

The Pennsylvania State University

The Graduate School

School of Hospitality Management

**VALUATION OF INTANGIBLE ASSETS FOR PUBLICLY TRADED HOTEL  
FIRMS IN THE US**

A Thesis in

Hotel, Restaurant and Institutional Management

by

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Submitted in Partial Fulfillment  
of the Requirements  
for the Degree of

Doctor of Philosophy

August 2007

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## **Abstract**

This study provides value estimates for intangible assets of publicly traded hotel firms in the United States, approaching from both time-series and cross-sectional perspectives. When evaluating a firm's tangible and intangible assets, tests of model usefulness reveal it is meaningful to decompose adjusted income (AI), measured by revenue minus expense in this study, into adjusted income derived from intangible assets (AII) and adjusted income derived from tangible assets (AIT). Specifically, a significant difference exists for contributions from AIT and AII to a firm's market value of equity. Further, decomposing AI into AIT and AII releases incremental information to the market. Finally, it appears that the crude approach frequently employed by practitioners, namely, the value of a firm's intangible assets equals its market value of equity plus liabilities minus book value of tangible assets, systematically overestimates values of firm intangible assets, assuming firms apply uniform capital structures across their tangible and intangible assets.

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## **Acknowledgements**

I dedicate this dissertation to my dearest wife, Jing Zhang, for her unconditional, genuine, and endless support and love, and to my parents and in-laws, Shibin Hua, Shixin Bao, Huamiao Zhang and Lifen Li, for their generous and selfless caring and encouragement. I am most fortunate to be part of this family.

As a distinct honor, I extend sincere thanks to my advisor, Dr. Arun Upneja, and doctoral committee members, Dr. Karl Muller, Dr. William Andrew and Dr. Amit Sharma, for their invaluable feedback and inspiring guidance all along the way.

Finally, I am deeply indebted to Dr. Hubert B. Van Hoof and Dr. Anna Mattila for their kind assistance through the years of my graduate studies.



## Chapter One

### INTRODUCTION

#### Overview

The valuation of intangible assets can be traced to Solow (1957) when he developed the aggregate production function to capture “technical changes.” However, no study in the hospitality industry has addressed the valuation issue of intangibles at the corporate level (intangible assets and intangibles are used interchangeably in this study). The main reason could be attributed to current US accounting practices, which require companies to expense almost all internally generated intangibles immediately, as incurred.<sup>1</sup> Together with the elusive nature of intangible assets,<sup>2</sup> lack of information in the financial statements makes valuation of intangibles in the hospitality industry extremely difficult. Taking an ex post perspective, this study relies on two models to address the valuation issue of intangibles. The basis of the first model is the aggregate production function developed by Solow (1957), given the rationale that each individual hotel firm can be considered as an aggregated entity. The basis of the second model is Solow (1957) and Gu and Lev (2001), who consider how output measures can be decomposed from the sources of tangible and intangible assets. The usefulness and explanatory powers of these decomposition approaches are also discussed and tested.

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<sup>1</sup> In the US, internally developed intangibles are usually expensed immediately with the only exception being software development costs after a feasibility test (SFAS No. 86 Financial Accounting Standards Board, 1985).

<sup>2</sup> The future benefits from intangible assets are not secured for their owners. Additionally the high risks associated with internally generated intangibles, as well as lack of mature markets for intangibles to trade in, make the nature of intangible assets elusive (Aboody & Lev, 1998; Lev, 2001a).

## **Motivations for the Study and a Statement of the Problem**

In general, current accounting and financial reporting practices in the US fail to capture a substantial portion of intangible assets (Aboody et al., 1998; Abrahams & Sidhu, 1998; Barth & Clinch, 1998; Goodwin, 2002; Lev & Zarowin, 1999b; Lev, 2001a; Sougiannis, 1994). Under the current US Generally Accepted Accounting Principles (GAAP), almost all internally generated intangible assets must be expensed immediately (Financial Accounting Standards Board, 1974). One exception, however, Statement of Financial and Accounting Standards (SFAS) NO. 86, allows companies to choose whether or not they capitalize software development costs from the point of “technological feasibility” (Financial Accounting Standards Board, 1985). Many companies have chosen not to utilize this option (Lev, 2003). Examples include profitable companies like Microsoft and Oracle that do not capitalize software expenditures. The intangible asset accounting rules may be due to reliability and relevance concerns; however, expensing intangible assets immediately leads directly to lack of quantitative information about these assets on companies’ financial statements and reports.

Moreover, a mature and regulated market for trading intangibles is nonexistent. Hence, no asset prices are available for use in deriving information about these intangible assets (Aboody & Lev, 2000). Other characteristics that render the intangibles assets more elusive are the high uncertainty associated with the future returns derived from these assets and the spillover and partial excludability effects of intangibles investments (Lev & Zarowin, 1999a; Lev, 2001a). To

elaborate, Christensen (1997) demonstrates the extent of risk associated with innovation in the disk drive industry. Scherer, Harhoff and Kukies (1998) provide corroborating evidence on the high risk associated with innovation and intangibles by examining a sample of German patents, bundles of US patents licensed by seven universities, and the capital market experience of US startup companies.

Furthermore, Kothari, Laguerre and Leone (2002) provide evidence that the earnings volatility, as a measure of risk associated with R&D, is three times larger than the earnings volatility associated with physical investment.

Regarding the spillover and excludability effects, nonowners can usually enjoy some of the benefits of investments in intangibles. A typical example is general employee training. When a firm invests in training its associates, other firms and even society at large will benefit from these investments if these associates change employers. Even under the legal framework, patented inventions have been frequently imitated by competitors before their expiration dates (Lev, 2001a).

Nevertheless, under US GAAP, publicly traded hotel firms expense internally generated intangible assets immediately as incurred. For example, publicly traded hotel companies immediately expense expenditures on employee training, brand enhancement and software technology. However, since benefits derived from these expenditures are recognized later and not matched with these previously expensed investments, and since a generally increased uncertainty associated with these future benefits exists, “the fundamental accounting measurement process of periodically matching costs with revenues is seriously

distorted, adversely affecting the informativeness of financial information” (Lev et al., 1999b).

Consequently, intangible assets are unreported on financial statements, and the future benefits derived from intangible assets are not matched with previously expensed investments in these intangible assets. Also, owners remain without security for future benefits of intangibles (Lev, 2001a), and no mature market exists for trading intangibles (Aboody et al., 2000). All these facts render finding a direct measure of intangibles for publicly traded hotel firms extremely difficult. Thus, no study in the hospitality industry addresses the valuation issue of intangibles at the corporate level.

However, an indirect measure of intangibles for publicly traded hotel firms is not beyond reach. Considering investors are usually satisfied with an aggregated value of intangibles in real world situations (Lev, 2001b) as well as service and fixed asset intensity features of the hospitality industry, the first step to address the valuation issue of intangibles for publicly traded hotel firms relies on two models adopting an ex post perspective. The first model employed is the aggregate production function developed by Solow (1957), which has its basis on the rationale that each individual hotel firm can be considered as an aggregated entity. The second model has its basis in Solow (1957) and Gu and Lev (2001), who consider output measures’ decomposition based on their sources of tangible and intangible assets. This study discusses and tests usefulness and explanatory powers of these decomposition approaches.

## **Importance and Contributions of Study**

A significant deterioration in the information content of key financial statement items can be attributed to omitting intangible assets from financial statements. Based on the correlation between the announcements and the change in stock prices around the time of the announcements, Lev and Zarowin (1999b) estimate the information content of earnings announcements. They find a constant decrease in the magnitude and stability of the role that earnings, the change in book values, and operating cash flow announcements all participate in investors' decisions. Throughout the 1980s and 1990s, the contribution made by earnings and other financial measures has been decreasing, assuming equity prices are a reflection of all the information investors receive from all sources. Moreover, Lev and Zarowin (1999b) find that those firms with significant changes in R&D spending, an important measure of intangible assets in their study, are the firms for which the information deterioration is the worst. The hospitality industry features intensive investments in fixed assets and services (Wong, 2004; Howells, 2001; Sirilli & Evangelista, 1998; Wilson, Murray, Black, & McDowell, 1997). Considering that investments in various programs, tailored to improve services, are likely internally generated intangible assets, the argument is that the industry likely suffers the deterioration severely. Therefore, valuation of intangible assets will help mitigate, if not eliminate, the problem.

Chan, Lakonishok and Sougiannis (2001) identify another serious consequence of financial statements' omission of intangible assets. They find that

those firms with intensive intangibles are systematically undervalued by the market. Chan et al. argue, in an efficient market, if investors fully recognize and value contemporaneous information, the subsequent risk adjusted returns of the portfolios should have a zero average. However, the risk adjusted returns to portfolios of those firms with high R&D expenditures, relative to their market values, appear to be systematically positive and as large as 6 to 7 percent per year for the subsequent two to four years. Chan, Lakonishok and Sougiannis (2001) and Lev (2001a) indicate that systematic undervaluation means excessive cost of capital for these companies. As an undesirable consequence of the lack of information on intangibles, these undervalued companies find financing their R&D and other investments in intangibles quite difficult. A special report from Hotel Online argued that because of the undervaluation issue, “public lodging companies were hesitant to use their stocks as acquisition currency or to raise additional public equity” (Hotel Online, 1998). In a report from PricewaterhouseCoopers by Brecht (1998), Bjorn Hanson, Ph.D., New York based chairman of the PricewaterhouseCoopers lodging and gaming group, argued for the lodging stocks’ undervaluation. Hensell (1999) also stated that lodging stocks were continually undervalued. Walsh (2003) reported comments by John Emery, President and COO of Interstate Hotels & Resorts that “lodging securities are undervalued and in an effort to rectify this problem, hotels need to deliver all the details regarding their financial and non-financial activities to investors and potential investors alike.” Lee and Upneja (2007) find that lodging stocks were undervalued compared to the non-lodging stocks during the sample period of the

1990s. The reason for undervaluation is attributable to the service intensity feature of hotel firms. Possibly this is due to the omission of existing internally generated intangible assets in the reporting regime; the market is not able to correctly price hotel firms. Thus, to improve market efficiency, estimating the value of intangible assets for the hospitality industry can be an important step.

Moreover, the misreporting or absence of reporting intangible assets can lead to gains misallocated to insiders. Aboody and Lev (2000) examine all insider transactions by corporate officers reported to the Securities and Exchange Commission (SEC) from 1985 to 1999. They measure the gains to insiders between the time of the transaction and the time of reporting the transaction to the SEC, and they find that in R&D-intensive (an important intangible asset measure) firms the gains are four times larger than the gains to insiders in other firms. They argue that the reason for this result is the large information asymmetry in companies with high levels of R&D spending. Barth and Kasznik (1999) find that firms with more intangible assets are more likely to repurchase shares and have more positive repurchase announcement returns, indicating that if the management has more information than outsiders on intangible assets, then they can derive potential profits from that information. Identified as a more serious consequence by Lev (2003) is “a deterioration in the integrity of capital markets.” A radical example is Enron, considered to have had numerous intangible assets by the capital market. The information asymmetry problem is likely to be worse for the hospitality industry. Compared to other industries where at least certain measures of intangible assets are

required to be reported separately, e.g., R&D, the hospitality industry is not restricted by this rule because the industry does not have any amount significant R&D investment.<sup>3</sup> All possible internally generated intangible assets are expensed in compliance with GAAP, thus likely resulting in more severe information asymmetry between insiders and outsiders. Valuation of intangible assets for the industry will help lower the information asymmetry and improve the integrity of capital markets.

Finally, but potentially more alarming, is the idea that “managers either do not have much better information themselves in many cases, or they are ‘managing by the numbers’ in response to the feedback they receive from capital markets and financial analysts” about intangibles (Lev, 2003). As financial analysts often know little about the importance of firm specific intangible assets, firms are underinvesting in these assets, resulting in a considerable social cost (Lev, 2001a; Lev, 2003).

To conclude, as an industry that features intensive fixed assets and services,<sup>4</sup> these aforementioned issues are critical to the hospitality industry. Thus, valuation of intangibles in the hospitality industry will provide the vital piece of information current accounting practices fail to capture and contribute to the following lines of research. First, valuation of intangibles will help to explain the decline in the value relevance of US firms’ earnings. Looking at intangibles, previous studies identified two main potential reasons for this decline: (1) Although investors consider intangibles as assets, US firms rarely recognize them as assets, and (2) the relative importance of intangible assets has changed considerably over time (Aboody et al.,

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<sup>3</sup> Few firms in the hospitality industry reported R&D, if any, during the study’s sample periods.

<sup>4</sup> Some hotel firms feature intensive ownership of properties such as Host Marriott, some intensive franchise and management activities, e.g., Marriott International, while some have both, e.g., Hilton group.



1998; Aboody et al., 2000; Abrahams et al., 1998; Barth et al., 1998; Goodwin, 2002; Lev et al., 1999b; Lev, 2001a; Sougiannis, 1994). Second, this study will improve the understanding of hotel firms' intangible assets, and thus provide opportunities for investors to fairly value these firms. Furthermore, this study will help reduce the information asymmetry between insiders and outsiders, resulting in potentially lower cost of capital and fair gain allocations for outsiders. Moreover, regulators may find the results of this study useful in considering improvements to financial reporting practices. Finally, managers can also benefit from this study by acquiring a way to reasonably estimate the value of their companies' intangibles, which will allow them to better gauge their strategic as well as operating decisions, instead of being driven blindly by capital markets.

### **Organization of Study**

With a focus on financial aspects, Chapter Two reviews literature related to intangibles. Chapter Three derives models and provides rationales for their use. The measurement of variables of interest and sources of data are also discussed. Further, the usefulness and explanatory powers of these decomposition approaches are tested in Chapter Three. Results are reported in Chapter Four and a summary of main findings, implications and routes for future research concludes this study in Chapter Five.

## **Chapter 2**

### **LITERATURE REVIEW**

#### **Introduction**

This chapter reviews various aspects of intangible assets and related research. First, attention focuses on definitions of intangible assets, followed by classifications of intangibles and presentation of key current US accounting rules for intangibles. Then I provide a review of research on valuation of intangibles with empirical evidence on value relevance of intangible assets and a follow-up discussion on the valuation progress of intangibles in the US hospitality industry. Finally this chapter ends with general conclusions.

#### **Definition of Intangible Assets**

In general, the main regulatory bodies in the world define intangible assets as non-physical and non-monetary sources of probable future economic profits accruing to the firm as a result of past events and transactions (Australian Accounting Research Foundation, 1989; Accounting Standards Committee, 1989; Accounting Standards Committee, 1990b; Canibano, Garcia-Ayuso, & Sanchez, 2000; Financial Accounting Standards Board, 1974; International Accounting Standards Committee, 1998a; New Zealand Society of Accountants, 1988). For example, the International Accounting Standards Committee defines intangible assets as “non-monetary assets without physical substance held for use in the production or supply of goods or services, for rental to others, or for administrative purposes, that are identifiable, controlled by an enterprise as a result of past events and from which future economic benefits are

expected to flow to the enterprise” (International Accounting Standards Committee, 1998b). A more recent definition, proposed by Lev (2001b), defines intangible assets as sources of future benefits that lack a physical embodiment.

Intangibles are also defined as the excess cost of an acquired company over the value of its net tangible assets. For example, White, Sondhi and Fried (1994) state goodwill and other intangible assets arise as residuals in purchase method acquisitions, and in most cases represent the portion of the purchase price that cannot be allocated to other tangible assets. Therefore, goodwill represents the premium paid for the target’s reputation, brand names, or other attributes that enable it to earn an excess return on investment. The Accounting Standards Board (ASB) in the UK embraces this view; they consider all intangibles as part of goodwill, since intangibles are unlikely sold without selling the whole business (Canibano et al., 2000).

Belkaoui (1992) provides converse view. He distinguishes two main types of intangible assets: unidentifiable assets included in goodwill and identifiable assets such as patents. Napier and Power (1992) propose an interesting distinction between “entry separability” and “exit separability”. On one hand, the asset, developed internally or acquired externally, is identifiable due to the costs of development, and acquisition is accurately measurable and identifiable. This is the concept of entry separability. This is implicit in some accounting standards, such as IAS 38 (International Accounting Standards Committee, 1998b), that requires the historical cost of an intangible asset to be ascertainable as a basic premise for recognition. On the other hand, the asset may trade separately from other intangibles of the firm or

from the firm as a whole.

Apparently no complete consensus on the definition of intangible assets exists. Yet identifying intangibles as a whole, in general, is not impossible, although accompanying problems arise, especially when attempting to pinpoint a particular aspect (Accounting Standards Committee, 1989; Belkaoui, 1992; International Accounting Standards Committee, 1998b; Napier & Power, 1992). Nevertheless, a handful of basic characteristics of intangibles are commonly identified. Intangibles that lack physical substance are non-monetary sources of probable future economic benefits to an entity. They are acquired or developed internally, likely to have a finite life and a market value apart from the entity, and the firm owns or controls them as a result of past transactions or events (Canibano et al., 2000; International Accounting Standards Committee, 1998b; Lev, 2001a).

To suit the purpose of this study, the analysis follows the definition by Lev (2001b) who defines intangible assets as sources of future benefits that lack a physical embodiment. The definition simplifies and yet adequately facilitates model construction.

### **Classification of Intangible Assets**

Like its definition, no consensus for classification of intangibles exists, largely due to “the vast amount of elements” involved that cannot be accurately quantified (Canibano et al., 2000). Hendriksen and van Breda (1992) suggest that intangibles may be classified into “traditional intangibles” such as goodwill, brand names or patents and “deferred charges” such as advertising, research and

development or training costs. This considers that most assets result from situations which expend cash, but the related expense remains unrecognized in the income statement.

Skandia (1994) divides intangible assets into three sections: human capital, structural or organizational capital, and customer capital. Human capital refers to employees' individual knowledge, which leaves the company's structural capital to include the company culture, information channels, and databases, among others. Generally, the company directly owns or controls structural capital, and thus, continues working after employee turnover. Customer capital attempts to capture the value of loyal customers and external networks.

Guilding and Pike (1990) classify intangible assets into four categories from a managerial perspective: value creators such as advertising, product development and other marketing support, marketing assets such as trademarks, brands, entry barriers and information systems, value manifestations such as image, reputation and premium price, and competitive advantage derived from the synthesis of marketing assets.

Mortensen, Eustace and Lannoo (1997) propose classifying intangibles into five categories: innovation capital, structural capital, executory contracts, market capital, and goodwill. Innovation capital is mainly research and development costs; structural capital consists of intellectual capital and knowledge assets, organizational coherence and flexibility, and workforce skills and loyalty; executory contracts are composed of operating licenses and franchises, media and other broadcast licenses, agricultural and other production quotas in regulated industries, maintenance,

servicing and environmental liabilities, outsourced operations of over a year's duration, material employment contracts, and risk-hedging financial instruments, derivatives, etc.; market capital includes brands, trademarks and mastheads, and goodwill.

Roos, Roos, Edvinsson and Dragonetti (1997) classified intangibles into human and structural capital. They suggest a further division of these two groups into three subcategories: human capital including competence based on knowledge and skills, attitude based on motivation, behavior and conduct, and intellectual agility based on innovation, imitation, adaptation and packaging; structural capital, in turn, consists of relationships including customers, suppliers, alliance partners, shareholders and other stakeholders, organization including infrastructure, processes and culture, and renewal and development.

A recent classification by Lev (2001a) divides intangibles into three categories based on the connections of these assets to their generators: discovery, organizational practices, and human resources. Intangibles related to discovery are mainly identified by internal renewal, acquired capabilities and networking. Intangibles related to organization practices are achieved by the organization's structure and governing process. Intangibles related to human resources are generally created by unique personnel and compensation policies. Mainly due to data constraints and consistency concerns, the classification of intangible assets is based on Lev (2001a) in this study.

## **Current US Accounting Rules for Intangibles**

SFAS No. 2 requires investments in R&D to be immediately expensed.

The only exception to US intangibles' expensing is the capitalization of some software development costs after feasibility tests, as allowed under SFAS No. 86 (Financial Accounting Standards Board, 1974; Financial Accounting Standards Board, 1985).

SFAS No. 141 addresses accounting for intangible assets acquired in a business combination. It requires an acquiring entity to allocate the purchase price to the assets acquired and liabilities assumed at their estimated fair values on the date of acquisition. To do so, the standard provides the following guidance: "An intangible asset shall be recognized as an asset apart from goodwill if it stems from contractual or other legal rights". If an intangible asset does not stem from contractual or other legal rights, it shall be recognized as an asset apart from goodwill only if it is separable, meaning it is capable of being separated or divided for the acquired entity and sold, transferred, licensed, rented, or exchanged. After allocating the acquisition cost to acquired assets and assumed liabilities, the remaining amount is goodwill. Acquired research and development assets, recognized as part of a business combination, are immediately expensed if they have no alternative future use (Financial Accounting Standards Board, 2001b).

SFAS No. 142 addresses accounting for all intangible assets (including goodwill) after their acquisition, including those acquired in a business combination, and requires subjecting goodwill to an annual, two-step impairment test instead of an

amortization process. The first step is comparing the fair value of a reporting entity to the carrying amount, including goodwill previously recognized. The second step is comparing the implied fair value of the reporting entity's goodwill to the carrying value of the goodwill. If the implied fair value is lower, it is considered impaired.

Accounting for other intangible assets is generally an amortization process. An intangible asset is amortized over its useful life based on how the benefits of the asset are consumed. If reliably determining the consumption pattern is not possible, SFAS 142 permits the use of straight-line method. For each reporting period, managers evaluate the useful life of an intangible asset and report adjustments as a change in accounting estimate, prospectively, over the remaining life (Financial Accounting Standards Board, 2001a).

### **Valuation of Intangible Assets**

Almost a century has passed since the beginning of the debate of how to account for intangible assets and how to report them in the financial statements (Dicksee, 1987; Leake, 1914; Canibano et al., 2000; Canning, 1929). A theoretical basis for setting recognition and measurement criteria is a requirement before disclosing information on intangible assets. In general, accountants traditionally follow two income theories (Canibano et al., 2000). One, the transactions approach, investigated by Hodgson, Okunev and Willet (1993), builds accounting numbers by matching transaction costs in activities to produce activity costs. However, due to the unknown distributional properties of accounting numbers relating to the subject of intangibles' measurement, this approach forges ahead slowly. The other theory is the



valuation approach, which relies on the assumption that true economic value associates with each element in the financial statements, and that true income is the estimate of the difference between the net value of the firm's assets at two different points of time (Canibano et al., 2000).

Gu and Lev (2001), proposing a comprehensive valuation approach of enterprise intangibles, contend "the problem of jointness of intangibles is mitigated when the objective is to place a combined value on all of the company's intangibles, rather than on individual assets" (Lev, 2001b). Lev and Radhakrishnan (2004) employ a similar approach to estimate the value of organization capital.

Nevertheless, these approaches suffer two major drawbacks. When the authors intentionally ignore all the intangible components in their regression models, they created omitted variable problems because intangibles are well known to interact with, and likely to highly correlate with other components in their models.

White, Sondhi and Fried (1994) consider goodwill and other intangible assets as residuals in purchase method acquisitions, and in most cases, they represent the portion of the purchase price that cannot be allocated to other tangible assets.

Therefore, goodwill represents the premium paid for the target's reputation, brand names, or other attributes that enable it to earn an excess return on investment.

Along the same line, Napier and Power (1992) propose an interesting distinction between "entry separability" and "exit separability", indicating intangibles can be estimated during acquisition activities. However, ignoring the interaction between intangible and tangible assets, as well as the possible correlation between them, is

likely to pose serious biases during estimation.

A crude approach frequently used by practitioners to estimate intangible assets is to take the difference between a firm's market value and its book value of tangible assets. However, the resultant estimates shed no light on the connection between input and output measures, such as R&D expenditures and revenue. Moreover, this ignores the well-known interaction between tangible and intangible assets (Hendriksen & Breda, 1992). Furthermore, these estimates are likely to be affected by confounding effects, possibly introduced by market mispricing, as well as accounting practices governing intangible assets, such as goodwill and recognized intangibles. Therefore, the difference between market value and book value of a certain firm can, at best, provide a very noisy proxy for intangibles at certain points of time, and no comfortable inference can be drawn *ex ante*.

Some studies have tried to develop estimates for unrecorded R&D assets in the US in order to explain the cross-sectional differences between market value and book value of equity. Typically, these R&D assets have been estimated by cross-sectional regressions of either lagged operating income (Lev & Sougiannis, 1996; Lev & Sougiannis, 1999; Sougiannis, 1994) or the market-to-book ratio (Cockburn & Griliches, 1988; Hall, 1993) on R&D expenditures. However, this line of research implicitly assumes that R&D growth, success probabilities and depreciation rates are constant and homogeneous within the same industry, as Canibano (2000) suggests. Megna and Mueller (1991) and Callen and Morel (2005) adopted an alternative approach to estimating firm-specific R&D assets on the basis

of time series. In contrast to the results obtained from cross-sectional and fixed effects panel models, Callen and Morel (2005) find only weak empirical support for the value relevance of R&D expenditures at the firm level.

### **Empirical Evidence on the Value Relevance of Intangible Assets**

Considering its elusive nature and growing importance, intangible assets have been the subject of intensive study for a long time (Dicksee, 1987; Leake, 1914; Canibano et al., 2000; Canning, 1929). This section provides an overview of various aspects of intangibles, considered value relevant by previous research.

#### ***Research and Development (R&D)***

Recent research documented that future profitability positively relates to R&D expenditures (Bublitz & Ettredge, 1989; Lev et al., 1996; Sougiannis, 1994). Additionally, consistent positive relationships between stock returns and increases in R&D expenditures and between market value and R&D investments have been documented (Chan, Lakonishok, & Sougiannis, 2000; Hirschey, 1982; Lev et al., 1996; Megna & Klock, 1993).

R&D intensity, typically measured as the R&D-to-sales ratio, is consistently documented to be positively related to subsequent stock returns (Chan, Lakonishok, & Sougiannis, 2001; Chambers, Jennings, & Thompson, 2002; Eberhart, Maxwell, & Siddique, 2004; Lev et al., 1996; Penman & Zhang, 2002). Explanations for this relationship include R&D expenditure mispricing (Chan et al., 2001; Eberhart et al., 2004) and risk premium (Chambers et al., 2002). Lev, Sarath and Sougiannis (2004) provide an interesting perspective to explain the misvaluation of firms in addition to

R&D intensity effects. They identified reporting biases due to R&D expensing as an accounting source of capital market misvaluations.

However, several limitations may affect the validity of these results. First, it is possible that certain other factors, which explain stock prices and returns, are not considered such as certain corporate or industry characteristics (Canibano et al., 2000). Second, this line of research is usually performed under the linear framework, but that nonlinearity between R&D and other variables of interest might impact the validity of results (Ittner & Larcker, 1998).

### *Advertising Expenses*

If advertising truly builds a firm's intangible assets (White & Miles, 1996), advertising expenses likely, positively relate to future stock performance. Comanor and Wilson (1967) perform an early investigation of the value relevance of advertising investments. They find evidence to support the usefulness of advertising intensity as a proxy for product differentiation entry barriers.

Previous research documented that future profitability positively relates to advertising expenses (Bublitz et al., 1989; Chauvin & Hirschey, 1993); however, the impact of advertising is found to be limited to an average of two years (Bublitz et al., 1989; Hall, 1993). Although Chauvin et al (1993) claim that they find large, positive and consistent influences for advertising investments on the value of companies, their results, considering their analysis also revealed that stock returns associated with expenditures are greater for large firms than for small firms, may be a consequence of the positive association between firm size and earnings persistence (Canibano et al.,

2000). Barth and Kasznik (1999) find market adjusted returns positively relate to advertising expenses. A recent study by Chan, Lakonishok and Sougiannis (2001) finds a positive relationship between advertising intensity, measured by the ratio of firm advertising expenses to market value of equity, and abnormal returns, measured as the difference between raw returns and returns from a portfolio matched on size and book to market. Moreover, it appears that investors implicitly capitalized advertising expenses in 1999, when the market was more optimistic about the prospects of business to customer companies (Demers & Lev, 2001).

### ***Information Technology (IT)***

Aboody and Lev (1998) examine the value relevance of software development cost, capitalized under SFAS 86, and find these capitalized assets positively relate to stock prices. Other studies that focus on IT's value relevance aspect generally find that IT constitutes an important intangible asset that goes unrecognized in the financial statement. Moreover, IT proxies exhibit incremental explanatory power for stock prices over traditional summary accounting measures, such as earnings and book value of equity (Wyatt, 2005; Rajgopal, Venkatachalam, & Kotha, 2003; Demers et al., 2001; Trueman, Wong, & Zhang, 2000; Ittner et al., 1998; Amir & Lev, 1996).

### ***Organizational Capital***

A recent study by Lev and Radhakrishnan (2004) addressing valuation on organizational capital supports the value relevance of organizational capital. They show that organization capital contributes significantly to the explanation of cross

sectional differences in market values of firms. Moreover, they argue that organizational capital is “an agglomeration of technologies—business practices, processes and designs, and incentive and compensation systems—that together enable some firms to consistently and efficiently extract from a given level of physical and human resources a higher value of product than other firms find possible to attain.”

### *Human Capital*

The capability of employees is likely to positively affect a firm’s profitability. Therefore, the value of a firm has a connection to the quality of its employees. However, current accounting rules prescribe that investments in recruiting and training be expensed as incurred, and thus, preclude reflecting any measure of value of human resources in financial statements (Canibano et al., 2000).

A few recent empirical studies have attempted to establish a consistent relationship between different measures of the value of human resources and the market value of companies. Hansson (1997) find, by using a sample of Swedish listed firms, that knowledge intensive companies showed higher average stock returns than those in which the knowledge of human resources is a less important value driver, such as manufacturing companies. Also, Huselid (1999) reports the existence of a positive and significant relationship between investments in human resources and the market value of companies. Rosett (2001) investigates the role of the stock of unionized labor in determining equity investment risk. He estimates a labor stock measure based on expected compensation costs and used the ratio of labor stock to total assets as a risk proxy and shows significant associations between labor-based

risk proxies and equity market risk measures. Moreover, the labor-based measures provide risk information over and above information contained in standard risk proxies, such as financial and operating leverage.

### **Valuation of Intangible Assets in US Hospitality Industry**

In the hospitality industry, three valuation approaches for intangibles at the property level have been proposed. One approach frequently used by practitioners considers hotel intangibles as equal to franchise and management fees (O'Neill, 2005). Another, developed by Belfrage (2001), values intangible assets based on hotel premiums over market occupancy and average daily rate. The most recent approach, developed by O'Neill and Belfrage (2005), estimates hotel intangibles as the difference between sales attributable to franchise/brand distribution channels and the relative cost of affiliation.

### **Conclusions**

This chapter reviews various aspects of intangible assets and related research. To begin, definitions of intangible assets are presented. Classifications of intangibles are discussed along with key current US accounting rules on intangibles. Research on valuation of intangibles undergoes review with empirical evidence on value relevance of intangible assets. A follow-up discussion considers valuation progress in the US hospitality industry.

In general, research done in the hospitality industry has mainly focused on one specific type of intangibles: intangibles related to franchise and management. Moreover, all hospitality research approaches the intangibles valuation issue at the

property level. For investors interested in corporate level valuation of intangibles, little guidance exists. Furthermore, all approaches employed are very naïve and lack solid theoretical grounds; therefore, hardly any reliable estimates are provided.

Considering the significant role intangibles play in the US hospitality industry, models that can reliably estimate the value of intangibles are invaluable for all interested parties, such as industry practitioners, investors, researchers, regulators and creditors.

Chapter Three derives models and provides rationales for their use, and discusses the measurement of variables of interest and sources of data. The chapter also discusses and tests the usefulness and explanatory powers of these decomposition approaches.



## Chapter Three

### RESEARCH DESIGN

#### Introduction

Direct accurate measures of intangible assets are difficult to determine due to lack of relevant and reliable information in companies' financial statements and reports. However, an indirect measure of intangibles is not beyond reach. Identifying such a measure employs a four-step procedure to derive the value of intangible assets for each sampled publicly traded hotel company in the United States. The initial consideration is that each hotel firm is an aggregated entity. In so doing, the aggregate production function developed by Solow (1957) can identify technical changes/intangibles changes.<sup>5</sup> Then, revenue derived from tangible assets<sup>6</sup> (REVT) is estimated based on a regression of intangibles-change adjusted revenue on tangible assets and total employee working hours for each firm. REVT is deducted from total revenue to arrive at revenue stemming from intangible assets (REVI). To empirically match revenue with expense, decomposing expense follows the same scheme employed for revenue decomposition to arrive at estimates of expenses associated with tangible assets (EXPT) and expenses associated with intangible assets (EXPI). Next, by taking the differences between REVT and EXPT and between REVI and EXPI, I have adjusted income derived from tangible (AIT) and intangible assets (AII). AIT and AII are used to decompose market value of equity into

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<sup>5</sup> According to Solow (1957) this is "a shorthand expression for any kind of shift in the production function" that is not due to changes in inputs of capital and labor. Therefore, it is identical to changes due to intangibles excluding labor inputs.

<sup>6</sup> This is defined as the sum of tangible and financial assets in this study. More on this can be found on the follow-up discussion of invoking the Cobb-Douglas production function.

tangible and intangible components for each hotel firm in the sample according to an estimation model adapted from Ely and Waymire (1999) and Ohlson (1995). Finally, estimated total values of intangible assets their basis in an assumption that firms apply similar debt utilization policies for investments of both intangible and tangible assets. A significant body of previous study in the area of optimal firm capital structure exists (e.g., Ruland and Zhou, 2005; Leland and Toft, 1996; Schneller, 1980; Santomero and Watson, 1977); however, it appears that no study shows that the composition of tangible and intangible components of a firm systematically affect the capital structure choice. Therefore, in this study, the assumption is that a firm will choose its optimal capital structure based on factors other than the composition of tangible and intangible assets, and apply the chosen capital structure uniformly across its tangible and intangible assets<sup>7</sup>.

Alternatively, considering that the well known interactions between intangible assets and tangible assets suggest an interactive functional form, I employ a four-factor Cobb-Douglas production function, following a similar four-step procedure, to explore the valuation issue of intangibles<sup>8</sup>. Instead of totally ignoring the fact that intangibles interact and possibly correlate with tangible assets (Lev, 2001b), I employ proxies to represent the three major classes of intangibles, namely: intangibles related to innovation, organization practices and human resources (Lev, 2001a). Explicitly incorporating these variables in the function mitigates the omitted

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<sup>7</sup> Further study of this issue is left for future research considering the possibility that firms deviate from this assumption, although idiosyncratic random deviations are not likely to bias the overall model estimates in this study.

<sup>8</sup> In fact, assuming constant returns to scale, the Cobb-Douglas production function is the only production function form (Cobb & Douglas, 1928).

variable problem and the bias in the constant term, if not eliminated. All financial variables are adjusted to 2005 dollars based on Consumer Price Index (CPI).

### **Models, Variables of Interest and Sample**

As mentioned earlier, this study employs two approaches to address the valuation issue of intangibles in the US hospitality industry. The following section maps the models, variables of interest and corresponding rationales behind each.

#### ***Invoking the Aggregate Production Function***

The first model employed is the aggregate production function developed by Solow (1957) which considers each individual hotel company as an aggregated entity. Although employing the aggregate production function does require time-series data and an assumption that the relevant factors are paid their marginal products, “the price may not be unreasonably high” considering the assumption is often made in the economics literature (Solow, 1957). Moreover, invoking the aggregate production function to address the valuation issue of intangibles in the US hospitality industry enjoys three advantages: (1) By focusing on the hospitality industry, data collected are likely to be homogeneous, (2) the hospitality industry highlights the importance of service providers and fixed assets, and (3) the hospitality industry is highly competitive and sensitive to the movements in the market (Miles, 1993; Sundbo, 1997; Tether & Metcalfe, 2002; Tether, Hipp, & Miles, 2001). This provides a natural setting for the aggregate production function.

Based on Solow (1957), if  $Q$  represents output,  $K$  capital inputs and  $L$  labor inputs in “physical” units, respectively, then the aggregate production function can be

written as:

$$Q = F(K, L; t) \tag{1}$$

Solow (1957) uses  $t$  for time in  $F$  to allow for technical changes, which he uses as “a shorthand expression for any kind of shift in the production function.” Therefore, it is a catchall measure that captures slowdowns, speedups, improvements in the education of the labor force and all sorts of other things not incorporated in  $K$  and  $L$ . Consequently, in this study technical changes’ effects are equivalent to intangibles’ effects (henceforth, “intangibles’ effects” and “technical changes’ effects” are interchangeable). Furthermore, if shifts in the production function leave marginal rates of substitution unchanged, but only increase or decrease the output attainable from given inputs (neutral technical change assumption)<sup>9</sup>, equation (1) can take the special form:

$$Q = A(t)f(K, L) \tag{1a}$$

Based on Solow (1957), this study uses the following regression. It provides the highest explanatory power for Solow’s study as well as better accommodates small samples<sup>10 11</sup> (Suppression of time subscripts eases presentation):

$$\ln q = \ln \alpha + \beta \ln k + \ln \varepsilon \tag{1b}$$

where  $q$  is the output per man hour, and  $k$  is the capital per man hour in Solow (1957).

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9 Tests conducted in this study did not find any significant relation between either  $\frac{\Delta A_r(t)}{A_r(t)}$  and  $K/L$  or  $\frac{\Delta A_e(t)}{A_e(t)}$  and  $K/L$ ; therefore, the neutrality assumption is empirically reasonable ( $\frac{\Delta A_r(t)}{A_r(t)}$  and  $\frac{\Delta A_e(t)}{A_e(t)}$  are defined on page 32).

<sup>10</sup> The hospitality sample is relatively small; thus, to avoid losing observations due to differencing, this regression is preferred.

<sup>11</sup> Proof appears in the appendix.

This leaves the intercept to capture the cumulative effects of intangibles.

Considering both revenue and expense streams are affected by intangibles' effects, a separate estimate of the following two regressions for intangibles' effects associated with revenue and expense streams allows parsing intangibles' effects during analyses<sup>12</sup>. These estimations establish the foundation for the follow-up empirical matching of revenue and expense net of intangibles' effects:

$$\ln rev = \ln \alpha_r + \beta_r \ln ta + \ln \varepsilon \quad (2a)$$

$$\ln exp = \ln \alpha_e + \beta_e \ln ta + \ln \varepsilon \quad (2b)$$

where *rev* is estimated by revenue (data12 from COMPUSTAT Industrial Annual) divided by total working hours (the number of employees times the annual average working hours per employee) for each hotel firm; *exp* is estimated by total expense<sup>13</sup> divided by total working hours (the number of employees times the annual average working hours per employee) for each hotel firm, and *ta* is estimated by tangible assets divided by total working hours. This leaves  $\alpha_r$  and  $\alpha_e$  to capture the cumulative intangibles' effects associated with revenue and expense, respectively<sup>14</sup>.

$A_r(t)$  and  $A_e(t)$  with subscripts of *r* and *e* distinguish intangibles' effects associated with revenue from those associated with expense. Arguably tangible assets' contributions to revenue, as well as their impacts on expense, are constant over time after parsing impacts from intangible assets. Therefore, based on Solow (1957),

<sup>12</sup> (2a) follows from the derivation in the appendix after replacing *q* with *rev*; while (2b) is attained similarly if replacing *q* with *exp*. The reason for introducing (2b) is that intangibles' effects may work differently on expense.

<sup>13</sup> Total expense is measured as the sum of Depreciation and Amortization Expense (data14), Cost of Goods Sold (data41), Rental Expense (data47), Labor and Related Expense (data42), Pension Service Cost (data331), Advertising Expense (data45), and Selling, General and Administrative Expense (data189).

<sup>14</sup>  $\alpha$  s are consistent estimates of intangibles' effects,  $A(t)$ .

$$\frac{\Delta rev}{rev} - \hat{\beta}_r \frac{\Delta ta}{ta} \quad \text{and} \quad \frac{\Delta exp}{exp} - \hat{\beta}_e \frac{\Delta ta}{ta} \quad \text{are estimates of} \quad \frac{\Delta A_r(t)}{A_r(t)} \quad \text{and} \quad \frac{\Delta A_e(t)}{A_e(t)}^{15},$$

respectively. If arbitrarily setting  $A_r(t)$  and  $A_e(t)$  equal to 1, where  $t$  is the earliest year of a firm in the sample, and using the fact that, in general,

$$A(t+1) = A(t) \left(1 + \frac{\Delta A(t)}{A(t)}\right),$$

I can reconstruct  $A_r(t)$  and  $A_e(t)$  time series for each

firm<sup>16</sup>, and name them Intangible Index (1) and (2), respectively.

To reiterate, in general, equation (1a) is  $Q = A(t)f(K, L)$ ; after reconstructing  $A(t)$  time series, I can parse impacts of intangible assets on revenue and expense by estimating the following regressions for each firm in the sample<sup>17</sup>, thus rendering possible the empirical matching of revenue with expense net of intangibles' effects for follow-up analyses:

$$\frac{REV}{A_r(t)} = f(K, L) \tag{3a}$$

$$\frac{EXP}{A_e(t)} = f(K, L) \tag{3b}$$

where REV and EXP are revenue and expense, respectively; K and L are tangible assets on book and total working hours, respectively. Choosing the Cobb-Douglas production function<sup>18</sup> for  $f$  allows obtaining estimates of revenue derived from, as well as expense associated with,  $K$  and  $L$  net of intangibles' effects. Specifically for

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<sup>15</sup>  $\hat{\beta}$ s are estimates of  $\beta$ s from regression (2a) and (ab).

<sup>16</sup> Arbitrarily setting  $A(t)$  equal to a constant will not bias the model estimates (McCombie, 2000).

<sup>17</sup> When contrasted with manufacturing firms, the service industry is characterized by the relatively low rate of innovation (Howells, 2001). Furthermore, most traditional services are viewed as non-innovative companies with low levels of technological dependence that provide non-technical products (Miles, 1993; Sundbo, 1997; Tether et al., 2002; Tether et al., 2001).

<sup>18</sup> The Cobb-Douglas production function is frequently used in the literature to describe the production process of a firm, sector, or economy (Dhrymes, 1962).

each firm in sample ( $t$  is the time subscript for year)<sup>19</sup>:

$$\frac{REV_t}{A_r(t)} = K_t^\gamma L_t^\varphi \varepsilon_t \quad (4a)$$

$$\frac{EXP_t}{A_e(t)} = K_t^\tau L_t^\theta \nu_t \quad (4b)$$

Estimating parameters in (4a) and (4b) uses the natural logarithm after

introducing an intercept (see footnote 19), thus:

$$\ln \frac{REV_t}{A_r(t)} = \ln \lambda + \gamma \ln K_t + \varphi \ln L_t + \ln \varepsilon_t \quad (5a)$$

$$\ln \frac{EXP_t}{A_e(t)} = \ln \delta + \tau \ln K_t + \theta \ln L_t + \ln \nu_t \quad (5b)$$

After getting estimates of  $\gamma$ ,  $\hat{\gamma}$ , as well as  $\tau$ ,  $\hat{\tau}$ , I estimate revenue<sup>20</sup> derived from tangible assets net of intangible effects of a firm in year  $t$  (REVT) by calculating  $K_t^{\hat{\gamma}}$ ; while expense associated with tangible assets net of intangibles' effects of a firm in year  $t$  (EXPT) by computing  $K_t^{\hat{\tau}}$ . Next by deducting  $K_t^{\hat{\gamma}}$  from the total revenue of a firm in year  $t$  and deducting  $K_t^{\hat{\tau}}$  from the total expense of a firm in year  $t$ , I have revenue stemming from (REVI) as well as expense associated with intangible assets (EXPI) for a firm in year  $t$ .

Next, by taking the difference between REVT and EXPT, I have adjusted

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<sup>19</sup> The Cobb-Douglas production function in the original general form is  $REV_t = A_r(t)K_t^\gamma L_t^\varphi \varepsilon_t$ , as a simple mathematic manipulation, an equivalent expression is  $\frac{REV_t}{A_r(t)} = K_t^\gamma L_t^\varphi \varepsilon_t$ . During empirical testing of the function,

inserting an intercept will not bias any of the parameter estimates, instead will provide a zero error expectation in regression analyses (Greene, 2003). The same arguments apply for (5b).

<sup>20</sup> Moreover, choosing revenue as the output measure is not without reason. The argument lies in the equivalence of total revenue and total costs under conditions of perfect competition, with which revenue can be expressed as the following, based on McCombie (2000):  $REV_t = w_t L_t + r_t K_t$ , Where REV, w, L, r and K are revenue, the average wage rate, labor, the accounting rate of profit and capital, respectively. By completing a similar derivation process as before, the result is an equation very similar to  $\frac{\partial q}{\partial t q} = \frac{\partial A}{\partial t A} + w_k \frac{\partial k}{\partial t k}$  (4a) in the appendix.

<sup>21</sup>  $K_t^{\hat{\gamma}}$  is a consistent estimate of  $K_t^\gamma$ . The same applies for  $K_t^{\hat{\tau}}$ .

income derived from tangible assets net of intangibles' effects (AIT). Similarly, the difference between REVI and EXPI gives adjusted income derived from intangible assets (AII).

Next, by estimating the regression (6), adapted from Ely and Waymire (1999) and Ohlson (1995):

$$MV_{i,t} = \beta_0 + \beta_1 BVT_{i,t} + \beta_2 BVI_{i,t} + \beta_3 AIT_{i,t} + \beta_4 AII_{i,t} + \varepsilon_t \quad (6)$$

I have,

$$VT_{i,t} = \hat{\beta}_1 BVT_{i,t} + \hat{\beta}_3 AIT_{i,t} \quad (7)$$

$$VI_{i,t} = MV_{i,t} - VT_{i,t} \quad (8)$$

where

$\hat{\beta}_1, \hat{\beta}_3$  are estimated from (6).

$VI_{i,t}$  = The intangible component of MV for firm  $i$  in year  $t$ .

$VT_{i,t}$  = The tangible component of MV for firm  $i$  in year  $t$ .

$MV_{i,t}$  = Market value of equity for firm  $i$  in year  $t$ , computed as the product

of price (data199) and Common shares outstanding (data54) from COMPUSTAT

Industrial Annual, adjusted based on Consumer Price Index to 2005 dollars.

$BVi,t$  = Total assets (data6) – Total liabilities (data181), for firm  $i$  in year  $t$ ,

adjusted based on Consumer Price Index to 2005 dollars.

$BVI_{i,t}$  = (Recognized intangibles (data33) + Goodwill (data204) + Other

intangibles (data352))\*(1-L/(FMV)), where FMV is the sum of MV and L (total

liabilities, data181), for firm  $i$  in year  $t$ , adjusted based on Consumer Price Index to



2005 dollars<sup>22</sup>.

$$BVT_{i,t} = BV_{i,t} - BVI_{i,t}, \text{ for firm } i \text{ in year } t.$$

$AIT_{i,t}$  = Adjusted income derived from tangible assets for firm  $i$  in year  $t$ ,

measured as  $REVT_{i,t} - EXPT_{i,t}$ .

$AII_{i,t}$  = Adjusted income derived from intangible assets for firm  $i$  in year  $t$ ,

measured as  $REVI_{i,t} - EXPI_{i,t}$ .

The final estimation of the total value of intangible assets is by  $VI/(1-L/FMV)$ , assuming firms apply uniform capital structures across their tangible and intangible assets<sup>23</sup>.

The key question now turns to whether this procedure, proposed thus far, is meaningful. In other words, if the contribution to the market value of equity from AIT is identical to that from AII, no need exists to decompose AI based on its sources. To test this, I have the following hypothesis, in null form, for the regression (6).

H01: No difference exists in the contributions to the market value of equity from AIT and AII, i.e.,  $\beta_3 = \beta_4$ .

Moreover, the two regressions below, (9) and (10), can be estimated and the resulting adjusted R-square values compared to show if decomposing AI provides incremental explanatory power. The null hypothesis is:

H02: No incremental information release occurs based on the decomposition of AI into AIT and AII, i.e., the adjusted R-square from (9)  $\geq$  the

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<sup>22</sup> Parsing out the liability component in recognized intangible assets, I assume firms apply similar debt utilization standards to investments in both tangible and intangible assets, on average. Further study of firms' debt utilization practices is left for future studies due to time and cost concerns.

<sup>23</sup> Firms might deviate from the assumptions made in this study; however, due to time and cost concerns, this issue is left for future research.

adjusted R-square from (10):

$$MV_{i,t} = \beta_0 + \beta_1 BV_{i,t} + \beta_2 AI_{i,t} + \varepsilon_t \quad (9)$$

$$MV_{i,t} = \beta_0 + \beta_1 BV_{i,t} + \beta_2 AIT_{i,t} + \beta_3 AII_{i,t} + \varepsilon_t \quad (10)$$

### ***Variables of Interest and Sample***

Data to estimate equations (2a), (2b), (5a), (5b), (6), (9) and (10) are collected from COMPUSTAT Industrial Annual and the March Supplements of The Current Population Survey (CPS)<sup>24</sup> by the Bureau of Census of the Bureau of Labor Statistics from 1963 to 2005<sup>25</sup>. Financial data and the number of employees are collected from COMPUSTAT Industrial Annual for publicly traded hotel firms (SIC codes 7000, 7010, and 7011). Tangible assets ( $K$ ) are calculated from deducting recognized intangibles (data33), goodwill (data204) and other intangibles (data352) from total assets (data6)<sup>26</sup>. The number of employees (data29) multiplied by the annual average working hours per employee for the hospitality industry, collected from CPS, is used to proxy for employee total working hours per year ( $twh$ ). Other relevant variables are previously defined.

### ***Limitations***

Caution needs to be exercised when interpreting the results considering the fact that, in order to introduce revenue as a measure for output in the aggregate production function, assumptions include: (1) Conditions for perfect competition are satisfied; (2) the impacts of tangible assets on revenue and expense are constant over

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<sup>24</sup> The Current Population Survey (CPS) is a monthly survey of households conducted by the Bureau of Census for the Bureau of Labor Statistics. It provides a comprehensive body of data on the labor force, employment, unemployment, and persons not in the labor force.

<sup>25</sup> Data on COMPUSTAT are affected by survivorship before 1963 (Davis, 1996).

<sup>26</sup> Ideally, current market values of these variables should be used; however, due to reliability concerns, book values will be employed in this study.

time after parsing effects of intangibles; (3) firms apply uniform capital structures across their tangible and intangible assets, and (4) the effects of technical changes are equivalent to those of intangible assets. Further, possible simultaneity issues and lag effects, related to input and output measures, remain for future studies due to time, data, and cost constraints of the current study. Finally, due to potential limitations on the availability of time series data for each hotel firm, the final sample of this study may not be representative of all publicly traded hotel firms.

### ***Invoking the Cobb-Douglas Production Function***

Considering the main regulatory bodies in the world typically define intangible assets as non-physical and non-monetary sources of probable future economic profits accruing to the firm as a result of past events and transactions (Australian Accounting Research Foundation, 1989; Financial Accounting Standards Board, 1974; Canibano et al., 2000; New Zealand Society of Accountants, 1988; Accounting Standards Committee, 1990a; Accounting Standards Committee, 1989; International Accounting Standards Committee, 1998a), reasonable assurance exists that output measures, e.g., revenue in this study<sup>27</sup>, can be decomposed based on their sources of tangible, intangible and financial assets (Gu & Lev, 2001). Moreover, considering that future benefits derived from financial assets and tangible assets are surely secured for owners, and trading of these assets occurs in organized markets (Aboody et al., 2000), as well as the way financial assets contribute to revenue is

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<sup>27</sup> Earnings before extraordinary items are not chosen because of concern for introducing bias. The Cobb-Douglas production function form calls for the procedure of taking logarithm on both dependent and independent variables during the parameter estimation process. However, as a mathematical property of logarithm, negative numbers will not be valid for this process, which directly leads to truncation of the dependent variable and biases model estimates.

similar to that of tangible assets, combining tangible and financial assets together in this study allows naming the sum as gross tangible assets<sup>28</sup> (henceforth, tangible assets and gross tangible assets are interchangeable). Thus, if choosing revenue (REV) as the output measure, it can be decomposed based on its sources of tangible and intangible assets. Similarly, matching revenue with expense empirically requires decomposing total expense based on the same sources that generate revenue. Considering that the well-known interactions between intangible assets and tangible assets call for an interactive function form, invoking the Cobb-Douglas production function form allows exploring the valuation issue of intangibles following a similar procedure as before.

First is estimating two empirical models with the following form (for ease of presentation, time and firm subscripts are suppressed):

$$REV = \alpha Tangible^{\beta_1} Org^{\beta_2} Ad^{\beta_3} twh^{\beta_4} \varepsilon \quad (11a)$$

$$EXP = \eta Tangible^{\omega_1} Org^{\omega_2} Ad^{\omega_3} twh^{\omega_4} \nu \quad (11b)$$

where REV is total revenue (data12) for firm  $i$  in year  $t$ ; Tangible is estimated by deducting goodwill and recognized intangibles from total assets for firm  $i$  in year  $t$ ;  $Org$  is estimated as the sum of franchise and management fees for firm  $i$  in year  $t$ ;  $Ad$  is estimated as advertising expenses for firm  $i$  in year  $t$ ; and  $twh$  is the total working hours estimated as the number of employees multiplied by the annual average working hours per employee for firm  $i$  in year  $t$ .

Rewrite (11a) and (11b) as the following by taking natural logarithm on both

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<sup>28</sup> A more practical reason for doing so is that in the hospitality industry, insufficient observations exist for each year to run a cross-section regression with more than four independent variables without sacrificing power.

sides:

$$\begin{aligned} \ln REV &= \ln \alpha + \beta_1 \ln Tangible + \beta_2 \ln Org \\ &+ \beta_3 \ln Ad + \beta_4 \ln twh + \ln \varepsilon \end{aligned} \quad (12a)$$

$$\begin{aligned} \ln EXP &= \ln \eta + \omega_1 \ln Tangible + \omega_2 \ln Org \\ &+ \omega_3 \ln Ad + \omega_4 \ln twh + \ln \nu \end{aligned} \quad (12b)$$

From (12a) and (12b), REVT is estimated by calculating  $Tangible^{\hat{\beta}_1}$ ; while EXPT by  $Tangible^{\hat{\omega}_1}$ . To estimate REVI and EXPI, I deduct  $Tangible^{\hat{\beta}_1}$  from total revenue and  $Tangible^{\hat{\omega}_1}$  from total expense, respectively. Consequently, AIT and AII are computed as the difference between REVT and EXPT, as well as between REVI and EXPI, respectively. Finally, similar estimation processes as those employed in the aggregate production function section arrive at value estimates of intangible and tangible assets. Specifically, MV decomposing into tangible and intangible components based on regression (6), equation (7), and (8) leads to value estimates of intangible assets, attained by calculating  $VI/(1-L/FMV)$ .

Similarly, the question of meaningfulness of these decomposition exercises is tested by forming the following two hypotheses: (1) Whether or not the contribution to the market value of equity from AII is identical to that from AIT. The hypothesis in null form below is tested based on (6), where AIT and AII estimated from (12a) and (12b):

H03: No difference exists in the contributions to market value of equity from AIT and AII, i.e.,  $\beta_3 = \beta_4$ .

(2) Whether or not decomposing AI into AIT and AII provides incremental information. The hypothesis in null form is presented below and tested based on (9)

and (10).

H04: No incremental information release exists based on the decomposition of AI into AIT and AII, i.e., the adjusted R-square from (9)  $\geq$  the adjusted R-square from (10).

### ***Variables of Interest and Sample***

Based on the Lev (2001a) classification, intangibles classify into intangibles: (a) related to discovery and innovation, (b) related to organization practices, and (c) related to human resources. For the hospitality industry, innovations usually correlate with advertising expenses (Hua, Denizci, Mattila, & Upneja, 2007), which strengthens the overall company image as well as provides unique competitive advantages. For this reason, *Ad* is adopted to proxy for innovations. Similarly, franchise and management fees are likely to result from strong organization practices; therefore, the sum of franchise and management fees is used to proxy for intangibles related to organization practices. Moreover, Selling, General and Administrative Expenses are considered to be able to generate intangible assets related to organization capital (Lev & Radhakrishnan, 2004). Therefore, the total of franchise and management fees and selling, general and administrative expenses is used to proxy for organizational capital. Along the same line of reasoning, total annual employee working hours are employed to proxy for intangibles related to human resources. Calculation of tangible assets is by deducting recognized intangibles, goodwill and other intangibles from total assets.

However, noteworthy is that inherent ambiguity, embedded in Lev's (2001a)

classifications, as well as data availability constraints, renders these aforementioned proxies fairly noisy. Considering the purpose of this study is to provide an overall value estimate of intangibles, this ambiguity problem is not likely to qualitatively affect the resultant estimates, assuming the chosen proxies are reasonably complete.

The sample is collected from COMPUSTAT Industrial Annual and CPS from 1996 to 2005. The subperiod is used because franchise and management fee data have to be collected manually.  $AI (REV - EXP)$ , the number of employees (data29), *tangible* [total assets (data6) – intangibles (data33) – goodwill (data204) – other intangibles (data352)], selling, general and administrative expenses (data189) and *Ad* (data45) are collected from COMPUSTAT Industrial Annual. The number of employees (data29) multiplied by the annual average working hours per employee for the hospitality industry, collected from CPS, is used to proxy for employee total working hours per year (*twh*). Franchise and management fees are collected manually from companies' annual reports.

### ***Limitations***

As an empirical estimating procedure, similar to the previous one in the aggregate production function section, proper caution is necessary when interpreting the results. Considering the decompositions based on the Cobb-Douglas production function assumptions are: (1) Conditions for perfect competition are satisfied; (2) the impacts of tangible assets on revenue and expense are constant over time after parsing effects of intangibles assets; (3) the set of proxies for intangible assets employed in this study is reasonably complete, and (4) firms apply uniform capital structures

across their tangible and intangible assets. Further, possible simultaneity issues and lag effects related to input and output measures are topics for future studies due to time, data, and cost constraints this study encountered. Finally, due to potential limitations on data availability, the final sample of this study may not be representative of all publicly traded hotel firms.

Chapter Four provides test results and corresponding discussions.



## Chapter Four

### EMPIRICAL RESULTS

#### Introduction

This chapter provides empirical results for both valuation approaches presented in Chapter Three. The initial results are from the procedure based on the aggregate production function and corresponding discussions. Subsequent are results from the procedure based on the Cobb-Douglas production function and applicable discussions. Relevant assumptions are tested and results reported.

#### **Empirical Results from the Aggregate Production Function Procedure**

##### *Sample for the aggregate production function*

Based on available data from COMPUSTAT Industry Annual, a total number of 470 firm-year observations constitute the collected data from 1963 to 2005 for 27 publicly traded, active and inactive, hotel firms. Considering decomposing *REV* and *EXP* based on the aggregate production function requires an estimation of three parameters employing time-series data, I place a restriction on the data selection by setting the minimum number of firm-year observations to be 10 for each firm included in the sample<sup>29 30</sup>. This ensures a reasonable sample and variability for the estimation. Noticeably, however, the majority of firms included in the sample have more than twenty firm-year observations<sup>31</sup>.

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<sup>29</sup> Admittedly, this restriction might introduce a selection bias for the parameter estimation based on regression (6); however, as the first exploratory study in this area for the hospitality industry, in-depth assessments of the restriction remain for future studies.

<sup>30</sup> Marriott Intl Inc is excluded from the sample due to an extremely poor fit of -0.21 provided by regression (5a) for estimating REVT as well as that of -.19 by regression (5b) for estimating EXPT, even though it has 12 firm-year observations.

<sup>31</sup> Sensitivity tests excluding firms with less than 15 or 20 firm-year observations do not qualitatively affect results from regression (6).

**Table One: Sampled Firm Names and the Number (N) of Firm-year Observations for the Firm-Specific Regression (5a).**

N	Company Name
11	ATLAS HOTELS INC
13	DIVI HOTELS NV
13	FABULOUS INNS OF AMERICA
20	FOUR SEASONS HOTELS -LTD VTG
15	GAYLORD ENTERTAINMENT CO
43	HILTON HOTELS CORP
26	HOLIDAY CORP
12	HUDSON HOTELS CP
12	INTEGRA A HOTEL & REST
17	INTERCONTINENTAL HOTELS -ADR
22	INTL LEISURE HOSTS
25	KAHLER CORP
11	KAMPGROUNDS OF AMERICA
33	LA QUINTA CORP
26	LA QUINTA INNS INC
30	LODGIAN INC
13	NORTHVIEW CORP
15	PEEK'N PEAK RECREATION INC
30	PRIME HOSPITALITY CORP
17	RIDGEWOOD HOTELS INC
41	SONESTA INTL HOTELS -CL A
31	SOUTHERN INVT SERVICES INC
31	STARWOOD HOTELS & RESORTS WRLD
27	SWISS CHALET INC
20	THOUSAND TRAILS INC
28	UNITED INNS INC
28	WESTERN STANDARD CORP

***Results based on the aggregate production function***

Based on Solow (1957), revenue is decomposed by running a firm-specific, time-series regression (5a). To reiterate, by estimating (5a) firm by firm, firm-specific  $\hat{\gamma}$  can be attained. Thus, revenue derived from tangible assets is attained by calculating  $K_t^{\hat{\gamma}}$  and revenue derived from intangible assets by total revenue minus  $K_t^{\hat{\gamma}}$ .  $\hat{\gamma}$  and firm-specific model adjusted R-squares are reported in Table Two with the number of firm-year observations for running (5a). In general,

reasonably high fits are observed for the majority of sampled firms.

**Table Two:  $\hat{\gamma}$  from Regression (5a) and Associated Firm Specific Adjusted R-squares.**

Company Name	N	$\hat{\gamma}$	Adj. R-Sq
ATLAS HOTELS INC	11	1.0281	0.8263
DIVI HOTELS NV	13	0.6056	0.9603
FABULOUS INNS OF AMERICA	13	0.2915	0.1785
FOUR SEASONS HOTELS -LTD VTG	20	0.5323	0.0967
GAYLORD ENTERTAINMENT CO	15	0.0234	0.1122
HILTON HOTELS CORP	43	0.8952	0.8985
HOLIDAY CORP	26	1.1014	0.9888
HUDSON HOTELS CP	12	1.1803	0.7896
INTEGRA A HOTEL & REST	12	0.8565	0.8343
INTERCONTINENTAL HOTELS -ADR	17	0.2088	0.3269
INTL LEISURE HOSTS	22	0.8725	0.6594
KAHLER CORP	25	1.0265	0.9492
KAMPGROUNDS OF AMERICA	11	0.2635	0.8533
LA QUINTA CORP	33	0.6034	0.8350
LA QUINTA INNS INC	26	0.8101	0.9586
LODGIAN INC	30	0.8376	0.9556
NORTHVIEW CORP	13	0.3525	0.3822
PEEK'N PEAK RECREATION INC	15	1.7831	0.3453
PRIME HOSPITALITY CORP	30	0.6314	0.8911
RIDGEWOOD HOTELS INC	17	1.2806	0.6221
SONESTA INTL HOTELS -CL A	41	0.1035	0.4644
SOUTHERN INVT SERVICES INC	31	0.4210	0.8912
STARWOOD HOTELS&RESORTS WRLD	31	0.8502	0.9848
SWISS CHALET INC	27	0.0958	0.4995
THOUSAND TRAILS INC	20	1.0713	0.6919
UNITED INNS INC	28	0.7242	0.9444
WESTERN STANDARD CORP	28	0.0024	0.9372

**Note:**

N: The number of firm-year observations utilized for running regression (5a).

To empirically match revenue and expense, based on their common source of tangible and intangible assets after parsing intangibles' effects, total expense is decomposed based on (5b). Expense associated with tangible assets is calculated by

$K_t^{\hat{\tau}}$ , and expense associated with intangible assets by total expense minus  $K_t^{\hat{\tau}}$ .  $\hat{\tau}$  estimates are from regression (5b), and corresponding firm-specific adjusted R-squares are reported in table three. Similarly, a general high fit is observed for sampled firms.

**Table Three:  $\hat{\tau}$  from Regression (5b) and Associated Firm Specific Adjusted R-squares.**

Company Name	N	$\hat{\tau}$	Adj. R-Sq
ATLAS HOTELS INC	11	1.0262	0.8113
DIVI HOTELS NV	13	0.5942	0.9633
FABULOUS INNS OF AMERICA	13	0.2732	0.1110
FOUR SEASONS HOTELS -LTD VTG	20	0.5061	0.1476
GAYLORD ENTERTAINMENT CO	15	0.1667	0.1156
HILTON HOTELS CORP	43	0.7318	0.8412
HOLIDAY CORP	26	1.0712	0.9880
HUDSON HOTELS CP	12	0.1702	0.8436
INTEGRA A HOTEL & REST	12	0.9945	0.9060
INTERCONTINENTAL HOTELS -ADR	17	0.3171	0.4093
INTL LEISURE HOSTS	22	0.9192	0.7364
KAHLER CORP	25	0.7458	0.8274
KAMPGROUNDS OF AMERICA	11	0.2516	0.8782
LA QUINTA CORP	33	0.5246	0.7213
LA QUINTA INNS INC	26	0.8605	0.9754
LODGIAN INC	30	0.8041	0.9430
NORTHVIEW CORP	13	0.3548	0.4680
PEEK'N PEAK RECREATION INC	15	1.8498	0.4659
PRIME HOSPITALITY CORP	30	0.5981	0.8916
RIDGEWOOD HOTELS INC	17	1.3554	0.6884
SONESTA INTL HOTELS -CL A	41	0.1462	0.4564
SOUTHERN INVT SERVICES INC	31	0.3567	0.8296
STARWOOD HOTELS&RESORTS WRLD	31	0.7030	0.9565
SWISS CHALET INC	27	0.4500	0.4285
THOUSAND TRAILS INC	20	1.1635	0.7007
UNITED INNS INC	28	0.7614	0.9461
WESTERN STANDARD CORP	28	0.1346	0.9125

**Note:**

N: the number of firm-year observations utilized for running regression (5b).

Utilizing results from Tables Two and Three, I decompose revenue and

expense based on their sources, namely, tangible and intangible assets. Taking the difference between REVT and EXPT, I have an estimate of adjusted income derived from tangible assets; similarly, REVI minus EXPI gives adjusted income derived from intangible assets. Table Four presents the summary statistics for the final sample used to estimate regression (6), the main model for intangible valuation. The sample size deflates to 445 firm-year observations due to data availability constraints<sup>32</sup>. Some of the sampled firms during certain years show negative book values, indicating their high leverage. Overall, these sample firms span a wide range of size, profitability, and leverage levels, as implied by minimum and maximum values of these corresponding variables.

**Table Four: Summary Statistics for Variables Used to Estimate Regression (6) (in Millions of Dollars Except for N).**

Variable	N	Mean	Std. Dev.	Minimum	Maximum
MV	445	872.98	2085.00	0.15	12668.00
L	445	726.49	1703.00	0.0470	11718.00
BV	445	488.31	1274.00	-769.95	8425.00
BVT	445	426.45	1155.00	-750.04	8104.00
BVI	445	61.85	259.81	-38.09	1981.00
AI	445	4.37	218.45	-2783.00	719.00
AIT	445	113.94	345.03	-385.24	2267.00
AII	445	-109.57	320.46	-2770.00	380.95

**Note:**

MV = Market value of firm *i* in year *t*, computed as the product of price (data199) and common shares outstanding (data54) from COMPUSTAT Industrial Annual, adjusted based on Consumer Price Index to 2005 dollars.

L = total liabilities (data181).

BV = Total assets (data6) – Total liabilities (data181), for firm *i* in year *t*, adjusted based on Consumer Price Index to 2005 dollars.

BVI = (Recognized intangibles (data33) + Goodwill (data204) + Other intangibles (data352))\*(1- L/FMV) for firm *i* in year *t*, where FMV is the sum of MV and L, adjusted based on Consumer Price Index to 2005 dollars.

BVT = BV – BVI, for firm *i* in year *t*.

AI = REV – EXP, where REV and EXP are as previously defined;

<sup>32</sup> The data constraints come from missing firm market value, which could cause bias in estimating regression (6). However, considering missing values consist of only 5% of the original sample and do not interrupt any time series, resulting serious biases are unlikely.

AIT = adjusted income derived from tangible assets, calculated as  $REVT - EXPT$ , where REVT equals revenue derived from tangible assets for firm  $i$  in year  $t$  and EXPT equals expense associated with tangible assets for firm  $i$  in year  $t$ , both estimated from the previous section based on regression (5a) and (5b).

AII = adjusted income derived from intangible assets, calculated as  $REVI - EXPI$ , where REVI equals revenue derived from intangible assets for firm  $i$  in year  $t$  and EXPI equals expense associated with intangible assets for firm  $i$  in year  $t$ , both estimated from the previous section based on regression 5(a) and 5(b).

### *Correlation Analysis*

Table Five presents results of the Pearson correlation analysis<sup>33</sup>. Certain interesting observations are worth particular attention. First, BVT and AIT, as well as BVI and AII, significantly and positively correlate, indicating, to some extent, the current accounting system is accomplishing a reasonable job establishing connections between the sources and benefit streams derived from these sources. Second, BVT and AII, as well as BVI and AIT, are significantly negatively correlated, given BVT and AIT, as well as BVI and AII, are significantly and positively correlated. The reason behind this is that of the decomposition of BV into BVT and BVI, namely, BV equals the sum of BVT and BVI, which directly leads to the significant negative correlation between BVT and BVI. Finally, a certain amount of moderate correlations exist between some of the independent variables, e.g., between AIT and AII, between AII and BVI, and between AII and BVT. However, multicollinearity, if not perfect, only poses serious problems when an omitted variable correlates with other independent variables in the model. In this study, the model is reasonably well specified, and correlations, if not perfect, between included independent variables, will not bias model parameter estimates (Greene, 2003).

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<sup>33</sup> Spearman correlation analysis gives, qualitatively, the same results.

**Table Five: Pearson's Correlation Table.**

	<b>MV</b>	<b>BVT</b>	<b>BVI</b>	<b>AIT</b>	<b>AII</b>
<b>MV</b>	1	0.8718 (<.0001)	0.5962 (<.0001)	0.7982 (<.0001)	0.7298 (<.0001)
<b>BVT</b>	0.8718 (<.0001)	1	-0.3674 (<.0001)	0.6639 (<.0001)	-0.3443 (<.0001)
<b>BVI</b>	0.5962 (<.0001)	-0.3674 (<.0001)	1	-0.4128 (<.0001)	0.6287 (<.0001)
<b>AIT</b>	0.7982 (<.0001)	0.6639 (<.0001)	-0.4128 (<.0001)	1	-0.7269 (<.0001)
<b>AII</b>	0.7298 (<.0001)	-0.3443 (<.0001)	0.6287 (<.0001)	-0.7269 (<.0001)	1

**Note:**

All variables are as specified in Table One.

P-values are reported in parentheses.

***MV Decomposition***

Table Six presents results from the regression (6), the main valuation model.

White's (1980) tests reveal signs of heteroscedasticity; therefore, standard errors are adjusted based on White (1980) and reported with corresponding t-values. All parameter estimates are significant at the 5% level and with expected signs. In general, an increase in assets and benefit streams, BVT, BVI, AIT and AII in this study, leads to higher market value (Ohlson, 1995).

To consider the possibility of the multicollinearity issue, variance inflation factors are calculated and reported. As shown in Table Six, there are moderate amounts of multicollinearity associated with AIT and AII. However, this is not likely to pose serious problems with parameter estimation, considering multicollinearity (if not perfect multicollinearity) among included independent variables will not bias parameter estimates (Greene, 2003). One major concern with moderate amounts of multicollinearity is that of instability of parameter estimates. A

frequent example occurs when analysis reveals one parameter estimate to be extremely large while another extremely small. This kind of concern is not present in Table Six. Adjusted R-square is reported and nicely at a level of 85.73%, indicating a very high model explanatory power. Subsequent tests of auto-correlation for five lags did not reveal any significant relationships<sup>34</sup>.

**Table Six: the Regression (6) Results.**

Variable	Estimate	S.E.	t-Value (w)	Pr >  t	VIF	Adj. R-Sq.
Intercept	81.4438	41.1728	1.9800	0.0485	0.0000	0.8573
BVT	1.3914	0.0506	27.4800	<.0001	2.4496	
BVI	1.7176	0.2131	8.0600	<.0001	2.1938	
AIT	1.0245	0.2354	4.3500	<.0001	4.7235	
AII	0.2262	0.0786	2.8787	0.0042	5.7055	

**Note:**

Estimate: Parameter estimates.

S. E.: standard error.

(w): White (1980) adjusted errors and associated *t* values.

VIF: variance inflation factor.

Adj. R-Sq.: adjusted R-square.

All variables are defined as in table one.

### *Hypotheses Testing*

Testing of Hypothesis One ( $H_{01}$ ) reveals significant difference between AIT and AII, indicating decomposition of AI into AIT and AII is a meaningful process. Specifically, the coefficient associated with AIT in Table Seven is significantly greater than zero at all reasonable levels<sup>35</sup>, indicating the coefficient associated with AIT is

<sup>34</sup> Testing for autocorrelation is based on regressing current residuals on lagged residuals from regression (6). The resultant regression is reported as the following (R denotes the current residual; while Lag1R denote residuals from lagged one time period and so on):  $R = 30.72477637 + 0.077 \cdot \text{Lag1R} - 0.068 \cdot \text{Lag2R} + 0.060 \cdot \text{lag3R} - 0.013 \cdot \text{Lag4R} - 0.056 \cdot \text{Lag5R}$ . However, none of the coefficient estimates is significantly different from zero; thus a reasonable interpretation results from regression (6) without making any autocorrelation adjustments.

<sup>35</sup> This is rendered possible by introducing a new parameter alpha, which equals to the difference of the two coefficients associated with AIT and AII, considering heteroscedasticity in the model. If  $\alpha = \beta_3 - \beta_4$ , based on regression (6), then  $MV = \beta_0 + \beta_1 \cdot \text{BVT} + \beta_2 \cdot \text{BVI} + (\alpha + \beta_4) \cdot \text{AIT} + \beta_4 \cdot \text{AII} + e \Rightarrow MV = \beta_0 + \beta_1 \cdot \text{BVT} + \beta_2 \cdot \text{BVI} + \alpha \cdot \text{AIT} + \beta_4 \cdot (\text{AIT} + \text{AII}) + e \Rightarrow MV = \beta_0 + \beta_1 \cdot \text{BVT} + \beta_2 \cdot \text{BVI} + \alpha \cdot \text{AIT} + \beta_4 \cdot \text{AI} + e$ . Therefore, a simple test of whether alpha is different from zero reveals whether beta3 is significantly different from beta4, after making necessary White (1980) adjustments to relevant



significantly greater than that associated with AII.

**Table Seven: Test Results for Hypothesis One.**

Variable	Estimate	S.E.	t-Value (w)	Pr >  t	VIF	Adj. R-Sq.
Intercept	81.4438	41.1728	1.9800	0.0485	0.0000	0.8573
BVT	1.3914	0.0506	27.4800	<.0001	2.4496	
BVI	1.7176	0.2131	8.0600	<.0001	2.1938	
AIT	0.7983	0.1845	4.3300	<.0001	2.9008	
AI	0.2262	0.0786	2.8787	0.0042	2.6514	

**Note:**

All variables are as previously defined.

Hypothesis Two (H<sub>02</sub>) testing employs regression (9) and (10). Results are reported in Table Eight and Nine. As indicated by the increase in the adjusted R-square from regression (9) to regression (10) from 83.79% to 85.70%, incremental information is released to and used by the market when decomposing AI into AIT and AII. Further, this increase in the adjusted R-square implies the decomposition of AI, following the procedure laid out in this study, is a meaningful and necessary exercise for intangibles valuation. Similar to regression (6), moderate amounts of multicollinearity are present in regression (10); however, as reasoned earlier, multicollinearity is not likely to pose serious problems with the parameter estimation process. Lastly, as indicated by the adjusted R-squares of 85.73% from Table Six and 85.70% from Table Nine, decomposing BV into BVT and BVI does not provide incremental information content. This is not surprising because BVT and BVI are pieces of information publicly available just the same as BV, and the market is able to impound them into price.

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values.

**Table Eight: Regression (9) Results.**

Variable	Estimate	S.E.	t-Value	Pr >  t	VIF	Adj. R-Sq.
Intercept	87.8980	42.0660	2.0900	0.0372	0.0000	0.8379
BV	1.5956	0.0337	47.3500	<.0001	1.2369	
AI	1.3621	0.1965	6.9300	<.0001	1.2369	

**Note:**

AI = REV – EXP, where REV equals data12 and EXP is the calculated sum of Depreciation and amortization expense (data14), Cost of goods sold (data41), Rental Expense (data47), Labor and Related Expense (data42) + Pension Service Cost (data331) + Advertising Expense (data45) + Selling, General and Administrative Expense (data189) from COMPUSTAT Industrial Annual.

Other variables are as defined in Table One.

**Table Nine: Regression (10) Results.**

Variable	Estimate	S.E. (w)	t-Value (w)	Pr >  t	VIF	Adj. R-Sq.
Intercept	73.8487	40.8710	1.8100	0.0715	0.0000	0.8570
BV	1.4221	0.0458	31.0300	<.0001	2.4336	
AIT	1.2177	0.1924	6.3300	<.0001	3.1463	
AII	0.3107	0.0725	4.2855	<.0001	5.4454	

**Note:**

Variables are as defined as in previous tables.

*Estimates of VT and VI*

Using equations (7) and (8), estimates of VI and VT for sampled firms in years 1996 through 2005 are presented in Table Nine from available data. As shown in the table, intangible assets play a very important role in firm MV. For sample hotel firms in this time period, those that survived generally show intangible assets' dominance. Further, for these firms, over the time, intangible assets increase substantially, indicating a timely strategic shift. In addition to improving tangible assets, it appears that these hotel firms are investing heavily in their intangible assets, which are, accordingly, valued and recognized by the market. Consequently, the likelihood is that stronger brands, better managerial expertise, as well as more efficient organizational structure result from this shift. Further, changes in VI,

surrounding the year 2001, indicate firms' strategic response to the drastic event, i.e., 9-11, is to conservatively endure the loss. Based on Table Ten, it appears that those firms that do not have significant value imbedded in intangible assets in general fail, over time, indicating the prominent role intangible assets play in deciding whether a hotel firm will survive or not. Finally, some estimates of VI are less than zero, indicating book values of tangible assets for these firms are higher than their market value of equity.

**Table Ten: Estimates of VT and VI for Year 1996 to 2005 Based on Regression (6), Where AIT and AII Derived from (5a) and (5b) (in Millions of Dollars, Except Year).**

Company Name	Year	MV	VT	VI
FOUR SEASONS HOTELS -LTD VTG	2005	2363.42	472.78	1890.65
FOUR SEASONS HOTELS -LTD VTG	2004	2382.36	483.24	1899.12
FOUR SEASONS HOTELS -LTD VTG	2003	1484.18	463.18	1021.00
FOUR SEASONS HOTELS -LTD VTG	2002	1494.79	375.51	1119.28
FOUR SEASONS HOTELS -LTD VTG	2001	1803.65	371.20	1432.45
FOUR SEASONS HOTELS -LTD VTG	2000	2175.48	638.78	1536.69
FOUR SEASONS HOTELS -LTD VTG	1999	1417.02	546.72	870.30
FOUR SEASONS HOTELS -LTD VTG	1998	888.30	280.61	607.69
FOUR SEASONS HOTELS -LTD VTG	1997	1071.12	217.29	853.83
GAYLORD ENTERTAINMENT CO	2005	1750.85	948.65	802.20
GAYLORD ENTERTAINMENT CO	2004	1369.45	984.20	385.25
GAYLORD ENTERTAINMENT CO	2003	812.39	1021.92	-209.52
GAYLORD ENTERTAINMENT CO	2002	766.76	1082.06	-315.31
GAYLORD ENTERTAINMENT CO	2001	799.45	892.31	-92.87
GAYLORD ENTERTAINMENT CO	2000	830.55	930.94	-100.39
GAYLORD ENTERTAINMENT CO	1999	928.62	1202.09	-273.47
GAYLORD ENTERTAINMENT CO	1998	975.95	631.75	344.20
GAYLORD ENTERTAINMENT CO	1997	1744.52	651.36	1093.16
GAYLORD ENTERTAINMENT CO	1996	2298.23	687.84	1610.39
HILTON HOTELS CORP	2005	8538.99	3341.97	5197.01
HILTON HOTELS CORP	2004	7307.52	2877.25	4430.27
HILTON HOTELS CORP	2003	5269.32	2632.43	2636.89
HILTON HOTELS CORP	2002	4983.44	2554.00	2429.44
HILTON HOTELS CORP	2001	3638.60	2577.74	1060.86
HILTON HOTELS CORP	2000	3407.97	3101.63	306.34

HILTON HOTELS CORP	1999	3397.02	2971.90	425.12
HILTON HOTELS CORP	1998	6007.34	1517.63	4489.72
HILTON HOTELS CORP	1997	7468.22	4762.86	2705.35
HILTON HOTELS CORP	1996	4635.94	4512.17	123.76
HUDSON HOTELS CP	2000	6.73	349.10	-342.37
HUDSON HOTELS CP	1999	7.84	346.76	-338.92
HUDSON HOTELS CP	1998	16.23	356.82	-340.59
HUDSON HOTELS CP	1997	26.70	403.42	-376.72
HUDSON HOTELS CP	1996	33.20	261.14	-227.95
INTERCONTINENTAL HOTELS -ADR	2005	7783.01	2172.58	5610.43
INTERCONTINENTAL HOTELS -ADR	2004	8752.85	4875.17	3877.68
INTERCONTINENTAL HOTELS -ADR	2003	5640.44	5949.26	-308.83
INTERCONTINENTAL HOTELS -ADR	2002	8716.30	11261.36	-2545.06
INTERCONTINENTAL HOTELS -ADR	2001	8522.13	10698.71	-2176.58
INTERCONTINENTAL HOTELS -ADR	2000	9712.13	10578.56	-866.43
INTERCONTINENTAL HOTELS -ADR	1999	10980.94	7547.30	3433.63
INTERCONTINENTAL HOTELS -ADR	1998	12668.16	6080.77	6587.38
INTERCONTINENTAL HOTELS -ADR	1997	11684.66	8439.42	3245.23
INTERCONTINENTAL HOTELS -ADR	1996	10214.09	8505.29	1708.81
INTL LEISURE HOSTS	1996	3.69	4.75	-1.05
LA QUINTA CORP	2004	1375.40	1908.66	-533.26
LA QUINTA CORP	2003	689.32	1975.61	-1286.28
LA QUINTA CORP	2002	857.81	1824.08	-966.27
LA QUINTA CORP	2001	639.80	2331.92	-1692.12
LA QUINTA CORP	2000	625.04	2500.40	-1875.36
LA QUINTA CORP	1999	1552.77	3145.04	-1592.28
LA QUINTA CORP	1998	2926.25	3579.02	-652.76
LA QUINTA CORP	1996	224.93	57.02	167.91
LA QUINTA INNS INC	1997	1563.04	430.75	1132.29
LA QUINTA INNS INC	1996	1605.49	371.26	1234.23
LODGIAN INC	2005	253.99	397.10	-143.11
LODGIAN INC	2004	238.83	365.69	-126.86
LODGIAN INC	2003	41.44	105.90	-64.46
LODGIAN INC	2002	212.21	338.21	-126.00
LODGIAN INC	2001	57.13	58.01	-0.89
LODGIAN INC	2000	97.77	270.27	-172.50
LODGIAN INC	1999	142.92	409.31	-266.40
LODGIAN INC	1998	250.53	496.53	-246.00
LODGIAN INC	1997	260.01	377.13	-117.13
LODGIAN INC	1996	135.30	134.92	0.37
PRIME HOSPITALITY CORP	2003	353.34	964.13	-610.80
PRIME HOSPITALITY CORP	2002	484.07	1001.23	-517.15
PRIME HOSPITALITY CORP	2001	489.01	1003.44	-514.43

PRIME HOSPITALITY CORP	2000	434.32	948.04	-513.72
PRIME HOSPITALITY CORP	1999	522.40	899.81	-377.41
PRIME HOSPITALITY CORP	1998	653.33	913.31	-259.98
PRIME HOSPITALITY CORP	1997	872.28	748.56	123.72
PRIME HOSPITALITY CORP	1996	540.67	597.96	-57.29
RIDGEWOOD HOTELS INC	2002	1.07	-13.76	14.82
RIDGEWOOD HOTELS INC	2001	1.64	-14.69	16.33
RIDGEWOOD HOTELS INC	2000	4.59	1.01	3.58
RIDGEWOOD HOTELS INC	1999	1.04	0.75	0.29
RIDGEWOOD HOTELS INC	1998	1.86	2.01	-0.15
RIDGEWOOD HOTELS INC	1997	2.24	3.00	-0.76
RIDGEWOOD HOTELS INC	1996	1.65	3.29	-1.64
SONESTA INTL HOTELS -CL A	2005	90.97	16.12	74.85
SONESTA INTL HOTELS -CL A	2004	20.99	15.30	5.68
SONESTA INTL HOTELS -CL A	2003	16.83	21.70	-4.88
SONESTA INTL HOTELS -CL A	2002	25.24	30.90	-5.66
SONESTA INTL HOTELS -CL A	2001	30.12	37.48	-7.36
SONESTA INTL HOTELS -CL A	2000	32.21	41.65	-9.43
SONESTA INTL HOTELS -CL A	1999	25.38	36.34	-10.96
SONESTA INTL HOTELS -CL A	1998	27.27	33.76	-6.49
SONESTA INTL HOTELS -CL A	1997	25.72	32.71	-6.99
SONESTA INTL HOTELS -CL A	1996	18.11	32.31	-14.19
STARWOOD HOTELS&RESORTS WRLD	2005	12664.12	6166.81	6497.31
STARWOOD HOTELS&RESORTS WRLD	2004	9761.09	5329.39	4431.69
STARWOOD HOTELS&RESORTS WRLD	2003	6016.92	4897.43	1119.49
STARWOOD HOTELS&RESORTS WRLD	2002	5923.47	4678.19	1245.28
STARWOOD HOTELS&RESORTS WRLD	2001	5828.00	4240.61	1587.39
STARWOOD HOTELS&RESORTS WRLD	2000	5610.50	6139.38	-528.88
STARWOOD HOTELS&RESORTS WRLD	1999	5410.13	6082.64	-672.51
STARWOOD HOTELS&RESORTS WRLD	1998	7087.81	7019.95	67.86
STARWOOD HOTELS&RESORTS WRLD	1997	2186.05	2053.16	132.88
STARWOOD HOTELS&RESORTS WRLD	1996	845.48	1123.84	-278.36
SWISS CHALET INC	1999	10.16	12.54	-2.38
SWISS CHALET INC	1998	12.00	9.38	2.62
SWISS CHALET INC	1997	8.76	8.41	0.34
SWISS CHALET INC	1996	7.53	7.85	-0.32
WESTERN STANDARD CORP	2003	1.30	-2.16	3.46
WESTERN STANDARD CORP	2002	0.54	-1.66	2.20
WESTERN STANDARD CORP	2001	0.47	-2.79	3.26
WESTERN STANDARD CORP	2000	0.15	-2.21	2.36
WESTERN STANDARD CORP	1999	1.47	-1.95	3.43
WESTERN STANDARD CORP	1998	0.31	-1.21	1.52
WESTERN STANDARD CORP	1997	0.46	-1.56	2.02

WESTERN STANDARD CORP	1996	0.62	-0.42	1.04
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**Note:**

VT: Value estimates of tangible asset components based on equation (7).

VI: Value estimates of intangible asset components based on equation (8).

***Total Value Estimates of Intangible Assets***

The total value of a firm (FMV) can also decompose into tangible and intangible components. The key, now, is to consider the effects of liabilities. This study assumes firms apply uniform capital structures across their tangible and intangible assets. Consequently, total value estimates for firms' intangible assets

(FVI) are calculated as:  $\frac{VI}{(1 - L / FMV)}$ , where L is total liabilities (data181), and

FMV is the sum of MV and L. Firms' total tangible assets (FVT) are the difference between FMV and FVI. A simple t-test reveals that the crude approach frequently employed by practitioners, where the total value of intangible assets [FVI(s)] equals market value of equity plus total liabilities, minus book value of tangible assets.

This systematically overestimates the total value of intangible assets<sup>36</sup>. However, caution is necessary when interpreting this result, considering it might be driven by firms' debt utilization practices, which may be significantly different from that proposed in this study.

**Table Eleven: Total Value Estimates of Firms' Intangible Assets for Year 1996 to 2005 (in Millions of Dollars Except Year).**

Company Name	Year	FMV	FVT	FVI	FVI (s)
FOUR SEASONS HOTELS -LTD VTG	2005	2696.90	539.48	2157.41	2154.98
FOUR SEASONS HOTELS -LTD VTG	2004	2699.66	547.60	2152.06	2168.81
FOUR SEASONS HOTELS -LTD VTG	2003	1624.36	506.93	1117.43	1215.94
FOUR SEASONS HOTELS -LTD VTG	2002	1602.02	402.45	1199.57	1277.78
FOUR SEASONS HOTELS -LTD VTG	2001	1910.55	393.20	1517.35	1590.39
FOUR SEASONS HOTELS -LTD VTG	2000	2359.69	692.88	1666.82	1726.43

<sup>36</sup> T-test is significant at all reasonable levels.

FOUR SEASONS HOTELS -LTD VTG	1999	1586.29	612.03	974.26	1034.49
FOUR SEASONS HOTELS -LTD VTG	1998	1027.91	324.71	703.20	698.94
FOUR SEASONS HOTELS -LTD VTG	1997	1210.21	245.50	964.70	935.67
GAYLORD ENTERTAINMENT CO	2005	3434.88	1861.09	1573.79	1394.75
GAYLORD ENTERTAINMENT CO	2004	3020.89	2171.07	849.82	965.10
GAYLORD ENTERTAINMENT CO	2003	2485.15	3126.08	-640.94	387.36
GAYLORD ENTERTAINMENT CO	2002	2171.37	3064.29	-892.91	1.73
GAYLORD ENTERTAINMENT CO	2001	2308.79	2576.98	-268.20	191.64
GAYLORD ENTERTAINMENT CO	2000	2042.24	2289.08	-246.84	254.80
GAYLORD ENTERTAINMENT CO	1999	1699.85	2200.43	-500.59	139.68
GAYLORD ENTERTAINMENT CO	1998	1462.78	946.89	515.89	585.07
GAYLORD ENTERTAINMENT CO	1997	2345.86	875.88	1469.98	1329.19
GAYLORD ENTERTAINMENT CO	1996	2967.51	888.15	2079.36	1824.63
HILTON HOTELS CORP	2005	14470.99	5663.63	8807.36	10099.99
HILTON HOTELS CORP	2004	12981.52	5111.32	7870.20	9159.52
HILTON HOTELS CORP	2003	11208.32	5599.41	5608.91	7450.32
HILTON HOTELS CORP	2002	11278.44	5780.17	5498.27	7416.44
HILTON HOTELS CORP	2001	10640.60	7538.26	3102.34	6343.60
HILTON HOTELS CORP	2000	10905.97	9925.65	980.32	5401.97
HILTON HOTELS CORP	1999	11235.02	9829.02	1406.00	5584.02
HILTON HOTELS CORP	1998	9764.34	2466.75	7297.59	5820.34
HILTON HOTELS CORP	1997	11911.22	7596.39	4314.82	6711.22
HILTON HOTELS CORP	1996	9001.94	8761.62	240.32	4014.94
HUDSON HOTELS CP	2000	128.93	6690.11	-6561.18	-5.34
HUDSON HOTELS CP	1999	143.99	6367.52	-6223.53	5.78
HUDSON HOTELS CP	1998	159.07	3497.95	-3338.88	16.39
HUDSON HOTELS CP	1997	165.68	2503.17	-2337.49	13.56
HUDSON HOTELS CP	1996	122.77	965.82	-843.05	19.88
INTERCONTINENTAL HOTELS -ADR	2005	10620.75	2964.72	7656.03	6665.79
INTERCONTINENTAL HOTELS -ADR	2004	14035.82	7817.69	6218.13	5555.11
INTERCONTINENTAL HOTELS -ADR	2003	10504.16	11079.29	-575.13	1647.40
INTERCONTINENTAL HOTELS -ADR	2002	14545.71	18792.89	-4247.18	834.90
INTERCONTINENTAL HOTELS -ADR	2001	13882.87	17428.61	-3545.73	1028.25
INTERCONTINENTAL HOTELS -ADR	2000	14778.15	16096.53	-1318.38	2317.15
INTERCONTINENTAL HOTELS -ADR	1999	18266.45	12554.71	5711.74	5571.52
INTERCONTINENTAL HOTELS -ADR	1998	20137.46	9666.07	10471.38	8288.54
INTERCONTINENTAL HOTELS -ADR	1997	16340.86	11802.44	4538.42	5610.16
INTERCONTINENTAL HOTELS -ADR	1996	14992.95	12484.65	2508.30	4092.21
INTL LEISURE HOSTS	1996	5.38	6.92	-1.54	0.02
LA QUINTA CORP	2004	2796.16	3880.27	-1084.10	102.98
LA QUINTA CORP	2003	2076.65	5951.71	-3875.06	-653.79
LA QUINTA CORP	2002	2092.07	4448.64	-2356.58	-377.84
LA QUINTA CORP	2001	1827.52	6660.93	-4833.41	-769.70

LA QUINTA CORP	2000	2395.38	9582.37	-7186.99	-693.68
LA QUINTA CORP	1999	4347.31	8805.24	-4457.93	-159.10
LA QUINTA CORP	1998	6434.88	7870.32	-1435.44	947.43
LA QUINTA CORP	1996	280.85	71.20	209.65	187.37
LA QUINTA INNS INC	1997	2632.54	725.48	1907.05	1130.51
LA QUINTA INNS INC	1996	2439.71	564.18	1875.54	1239.91
LODGIAN INC	2005	731.63	1143.85	-412.22	4.95
LODGIAN INC	2004	735.50	1126.19	-390.69	12.19
LODGIAN INC	2003	710.01	1814.45	-1104.44	0.83
LODGIAN INC	2002	769.91	1227.03	-457.12	7.24
LODGIAN INC	2001	1039.17	1055.27	-16.10	63.81
LODGIAN INC	2000	1124.84	3109.45	-1984.61	-39.11
LODGIAN INC	1999	1342.35	3844.50	-2502.15	-81.63
LODGIAN INC	1998	1464.69	2902.88	-1438.20	-33.24
LODGIAN INC	1997	648.12	940.08	-291.96	20.47
LODGIAN INC	1996	500.34	498.97	1.37	60.56
PRIME HOSPITALITY CORP	2003	679.63	1854.46	-1174.84	-327.68
PRIME HOSPITALITY CORP	2002	897.05	1855.39	-958.35	-222.60
PRIME HOSPITALITY CORP	2001	937.84	1924.42	-986.59	-218.93
PRIME HOSPITALITY CORP	2000	926.06	2021.41	-1095.35	-233.78
PRIME HOSPITALITY CORP	1999	1219.18	2099.98	-880.80	-109.60
PRIME HOSPITALITY CORP	1998	1420.68	1986.03	-565.34	12.29
PRIME HOSPITALITY CORP	1997	1544.54	1325.47	219.07	347.87
PRIME HOSPITALITY CORP	1996	906.87	1002.97	-96.10	120.78
RIDGEWOOD HOTELS INC	2002	25.73	-331.41	357.14	5.16
RIDGEWOOD HOTELS INC	2001	26.80	-240.27	267.07	3.59
RIDGEWOOD HOTELS INC	2000	8.66	1.91	6.76	2.89
RIDGEWOOD HOTELS INC	1999	5.39	3.88	1.51	-0.52
RIDGEWOOD HOTELS INC	1998	6.20	6.71	-0.51	-1.08
RIDGEWOOD HOTELS INC	1997	6.46	8.66	-2.20	-1.80
RIDGEWOOD HOTELS INC	1996	5.93	11.83	-5.90	-2.79
SONESTA INTL HOTELS -CL A	2005	209.72	37.15	172.57	79.11
SONESTA INTL HOTELS -CL A	2004	119.26	86.96	32.30	9.72
SONESTA INTL HOTELS -CL A	2003	111.08	143.29	-32.21	0.96
SONESTA INTL HOTELS -CL A	2002	121.21	148.40	-27.19	2.76
SONESTA INTL HOTELS -CL A	2001	131.72	163.91	-32.19	2.90
SONESTA INTL HOTELS -CL A	2000	140.31	181.40	-41.09	1.99
SONESTA INTL HOTELS -CL A	1999	106.52	152.49	-45.97	-1.00
SONESTA INTL HOTELS -CL A	1998	109.35	135.36	-26.01	2.74
SONESTA INTL HOTELS -CL A	1997	78.39	99.69	-21.30	1.98
SONESTA INTL HOTELS -CL A	1996	63.64	113.51	-49.87	-5.33
STARWOOD HOTELS&RESORTS WRLD	2005	19907.12	9693.79	10213.33	11979.12
STARWOOD HOTELS&RESORTS WRLD	2004	17271.09	9429.73	7841.35	10061.09



STARWOOD HOTELS&RESORTS WRLD	2003	13553.92	11032.12	2521.80	6635.92
STARWOOD HOTELS&RESORTS WRLD	2002	14134.47	11163.01	2971.46	7015.47
STARWOOD HOTELS&RESORTS WRLD	2001	14491.00	10544.04	3946.96	7680.00
STARWOOD HOTELS&RESORTS WRLD	2000	14302.50	15650.75	-1348.25	4523.50
STARWOOD HOTELS&RESORTS WRLD	1999	14488.13	16289.09	-1800.97	4437.13
STARWOOD HOTELS&RESORTS WRLD	1998	18805.81	18625.77	180.05	6402.81
STARWOOD HOTELS&RESORTS WRLD	1997	4173.89	3920.17	253.71	1181.18
STARWOOD HOTELS&RESORTS WRLD	1996	1565.56	2080.99	-515.43	252.82
SWISS CHALET INC	1999	11.48	14.18	-2.70	1.84
SWISS CHALET INC	1998	14.01	10.95	3.06	5.91
SWISS CHALET INC	1997	10.60	10.19	0.41	3.34
SWISS CHALET INC	1996	9.31	9.71	-0.40	2.50
WESTERN STANDARD CORP	2003	13.49	-22.41	35.90	3.08
WESTERN STANDARD CORP	2002	12.30	-37.95	50.25	1.96
WESTERN STANDARD CORP	2001	13.31	-78.46	91.77	2.71
WESTERN STANDARD CORP	2000	12.95	-191.08	204.03	1.97
WESTERN STANDARD CORP	1999	13.96	-18.47	32.43	3.11
WESTERN STANDARD CORP	1998	10.35	-40.62	50.97	1.40
WESTERN STANDARD CORP	1997	11.04	-37.10	48.14	1.80
WESTERN STANDARD CORP	1996	11.41	-7.73	19.15	1.14

**Note:**

FMV:  $MV + L$  (total liabilities, data181).

FVI:  $VI/(1-L/FMV)$ .

FVT:  $FMV - FVI$ .

FVI (s):  $FMV - K$ .

### **Empirical Results from the Cobb-Douglas Production Function Procedure**

#### *Sample*

The sample for the cross-sectional analysis is collected for publicly traded hotel firms from 1996 to 2005 (SIC code 7000, 7010, and 7011) and resultant summary statistics reported in Table Twelve. Based on available data from COMPUSTAT Industry Annual, a total number of 339 firm-year observations are collected for 54 publicly traded hotel firms, including both active and inactive firms. Again, the wide range of firm observations is observed based on reported values of asset, revenue, and expense items.

**Table Twelve: Summary Statistics for Regression (12a) and (12b).**

<b>Variable</b>	<b>N</b>	<b>Mean</b>	<b>Std</b>	<b>Minimum</b>	<b>Maximum</b>
LNREV	339	4.8467	2.5300	-3.9300	9.5916
LNEXP	339	4.7672	2.4556	-2.8198	9.5589
LNTA	339	5.4253	2.5302	-2.4317	9.6082
LNAD	339	0.3729	1.3713	-4.7105	4.7875
LNORG	339	1.6025	2.0775	-3.5066	6.7310
LNH	339	8.0134	2.5593	1.1378	12.8976

**Note:**

LNREV = LN(REV).

LNEXP = LN(EXP).

LNTA = LN(TANGIBLE ASSETS).

LNAD = LN(AD);

LNORG = LN(ORG);

LNH = LN(TWH);

Variables in parentheses are as previously defined.

***Correlation Analysis***

Table Thirteen presents results of the Pearson correlation analysis. A moderate amount of correlation appears between LNH and LNTK, indicating assets and service providers are working together to generate services and products for customers. No substantial multicollinearity issues are present.

**Table Thirteen: Pearson Correlation Analysis.**

	LNREV	LNEXP	LNTK	LNAD	LNORG	LNH
LNREV	1	0.9905 (<.0001)	0.9031 (<.0001)	0.3666 (<.0001)	0.5937 (<.0001)	0.8401 (<.0001)
LNEXP	0.9905 (<.0001)	1	0.8876 (<.0001)	0.3674 (<.0001)	0.6183 (<.0001)	0.8582 (<.0001)
LNTK	0.9031 (<.0001)	0.8876 (<.0001)	1	0.3780 (<.0001)	0.5545 (<.0001)	0.7269 (<.0001)
LNAD	0.3666 (<.0001)	0.3674 (<.0001)	0.3780 (<.0001)	1	0.3777 (<.0001)	0.3396 (<.0001)
LNORG	0.5937 (<.0001)	0.6183 (<.0001)	0.5545 (<.0001)	0.3777 (<.0001)	1	0.5957 (<.0001)
LNH	0.8401 (<.0001)	0.8582 (<.0001)	0.7269 (<.0001)	0.3396 (<.0001)	0.5957 (<.0001)	1

**Note:**

Variables are as previously defined.

***Results Based on the Cobb-Douglas Production Function***

By employing (12a), revenue is decomposed based on its sources of tangible and intangible assets. Assuming the model is reasonably specified, by running (12a), I can attain REVT net of intangibles' effects by calculating  $Tangible^{\hat{\beta}_1}$ . REVI is, therefore, computed by the difference between total revenue and REVT. Relevant coefficients associated with other independent variables, as well as the adjusted R-square, are reported in Table Fourteen. Noticeably, proxies for intangibles related to innovation (*AD*), as well as intangibles related to organization capital (*ORG*), do not significantly contribute to revenue, while tangible assets and the proxy for human capital are both significantly positive. This, to some extent, strengthens the solidity of the estimation process based on the aggregate production function, considering in the first step of the aggregate production procedure, only tangible assets and total working hours are used to decompose revenue and expense. Further, the high

adjusted R-square of 89.69% indicates a strong model explanatory power.

**Table Fourteen: Results from Regression (12a).**

Variable	Estimate	S.E.	t-Value	Pr >  t	VIF	Adj. R-Sq.
Intercept	-1.2100	0.1502	-8.0600	<.0001	0.0000	0.8969
LNTK	0.5959	0.0250	23.8000	<.0001	2.2143	
LNAD	0.0066	0.0325	0.2000	0.8390	1.2341	
LNORG	0.0421	0.0249	1.6900	0.0911	1.6707	
LNH	0.3463	0.0257	13.4600	<.0001	2.4125	

**Note:**

Variables are as previously defined.

To empirically match revenue and expense, based on their common sources of tangible and intangible assets, total expense is decomposed based on (12b) and results reported in Table Fifteen. EXPT then can be calculated by  $Tangible^{\hat{\alpha}_1}$  and EXPI by the difference between total expense and EXPT. Similar to Table Fourteen, Table Fifteen records a high fit of 88.06%, indicating a high model explanatory power. However, the coefficient associated with advertising does not show significance.

**Table Fifteen: Results from Regression (12b).**

Variable	Estimate	S.E.	t-Value	Pr >  t	VIF	Adj. R-Sq.
Intercept	-1.0239	0.1500	-6.8300	<.0001	0.0000	0.8806
LNTK	0.4968	0.0261	19.0600	<.0001	2.2577	
LNAD	0.0162	0.0341	0.4700	0.6351	1.2323	
LNORG	0.0564	0.0260	2.1700	0.0306	1.6678	
LNH	0.3847	0.0261	14.7200	<.0001	2.4394	

**Note:**

Variables are as previously defined.

Utilizing results from Tables Fourteen and Fifteen, I decompose revenue and expense based on their sources, namely, tangible and intangible assets. Further, by taking the difference between REVT and EXPT, I have an estimate of AIT; similarly, REVI minus EXPI provides AII. Table Sixteen presents the summary statistics for the final sample used to estimate regression (6), the main model for intangible

valuation. The sample size reduction to 288 firm-year observations is due to loss of observations during matching manual data with firms in COMPUSTAT and missing firm market values<sup>37</sup>. Notice the mean of AII is negative, which might indicate high risks associated intangible assets<sup>38</sup>. Overall, these sample firms span a wide range of size, profitability, and leverage level, as implied by minimum and maximum values of these corresponding variables.

**Table Sixteen: Summary Statistics for Regression (6) Where AIT and AII Derived Based on (12a) and (12b).**

Variable	N	Mean	Std. Dev.	Minimum	Maximum
MV	288	1595.00	3174.00	0.12	14805.00
L	288	1225.00	2129.00	0.03	11718.00
BV	288	687.91	1385.00	-1399.00	8915.00
BVT	288	460.09	1325.00	-2983.00	8557.00
BVI	288	227.82	614.01	0.00	3286.00
AI	288	35.81	43.27	-0.07	188.20
AIT	288	21.31	330.00	-3338.00	768.03
AII	288	-14.50	324.30	-3156.00	874.77

**Note:**

Variables are as previously defined.

### *Correlation Analysis*

Table Seventeen presents results of the Pearson correlation analysis. No substantial multicollinearity is observed for running regression (6) using AIT and AII derived based on (12a) and (12b). Results are consistent with those based the aggregate production function. Positive correlations between AIT and BVT and between AII and BVI exist, indicating current accounting produces reasonably good results in connecting the sources with the benefits generated from them. BVT and

<sup>37</sup> This could introduce bias in the empirical model estimation because it might cause sample selection bias based on the dependent variable; however, since missing values constitute a small portion of the total original sample, a reasonable argument is that the likelihood of resulting serious bias is low. To be conservative, I would consider missing the dependent variable as part of the limitation in this study.

<sup>38</sup> Further inspection of the data did not reveal signs of outlier effects.

AII, as well as BVI and AIT, significantly, negatively correlate due to the negative correlation between BVT and BVI.

**Table Seventeen: Pearson’s Correlation Analysis.**

	<b>MV</b>	<b>BVT</b>	<b>BVI</b>	<b>AIT</b>	<b>AII</b>
<b>MV</b>	1	0.8532 (<.0001)	0.74312 (<.0001)	0.81152 (<.0001)	0.7298 (<.0001)
<b>BVT</b>	0.8532 (<.0001)	1	-0.3374 (<.0001)	0.60174 (<.0001)	-0.61235 (<.0001)
<b>BVI</b>	0.74312 (<.0001)	-0.3374 (<.0001)	1	-0.7128 (<.0001)	0.6287 (<.0001)
<b>AIT</b>	0.81152 (<.0001)	0.60174 (<.0001)	-0.7128 (<.0001)	1	-0.7269 (<.0001)
<b>AII</b>	0.7298 (<.0001)	-0.61235 (<.0001)	0.6287 (<.0001)	-0.7269 (<.0001)	1

**Note:**

Variables are as previously defined.

### ***MV Decomposition***

Table Eighteen presents results from the regression (6) using AIT and AII derived based on (12a) and (12b). Similarly, White’s (1980) tests reveal signs of heteroscedastisity; therefore, standard errors are adjusted, based on White (1980), and are reported with corresponding t-values. All parameter estimates are significant at the 5% level and with expected signs. In general, increases in assets and benefit streams, BVT, BVI, AIT and AII in this study, lead to higher market value (Ohlson, 1995).

To consider the possibility of the multicollinearity issue, variance inflation factors are calculated and reported. As shown in the table, moderate amounts of multicollinearity associated with BVT, AIT and AII appear. However, multicollinearity is unlikely to pose serious problems with parameter estimation,

when considering that multicollinearity (if not perfect multicollinearity), among included independent variables, will not bias parameter estimates (Greene, 2003).

The major concern of instability of parameter estimates due to multicollinearity is not apparent in Table Eighteen, either. Adjusted R-square is reported and nicely at a level of 75.77%. Although it is relatively lower than that from results derived based on the aggregate production function, possibly due to the noisy proxies utilized, the adjusted R-square still indicates a high model explanatory power.

**Table Eighteen: Results from (6) Using AIT and AII Derived Based on (12a) and (12b).**

Variable	Estimate	S.E. (w)	t-Value (w)	Pr >  t	VIF	Adj. R-Sq.
Intercept	-9.1151	131.1999	-0.0700	0.9447	0.0000	0.7577
BVT	1.4442	0.1810	7.9800	<.0001	6.7638	
BVI	1.9695	0.1812	10.8700	<.0001	5.1479	
AIT	2.7815	1.0894	2.5533	0.0112	5.1660	
AII	0.8055	0.3709	2.1700	0.0307	1.7615	

**Note:**

Variables are as previously defined.

### *Hypotheses Testing*

Testing of Hypothesis Three ( $H_{03}$ ) reveals significant difference between AIT and  $AII^{39}$ , indicating decomposing AI into AIT and AII is a meaningful process. Specifically, the coefficient associated with AIT is significantly higher than that associated with AII at all reasonable levels, as supported by the significantly positive coefficient associated with AIT in Table Nineteen.

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<sup>39</sup> Testing is completed as previously in the aggregate production function section.

**Table Nineteen: Test Results for Hypothesis Three.**

Variable	Estimate	S.E. (w)	t-Value (w)	Pr >  t	VIF	Adj. R-Sq.
Intercept	-9.1151	131.1999	-0.0700	0.9447	0.0000	0.7577
BVT	1.4442	0.1810	7.9800	<.0001	6.7638	
BVI	1.9695	0.1812	10.8700	<.0001	5.1479	
AIT	1.9760	0.7800	2.5331	0.0118	3.2650	
AI	0.8055	0.3709	2.1700	0.0307	1.3261	

**Note:**

Variables are as previously defined.

Hypothesis Four ( $H_{04}$ ) testing employs regression (9) and (10) with AIT and AII derived based on (12a) and (12b). Results are reported in Tables Twenty and Twenty-one. As indicated by the increase in the adjusted R-square from regression (9) to regression (10) from 74.12% to 75.33%, incremental information is released to and used by the market when AI is decomposed into AIT and AII. Noticeably, if comparing the adjusted R-square reported in Table Eighteen with that reported in Table Twenty-one, not much of a difference appears. This is expected because BVT and BVI are readily available as public information for the market; thus decomposing BV into BVT and BVI does not release any incremental information. Taken together, an increase in the adjusted R-square implies the decomposition of AI following the procedure based on the Cobb-Douglas production function form is a meaningful and necessary exercise for intangibles valuation. Similar to those in Tables Six and Nine, moderate amounts of multicollinearity are present in Table Eighteen and Twenty-one; however, as reasoned earlier, it is unlikely to pose serious problems with the parameter estimation process.



**Table Twenty: Results from Regression (9) Using AIT and AII Derived Based on (12a) and (12b).**

Variable	Estimate	S.E.	t-Value	Pr >  t	VIF	Adj. R-Sq.
Intercept	165.7954	107.9395	1.5400	0.1256	1.0000	0.7412
BV	1.5858	0.0853	18.5900	<.0001	1.6837	
AI	3.0930	0.5352	5.7800	<.0001	1.6837	

**Note:**

Variables are as previously defined.

**Table Twenty-one: Results from Regression (10) Using AIT and AII Derived Based on (12a) and (12b).**

Variable	Estimate	S.E. (w)	t-Value (w)	Pr >  t	VIF	Adj. R-Sq.
Intercept	-25.9217	130.8964	-0.2000	0.8432	0.0000	0.7533
BV	1.9572	0.1860	10.5200	<.0001	5.0716	
AIT	2.8082	0.8785	3.1968	0.0015	4.4744	
AII	1.7707	0.3135	5.6500	<.0001	1.2363	

**Note:**

Variables are as previously defined.

### *Estimates of VT and VI*

Using equations (7) and (8), value estimates of VT and VI, for sample firms in years 1996 through 2005, appear in Table Twenty-two, with available data.

Similar to those in Table Ten, results in Table Twenty-two show intangible assets playing a very important role in firm market value. For sample hotel firms, in this time period, those that survived exhibit intangible assets' dominance. Further, as seen in Table Twenty-two, over the time, a generally upward trend in intangible assets of these firms exists. Instead of pouring money into tangible assets, it appears that these hotel firms heavily invest in their intangible assets. Stronger brands, managerial expertise, as well as organizational structure, are the likely result of this trend. Moreover, consistent with findings in Table Ten, firms' strategic responses to the drastic event of 9-11 is to conservatively endure the loss. This can be seen by inspecting changes of VI surrounding the year of 2001. Those firms that do not have

significant value imbedded in intangible assets fail over time, indicating the prominent role intangible assets play in deciding whether a hotel firm will survive or not. Finally, some estimates of VI are less than zero, indicating book values of tangible assets for these firms are higher than their market value of equity.

**Table Twenty-two: Estimates of VT and VI for Year 1996 to 2005 (in Millions of Dollars Except Year).**

Company Name	Year	MV	VT	VI
AIRCOA HOTEL PARTNRS -LP-A	1996	12.58	27.57	-14.99
ALLSTAR INNS INC	1997	1.96	6.09	-4.13
ALLSTAR INNS INC	1996	28.54	-29.23	57.77
AMERICAN R E PTRS -LP	2005	2084.98	2505.44	-420.46
AMERICAN R E PTRS -LP	2004	1318.40	2184.55	-866.15
AMERICAN R E PTRS -LP	2003	783.67	1924.07	-1140.40
AMERICAN R E PTRS -LP	2002	423.64	1845.52	-1421.88
AMERICAN R E PTRS -LP	2001	416.26	1699.00	-1282.74
AMERICAN R E PTRS -LP	2000	412.00	1613.88	-1201.88
AMERICAN R E PTRS -LP	1999	351.50	1491.72	-1140.22
AMERICAN R E PTRS -LP	1998	464.62	1375.56	-910.94
AMERICAN R E PTRS -LP	1997	304.00	1252.86	-948.87
AMERICAN R E PTRS -LP	1996	255.72	763.16	-507.44
ARLINGTON HOSPITALITY INC	2004	14.99	25.65	-10.66
ARLINGTON HOSPITALITY INC	2003	18.85	32.83	-13.99
ARLINGTON HOSPITALITY INC	2002	17.15	43.29	-26.14
ARLINGTON HOSPITALITY INC	2001	10.40	45.19	-34.79
ARLINGTON HOSPITALITY INC	2000	15.55	42.00	-26.45
ARLINGTON HOSPITALITY INC	1999	18.79	36.70	-17.91
ARLINGTON HOSPITALITY INC	1998	23.56	44.12	-20.56
ARLINGTON HOSPITALITY INC	1997	36.13	46.13	-10.00
ARLINGTON HOSPITALITY INC	1996	41.85	41.80	0.05
BOCA RESORTS INC	2004	787.92	835.88	-47.96
BOCA RESORTS INC	2003	511.49	781.70	-270.21
BOCA RESORTS INC	2002	527.26	777.89	-250.64
BOCA RESORTS INC	2001	593.87	734.97	-141.10
BOCA RESORTS INC	2000	403.50	624.86	-221.36
BOCA RESORTS INC	1999	395.36	608.16	-212.79
BOCA RESORTS INC	1998	675.95	686.58	-10.63
BOCA RESORTS INC	1997	335.35	467.55	-132.19
BRISTOL HOTEL & RESORT INC	1999	90.11	79.05	11.06
BRISTOL HOTEL & RESORT INC	1998	59.95	67.65	-7.70

BRISTOL HOTEL & RESORT INC	1997	1085.73	978.32	107.41
BRISTOL HOTEL & RESORT INC	1996	540.32	422.72	117.60
BUCKHEAD AMERICA CORP	2001	2.02	4.85	-2.84
BUCKHEAD AMERICA CORP	2000	7.33	29.55	-22.22
BUCKHEAD AMERICA CORP	1999	11.03	42.89	-31.86
BUCKHEAD AMERICA CORP	1998	9.15	40.17	-31.02
BUCKHEAD AMERICA CORP	1997	13.14	37.47	-24.33
BUCKHEAD AMERICA CORP	1996	10.89	24.43	-13.54
CASTLE GROUP INC/UT	2000	4.26	0.63	3.63
CASTLE GROUP INC/UT	1999	10.96	1.50	9.46
CASTLE GROUP INC/UT	1998	8.57	0.89	7.68
CASTLE GROUP INC/UT	1997	10.22	0.37	9.85
CCI GROUP INC	2005	4.85	-7.44	12.29
CCI GROUP INC	2004	19.14	1.55	17.59
CCI GROUP INC	2003	15.81	-0.24	16.05
CCI GROUP INC	2002	12.14	0.80	11.34
CENTRAL AMERN EQUITIES CORP	2002	0.45	9.27	-8.83
CENTRAL AMERN EQUITIES CORP	2001	0.66	10.98	-10.32
CENTRAL AMERN EQUITIES CORP	2000	0.54	11.12	-10.58
CHARTWELL LEISURE INC	1996	102.51	190.41	-87.91
CRESTLINE CAPITAL CORP	2001	479.66	892.92	-413.26
CRESTLINE CAPITAL CORP	2000	415.89	680.70	-264.82
CRESTLINE CAPITAL CORP	1999	421.22	661.22	-240.00
CRESTLINE CAPITAL CORP	1998	316.28	739.27	-422.99
DOUBLETREE CORP	1996	1159.47	754.39	405.08
EXTENDED STAY AMERICA INC	2003	1377.93	1818.49	-440.56
EXTENDED STAY AMERICA INC	2002	1381.91	1706.93	-325.01
EXTENDED STAY AMERICA INC	2001	1544.39	1608.70	-64.31
EXTENDED STAY AMERICA INC	2000	1225.53	1561.15	-335.62
EXTENDED STAY AMERICA INC	1999	727.92	1455.29	-727.37
EXTENDED STAY AMERICA INC	1998	1006.91	1373.17	-366.26
EXTENDED STAY AMERICA INC	1997	1171.98	1293.95	-121.97
EXTENDED STAY AMERICA INC	1996	1201.95	769.14	432.81
FAIRMONT HOTELS RESORTS INC	2001	1885.71	1913.20	-27.49
FOUR SEASONS HOTELS -LTD VTG	2005	1822.24	768.96	1053.28
FOUR SEASONS HOTELS -LTD VTG	2004	2915.65	846.36	2069.29
FOUR SEASONS HOTELS -LTD VTG	2003	1790.05	866.40	923.64
FOUR SEASONS HOTELS -LTD VTG	2002	990.22	729.44	260.78
FOUR SEASONS HOTELS -LTD VTG	2001	1633.05	746.11	886.94
FOUR SEASONS HOTELS -LTD VTG	2000	2201.43	740.83	1460.59
FOUR SEASONS HOTELS -LTD VTG	1999	1826.48	640.43	1186.05
FOUR SEASONS HOTELS -LTD VTG	1998	988.65	344.21	644.44
FOUR SEASONS HOTELS -LTD VTG	1997	1037.30	283.70	753.60

GAYLORD ENTERTAINMENT CO	2005	1751.05	1015.11	735.95
GAYLORD ENTERTAINMENT CO	2004	1646.83	1058.45	588.38
GAYLORD ENTERTAINMENT CO	2003	1028.63	1018.44	10.19
GAYLORD ENTERTAINMENT CO	2002	695.52	1259.85	-564.34
GAYLORD ENTERTAINMENT CO	2001	825.63	1045.49	-219.87
GAYLORD ENTERTAINMENT CO	2000	697.00	1038.02	-341.03
GAYLORD ENTERTAINMENT CO	1999	985.18	1393.94	-408.76
GAYLORD ENTERTAINMENT CO	1998	988.25	771.62	216.63
GAYLORD ENTERTAINMENT CO	1997	1032.87	777.44	255.44
GAYLORD ENTERTAINMENT CO	1996	2237.11	820.50	1416.60
GREAT WOLF RESORTS INC	2005	310.68	456.91	-146.23
GREAT WOLF RESORTS INC	2004	673.17	464.66	208.51
HAMMONS JOHN Q HOTELS -CL A	2004	104.77	72.11	32.66
HAMMONS JOHN Q HOTELS -CL A	2003	35.91	70.17	-34.27
HAMMONS JOHN Q HOTELS -CL A	2002	28.10	82.58	-54.48
HAMMONS JOHN Q HOTELS -CL A	2001	29.16	87.81	-58.65
HAMMONS JOHN Q HOTELS -CL A	2000	32.43	94.60	-62.17
HAMMONS JOHN Q HOTELS -CL A	1999	23.51	100.63	-77.12
HAMMONS JOHN Q HOTELS -CL A	1998	23.36	102.88	-79.51
HAMMONS JOHN Q HOTELS -CL A	1997	57.02	100.11	-43.09
HAMMONS JOHN Q HOTELS -CL A	1996	53.86	86.29	-32.43
HARRELL HOSPITALITY GRP INC	2005	3.20	-0.57	3.77
HARRELL HOSPITALITY GRP INC	2004	8.43	-0.82	9.25
HARRELL HOSPITALITY GRP INC	2003	3.99	1.65	2.34
HARRELL HOSPITALITY GRP INC	2002	4.41	2.07	2.34
HARRELL HOSPITALITY GRP INC	2001	2.55	1.57	0.98
HARRELL HOSPITALITY GRP INC	2000	1.52	1.67	-0.15
HILTON HOTELS CORP	2005	9234.13	1821.78	7412.35
HILTON HOTELS CORP	2004	8732.16	1406.30	7325.86
HILTON HOTELS CORP	2003	6475.14	389.06	6086.08
HILTON HOTELS CORP	2002	4753.44	-513.17	5266.60
HILTON HOTELS CORP	2001	4029.76	-1309.84	5339.60
HILTON HOTELS CORP	2000	3868.50	-822.07	4690.57
HILTON HOTELS CORP	1999	2547.77	-1607.05	4154.81
HILTON HOTELS CORP	1998	4787.10	486.33	4300.77
HILTON HOTELS CORP	1997	7429.26	3726.91	3702.35
HILTON HOTELS CORP	1996	5175.00	3178.92	1996.09
HOMEGATE HOSPITALITY INC	1996	89.82	107.85	-18.03
HOST FUNDING INC -CL A	2001	0.18	2.25	-2.07
HOST FUNDING INC -CL A	2000	1.49	15.06	-13.57
HOST FUNDING INC -CL A	1999	3.64	12.23	-8.59
HOST FUNDING INC -CL A	1998	3.51	11.49	-7.98
HOST FUNDING INC -CL A	1997	9.86	12.42	-2.56

HOST FUNDING INC -CL A	1996	9.34	11.07	-1.73
HOTELWORKS.COM INC	2000	5.56	-6.74	12.30
HOTELWORKS.COM INC	1999	68.33	2.45	65.87
HOTELWORKS.COM INC	1998	58.95	81.27	-22.32
HOTELWORKS.COM INC	1997	116.63	75.77	40.86
HOTELWORKS.COM INC	1996	48.55	9.52	39.03
HUDSON HOTELS CP	2000	3.52	37.25	-33.73
HUDSON HOTELS CP	1999	4.31	23.25	-18.94
HUDSON HOTELS CP	1998	7.53	20.52	-12.99
HUDSON HOTELS CP	1997	20.61	40.75	-20.14
HUDSON HOTELS CP	1996	24.96	35.43	-10.47
INTERCONTINENTAL HOTELS -ADR	2005	7528.45	2612.59	4915.86
INTERCONTINENTAL HOTELS -ADR	2004	9061.16	5468.50	3592.66
INTERCONTINENTAL HOTELS -ADR	2003	7014.81	6619.11	395.70
INTERCONTINENTAL HOTELS -ADR	2002	8319.32	12339.65	-4020.33
INTERCONTINENTAL HOTELS -ADR	2001	7464.95	11727.80	-4262.85
INTERCONTINENTAL HOTELS -ADR	2000	8730.00	11656.39	-2926.39
INTERCONTINENTAL HOTELS -ADR	1999	9987.19	8319.46	1667.73
INTERCONTINENTAL HOTELS -ADR	1998	10103.44	6775.49	3327.95
INTERCONTINENTAL HOTELS -ADR	1997	12168.75	9194.71	2974.04
INTERCONTINENTAL HOTELS -ADR	1996	10737.19	9267.56	1469.63
INTERSTATE HOTELS & RESORTS	2005	133.38	51.99	81.39
INTERSTATE HOTELS & RESORTS	2004	163.34	46.63	116.71
INTERSTATE HOTELS & RESORTS	2003	114.89	31.96	82.93
INTERSTATE HOTELS & RESORTS	2002	65.10	-75.60	140.70
INTERSTATE HOTELS & RESORTS	2001	25.52	-111.63	137.15
INTERSTATE HOTELS & RESORTS	2000	89.64	-50.43	140.07
INTERSTATE HOTELS & RESORTS	1999	99.28	-36.26	135.54
INTERSTATE HOTELS & RESORTS	1998	66.50	-79.09	145.60
INTERSTATE HOTELS CORP	2001	8.80	84.92	-76.11
INTERSTATE HOTELS CORP	2000	10.72	102.59	-91.87
INTL LEISURE HOSTS	1996	3.65	6.46	-2.81
ITT CORPORATION	1996	5118.25	3708.75	1409.50
JANUS HOTELS & RESORTS INC	2002	6.21	28.64	-22.43
JANUS HOTELS & RESORTS INC	2001	10.48	35.16	-24.67
JANUS HOTELS & RESORTS INC	2000	12.72	65.94	-53.22
JANUS HOTELS & RESORTS INC	1999	17.35	67.29	-49.95
JANUS HOTELS & RESORTS INC	1998	22.28	59.12	-36.84
JENSON INTERNATIONAL INC	1998	0.11	-12.46	12.57
LA QUINTA CORP	2004	1608.02	2094.65	-486.62
LA QUINTA CORP	2003	926.32	2150.84	-1224.52
LA QUINTA CORP	2002	629.59	1979.94	-1350.36
LA QUINTA CORP	2001	820.88	2561.65	-1740.77

LA QUINTA CORP	2000	363.50	2334.92	-1971.42
LA QUINTA CORP	1999	785.31	3013.44	-2228.13
LA QUINTA CORP	1998	1807.73	3605.20	-1797.48
LA QUINTA CORP	1996	297.07	69.29	227.78
LA QUINTA INNS INC	1997	1495.25	736.72	758.53
LA QUINTA INNS INC	1996	1548.15	623.91	924.23
LODGIAN INC	2005	263.70	427.28	-163.58
LODGIAN INC	2004	169.95	394.69	-224.74
LODGIAN INC	2003	36.75	125.10	-88.35
LODGIAN INC	2002	395.70	365.96	29.74
LODGIAN INC	2001	2.55	73.43	-70.88
LODGIAN INC	2000	93.37	291.63	-198.26
LODGIAN INC	1999	136.11	432.30	-296.19
LODGIAN INC	1998	98.69	521.67	-422.97
LODGIAN INC	1997	256.21	406.91	-150.70
LODGIAN INC	1996	157.23	155.28	1.95
MARRIOTT INTL INC	2005	14492.31	3903.29	10589.02
MARRIOTT INTL INC	2004	14271.27	5165.00	9106.27
MARRIOTT INTL INC	2003	10741.50	4601.75	6139.75
MARRIOTT INTL INC	2002	7898.66	3896.61	4002.05
MARRIOTT INTL INC	2001	9890.15	3447.87	6442.28
MARRIOTT INTL INC	2000	10182.25	4149.28	6032.97
MARRIOTT INTL INC	1999	7811.72	3521.03	4290.69
MARRIOTT INTL INC	1998	7244.20	3118.37	4125.83
MARRIOTT INTL INC	1997	8794.75	1494.05	7300.70
MARRIOTT INTL INC	1996	7469.80	1762.22	5707.58
ORIENT-EXPRESS HOTELS	2005	1204.51	1004.18	200.33
ORIENT-EXPRESS HOTELS	2004	704.52	840.27	-135.75
ORIENT-EXPRESS HOTELS	2003	511.61	783.16	-271.54
ORIENT-EXPRESS HOTELS	2002	415.80	647.48	-231.68
ORIENT-EXPRESS HOTELS	2001	558.82	600.11	-41.29
ORIENT-EXPRESS HOTELS	2000	599.72	595.07	4.65
PRIME HOSPITALITY CORP	2003	456.79	1068.50	-611.71
PRIME HOSPITALITY CORP	2002	367.17	1112.04	-744.88
PRIME HOSPITALITY CORP	2001	494.38	1115.97	-621.59
PRIME HOSPITALITY CORP	2000	531.47	1058.60	-527.13
PRIME HOSPITALITY CORP	1999	449.14	1015.72	-566.58
PRIME HOSPITALITY CORP	1998	546.60	1033.00	-486.40
PRIME HOSPITALITY CORP	1997	952.63	853.14	99.50
PRIME HOSPITALITY CORP	1996	588.58	677.86	-89.28
PRIME MOTOR INNS -LP	1997	11.00	-21.24	32.24
PRIME MOTOR INNS -LP	1996	3.00	-16.10	19.10
PROMUS HOTEL CORP	1998	2790.01	1632.01	1158.00

PROMUS HOTEL CORP	1997	3636.07	1578.00	2058.07
PROMUS HOTEL CORP	1996	1531.32	419.56	1111.76
PSH MASTER -LP	1996	3.11	-4.75	7.86
RED LION HOTELS CORP	2005	117.29	130.01	-12.72
RED LION HOTELS CORP	2004	79.60	111.21	-31.61
RED LION HOTELS CORP	2003	61.36	158.97	-97.62
RED LION HOTELS CORP	2002	73.96	164.41	-90.45
RED LION HOTELS CORP	2000	66.32	162.64	-96.32
RED LION INNS -LP	1997	104.64	32.71	71.93
RED LION INNS -LP	1996	96.12	42.01	54.10
RED ROOF INNS INC	1998	465.18	497.10	-31.92
RED ROOF INNS INC	1997	428.46	442.89	-14.43
RED ROOF INNS INC	1996	427.38	410.58	16.80
RENAISSANCE HOTEL GROUP NV	1996	650.78	46.11	604.67
RIDGEWOOD HOTELS INC	2002	0.75	-1.41	2.16
RIDGEWOOD HOTELS INC	2001	1.46	2.22	-0.76
RIDGEWOOD HOTELS INC	2000	1.33	3.72	-2.38
RIDGEWOOD HOTELS INC	1999	1.29	3.54	-2.26
RIDGEWOOD HOTELS INC	1998	1.53	5.87	-4.35
RIDGEWOOD HOTELS INC	1997	2.53	7.68	-5.15
RIDGEWOOD HOTELS INC	1996	0.79	8.37	-7.58
SIGNATURE INNS INC	1998	6.38	89.49	-83.10
SIGNATURE INNS INC	1997	10.52	90.90	-80.38
SONESTA INTL HOTELS -CL A	2005	99.85	36.56	63.29
SONESTA INTL HOTELS -CL A	2004	24.04	33.26	-9.22
SONESTA INTL HOTELS -CL A	2003	18.31	39.97	-21.67
SONESTA INTL HOTELS -CL A	2002	17.00	50.50	-33.51
SONESTA INTL HOTELS -CL A	2001	22.76	58.53	-35.77
SONESTA INTL HOTELS -CL A	2000	31.52	63.92	-32.40
SONESTA INTL HOTELS -CL A	1999	29.92	54.85	-24.93
SONESTA INTL HOTELS -CL A	1998	26.88	52.06	-25.18
SONESTA INTL HOTELS -CL A	1997	28.44	47.16	-18.73
SONESTA INTL HOTELS -CL A	1996	20.70	45.74	-25.04
STARWOOD HOTELS&RESORTS WRLD	2005	13857.62	5627.17	8230.45
STARWOOD HOTELS&RESORTS WRLD	2004	12088.80	4423.14	7665.66
STARWOOD HOTELS&RESORTS WRLD	2003	7301.91	2957.46	4344.45
STARWOOD HOTELS&RESORTS WRLD	2002	4771.74	1472.52	3299.22
STARWOOD HOTELS&RESORTS WRLD	2001	5999.85	976.09	5023.76
STARWOOD HOTELS&RESORTS WRLD	2000	6909.00	3809.15	3099.85
STARWOOD HOTELS&RESORTS WRLD	1999	4441.50	3171.80	1269.70
STARWOOD HOTELS&RESORTS WRLD	1998	4197.19	2861.92	1335.27
STARWOOD HOTELS&RESORTS WRLD	1997	2663.52	1644.57	1018.96
STARWOOD HOTELS&RESORTS WRLD	1996	1098.26	958.04	140.21

STUDIO PLUS HOTELS INC	1996	182.39	214.11	-31.73
SUBURBAN LODGES AMER INC	2001	82.09	306.90	-224.81
SUBURBAN LODGES AMER INC	2000	73.40	330.68	-257.28
SUBURBAN LODGES AMER INC	1999	78.52	340.23	-261.71
SUBURBAN LODGES AMER INC	1998	126.33	342.25	-215.92
SUBURBAN LODGES AMER INC	1997	168.97	332.72	-163.75
SUBURBAN LODGES AMER INC	1996	110.78	181.49	-70.71
SUNBURST HOSPITALITY CORP	1999	107.08	165.21	-58.14
SUNBURST HOSPITALITY CORP	1998	84.81	194.23	-109.42
SUPERTEL HOSPITALITY INC-OLD	1998	44.17	71.36	-27.19
SUPERTEL HOSPITALITY INC-OLD	1997	48.40	63.72	-15.32
SUPERTEL HOSPITALITY INC-OLD	1996	43.56	56.43	-12.87
SWISS CHALET INC	1999	9.11	14.18	-5.07
SWISS CHALET INC	1998	9.81	10.59	-0.79
SWISS CHALET INC	1997	9.46	9.44	0.02
SWISS CHALET INC	1996	8.41	8.77	-0.36
THOUSAND TRAILS INC	2002	92.46	44.73	47.72
THOUSAND TRAILS INC	2001	42.32	46.25	-3.93
THOUSAND TRAILS INC	2000	35.91	38.77	-2.86
THOUSAND TRAILS INC	1999	33.86	24.12	9.74
THOUSAND TRAILS INC	1998	37.50	16.56	20.94
THOUSAND TRAILS INC	1997	16.31	-20.92	37.23
WESTERN STANDARD CORP	2003	1.30	-0.24	1.54
WESTERN STANDARD CORP	2002	0.30	0.26	0.04
WESTERN STANDARD CORP	2001	0.50	-0.86	1.35
WESTERN STANDARD CORP	2000	0.11	-0.17	0.28
WESTERN STANDARD CORP	1999	0.15	0.06	0.08
WESTERN STANDARD CORP	1998	0.31	0.43	-0.13
WESTERN STANDARD CORP	1997	0.31	0.14	0.17
WESTERN STANDARD CORP	1996	0.62	1.54	-0.92
WHG RESORTS & CASINOS INC	1997	66.19	83.57	-17.38
WYNDHAM HOTEL CORP	1996	492.94	139.97	352.97
WYNDHAM INTERNATIONAL INC	2004	201.26	220.54	-19.28
WYNDHAM INTERNATIONAL INC	2003	112.65	910.66	-798.01
WYNDHAM INTERNATIONAL INC	2002	38.63	1508.78	-1470.15
WYNDHAM INTERNATIONAL INC	2001	93.91	1348.77	-1254.86
WYNDHAM INTERNATIONAL INC	2000	292.79	2266.49	-1973.70
WYNDHAM INTERNATIONAL INC	1999	473.69	2737.77	-2264.09
WYNDHAM INTERNATIONAL INC	1998	826.58	3230.99	-2404.41
WYNDHAM INTERNATIONAL INC	1997	1561.64	1399.55	162.09
WYNDHAM INTERNATIONAL INC	1996	774.91	701.01	73.90

**Note:**

Variables are as defined before.



### *Total Value Estimates of Intangible Assets*

Similar to the calculation under the aggregate production function section, FMV can be decomposed into tangible and intangible components, assuming firms apply similar debt utilization standards to tangible and intangible asset investment needs. Consequently, total value estimates for firms' intangible assets (FVI) are calculated as:  $\frac{VI}{(1 - L / FMV)}$ , where L is total liabilities (data181) and FMV is the sum of MV and L. Estimates of firms' total tangible assets (FVT) are the difference between FMV and FVI. Consistent with results in Table Eleven, a simple t-test reveals that the crude approach frequently employed by practitioners, where the total value of intangible assets [FVI(s)] equals market value of equity, plus total liabilities, minus book value of tangible assets, systematically overestimates the total value of intangible assets<sup>40</sup>. Caution is necessary when interpreting this result, considering it might be driven by firms' capital structure choices which may be significantly different from what this study proposes.

**Table Twenty Three: Total Value Estimates of Firms' Intangible Assets for Year 1996 to 2005 (in Millions of Dollars Except Year).**

Company Name	Year	FMV	FVT	FVI	FVI (s)
AIRCOA HOTEL PARTNRS -LP-A	1996	71.95	157.71	-85.76	1.82
ALLSTAR INNS INC	1997	2.39	7.42	-5.03	-1.68
ALLSTAR INNS INC	1996	243.39	-249.25	492.65	65.72
AMERICAN R E PTRS -LP	2005	4440.92	5336.49	-895.57	521.26
AMERICAN R E PTRS -LP	2004	2171.60	3598.28	-1426.67	-91.45
AMERICAN R E PTRS -LP	2003	1018.50	2500.64	-1482.14	-471.43
AMERICAN R E PTRS -LP	2002	642.15	2797.41	-2155.26	-779.53
AMERICAN R E PTRS -LP	2001	767.28	3131.67	-2364.40	-684.36
AMERICAN R E PTRS -LP	2000	792.26	3103.43	-2311.17	-630.72
AMERICAN R E PTRS -LP	1999	544.20	2309.52	-1765.32	-616.47

<sup>40</sup> T-test is significant at all reasonable level.

AMERICAN R E PTRS -LP	1998	712.03	2108.07	-1396.03	-423.88
AMERICAN R E PTRS -LP	1997	485.90	2002.55	-1516.65	-505.33
AMERICAN R E PTRS -LP	1996	411.47	1227.98	-816.51	-229.84
ARLINGTON HOSPITALITY INC	2004	111.85	191.37	-79.52	8.48
ARLINGTON HOSPITALITY INC	2003	106.77	186.03	-79.26	7.06
ARLINGTON HOSPITALITY INC	2002	119.72	302.12	-182.40	-0.22
ARLINGTON HOSPITALITY INC	2001	106.50	462.87	-356.37	-8.67
ARLINGTON HOSPITALITY INC	2000	95.43	257.75	-162.32	-2.72
ARLINGTON HOSPITALITY INC	1999	107.72	210.42	-102.70	4.61
ARLINGTON HOSPITALITY INC	1998	120.53	225.68	-105.15	5.25
ARLINGTON HOSPITALITY INC	1997	107.20	136.88	-29.68	14.53
ARLINGTON HOSPITALITY INC	1996	87.84	87.73	0.11	20.94
BOCA RESORTS INC	2004	1187.40	1259.67	-72.27	309.49
BOCA RESORTS INC	2003	911.59	1393.17	-481.59	62.11
BOCA RESORTS INC	2002	927.72	1368.72	-441.00	80.02
BOCA RESORTS INC	2001	1054.36	1304.87	-250.51	177.26
BOCA RESORTS INC	2000	1199.83	1858.05	-658.22	100.28
BOCA RESORTS INC	1999	1189.99	1830.47	-640.48	101.66
BOCA RESORTS INC	1998	1373.65	1395.24	-21.60	279.74
BOCA RESORTS INC	1997	634.59	884.74	-250.15	69.43
BRISTOL HOTEL & RESORT INC	1999	155.29	136.23	19.06	47.03
BRISTOL HOTEL & RESORT INC	1998	130.06	146.77	-16.70	24.54
BRISTOL HOTEL & RESORT INC	1997	2103.57	1895.47	208.10	542.48
BRISTOL HOTEL & RESORT INC	1996	880.95	689.22	191.73	288.16
BUCKHEAD AMERICA CORP	2001	31.43	75.63	-44.20	2.69
BUCKHEAD AMERICA CORP	2000	46.94	189.18	-142.24	-6.42
BUCKHEAD AMERICA CORP	1999	47.29	183.87	-136.58	-11.42
BUCKHEAD AMERICA CORP	1998	48.20	211.53	-163.33	-11.34
BUCKHEAD AMERICA CORP	1997	45.95	131.03	-85.08	-6.22
BUCKHEAD AMERICA CORP	1996	24.84	55.72	-30.87	-2.19
CASTLE GROUP INC/UT	2000	8.21	1.21	7.00	4.61
CASTLE GROUP INC/UT	1999	13.38	1.83	11.55	10.32
CASTLE GROUP INC/UT	1998	11.31	1.18	10.14	8.33
CASTLE GROUP INC/UT	1997	11.70	0.42	11.27	10.09
CCI GROUP INC	2005	14.03	-21.50	35.53	11.58
CCI GROUP INC	2004	29.95	2.43	27.52	21.79
CCI GROUP INC	2003	21.86	-0.33	22.18	19.17
CCI GROUP INC	2002	12.17	0.80	11.37	11.52
CENTRAL AMERN EQUITIES CORP	2002	1.61	33.49	-31.88	-4.97
CENTRAL AMERN EQUITIES CORP	2001	2.04	33.77	-31.73	-5.74
CENTRAL AMERN EQUITIES CORP	2000	2.03	41.75	-39.72	-5.93
CHARTWELL LEISURE INC	1996	223.33	414.84	-191.52	-8.71
CRESTLINE CAPITAL CORP	2001	836.09	1556.43	-720.35	-76.78

CRESTLINE CAPITAL CORP	2000	1021.21	1671.46	-650.25	3.80
CRESTLINE CAPITAL CORP	1999	985.34	1546.76	-561.41	20.48
CRESTLINE CAPITAL CORP	1998	715.78	1673.06	-957.28	-142.97
DOUBLETREE CORP	1996	2088.89	1359.10	729.79	1114.59
EXTENDED STAY AMERICA INC	2003	2741.08	3617.46	-876.38	229.11
EXTENDED STAY AMERICA INC	2002	2767.46	3418.35	-650.88	308.74
EXTENDED STAY AMERICA INC	2001	2908.48	3029.58	-121.11	536.61
EXTENDED STAY AMERICA INC	2000	2364.50	3012.03	-647.53	242.90
EXTENDED STAY AMERICA INC	1999	1739.58	3477.85	-1738.27	-187.67
EXTENDED STAY AMERICA INC	1998	1834.74	2502.12	-667.38	140.67
EXTENDED STAY AMERICA INC	1997	1408.21	1554.77	-146.56	337.80
EXTENDED STAY AMERICA INC	1996	1229.04	786.47	442.57	706.66
FAIRMONT HOTELS RESORTS INC	2001	2475.61	2511.70	-36.09	849.21
FOUR SEASONS HOTELS -LTD VTG	2005	2155.72	909.68	1246.04	1613.80
FOUR SEASONS HOTELS -LTD VTG	2004	3232.95	938.46	2294.49	2702.11
FOUR SEASONS HOTELS -LTD VTG	2003	1930.22	934.25	995.97	1521.80
FOUR SEASONS HOTELS -LTD VTG	2002	1097.44	808.43	289.02	773.21
FOUR SEASONS HOTELS -LTD VTG	2001	1739.94	794.95	944.99	1419.78
FOUR SEASONS HOTELS -LTD VTG	2000	2385.64	802.83	1582.82	1752.38
FOUR SEASONS HOTELS -LTD VTG	1999	1995.75	699.78	1295.97	1443.94
FOUR SEASONS HOTELS -LTD VTG	1998	1128.26	392.81	735.45	799.30
FOUR SEASONS HOTELS -LTD VTG	1997	1176.39	321.74	854.65	901.86
GAYLORD ENTERTAINMENT CO	2005	3435.08	1991.35	1443.72	1394.95
GAYLORD ENTERTAINMENT CO	2004	3298.27	2119.87	1178.40	1242.48
GAYLORD ENTERTAINMENT CO	2003	2701.39	2674.62	26.77	603.60
GAYLORD ENTERTAINMENT CO	2002	2100.13	3804.16	-1704.03	-69.51
GAYLORD ENTERTAINMENT CO	2001	2334.97	2956.78	-621.81	217.82
GAYLORD ENTERTAINMENT CO	2000	1908.68	2842.57	-933.88	121.25
GAYLORD ENTERTAINMENT CO	1999	1756.41	2485.15	-728.74	196.24
GAYLORD ENTERTAINMENT CO	1998	1475.08	1151.73	323.35	597.38
GAYLORD ENTERTAINMENT CO	1997	1634.21	1230.06	404.15	617.55
GAYLORD ENTERTAINMENT CO	1996	2906.39	1065.98	1840.42	1763.51
GREAT WOLF RESORTS INC	2005	552.30	812.25	-259.95	128.42
GREAT WOLF RESORTS INC	2004	906.88	625.98	280.90	633.47
HAMMONS JOHN Q HOTELS -CL A	2004	922.14	634.69	287.46	105.64
HAMMONS JOHN Q HOTELS -CL A	2003	860.55	1681.79	-821.24	38.37
HAMMONS JOHN Q HOTELS -CL A	2002	883.57	2596.74	-1713.16	23.60
HAMMONS JOHN Q HOTELS -CL A	2001	903.69	2721.08	-1817.39	21.97
HAMMONS JOHN Q HOTELS -CL A	2000	943.08	2750.75	-1807.67	22.19
HAMMONS JOHN Q HOTELS -CL A	1999	943.97	4040.00	-3096.03	9.66
HAMMONS JOHN Q HOTELS -CL A	1998	882.00	3883.70	-3001.70	5.52
HAMMONS JOHN Q HOTELS -CL A	1997	855.25	1501.51	-646.26	38.52
HAMMONS JOHN Q HOTELS -CL A	1996	695.83	1114.83	-418.99	37.76

HARRELL HOSPITALITY GRP INC	2005	3.58	-0.64	4.22	3.47
HARRELL HOSPITALITY GRP INC	2004	8.96	-0.87	9.83	8.88
HARRELL HOSPITALITY GRP INC	2003	4.24	1.75	2.49	2.91
HARRELL HOSPITALITY GRP INC	2002	4.97	2.33	2.64	3.14
HARRELL HOSPITALITY GRP INC	2001	2.62	1.61	1.00	1.49
HARRELL HOSPITALITY GRP INC	2000	1.60	1.76	-0.16	0.40
HILTON HOTELS CORP	2005	15166.13	2992.09	12174.04	10795.13
HILTON HOTELS CORP	2004	14406.16	2320.09	12086.07	10584.16
HILTON HOTELS CORP	2003	12414.14	745.90	11668.24	8656.14
HILTON HOTELS CORP	2002	11048.44	-1192.76	12241.19	7186.44
HILTON HOTELS CORP	2001	11031.76	-3585.78	14617.54	6734.76
HILTON HOTELS CORP	2000	11366.50	-2415.41	13781.91	5862.50
HILTON HOTELS CORP	1999	10385.77	-6551.01	16936.77	4734.77
HILTON HOTELS CORP	1998	8544.10	868.01	7676.09	4600.10
HILTON HOTELS CORP	1997	11872.26	5955.76	5916.50	6672.26
HILTON HOTELS CORP	1996	9541.00	5860.88	3680.13	4554.00
HOMEGATE HOSPITALITY INC	1996	113.67	136.48	-22.82	25.13
HOST FUNDING INC -CL A	2001	21.98	271.60	-249.62	1.62
HOST FUNDING INC -CL A	2000	26.98	273.16	-246.17	-4.57
HOST FUNDING INC -CL A	1999	29.92	100.59	-70.68	-0.58
HOST FUNDING INC -CL A	1998	32.37	105.94	-73.57	0.02
HOST FUNDING INC -CL A	1997	37.58	47.32	-9.75	5.69
HOST FUNDING INC -CL A	1996	25.07	29.72	-4.65	4.69
HOTELWORKS.COM INC	2000	73.85	-89.62	163.47	17.98
HOTELWORKS.COM INC	1999	129.63	4.66	124.97	78.89
HOTELWORKS.COM INC	1998	133.89	184.58	-50.69	25.26
HOTELWORKS.COM INC	1997	149.17	96.91	52.26	93.38
HOTELWORKS.COM INC	1996	53.52	10.49	43.02	52.87
HUDSON HOTELS CP	2000	125.73	1328.93	-1203.21	-8.54
HUDSON HOTELS CP	1999	140.46	757.16	-616.70	2.25
HUDSON HOTELS CP	1998	150.37	409.84	-259.48	7.69
HUDSON HOTELS CP	1997	159.59	315.54	-155.95	7.47
HUDSON HOTELS CP	1996	114.54	162.56	-48.02	11.65
INTERCONTINENTAL HOTELS -ADR	2005	10366.19	3597.36	6768.83	6411.23
INTERCONTINENTAL HOTELS -ADR	2004	14344.13	8656.82	5687.31	5863.42
INTERCONTINENTAL HOTELS -ADR	2003	11878.54	11208.48	670.06	3021.77
INTERCONTINENTAL HOTELS -ADR	2002	14148.73	20986.14	-6837.41	437.92
INTERCONTINENTAL HOTELS -ADR	2001	12825.70	20149.79	-7324.09	-28.93
INTERCONTINENTAL HOTELS -ADR	2000	13796.03	18420.60	-4624.57	1335.02
INTERCONTINENTAL HOTELS -ADR	1999	17272.70	14388.39	2884.32	4577.77
INTERCONTINENTAL HOTELS -ADR	1998	17572.74	11784.49	5788.25	5723.83
INTERCONTINENTAL HOTELS -ADR	1997	16824.95	12712.93	4112.02	6094.25
INTERCONTINENTAL HOTELS -ADR	1996	15516.05	13392.33	2123.72	4615.30

INTERSTATE HOTELS & RESORTS	2005	295.82	115.31	180.51	195.67
INTERSTATE HOTELS & RESORTS	2004	321.82	91.87	229.95	238.81
INTERSTATE HOTELS & RESORTS	2003	274.10	76.24	197.86	180.42
INTERSTATE HOTELS & RESORTS	2002	269.36	-312.79	582.15	172.60
INTERSTATE HOTELS & RESORTS	2001	211.33	-924.40	1135.73	131.74
INTERSTATE HOTELS & RESORTS	2000	354.55	-199.45	554.00	183.23
INTERSTATE HOTELS & RESORTS	1999	292.22	-106.72	398.94	188.00
INTERSTATE HOTELS & RESORTS	1998	269.30	-320.27	589.57	168.55
INTERSTATE HOTELS CORP	2001	70.37	678.72	-608.36	-38.30
INTERSTATE HOTELS CORP	2000	98.13	938.91	-840.78	-45.84
INTL LEISURE HOSTS	1996	5.34	9.46	-4.12	-0.02
ITT CORPORATION	1996	11319.25	8202.07	3117.18	3403.61
JANUS HOTELS & RESORTS INC	2002	85.05	392.12	-307.07	-2.66
JANUS HOTELS & RESORTS INC	2001	101.54	340.51	-238.97	-1.19
JANUS HOTELS & RESORTS INC	2000	90.38	468.56	-378.18	-19.12
JANUS HOTELS & RESORTS INC	1999	98.04	380.32	-282.28	-14.56
JANUS HOTELS & RESORTS INC	1998	90.77	240.84	-150.08	-4.84
JENSON INTERNATIONAL INC	1998	16.00	-1817.11	1833.11	9.70
LA QUINTA CORP	2004	3028.79	3945.37	-916.58	335.61
LA QUINTA CORP	2003	2313.65	5372.10	-3058.45	-416.79
LA QUINTA CORP	2002	1863.84	5861.46	-3997.62	-606.06
LA QUINTA CORP	2001	2008.61	6268.08	-4259.47	-588.62
LA QUINTA CORP	2000	2133.84	13706.53	-11572.70	-955.23
LA QUINTA CORP	1999	3579.85	13736.87	-10157.02	-926.56
LA QUINTA CORP	1998	5316.35	10602.56	-5286.21	-171.10
LA QUINTA CORP	1996	353.00	82.33	270.67	259.51
LA QUINTA INNS INC	1997	2564.75	1263.67	1301.08	1062.72
LA QUINTA INNS INC	1996	2382.37	960.11	1422.26	1182.57
LODGIAN INC	2005	741.34	1201.21	-459.87	14.66
LODGIAN INC	2004	666.62	1548.18	-881.55	-56.68
LODGIAN INC	2003	705.32	2400.93	-1695.61	-3.86
LODGIAN INC	2002	953.40	881.74	71.66	190.73
LODGIAN INC	2001	984.59	28335.61	-27351.01	9.23
LODGIAN INC	2000	1120.43	3499.69	-2379.25	-43.51
LODGIAN INC	1999	1335.55	4241.80	-2906.25	-88.43
LODGIAN INC	1998	1312.85	6939.29	-5626.45	-185.07
LODGIAN INC	1997	644.33	1023.31	-378.98	16.68
LODGIAN INC	1996	522.28	515.80	6.49	82.50
MARRIOTT INTL INC	2005	19770.31	5324.84	14445.46	14020.31
MARRIOTT INTL INC	2004	18858.27	6825.10	12033.16	13062.27
MARRIOTT INTL INC	2003	15080.50	6460.61	8619.89	9801.50
MARRIOTT INTL INC	2002	12621.66	6226.59	6395.07	7161.66
MARRIOTT INTL INC	2001	15519.15	5410.23	10108.92	9940.15

MARRIOTT INTL INC	2000	15152.25	6174.56	8977.69	8748.25
MARRIOTT INTL INC	1999	12227.72	5511.49	6716.23	6723.72
MARRIOTT INTL INC	1998	10907.20	4695.15	6212.05	6386.20
MARRIOTT INTL INC	1997	13653.75	2319.49	11334.26	9005.75
MARRIOTT INTL INC	1996	11284.80	2662.22	8622.58	6809.80
ORIENT-EXPRESS HOTELS	2005	1946.67	1622.91	323.76	656.84
ORIENT-EXPRESS HOTELS	2004	1425.12	1699.72	-274.60	218.59
ORIENT-EXPRESS HOTELS	2003	1172.82	1795.31	-622.49	58.23
ORIENT-EXPRESS HOTELS	2002	987.85	1538.26	-550.41	48.38
ORIENT-EXPRESS HOTELS	2001	1002.48	1076.55	-74.07	225.29
ORIENT-EXPRESS HOTELS	2000	946.88	939.53	7.35	253.64
PRIME HOSPITALITY CORP	2003	783.08	1831.75	-1048.67	-224.23
PRIME HOSPITALITY CORP	2002	780.14	2362.83	-1582.69	-339.51
PRIME HOSPITALITY CORP	2001	943.21	2129.11	-1185.91	-213.56
PRIME HOSPITALITY CORP	2000	1023.21	2038.06	-1014.85	-136.63
PRIME HOSPITALITY CORP	1999	1145.92	2591.47	-1445.55	-182.86
PRIME HOSPITALITY CORP	1998	1313.95	2483.20	-1169.25	-94.45
PRIME HOSPITALITY CORP	1997	1624.89	1455.18	169.71	428.22
PRIME HOSPITALITY CORP	1996	954.78	1099.62	-144.84	168.68
PRIME MOTOR INNS -LP	1997	83.96	-162.14	246.10	32.25
PRIME MOTOR INNS -LP	1996	74.89	-402.03	476.93	20.92
PROMUS HOTEL CORP	1998	4105.32	2401.39	1703.93	2023.74
PROMUS HOTEL CORP	1997	4919.38	2134.93	2784.44	2914.83
PROMUS HOTEL CORP	1996	1915.19	524.74	1390.45	1283.23
PSH MASTER -LP	1996	51.52	-78.65	130.17	11.69
RED LION HOTELS CORP	2005	351.64	389.78	-38.14	77.83
RED LION HOTELS CORP	2004	327.82	458.02	-130.19	46.58
RED LION HOTELS CORP	2003	262.39	679.86	-417.47	-5.93
RED LION HOTELS CORP	2002	276.55	614.78	-338.22	6.30
RED LION HOTELS CORP	2000	260.42	638.61	-378.19	-15.52
RED LION INNS -LP	1997	255.94	80.01	175.93	97.53
RED LION INNS -LP	1996	249.63	109.11	140.52	83.16
RED ROOF INNS INC	1998	1065.37	1138.47	-73.10	231.83
RED ROOF INNS INC	1997	1044.48	1079.65	-35.17	230.09
RED ROOF INNS INC	1996	975.91	937.54	38.37	253.17
RENAISSANCE HOTEL GROUP NV	1996	900.38	63.80	836.59	740.41
RIDGEWOOD HOTELS INC	2002	25.42	-47.41	72.83	4.84
RIDGEWOOD HOTELS INC	2001	26.62	40.51	-13.90	3.41
RIDGEWOOD HOTELS INC	2000	5.41	15.05	-9.64	-0.37
RIDGEWOOD HOTELS INC	1999	5.64	15.53	-9.89	-0.27
RIDGEWOOD HOTELS INC	1998	5.86	22.56	-16.70	-1.42
RIDGEWOOD HOTELS INC	1997	6.76	20.51	-13.75	-1.51
RIDGEWOOD HOTELS INC	1996	5.07	53.66	-48.58	-3.65

SIGNATURE INNS INC	1998	81.36	1140.51	-1059.15	-42.65
SIGNATURE INNS INC	1997	85.40	737.92	-652.52	-39.43
SONESTA INTL HOTELS -CL A	2005	218.60	80.03	138.57	87.98
SONESTA INTL HOTELS -CL A	2004	122.31	169.23	-46.92	12.77
SONESTA INTL HOTELS -CL A	2003	112.56	245.80	-133.24	2.44
SONESTA INTL HOTELS -CL A	2002	112.96	335.66	-222.70	-5.49
SONESTA INTL HOTELS -CL A	2001	124.35	319.84	-195.48	-4.46
SONESTA INTL HOTELS -CL A	2000	139.61	283.15	-143.54	1.30
SONESTA INTL HOTELS -CL A	1999	111.06	203.60	-92.54	3.54
SONESTA INTL HOTELS -CL A	1998	108.96	211.01	-102.05	2.36
SONESTA INTL HOTELS -CL A	1997	81.11	134.52	-53.41	4.69
SONESTA INTL HOTELS -CL A	1996	66.23	146.33	-80.10	-2.75
STARWOOD HOTELS&RESORTS WRLD	2005	21100.62	8568.34	12532.28	13172.62
STARWOOD HOTELS&RESORTS WRLD	2004	19598.80	7170.96	12427.84	12388.80
STARWOOD HOTELS&RESORTS WRLD	2003	14838.91	6010.15	8828.76	7920.91
STARWOOD HOTELS&RESORTS WRLD	2002	12982.74	4006.37	8976.37	5863.74
STARWOOD HOTELS&RESORTS WRLD	2001	14662.85	2385.45	12277.40	7851.85
STARWOOD HOTELS&RESORTS WRLD	2000	15601.00	8601.32	6999.68	5822.00
STARWOOD HOTELS&RESORTS WRLD	1999	13519.50	9654.66	3864.84	3468.50
STARWOOD HOTELS&RESORTS WRLD	1998	15915.19	10852.02	5063.17	3512.19
STARWOOD HOTELS&RESORTS WRLD	1997	4651.36	2871.94	1779.42	1658.66
STARWOOD HOTELS&RESORTS WRLD	1996	1818.33	1586.19	232.15	505.59
STUDIO PLUS HOTELS INC	1996	195.01	228.93	-33.92	48.77
SUBURBAN LODGES AMER INC	2001	212.31	793.74	-581.43	-103.31
SUBURBAN LODGES AMER INC	2000	206.69	931.21	-724.52	-127.42
SUBURBAN LODGES AMER INC	1999	187.84	813.93	-626.10	-129.63
SUBURBAN LODGES AMER INC	1998	222.22	602.03	-379.80	-85.31
SUBURBAN LODGES AMER INC	1997	202.77	399.28	-196.51	-40.08
SUBURBAN LODGES AMER INC	1996	129.59	212.31	-82.71	-1.41
SUNBURST HOSPITALITY CORP	1999	437.22	674.60	-237.38	24.03
SUNBURST HOSPITALITY CORP	1998	404.69	926.80	-522.11	-17.82
SUPERTEL HOSPITALITY INC-OLD	1998	112.49	181.73	-69.24	6.26
SUPERTEL HOSPITALITY INC-OLD	1997	118.95	156.59	-37.64	15.54
SUPERTEL HOSPITALITY INC-OLD	1996	107.08	138.72	-31.64	14.80
SWISS CHALET INC	1999	10.43	16.24	-5.81	0.79
SWISS CHALET INC	1998	11.82	12.77	-0.95	3.73
SWISS CHALET INC	1997	11.30	11.28	0.02	4.04
SWISS CHALET INC	1996	10.19	10.62	-0.44	3.38
THOUSAND TRAILS INC	2002	164.04	79.36	84.67	71.80
THOUSAND TRAILS INC	2001	103.83	113.47	-9.64	19.88
THOUSAND TRAILS INC	2000	92.32	99.67	-7.34	17.81
THOUSAND TRAILS INC	1999	81.01	57.71	23.30	24.21
THOUSAND TRAILS INC	1998	109.01	48.14	60.87	34.75

THOUSAND TRAILS INC	1997	101.78	-130.51	232.29	38.48
WESTERN STANDARD CORP	2003	13.48	-2.52	16.00	3.07
WESTERN STANDARD CORP	2002	12.06	10.61	1.45	1.72
WESTERN STANDARD CORP	2001	13.34	-22.90	36.23	2.73
WESTERN STANDARD CORP	2000	12.91	-20.37	33.28	1.93
WESTERN STANDARD CORP	1999	12.63	5.47	7.16	1.78
WESTERN STANDARD CORP	1998	10.35	14.54	-4.20	1.40
WESTERN STANDARD CORP	1997	10.88	4.86	6.02	1.65
WESTERN STANDARD CORP	1996	11.41	28.37	-16.95	1.14
WHG RESORTS & CASINOS INC	1997	128.33	162.04	-33.71	28.28
WYNDHAM HOTEL CORP	1996	660.32	187.50	472.82	417.36
WYNDHAM INTERNATIONAL INC	2004	2873.38	3148.64	-275.26	170.73
WYNDHAM INTERNATIONAL INC	2003	3245.70	26239.12	-22993.42	-370.89
WYNDHAM INTERNATIONAL INC	2002	3449.71	134746.85	-131297.15	-845.49
WYNDHAM INTERNATIONAL INC	2001	4273.76	61380.67	-57106.91	-647.62
WYNDHAM INTERNATIONAL INC	2000	4565.50	35341.69	-30776.19	-1058.12
WYNDHAM INTERNATIONAL INC	1999	5339.51	30860.87	-25521.36	-1168.54
WYNDHAM INTERNATIONAL INC	1998	5639.22	22042.85	-16403.64	-1096.59
WYNDHAM INTERNATIONAL INC	1997	2973.72	2665.06	308.65	740.61
WYNDHAM INTERNATIONAL INC	1996	1098.80	994.01	104.79	337.87

**Note:** Variables are as defined before.

Chapter Five provides the main findings, sensitivity tests, implications and routes for future research.



## **Chapter Five**

### **CONCLUSION**

#### **Introduction**

This chapter provides a concise summary of main findings followed by implications for parties of interest. The concluding section indicates possible future routes for research.

#### **Main Findings**

As a first step into exploring the valuation issue of intangible assets at the corporate level in the US hospitality industry, this study provides value estimates from both time-series and cross-sectional perspectives. Based on resultant estimates of intangible assets, it appears that intangible assets play a decisive role in deciding whether a hotel firm survives or not. Moreover, for those hotel firms that survive, intangible assets generally play a dominant role. In addition, firms' strategic response to a drastic event, i.e., 9-11, is to conservatively endure the loss, as seen by inspecting value changes of intangible assets surrounding the year of 2001.

Furthermore, when evaluating a firm's tangible and intangible assets, tests of model usefulness reveal it is meaningful to decompose adjusted income (AI) (measured by revenue minus expense in this study) into adjusted income derived from intangible assets (AII), and adjusted income derived from tangible assets (AIT). Specifically, a significant difference exists for contributions from AIT and AII to a firm's market value of equity. Further, decomposing AI into AIT and AII releases incremental information to the market.

Finally, by comparing the value estimates, based on the crude approach frequently employed by practitioners and those from the models proposed in this study, findings indicate the crude approach systematically overestimates hotel firms' intangible assets, when the assumption is application of a uniform capital structure across tangible and intangible assets within a firm.

### **Sensitivity Tests**

The effect of the composition of recognized intangible assets and tangible assets might have an impact on regression (6), considering these two different kinds of assets could systematically affect contributions of AIT and AII to firms' market value of equity. To facilitate the testing, the first step is to construct a ratio based on BVI/Total Assets. The ratio has a mean of 0.0130 with a standard deviation of 0.0443, a minimum value of -0.0178 and a maximum value of 0.3966 for the aggregate production function sample. Next is the creation of a dummy variable (DUM) with its value set to be one when the ratio is above its 50 percentile and zero otherwise. Introducing this dummy variable as an independent variable in regression (6) makes possible testing whether or not the composition of recognized intangible assets and tangible assets systematically impacts contributions of AIT and AII to firms' market value of equity. Test results are reported in Table Twenty-four. The coefficient associated with DUM is not significantly different from zero, indicating no detectable systematic effect of the composition of recognized intangible assets and tangible assets. Furthermore, coefficient estimates associated with AIT and AII in Table Twenty-four are not significantly different from those in Table Six.

**Table Twenty-four: Effect Test Results of the Composition of Recognized Intangible Assets and Tangible Assets on Contributions of AIT and AII Based on (5a) and (5b).**

Variable	Estimate	S.E. (w)	t-Value (w)	Pr >  t	VIF	Adj. R-Sq.
Intercept	98.2914	49.4254	1.9900	0.0474	0.0000	0.8571
DUM	-50.3343	81.5622	-0.6200	0.5375	1.1121	
BVT	1.3909	0.0507	27.4400	<.0001	2.4501	
BVI	1.7474	0.2186	7.9900	<.0001	2.3062	
AIT	1.0173	0.2359	4.3100	<.0001	4.7352	
AII	0.2172	0.0792	2.7424	0.0032	5.7210	

**Note:**

DUM = 1 if BVI/DATA6 is above 50 percentile, and DUM = 0 otherwise.

Other variables are as previously defined.

Similarly, the same ratios, calculated for the Cobb-Douglas production function sample, tests whether or not the composition of recognized intangible assets and tangible assets systematically affect contributions of AIT and AII to firms' market value of equity. The ratio computed has a mean of 0.0607 with a standard deviation of 0.1211, a minimum value of -0.0103 and a maximum value of 1.0918. Along the same line, a created dummy variable (DUM) has its value set to be one when the ratio is above its 50 percentile and zero otherwise. Introducing this dummy variable as an independent variable in regression (6) makes possible testing whether or not the composition of recognized intangible assets and tangible assets systematically impacts contributions of AIT and AII to firms' market value of equity. Test results are reported in Table Twenty-five. Consistent with test results in Table Twenty-four, the coefficient associated with DUM is not significantly different from zero, indicating no detectable systematic effect of the composition of recognized intangible assets and tangible assets. Furthermore, coefficient estimates associated with AIT and AII in Table Twenty-five are not significantly different from those in Table Eighteen.

**Table Twenty Five: Effect Test Results of the Composition of Recognized Intangible Assets and Tangible Assets on Contributions of AIT and AII Based on (12a) and (12b).**

Variable	Estimate	S.E. (w)	t-Value (w)	Pr >  t	VIF	Adj. R-Sq.
Intercept	2.1151	31.1999	0.0678	0.4730	0.0000	0.7572
DUM	-13.2413	46.0293	-0.2877	0.6131	1.2118	
BVT	1.4412	0.1800	8.0067	<.0001	4.3962	
BVI	1.9655	0.1802	10.9073	<.0001	3.0891	
AIT	2.9824	1.0734	2.7785	0.0028	4.9759	
AII	0.7846	0.3427	2.2895	0.0113	1.7315	

**Note:**

Variables are as previously defined.

### **Implications**

This study provides total value estimates for hotel firms' intangible assets, which can serve as a vital piece of information for appraisers, investors, creditors, managers, as well as other parties of interest. For example, appraisers complain that no consensus estimates of "total intangible assets" is available, which makes the appraisal process "trickier" (Henry, L. E., 2004). This may be due to certain reliability concerns, considering no theoretical model with high explanatory power is readily available for appraisers to produce consistent value estimates of intangible assets. Moreover, investors and creditors cannot objectively judge the strategic shift maneuvered by managers without knowing the composition of a firm's tangible and intangible assets; thus, may introduce higher risks to investment decisions. Even managers, who are responsible for guiding the direction of a company's future, can only rely on vague feedback from the market to tune their managerial decisions without a reasonable estimate of their company's intangible assets. This study offers with sound theoretical basis this particular vital piece of information for publicly traded hotel firms, thereby rendering possible consensus value estimates for hotel

firms' intangible assets.

Moreover, the methodology employed in this study, either based on time-series or cross-sectional data, has additional application for the property level, where each property is considered as an aggregate entity. It is highly likely that reliable and consensus estimates are achieved and valuable guidance provided at the property level, considering equivalent and even more accurate data are available for insiders. Along the same line of reasoning, managers of publicly traded hotel firms are able to improve their decisions related to investments in intangible assets because they have access to accurate firm specific data to execute the models proposed in this study. For outsiders, employing the models proposed in this study to estimate values of intangible assets for hotel firms will facilitate investment decision making processes by improving the information set available.

Finally, as indicated by the findings in this study, intangible assets are vital to the survival of hotel firms, echoing the service intensive feature of the hospitality industry. Strategically speaking, of paramount importance is placing great emphasis on effective investments in firms' intangible assets while improving tangible assets, given tangible and intangible assets work together to enhance firms' value.

### **Future Research**

To improve estimates from the procedures proposed in this study, further research needs to be done in the area of company capital structure choices. In this study the assumption is that firms apply uniform capital structures across their tangible and intangible assets. However, it might be the case that some firms deviate

from that assumption, therefore, necessitating further study.

Further, proxies employed in this study for intangible assets are somewhat noisy, especially the proxy for innovation (*AD*). Consequently, models that rely on these proxies suffer relatively lower explanatory power. Moreover, ambiguities exist when employing these proxies for different groups of intangible assets. The direction of future studies can be to identify better proxies for intangible assets.

Moreover, identifying cost of capital associated with tangible and intangible assets is interesting. Perhaps, the cost of capital differs for the two different kinds of assets, considering they may have different risk characteristics. In addition, when attaining value estimates for intangible assets, their contribution patterns to firms' value, over time, can be identified; thus offering implications for investment portfolio construction. Similarly, future studies along the same line are likely to reveal the reasons for systematically undervaluing hotel firms as suggested by Lee, S. and Upneja, A. (2007).

Finally, this study does not distinguish between contributions of supervisors from those of line associates when employing the proxy of total working hours for human capital. Supervisors' contributions are likely different from line associates with regard to a firm's value, considering the former have different training and are likely to have certain expertise in their working areas. Further study of this issue might reveal interesting results.

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## Appendix

### PROOF OF DERIVING (1b)

The Solow (1957) derivation is reproduced as:

$$Q = A(t)f(K, L) \quad (1a)$$

$A(t)$  measures the cumulated effect of shifts over time. Differentiate (1a) totally

with respect to time, (1a) becomes:

$$\frac{\partial Q}{\partial t} = \frac{\partial A(t)f(K, L)}{\partial t} + \frac{A(t)\partial f(K, L)\partial K}{\partial K\partial t} + \frac{A(t)\partial f(K, L)\partial L}{\partial L\partial t} \quad (2)$$

Knowing from (1a) that  $A(t) = \frac{Q}{f(K, L)}$ ; dividing both sides of (2) by  $Q$  results

in:

$$\frac{\partial Q}{\partial t Q} = \frac{\partial A(t)}{\partial A(t)} + \frac{A(t)\partial f(K, L)\partial K}{\partial K\partial t Q} + \frac{A(t)\partial f(K, L)\partial L}{\partial L\partial t Q} \quad (3)$$

By defining  $w_K = \frac{\partial Q}{\partial K} \frac{K}{Q}$  and  $w_L = \frac{\partial Q}{\partial L} \frac{L}{Q}$ , I know from (1a),  $\frac{\partial Q}{\partial K} = A \frac{\partial f}{\partial K}$  and

$$\frac{\partial Q}{\partial L} = A \frac{\partial f}{\partial L}.$$

Substituting the above in (3) results in:

$$\frac{\partial Q}{\partial t Q} = \frac{\partial A(t)}{\partial A(t)} + w_K \frac{\partial K}{K\partial t} + w_L \frac{\partial L}{L\partial t} \quad (4)$$

If all inputs are classified as either  $K$  or  $L$ , then  $w_K + w_L = 1$ .

If  $q = \frac{Q}{L}$  and  $k = \frac{K}{L}$ , then  $\frac{\partial q}{\partial t} = \frac{\partial(\frac{Q}{L})}{\partial t} = (\frac{\partial Q}{\partial t} L - \frac{\partial L}{\partial t} Q) / L^2$ . Dividing

both sides by  $q$  results in:

$$\frac{\partial q}{\partial t q} = \left( \frac{\partial Q}{\partial t L} - \frac{\partial L}{\partial t} \frac{Q}{L^2} \right) \frac{L}{Q} = \frac{\partial Q}{\partial t Q} - \frac{\partial L}{\partial t L}.$$

Similarly, with:

$$\frac{\partial k}{\partial tk} = \left( \frac{\partial K}{\partial tL} - \frac{\partial L}{\partial t} \frac{K}{L^2} \right) \frac{L}{K} = \frac{\partial K}{\partial tK} - \frac{\partial L}{\partial tL}$$

Substituting the above in (4) results in:

$$\frac{\partial q}{\partial tq} = \frac{\partial A}{\partial tA} + w_K \frac{\partial k}{\partial tk} \quad (4a)$$

Thus, to estimate  $A(t)$ , the only need is the output per man hour, capital per man hour, and the share of capital.<sup>41</sup>

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<sup>41</sup> Relaxing the assumption of neutral technical change, I can follow the same reasoning to derive from (1) a similar result very like (4a), namely,  $\frac{\partial q}{\partial tq} = \frac{\partial F}{\partial tF} + w_K \frac{\partial k}{\partial tk}$ . According to Solow (1957), if  $\frac{\partial F}{\partial tF}$  is independent of K and L, then by integrating a partial differential equation, (1) will have the special form of (1a) and shifts in the production function will be neutral.

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