EI_b)	Wilcoxon Z-Score	
Panel B: Computers (N=322)					
Model 1	Inputs: OE, AT Outputs: S	128.80	194.20	6.31	***
Model 2	Inputs: OE, AT Outputs: S, OCF	120.60	202.40	7.89	***
Model 3	Inputs: OE, AT Outputs: S, OCF, IB	118.98	204.02	8.20	***
Model 4	Inputs: OE, CA, FA, INTAN Outputs: S	128.39	194.61	6.42	***
Model 5	Inputs: OE, CA, FA, INTAN Outputs: S, OCF	123.07	199.93	7.45	***
Model 6	Inputs: OE, CA, FA, INTAN Outputs: S, OCF, IB	121.58	201.42	7.73	***
Model 7	Inputs: COGS, SGA, CA, FA, INTAN Outputs: S	124.30	198.70	7.23	***
Model 8	Inputs: COGS, SGA, CA, FA, INTAN Outputs: S, OCF, IB	123.68	199.32	7.39	***

TABLE 4.8 (Continued)

Difference in Distribution		Wilcoxon Mean Score: Impairment (EI_b)	Wilcoxon Mean Score: Non-Impairment (EI_b)	Wilcoxon Z-Score	
Panel C: Services (N=222)					
Model 1	Inputs: OE, AT Outputs: S	81.47	141.53	6.97	***
Model 2	Inputs: OE, AT Outputs: S, OCF	83.56	139.44	6.49	***
Model 3	Inputs: OE, AT Outputs: S, OCF, IB	75.07	147.93	8.48	***
Model 4	Inputs: OE, CA, FA, INTAN Outputs: S	74.77	148.23	8.54	***
Model 5	Inputs: OE, CA, FA, INTAN Outputs: S, OCF	73.99	149.01	8.81	***
Model 6	Inputs: OE, CA, FA, INTAN Outputs: S, OCF, IB	73.03	149.97	9.06	***
Model 7	Inputs: COGS, SGA, CA, FA, INTAN Outputs: S	82.36	140.64	6.89	***
Model 8	Inputs: COGS, SGA, CA, FA, INTAN Outputs: S, OCF, IB	83.82	139.18	6.63	***

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level (one-tailed), respectively. The null hypothesis assumes that the impairment firms are at least as efficient as the non-impairment firms. Wilcoxon Z-cores are one-sided tests.
2. Input variable definitions: *COGS* is cost of goods sold; *SG&A* is selling, general, and administrative expenses; *OE* is operating expenses, equaling to cost of goods sold plus selling, general and administrative expenses; *CA* is current assets; *FA* is fixed assets; *INTAN* is intangible assets; *TA* is total assets. *CA, FA,INTAN*, and *TA* are average balances calculated by adding the beginning balances to the ending balances of the fiscal year and dividing by two.
3. Output variable definitions: *S* is sales; *OCF* is operating cash flows; *IB* is income before extraordinary items.

TABLE 4.9
Durable Manufacturers: Cross-Sectional Analysis by Year

Panel A: Frequencies and Summary Statistics

Efficiency Score		Overall Index (EI)		Within-Group Index (EI_w)		Between-Group Index (EI_b)	
Ranges	Total	Imp	Non-Imp	Imp	Non-Imp	Imp	Non-Imp
1) Year 2002							
1.00	43	17	26	25	35	17	30
0.9-0.99	27	8	19	8	13	21	20
0.8-0.89	9	5	4	2	2	11	0
0.7-0.79	6	5	1	4	1	2	0
0.6-0.69	10	9	1	9	0	0	1
0.5-0.59	5	5	0	2	0	0	0
0.4-0.49	2	2	0	1	0	0	0
< 0.4	0	0	0	0	0	0	0
N	102	51	51	51	51	51	51
Mean		0.83	0.96	0.88	0.98	0.94	0.98
S.D.		0.18	0.06	0.16	0.05	0.07	0.05
2) Year 2003							
1.00	35	17	18	24	25	17	18
0.9-0.99	21	6	15	5	12	21	19
0.8-0.89	13	9	4	3	2	2	1
0.7-0.79	4	3	1	4	0	0	0
0.6-0.69	1	1	0	2	1	0	0
0.5-0.59	4	3	1	1	0	0	2
0.4-0.49	1	1	0	1	0	0	0
< 0.4	1	0	1	0	0	0	0
N	80	40	40	40	40	40	40
Mean		0.89	0.94	0.91	0.97	0.98	0.96
S.D.		0.15	0.12	0.14	0.06	0.04	0.10
3) Year 2004							
1.00	42	19	23	23	29	19	24
0.9-0.99	19	8	11	10	7	16	12
0.8-0.89	10	7	3	2	1	2	1
0.7-0.79	2	2	0	2	0	0	0
0.6-0.69	1	1	0	0	0	0	0
0.5-0.59	0	0	0	0	0	0	0
0.4-0.49	0	0	0	0	0	0	0
< 0.4	0	0	0	0	0	0	0
N	74	37	37	37	37	37	37
Mean		0.94	0.97	0.96	0.99	0.98	0.99
S.D.		0.08	0.04	0.07	0.03	0.03	0.03

TABLE 4.9 (Continued)

Efficiency Score Ranges	Total	Overall Index (EI)		Within-Group Index (EI_w)		Between-Group Index (EI_b)	
		Imp	Non-Imp	Imp	Non-Imp	Imp	Non-Imp
4) Year 2005							
1.00	40	18	22	24	30	18	24
0.9-0.99	23	7	16	12	11	14	17
0.8-0.89	13	10	3	3	3	8	3
0.7-0.79	5	2	3	1	1	4	0
0.6-0.69	3	3	0	0	0	0	0
0.5-0.59	1	1	0	4	0	1	0
0.4-0.49	2	2	0	1	0	0	0
< 0.4	3	2	1	0	0	0	1
N	90	45	45	45	45	45	45
Mean		0.86	0.94	0.92	0.97	0.93	0.96
S.D.		0.19	0.13	0.15	0.05	0.10	0.13

Panel B: Relative Efficiency Scores Based on Overall Index vs. Within-Group Index Comparison

Difference in Distribution	Wilcoxon Mean Score: Overall Index	Wilcoxon Mean Score: Within-Group Index	Wilcoxon Z-Score	
1) Year 2002 (N=102)				
Impairment firms	46.32	56.68	1.83	*
Non-impairment firms	47.11	55.89	1.69	*
2) Year 2003 (N=80)				
Impairment firms	37.50	43.50	1.24	
Non-impairment firms	36.43	44.58	1.70	*
3) Year 2004 (N=74)				
Impairment firms	34.82	40.18	1.18	
Non-impairment firms	34.22	40.78	1.62	
4) Year 2005 (N=90)				
Impairment firms	40.58	50.42	1.88	*
Non-impairment firms	40.88	50.12	1.86	*

TABLE 4.9 (Continued)

Panel C: Impairment vs. Non-impairment Comparison

Difference in Distribution	Wilcoxon Mean Score		Wilcoxon Z-Score	
	Impairment	Non-Impairment		
1) Year 2002 (N=102)				
Impairment (EI_b) vs. Non-Impairment (EI_b)	40.21	62.79	4.04	***
2) Year 2003 (N=80)				
Impairment (EI_b) vs. Non-Impairment (EI_b)	39.25	41.75	0.50	
3) Year 2004 (N=74)				
Impairment (EI) vs. Non-Impairment (EI)	34.18	40.82	1.46	*
4) Year 2005 (N=90)				
Impairment (EI_b) vs. Non-Impairment (EI_b)	39.71	51.29	2.20	**

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively.
2. For Panel B, the null hypothesis assumes that the expected rank sums of the overall indices and the within-group indices are the same. Wilcoxon Z-cores are two-sided tests.
3. For Panel C, the null hypothesis assumes that the impairment firms are at least as efficient as the non-impairment firms. Wilcoxon Z-cores are one-sided tests.
4. The DEA Model for this analysis has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and an output variable (sales).

TABLE 4.10
Computers: Cross-Sectional Analysis by Year

Panel A: Frequencies and Summary Statistics

Efficiency Score Ranges	Total	Overall Index (EI)		Within-Group Index (EI_w)		Between-Group Index (EI_b)	
		Imp	Non-Imp	Imp	Non-Imp	Imp	Non-Imp
1) Year 2002							
1.00	45	13	32	32	36	14	45
0.9-0.99	16	6	10	7	12	13	21
0.8-0.89	21	8	13	10	8	20	3
0.7-0.79	25	13	12	4	12	13	1
0.6-0.69	10	9	1	5	0	7	0
0.5-0.59	10	8	2	4	2	3	1
0.4-0.49	5	5	0	6	0	1	0
< 0.4	10	9	1	3	1	0	0
N	142	71	71	71	71	71	71
Mean		0.71	0.89	0.84	0.91	0.84	0.98
S.D.		0.23	0.16	0.21	0.15	0.13	0.07
2) Year 2003							
1.00	34	13	21	24	24	13	22
0.9-0.99	4	3	1	3	2	7	9
0.8-0.89	12	6	6	4	3	6	2
0.7-0.79	9	5	4	1	3	4	1
0.6-0.69	5	3	2	0	2	3	0
0.5-0.59	1	1	0	1	0	1	0
0.4-0.49	3	3	0	1	0	0	0
< 0.4	0	0	0	0	0	0	0
N	68	34	34	34	34	34	34
Mean		0.84	0.93	0.94	0.94	0.89	0.98
S.D.		0.18	0.12	0.13	0.11	0.13	0.05
3) Year 2004							
1.00	29	13	16	16	17	14	17
0.9-0.99	4	3	1	4	5	3	3
0.8-0.89	6	2	4	2	0	4	2
0.7-0.79	2	2	0	0	0	2	0
0.6-0.69	4	2	2	1	1	0	1
0.5-0.59	1	1	0	0	0	0	0
0.4-0.49	0	0	0	0	0	0	0
< 0.4	0	0	0	0	0	0	0
N	46	23	23	23	23	23	23
Mean		0.91	0.94	0.96	0.98	0.94	0.96
S.D.		0.13	0.1	0.09	0.07	0.08	0.08

TABLE 4.10 (Continued)

Efficiency Score Ranges	Total	Overall Index (EI)		Within-Group Index (EI_w)		Between-Group Index (EI_b)	
		Imp	Non-Imp	Imp	Non-Imp	Imp	Non-Imp
4) Year 2005							
1.00	32	16	16	20	23	17	17
0.9-0.99	11	3	8	2	5	12	14
0.8-0.89	12	6	6	4	4	2	1
0.7-0.79	2	1	1	2	0	0	0
0.6-0.69	3	3	0	3	0	2	0
0.5-0.59	3	2	1	0	0	0	1
0.4-0.49	2	1	1	1	1	0	0
< 0.4	1	1	0	1	0	0	0
N	66	33	33	33	33	33	33
Mean		0.86	0.93	0.9	0.96	0.96	0.97
S.D.		0.19	0.13	0.17	0.1	0.09	0.08

Panel B: Relative Efficiency Scores Based on Overall Index vs. Within-Group Index Comparison

Difference in Distribution	Wilcoxon Mean Score: Overall Index	Wilcoxon Mean Score: Within-Group Index	Wilcoxon Z-Score	
1) Year 2002 (N=142)				
Impairment firms	59.40	83.60	3.56	***
Non-impairment firms	68.87	74.13	0.80	
2) Year 2003 (N=68)				
Impairment firms	28.09	40.91	2.91	***
Non-impairment firms	32.87	36.13	0.80	
3) Year 2004 (N=46)				
Impairment firms	21.35	25.65	1.24	
Non-impairment firms	22.41	24.59	0.68	
4) Year 2005 (N=66)				
Impairment firms	31.55	35.45	0.90	
Non-impairment firms	29.91	37.09	1.70	*

TABLE 4.10 (Continued)

Panel C: Impairment vs. Non-impairment Comparison

Difference in Distribution	Wilcoxon Mean Score		Wilcoxon Z-Score	
	Impairment	Non-Impairment		
1) Year 2002 (N=142)				
Impairment (EI_b) vs. Non-Impairment (EI_b)	48.77	94.23	6.77	***
2) Year 2003 (N=68)				
Impairment (EI_b) vs. Non-Impairment (EI_b)	27.76	41.24	3.02	***
3) Year 2004 (N=46)				
Impairment (EI) vs. Non-Impairment (EI)	21.87	25.13	0.94	
4) Year 2005 (N=66)				
Impairment (EI_b) vs. Non-Impairment (EI_b)	32.48	34.52	0.45	

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively.
2. For Panel B, the null hypothesis assumes that the expected rank sums of the overall indices and the within-group indices are the same. Wilcoxon Z-cores are two-sided tests.
3. For Panel C, the null hypothesis assumes that the impairment firms are at least as efficient as the non-impairment firms. Wilcoxon Z-cores are one-sided tests.
4. The DEA Model for this analysis has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and an output variable (sales).

TABLE 4.11
Services: Cross-Sectional Analysis by Year

Panel A: Frequencies and Summary Statistics

Efficiency Score Ranges	Total	Overall Index (EI)		Within-Group Index (EI_w)		Between-Group Index (EI_b)	
		Imp	Non-Imp	Imp	Non-Imp	Imp	Non-Imp
1) Year 2002							
1.00	31	10	21	19	22	10	22
0.9-0.99	7	5	2	5	1	8	4
0.8-0.89	7	6	1	1	2	5	0
0.7-0.79	4	3	1	1	0	2	0
0.6-0.69	2	2	0	0	0	1	0
0.5-0.59	1	0	1	0	1	0	0
< 0.5	0	0	0	0	0	0	0
N	52	26	26	26	26	26	26
Mean		0.9	0.97	0.97	0.97	0.92	0.99
S.D.		0.12	0.09	0.05	0.09	0.1	0.01
2) Year 2003							
1.00	31	13	18	23	22	13	20
0.9-0.99	14	4	10	4	7	6	9
0.8-0.89	5	5	0	3	0	9	0
0.7-0.79	8	7	1	0	0	1	1
0.6-0.69	2	1	1	0	1	1	0
0.5-0.59	0	0	0	0	0	0	0
< 0.5	0	0	0	0	0	0	0
N	60	30	30	30	30	30	30
Mean		0.91	0.97	0.98	0.98	0.92	0.99
S.D.		0.11	0.07	0.05	0.06	0.09	0.04
3) Year 2004							
1.00	27	7	20	22	21	7	21
0.9-0.99	13	8	5	4	4	9	8
0.8-0.89	14	10	4	3	4	11	0
0.7-0.79	3	3	0	0	0	2	0
0.6-0.69	1	1	0	0	0	0	0
0.5-0.59	0	0	0	0	0	0	0
< 0.5	0	0	0	0	0	0	0
N	58	29	29	29	29	29	29
Mean		0.9	0.96	0.98	0.97	0.92	0.99
S.D.		0.07	0.06	0.05	0.05	0.07	0.02

TABLE 4.11 (Continued)

Efficiency Score Ranges	Total	Overall Index (EI)		Within-Group Index (EI_w)		Between-Group Index (EI_b)	
		Imp	Non-Imp	Imp	Non-Imp	Imp	Non-Imp
4) Year 2005							
1.00	32	14	18	18	21	14	18
0.9-0.99	10	6	4	7	3	11	6
0.8-0.89	8	6	2	1	1	1	2
0.7-0.79	2	0	2	0	1	0	0
0.6-0.69	0	0	0	0	0	0	0
0.5-0.59	0	0	0	0	0	0	0
< 0.5	0	0	0	0	0	0	0
N	52	26	26	26	26	26	26
Mean		0.96	0.96	0.98	0.98	0.98	0.98
S.D.		0.06	0.07	0.04	0.05	0.04	0.04

Panel B: Relative Efficiency Scores Based on Overall Index vs. Within-Group Index Comparison

Difference in Distribution	Wilcoxon Mean Score: Overall Index	Wilcoxon Mean Score: Within-Group Index	Wilcoxon Z-Score	
1) Year 2002 (N=52)				
Impairment firms	21.04	31.96	2.85	***
Non-impairment firms	26.02	26.98	0.33	
2) Year 2003 (N=60)				
Impairment firms	24.42	36.58	3.04	***
Non-impairment firms	28.57	32.43	1.01	
3) Year 2004 (N=58)				
Impairment firms	20.90	38.10	4.14	***
Non-impairment firms	28.83	30.17	0.37	
4) Year 2005 (N=52)				
Impairment firms	24.04	28.96	1.33	
Non-impairment firms	24.81	28.19	1.05	

TABLE 4.11 (Continued)

Panel C: Impairment vs. Non-impairment Comparison

Difference in Distribution	Wilcoxon Mean Score		Wilcoxon Z-Score	
	Impairment	Non-Impairment		
1) Year 2002 (N=52)				
Impairment (EI_b) vs. Non-Impairment (EI_b)	19.54	33.46	3.77	***
2) Year 2003 (N=60)				
Impairment (EI_b) vs. Non-Impairment (EI_b)	25.03	35.97	2.65	***
3) Year 2004 (N=58)				
Impairment (EI_b) vs. Non-Impairment (EI_b)	19.83	39.17	4.59	***
4) Year 2005 (N=52)				
Impairment (EI) vs. Non-Impairment (EI)	24.85	28.15	0.89	

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively.
2. For Panel B, the null hypothesis assumes that the expected rank sums of the overall indices and the within-group indices are the same. Wilcoxon Z-cores are two-sided tests.
3. For Panel C, the null hypothesis assumes that the impairment firms are at least as efficient as the non-impairment firms. Wilcoxon Z-cores are one-sided tests.
4. The DEA Model for this analysis has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and an output variable (sales).

TABLE 4.12
Sample Distribution by Industry for Longitudinal Analysis

Description	2002 vs. 2003		2003 vs. 2004		2004 vs. 2005		Total Year t vs. t+1	
	2002	2003	2003	2004	2004	2005	Year t	Year t+1
Panel A: Durable Manufacturers								
1. Impairment t, Impairment t+1	9	9	10	10	9	9	28	28
2. Impairment t, Non-Impairment t+1	28	28	27	27	19	19	74	74
3. Non-Impairment t, Impairment t+1	36	36	29	29	42	42	107	107
4. Non-Impairment t, Non-Impairment t+1	50	50	51	51	40	40	141	141
Total impairment sample	123	123	117	117	110	110	350	350
Control sample	124	124	123	123	122	122	369	369
Panel B: Computers								
1. Impairment t, Impairment t+1	15	15	4	4	7	7	26	26
2. Impairment t, Non-Impairment t+1	33	33	22	22	8	8	63	63
3. Non-Impairment t, Impairment t+1	18	18	14	14	24	24	56	56
4. Non-Impairment t, Non-Impairment t+1	22	22	43	43	40	40	105	105
Total impairment sample	88	88	83	83	79	79	250	250
Control sample	107	107	109	109	104	104	320	320
Panel C: Services								
1. Impairment t, Impairment t+1	9	9	8	8	8	8	25	25
2. Impairment t, Non-Impairment t+1	16	16	20	20	14	14	50	50
3. Non-Impairment t, Impairment t+1	19	19	16	16	17	17	52	52
4. Non-Impairment t, Non-Impairment t+1	25	25	25	25	27	27	77	77
Total impairment sample	69	69	69	69	66	66	204	204
Control sample	80	80	83	83	81	81	244	244

TABLE 4.13
Pooled Longitudinal Analysis

Panel A: Relative Efficiency Scores Based on Overall Index vs. Within-Group Index Comparison

	Durable Manufacturers				Computers				Services			
	Wilcoxon Mean Score				Wilcoxon Mean Score				Wilcoxon Mean Score			
Difference in Distribution	Overall Index	Within-Group Index	Wilcoxon Z-Score		Overall Index	Within-Group Index	Wilcoxon Z-Score		Overall Index	Within-Group Index	Wilcoxon Z-Score	
1) Impairment t, Impairment t+1												
Year t	27.41	29.6	0.55		25.19	27.81	0.72		23.36	27.64	1.47	
Year t+1	27.88	29.13	0.31		25.15	27.85	0.88		25.44	25.56	0.03	
2) Impairment t, Non-Impairment t+1												
Year t	65.32	83.68	2.7	***	56.06	70.94	2.30	**	44.54	56.46	2.17	**
Year t+1	72.16	76.85	0.7		61.32	65.68	0.70		48.63	52.37	0.72	
3) Non-Impairment t, Impairment t+1												
Year t	100.58	114.42	1.66	*	52.23	60.77	1.47		50.01	54.99	0.94	
Year t+1	103.38	111.62	0.99		54.03	58.97	0.84		47.60	57.40	1.75	*
4) Non-Impairment t, Non-Impairment t+1												
Year t	136.76	146.24	0.99		99.49	111.51	1.47		74.82	80.18	0.80	
Year t+1	130.25	152.75	2.37	**	100.30	110.70	1.27		73.47	81.53	1.22	
Control Sample												
Year t	353.57	385.43	2.04	**	309.28	331.72	1.55		233.67	255.33	1.72	*
Year t+1	347.29	391.71	2.84	***	313.64	327.36	0.95		234.50	254.50	1.58	

TABLE 4.13 (Continued)

Panel B: Year t vs. Yeat t+1 Comparison

	Durable Manufacturers				Computers				Services			
	Wilcoxon Mean Score		Wilcoxon		Wilcoxon Mean Score		Wilcoxon		Wilcoxon Mean Score		Wilcoxon	
Difference in Distribution	Year t	Year t+1	Z-Score		Year t	Year t+1	Z-Score		Year t	Year t+1	Z-Score	
1) Impairment t, Impairment t+1	27.96	29.04	0.26		24.74	28.27	1.00		24.12	26.88	0.91	
2) Impairment t, Non-Impairment t+1	57.64	91.36	4.93	***	44.47	82.53	5.96	***	44.52	56.48	2.19	**
3) Non-Impairment t, Impairment t+1	101.01	113.99	1.55	*	56.20	56.80	0.10		60.83	44.17	-2.97	***
4) Non-Impairment t, Non-Impairment t+1	158.77	124.23	-3.62	***	103.85	107.15	0.40		75.86	79.14	0.48	
Control Sample Non-Impairment t, Non-Impairment t+1	359.53	379.47	1.28		317.64	323.36	0.39		243.90	245.10	0.10	

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively.
2. For Panel A, the null hypothesis assumes that the expected rank sums of the overall indices and the within-group indices are the same. Wilcoxon Z-cores are two-sided tests.
3. For Panel B, the null hypothesis assumes that firms in year t are at least as efficient as firms in year t+1, or vice versa. Wilcoxon Z-cores are one-sided tests.
4. The DEA Model for this analysis has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets, fixed assets; and intangible assets) and an output variable (sales).

TABLE 4.14
Durable Manufacturers: Longitudinal Analysis by Two Years

Panel A: Relative Efficiency Scores Based on Overall Index vs. Within-Group Index Comparison

	2002 vs. 2003				2003 vs. 2004				2004 vs. 2005			
	Wilcoxon Mean Score				Wilcoxon Mean Score				Wilcoxon Mean Score			
Difference in Distribution	Overall Index	Within-Group Index	Wilcoxon Z-Score		Overall Index	Within-Group Index	Wilcoxon Z-Score		Overall Index	Within-Group Index	Wilcoxon Z-Score	
1) Impairment t, Impairment t+1												
Year t	8.89	10.11	0.56		10.05	10.95	0.40		8.61	10.39	0.79	
Year t+1	8.56	10.44	0.97		10.00	11.00	0.40		9.28	9.72	0.18	
2) Impairment t, Non-Impairment t+1												
Year t	22.52	34.48	3.11	***	22.02	32.98	2.75	***	19.32	19.68	0.11	
Year t+1	26.54	30.46	1.24		26.81	28.19	0.39		17.84	21.16	1.21	
3) Non-Impairment t, Impairment t+1												
Year t	33.60	39.40	1.33		28.79	30.21	0.36		39.83	45.17	1.05	
Year t+1	35.44	37.56	0.49		27.40	31.60	1.15		39.40	45.60	1.23	
4) Non-Impairment t, Non-Impairment t+1												
Year t	48.69	52.31	0.65		45.01	57.99	2.32	**	37.33	43.66	1.34	
Year t+1	44.76	56.24	2.09	**	48.94	54.06	1.00		38.05	42.95	1.07	
Control Sample												
Year t	112.84	136.16	2.60	***	114.38	132.62	2.05	**	114.10	130.90	1.92	*
Year t+1	114.82	134.18	2.18	**	115.86	131.14	1.72	*	116.12	128.88	1.45	

TABLE 4.14 (Continued)

Panel B: Year t vs. Year t+1 Comparison

	2002 vs. 2003				2003 vs. 2004				2004 vs. 2005			
	Wilcoxon Mean Score		Wilcoxon		Wilcoxon Mean Score		Wilcoxon		Wilcoxon Mean Score		Wilcoxon	
Difference in Distribution	2002	2003	Z-Score		2003	2004	Z-Score		2004	2005	Z-Score	
1) Impairment t, Impairment t+1	9.33	9.67	0.11		10.80	10.20	-0.22		8.50	10.50	0.89	
2) Impairment t, Non-Impairment t+1	22.21	34.79	3.16	***	19.72	35.28	4.07	***	19.47	19.53	0.00	
3) Non-Impairment t, Impairment t+1	36.00	37.00	0.22		28.90	30.10	0.30		42.33	42.67	0.06	
4) Non-Impairment t, Non-Impairment t+1	56.82	44.18	-2.28	**	45.19	57.81	2.26	**	38.38	42.63	0.87	
Control Sample												
Non-Impairment t, Non-Impairment t+1	119.85	129.15	1.03		111.03	135.97	2.80	***	111.8	133.2	2.42	***

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively.
2. For Panel A, the null hypothesis assumes that the expected rank sums of the overall indices and the within-group indices are the same. Wilcoxon Z-cores are two-sided tests.
3. For Panel B, the null hypothesis assumes that firms in year t are at least as efficient as firms in year t+1, or vice versa. Wilcoxon Z-cores are one-sided tests.
4. The DEA Model for this analysis has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and an output variable (sales).

TABLE 4.15
Computers: Longitudinal Analysis by Two Years

Panel A: Relative Efficiency Scores Based on Overall Index vs. Within-Group Index Comparison

	2002 vs. 2003				2003 vs. 2004				2004 vs. 2005			
	Wilcoxon Mean Score				Wilcoxon Mean Score				Wilcoxon Mean Score			
Difference in Distribution	Overall Index	Within-Group Index	Wilcoxon Z-Score		Overall Index	Within-Group Index	Wilcoxon Z-Score		Overall Index	Within-Group Index	Wilcoxon Z-Score	
1) Impairment t, Impairment t+1												
Year t	14.57	16.43	0.67		4.50	4.50	0.00		7.50	7.50	0.00	
Year t+1	14.43	16.57	0.92		4.50	4.50	0.00		7.50	7.50	0.00	
2) Impairment t, Non-Impairment t+1												
Year t	28.89	38.11	2.01	**	19.11	25.89	2.02	**	7.50	9.50	1.37	
Year t+1	32.21	34.79	0.60		21.07	23.93	0.83		8.50	8.50	0.00	
3) Non-Impairment t, Impairment t+1												
Year t	16.06	20.94	1.69	*	13.43	15.57	0.93		22.94	26.06	0.89	
Year t+1	17.94	19.06	0.37		13.93	15.07	0.52		23.92	25.08	0.32	
4) Non-Impairment t, Non-Impairment t+1												
Year t	21.11	23.89	0.82		40.07	46.93	1.36		38.10	42.90	0.99	
Year t+1	21.05	23.95	1.05		42.43	44.57	0.43		37.69	43.31	1.17	
Control Sample												
Year t	101.85	113.15	1.38		99.67	119.33	2.40	**	99.68	109.32	1.20	
Year t+1	101.21	113.79	1.58		106.45	112.55	0.75		99.50	109.50	1.23	

TABLE 4.15 (Continued)

Panel B: Year t vs. Year t+1 Comparison

	2002 vs. 2003				2003 vs. 2004				2004 vs. 2005			
	Wilcoxon Mean Score		Wilcoxon		Wilcoxon Mean Score		Wilcoxon		Wilcoxon Mean Score		Wilcoxon	
Difference in Distribution	2002	2003	Z-Score		2003	2004	Z-Score		2004	2005	Z-Score	
1) Impairment t, Impairment t+1	14.10	16.90	1.01		4.50	4.50	0.00		7.50	7.50	0.00	
2) Impairment t, Non-Impairment t+1	24.82	42.18	3.83	***	20.11	24.89	1.37	*	7.50	9.50	1.37	*
3) Non-Impairment t, Impairment t+1	16.00	21.00	1.68	**	14.07	14.93	0.33		24.92	24.08	-0.22	
4) Non-Impairment t, Non-Impairment t+1	20.86	24.14	0.99		43.16	43.84	0.13		40.03	40.98	0.19	
Control Sample												
Non-Impairment t, Non-Impairment t+1	101.44	113.56	1.47	*	89.50	129.50	4.85	***	107.10	101.90	-0.64	

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively.
2. For Panel A, the null hypothesis assumes that the expected rank sums of the overall indices and the within-group indices are the same. Wilcoxon Z-cores are two-sided tests.
3. For Panel B, the null hypothesis assumes that firms in year t are at least as efficient as firms in year t+1, or vice versa. Wilcoxon Z-cores are one-sided tests.
4. The DEA Model for this analysis has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and an output variable (sales).

TABLE 4.16
Services: Longitudinal Analysis by Two Years

Panel A: Relative Efficiency Scores Based on Overall Index vs. Within-Group Index Comparison

	2002 vs. 2003			2003 vs. 2004				2004 vs. 2005			
	Wilcoxon Mean Score			Wilcoxon Mean Score				Wilcoxon Mean Score			
Difference in Distribution	Overall Index	Within-Group Index	Wilcoxon Z-Score	Overall Index	Within-Group Index	Wilcoxon Z-Score		Overall Index	Within-Group Index	Wilcoxon Z-Score	
1) Impairment t, Impairment t+1											
Year t	9.50	9.50	0.00	8.50	8.50	0.00		8.00	9.00	0.88	
Year t+1	9.50	9.50	0.00	8.50	8.50	0.00		8.50	8.80	0.00	
2) Impairment t, Non-Impairment t+1											
Year t	15.13	17.88	1.02	17.4	23.6	2.19	**	12.00	17.00	2.37	**
Year t+1	15.91	17.09	0.43	20.3	20.7	0.14		14.46	14.54	0.00	
3) Non-Impairment t, Impairment t+1											
Year t	18.55	20.45	0.80	15.53	17.47	0.98		17.47	17.52	0.00	
Year t+1	17.42	21.58	1.47	14.47	18.53	1.77	*	16.82	18.18	0.49	
4) Non-Impairment t, Non-Impairment t+1											
Year t	25.00	26.00	0.32	24.28	26.72	0.70		26.00	29.00	0.81	
Year t+1	24.00	27.00	0.93	24.96	26.04	0.35		26.54	28.46	0.53	
Control Sample											
Year t	75.56	85.44	1.42	78.54	88.45	1.38		76.59	86.41	1.38	
Year t+1	76.74	84.26	1.08	80.05	86.95	0.96		76.16	86.84	1.49	

TABLE 4.16 (Continued)

Panel B: Year t vs. Year t+1 Comparison

	2002 vs. 2003			2003 vs. 2004				2004 vs. 2005			
	Wilcoxon Mean Score		Wilcoxon	Wilcoxon Mean Score		Wilcoxon		Wilcoxon Mean Score		Wilcoxon	
Difference in Distribution	2002	2003	Z-Score	2003	2004	Z-Score		2004	2005	Z-Score	
1) Impairment t, Impairment t+1	9.50	9.50	0.00	8.50	8.50	0.00		8.00	9.00	-0.88	
2) Impairment t, Non-Impairment t+1	16.44	16.56	0.02	18.20	22.8	1.52	*	12.39	16.61	1.86	**
3) Non-Impairment t, Impairment t+1	20.89	18.11	-0.95	17.59	15.41	-0.84		18.88	16.12	-1.13	
4) Non-Impairment t, Non-Impairment t+1	26.34	24.66	-0.50	24.32	26.68	0.69		26.70	28.30	0.41	
Control Sample											
Non-Impairment t, Non-Impairment t+1	79.93	81.08	0.16	85.17	81.83	-0.46		83.43	79.57	-0.53	

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively.
2. For Panel A, the null hypothesis assumes that the expected rank sums of the overall indices and the within-group indices are the same. Wilcoxon Z-cores are two-sided tests.
3. For Panel B, the null hypothesis assumes that firms in year t are at least as efficient as firms in year t+1, or vice versa. Wilcoxon Z-cores are one-sided tests.
4. The DEA Model for this analysis has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and an output variable (sales).

TABLE 4.17
Sensitivity Analysis: Firms without Fixed Asset Impairment

Panel A: Pooled Cross-Sectional Frequencies and Summary Statistics

Efficiency Score Ranges	Total	Overall Index (EI)		Within-Group Index (EI_w)		Between-Group Index (EI_b)	
		Imp	Non-Imp	Imp	Non-Imp	Imp	Non-Imp
1) Durable Manufacturers							
1.00	58	27	31	39	52	28	31
0.9-0.99	53	17	36	13	28	56	59
0.8-0.89	38	18	20	18	15	20	9
0.7-0.79	25	12	13	8	9	0	4
0.6-0.69	13	10	3	13	1	0	0
0.5-0.59	9	9	0	4	0	1	1
0.4-0.49	4	3	1	3	0	0	0
< 0.4	10	9	1	7	0	0	1
N	210	105	105	105	105	105	105
Mean		0.79	0.90	0.82	0.94	0.95	0.95
S.D.		0.22	0.13	0.21	0.08	0.06	0.10
2) Computers							
1.00	63	24	39	39	55	25	46
0.9-0.99	30	10	20	13	12	48	51
0.8-0.89	34	13	21	15	18	18	6
0.7-0.79	38	21	17	13	14	8	2
0.6-0.69	17	12	5	10	4	7	1
0.5-0.59	15	12	3	4	3	1	1
0.4-0.49	4	3	1	1	1	0	0
< 0.4	13	12	1	12	0	0	0
N	214	107	107	107	107	107	107
Mean		0.74	0.88	0.82	0.91	0.91	0.97
S.D.		0.23	0.14	0.22	0.12	0.11	0.07
3) Services							
1.00	41	15	26	28	36	16	32
0.9-0.99	22	8	14	15	9	18	30
0.8-0.89	28	18	10	19	8	29	2
0.7-0.79	30	20	10	4	9	3	0
0.6-0.69	9	4	5	0	5	1	1
0.5-0.59	1	1	0	0	0	0	0
0.4-0.49	0	0	0	0	0	0	0
< 0.4	3	1	2	1	0	0	2
N	134	67	67	67	67	67	67
Mean		0.84	0.87	0.92	0.92	0.90	0.95
S.D.		0.14	0.18	0.11	0.12	0.08	0.15

TABLE 4.17 (Continued)

Panel B: Relative Efficiency Scores Based on Overall Index vs. Within-Group Index Comparison

Difference in Distribution	Wilcoxon Mean Score: Overall Index	Wilcoxon Mean Score: Within-Group Index	Wilcoxon Z-Score	
1) Durable Manufacturers (N=210)				
Impairment firms	92.98	118.02	3.08	***
Non-Impairment firms	99.13	111.87	1.54	
2) Computers (N=214)				
Impairment firms	95.69	119.31	2.82	***
Non-Impairment firms	100.10	114.90	1.83	*
3) Services (N=134)				
Impairment firms	53.30	81.70	4.3	***
Non-Impairment firms	62.40	72.60	1.6	

Panel C: Impairment vs. Non-impairment Comparison

Difference in Distribution	Wilcoxon Mean Score: Impairment	Wilcoxon Mean Score: Non-Impairment	Wilcoxon Z-Score	
1) Durable Manufacturers (N=210)				
Impairment (EI_b) vs. Non-Impairment (EI_b)	98.26	112.74	1.75	**
2) Computers (N=214)				
Impairment (EI_b) vs. Non-Impairment (EI_b)	85.64	129.36	5.25	***
3) Services (N=134)				
Impairment (EI_b) vs. Non-Impairment (EI_b)	50.32	84.68	5.19	***

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively.
2. For Panel B, the null hypothesis assumes that the expected rank sums of the overall indices and the within-group indices are the same. Wilcoxon Z-cores are two-sided tests.
3. For Panel C, the null hypothesis assumes that the impairment firms are at least as efficient as the non-impairment firms. Wilcoxon Z-cores are one-sided tests.
4. The DEA Model for this analysis has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and an output variable (sales).

APPENDIX F

TABLE 5.1
Distribution of Goodwill Impairment Sample

	Impairment Obs. (N=192)	%
Panel A: Circumstances Leading to Goodwill Impairment		
Economy Downturn	9	4.7%
Decline in Stock Prices	5	2.6%
Decline in Firm Operating Performance, Change in Strategies, and Reorganization	90	46.9%
Adverse Change in Legal Action	2	1.0%
Unanticipated Competition	1	0.5%
Loss of Key Personnel	9	4.7%
Combination of Reasons	31	16.2%
Could Not Identify	45	23.4%
	192	100.0%
Panel B: Fair Value Method		
Discounted Future Cash Flows (DCF)	113	58.9%
Market Capitalization	7	3.6%
Multiples of Earnings	3	1.6%
All Three Methods	8	4.2%
DCF and Market Capitalization	11	5.7%
DCF and Multiple of Earnings	29	15.1%
Could Not Identify	21	10.9%
	192	100.0%

TABLE 5.1 (Continued)

	Impairment Obs. (N=192)	%
Panel C: Quarter in Which Goodwill Impairment is Recorded		
1st Quarter	16	8.3%
2nd Quarter	25	13.0%
3rd Quarter	27	14.1%
4th Quarter	124	64.6%
	192	100.0%
Panel D: Number of Reportable Segments		
One Segment	52	27.1%
Two Segments	60	31.2%
Three Segments	41	21.3%
Four Segments	22	11.5%
More Than Four Segments	17	8.9%
	192	100.0%

Note:

1. This table provides distribution of the goodwill impairment sample.
2. For observations having goodwill impairment in the multiple quarters, this study selects the largest amount of goodwill impairment to determine the quarter.

TABLE 5.2
Descriptive Statistics: Determinants of Goodwill Impairment

	Impairment N = 192			No Impairment N = 192			Mean Differences	Median Differences
Variable	Mean	Median	S.D.	Mean	Median	S.D.	|t-Stat|	|z-Stat|
$EFF_{i,t-1}$	0.93	1.00	0.12	0.97	1.00	0.07	3.89***	3.48***
$RET_{i,t-1}$	0.14	-0.08	1.08	0.68	0.17	2.18	3.08***	4.28***
CEO_{it}	0.23	0	0.42	0.09	0	0.28	3.83***	3.76***
$BATH_{it}$	-0.13	0	0.52	-0.04	0	0.14	2.42**	3.15***
$SMOOTH_{it}$	0.08	0	0.20	0.06	0	0.20	0.81	0.23
$SM\_INCREASE_{it}$	0.12	0	0.33	0.26	0	0.44	3.56***	3.51***
$SIZE_{i,t-1}$	5.10	5.18	2.48	5.24	5.15	2.27	0.60	0.20
$LEV_{i,t-1}$	0.28	0.19	0.41	0.21	0.17	0.30	2.01**	0.82
Goodwill/Total Assets	0.23	0.17	0.19	0.19	0.15	0.17	1.95*	1.02
Impairment/Goodwill	0.66	0.37	2.50					
Impairment/Total Assets	0.16	0.05	0.53					

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level (two-tailed), respectively. The t-statistics for mean differences and z-statistics for median differences are presented in absolute values.

2. Variable definitions:
   $EFF_{i,t-1}$ Firm *i*'s relative efficiency score for the fiscal year *t-1*;
   $RET_{i,t-1}$ Firm *i*'s stock returns over the fiscal year *t-1*;
   CEO_{it} A dichotomous variable equal to 1 if firm *i* has a change in CEO in the year of impairment reporting, and 0 otherwise;

TABLE 5.2 (Continued)

$BATH_{it}$	A proxy for "unexpectedly low" earnings, equal to a *decrease* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the decrease is *below* the median of *negative* values of this variable, and 0 otherwise;
$SMOOTH_{it}$	A proxy for "unexpectedly high" earnings, equal to an *increase* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the increase is *above* the median of *positive* values of this variable, and 0 otherwise;
$SM\_INCREASE_{it}$	A dichotomous variable, equal to 1 when the difference in net income before goodwill impairment between year *t* and *t-1*, scaled by market value of equity the end of year *t-1*, falls in the interval [0.00, 0.02), and 0 otherwise.
$SIZE_{i,t-1}$	Firm *i*'s log of total assets at the end of year *t-1*;
$LEV_{i,t-1}$	Total debts divided by total assets at the end of year *t-1*;

TABLE 5.3
Descriptive Statistics: Predictive Ability of Relative Efficiency

	Impairment N = 126			No Impairment N = 126			Mean Differences	Median Differences
Variable	Mean	Median	S.D.	Mean	Median	S.D.	|t-Stat|	|z-Stat|
$DecEFF_{i,t-1}$	0.33	0	0.47	0.18	0	0.39	2.63***	2.60***
$DecEFF\_Hist_{i,t-3}$	0.61	0	0.76	0.37	0	0.58	2.81***	1.94*
$\%ChgEFF_{i,t-1}$	-0.03	0	0.17	-0.003	0	0.12	1.19	2.84***
$\%ChgEFF_{i,t-2}$	0	0	0.11	0.04	0	0.25	1.54	2.42**
$\%ChgEFF_{i,t-3}$	-0.03	0	0.14	0.03	0	0.25	2.53**	3.59***
$RET_{i,t-1}$	0.27	0.05	1.06	1.00	0.37	2.53	2.96***	3.91***
$CEO_{i,t-1}$	0.18	0	0.39	0.06	0	0.24	2.91***	2.87***
$MKBK_{i,t-1}$	3.98	1.71	23.59	4.42	2.55	22.79	0.15	4.28***
$LEV_{i,t-1}$	0.26	0.18	0.42	0.18	0.17	0.20	2.11**	0.50

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level (two-tailed), respectively. The t-statistics for mean differences and z-statistics for median differences are presented in absolute values.

2. Variable definitions:
   - $DecEFF_{i,t-1}$ A dichotomous variable equal to 1 when there is a decline in firm *i*'s relative efficiency scores from year *t-2* to *t-1*, and 0 otherwise;
   - $DecEFF\_Hist_{i,t-3}$ Number of years in which firm *i* has a decline in the relative efficiency from year *t-3* to *t-1* prior to goodwill impairment recognition;
   - $\%ChgEFF_{i,t-1}$ A percent change in relative efficiency scores from year *t-2* to *t-1*;
   - $\%ChgEFF_{i,t-2}$ A percent change in relative efficiency scores from year *t-3* to *t-2*;
   - $\%ChgEFF_{i,t-3}$ A percent change in relative efficiency scores from year *t-3* to *t-1*;

TABLE 5.3 (Continued)

$RET_{i,t-1}$	Firm *i*'s stock returns over the fiscal year *t-1*;
$CEO_{i,t-1}$	A dichotomous variable equal to 1 if firm *i* has a change in CEO in a year prior to impairment reporting (year *t-1*), and 0 otherwise;
$MKBK_{i,t-1}$	Market to book ratio at the end of year *t-1*;
$LEV_{i,t-1}$	Total debts divided by total assets at the end of year *t-1*.

TABLE 5.4
Pearson Correlations: Determinants of Goodwill Impairment

	$EFF_{i,t-1}$	$RET_{i,t-1}$	CEO_{it}	$BATH_{it}$	$SMOOTH_{it}$	$SM\_INCREASE_{it}$	$SIZE_{i,t-1}$	$LEV_{i,t-1}$
$EFF_{i,t-1}$	1.00							
$RET_{i,t-1}$	0.1* (0.05)	1.00						
CEO_{it}	-0.03 (0.57)	-0.09* (0.09)	1.00					
$BATH_{it}$	-0.002 (0.96)	-0.03 (0.53)	0.01 (0.82)	1.00				
$SMOOTH_{it}$	-0.2*** (0.0001)	-0.04 (0.45)	0.09* (0.06)	0.08 (0.14)	1.00			
$SM\_INCREASE_{it}$	0.11** (0.04)	0.02 (0.71)	-0.03 (0.57)	0.11* (0.04)	-0.14*** (0.007)	1.00		
$SIZE_{i,t-1}$	0.16*** (0.002)	-0.11** (0.03)	0.08 (0.10)	0.3*** (<0.0001)	-0.33*** (<0.0001)	0.19*** (0.0003)	1.00	
$LEV_{i,t-1}$	0.08 (0.11)	-0.07 (0.18)	-0.005 (0.92)	-0.15*** (0.002)	0.23*** (<0.0001)	-0.07 (0.19)	-0.17*** (0.0009)	1.00

TABLE 5.4 (Continued)

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level (two-tailed), respectively. P-values for two-tailed tests are in parentheses.

2. Variable definitions:

$EFF_{i,t-1}$	Firm *i*'s relative efficiency score for the fiscal year *t-1*;
$RET_{i,t-1}$	Firm *i*'s stock returns over the fiscal year *t-1*;
CEO_{it}	A dichotomous variable equal to 1 if firm *i* has a change in CEO in the year of impairment reporting, and 0 otherwise;
$BATH_{it}$	A proxy for "unexpectedly low" earnings, equal to a *decrease* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the decrease is *below* the median of *negative* values of this variable, and 0 otherwise;
$SMOOTH_{it}$	A proxy for "unexpectedly high" earnings, equal to an *increase* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the increase is *above* the median of *positive* values of this variable, and 0 otherwise;
$SM\_INCREASE_{it}$	A dichotomous variable, equal to 1 when the difference in net income before goodwill impairment between year *t* and *t-1*, scaled by market value of equity the end of year *t-1*, falls in the interval [0.00, 0.02), and 0 otherwise.
$SIZE_{i,t-1}$	Firm *i*'s log of total assets at the end of year *t-1*;
$LEV_{i,t-1}$	Total debts divided by total assets at the end of year *t-1*;

TABLE 5.5
Pearson Correlations: Predictive Ability of Relative Efficiency

	$DecEFF_{i,t-1}$	$DecEFF\_Hist_{i,t-3}$	$\%ChgEFF_{i,t-1}$	$\%ChgEFF_{i,t-2}$	$\%ChgEFF_{i,t-3}$	$RET_{i,t-1}$	$CEO_{i,t-1}$	$MKBK_{i,t-1}$	$LEV_{i,t-1}$
$DecEFF_{i,t-1}$	1.00								
$DecEFF\_Hist_{i,t-3}$	0.80*** (<0.0001)	1.00							
$\%ChgEFF_{i,t-1}$	-0.49*** (<0.0001)	-0.24*** (0.0001)	1.00						
$\%ChgEFF_{i,t-2}$	0.17*** (0.007)	-0.059 (0.35)	-0.21*** (0.0007)	1.00					
$\%ChgEFF_{i,t-3}$	-0.23*** (0.0003)	-0.26*** (<0.0001)	0.53*** (<0.0001)	0.69*** (<0.0001)	1.00				
$RET_{i,t-1}$	-0.15** (0.02)	-0.13** (0.04)	0.09 (0.14)	-0.05 (0.46)	0.03 (0.62)	1.00			
$CEO_{i,t-1}$	0.01 (0.96)	0.08 (0.18)	-0.07 (0.26)	0.10 (0.12)	0.03 (0.63)	-0.08 (0.22)	1.00		
$MKBK_{i,t-1}$	-0.04 (0.52)	-0.03 (0.68)	-0.002 (0.98)	-0.04 (0.51)	-0.04 (0.55)	-0.01 (0.91)	0.02 (0.71)	1.00	
$LEV_{i,t-1}$	-0.009 (0.89)	0.05 (0.44)	0.22*** (0.0004)	-0.15** (0.02)	-0.03 (0.59)	-0.04 (0.56)	-0.002 (0.97)	-0.07 (0.30)	1.00

TABLE 5.5 (Continued)

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level (two-tailed), respectively. P-values for two-tailed tests are in parentheses.

2. Variable definitions:

$DecEFF_{i,t-1}$	A dichotomous variable equal to 1 when there is a decline in firm *i*'s relative efficiency scores from year *t-2* to *t-1*, and 0 otherwise;
$DecEFF\_Hist_{i,t-3}$	Number of years in which firm *i* has a decline in the relative efficiency from year *t-3* to *t-1* prior to goodwill impairment recognition;
$\%ChgEFF_{i,t-1}$	A percent change in relative efficiency scores from year *t-2* to *t-1*;
$\%ChgEFF_{i,t-2}$	A percent change in relative efficiency scores from year *t-3* to *t-2*;
$\%ChgEFF_{i,t-3}$	A percent change in relative efficiency scores from year *t-3* to *t-1*;
$RET_{i,t-1}$	Firm *i*'s stock returns over the fiscal year *t-1*;
$CEO_{i,t-1}$	A dichotomous variable equal to 1 if firm *i* has a change in CEO in a year prior to impairment reporting (year *t-1*), and 0 otherwise;
$MKBK_{i,t-1}$	Market to book ratio at the end of year *t-1*;
$LEV_{i,t-1}$	Total debts divided by total assets at the end of year *t-1*.

TABLE 5.6
Determinants of Goodwill Impairment

Tobit Regression:

$$IMP\,\%_{it} = \beta_0 + \beta_1 EFF_{i,t-1} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{it} + \beta_4 POOR_{it} + \beta_5 GOOD_{it} + \beta_6 SM\_PROFIT_{it} + \beta_7 SIZE_{i,t-1} + \beta_8 LEV_{i,t-1} + \varepsilon_{it} \quad (2)$$

Logistic Regression:

$$IMPAIR_{it} = \beta_0 + \beta_1 EFF_{i,t-1} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{it} + \beta_4 POOR_{it} + \beta_5 GOOD_{it} + \beta_6 SM\_PROFIT_{it} + \beta_7 SIZE_{i,t-1} + \beta_8 LEV_{i,t-1} + \varepsilon_{it} \quad (3)$$

		Tobit Regression	Logistic Regression		
Variable	Predicted Sign	Coeff (t-Stat)	Coeff (z-Stat)	Marginal Effect (z-Stat)	WESML Coeff (t-Stat)
Intercept	?	2.04*** (3.99)	4.33*** (3.18)		1.63 (1.05)
$EFF_{i,t-1}$	-	-2.34*** (-4.07)	-4.93*** (-3.48)	-1.23*** (-3.48)	-4.43*** (-2.63)
$RET_{i,t-1}$	-	-0.17** (-1.91)	-0.23** (-2.18)	-0.06** (-2.18)	-0.30* (-1.30)
CEO_{it}	+	0.35*** (2.80)	1.11*** (3.44)	0.26*** (3.89)	1.14*** (2.49)
$BATH_{it}$	-	-0.95 (-1.04)	-1.29** (-1.89)	-0.32** (-1.89)	-1.48* (-1.59)
$SMOOTH_{it}$	+	-0.42 (-1.14)	-0.50 (-0.75)	-0.12 (-0.75)	-0.26 (-0.28)
$SM\_INCREASE_{it}$	-	-0.26** (-1.79)	-0.81*** (-2.73)	-0.20*** (-2.88)	-0.84* (-1.57)
$SIZE_{i,t-1}$	?	0.001 (0.04)	0.04 (0.79)	0.01 (0.79)	0.07 (0.72)
$LEV_{i,t-1}$	?	0.39* (1.79)	0.69* (1.94)	0.17* (1.94)	0.23 (0.44)

TABLE 5.6 (Continued)

Variable	Predicted Sign	Tobit Regression Coeff (t-Stat)	Logistic Regression Coeff (z-Stat)	Logistic Regression Marginal Effect (z-Stat)	WESML Coeff (t-Stat)
No. of obs.		384	384		384
Log likelihood		-370.60	-236.08		-112.75
Likelihood Ratio			60.18***		
Pseudo R Square			0.11		

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively. One-tailed test is employed for directional hypotheses.

2. Variable definitions:

$IMP\%_{it}$	Firm *i*'s reported pre-tax goodwill impairment (measured as a positive sign) for year *t*, divided by goodwill at the end of year *t-1* for impairment firms, and 0 for non-impairment firms;
$IMPAIR_{it}$	A dichotomous variable equal to 1 if firm *i* reports goodwill impairment for the fiscal year *t,* and 0 otherwise;
$EFF_{i,t-1}$	Firm *i*'s relative efficiency scores for the fiscal year *t-1*;
$RET_{i,t-1}$	Firm *i*'s stock returns over the fiscal year *t-1*;
CEO_{it}	A dichotomous variable equal to 1 if firm *i* has a change in CEO in the year of impairment reporting, and 0 otherwise;
$BATH_{it}$	A proxy for "unexpectedly low" earnings, equal to a *decrease* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the decrease is *below* the median of *negative* values of this variable, and 0 otherwise;
$SMOOTH_{it}$	A proxy for "unexpectedly high" earnings, equal to an *increase* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the increase is *above* the median of *positive* values of this variable, and 0 otherwise;
$SM\_INCREASE_{it}$	A dichotomous variable equal to 1 when the difference in net income before goodwill impairment between year *t* and *t-1*, scaled by market value of equity the end of year *t-1*, falls in the interval [0.00, 0.02), and 0 otherwise.
$SIZE_{i,t-1}$	Firm *i*'s log of total assets at the end of year *t-1*;
$LEV_{i,t-1}$	Total debts divided by total assets at the end of year *t-1*;

3. The DEA Model for this analysis has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and an output variable (sales).

TABLE 5.7
Logistic Regression: Predictive Ability of Relative Efficiency

Variable	Predicted Sign	Model 4.1 Coeff	Model 4.2 Coeff	Model 4.3 Coeff	Model 4.4 Coeff	Model 4.5 Coeff
Intercept	?	-0.36*	-0.37*	-0.22	-0.12	-0.19
		(3.03)	(3.09)	(1.30)	(0.39)	(0.97)
$DecEFF_{i,t-1}$	+	0.66**				
		(4.45)				
$DecEFF\_Hist_{i,t-3}$	+		0.42**			
			(4.36)			
$\%ChgEFF_{i,t-1}$	-			-1.13		
				(1.24)		
$\%ChgEFF_{i,t-2}$	-				-1.46*	
					(2.16)	
$\%ChgEFF_{i,t-3}$	-					-2.08**
						(4.14)
$RET_{i,t-1}$	-	-0.30**	-0.33**	-0.32**	-0.37***	-0.32**
		(4.56)	(5.06)	(5.21)	(6.15)	(5.17)
$CEO_{i,t-1}$	+	1.13***	1.05***	1.09***	1.19***	1.19***
		(6.62)	(5.73)	(6.13)	(6.86)	(6.64)
$MKBK_{i,t-1}$	-	-0.0002	-0.0005	-0.001	-0.001	-0.001
		(0.002)	(0.01)	(0.01)	(0.07)	(0.07)
$LEV_{i,t-1}$	?	1.03*	1.00*	1.13**	0.93*	1.00*
		(3.53)	(3.18)	(4.32)	(2.74)	(3.26)
No. of obs.		252	252	252	252	252
Log Likelihood		-160.46	-160.50	-162.10	-161.04	-159.05
Likelihood Ratio		28.42***	28.35***	25.15***	27.27***	31.24***

TABLE 5.7 (Continued)

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively. One-tailed test is employed for directional hypotheses. Chi-square statistics are in parentheses.

2. Model

$$IMPAIR_{it} = \beta_0 + \beta_1 DecEFF_{i,t-1} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{i,t-1} + \beta_4 MKBK_{i,t-1} + \beta_5 LEV_{i,t-1} + \varepsilon_i \quad (4.1)$$

$$IMPAIR_{it} = \beta_0 + \beta_1 DecEFF\_Hist_{i,t-3} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{i,t-1} + \beta_4 MKBK_{i,t-1} + \beta_5 LEV_{i,t-1} + \varepsilon_i \quad (4.2)$$

$$IMPAIR_{it} = \beta_0 + \beta_1 \%ChgEFF_{i,t-1} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{i,t-1} + \beta_4 MKBK_{i,t-1} + \beta_5 LEV_{i,t-1} + \varepsilon_i \quad (4.3)$$

$$IMPAIR_{it} = \beta_0 + \beta_1 \%ChgEFF_{i,t-2} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{i,t-1} + \beta_4 MKBK_{i,t-1} + \beta_5 LEV_{i,t-1} + \varepsilon_i \quad (4.4)$$

$$IMPAIR_{it} = \beta_0 + \beta_1 \%ChgEFF_{i,t-3} + \beta_2 RET_{i,t-1} + \beta_3 CEO_{i,t-1} + \beta_4 MKBK_{i,t-1} + \beta_5 LEV_{i,t-1} + \varepsilon_i \quad (4.5)$$

3. Variable definitions:

$DecEFF_{i,t-1}$	A dichotomous variable equal to 1 when there is a decline in firm *i*'s relative efficiency scores from year *t-2* to *t-1*, and 0 otherwise;
$DecEFF\_Hist_{i,t-3}$	Number of years in which firm *i* has a decline in the relative efficiency from year *t-3* to *t-1* prior to goodwill impairment recognition;
$\%ChgEFF_{i,t-1}$	A percent change in relative efficiency scores from year *t-2* to *t-1*;
$\%ChgEFF_{i,t-2}$	A percent change in relative efficiency scores from year *t-3* to *t-2*;
$\%ChgEFF_{i,t-3}$	A percent change in relative efficiency scores from year *t-3* to *t-1*;
$RET_{i,t-1}$	Firm *i*'s stock returns over the fiscal year *t-1*;
$CEO_{i,t-1}$	A dichotomous variable equal to 1 if firm *i* has a change in CEO in a year prior to impairment reporting (year *t-1*), and 0 otherwise;
$MKBK_{i,t-1}$	Market to book ratio at the end of year *t-1*;
$LEV_{i,t-1}$	Total debts divided by total assets at the end of year *t-1*.

4. The DEA Model for this analysis has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and an output variable (sales).

TABLE 5.8
Multivariate Discriminant Analysis: Predictive Ability of Relative Efficiency

Panel A: Decline in efficiency from year t-2 to t-1 ($DecEFF_{i,t-1}$)

	Resubstitution Method			Cross-validation Method		
Actual	Model Classification			Model Classification		
Outcome	No Impairment	Impairment	Total Error	No Impairment	Impairment	Total Error
No Impairment	92	34	36.51%	91	35	37.30%
	73.02%	26.98%		72.22%	27.18%	
Impairment	58	68		59	67	
	46.03%	53.97%		46.83%	53.17%	

Panel B: Number of years in which a firm has a decline in efficiency from year t-3 to t-1 ($DecEFF\_Hist_{i,t-3}$)

	Resubstitution Method			Cross-validation Method		
Actual	Model Classification			Model Classification		
Outcome	No Impairment	Impairment	Total Error	No Impairment	Impairment	Total Error
No Impairment	85	41	40.48%	83	43	41.67%
	67.46%	32.54%		65.87%	34.13%	
Impairment	61	65		62	64	
	48.41%	51.59%		49.21%	50.79%	

Panel C: Percentage change in efficiency from year t-2 to t-1 ($\%ChgEFF_{i,t-1}$)

	Resubstitution Method			Cross-validation Method		
Actual	Model Classification			Model Classification		
Outcome	No Impairment	Impairment	Total Error	No Impairment	Impairment	Total Error
No Impairment	97	29	35.71%	95	31	37.30%
	76.98%	23.02%		75.40%	24.60%	
Impairment	61	65		63	63	
	48.41%	51.59%		50.00%	50.00%	

TABLE 5.8 (Continued)

Panel D: Percentage change in efficiency from year t-3 to t-2 ($\%ChgEFF_{i,t-2}$)

Actual	Resubstitution Method			Cross-validation Method		
	Model Classification			Model Classification		
Outcome	No Impairment	Impairment	Total Error	No Impairment	Impairment	Total Error
No Impairment	96	30	37.30%	93	33	39.29%
	76.19%	23.81%		73.81%	26.19%	
Impairment	64	62		66	60	
	50.79%	49.21%		52.38%	47.62%	

Panel E: Percentage change in efficiency from year t-3 to t-1 ($\%ChgEFF_{i,t-3}$)

Actual	Resubstitution Method			Cross-validation Method		
	Model Classification			Model Classification		
Outcome	No Impairment	Impairment	Total Error	No Impairment	Impairment	Total Error
No Impairment	97	29	34.13%	96	30	35.32%
	76.98%	23.02%		76.19%	23.81%	
Impairment	57	69		59	67	
	45.24%	54.76%		46.83%	53.17%	

Panel F: Exclude measurement of relative efficiency

Actual	Resubstitution Method			Cross-validation Method		
	Model Classification			Model Classification		
Outcome	No Impairment	Impairment	Total Error	No Impairment	Impairment	Total Error
No Impairment	100	26	38.49%	98	28	39.29%
	79.37%	20.63%		77.78%	22.22%	
Impairment	71	55		71	55	
	56.35%	43.65%		56.35%	43.65%	

Note:

1. The DEA Model for this analysis has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and an output variable (sales).

2. Variable definitions:

$DecEFF_{i,t-1}$	A dichotomous variable equal to 1 when there is a decline in firm *i*'s relative efficiency scores from year *t-2* to *t-1*, and 0 otherwise;
$DecEFF\_Hist_{i,t-3}$	Number of years in which firm *i* has a decline in the relative efficiency from year *t-3* to *t-1* prior to goodwill impairment recognition;
$\%ChgEFF_{i,t-1}$	A percent change in relative efficiency scores from year *t-2* to *t-1*;
$\%ChgEFF_{i,t-2}$	A percent change in relative efficiency scores from year *t-3* to *t-2*;
$\%ChgEFF_{i,t-3}$	A percent change in relative efficiency scores from year *t-3* to *t-1*;

3. The discriminant analysis also includes the following variables:

$RET_{i,t-1}$	Firm *i*'s stock returns over the fiscal year *t-1*;
$CEO_{i,t-1}$	A dichotomous variable equal to 1 if firm *i* has a change in CEO in a year prior to impairment reporting (year *t-1*), and 0 otherwise;
$MKBK_{i,t-1}$	Market to book ratio at the end of year *t-1*;
$LEV_{i,t-1}$	Total debts divided by total assets at the end of year *t-1*.

TABLE 5.9
Sensitivity Analysis on Choices of Input/Output Variables in DEA Model

Panel A: DEA Model Inputs (OE, CA, FA, INTAN), Output (S)

		Tobit Regression		Logistic Regression					
						Marginal		WESML	
	Predicted	Coeff		Coeff		Effect		Coeff	
Variable	Sign	(t-Stat)		(z-Stat)		(z-Stat)		(t-Stat)	
Intercept	?	1.53	***	2.55	***			-0.07	
		(4.06)		(2.85)				(-0.06)	
$EFF_{i,t-1}$	-	-1.89	***	-3.25	***	-0.81	***	-2.74	**
		(-4.53)		(-3.36)		(-3.36)		(-2.33)	
$RET_{i,t-1}$	-	-0.18	**	-0.22	**	-0.06	**	-0.29	*
		(-1.98)		(-2.18)		(-2.18)		(-1.30)	
CEO_{it}	+	0.37	***	1.09	***	0.26	***	1.13	***
		(3.01)		(3.37)		(3.79)		(2.45)	
$BATH_{it}$	-	-0.75		-1.27	**	-0.32	**	-1.35	*
		(-0.98)		(-1.90)		(-1.90)		(-1.50)	
$SMOOTH_{it}$	+	-0.37		-0.41		-0.09		-0.22	
		(-0.96)		(-0.62)		(-0.55)		(-0.24)	
$SM\_INCREASE_{it}$	-	-0.24	**	-0.80	***	-0.20	***	-0.79	*
		(-1.70)		(-2.69)		(-2.84)		(-1.49)	
$SIZE_{i,t-1}$	?	0.003		0.05		0.01		0.06	
		(0.09)		(0.93)		(0.93)		(0.68)	
$LEV_{i,t-1}$	?	0.44	**	0.75	**	0.19	**	0.28	
		(2.00)		(2.05)		(2.05)		(0.54)	
No. of obs.		384		384				384	
Log likelihood		-368.71		-237.08				-113.45	
Likelihood Ratio				58.19	***				
Pseudo R Square				0.11					

TABLE 5.9 (Continued)

Panel B: DEA Model Inputs (OE, AT), Outputs (S, OCF, IB)

		Tobit Regression		Logistic Regression				
Variable	Predicted Sign	Coeff (t-Stat)		Coeff (z-Stat)		Marginal Effect (z-Stat)		WESML Coeff (t-Stat)	
Intercept	?	1.17	***	1.62	**			-0.98	
		(3.36)		(2.32)				(-1.00)	
$EFF_{i,t-1}$	-	-1.57	***	-2.31	***	-0.58	***	-1.83	**
		(-4.03)		(-3.01)		(-3.01)		(-1.83)	
$RET_{i,t-1}$	-	-0.18	**	-0.24	**	-0.06	**	-0.32	*
		(-1.98)		(-2.27)		(-2.27)		(-1.42)	
CEO_{it}	+	0.35	***	1.06	***	0.25	***	1.10	***
		(2.90)		(3.28)		(3.67)		(2.42)	
$BATH_{it}$	-	-0.95		-1.08	**	-0.27	**	-1.15	*
		(-1.22)		(-1.75)		(-1.75)		(-1.34)	
$SMOOTH_{it}$	+	-0.35		-0.35		-0.09		-0.12	
		(-0.89)		(-0.54)		(-0.54)		(-0.13)	
$SM\_INCREASE_{it}$	-	-0.21	*	-0.80	***	-0.20	***	-0.82	*
		(-1.58)		(-2.71)		(-2.87)		(-1.54)	
$SIZE_{i,t-1}$	?	0.006		0.05		0.01		0.07	
		(0.18)		(0.92)		(0.92)		(0.70)	
$LEV_{i,t-1}$	?	0.38	*	0.63	*	0.16	*	-0.03	
		(1.68)		(1.75)		(1.75)		(-0.06)	
No. of obs.		384		384				384	
Log likelihood		-369.41		-238.62				-114.36	
Likelihood Ratio				55.11	***				
Pseudo R Square				0.10					

TABLE 5.9 (Continued)

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively. One-tailed test is employed for directional hypotheses.

2. Variable definitions:

$EFF_{i,t-1}$	Firm *i*'s relative efficiency scores for the fiscal year *t-1*;
$RET_{i,t-1}$	Firm *i*'s stock returns over the fiscal year *t-1*;
CEO_{it}	A dichotomous variable equal to 1 if firm *i* has a change in CEO in the year of impairment reporting, and 0 otherwise;
$BATH_{it}$	A proxy for "unexpectedly low" earnings, equal to a *decrease* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the decrease is *below* the median of *negative* values of this variable, and 0 otherwise;
$SMOOTH_{it}$	A proxy for "unexpectedly high" earnings, equal to an *increase* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the increase is *above* the median of *positive* values of this variable, and 0 otherwise;
$SM\_INCREASE_{it}$	A dichotomous variable equal to 1 when the difference in net income before goodwill impairment between year *t* and *t-1*, scaled by market value of equity the end of year *t-1*, falls in the interval [0.00, 0.02), and 0 otherwise.
$SIZE_{i,t-1}$	Firm *i*'s log of total assets at the end of year *t-1*;
$LEV_{i,t-1}$	Total debts divided by total assets at the end of year *t-1*;

TABLE 5.10
Sensitivity Analysis Using Conditional Logistic Regression

Variable	Predicted Sign	DEA Model 1 Coefficient (Chi-Square)		DEA Model 2 Coefficient (Chi-Square)		DEA Model 3 Coefficient (Chi-Square)	
$EFF_{i,t-1}$	-	-3.86	***	-2.37	**	-1.95	**
		(5.98)		(4.59)		(4.69)	
$RET_{i,t-1}$	-	-0.38	**	-0.39	***	-0.38	***
		(5.30)		(5.63)		(5.45)	
CEO_{it}	+	1.33	***	1.34	***	1.37	***
		(11.76)		(11.99)		(12.06)	
$BATH_{it}$	-	-2.46	**	-2.37	**	-1.9	**
		(3.32)		(3.41)		(3.43)	
$SMOOTH_{it}$	+	0.74		1.04		0.92	
		(0.41)		(0.96)		(0.75)	
$SM\_INCREASE_{it}$	-	-0.89	***	-0.87	***	-0.92	***
		(6.60)		(6.10)		(6.86)	
$SIZE_{i,t-1}$	?	-1.81	***	-1.76	***	-1.73	***
		(8.62)		(8.26)		(8.45)	
$LEV_{i,t-1}$	?	1.46	**	1.5	**	1.59	**
		(3.98)		(4.29)		(4.83)	
No. of obs.		384		384		384	
Log Likelihood		-133.09		-93.6		-93.61	
Likelihood Ratio		81.06	***	78.97	***	78.95	***

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively. One-tailed test is employed for directional hypotheses.

TABLE 5.10 (Continued)

2. Variable definitions:

$EFF_{i,t-1}$	Firm *i*'s relative efficiency scores for the fiscal year *t-1*;
$RET_{i,t-1}$	Firm *i*'s stock returns over the fiscal year *t-1*;
CEO_{it}	A dichotomous variable equal to 1 if firm *i* has a change in CEO in the year of impairment reporting, and 0 otherwise;
$BATH_{it}$	A proxy for "unexpectedly low" earnings, equal to a *decrease* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the decrease is *below* the median of *negative* values of this variable, and 0 otherwise;
$SMOOTH_{it}$	A proxy for "unexpectedly high" earnings, equal to an *increase* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the increase is *above* the median of *positive* values of this variable, and 0 otherwise;
$SM\_INCREASE_{it}$	A dichotomous variable equal to 1 when the difference in net income before goodwill impairment between year *t* and *t-1*, scaled by market value of equity the end of year *t-1*, falls in the interval [0.00, 0.02), and 0 otherwise.
$SIZE_{i,t-1}$	Firm *i*'s log of total assets at the end of year *t-1*;
$LEV_{i,t-1}$	Total debts divided by total assets at the end of year *t-1*;

3. The DEA Model 1 has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and single output variable (sales).

4. The DEA Model 2 has four input variables (operating expenses; current assets; fixed assets; and intangible assets) and single output variable (sales).

5. The DEA Model 3 has two input variables (operating expenses; total assets) and three output variables (sales; operating cash flows; income before extraordinary items).

TABLE 5.11
Sensitivity Analysis Including One Segment Variable

		Tobit Regression		Logistic Regression				
						Marginal		WESML
	Predicted	Coeff		Coeff		Effect		Coeff
Variable	Sign	(t-Stat)		(z-Stat)		(z-Stat)		(t-Stat)	
Intercept	?	2.15	***	4.17	***			1.83	
		(4.05)		(3.17)				(1.17)	
$EFF_{i,t-1}$	-	-2.20	***	-3.9	***	-0.98	***	-3.8	**
		(-3.65)		(-2.82)		(-2.82)		(-2.20)	
$RET_{i,t-1}$	-	-0.16	**	-0.26	**	-0.07	**	-0.31	*
		(-1.82)		(-2.30)		(-2.30)		(-1.32)	
CEO_{it}	+	0.29	**	1.11	***	0.26	***	1.08	**
		(2.26)		(3.37)		(3.81)		(2.31)	
$BATH_{it}$	-	-1.27	*	-1.32	**	-0.33	**	-1.6	*
		(-1.29)		(-1.79)		(-1.79)		(-1.56)	
$SMOOTH_{it}$	+	-0.32		-0.39		-0.1		-0.09	
		(-0.86)		(-0.57)		(-0.57)		(-0.09)	
$SM\_INCREASE_{it}$	-	-0.28	**	-0.73	***	-0.18	***	-0.81	*
		(-2.06)		(-2.38)		(-2.50)		(-1.52)	
$SIZE_{i,t-1}$	?	-0.02		-0.03		-0.009		-0.008	
		(-0.53)		(-0.59)		(-0.59)		(-0.08)	
$LEV_{i,t-1}$	?	0.43	*	0.65	*	0.16	*	0.28	
		(1.94)		(1.71)		(1.71)		(0.53)	
$OneSEG_{i,t-1}$	?	-0.43	***	-1.1	***	-0.27	***	-1.13	***
		(-2.70)		(-4.34)		(-4.59)		(-2.62)	
No. of obs.		384		384				384	
Log Likelihood		-366.4		-226.25				-108.9	
Likelihood Ratio				79.85	***				
Pseudo R Square				0.15					

TABLE 5.11 (Continued)

Note:

1. Statistical significance indicated by ***, **, and * for 1%, 5%, and 10% level, respectively. One-tailed test is employed for directional hypotheses.

2. Variable definitions:

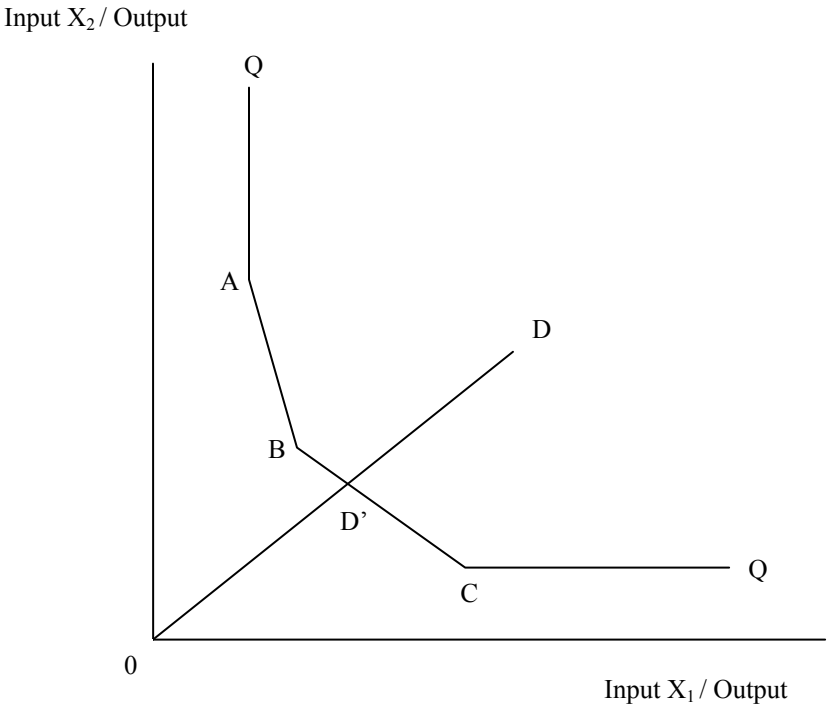
$EFF_{i,t-1}$	Firm *i*'s relative efficiency scores for the fiscal year *t-1*;
$RET_{i,t-1}$	Firm *i*'s stock returns over the fiscal year *t-1*;
CEO_{it}	A dichotomous variable equal to 1 if firm *i* has a change in CEO in the year of impairment reporting, and 0 otherwise;
$BATH_{it}$	A proxy for "unexpectedly low" earnings, equal to a *decrease* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the decrease is *below* the median of *negative* values of this variable, and 0 otherwise;
$SMOOTH_{it}$	A proxy for "unexpectedly high" earnings, equal to an *increase* in net income before goodwill impairment from year *t-1* to *t*, scaled by total assets at the end of year *t-1*, when the increase is *above* the median of *positive* values of this variable, and 0 otherwise;
$SM\_INCREASE_{it}$	A dichotomous variable equal to 1 when the difference in net income before goodwill impairment between year *t* and *t-1*, scaled by market value of equity the end of year *t-1*, falls in the interval [0.00, 0.02), and 0 otherwise.
$SIZE_{i,t-1}$	Firm *i*'s log of total assets at the end of year *t-1*;
$LEV_{i,t-1}$	Total debts divided by total assets at the end of year *t-1*;
$OneSEG_{it}$	A dichotomous variable equal to 1 if firm *i* has only one reportable segment, and 0 otherwise.

3. The DEA Model has five input variables (cost of goods sold; selling, general, and administrative expenses; current assets; fixed assets; and intangible assets) and single output variable (sales).

APPENDIX G

FIGURE 1

Efficiency Measurement for Two Inputs and One Output

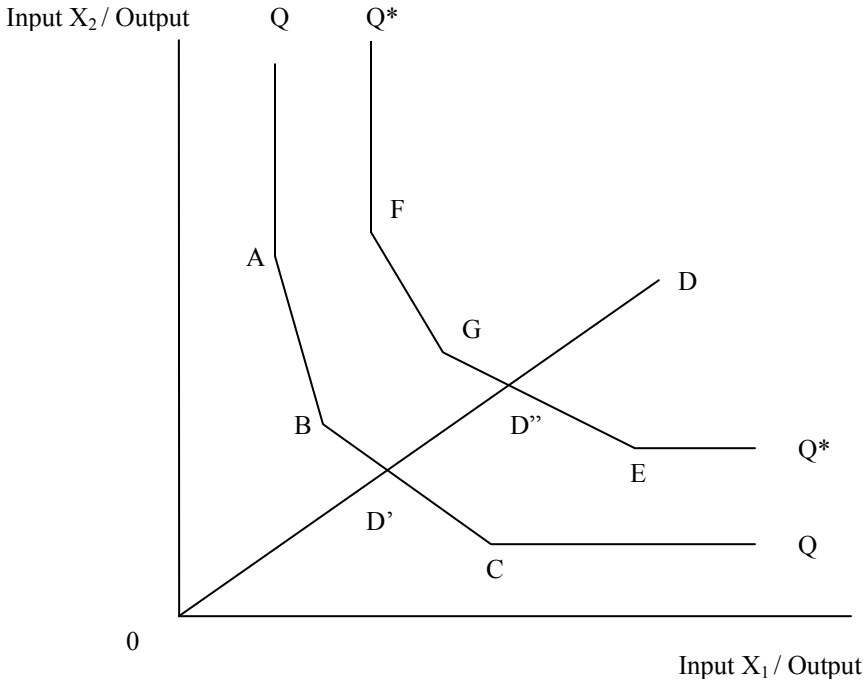


Note:

1. Production function is represented as $y = f(x_1, x_2)$; where y is an output; and x_1, x_2 are two inputs. An isoquant QQ shows all combinations of two inputs that efficient firms can use to produce a unit of output.

FIGURE 2

Pooled Sample and Subsample Frontiers



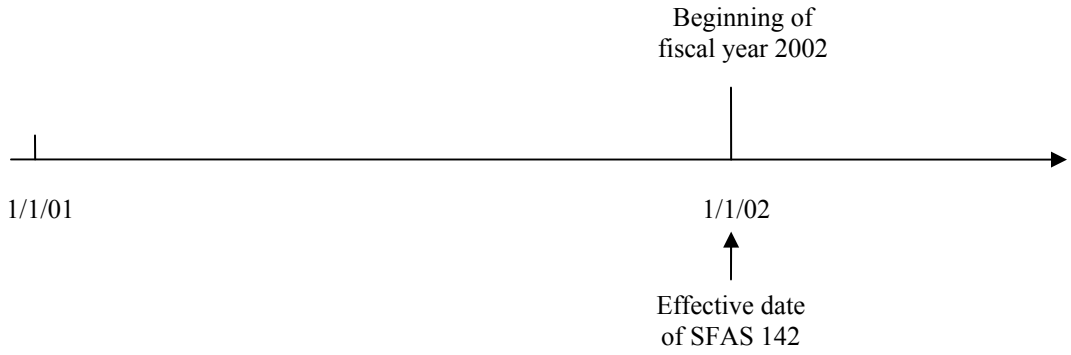
Note:

1. QQ represents the frontier isoquant from the pooled sample, while Q^*Q^* represents the frontier for the impairment firms. Considering firm D, the technical efficiency relative to the pooled frontier is called an *overall index (EI)*, which equals to OD'/OD.
2. The efficiency of each firm which is calculated relative to its separate group's frontier is called a *within-group index (EI_w)*. The technical efficiency index for firm D relative to its own group equals to OD"/OD.
3. A *between-group index (EI_b)* that captures the difference in the frontier for the two groups is calculated as the ratio of the overall efficiency index to the within-group efficiency index such that $EI_b = EI/EI_w$.

FIGURE 3

Effective Date of SFAS No. 142 Implementation

1. December 31 year-end firms



2. Firms with fiscal year-end of March 15 – December 15

3. Firms with other fiscal year-end (e.g. January 31, or February 28)

(Source: Long 2005)

VITA

Thanyaluk Vichitsarawong

Candidate for the Degree of

Doctor of Philosophy

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Title of Study: THE USEFULNESS OF GOODWILL IMPAIRMENT UNDER SFAS NO. 142 IN REFLECTING THE RELATIVE EFFICIENCY OF FIRMS

Pages in Study: 197 Candidate for the Degree of Doctor of Philosophy

Major Field: Business Administration--Accounting

Scope and Method of Study: This study examines goodwill impairment under SFAS No. 142 whether it improves financial reporting quality by better reflecting the underlying relative efficiency of a firm. A firm's relative efficiency is measured by using Data Envelopment Analysis (DEA). The analysis is undertaken on three selected industries--durable manufacturers, computers, and services. First, Wilcoxon rank sum tests are used to compare the efficiency of a firm with other firms in the same industry (the cross-sectional analysis) and with similar firms over different periods (the longitudinal analysis). Second, Tobit and logistic regressions are applied to analyze factors affecting the percentage of goodwill impairment and a decision to report goodwill impairment. Finally, a logistic regression and a multivariate discriminant analysis (MDA) are used to assess the predictive ability of relative efficiency in determining potential goodwill impairment.

Findings and Conclusions: Results of Wilcoxon rank sum tests strongly support the hypothesis that impairment firms are relatively less efficient than non-impairment firms in the year of goodwill impairment reporting. Tobit and logistic regressions provide evidence that lagged relative efficiency of firms is negatively associated with the percentage of goodwill impairment and a decision to report goodwill impairment, after controlling for managerial reporting incentives. The inferences are robust to the choice of various input/output variables in the DEA model. The results suggest that the relative efficiency is an important determinant of goodwill impairment. Finally, results of logistic regressions used to assess the predictive ability of relative efficiency indicate that measures of relative efficiency can be used to identify the likelihood of goodwill impairment. The MDA models including relative efficiency measures correctly predict more than 50 percent of the actual impairment. These findings provide opportunity for future research to include a measure of firm overall performance in the prediction model. Overall, goodwill impairment under SFAS No. 142 can reflect the decline in relative efficiency of firms, thereby achieving the FASB's objective.

ADVISER'S APPROVAL: Don R. Hansen