# Intangible Assets and Stock Trading Strategies

by *Duo Zhang,* Division of Economics and Finance, West Virginia University, Box 6025, Morgantown, WV 26506-6025

**Abstract**

Hall (2001a) argues that the value of intangible assets can be inferred from firms' stock market value and the value of tangible assets, which suggests rational valuation in the market. This paper investigates the relationship between firms' future stock returns and their inferred intangibles and indirectly tests Hall's hypothesis by using various trading strategies. It is found that the inferred intangibles have predictive power for stock returns, which might be because of mean-reverting misvaluation by the stock market; and the way the inferred intangibles predict stock returns is consistent with the three-factor model of Fama and French (1992). However, I find that the predictive power of inferred intangibles is consistent with market inefficiency, rather than a rational premium for distress risk related to the book-to-market equity ratio. Thus the intangible assets hypothesis of Hall does not hold and the discrepancy between market equity and book equity suggests market inefficiency.

**JEL Classification Number:** G12

**Keywords:** intangible assets, stock returns, stock market overreaction, mean reversion of stock prices, book-to-market-equity ratio.

## 1. Introduction

Hall (2001a) proposes that the rational stock market valuation of intangible assets — assets that are not directly measurable such as human capital, trademarks, research and development, customer relationships, goodwill, etc. — explains the observed discrepancy between the stock market value of the firm and the reproduction cost[1] of the firm's tangible assets. This sounds intuitively plausible because intangible assets generate cash flows and thus affect a firm's future earning power. Also, since the value of tangible assets is typically just a fraction of the market value, presumably the rest of the value comes from intangible assets.

If Hall's interpretation is correct, from a simple efficient markets perspective intangible assets should not be able to forecast risk-adjusted returns. Thus, investing in firms with different fractions of intangible assets should not generate significantly different risk-adjusted returns.

Alternatively, the proposition that stock prices are mean-reverting can be applied to the intangibles component of stock prices. Stocks might be temporarily mispriced and stock prices will revert to some fundamental value. So an unusually high value of inferred intangible assets might serve as an indicator that the stock has reached a point of excess valuation. Hence this stock is at risk of suffering a significant price correction (reduction in this case) and this stock will have lower subsequent returns once the price reversal is realized in the stock market.[2] Conversely, an unusually low value of inferred intangible assets might signal mean-reverting undervaluation and higher subsequent returns.

Thus from Hall's theory of rational valuation of intangible assets and the mean-reversion theory of stock prices, I develop these null and alternative hypotheses: The null hypothesis is that "a higher value of inferred intangible assets is associated with equal or higher expected future returns in an efficient stock market"; the alternative hypothesis asserts that "a higher inferred intangible level will be associated with lower expected future returns".

The alternative, mean-reversion hypothesis implies the possibility of formulating trading strategies for stocks or portfolios of stocks leading to excess profits.[3] Under the null hypothesis, no profitable trading strategies exist. In the present paper I find that intangible assets systematically forecast returns in a way consistent with mean reversion of stock prices. As a result, profitable trading strategies are identified.

The remainder of the paper is organized as follows. The next section presents the theoretical background and the specific issues studied in this paper. Section 3 discusses the methodology used and the hypotheses to be examined. Section 4 describes the data, portfolio formation methods and trading strategies. Section 5 presents the empirical results that show the relationship between portfolio returns and inferred intangibles for portfolios formed based on three different standards. Section 5 also examines the linkage between the inferred intangibles and the book-to-market ratio (BE/ME). Section 6 ends the paper with a brief summary of conclusions.

## 2. Background

Since both tangible assets and intangible assets generate an expected stream of cash flows, a rational stock market should recognize the value of intangible assets just as it values firms' property, plant and equipment. Indeed, there are various studies providing theoretical and empirical evidence that firms' intangible assets are positively valued in the stock market. Among others, McCarthy and Schneider (1995) presents a significant positive relationship between goodwill and the market value of a firm; Choi, Kwon and Lobo (2000) concludes that the level of intangible assets reported on the balance sheet is positively related to market valuation of firms' equity; Berk, Green and Naik (1999) stresses the importance of growth options (intangible assets) versus assets-in-place in affecting stock market value.

Consistent with the widespread assumption that the difference between a firm's book value and its market value is attributable primarily to the firm's skill in leveraging its knowledge and intellectual capital assets, Hall (2001a) argues that firms' value of intangible assets can be inferred from the gap between firms' stock market value and book value. This argument is appealing: it is consistent with market efficiency, and it provides a ready explanation for the stock market expansion in high technology companies for which there has been an enormous and increasing differential between a company's book value and market value. Evidence that supports Hall's hypothesis that rational market valuation of intangible assets results in the deviation of market value from book value is presented by various researchers. Among others, Brynjolfsson and Yang (1999) show that the stock market valuation of firms can be used to estimate the cost and benefits of one type of intangible asset, computer capital; using Hall's hypothesis Hall (2000) and Hall (2001b) successfully explain the link between the stock market and the labor market in the 1990s, and the stock market movements in the mid-1970's and 1990's.

Given the scarcity of public information about firms' intangible assets and the importance of intangible assets in the current economy, investing in firms with a higher fraction of intangible assets involves bearing higher risks. The relatively greater level of risk related to intangible assets might be due to the greater uncertainty in the degree and timing of future cash flows expected from intangible assets. Also, an adverse selection bias against stocks with a higher fraction of intangible assets might require higher average returns for stocks with a higher fraction of intangible assets. For example, Aboody and Lev (2000) provides empirical evidence that firms with a higher proportion of research and development (R&D) input (an example of intangible assets) tend to have more insider trading problems. Hence, rational investors will then demand a larger return for the added risk from possible insider trading.

Therefore, if Hall's hypothesis is correct and if at least a part of the risk in investing in high-intangibles firms is systematic or due to adverse selection, higher returns should be expected for firms with a larger proportion of inferred intangible assets. If the adverse selection risks are negligible and the intangibles risks are non-systematic and diversifiable in portfolios, then we conventionally[4] might not expect different returns on securities with different levels of intangible assets. Either way, Hall's hypothesis implies that stocks with higher inferred intangibles will have returns no lower than stocks with lower inferred intangibles.

Alternatively, the rationality of asset prices is not an inevitable assumption. As Hirshleifer (2001) argues, people are prone to bias in valuing stocks when information is either sparse or widely available. According to Hirshleifer (2001), markets are not governed by purely rational participants but by investors acting based on both reason and emotion. The 2000 'dot.com crash' then highlighted the oversimplification inherent in Hall's rationality hypothesis and the role of factors other than rational valuation of intangible assets in driving stock market values.

Fundamentals matter, but it takes time for the market to recognize and fully absorb the improvement in a sector's fundamentals. When the market is not perfectly efficient, the firm's market value can differ from its fundamental value. The value of intangible assets that Hall (2001a) infers then contains "noise". The alternative to Hall's interpretation of "inferred intangibles" is misvaluation in the stock market; here I will consider specifically mean-reverting misvaluation, which would arise if market participants gradually perceive and correct the misvaluation.[5] Considering such a mean-reversion process of stock prices, firms with higher inferred intangible assets are expected to have lower future returns, and vice versa. So we would expect a pattern of stock returns in relation to the value of inferred intangible assets opposite to what Hall (2001a) leads to. Thus two competing theories lead to conflicting predictions, allowing them to be tested against each other empirically.

Specifically, I devise dynamic portfolio trading strategies, based on ranking firms by deciles in terms of their level of intangibles scaled by their level of hard assets, to test the null hypothesis. In each year, the portfolio is reshuffled based on the most recent decile rankings. In one version, positive initial wealth is invested each year in the firms in the lowest-intangibles decile. In the other version, zero-net-investment portfolios are formed each year by shorting the firms in the highest-intangibles decile and investing in the firms in the lowest-intangibles decile. It is found that these portfolios earn large positive excess returns: higher returns are associated with a lower intangibles-to-hard-assets

ratio, which suggests both market inefficiency and mean reversion, and leads to rejection of Hall's hypothesis of rational intangibles valuation.

## 3. Methodology and Hypotheses

### *3.1 Valuation of Intangible Assets*

The value of intangible assets is not usually reflected completely in the balance sheet. Under APB Opinion No. 17 (American Institute of Certified Public Accountants, 1970), intangible assets are accounted at historical cost and amortized over a period not to exceed 40 years or the economic life of the assets, whichever is shorter. But unlike tangible assets, there is considerably greater uncertainty[6] involved in determining what specific benefit intangible assets will bring and how long the duration of the benefit is. This greater degree of uncertainty results in a reduction in the accuracy of the accounting value of intangible assets.

Under Hall's hypothesis, a firm's value of intangible assets is calculated as a residual by subtracting the value of hard assets from net financial claims[7], since the stock market forms a risk-adjusted expected value of the future cash flows generated from all assets. Thus,

*Intangibles* = Total Financial Claims on the Firm
*- Financial Claims on Others at Book Value*
*- Hard Assets at Book Value ,* (1)

where total financial claims includes the value of common equity outstanding at market prices, the value of debt outstanding on the books[8], the value of payables and other financial obligations on the books; financial claims on others is composed of the book value of common equity, long term debt, current liabilities, receivables and other financial claims on others; and the value of hard assets refers to the book value of net plant, property and equipment together with inventories.

This definition reflects the assumption of market efficiency. Under the hypothesis of rational securities markets, the net financial claims outstanding are equal to the net value of non-financial assets.[9] The net financial claims are observed from securities markets and the value of hard assets is available in firms' books. The calculation of equation (1) does not take into account adjustment costs in investment, as Hall (2001b) argues that the effects on the valuation of intangible assets from taking them into account are probably a small part of the overall effect, since Hall believes that firm value comes mostly from intangible assets. Bond and Cummins (2000) address this issue in more detail: "When inflation, economic depreciation and technical progress are modest, the replacement cost of tangible assets is close to their book value."

### *3.2 Hypotheses*

Hall's implied hypothesis is that, due to the potentially higher risk of higher intangible assets, we will find that a lower value of intangible assets is associated with equal or lower returns in an efficient stock market; hence $\underline{R}_{\text{lowest-intan}} \leq \overline{R}_{\text{lowest-intan}}$ where $\underline{R}_{\text{lowest-intan}}$ denotes the return from the portfolio with the lowest value of intangible assets, and $\overline{R}_{\text{lowest-intan}}$ the return form the portfolio with the highest value of intangible assets.[10] The alternative hypothesis asserts a mean reversion process in stock prices due to investors'

overreaction and the inevitable market correction; hence lower intangibles levels will be associated with higher expected returns, or, $\overline{R}_{\text{lowest-intan}} > \overline{R}_{\text{lowest-intan}}$ .

Thus the formalized null hypothesis and the alternative hypothesis are as follows:

$$H_0: \overline{R}_{\text{lowest-intan}} - \overline{R}_{\text{lowest-intan}} - \overline{R}_{\text{highest-intan}} \leq 0$$

$$H_0: \overline{R}_{\text{lowest-intan}} - \overline{R}_{\text{lowest-intan}} - \overline{R}_{\text{highest-intan}} > 0$$

In summary, under the null hypothesis, the return on the portfolio with the lowest market value assigned to intangible assets is equal to or less than the return on the portfolio with the highest market valuation of intangible assets; alternatively, if the market value placed on intangible assets is not fully rational, the return on the portfolio with the lowest intangibles portfolio will be greater than that with the highest intangibles.

## 4. Data, Portfolio Formation, and Trading Strategies

### *4.1 Data Description*

In this paper companies listed on both the COMPUSTAT (Standard & Poor's Research Insight) current edition, 1982-2001, and the Center for the Research in Security Prices (CRSP) are studied. Items on the balance sheet are from COMPUSTAT while all returns are exclusively from CRSP and consist of the annual returns for all stocks from 1982 to 2001 in the merged COMPUSTAT-CRSP data.

To be included in the empirical test, a stock is required to be listed in both CRSP and COMPUSTAT; it also needs to have annual returns from CRSP and all the necessary items as listed below from COMPUSTAT. Any missing data result in deletion from the sample. Also, the firm needs to exist continuously for at least two years – the first year of data to compute the intangibles, which provide information in forming portfolios, the second year to be the holding period of the asset.

Shares, price, long-term debt, current debt, cash, receivables, prepaid expenses, investment equity, inventory and property, plant, and equipment are used to compute intangibles according to equation (1). Specifically,

$$\text{Market Equity}^{11} = \text{Shares} \times \text{Price}^{12}$$

$$\begin{aligned}\text{Total Financial Claims on the Firm} = {} & \text{Shares} \times \text{Price} \\ & + \text{Long Term Debt} \\ & + \text{Short Term Debt}\end{aligned}$$

$$\begin{aligned}\text{Total Financial Claims on Others} = {} & \text{Cash} + \text{Receivables} + \text{Prepaid Expenses} + \\ & \text{Equity Investments in Others at Book Value}\end{aligned}$$

$$\text{Hard Assets} = \text{Property, Plant, and Equipment} + \text{Inventory}$$

To obtain ratios independent of firm size, for all firms the book value of hard assets is used to normalize the value of inferred intangible assets. Hence intangibles-to-hard-assets ratios are formed to measure firms' intangible asset levels.

*4.2 Forming Portfolios*

Intangibles-to-hard-assets ratios vary sharply across industries. For example, for the auto repair industry, we would expect that most of its value is in its hard assets — buildings, inventories, and physical equipment; while for the financial industry, the company value is derived more from its intangible assets, such as management know-how, goodwill, and customer relationships. As an example, Figure 1 shows wide variation in the intangibles-to-hard-assets ratios across industries in 2001. Given such variation, pooling all companies in different industries might neglect the important industry characteristics in terms of the value of intangibles-to-hard-assets ratios. For purposes of comparison, alternative portfolio formation methods are employed: the first method ignores the industry characteristics so that individual companies, regardless of their industry, are investment units; the second investigates investment strategies over all individual firms while normalizing firms' intangibles ratios by their industry's norm; the third one treats different industries separately so that investors are allowed to form investment portfolios of companies within any one industry.

*Portfolio formation method 1* (for firms in all industries): All individual securities are ranked each year on the basis of the intangibles-to-hard-assets ratios at the end of the year in a descending order. In each year, 10 (decile) portfolios are formed according to the ranking. So the first portfolio includes the 10% (approximately) of companies with the highest intangibles levels and the tenth portfolio includes the 10% (approximately) of companies with the lowest intangibles levels. After portfolios are constructed, equal-weighted annual portfolio returns are calculated.

*Portfolio formation method 2* (for firms in all industries, adjusted by their industry norm): Industry identifications are assigned to individual companies based on the appropriate two-digit primary SIC code in COMPUSTAT. These assignments are only approximate because many companies operate in more than one industry. The list of 74 industries can be found in the appendix, ordered by their two-digit primary SIC codes in COMPUSTAT. Portfolios are formed on the basis of "normalized intangibles ratios". The "normalized intangibles ratios" are obtained by subtracting the industry average intangibles-to-hard-assets ratios from firms' intangibles-to-hard-assets ratios. This way, industry-specific characteristics of intangible assets are purged; hence all firms from different industries can be more justifiably pooled. The rest of the procedure is conducted in the same way as in portfolio formation method 1.

*Portfolio formation method 3* (within industries): 10 (decile) portfolios are formed separately for each industry having at least 30 firms' data available for all years. This way, in each year from 1983 to 2001 each portfolio within each industry has at least three securities. Within each of the selected industries, the procedure described in portfolio formation method 1 is conducted.

In all of the three approaches, portfolios are rebalanced each year on the basis of the appropriate non-normalized or normalized intangibles-to-hard-assets ratios.

*4.3 Trading Strategies*

For each portfolio formation method, after portfolios are formed, the standard contrarian strategy devised by DeBondt and Thaler (1985), which exploits the latest information on the inferred intangible assets, is performed. Initially, the portfolio that consists of the decile with the lowest portfolio intangibles ratios in 1982 (the tenth decile, with the highest expected return according to the overreaction theory) is purchased and held during the following period, 1983; at the beginning of 1984, the portfolio switches to the tenth decile of 1983. This rolling process is repeated until 2001. In summary, each year the portfolio with the lowest portfolio intangibles ratio in the previous year is held. Completing this process creates a portfolio sequence with the lowest intangibles ratio (the lowest-intan portfolio) in each year from 1982 to 2000. A portfolio sequence that consists of deciles with the highest intangibles is created in the same way (the highest-intan portfolio). Annualized returns over the 19-year period (1983-2001) of holding the lowest-intan portfolio sequence or holding the highest-intan portfolio sequence are computed as geometric mean returns, which are denoted as $\overline{R}_{\text{lowest-intan}}$ and $\overline{R}_{\text{highest-intan}}$. In addition, returns from sequentially holding each of the other eight decile portfolios from 1983 to 2001 are also computed.

Furthermore, for each portfolio formation method, the annualized return over the 19-year period (1983-2001) from short-selling the highest-intan portfolio sequence and purchasing the lowest-intan portfolio sequence of the previous year is calculated, giving excess returns from the zero-net-investment strategy.

## 5. Empirical Results

*5.1 Hypotheses Testing*

I compare the annualized portfolio returns on the first decile (lowest-intan) portfolio and the tenth decile (highest-intan) portfolio using t-statistics as the basis for testing the null hypothesis. The results on the basis of three types of portfolio formation methods are reported in Figures 2 through 4, and Tables 1 and 2. The general return pattern of all 10 decile portfolios is shown in figures; more detailed numerical results are in tables.

*5.1.1 Results for Portfolio Formation Method 1*

The results from the investment strategies based on *portfolio formation method 1*, pooling all companies without normalizing by the industry norm., are plotted in Figure 2. The general pattern shows that, over the 19-year period, 1983-2001, there is a negative relationship between the intangibles ratios of portfolios and portfolio returns. Furthermore, the lowest-intan portfolio sequence outperforms the highest-intan portfolio sequence to a statistically significant extent and to an economically dramatic extent. Specifically, the lowest-intan portfolio sequence provides an average annual return of 28.0%, while the highest-intan portfolio sequence only provides an average annual return of 3.9%. Hall's intangibles hypothesis states that the mean return on the lowest-intan portfolio sequence is less than or equal to the mean return on the highest-intan portfolio sequence, i.e., $\overline{R}_{\text{lowest-intan}} \leq \overline{R}_{\text{highest-intan}}$. Testing this hypothesis (with a one-tailed test) yields a t-statistic of 4.539, which has a p-value 0.01%. With the positive profit opportunity in holding the lowest-intan portfolio sequence and short-selling highest-intan portfolio sequence, the intangibles hypothesis is strongly rejected.

Is this profit opportunity due to any abnormal effect in some certain years or it is the general pattern for all 19 years? To answer this question, annual returns in each year for the highest-intan portfolio sequence and the lowest-intan portfolio sequence are computed and presented in Table 1. The results in Table 1 are hardly surprising: in 16 out of 19 years, the returns from holding the lowest-intan decile portfolio are higher than the returns from holding the highest-intan decile portfolio. This shows that the investment strategy based on mean-reverting stock prices works and the profit opportunity is not caused by any abnormal effect in some years; but it also shows that the investment strategy comes with inherent risks as some individual years deviate from the pattern.[13]

*5.1.2 Results for Portfolio Formation Method 2*

In this method, I again pool firms from all industries, but for each firm, I first normalize its intangibles ratio by subtracting its industry-average intangibles ratio. Then the normalized intangibles-to-hard-assets ratios are used as the basis for the portfolio grouping. This way, the industry effect on intangibles is purged.

The difference between deciles' returns is again dramatic, as shown in Figure 3. Using the portfolios formed on individual companies' intangibles-to-hard-assets ratios in excess of their industry norm, the lowest-intan portfolio provides an average annual return of 17.9%, while the highest-intan portfolio only provides an average annual return of 5.2%. The intangibles hypothesis states that the mean return on the lowest-intan portfolio sequence is less than or equal to the mean return on the highest-intan portfolio sequence, i.e., $\overline{R}_{\text{lowest-intan}} \leq \overline{R}_{\text{highest-intan}}$. Testing this hypothesis (with a one-tailed test) yields a t-statistic of 4.356, which has a p-value of 0.02%, so the intangibles hypothesis is again strongly rejected at the 1% significance level. This suggests that it is likely that the observed difference in intangibles-to-hard-assets ratios between individual companies and their industry norm is an effective signal of mis-pricing. Again, checking the portfolio returns on the highest-intan and lowest intan portfolios in each year of the 19-year holding period shows that the profit opportunity is not caused by any abnormal effect in some years.

*5.1.3 Results for Portfolio Formation Method 3*

To further test the intangibles effect on returns controlling for industry characteristics, investment now is restricted to any one industry. The results of the within-industry trading strategies based on *portfolio formation method 3* are presented in Table 2. All nine industries are used for which at least 30 companies exist in each year (thus, within each industry, there are at least three stocks in each of the ten portfolios) from 1983 to 2001. To test the null hypothesis, I compare returns on the lowest-intan portfolio sequence and the highest-intan portfolio sequence within each industry separately. Again, positive returns exist on the zero-net-investment strategy in all nine cases; in eight out of the nine cases, positive profit opportunities are statistically significant at the five percent significance level. And again the results are economically dramatic: as an average across industries, the annualized return for the lowest-intan sequence is 27%, while that for the highest-intan sequence is only 1%.

Again, consistent with the results of portfolio formation methods 1 and 2, sequentially holding industry decile portfolios for all the deciles yields returns negatively related

to the intangibles order. As Figure 4 shows, there is a monotonic relationship between annualized 19-year portfolio sequence returns and intangibles ratio deciles.

*5.2 Discussion and Interpretation*

Overall, the null hypothesis, that the returns on the lowest-intan portfolio sequence are no higher than those from the highest-intan portfolio sequence, is rejected, and the rejection of Hall's intangibles hypothesis is robust with respect to the choice of portfolio formation method. The profit opportunities shown in Table 1 and Table 2 mean that at least part of the "inferred intangibles" is due to market misvaluation instead of being entirely the rational market valuation of firms' intangible assets. This is consistent with the implication of the alternative hypothesis, that both investors' overreaction and rational market valuation of risks determine stock returns.

Corporations have accumulated large amounts of intangible assets not recorded on the books, and indeed intangible assets generate present or future cash flows; therefore it is sensible and convenient to relate firms' stock market value to the market valuation of intangible assets. However, the expected future profits that intangible assets might generate, as perceived by the market, appear to be overstated and thus the value that the stock market assigns to intangible assets can serve as a predictive factor for stock returns based on the resulting mean reversion of stock prices.

*5.3 Intangibles and BE/ME: Similarity and Difference*

It is noted that Hall's intangibles in equation (1) are closely related to the market-to-book-equity discrepancy. First, the definition of Hall's intangibles is based on the explanatory power of market valuation of intangible assets for the deviation of firms' market value from the book value. Second, for the 439 companies which survive the full 20-year testing period and meet all the sample requirements, the correlation coefficient between inferred intangibles from equation (1) and the market-to-book-equity discrepancy (ME-BE) is on average (across securities) 90%, which shows an imperfect but strong positive correlation.

Therefore intangibles-to-hard-assets ratios are also related to the book-to-market equity ratio (BE/ME) in Fama and French (1992), if we believe that book equity is related to the book value of hard assets. Fama and French (1992) suggests that returns may be predictable based on BE/ME in a way similar to what I have shown to be their predictability based on the intangibles-to-hard-assets ratio. The return-predicting ability of "inferred intangibles" thus is consistent with that of BE/ME. This confirms my results from the trading strategies performed and it reiterates the rejection of Hall's hypothesis.

One important difference between my study and Fama and French's (1992) is that the predictive power of the intangibles-to-hard-assets ratio views the intangibles-to-hard-assets ratio as a proxy for mis-pricing, while BE/ME in Fama and French (1992) is viewed as a proxy for distress risk. The predictability of stock returns based on the intangibles-to-hard-assets ratio thus is viewed as due to price reversal in an inefficient market while the predictability of returns based on BE/ME is viewed as due to different risks and different risk premiums. The linkage between intangibles-to-hard-assets ratios and BE/ME can be explained by the empirical evidence shown in Giffin and Lemmon (2002): investors underestimate the importance of information about current fundamentals and overestimate the payoffs from future growth opportunities.[14] Therefore, they

find that controlling for distress risk, low book-to-market stocks (high-intangibles firms) are often overpriced because investors overreact to information about the future growth potential of these firms; and high book-to-market stocks (low-intangibles firms) are usually underpriced because of lagging growth options.

Aside from the different theoretical foundations, there is one advantage in using the intangibles-to-hard-assets ratio as the return predictor rather than BE/ME. When BE is negative or zero, firms are typically dropped from the study (as Fama and French (1992) does), while by using intangibles-to-hard-assets ratios, one can conduct tests on all available companies, with positive, negative or zero book equity. In fact, using the intangibles-to-hard-assets ratio as the ranking criterion, positive profit can be found from investing in companies with negative or zero book equity, as shown in the following test. In each year from 1982 to 2001, I collect all the companies which have negative or zero book equity; then I form decile portfolios based on portfolio formation method 1. The returns on holding each decile portfolio sequence are plotted in Figure 5. Again, the lowest-intan portfolio sequence outperforms the highest-intan portfolio sequence to both a statistically significant extent and to an economically substantial extent. Specifically, the lowest-intan portfolio sequence provides an average annual return of 39.1%, while the highest-intan portfolio sequence only provides an average annual return of 27.2%. Testing the hypothesis that , $\overline{R}_{\text{lowest-intan}} \leq \overline{R}_{\text{highest-intan}}$ yields a t-statistic of 2.23, which has a p-value 2.0%. So for companies with negative or zero book equity, which are not explained by Fama and French's distress factor, the overreaction theory results in a positive profit opportunity in holding during each period the lowest-intan portfolio and short-selling the highest-intan portfolio.

*5.4 The Forecasting Performance of Intangibles and BE/ME*

To show explicitly the different empirical results that the mean reversion theory and the Fama and French theory lead to, a test is conducted on positive-book-equity firms which are ranked substantially differently by the two criteria. Each year from 1982-2000, all firms which have positive book equity are ranked on the value of intangibles-to-hard-assets ratios in a descending order, and then the same firms are ranked on their BE/ME ratio in ascending order. Then, decile portfolios are formed based on each of the two ranking criteria. According to the overreaction hypothesis, firms in low deciles (with higher intangibles-to-hard-assets ratios) have lower returns; and according to Fama and French's distress theory, firms in low BE/ME deciles also have lower returns because of the low risk premium associated with low BE/ME (low distress). If the two theories were identical, the rankings would be the same; if not, companies in different deciles by the different rankings contain information for us to compare the forecasting ability of the two ranking criteria.

I compare the two ranking series for each year, then I select firms with ranks that differ by at least five deciles. Each year, those firms with decile ranking by the intangibles-to-hard-assets ratio five deciles lower than the decile ranking by BE/ME are shorted, and those firms with decile ranking by intangibles-hard-assets ratio at least five deciles higher than the decile ranking by BE/ME are bought. That is, for these selected firms, buying and selling decisions are based on the intangibles-to-hard-assets ratios and are contrary to decisions that would be implied by BE/ME. It turns out that the return from the zero-net-investment portfolio is significantly positive, with a t-statistic of 2.080 and a p-value of 2.62% for the one-tailed test, as reported in Table 3. This shows the su-

periority of using the intangibles-to-hard-assets ratio as the predictor according to the mean-reversion misvaluation theory rather than the BE/ME ratio as the predictor according to the distress theory.

## 6. Conclusion

Hall's proposed interpretation of the large discrepancy between book equity and market equity is that it is entirely due to rational stock market valuation of intangible assets that reflect future earning power of the firm. Under this interpretation, the high-intangibles companies should require higher returns due to higher risks associated with intangible assets or equally high returns if these risks are non-systematic. One alternative to Hall's interpretation is that at least part of the book-versus-market valuation discrepancy is due to temporary mean-reverting misvaluation. Such a non-rational discrepancy should experience mean reversion as market participants gradually perceive the mistake, and this mean reversion of stock prices should allow for the formulation of portfolio-trading strategies that earn excess profits.

This paper shows that dramatically positive profits are generated in the same direction as the alternative hypothesis indicates; thus it is found that Hall's intangibles hypothesis is rejected statistically. While this conclusion is consistent with the role of BE/ME as a distress indicator in Fama and French's (1992) three-factor model, the interpretation adopted here in the context of the alternative hypothesis is one based on mean reversion due to market mis-pricing of intangibles, and it turns out that the intangibles-to-hard-assets ratio outperforms the BE/ME ratio in forecasting stock returns.

**Acknowledgments**

I am grateful to Ronald Balvers, Karen Denning, Stratford Douglas and a referee for helpful comments.

* Contact Address: Duo Zhang, Division of Economics and Finance, West Virginia University, Box 6025, Morgantown, WV 26506-6025; Phone: (304) 293-7859; E-mail: duzhang@mail.wvu.edu

| Appendix: Industries and the Corresponding Primary SIC codes | | | |
|---|---|---|---|
| **SIC** | **Industries** | **SIC** | **Industries** |
| 1 | Agricultural Crops | 46 | Pipe Lines and Nature Gas |
| 2 | Agricultural Produce, Animal | 47 | Transportation Services |
| 7 | Agricultural Services | 48 | Communication |
| 8 | Forestry | 49 | Electric, Gas and Sanitary Services |
| 9 | Fishing, Hunting and Trapping | 50 | Wholesale Trade-Durables |
| 10 | Metal Mining | 51 | Wholesale Nondurables |
| 12 | Coal Mining | 52 | Building Materials |
| 13 | Oil and Gas Extraction | 53 | General Merchandise Stores |
| 14 | Nonmetallic Minerals | 54 | Food Stores |
| 15 | General Bldg Contractors | 55 | Automotive Dealers |
| 16 | Heavy Construction | 56 | Apparel Stores |
| 17 | Construction – Special Trade | 57 | Furniture Stores |
| 20 | Food and Kindred Products | 58 | Eating and Drinking Places |
| 21 | Tobacco Products | 59 | Miscellaneous Retail |
| 22 | Textile Mill Products | 60 | Depository Institutions |
| 23 | Apparel | 61 | Nondepository Institutions |
| 24 | Lumber and Wood Products | 62 | Security Brokers |
| 25 | Furniture and Fixtures | 63 | Insurance |
| 26 | Paper and Allied Products | 64 | Insurance Agent and Brokers |
| 27 | Printing and Publishing | 65 | Real Estate |
| 28 | Chemicals | 67 | Holding and Other Investment |
| 29 | Petroleum and Coal Prods | 70 | Hotels and Lodging Places |
| 30 | Rubber and Plastics | 72 | Personal Services |
| 31 | Leather and Leather Products | 73 | Business Services |
| 32 | Stone, Clay and Glass | 75 | Auto Repair |
| 33 | Primary Metal Industries | 76 | Misc. Repair |
| 34 | Fabricated Metal Products | 78 | Motion Pictures |
| 35 | Industry Machinery | 79 | Amusement and Recreation Services |
| 36 | Electronic and Electric EQ. | 80 | Health Services |
| 37 | Transportation Equipment | 81 | Legal Services |
| 38 | Instruments | 82 | Educational Services |
| 39 | Miscellaneous Manufacturing | 83 | Social Services |
| 40 | Railroad Transportation | 84 | Museum, Gallery Botanic Garden |
| 41 | Transit and Passenger Transportation | 86 | Membership Organizations |
| 42 | Motor Freight Transit, Warehouse | 87 | Engineering Services |
| 44 | Water Transportation | 89 | Services, NEC |
| 45 | Transportation by Air | 99 | Nonclassifiable Establishment |

**Figure 1: Industry Intangibles / Hard Assets, 2001**

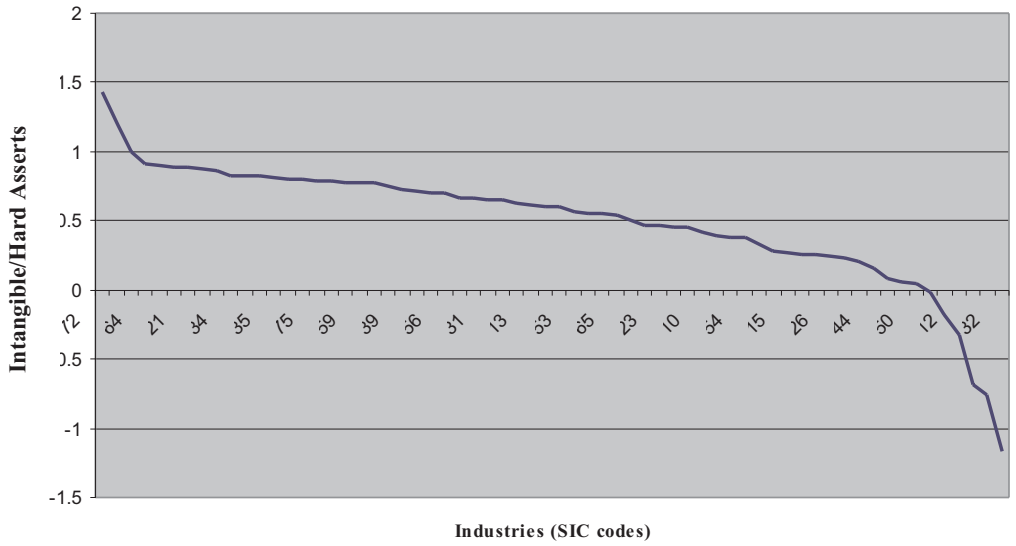
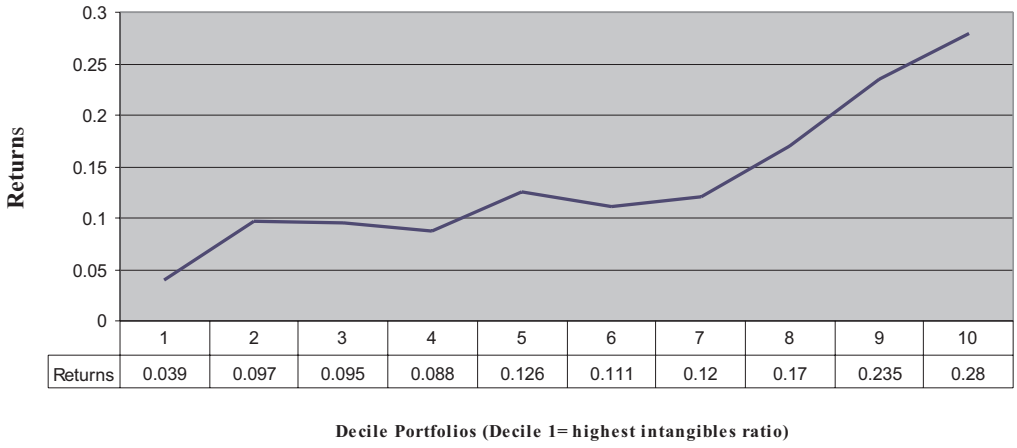



**Figure 2: Annualized 19-Year Portfolio Returns by Decile[1]: Firms from All Industries (Portfolio Formation Method 1)**




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Returns | 0.039 | 0.097 | 0.095 | 0.088 | 0.126 | 0.111 | 0.12 | 0.17 | 0.235 | 0.28 |

[1] A one-tailed t-test rejects the null hypothesis that $\overline{R}_{\text{lowest-intan}} \leq \overline{R}_{\text{highest-intan}}$ at the 1% level, with t-value of 4.539.

| Table 1: Annual Portfolio Returns: Firms from All Industries (Portfolio Formation Method 1) | | | | | | |
|---|---|---|---|---|---|---|
| **PFL** [1] | **1983** | **1984** | **1985** | **1986** | **1987** | **1988** |
| 1 | 0.216 | -0.293 | 0.089 | -0.022 | -0.176 | 0.052 |
| 10 | 0.647 | 0.080 | 0.281 | 0.131 | 0.101 | 0.318 |
| **PFL** | **1989** | **1990** | **1991** | **1992** | **1993** | **1994** |
| 1 | 0.072 | -0.193 | 0.918 | -0.018 | 0.106 | -0.212 |
| 10 | 0.158 | -0.144 | 0.725 | 0.468 | 0.569 | 0.252 |
| **PFL** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** |
| 1 | 0.553 | 0.101 | 0.094 | 0.004 | 0.720 | -0.362 |
| 10 | 0.417 | 0.394 | 0.410 | 0.008 | 0.595 | -0.093 |

[1] Portfolio 1 is the decile with the highest intangibles/hard assets; portfolio 10 is the decile with the lowest intangibles/hard assets ratio.

**Figure 3: Returns on Portfolios Ranked by Normalized Intangibles Ratios by Decile [1] (Portfolio Formation Method 2)**

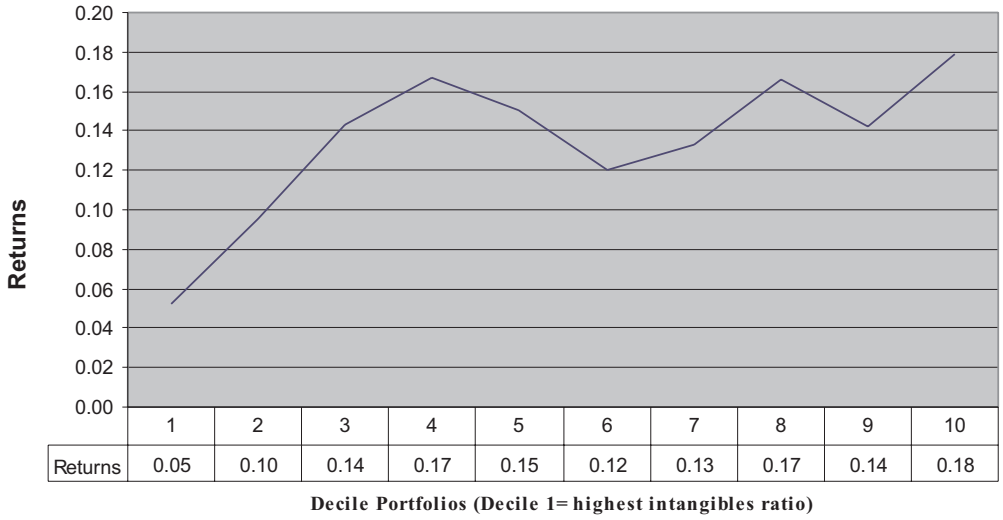
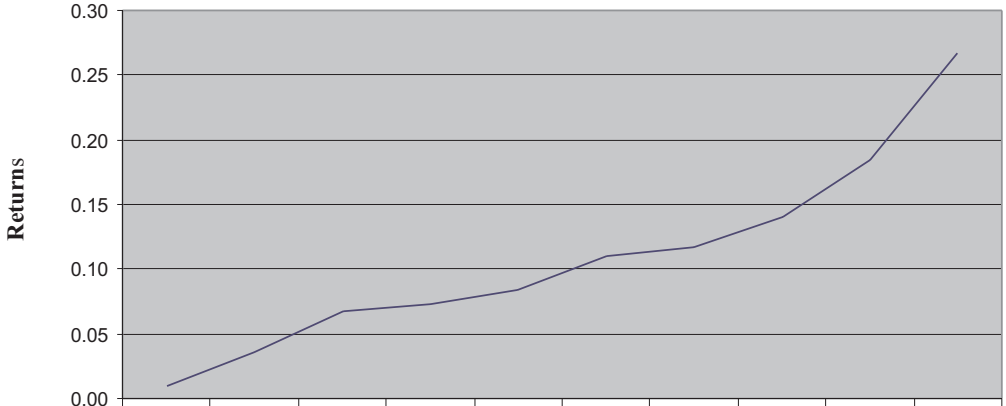


**Table 2: Annualized 19-Year Portfolio Returns by Deciles within Industries (Portfolio Formation Method 3)**

| | Industry SIC Codes[1] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| PFL (1=decile with the highest ratio) | 13 | 20 | 28 | 35 | 36 | 38 | 49 | 50 | 73 | Average |
| 1 | **-0.065** | **-0.900** | **0.217** | **0.073** | **-0.007** | **0.054** | **0.015** | **-0.111** | **0.003** | 0.01 |
| 2 | 0.004 | 0.103 | 0.039 | -0.022 | 0.033 | 0.087 | 0.080 | 0.023 | -0.025 | 0.04 |
| 3 | 0.036 | 0.148 | 0.096 | 0.079 | 0.101 | 0.030 | 0.153 | -0.042 | 0.000 | 0.07 |
| 4 | 0.003 | 0.053 | 0.216 | 0.089 | 0.026 | 0.077 | 0.112 | 0.020 | 0.064 | 0.07 |
| 5 | -0.061 | 0.076 | 0.234 | 0.101 | 0.115 | 0.078 | 0.142 | 0.019 | 0.050 | 0.08 |
| 6 | -0.010 | 0.134 | 0.178 | 0.066 | 0.160 | -0.109 | 0.147 | 0.077 | 0.133 | 0.11 |
| 7 | 0.047 | 0.211 | 0.122 | 0.072 | 0.077 | 0.125 | 0.200 | 0.115 | 0.087 | 0.12 |
| 8 | 0.067 | 0.127 | 0.138 | 0.194 | 0.142 | 0.137 | 0.191 | 0.091 | 0.176 | 0.14 |
| 9 | 0.097 | 0.156 | 0.173 | 0.174 | 0.192 | 0.213 | 0.224 | 0.232 | 0.201 | 0.18 |
| 10 | **0.176** | **0.221** | **0.242** | **0.288** | **0.266** | **0.345** | **0.296** | **0.251** | **0.323** | 0.27 |
| t-statistic[2] | 3.583 | 4.153 | 0.138 | 2.081 | 2.815 | 1.980 | 3.449 | 4.318 | 2.996 | - |
| p-values | 0.11% | 0.03% | 51.95% | 2.46% | 0.70% | 3.61% | 0.14% | 0.02% | 0.40% | - |

[1], Included industries are those for which at least 30 firms have data available for all years. Corresponding industry names are given in appendix.
[2] t-statistic is to test the null hypothesis, $-\ \overline{R}_{\text{lowest-intan}} - \overline{R}_{\text{highest-intan}} \leq 0$, and p-value is calculated as a one-tailed test.

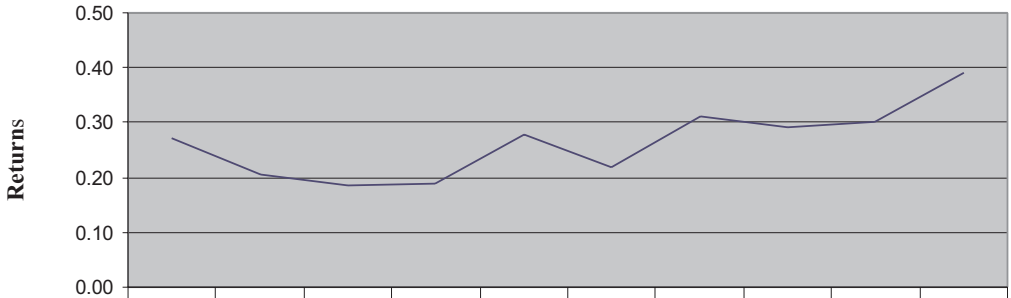
**Figure 4: Average across Industries of Annualized 19-Year Portfolio Returns by Decile (Portfolio Formation Method 3)**




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Returns | 0.01 | 0.04 | 0.07 | 0.07 | 0.08 | 0.11 | 0.12 | 0.14 | 0.18 | 0.27 |

**Decile Portfolios (Decile 1 = highest intangibles ratio)**

**Figure 5: Annualized 19-Year Portfolio Returns by Deciles for Companies with Negative Book Equity (Portfolio Formation Method 1)**




| | Highest-intan | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Low est-intan |
|---|---|---|---|---|---|---|---|---|---|---|
| Returns | 0.27 | 0.21 | 0.18 | 0.19 | 0.28 | 0.22 | 0.31 | 0.29 | 0.30 | 0.39 |

**Decile Portfolios**

**Table 3: Returns on the Buy Portfolio and the Sell Portfolio: Intangibles Ratios versus BE/ME[1]**

| | Returns of the "buy" portfolio | Returns of the "sell" portfolio | Net Returns |
|---|---|---|---|
| mean | 0.297 | 0.079 | 0.128 |
| t-statistic2 | - | - | 2.080 |
| p-value | - | - | 2.62% |

[1] Included firms in each year are those for which rankings based on intangibles-to-hard-assets ratios and rankings based on BE/ME differ by more than 5 deciles at the end of the previous year. The buy portfolio is the one that the mean-reversion theory says to buy and the BE/ME theory says to sell, and the sell portfolio is the opposite. The number of firms in the "buy" portfolio ranges from 88 in 1983 to 402 in 1998, with a mean of 242.0; the number of firms in the "sell" portfolio ranges from 29 in 1991 to 353 in 1997, with a mean of 198.6.

[2] t-statistic is to test the null hypothesis, $-\overline{R}_{\text{lowest-intan}} - \overline{R}_{\text{highest-intan}} \geq 0$, and p-value is calculated as a one-tailed test based on 18 degrees of freedom (19 years minus 1).

**Endnotes**

1. Firms' book value of assets is used as a proxy for the replacement cost of assets here, which is consistent with what Bond and Cummins (2000) argues: the book value of tangible assets is typically the most readily available measure of the replacement cost of assets in company accounts data.

2. One version of the mis-pricing hypothesis is "momentum", which is the tendency for stocks that have recently performed well to continue outperforming.

3. In order to diminish the measurement errors from individual stocks' returns, I look for strategies based on trading portfolios of stocks rather than on trading individual stocks.

4. There is literature that does not support this statement; as an example, Goyal and Santa-Clara (2002) finds that idiosyncratic risk matters for the market return.

5. Among other possibilities are distress risk and noisy share prices.

6. For example, an intangible asset, such as goodwill, has no limited term of existence and is not utilized or consumed in the earnings process.

7. Strictly, the residual is not intangibles but intangibles subtracting stakeholders' value. Since stakeholders' value is stable relative to intangibles, its effect on the stock market value is neglected. Hereafter this residual value is referred to as intangibles. For details, see Hall (2001a).

8. Theoretically, debt needs to be valued at the market value. However, much of a firm's debt may not be publicly traded; thus the book value of debt is used as a proxy for its market value.

9. For details of this definition, see the accounting set-up in Hall (2001a).

10. For a detailed discussion of portfolio formation and intangibles valuation, see Section 4.

11. Market Equity refers to common equity at market value. The value of preferred stocks and other preferred equity is excluded.

12. Annual market equity is available in COMPUSTAT. But because of its particular way of computation, a lot of missing data result. Thus I compute market equity using price and shares outstanding from COMPUSTAT.

13. To save space, annual returns on the lowest-intan decile portfolio and the highest-intan decile portfolio in each year based on other Portfolio Formation Methods (2&3) are not reported, but the results are very similar.

14. In Giffin and Lemmon (2002) growth opportunities are quantified by R&D, capital spending and sales growth, which are closely related to intangible assets.

**References:**

Aboody, D. and B. Lev. "Information Asymmetry, R&D, and Insider Gains.", *Journal of Finance* 55, (2000), pp. 2747-2766.

Berk, J. B., R. C. Green and V. Naik. "Optimal Investment, Growth Options and Security Returns." *Journal of Finance* 54, (1999), pp. 1553-1607.

Bond, S. R. and J. G. Cummins. "The Stock Market and Investment in the New Economy: Some Tangible Facts and Intangible Fictions." *Brookings Papers on Economic Activity* 1, (2000), pp. 61-122.

Brynjolfsson, E. and S. Yang. "The Intangible Costs and Benefits of Computer Investments: Evidence from the Financial Markets." Proceedings of the International Conference on Information Systems, Atlanta, Georgia, (1999).

Choi, W. W., S. S. Kwon and G. J. Lobo. "Market Valuation of Intangible Assets." *Journal of Business Research* 49, (2000), pp. 35-45.

De Bondt, W. F. M. and R. Thaler. "Does the Stock Market Overreact?" *Journal of Finance* 40, (1985), pp. 793-805.

Fama, E. F. and K. R. French. "The Cross-Section of Expected Stock Returns." *Journal of Finance* 47 , (1992), pp. 427-465.

Giffin, J. M. and M. L. Lemmon. "Book-to-Market Equity, Distress Risk, and Stock Returns." *Journal of Finance* 57, (2002), pp. 2317-2336.

Goyal, A. and P. Santa-Clara. "Idiosyncratic Risk Matters!" Anderson School of Management (UCLA) working paper, (Forthcoming in *Journal of Finance*), (2002).

Hall, R. E. "e-capital: the Link between the Labor Market and the Stock Market in the 1990s." *Brookings Papers on economic Activity* 2, (2000), pp. 73-118.

Hall, R. E. "Struggling to Understand the Stock Market (the Richard T. Ely Lecture)." *American Economic Review Papers and Proceedings* 91, (2001a), pp. 1-11.

Hall, R. E.. "The Stock Market and Capital Accumulation." *American Economic Review* 91, (2001b), pp. 1185-1202.

Hirshleifer, D. "Investor Psychology and Asset Pricing." *Journal of Finance* 56, (2001), pp. 1533-1597.

McCarthy, M. G. and D. K. Schneider. "Market Perception of Goodwill: Some Empirical Evidence." *Accounting and Business Research* 26, (1995), pp. 69-81.