# Measuring the Intrinsic Value

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## Abstract

One common belief in equity valuation is all valuation models measure the same intrinsic value. This paper explains why this is not the case theoretically, and addresses an unresolved question in Liu, Nissim and Thomas (2002): how simple earnings multiples outperform complex discount based valuation models (DBVM). Our theoretical reasoning suggests the DBVMs are designed to measure the intrinsic value of stock, while the multiples are to measure the current stock price. The paper extends the pricing error result and examines the performance of models when their estimates are compared to the intrinsic value directly. Three alternative measures of the intrinsic value are chosen: i) linear fitted value, ii) moving average of prices for the next five years, and iii) return generation ability. A surprising result is, contrary to the theory and our expectation that the DBVMs would outperform the multiples in intrinsic value measurement, the multiples still outperform the DBVMs in all three measures. I suspect this is because the DBVMs have lower correlation with price but higher dispersion of their estimates than the multiples'.

**Keywords:** discount based valuation model, multiples, residual income model, valuation, pricing, intrinsic value

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## I. Introduction

What is the best model to measure the intrinsic value of stock? This question is one of the most important questions in investment, leading to extensive research on which valuation models measure the intrinsic value best. Unfortunately, because the intrinsic value itself is not observable, current stock price has been widely used in practice as an alternative to the intrinsic value. A number of research papers examine model performances in terms of how close their estimates are to current stock prices (i.e., the pricing error). The closer the estimate is to current stock price, the more accurate a model is. One finding in the pricing error literature is forward price-earnings (P/E) multiples outperform the discount based valuation models (Liu et al., 2002). This finding is peculiar given the fact that the discount based valuation model (DBVM) actually includes information of earnings forecasts in its estimation. Some argue that this may be due to large errors the DBVM has when it makes assumptions (Block, 1999, Liu et al., 2002). Others advocate the multiple as a better model because it uses assumptions made by the market (Kaplan and Ruback, 1995, Baker and Ruback, 1999). This paper provides another reason why the multiple outperforms the DBVM: they measure different values. Until now, it has been widely believed that the DBVM and multiple measure the same intrinsic value. This paper challenges this common belief and explains theoretically that the multiple is designed to measure current stock price, while the DBVM to measure the intrinsic value.

The paper first explains theoretical difference between the DBVM and multiple in terms of what value they measure. This difference is examined empirically in the pricing error context. The paper next examines models' abilities to estimate the intrinsic value directly. Three alternative measures of the intrinsic value are chosen: linear fitted value, the moving average of future prices for the next five years and future return generation ability.

The research design, primarily, takes into account the perspective of investors. For example, firstly, I mainly demonstrate the result of the multiples based on simple mean, instead of harmonic mean, median and value-weighted mean. Results based on all four measures are generally consistent, although they are different in magnitude. I chose a simple mean measure because it is simplest and presumably most widely used in practice. Secondly, the paper does not modify the estimate of the DBVM after calculation because I believe the DBVM is a theoretically self-contained model to measure the intrinsic value directly. This is contrary to Liu et al. (2002) which uses the estimate of the DBVM as a variable of the multiple. Finally, in selecting the DBVM, I adopt the view of Lundholm and O'Keefe (2001) that the dividend discount model (DDM) , discount cash flow model (DCF) and residual income model (RIM) all produce the same result both theoretically and empirically if identical information is used. Therefore, I only chose the RIM as a representative model of the DBVMs based on empirical results which favor the RIM over DDM and DCF (Penman and Sougiannis, 1998, Francis et al., 2000).

The main finding of this paper is that the DBVM and multiple estimate different values theoretically. While the DBVM is designed to measure the intrinsic value, the multiple is designed to measure current stock price. This difference explains the outperformance of the multiple over DBVM when their estimates are compared to current stock price (i.e., in terms of the pricing error). A surprising result is when models are compared in terms of the ability to estimate the intrinsic value, multiples still outperform the DBVMs. This is in contrast to our motivation to prove how good the DBVMs are at estimating the intrinsic value. I suspect the underperformance of the DBVMs is due to the low correlation with prices and high dispersion of their estimates.

The paper contributes by addressing the common misunderstanding in equity valuation that all valuation models estimate the same intrinsic value. This correction explains the unresolved question of how simple earnings forecast multiples outperform complex DBVMs in the pricing error. In addition, the paper first introduces alternative measures of the intrinsic value in the model performance literature, and identifies contrast between the theoretical value and empirical results of the DBVMs.

The paper proceeds in the following order: section 2 reviews previous literature about model performance. Section 3 covers methodologies including the theoretical explanation of models and the calculation of alternative measures of the intrinsic value. Data and results are explained in section 4 and 5, respectively. The results are further investigated in a discussion part in section 6, followed by conclusion in section 7.

## II. Literature Review

Literature on the comparison of valuation models aims to answer one research question: which valuation model can measure the intrinsic value best? Since the intrinsic value is not observable, stock price is widely used instead for the intrinsic value. Two most popular criteria in measuring model's performance are the pricing error and explanatory power (i.e., $R^2$).

Among literature measuring the pricing error, Kaplan and Ruback (1995) compare the DCF with EBITDA multiple in estimating transaction values in management buyouts. They find the DCF generates within 10% pricing error, and performs at least as well as the multiple. Similar results are found in Berkman et al. (2000) in IPOs on the New Zealand Stock Exchange. Penman and Sougiannis (1998) and Francis et al. (2000) compare three DBVMs (i.e., DDM, DCF and RIM) and find the RIM outperforms DDM and DCF in terms of both pure and absolute pricing error. However, their results are refuted by Lundholm and O'Keefe (2001) who argue the outperformance of the RIM is due to inconsistent forecast error and discount rate error in research design rather than the superiority of the RIM. Lundholm and O'Keefe argue all three theoretically identical DBVMs generate empirically identical results if consistent information is employed. The consistency between the DBVMs is also found in Courteau et al. (2001) when identical Value Line terminal value forecasts are used for terminal value estimation. Liu et al. (2002) compare 17 most widely used models and find earnings forecast multiples outperform multiples using historical values. An interesting result is earnings forecast multiples even outperform the RIMs. Liu et al. (2007) find earnings forecast multiples produce smaller pricing errors than multiples using cash flow forecast and dividends forecast.

Some papers believe combining valuation models can improve performance because each model employs different information sets. Collins et al. (1999) argue that book value should be used together with earnings in estimating price because book value serves a role as a proxy for future normal earnings and liquidation value. Cheng and McNamara (2000) combine P/E and price-book value (P/B), and find the combined model generates smaller pricing error than the individual models. Similar results are found in Courteau et al. (2006) when they combine the RIM and P/E in equal weight. The combined model outperforms the individual ones in terms of both pricing error and cumulative returns. Yoo (2006) finds a combination of multiples using historical values outperforms individual historical multiples, but not earnings forecast multiples.

By measuring the explanatory power ($R^2$), Bernard (1995) examines a relationship between price and the components of the RIM and DDM. When book value and expected abnormal earnings are used, the RIM components can explain 68% of price, while expected dividends can explain 29%. Kim and Ritter (1999) examine the explanatory power of P/E, P/B and price-sales (P/S) of comparable firms in estimating multiples in IPOs. They find multiples using historical values have limited merit compared to multiples using forecast values.

Three general findings are observed in the literature. Firstly, earnings forecast multiples perform better than multiples using historical values. Secondly, all DBVMs perform equivalently if consistent information is used. Finally, earnings forecast multiples outperform the RIM in the pricing error. The first finding was proved by Yee (2004) demonstrating the more-forward earnings are used, the more accurate earnings-value relations. The second finding was validated by Lundholm and O'Keefe (2001) that all DBVMs produce the identical result if information is based on the same pro forma financial statement forecasts. However, the reason for the third finding has not been explained or explored yet. This paper aims to investigate the third finding that how earnings forward multiples outperform the DBVMs.

## III. Methodologies

### *Theoretical Explanation of Valuation Models*

To understand the difference between the DBVM and multiple, it is important to understand the difference between what equity valuation attempts to measure and what valuation models actually measure. In valuation, there are two prices most widely referred. The first is the intrinsic value. Intrinsic value is, by definition, the underlying value of stock based on fundamentals without irrational noise. Emphasis on fundamentals is widely observed by the fact that analyst forecasts normally exclude the impact of one-off events. Investors believe irrational noise is to be cancelled out in the long term, and stock price will converge on its intrinsic value. Therefore, the intrinsic value is what investors aim to measure in valuation. On the other hand, stock price is an observable price which contains all information in the stock market including discontinuous information and the market sentiment.

To examine what valuation models actually measure, I investigate how the stock price is composed of. Stock price is the sum of the price of realized events and the price of expectation of future events, which influence company's future cash flows. This can be described as,

$$Price_{stock} = Price_{realized\ events} + Price_{expectation} \tag{1}$$

If the price of expectation is decomposed further, stock price becomes,

$$Price_{stock} = Price_{realized\ events} + Price_{rational\ expectation} + Price_{irrational\ expectation} \tag{2}$$

where $Price_{realized\ events}$ is price based on past events (e.g., accounting information), $Price_{rational\ expectation}$ is the price of expectation based on market or company fundamentals, and $Price_{irrational\ expectation}$ is the price of expectation not based on fundamentals (e.g., rumor, discontinuous information, and bubble and bust).

The intrinsic value can be described as,

$$Price_{intrinsic\ value} = Price_{realized\ events} + Price_{rational\ expectation} \tag{3}$$

assuming $E(Price_{irrational\ expectation}) = 0$ in the long term. Therefore, an essential difference between estimating stock price and the intrinsic value is how much information models include in their estimation. I categorize valuation models into three groups according to the extent to which information they use.

$$Price_{stock} = \underbrace{\underbrace{\underbrace{Price_{realized\ events}}_{\text{Book Value} \ + \ \text{Error}} + Price_{rational\ expectation}}_{\text{Residual Income Model} \ + \ \text{Error}} + Price_{irrational\ expectation}}_{\text{Multiple}}$$

The most basic valuation model is book value (i.e., net asset value). Although book value estimates the price of realized events, it fails to incorporate information on expectation, thereby generates large difference between stock price and the estimate. A more advanced model is the RIM that incorporates the price of rational expectation into book value. Although deciding how much fundamental information analyst forecasts apprehend is controversial, the RIM attempts to measure the intrinsic value without information on irrational expectation by using analyst forecasts. On the other hand, the multiple includes not only the price of intrinsic value but also the price of irrational expectation because its estimates rely on other companies' stock prices, which already contain information on irrational expectation. In this paper, I categorize book value and the RIM as the DBVM, because they do not incorporate information on irrational expectation.

If the theoretical reasoning is sound, I expect the estimate of the multiple would follow the market price. On the other hand, I expect the estimate of the DBVM would not mimic the current market price but instead has its distinct trend. Therefore, the first two hypotheses are,

*H1*: the estimate of the multiple would follow the current market price.

*H2*: the estimate of the DBVM would not follow the current market price.

Both hypotheses are tested by graphic illustration of the estimates over time along the market index, and the Engle-Granger cointegration test between the estimates and market index.

### *Valuation Model Selection*

Ten popular multiples and three DBVMs (i.e., two RIMs and book value) are examined in this paper. All multiples are measured out of sample based on mean, median, harmonic mean and value-weighted mean. Consistent with other literature, multiples based on harmonic mean produce the closest estimate to stock price, followed by median, mean and value-weighted mean, respectively. Although there are differences in magnitude, all four measures produce similar results. Therefore, the results of mean multiples, which are simplest and presumably most widely used, are mainly reported in this paper.

In selecting multiples, price to book value (P/BV) ratio is included due to its prominent role in both academia and practice. Price to cash flows from operation (P/CFO) ratio is also widely used because cash flows are the source of dividends and often considered less susceptible to management manipulation. Although price to sales (P/SALES) ratio is not widely used in academic literature, the survey result shows that P/SALES is the second most popular multiple across sectors (Demirakos et al., 2004). Also, P/SALES is often considered as an alternative to P/E or P/CFO because sales figures are always positive while earnings and cash flows are often negative.

Compustat EPS (EPS_COM) is earnings per share (EPS) calculated as reported net income divided by the number of shares outstanding. On the other hand, I/B/E/S EPS (EPS_IBES) is adjusted EPS to one-time events. More than one type of earnings multiples (e.g., P/EBITDA, P/EPS_COM and P/EPS_IBES) are used because earnings are the most important values considered by analysts and the source of cash flows, which in turn determine the size of dividends.

Earnings forecast multiples and the RIMs are estimated consistent with Liu et al. (2002). One-year ahead earnings (EPS1) and two-year ahead earnings (EPS2) are obtained from I/B/E/S forecast file. Three-year ahead earnings (EPS3) are calculated as EPS2 multiplied by one plus long term growth rate ($g$), $EPS2 \times (1 + g)$, if three-year ahead earnings are missing in I/B/E/S. PEG (P/EG) ratio is calculated as $P/(EPS2 \cdot g)$, where $EPS2 \cdot g$ represents earnings-and-growth. PEG ratio makes the comparison between companies with different growth rates comparable by taking into account firm's future earnings growth.

RIM1 uses analyst earnings forecasts up to five years during the forecast period, and calculates the terminal value assuming the abnormal earnings in five years will continue in the future.

$$RIM_1 = BV_t + \sum_{s=1}^{s=5}\left[\frac{E_t(EA_{t+s} - r_t BV_{t+s-1})}{(1+r_t)^s}\right] + \frac{E_t(EA_{t+5} - r_t BV_{t+4})}{r_t(1+r_t)^5} \quad (4)$$

RIM2 is identical to RIM1, only without the terminal value estimation, assuming return on equity will be the same as the cost of equity after five years.

$$RIM_2 = BV_t + \sum_{s=1}^{s=5}\left[\frac{E_t(EA_{t+s} - r_t BV_{t+s-1})}{(1+r_t)^s}\right] \quad (5)$$

***Pricing Error and Intrinsic Value Estimate Errors***

**a. Pricing Error**

Pricing error is the most widely used criterion in model comparison literature. It considers current stock price as the intrinsic value of stock based on the Efficient Market Hypothesis that current price reflects all available information. The pricing error is calculated as,

$$Pricing\ Error_{it} = \frac{P_{it} - Estimate_{it}}{P_{it}} \quad (6)$$

I expect the multiples would have smaller pricing errors than the DBVMs, since the multiples are to estimate current stock price in contrast to the DBVMs. Therefore, the third hypothesis is,

*H3*: the multiples would have smaller pricing errors than the DBVMs.

The hypothesis is tested by the ranks in performance and the regression analysis of price movement on estimate movement. The ranks of both simple and absolute error are measured. The paper puts more emphasis on the result of absolute error than simple error because the purpose of the paper is to measure the accuracy of models rather than their bias. Ranks are measured in terms of mean, standard deviation and an interquartile range to present both bias and dispersion of the pricing errors. The regression analysis measures a relationship between price movement and estimate movement. The estimation model is,

$$\Delta P_{it} = \alpha + \beta \Delta Estimate_{it} + \gamma Market\ Cap_{it} + \sum_{t=1988}^{t=2010} \delta_{t-1987} Year_t + \varepsilon \qquad (7)$$

where $Year_t$ are annual indicator variables.

### b. Fitted Value Error

Since the intrinsic value is unobservable, one alternative measure of the intrinsic value is fitted value. Fitted value assumes stock price fluctuates along the intrinsic value over time. Therefore, the intrinsic value can be calculated as the predicted value of the regression of price on a time variable.

$$E(P_{it}) = \alpha + \beta T_i \qquad (8)$$

where $T_i$ is a monthly time variable. Specifically, $T_i$ = 1 for the earliest price observation of company $i$, $T_i$ = 2 for the second observation, and so on. CRSP monthly price data is used to estimate the fitted value, and I require at least five observations for each company.

The fitted value error is calculated as,

$$Fitted\ Value\ Error_{it} = \frac{Fitted\ Value_{it} - Estimate_{it}}{Fitted\ Value_{it}} \qquad (9)$$

Because the DBVM is supposed to measure the intrinsic value of stock, I expect the DBVM would generate smaller fitted value error than the multiple.

*H4*: the DBVM would have smaller fitted value error than the multiple.

The hypothesis is tested by rank and regression analysis consistent with the pricing error. For regression analysis, the estimation model is,

$$\Delta Fitted\ Value_{it} = \alpha + \beta \Delta Estimate_{it} + \gamma Market\ Cap_{it} + \sum_{t=1988}^{t=2010} \delta_{t-1987} Year_t + \varepsilon \qquad (10)$$

### c. Moving Average Value Error

Moving average value assumes stock price will converge to the intrinsic value in the long term. Therefore, it estimates the intrinsic value as future stock price, measured by the moving average of monthly prices for the next five years.

$$Moving\ Average\ Value_{it} = \frac{1}{N}\left(\sum_{n=1}^{n=60} P_{i,t+n}\right) \tag{11}$$

where $N$ is the number of monthly prices available over the next five years. I require there are at least 30 observations (i.e., $N \geq 30$) available to calculate the moving average value.

The moving average value error is calculated as,

$$Moving\ Average\ Value\ Error_{it} = \frac{Moving\ Average\ Value_{it} - Estimate_{it}}{Moving\ Average\ Value_{it}} \tag{12}$$

Similar to the fitted value error, I expect the DBVM has smaller moving average value error than the multiple.

*H5*: the DBVM would have smaller moving average value error than the multiple.

### d. Future Return Generation

The last measure of intrinsic value is the return generation ability. The return generation indirectly measures model's ability to estimate the intrinsic value. The more accurate a model is to identify the discrepancy between price and the intrinsic value, the more returns investors can expect. This paper calculates one-, two-, and five-year buy-and-hold returns based on a decile portfolio (i.e., buying the top decile and short-selling the bottom decile based on the estimate ratio, explained below). I expect a portfolio based on the DBVM's estimate would generate higher return than the multiple's, especially during boom and bust periods when there are better chances to exploit the market inefficiency.

*H6*: the returns of the portfolio based on the DBVM's estimates would be higher than those of the multiples, especially during boom and bust periods.

The hypothesis is first tested by illustrating the returns of the portfolio over time. After that, a regression analysis of size-adjusted return (SAR) on the estimate ratio is conducted to examine a general relationship between stock return and the estimate ratio. The SAR regression model is,

$$SAR_{it} = \alpha + \beta Estimate\ Ratio_{it} + \sum_{t=1988}^{t=2010} \delta_{t-1987} Year_t + \varepsilon \tag{13}$$

SAR (1 year) is measured following Bradshaw (2004),

$$SAR_{it} = \left[\prod_{t=1}^{t=12}(1 + r_{it}) - \prod_{t=1}^{t=12}\left(1 + r_{decile,t}\right)\right] \tag{14}$$

where $r_{it}$is the monthly return for stock *i* and $r_{decile,t}$ is the monthly return of the size decile to which firm *i* belongs.

The estimate ratio is the ratio of estimate to stock price.

$$Estimate\ Ratio_{it} = \frac{Estimate_{it}}{P_{it}} \tag{15}$$

The higher the estimate ratio is, the more undervalued stock is, and implying buy recommendation.

## IV. Data

The research covers US data from 1987 to 2010. Price and the number of shares outstanding are obtained from CRSP, accounting data from Compustat, and analyst forecasts from I/B/E/S. The sample consists of firms listed in New York Stock Exchange, American Stock Exchange and NASDAQ, excluding financial firms.

To construct the sample, I impose six conditions. 1) Accounting data, price, the number of shares outstanding, and the cost of equity (explained below) are not missing; 2) current EPS, one- and two-year ahead EPS forecasts, and long term growth forecasts are not missing; 3) stock price is greater than $1 and below 99$^{th}$ percentile; 4) all multiples, RIM1 and RIM2 are positive; 5) under the condition 4), multiples and price to RIM1 and RIM2 are within 1$^{st}$ and 99$^{th}$ percentile of the pooled distribution; 6) each industry-year combination has at least five observations. Condition 1) and 2) are used to maintain identical firm-years across models. Condition 3) is imposed to eliminate extreme ratios caused by exceptionally low or high prices. Condition 4) is to prevent models from generating negative estimates. Visual inspection of scattergrams between price and accounting values indicates there are a small number of outliers. Condition 5) eliminates the outliers. Finally, condition 6) is imposed to maintain a minimum number of comparable firms in estimating multiples. All data are measured on a per-share basis. The resulting sample comprises 4,815 firms with 26,340 firm-year observations.

All items are as of four months after the fiscal year end (FYE), except the accounting data that are as of the FYE. I choose four months because most I/B/E/S earnings forecasts start estimating the next FYE earnings from four months after the FYE. The cost of equity is estimated as risk-free rate plus beta multiplied by the equity risk premium based on the Capital Asset Pricing Model. I use US 10 year treasury yield for the risk-free rate and 5% for the risk premium. Historical betas are obtained from Datastream. Manual calculation confirms Datastream historical beta is the coefficient of regression of S&P 500 returns on stock returns over the past 60 months. Consistent with Liu et al. (2002), median beta of all firms in the same beta decile is used instead for firm's beta to mitigate the high variability of individual firm beta. I calculate 3 to 5 years ahead EPS forecasts by multiplying long term growth rate ($g$) by earnings forecast for the prior year; e.g., $EPS_{t+s} = EPS_{t+s-1} \times (1 + g)$, if 3 to 5 years ahead EPS forecasts are missing. For the future dividends, I assume the current dividend payout ratio would persist in the future. Dividend payout ratios are winsorized at 10% and 50% to estimate a long term ratio. Future dividends are then calculated by multiplying the winsorized payout ratio by future earnings forecasts. Future book values are estimated based on the clean-surplus accounting as $BV_{t+s+1} = BV_{t+s} + EPS_{t+s+1} - DPS_{t+s+1}$. Comparable firms are chosen from the same industry according to I/B/E/S industry classification for the calculation of the multiple.

## V. Results

### *Descriptive Statistics*

The distributions of the multiples and DBVMs are described in panel A and B of table 1. In panel A, the ratios of book value and the RIMs are higher than those of multiples, except for SALES/P, because book value and the RIMs produce estimates that are directly comparable to price. One interesting observation is there is a clear distinction between multiples using historical values and forecast values in terms of the relative size of standard deviation to mean. While historical multiples have standard deviations bigger than their means, forecast multiples have standard deviations almost half the size of their means. This implies analyst earnings forecasts have high correlation with price.

<Table 1 Here>

Panel C describes the correlation coefficients between price and accounting values. Below the diagonal are Pearson correlations and above the diagonal are Spearman correlations. Two correlations are to some extent different, indicating values do not generally have linear relationship. As observed in panel A and B, price has high correlations with forecast values, but not with historical values. RIM2 has high correlations with historical accounting values while RIM1 does not. This implies the weight of the terminal value in RIM1 is significant and the terminal value has little commonality with historical accounting values. The high correlation between RIM2 and book value means the discounted abnormal earnings during the forecast period have little weight in RIM2. The distinction between historical and forecast accounting values is also evident in correlation. While correlations are high within each group, correlations are low between the two groups. This confirms analyst forecasts have little commonality with historical values. Even for the same current EPS, EPS based on reported net income (i.e., EPS_COM) and adjusted EPS (i.e., EPS_IBES) have low correlation (0.396) indicating analyst adjustments have big impact on forecast values.

### *Theoretical Explanation of Valuation Models*

If the multiple is the current stock price estimation model as the theoretical reasoning suggests, I expect its estimate would follow the market price. On the other hand, if the DBVM is the intrinsic value estimation model, I expect its estimate has its own trend. Figure 1 and 2 describe the estimates of the multiples and DBVMs, respectively, along with S&P 500 index over time. To make the estimates comparable, they are indexed based on values in 1987. Figure 1 demonstrates multiples generally have common trends with the market index. Although there is discrepancy at the peak of the Technology Bubble in 1999, the estimates of multiples generally resemble the market movement. On the other hand, figure 2 indicates book value and the RIMs have different trends from the market index. Not only do they move independently from the market index, but also increase steadily over time. The graphic trends show the estimates of book value and the RIMs are less influenced by the extreme market movements or noise.

<Figure 1 & 2 Here>

Table 2 reports the results of the Engle-Granger cointegration test between the market index and the estimates. The Dickey-Fuller unit root tests show all estimates are I(1) and can be used in the Engle-Granger cointegration test. The Engle-Granger cointegration test indicates I cannot reject the null hypothesis that there is no cointegration for most of multiples based on mean. However, for multiples based on value-weighted mean, most estimates have cointegration with the market index. Considering S&P 500 is also a value-weighted portfolio, I believe the significant cointegration between the market index and the estimates of value-weighted multiples supports the hypothesis 1 that the estimates of multiples follow the market trend. In contrast, the cointegration tests fail to reject the null hypothesis for both book value and RIMs. Based on both graphic illustration and the cointegration test results, I support the hypothesis 2 that book value and RIMs do not follow the market index.

<Table 2 Here>

What is important to users of a valuation model is whether a model can identify when stock is over/under valued. Figure 3 and 4 report the estimate ratio, the ratio of estimate to price. If the ratio is high, a model indicates the intrinsic value is high relative to current price, implying buy recommendation. Figure 3 demonstrates the estimate ratios for multiples. Although they do not have clear trends, most multiples have their peaks around the peak of the Technology Bubble. This implies multiples give buy recommendations at the peak of the bubble, and sell recommendations as the price goes down. The estimate ratios for book value and RIMs are depicted in figure 4. Although they also have some common trends with the market, they correctly send buy signals when the market experienced its trough in 2002, send sell signals as price increases afterward, and identify when stock is undervalued again in 2008. The figures support the theoretical explanation that the DBVMs have potential to measure the intrinsic value of stock.

### ***Pricing Error***

Since the multiple is designed to estimate current stock price, I expect the multiple would have smaller pricing error than the DBVM. Panel A and B of table 3 report the absolute and pure pricing error, respectively. Consistent with Liu et al. (2002), the earnings forecast multiples perform best, followed by DBVMs, and multiples using historical values last. In terms of ranks in mean, standard deviation and an interquartile range, earnings forecast multiples generally outperform the DBVMs. Although RIM1 ranks first based on the pure mean error in panel B, I do not consider it notable because its median and standard deviation are still higher than those of forecast multiples. I suspect the small pure mean error of RIM1 is coincidental in the process of averaging highly dispersed pricing errors.

<Table 3 Here>

The results of the regression analysis in panel C support the results in panel A and B. Although all coefficients are significantly positive, the adjusted $R^2$ shows the earnings forecast multiples explain the movement of price better than the DBVMs.

An interesting result is not all multiples outperform the DBVMs. In fact, multiples using historical values underperform the DBVMs. I suspect this is due to low correlations of historical accounting values with price, combined with the high standard deviations of their estimates as demonstrated in table 1.

### *Fitted Value Error*

If the DBVM is to estimate the intrinsic value, I expect the DBVM would generate a closer estimate to the intrinsic value than the multiple. I use fitted value as the first alternative of the intrinsic value.

Panel A and B of table 4 report absolute and pure fitted value errors, respectively. A surprising result is ranks are similar to those in the pricing error. Absolute mean errors for EPS1, 2 and 3 are still smaller than those for book value and RIMs. Although the pure mean error for RIM1 is zero, I do not consider it noteworthy because of the same reason explained in the pricing error. One different result is book value and RIM2 rank first and second in terms of an interquartile range measure. This implies half of the sample clusters more closely to the mean error for book value and RIM2 than the multiples. Considering book value and RIM2 do not have the terminal value estimation, thereby bear inherent discrepancy between their estimates and prices, the narrow distribution around the mean indicates they produce more reliable estimates if investors know how to handle the discrepancy. Figure 5 illustrates the absolute fitted value errors over the period. Consistent with the analysis, book value and RIMs generate more stable errors, less influenced by the market conditions. However, their means are in general higher than those of the earnings forecast multiples.

<Table 4 & Figure 5 Here>

Panel C reports the result of the regression analysis. Consistent with the result in the pricing error, all coefficients are significantly positive. However, explanatory powers indicate earnings forecast multiples still explain the movement of fitted value better than the DBVMs.

### *Moving Average Value Error*

The second alternative of the intrinsic value is the moving average of monthly prices for the next five years. The moving average value errors in table 5 present similar results to those of the fitted value errors. Earnings forecast multiples rank high in terms of mean error, but book value and RIM2 rank high in an interquartile range. When absolute moving average value errors are displayed over time in figure 6, the DBVMs have more stable errors than the multiples but their means are higher than those of the earnings forecast multiples. Although book value and RIM2 generate smaller errors in an interquartile range, I believe this is not sufficient to accept the hypothesis 5 that the DBVM would have smaller moving average value error than the multiples.

<Table 5 & Figure 6 Here>

Regression results are reported in panel C of table 5. Although adjusted $R^2$ are similar across models, the coefficient of RIM2 is not significant and that of book value is significantly negative. On the contrary, the coefficients of earnings forecast multiples are significantly positive. This indicates earnings forecast multiples still better explain changes in moving average value than the DBVMs.

### *Future Return Generation*

Return generation indirectly measures the intrinsic value by making use of discrepancy between the intrinsic value and price. Table 6 reports the future returns of the decile portfolio (i.e., buying most undervalued top decile stock and short-selling most overvalued bottom decile stock). Panel A, B and C represent one-, two- and five-year buy-and-hold returns over time, respectively. Total returns reported at the bottom row of each panel do not support the hypothesis 6 that the DBVMs would have higher returns than the multiples. In fact, the DBVMs rank in the middle. An interesting observation is P/EPS3, which ranks first in terms of all three error measures, does not rank first anymore. The fact that P/CFO ranks first in return generation indicates the superiority in estimating price and intrinsic value does not necessarily extend to the superiority in return generation. The last column of each panel reports the t-test results for the mean difference between RIM1 and P/EPS3. I choose RIM1 as a representative DBVM because it is a complete RIM with the terminal value estimation. P/EPS3 is chosen because it performs best in all error measures. The outperformance of RIM1 over P/EPS3 during the Technology Bubble in 1999 partially supports the hypothesis 6 that the DBVM would generate higher return during boom and bust periods. However, I believe this outperformance is not sufficient to support the hypothesis 6 because RIM1 does not outperform P/EPS3 in another boom and bust period (e.g., the Credit Bubble in 2008).

<Table 6 Here>

Table 7 reports the regression results of stock return on the estimate ratio. While table 6 illustrates the returns of the decile portfolio, which is more applicable but utilizes only 20% of the sample data, the regression analysis identifies overall relationship between returns and estimates. Panel A and B use one- and five-year SAR as a dependent variable, respectively. In panel A, the ratios using book value and RIM2 do not have significant relationship with the SAR. In addition, the ratio using RIM1 has significantly negative relationship. When five-year SAR is used in panel B, the ratios using book value and the RIM2 have significantly positive relationship. However, the RIM1 still has no relationship with the SAR. This result is in contrast to the hypothesis 6 that the DBVM would have better return generation ability than the multiple.

<Table 7 Here>

Panel C and D report the results of a more conventional regression model. Instead of calculating the SAR, it uses simple stock return as a dependent variable and the estimate ratio and market capitalization as independent variables. The results in panel C and D are similar to those in panel A and B. When one-year stock return is used (panel C), the estimate ratios of all multiples have significantly positive relationship with stock return. However, no DBVMs display significant relationship. When five-year stock return is used (panel D), all models have significantly positive relationships, but with RIM1 the least.

## VI. Discussion

In summary, I have found evidence to support our theoretical reasoning in terms of the trends of estimates over time and the pricing error. However, I could not find evidence in the fitted value error, moving average value error and future return generation.

Why do the DBVMs underperform earnings forecast multiples in the measures of the intrinsic value? I suspect this can be due to two reasons. First, the measures of the intrinsic value are derived from price. Therefore, the more an accounting value is correlated with price, the more likely its model will perform well in an intrinsic value measure regardless of theoretical reasoning. Panel C of table 1 illustrates the correlation coefficients between price and accounting values. Historical accounting values have low correlations while forecast accounting values have high correlations, leaving the DBVMs in the middle. This sequence is consistent with the ranks observed in the three measures of the intrinsic value.

The other reason is due to the wider distribution of DBVMs' estimates than the multiples'. Table 8 illustrates the adjusted standard deviation, calculated as standard deviation divided by mean, indicating the size of standard deviation for each unit of estimates. The table shows the DBVMs have higher adjusted standard deviations than the multiples, implying the estimates of the DBVMs are more dispersed than those of the multiples. More dispersed estimates reduce the accuracy of models, their explanatory power and the significance of coefficients in regression.

<Table 8 Here>

## VII. Conclusion

The theoretical reasoning suggests the DBVM is designed to measure the intrinsic value, while the multiple is to measure current stock price. Although the trends of estimates over time and the pricing error results support our reasoning, I could not find enough evidence when three alternative measures of the intrinsic value are used. This result is surprising considering the motivation of this paper is to prove how good the DBVMs are at estimating the intrinsic value. Our conclusion is, although the DBVMs have potential to measure the intrinsic value, this potential is overwhelmed by the lower correlation with price and higher dispersion of their estimates than the forecast multiples'.

This paper contributes by identifying the difference between the DBVM and multiple in terms of what value they measure. Until now, it is believed that both models measure the same intrinsic value. By identifying the difference, this paper addresses the unresolved question of how earnings forecast multiples outperform the DBVMs in the pricing error. In addition, the paper first introduces alternative measures of the intrinsic value in model performance literature. Finally, this paper demonstrates contrast between the theoretical value and empirical results of the DBVM.

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## Table 1
## Descriptive Statistics

Details of accounting values are as follows: P is stock price; BV is book value; CFO is operating cash flow; EBITDA is earnings before interest, tax, depreciation and amortization; SALES is sales; EPS_COM is reported earnings divided by the number of shares outstanding; EPS_IBES is current I/B/E/S EPS obtained from I/B/E/S Actuals file; EPS1 is one-year ahead analyst forecast; EPS2 is two-year ahead analyst forecast; EPS3 is three-year ahead analyst forecast calculated as $EPS3 = EPS2 \times (1 + g)$, where $g$ is long term growth rate; EG is earnings times growth (i.e., $EG = EPS2 \times g$); $EA$ is earnings; and $r$ is the cost of equity. All values are on a per-share basis. Sample covers 4,815 US firms with 26,340 firm-year observations from 1987 to 2010.
Panel A and B describe the descriptive statistics of the multiples. Panel C describes correlation coefficients. Pearson correlations are described under the diagonal and Spearman correlations are described above the diagonal.

$$RIM_1 = BV_t + \sum_{s=1}^{s=5}\left[\frac{E_t(EA_{t+s} - r_t BV_{t+s-1})}{(1+r_t)^s}\right] + \frac{E_t(EA_{t+5} - r_t BV_{t+4})}{r_t(1+r_t)^5}, \qquad RIM_2 = BV_t + \sum_{s=1}^{s=5}\left[\frac{E_t(EA_{t+s} - r_t BV_{t+s-1})}{(1+r_t)^s}\right]$$

Panel A

| | Mean | Median | SD | Min | 5% | 95% | Max |
|---|---|---|---|---|---|---|---|
| BV/P | 0.560 | 0.425 | 0.695 | 0.047 | 0.127 | 1.219 | 12.577 |
| CFO/P | 0.132 | 0.089 | 0.199 | 0.005 | 0.023 | 0.330 | 3.815 |
| EBITDA/P | 0.178 | 0.130 | 0.245 | 0.015 | 0.042 | 0.400 | 4.555 |
| SALES/P | 1.255 | 0.772 | 1.713 | 0.071 | 0.174 | 3.947 | 26.374 |
| EPS_COM/P | 0.072 | 0.054 | 0.104 | 0.003 | 0.016 | 0.148 | 1.819 |
| EPS_IBES/P | 0.058 | 0.054 | 0.029 | 0.006 | 0.021 | 0.113 | 0.197 |
| EPS1/P | 0.065 | 0.061 | 0.027 | 0.011 | 0.028 | 0.116 | 0.183 |
| EPS2/P | 0.077 | 0.072 | 0.029 | 0.020 | 0.038 | 0.132 | 0.207 |
| EPS3/P | 0.088 | 0.082 | 0.032 | 0.026 | 0.046 | 0.151 | 0.238 |
| EG/P | 0.011 | 0.010 | 0.006 | 0.002 | 0.004 | 0.023 | 0.044 |
| RIM1/P | 0.931 | 0.803 | 0.529 | 0.169 | 0.331 | 1.967 | 3.867 |
| RIM2/P | 0.635 | 0.546 | 0.478 | 0.139 | 0.245 | 1.210 | 8.559 |

Panel B

| | Mean | Median | SD | Min | 5% | 95% | Max |
|---|---|---|---|---|---|---|---|
| P/BV | 3.092 | 2.353 | 2.511 | 0.080 | 0.820 | 7.888 | 21.093 |
| P/CFO | 15.857 | 11.196 | 17.833 | 0.262 | 3.026 | 42.680 | 197.635 |
| P/EBITDA | 9.727 | 7.704 | 7.482 | 0.220 | 2.497 | 23.994 | 67.025 |
| P/SALES | 1.924 | 1.296 | 1.890 | 0.038 | 0.253 | 5.746 | 14.017 |
| P/EPS_COM | 24.913 | 18.632 | 24.652 | 0.550 | 6.736 | 60.830 | 306.994 |
| P/EPS_IBES | 22.331 | 18.574 | 14.761 | 5.078 | 8.850 | 48.609 | 162.500 |
| P/EPS1 | 18.397 | 16.324 | 8.875 | 5.450 | 8.656 | 35.259 | 87.645 |
| P/EPS2 | 14.980 | 13.846 | 5.910 | 4.829 | 7.580 | 26.374 | 49.327 |
| P/EPS3 | 12.887 | 12.144 | 4.753 | 4.205 | 6.623 | 21.969 | 38.852 |
| P/EG | 112.967 | 98.245 | 64.783 | 22.817 | 43.175 | 240.417 | 501.074 |
| P/RIM1 | 1.426 | 1.245 | 0.810 | 0.259 | 0.508 | 3.023 | 5.900 |
| P/RIM2 | 2.054 | 1.830 | 1.025 | 0.117 | 0.827 | 4.076 | 7.208 |

Panel C

| | P | BV | CFO | EBITDA | SALES | EPS_ COM | EPS_ IBES | EPS1 | EPS2 | EPS3 | EG | RIM1 | RIM2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P | | 0.619 | 0.642 | 0.678 | 0.478 | 0.714 | 0.789 | 0.834 | 0.854 | 0.862 | 0.734 | 0.778 | 0.776 |
| BV | 0.323 | | 0.744 | 0.794 | 0.674 | 0.720 | 0.712 | 0.711 | 0.720 | 0.702 | 0.438 | 0.638 | 0.920 |
| CFO | 0.326 | 0.853 | | 0.865 | 0.669 | 0.761 | 0.749 | 0.740 | 0.738 | 0.718 | 0.439 | 0.646 | 0.799 |
| EBITDA | 0.319 | 0.890 | 0.921 | | 0.777 | 0.844 | 0.836 | 0.824 | 0.818 | 0.797 | 0.488 | 0.704 | 0.863 |
| SALES | 0.279 | 0.772 | 0.724 | 0.767 | | 0.626 | 0.621 | 0.627 | 0.632 | 0.613 | 0.380 | 0.528 | 0.689 |
| EPS_COM | 0.336 | 0.851 | 0.865 | 0.918 | 0.690 | | 0.882 | 0.845 | 0.832 | 0.818 | 0.563 | 0.710 | 0.824 |
| EPS_IBES | 0.756 | 0.353 | 0.373 | 0.367 | 0.333 | 0.396 | | 0.947 | 0.937 | 0.922 | 0.638 | 0.796 | 0.851 |
| EPS1 | 0.812 | 0.362 | 0.380 | 0.374 | 0.348 | 0.393 | 0.942 | | 0.985 | 0.976 | 0.713 | 0.832 | 0.872 |
| EPS2 | 0.836 | 0.368 | 0.380 | 0.370 | 0.352 | 0.386 | 0.928 | 0.984 | | 0.996 | 0.759 | 0.844 | 0.881 |
| EPS3 | 0.844 | 0.359 | 0.372 | 0.362 | 0.345 | 0.378 | 0.913 | 0.975 | 0.996 | | 0.808 | 0.844 | 0.869 |
| EG | 0.716 | 0.224 | 0.239 | 0.223 | 0.216 | 0.247 | 0.616 | 0.708 | 0.756 | 0.809 | | 0.662 | 0.602 |
| RIM1 | 0.728 | 0.305 | 0.304 | 0.297 | 0.273 | 0.311 | 0.741 | 0.781 | 0.796 | 0.796 | 0.628 | | 0.862 |
| RIM2 | 0.521 | 0.953 | 0.830 | 0.866 | 0.744 | 0.840 | 0.565 | 0.585 | 0.593 | 0.584 | 0.397 | 0.552 | |

**Figure 1. Estimates of the Multiples**: The figure demonstrates the estimates of the multiples from 1987 to 2010 along the market index, S&P 500. The estimates and S&P 500 are indexed based on values in 1987. The left-hand side axis represents the indexed estimates, and the right-hand side axis represents the indexed S&P 500.

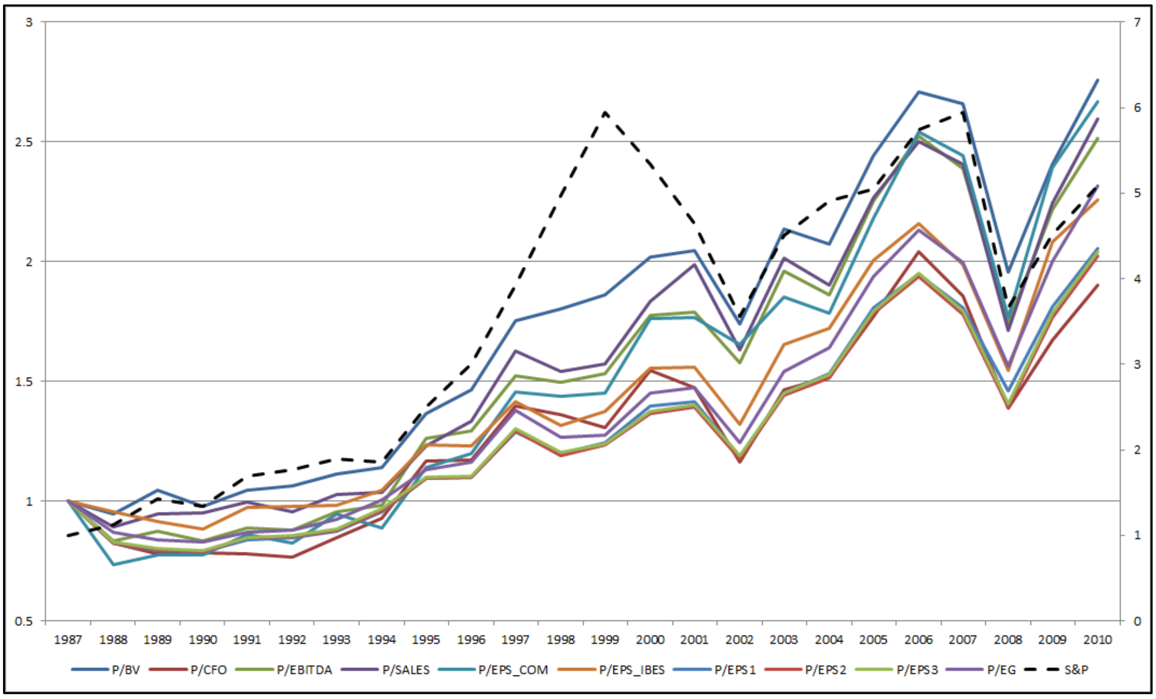



**Figure 2. Estimates of the DBVMs**: The figure demonstrates the estimates of the DBVMs from 1987 to 2010 along the market index, S&P 500. The estimates and S&P 500 are indexed based on values in 1987. The left-hand side axis represents the indexed estimates, and the right-hand side axis represents the indexed S&P 500.

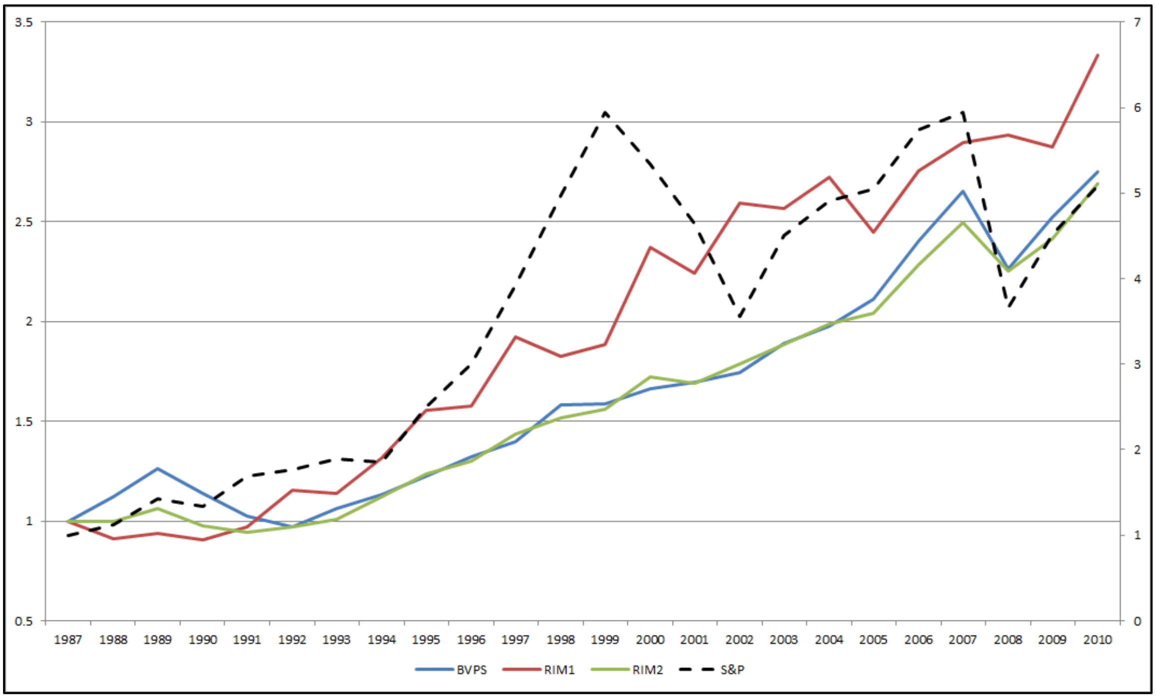


**Table 2**
**Cointegration Test**

Details of accounting values are explained in Table 1. The Dickey-Fuller unit root test and Adjusted Dickey-Fuller unit root test are used to determine the degree of integration in column three through five. The Engle-Granger cointegration tests are used to identify the common trend between S&P 500 and the estimates of models. Critical values for the (Adjusted) Dickey-Fuller unit root tests are -2.630, -3.000 and -3.750 for 10%, 5% and 1% significance level, respectively. Critical values for the Engle-Granger cointegration tests are -2.639, -2.998 and -3.753 for 10%, 5% and 1% significance level, respectively. *, ** and *** represent significance at 10%, 5% and 1%, respectively.

| | | Dickey-Fuller Unit Root Test | ADF(1) Unit Root Test | DF Unit Root Test for First Difference | Engle-Granger Cointegration Test w/o Trend | Engle-Granger Cointegration Test with Trend |
|---|---|---|---|---|---|---|
| | S&P 500 | -1.445 | -1.527 | -4.288 | | |
| Multiples Based on Mean | P/BV | -0.596 | -0.552 | -5.372 | -1.514 | -1.808 |
| | P/CFO | -0.811 | -0.957 | -4.689 | -2.670* | -2.206 |
| | P/EBITDA | -0.487 | -0.469 | -5.438 | -1.893 | -1.767 |
| | P/SALES | -0.637 | -0.501 | -5.704 | -1.859 | -1.715 |
| | P/EPS_COM | -0.254 | -0.223 | -5.546 | -1.883 | -1.677 |
| | P/EPS_IBES | -0.446 | -0.277 | -5.365 | -1.637 | -1.549 |
| | P/EPS1 | -0.134 | -0.288 | -4.687 | -1.874 | -1.669 |
| | P/EPS2 | -0.266 | -0.401 | -4.719 | -1.880 | -1.627 |
| | P/EPS3 | -0.253 | -0.389 | -4.698 | -1.860 | -1.626 |
| | P/EG | -0.034 | -0.138 | -4.579 | -1.597 | -1.662 |
| Multiples Based on Value-Weighted Mean | P/BV | -1.179 | -1.356 | -4.232 | -3.333** | -3.337* |
| | P/CFO | -0.909 | -1.119 | -5.039 | -3.687** | -3.727** |
| | P/EBITDA | -0.893 | -1.018 | -5.255 | -3.159** | -3.833** |
| | P/SALES | -0.924 | -0.932 | -5.901 | -2.780* | -3.332* |
| | P/EPS_COM | -0.676 | -0.814 | -5.931 | -3.494** | -3.108 |
| | P/EPS_IBES | -0.831 | -0.923 | -5.138 | -2.638 | -3.040 |
| | P/EPS1 | -0.491 | -1.056 | -3.915 | -3.253** | -4.006** |
| | P/EPS2 | -0.712 | -1.130 | -4.260 | -3.308** | -3.610* |
| | P/EPS3 | -0.702 | -1.116 | -4.219 | -3.292** | -3.599* |
| | P/EG | -0.561 | -0.847 | -4.117 | -2.389 | -2.707 |
| Discount Based Valuation Models | BVPS | 0.496 | 0.733 | -4.801 | -1.369 | -2.093 |
| | RIM1 | 0.151 | 0.291 | -7.590 | -2.458 | -2.176 |
| | RIM2 | 1.104 | 1.119 | -4.611 | -1.610 | -2.010 |

**Figure 3. Estimate Ratios of The Multiples:** The figure demonstrates the estimate ratios of the multiples along the market index. The estimate ratio is calculated as the estimate of a model divided by price. The estimate ratios and S&P 500 are indexed based on values in 1987. The higher the estimate ratios, the higher the estimates relative to price, implying stock is more undervalued.

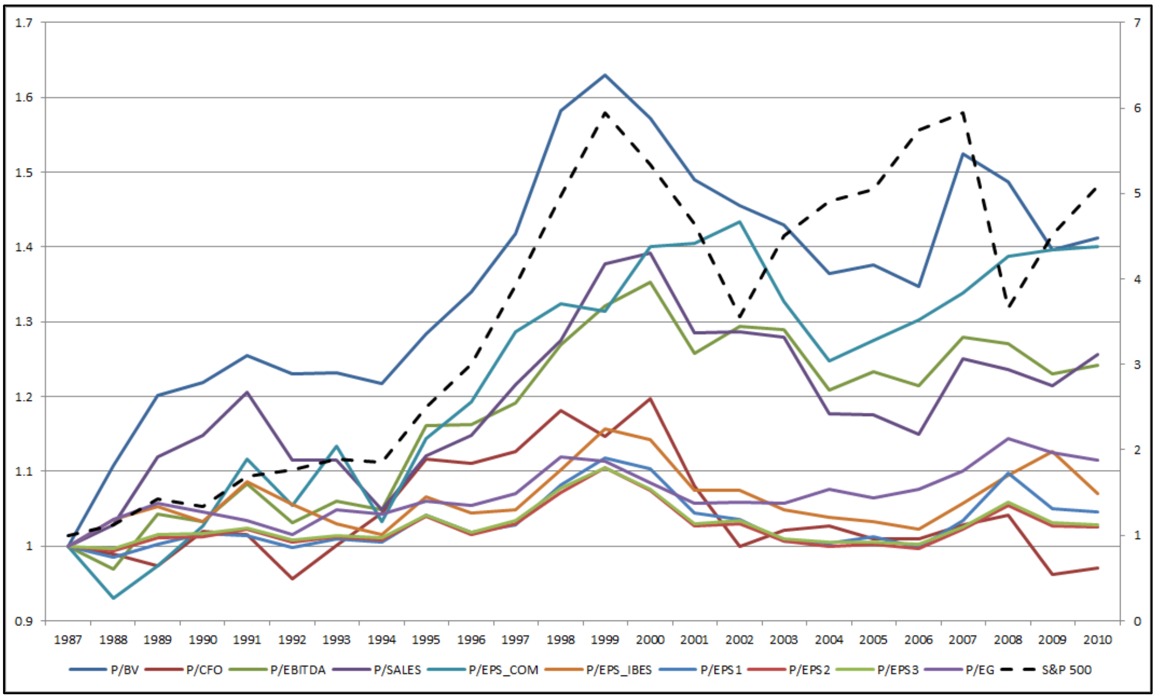



**Figure 4. Estimate Ratios of The DBVMs:** The figure demonstrates the estimate ratios of the DBVMs along the market index. The estimate ratio is calculated as the estimate of a model divided by price. The estimate ratios and S&P 500 are indexed based on values in 1987. The higher the estimate ratios, the higher the estimates relative to price, implying stock is more undervalued.

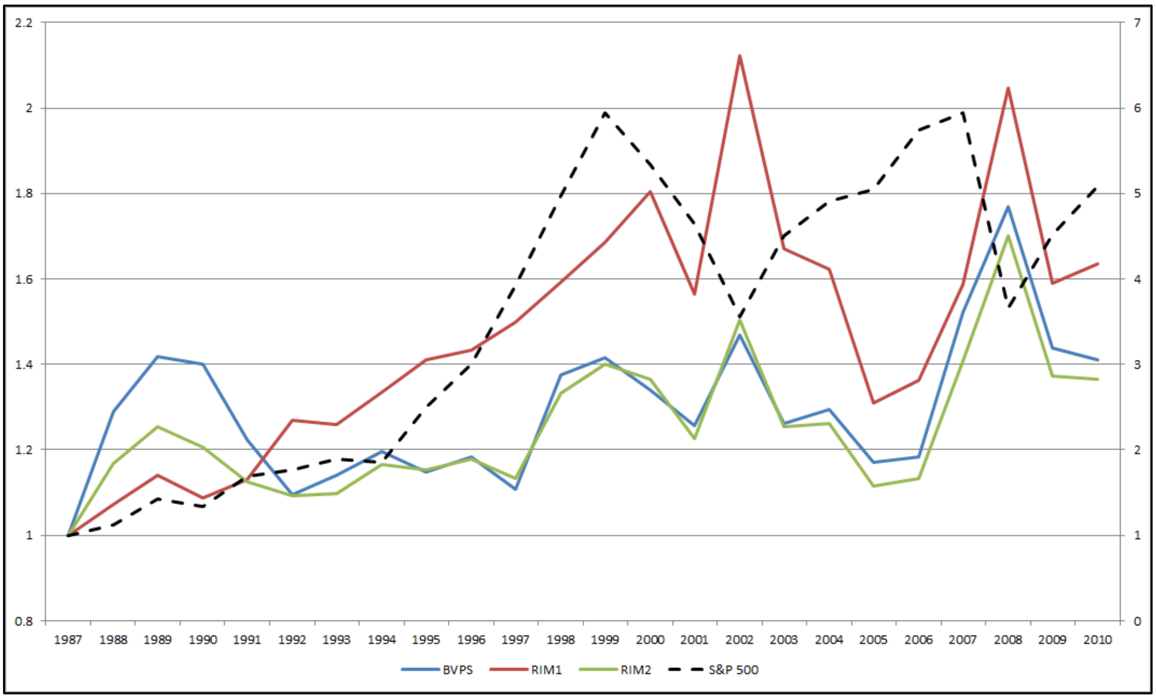


**Table 3**
**Pricing Error**

Details of accounting values are explained in Table 1. Panel A and B demonstrate absolute and pure pricing errors, respectively. Pricing error is calculated as $Pricing\ Error_{it} = (P_{it} - Estimate_{it})/P_{it}$. Interquartile represents the difference of the pricing errors between 75th percentile and 25th percentile. Panel C reports the results of regression analysis. The regression model is,

$$\Delta P_{it} = \alpha + \beta \Delta Estimate_{it} + \gamma Market\ Cap_{it} + \sum_{t=1988}^{t=2010} \delta_{t-1987} Year_t + \varepsilon$$

*, ** and *** represent significance at 10%, 5% and 1%, respectively.

Panel A: Absolute Pricing Error

| | Mean | Median | SD | Interquartile | Rank (Mean) | Rank (SD) | Rank (Interquartile) |
|---|---|---|---|---|---|---|---|
| P/BV | 0.879 | 0.420 | 2.131 | 0.610 | 10 | 9 | 11 |
| P/CFO | 1.110 | 0.478 | 2.844 | 0.753 | 12 | 12 | 12 |
| P/EBITDA | 0.807 | 0.353 | 2.299 | 0.507 | 9 | 10 | 9 |
| P/SALES | 1.338 | 0.519 | 3.207 | 0.890 | 13 | 13 | 13 |
| P/EPS_COM | 0.915 | 0.399 | 2.774 | 0.595 | 11 | 11 | 10 |
| P/EPS_IBES | 0.438 | 0.304 | 0.468 | 0.429 | 6 | 6 | 8 |
| P/EPS1 | 0.330 | 0.237 | 0.332 | 0.326 | 3 | 3 | 4 |
| P/EPS2 | 0.285 | 0.205 | 0.286 | 0.285 | 2 | 2 | 2 |
| P/EPS3 | 0.274 | 0.196 | 0.277 | 0.273 | 1 | 1 | 1 |
| P/EG | 0.395 | 0.257 | 0.474 | 0.357 | 4 | 7 | 6 |
| BVPS | 0.608 | 0.596 | 0.555 | 0.349 | 8 | 8 | 5 |
| RIM1 | 0.409 | 0.351 | 0.344 | 0.363 | 5 | 4 | 7 |
| RIM2 | 0.477 | 0.471 | 0.366 | 0.322 | 7 | 5 | 3 |

Panel B: Pure Pricing Error

| | Mean | Median | SD | Interquartile | Rank (Mean) | Rank (SD) | Rank (Interquartile) |
|---|---|---|---|---|---|---|---|
| P/BV | -0.636 | -0.189 | 2.215 | 0.983 | 10 | 9 | 11 |
| P/CFO | -0.872 | -0.267 | 2.925 | 1.140 | 12 | 12 | 12 |
| P/EBITDA | -0.575 | -0.135 | 2.367 | 0.811 | 9 | 10 | 9 |
| P/SALES | -1.070 | -0.259 | 3.306 | 1.355 | 13 | 13 | 13 |
| P/EPS_COM | -0.697 | -0.211 | 2.836 | 0.871 | 11 | 11 | 10 |
| P/EPS_IBES | -0.239 | -0.137 | 0.595 | 0.635 | 6 | 7 | 8 |
| P/EPS1 | -0.146 | -0.081 | 0.445 | 0.491 | 4 | 3 | 5 |
| P/EPS2 | -0.113 | -0.051 | 0.388 | 0.431 | 3 | 2 | 4 |
| P/EPS3 | -0.105 | -0.042 | 0.375 | 0.415 | 2 | 1 | 3 |
| P/EG | -0.193 | -0.062 | 0.586 | 0.569 | 5 | 6 | 6 |
| BVPS | 0.440 | 0.575 | 0.695 | 0.376 | 8 | 8 | 2 |
| RIM1 | 0.069 | 0.197 | 0.529 | 0.576 | 1 | 5 | 7 |
| RIM2 | 0.365 | 0.454 | 0.478 | 0.348 | 7 | 4 | 1 |

Panel C: Regression of Δ Price on Δ Estimate

| | Intercept | Δ Estimate | Adj. $R^2$ |
|---|---|---|---|
| P/BV | 1.747<br>(1.244) | 0.024 ***<br>(0.003) | 0.192 |
| P/CFO | 1.785<br>(1.245) | 0.008 ***<br>(0.001) | 0.191 |
| P/EBITDA | 1.741<br>(1.242) | 0.023 ***<br>(0.002) | 0.194 |
| P/SALES | 1.730<br>(1.245) | 0.012 ***<br>(0.002) | 0.191 |
| P/EPS_COM | 1.773<br>(1.242) | 0.012 ***<br>(0.001) | 0.194 |
| P/EPS_IBES | 1.173<br>(1.207) | 0.163 ***<br>(0.005) | 0.239 |
| P/EPS1 | 1.333<br>(1.100) | 0.411 ***<br>(0.006) | 0.368 |
| P/EPS2 | 1.137<br>(1.033) | 0.589 ***<br>(0.006) | 0.443 |
| P/EPS3 | 1.127<br>(1.023) | 0.597 ***<br>(0.006) | 0.454 |
| P/EG | 1.441<br>(1.116) | 0.269 ***<br>(0.004) | 0.350 |
| BVPS | 1.732<br>(1.245) | 0.091 ***<br>(0.013) | 0.191 |
| RIM1 | 1.584<br>(1.172) | 0.275 ***<br>(0.006) | 0.283 |
| RIM2 | 1.370<br>(1.195) | 0.581 ***<br>(0.015) | 0.254 |

**Table 4**
**Fitted Value Error**

Details of accounting values are explained in Table 1. Panel A and B demonstrate absolute and pure fitted value errors, respectively. Fitted value is the predicted value of the regression of price on a time variable, $E(P_{it}) = \alpha + \beta T_i$, where $T_i$ is a monthly time variable. Specifically, $T_i$ = 1 for the earliest price observation of company $i$, $T_i$ = 2 for the second observation, and so on. Fitted value error is $Fitted\,Value\,Error_{it} = (Fitted\,Value_{it} - Estimate_{it})/Fitted\,Value_{it}$. Panel C reports the results of regression analysis. The regression model is,

$$\Delta Fitted\,Value_{it} = \alpha + \beta\Delta Estimate_{it} + \gamma Market\,Cap_{it} + \sum_{t=1988}^{t=2010}\delta_{t-1987}Year_t + \varepsilon$$

*, ** and *** represent significance at 10%, 5% and 1%, respectively.

Panel A: Absolute Fitted Value Error

| | Mean | Median | SD | Interquartile | Rank (Mean) | Rank (SD) | Rank (Interquartile) |
|---|---|---|---|---|---|---|---|
| P/BV | 0.957 | 0.440 | 6.127 | 0.642 | 10 | 13 | 10 |
| P/CFO | 1.191 | 0.502 | 4.257 | 0.783 | 12 | 11 | 12 |
| P/EBITDA | 0.888 | 0.383 | 3.277 | 0.551 | 9 | 9 | 9 |
| P/SALES | 1.381 | 0.531 | 3.768 | 0.920 | 13 | 10 | 13 |
| P/EPS_COM | 1.054 | 0.455 | 4.676 | 0.653 | 11 | 12 | 11 |
| P/EPS_IBES | 0.543 | 0.359 | 1.291 | 0.493 | 6 | 1 | 8 |
| P/EPS1 | 0.460 | 0.309 | 1.363 | 0.411 | 3 | 2 | 6 |
| P/EPS2 | 0.422 | 0.279 | 1.396 | 0.374 | 2 | 3 | 4 |
| P/EPS3 | 0.419 | 0.274 | 1.468 | 0.367 | 1 | 4 | 3 |
| P/EG | 0.576 | 0.339 | 2.255 | 0.453 | 7 | 8 | 7 |
| BVPS | 0.622 | 0.586 | 2.041 | 0.354 | 8 | 7 | 2 |
| RIM1 | 0.486 | 0.379 | 1.565 | 0.410 | 4 | 5 | 5 |
| RIM2 | 0.495 | 0.462 | 1.755 | 0.346 | 5 | 6 | 1 |

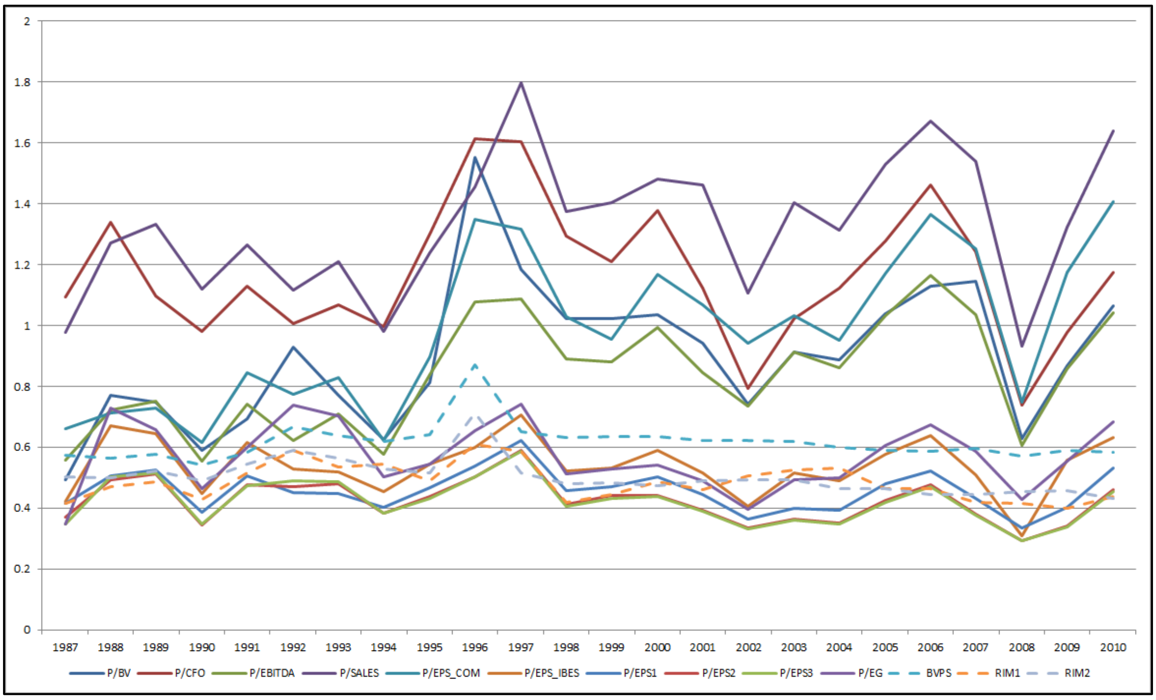
Panel B: Pure Fitted Value Error

| | Mean | Median | SD | Interquartile | Rank (Mean) | Rank (SD) | Rank (Interquartile) |
|---|---|---|---|---|---|---|---|
| P/BV | -0.709 | -0.214 | 6.161 | 1.027 | 10 | 13 | 11 |
| P/CFO | -0.945 | -0.282 | 4.319 | 1.185 | 12 | 11 | 12 |
| P/EBITDA | -0.642 | -0.152 | 3.334 | 0.886 | 9 | 9 | 9 |
| P/SALES | -1.112 | -0.275 | 3.856 | 1.385 | 13 | 10 | 13 |
| P/EPS_COM | -0.810 | -0.239 | 4.724 | 0.992 | 11 | 12 | 10 |
| P/EPS_IBES | -0.312 | -0.152 | 1.365 | 0.750 | 5 | 1 | 7 |
| P/EPS1 | -0.227 | -0.094 | 1.421 | 0.647 | 4 | 2 | 5 |
| P/EPS2 | -0.194 | -0.059 | 1.445 | 0.589 | 3 | 3 | 4 |
| P/EPS3 | -0.190 | -0.051 | 1.515 | 0.580 | 2 | 4 | 3 |
| P/EG | -0.314 | -0.073 | 2.306 | 0.759 | 6 | 8 | 8 |
| BVPS | 0.421 | 0.568 | 2.092 | 0.374 | 8 | 7 | 1 |
| RIM1 | 0.000 | 0.171 | 1.639 | 0.662 | 1 | 5 | 6 |
| RIM2 | 0.332 | 0.441 | 1.793 | 0.376 | 7 | 6 | 2 |

Panel C: Regression of Δ Fitted Value on Δ Estimate

| | Intercept | Δ Estimate | Adj. $R^2$ |
|---|---|---|---|
| P/BV | 1.255 *** | 0.003 *** | 0.014 |
| | (0.268) | (0.001) | |
| P/CFO | 1.260 *** | 0.001 *** | 0.013 |
| | (0.268) | (0.000) | |
| P/EBITDA | 1.254 *** | 0.003 *** | 0.014 |
| | (0.267) | (0.000) | |
| P/SALES | 1.255 *** | 0.001 *** | 0.012 |
| | (0.268) | (0.000) | |
| P/EPS_COM | 1.259 *** | 0.001 *** | 0.014 |
| | (0.268) | (0.000) | |
| P/EPS_IBES | 1.206 *** | 0.015 *** | 0.023 |
| | (0.266) | (0.001) | |
| P/EPS1 | 1.230 *** | 0.029 *** | 0.036 |
| | (0.265) | (0.001) | |
| P/EPS2 | 1.218 *** | 0.040 *** | 0.043 |
| | (0.263) | (0.002) | |
| P/EPS3 | 1.218 *** | 0.040 *** | 0.044 |
| | (0.263) | (0.002) | |
| P/EG | 1.241 *** | 0.016 *** | 0.028 |
| | (0.266) | (0.001) | |
| BVPS | 1.243 *** | 0.024 *** | 0.016 |
| | (0.267) | (0.003) | |
| RIM1 | 1.246 *** | 0.021 *** | 0.027 |
| | (0.266) | (0.001) | |
| RIM2 | 1.218 *** | 0.060 *** | 0.031 |
| | (0.265) | (0.003) | |

**Figure 5. Absolute Fitted Value Errors:** The figure demonstrates absolute fitted value errors over time.



## Table 5
## Moving Average Value Error

Details of accounting values are explained in Table 1. Panel A and B demonstrate absolute and pure moving average value errors, respectively. Moving average value is the moving average of monthly prices for the next five years, $Moving\ Average\ Value_{it} = {}^{1}/_{N}\left(\sum_{n=1}^{n=60} P_{i,t+n}\right)$. Moving average value error is $Moving\ Average\ Value\ Error_{it} = (Moving\ Average\ Value_{it} - Estimate_{it})/Moving\ Average\ Value_{it}$. Panel C reports the results of regression analysis. *, ** and *** represent significance at 10%, 5% and 1%, respectively. The regression model is,

$$\Delta Moving\ Average\ Value_{it} = \alpha + \beta \Delta Estimate_{it} + \gamma Market\ Cap_{it} + \sum_{t=1988}^{t=2010} \delta_{t-1987} Year_t + \varepsilon$$

Panel A: Absolute Moving Average Value Error

| | Mean | Median | SD | Interquartile | Rank (Mean) | Rank (SD) | Rank (Interquartile) |
|---|---|---|---|---|---|---|---|
| P/BV | 0.972 | 0.461 | 2.320 | 0.602 | 10 | 9 | 11 |
| P/CFO | 1.156 | 0.495 | 3.009 | 0.691 | 12 | 12 | 12 |
| P/EBITDA | 0.895 | 0.409 | 2.413 | 0.532 | 9 | 10 | 9 |
| P/SALES | 1.359 | 0.544 | 3.383 | 0.783 | 13 | 13 | 13 |
| P/EPS_COM | 0.996 | 0.442 | 2.960 | 0.590 | 11 | 11 | 10 |
| P/EPS_IBES | 0.552 | 0.371 | 0.714 | 0.473 | 6 | 7 | 8 |
| P/EPS1 | 0.477 | 0.336 | 0.575 | 0.416 | 3 | 5 | 5 |
| P/EPS2 | 0.454 | 0.323 | 0.538 | 0.395 | 2 | 3 | 4 |
| P/EPS3 | 0.451 | 0.323 | 0.536 | 0.389 | 1 | 2 | 3 |
| P/EG | 0.560 | 0.368 | 0.777 | 0.422 | 7 | 8 | 7 |
| BVPS | 0.659 | 0.650 | 0.648 | 0.358 | 8 | 6 | 1 |
| RIM1 | 0.515 | 0.437 | 0.540 | 0.421 | 4 | 4 | 6 |
| RIM2 | 0.547 | 0.542 | 0.434 | 0.360 | 5 | 1 | 2 |

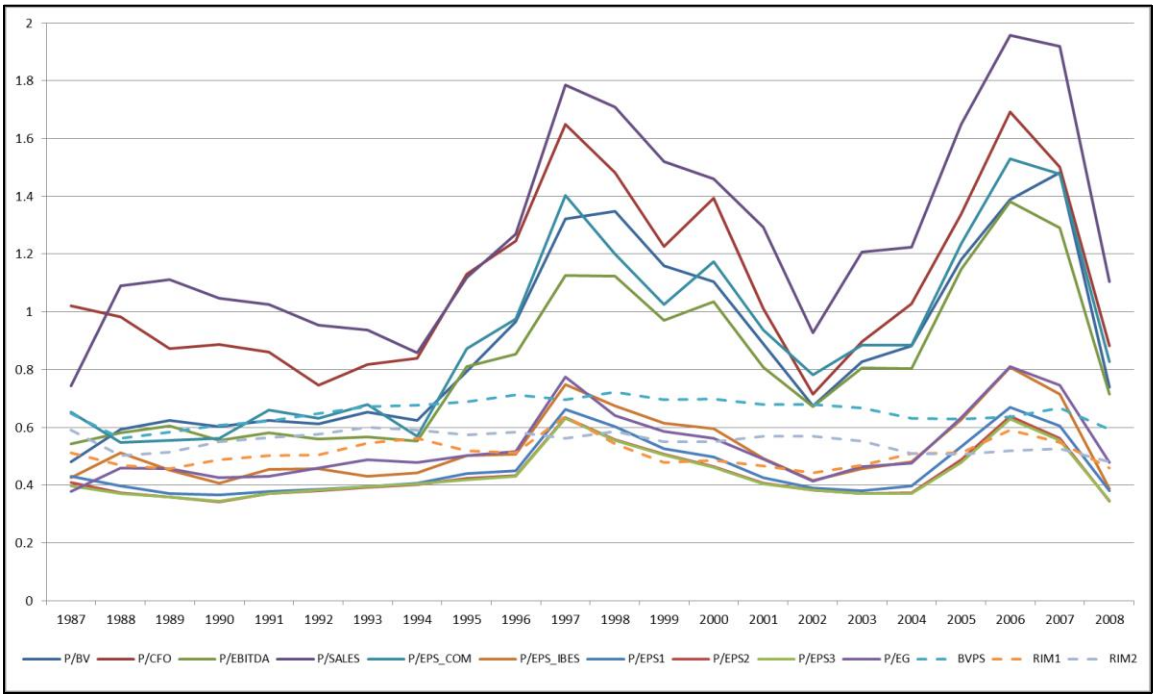
Panel B: Pure Moving Average Value Error

| | Mean | Median | SD | Interquartile | Rank (Mean) | Rank (SD) | Rank (Interquartile) |
|---|---|---|---|---|---|---|---|
| P/BV | -0.610 | -0.049 | 2.440 | 1.096 | 10 | 9 | 11 |
| P/CFO | -0.824 | -0.142 | 3.116 | 1.212 | 12 | 12 | 12 |
| P/EBITDA | -0.539 | -0.008 | 2.517 | 0.918 | 9 | 10 | 9 |
| P/SALES | -0.997 | -0.135 | 3.507 | 1.398 | 13 | 13 | 13 |
| P/EPS_COM | -0.664 | -0.092 | 3.051 | 1.000 | 11 | 11 | 10 |
| P/EPS_IBES | -0.214 | -0.011 | 0.877 | 0.787 | 6 | 7 | 8 |
| P/EPS1 | -0.127 | 0.042 | 0.736 | 0.683 | 4 | 4 | 6 |
| P/EPS2 | -0.098 | 0.067 | 0.697 | 0.641 | 3 | 3 | 4 |
| P/EPS3 | -0.092 | 0.074 | 0.695 | 0.632 | 2 | 2 | 3 |
| P/EG | -0.185 | 0.074 | 0.940 | 0.760 | 5 | 8 | 7 |
| BVPS | 0.453 | 0.625 | 0.806 | 0.396 | 8 | 6 | 1 |
| RIM1 | 0.090 | 0.278 | 0.741 | 0.661 | 1 | 5 | 5 |
| RIM2 | 0.380 | 0.514 | 0.586 | 0.410 | 7 | 1 | 2 |

Panel C: Regression of Δ Moving Average Value on Δ Estimate

| | Intercept | Δ Estimate | Adj. $R^2$ |
|---|---|---|---|
| P/BV | 0.727 *** | -0.002 | 0.094 |
| | (0.163) | (0.001) | |
| P/CFO | 0.726 *** | 0.001 | 0.094 |
| | (0.163) | (0.000) | |
| P/EBITDA | 0.724 *** | 0.002 ** | 0.094 |
| | (0.163) | (0.001) | |
| P/SALES | 0.726 *** | 0.000 | 0.093 |
| | (0.163) | (0.001) | |
| P/EPS_COM | 0.725 *** | 0.001 | 0.094 |
| | (0.163) | (0.000) | |
| P/EPS_IBES | 0.723 *** | 0.005 ** | 0.094 |
| | (0.163) | (0.002) | |
| P/EPS1 | 0.721 *** | 0.016 *** | 0.095 |
| | (0.163) | (0.003) | |
| P/EPS2 | 0.718 *** | 0.017 *** | 0.095 |
| | (0.163) | (0.004) | |
| P/EPS3 | 0.719 *** | 0.018 *** | 0.095 |
| | (0.163) | (0.004) | |
| P/EG | 0.723 *** | 0.007 *** | 0.094 |
| | (0.163) | (0.002) | |
| BVPS | 0.735 *** | -0.016 *** | 0.094 |
| | (0.163) | (0.006) | |
| RIM1 | 0.718 *** | 0.009 *** | 0.094 |
| | (0.163) | (0.003) | |
| RIM2 | 0.726 *** | -0.001 | 0.093 |
| | (0.163) | (0.007) | |

**Figure 6. Absolute Moving Average Value Errors:** The figure demonstrates absolute moving average value errors over time.



## Table 6
## Return Generation Based on Decile Portfolio

Details of accounting values are explained in Table 1. A decile portfolio is formulated by buying most undervalued top decile stock and short-selling most overvalued bottom decile stock. Panel A, B and C represent one-, two- and five-year return of a decile portfolio. Diff (RIM1-EPS3) describes the t-test result for the mean difference of returns between RIM1 and P/EPS3. *, ** and *** represent the outperformance of RIM1 over P/EPS3 at 10%, 5% and 1% significance level, respectively. (*), (**) and (***) represent the outperformance of P/EPS3 over RIM1 at 10%, 5% and 1% significance level, respectively.

Panel A: One Year Return

| YEAR | P/BV | P/CFO | P/ EBITDA | P/ SALES | P/EPS _COM | P/EPS _IBES | P/EPS1 | P/EPS2 | P/EPS3 | P/EG | BVPS | RIM1 | RIM2 | Diff (RIM1 - EPS3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1987 | 0.088 | 0.022 | 0.124 | 0.177 | -0.010 | -0.046 | -0.140 | -0.140 | -0.071 | 0.137 | 0.129 | 0.054 | 0.058 | |
| 1988 | -0.008 | 0.082 | -0.020 | -0.047 | 0.022 | -0.007 | -0.018 | -0.030 | -0.032 | 0.034 | -0.064 | -0.047 | -0.057 | |
| 1989 | 0.114 | 0.102 | 0.089 | 0.040 | 0.110 | 0.099 | 0.088 | 0.089 | 0.065 | 0.087 | 0.034 | 0.060 | 0.011 | |
| 1990 | 0.137 | 0.142 | 0.159 | 0.084 | 0.112 | 0.151 | 0.134 | 0.179 | 0.166 | 0.058 | 0.080 | 0.113 | 0.089 | |
| 1991 | 0.119 | 0.202 | 0.164 | 0.145 | 0.074 | 0.114 | 0.119 | 0.145 | 0.141 | 0.065 | 0.193 | 0.130 | 0.175 | |
| 1992 | 0.073 | 0.069 | 0.044 | 0.073 | 0.068 | 0.042 | 0.100 | 0.084 | 0.090 | 0.078 | 0.070 | 0.062 | 0.058 | |
| 1993 | 0.036 | 0.113 | 0.041 | 0.048 | 0.044 | 0.078 | 0.158 | 0.162 | 0.145 | 0.088 | 0.017 | 0.072 | 0.021 | |
| 1994 | 0.070 | 0.072 | 0.127 | 0.065 | 0.078 | 0.101 | 0.127 | 0.087 | 0.104 | 0.068 | 0.074 | 0.025 | 0.071 | (*) |
| 1995 | 0.138 | 0.253 | 0.206 | 0.129 | 0.199 | 0.232 | 0.214 | 0.226 | 0.252 | 0.244 | 0.155 | 0.168 | 0.154 | (*) |
| 1996 | 0.135 | 0.190 | 0.180 | 0.104 | 0.127 | 0.185 | 0.168 | 0.165 | 0.131 | 0.136 | 0.167 | 0.125 | 0.155 | |
| 1997 | 0.125 | 0.255 | 0.237 | 0.189 | 0.166 | 0.189 | 0.125 | 0.111 | 0.070 | -0.030 | 0.108 | -0.010 | 0.053 | (*) |
| 1998 | 0.161 | 0.167 | 0.120 | 0.184 | 0.243 | 0.232 | 0.185 | 0.142 | 0.091 | 0.155 | 0.138 | -0.014 | 0.057 | (**) |
| 1999 | 0.297 | 0.404 | 0.328 | 0.264 | 0.221 | 0.285 | 0.307 | 0.312 | 0.266 | 0.155 | 0.332 | 0.451 | 0.440 | ** |
| 2000 | 0.245 | 0.233 | 0.286 | 0.266 | 0.201 | 0.280 | 0.273 | 0.305 | 0.292 | 0.156 | 0.285 | 0.372 | 0.348 | |
| 2001 | 0.085 | 0.145 | 0.100 | 0.092 | 0.197 | 0.173 | 0.093 | 0.074 | 0.043 | 0.042 | 0.059 | 0.121 | 0.094 | * |
| 2002 | 0.177 | 0.156 | 0.213 | 0.199 | 0.122 | 0.206 | 0.223 | 0.226 | 0.219 | 0.184 | 0.195 | 0.184 | 0.228 | |
| 2003 | 0.077 | 0.110 | 0.086 | 0.091 | 0.070 | 0.105 | 0.105 | 0.090 | 0.096 | 0.030 | 0.061 | 0.160 | 0.109 | ** |
| 2004 | 0.057 | 0.110 | 0.120 | 0.175 | 0.145 | 0.122 | 0.141 | 0.145 | 0.173 | 0.198 | 0.081 | 0.021 | 0.081 | (***) |
| 2005 | 0.092 | 0.099 | 0.116 | 0.115 | 0.095 | 0.090 | 0.098 | 0.108 | 0.104 | 0.049 | 0.096 | 0.102 | 0.122 | |
| 2006 | 0.105 | 0.060 | 0.084 | 0.118 | 0.096 | 0.074 | 0.114 | 0.067 | 0.071 | 0.109 | 0.105 | 0.063 | 0.066 | |
| 2007 | 0.184 | 0.299 | 0.224 | 0.275 | 0.264 | 0.334 | 0.324 | 0.224 | 0.226 | 0.341 | 0.153 | 0.405 | 0.201 | ** |
| 2008 | 0.142 | 0.203 | 0.190 | 0.132 | 0.214 | 0.221 | 0.132 | 0.153 | 0.152 | 0.126 | 0.154 | 0.043 | 0.130 | (***) |
| 2009 | 0.067 | 0.059 | 0.049 | 0.082 | 0.046 | 0.037 | 0.036 | 0.052 | 0.048 | 0.048 | 0.026 | -0.013 | -0.007 | (**) |
| 2010 | 0.157 | 0.226 | 0.316 | 0.157 | 0.046 | 0.071 | 0.083 | 0.109 | 0.116 | 0.063 | 0.205 | 0.048 | 0.146 | |
| Total | 0.122 | 0.162 | 0.148 | 0.140 | 0.139 | 0.158 | 0.154 | 0.144 | 0.136 | 0.119 | 0.119 | 0.123 | 0.123 | |

Panel B: Two Year Return

| YEAR | P/BV | P/CFO | P/ EBITDA | P/ SALES | P/EPS_ COM | P/EPS_ IBES | P/EPS1 | P/EPS2 | P/EPS3 | P/EG | BVPS | RIM1 | RIM2 | Diff (RIM1 - EPS3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1987 | 0.204 | 0.301 | 0.451 | 0.231 | 0.077 | 0.266 | -0.332 | -0.332 | -0.133 | -0.121 | 0.215 | 0.091 | 0.234 | |
| 1988 | 0.039 | 0.106 | 0.005 | -0.001 | 0.076 | 0.030 | 0.009 | -0.014 | -0.014 | 0.081 | -0.017 | 0.001 | -0.048 | |
| 1989 | 0.180 | 0.137 | 0.133 | 0.089 | 0.211 | 0.172 | 0.168 | 0.120 | 0.095 | 0.125 | 0.122 | 0.114 | 0.071 | |
| 1990 | 0.313 | 0.289 | 0.369 | 0.245 | 0.207 | 0.316 | 0.318 | 0.389 | 0.362 | 0.163 | 0.296 | 0.307 | 0.317 | |
| 1991 | 0.220 | 0.434 | 0.328 | 0.312 | 0.164 | 0.244 | 0.338 | 0.352 | 0.380 | 0.235 | 0.363 | 0.271 | 0.335 | |
| 1992 | 0.139 | 0.170 | 0.130 | 0.173 | 0.106 | 0.133 | 0.194 | 0.172 | 0.178 | 0.151 | 0.134 | 0.139 | 0.123 | |
| 1993 | 0.026 | 0.177 | 0.095 | 0.134 | 0.107 | 0.206 | 0.273 | 0.252 | 0.242 | 0.083 | 0.018 | 0.110 | 0.070 | (*) |
| 1994 | 0.161 | 0.268 | 0.303 | 0.194 | 0.280 | 0.202 | 0.293 | 0.243 | 0.271 | 0.218 | 0.146 | 0.119 | 0.163 | (**) |
| 1995 | 0.144 | 0.333 | 0.262 | 0.232 | 0.209 | 0.253 | 0.298 | 0.279 | 0.270 | 0.221 | 0.243 | 0.227 | 0.228 | |
| 1996 | 0.185 | 0.323 | 0.311 | 0.191 | 0.228 | 0.312 | 0.254 | 0.217 | 0.135 | 0.055 | 0.208 | 0.037 | 0.123 | (*) |
| 1997 | 0.301 | 0.393 | 0.388 | 0.386 | 0.452 | 0.353 | 0.259 | 0.271 | 0.191 | 0.159 | 0.294 | 0.078 | 0.224 | |
| 1998 | 0.155 | 0.408 | 0.220 | 0.183 | 0.379 | 0.318 | 0.262 | 0.203 | 0.209 | 0.244 | 0.168 | 0.187 | 0.147 | |
| 1999 | 0.662 | 0.778 | 0.699 | 0.712 | 0.444 | 0.666 | 0.679 | 0.691 | 0.551 | 0.334 | 0.754 | 0.952 | 0.939 | ** |
| 2000 | 0.397 | 0.514 | 0.500 | 0.400 | 0.391 | 0.472 | 0.429 | 0.401 | 0.400 | 0.243 | 0.416 | 0.736 | 0.553 | * |
| 2001 | 0.168 | 0.170 | 0.194 | 0.163 | 0.231 | 0.193 | 0.153 | 0.131 | 0.132 | 0.136 | 0.182 | 0.127 | 0.228 | |
| 2002 | 0.216 | 0.251 | 0.285 | 0.255 | 0.172 | 0.214 | 0.279 | 0.271 | 0.264 | 0.230 | 0.255 | 0.342 | 0.343 | |
| 2003 | 0.246 | 0.251 | 0.220 | 0.312 | 0.124 | 0.149 | 0.238 | 0.217 | 0.275 | 0.222 | 0.218 | 0.190 | 0.228 | |
| 2004 | 0.131 | 0.219 | 0.225 | 0.277 | 0.206 | 0.164 | 0.176 | 0.206 | 0.213 | 0.241 | 0.153 | 0.061 | 0.172 | (***) |
| 2005 | 0.230 | 0.261 | 0.241 | 0.250 | 0.248 | 0.224 | 0.233 | 0.255 | 0.237 | 0.138 | 0.207 | 0.206 | 0.258 | |
| 2006 | 0.405 | 0.636 | 0.514 | 0.697 | 0.512 | 0.490 | 0.534 | 0.433 | 0.472 | 0.917 | 0.503 | 0.518 | 0.390 | |
| 2007 | 0.113 | 0.189 | 0.145 | 0.199 | 0.135 | 0.178 | 0.182 | 0.153 | 0.153 | 0.101 | 0.085 | 0.198 | 0.098 | |
| 2008 | 0.334 | 0.361 | 0.356 | 0.308 | 0.467 | 0.402 | 0.328 | 0.308 | 0.308 | 0.247 | 0.290 | 0.097 | 0.262 | (***) |
| 2009 | 0.262 | 0.189 | 0.513 | 0.415 | 0.206 | 0.356 | 0.146 | 0.150 | 0.093 | 0.038 | 0.218 | 0.019 | -0.129 | |
| Total | 0.233 | 0.327 | 0.293 | 0.294 | 0.267 | 0.280 | 0.288 | 0.270 | 0.260 | 0.238 | 0.248 | 0.245 | 0.255 | |

Panel C: Five Year Return

| YEAR | P/BV | P/CFO | P/ EBITDA | P/ SALES | P/EPS_ COM | P/EPS_ IBES | P/EPS1 | P/EPS2 | P/EPS3 | P/EG | BVPS | RIM1 | RIM2 | Diff (RIM1 - EPS3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1987 | -0.098 | 1.001 | 1.587 | 0.201 | 0.346 | 0.352 | -0.496 | -0.496 | -0.103 | 0.364 | 0.343 | 0.521 | 0.435 | |
| 1988 | 0.207 | 0.178 | 0.151 | 0.112 | 0.016 | 0.038 | 0.202 | 0.133 | 0.133 | 0.331 | 0.171 | 0.121 | 0.141 | |
| 1989 | 0.593 | 0.658 | 0.440 | 0.371 | 0.368 | 0.510 | 0.576 | 0.611 | 0.529 | 0.467 | 0.397 | 0.477 | 0.431 | |
| 1990 | 0.649 | 0.597 | 0.692 | 0.514 | 0.375 | 0.561 | 0.579 | 0.968 | 0.944 | 0.567 | 0.850 | 0.501 | 0.612 | (**) |
| 1991 | 0.670 | 0.954 | 0.988 | 0.770 | 0.644 | 0.798 | 0.921 | 0.865 | 0.932 | 0.598 | 0.891 | 0.677 | 0.869 | |
| 1992 | 0.928 | 1.117 | 1.032 | 1.075 | 0.636 | 0.850 | 0.893 | 0.745 | 0.717 | 0.505 | 0.847 | 0.526 | 0.738 | |
| 1993 | 0.248 | 0.507 | 0.479 | 0.398 | 0.472 | 0.696 | 0.713 | 0.683 | 0.602 | 0.424 | 0.254 | 0.241 | 0.288 | (**) |
| 1994 | 0.505 | 0.805 | 0.840 | 0.610 | 0.651 | 0.631 | 0.728 | 0.590 | 0.567 | 1.043 | 0.305 | 0.091 | 0.180 | (***) |
| 1995 | 0.570 | 0.697 | 0.608 | 0.503 | 0.457 | 0.618 | 0.810 | 0.714 | 1.038 | 1.059 | 0.536 | 0.390 | 0.547 | (**) |
| 1996 | 0.406 | 0.621 | 0.532 | 0.397 | 0.575 | 0.487 | 0.465 | 0.370 | 0.332 | 0.247 | 0.377 | 0.320 | 0.289 | |
| 1997 | 0.684 | 0.572 | 0.537 | 0.577 | 0.670 | 0.627 | 0.570 | 0.355 | 0.288 | 0.369 | 0.730 | 0.398 | 0.581 | |
| 1998 | 0.375 | 0.533 | 0.358 | 0.340 | 0.398 | 0.360 | 0.370 | 0.416 | 0.407 | 0.459 | 0.515 | 0.560 | 0.518 | |
| 1999 | 1.150 | 1.099 | 1.220 | 1.223 | 0.935 | 1.236 | 1.270 | 1.255 | 1.068 | 0.912 | 1.439 | 1.428 | 1.601 | * |
| 2000 | 0.654 | 0.749 | 0.716 | 0.899 | 0.623 | 0.748 | 0.772 | 0.677 | 0.579 | 0.394 | 0.898 | 1.138 | 1.007 | *** |
| 2001 | 0.506 | 0.691 | 0.722 | 0.644 | 0.590 | 0.642 | 0.813 | 0.658 | 0.629 | 0.646 | 0.648 | 0.668 | 0.794 | |
| 2002 | 0.603 | 0.641 | 0.755 | 0.830 | 0.765 | 0.738 | 0.603 | 0.543 | 0.565 | 0.655 | 0.779 | 0.640 | 0.848 | |
| 2003 | 0.557 | 0.525 | 0.463 | 0.776 | 0.357 | 0.627 | 0.783 | 0.760 | 0.688 | 1.901 | 0.512 | 0.695 | 0.419 | |
| 2004 | 0.191 | 0.347 | 0.294 | 0.324 | 0.258 | 0.258 | 0.243 | 0.210 | 0.168 | 0.397 | 0.198 | 0.069 | 0.168 | (*) |
| 2005 | 0.367 | 0.465 | 0.375 | 0.364 | 0.527 | 0.429 | 0.421 | 0.420 | 0.424 | 0.369 | 0.316 | 0.280 | 0.357 | (*) |
| 2006 | -0.060 | 2.909 | 0.332 | 2.080 | 0.196 | 0.454 | 0.582 | 0.532 | 0.199 | 0.469 | 2.233 | 0.288 | 0.393 | |
| Total | 0.526 | 0.642 | 0.602 | 0.599 | 0.522 | 0.593 | 0.630 | 0.585 | 0.559 | 0.640 | 0.588 | 0.520 | 0.571 | |

**Table 7**
**Regression of Return on Estimate Ratio**

Details of accounting values are explained in Table 1. Panel A and B represent the regression results of size-adjusted return (SAR) on the estimate ratio. Panel A uses one-year SAR and panel B uses five-year SAR. SAR is calculated as $SAR_{it} = \left[\prod_{t=1}^{t=12}(1 + r_{it}) - \prod_{t=1}^{t=12}(1 + r_{decile,t})\right]$ for one year. The estimate ratio is calculated as the estimate of a model divided by price. The regression model of SAR is,

$$SAR_{it} = \alpha + \beta Estimate\ Ratio_{it} + \sum_{t=1988}^{t=2010} \delta_{t-1987} Year_t + \varepsilon$$

Panel C and D represent the results of an alternative regression of stock return on the estimate ratio controlling for the size of a firm. Panel C employs one-year return and panel D employs five-year return. The alternative regression model is,

$$Return_{it} = \alpha + \beta Estimate\ Ratio_{it} + \gamma Market\ Cap_{it} + \sum_{t=1988}^{t=2010} \delta_{t-1987} Year_t + \varepsilon$$

*, ** and *** represent significance at 10%, 5% and 1%, respectively.

Panel A: Regression of SAR (1 Year) on Estimate Ratio

| | Intercept | | Ratio | | $R^2$ |
|---|---|---|---|---|---|
| P/BV | 0.048 | | 0.002 | ** | 0.018 |
| | (0.043) | | (0.001) | | |
| P/CFO | 0.044 | | 0.004 | *** | 0.018 |
| | (0.043) | | (0.001) | | |
| P/EBITDA | 0.047 | | 0.003 | *** | 0.018 |
| | (0.043) | | (0.001) | | |
| P/SALES | 0.044 | | 0.004 | *** | 0.019 |
| | (0.043) | | (0.001) | | |
| P/EPS_COM | 0.048 | | 0.002 | ** | 0.018 |
| | (0.043) | | (0.001) | | |
| P/EPS_IBES | 0.025 | | 0.022 | *** | 0.019 |
| | (0.044) | | (0.005) | | |
| P/EPS1 | 0.015 | | 0.032 | *** | 0.019 |
| | (0.044) | | (0.007) | | |
| P/EPS2 | 0.002 | | 0.044 | *** | 0.019 |
| | (0.045) | | (0.009) | | |
| P/EPS3 | -0.001 | | 0.047 | *** | 0.020 |
| | (0.044) | | (0.009) | | |
| P/EG | 0.020 | | 0.028 | *** | 0.019 |
| | (0.044) | | (0.006) | | |
| BVPS | 0.051 | | 0.000 | | 0.018 |
| | (0.043) | | (0.004) | | |
| RIM1 | 0.059 | | -0.013 | ** | 0.018 |
| | (0.043) | | (0.006) | | |
| RIM2 | 0.052 | | -0.002 | | 0.018 |
| | (0.043) | | (0.005) | | |

Panel B: Regression of SAR (5 Years) on Estimate Ratio

| | Intercept | | Ratio | | $R^2$ |
|---|---|---|---|---|---|
| P/BV | -0.012 | | 0.014 | *** | 0.006 |
| | (0.169) | | (0.004) | | |
| P/CFO | -0.037 | | 0.024 | *** | 0.008 |
| | (0.169) | | (0.004) | | |
| P/EBITDA | -0.025 | | 0.023 | *** | 0.007 |
| | (0.168) | | (0.004) | | |
| P/SALES | -0.026 | | 0.020 | *** | 0.007 |
| | (0.168) | | (0.004) | | |
| P/EPS_COM | -0.008 | | 0.009 | *** | 0.006 |
| | (0.169) | | (0.004) | | |
| P/EPS_IBES | -0.097 | | 0.085 | *** | 0.007 |
| | (0.172) | | (0.030) | | |
| P/EPS1 | -0.193 | | 0.178 | *** | 0.008 |
| | (0.173) | | (0.034) | | |
| P/EPS2 | -0.270 | | 0.252 | *** | 0.009 |
| | (0.175) | | (0.041) | | |
| P/EPS3 | -0.302 | * | 0.286 | *** | 0.010 |
| | (0.175) | | (0.042) | | |
| P/EG | -0.240 | | 0.231 | *** | 0.011 |
| | (0.172) | | (0.031) | | |
| BVPS | -0.019 | | 0.056 | *** | 0.006 |
| | (0.169) | | (0.018) | | |
| RIM1 | -0.017 | | 0.033 | | 0.006 |
| | (0.170) | | (0.029) | | |
| RIM2 | -0.042 | | 0.092 | *** | 0.007 |
| | (0.169) | | (0.028) | | |

| Panel C: Regression of Return (1 Year) on Estimate Ratio and Market Capitalization | | | | | |
|---|---|---|---|---|---|
| | Intercept | | Ratio | | $R^2$ |
| P/BV | 0.213 | *** | 0.003 | *** | 0.139 |
| | (0.044) | | (0.001) | | |
| P/CFO | 0.208 | *** | 0.004 | *** | 0.140 |
| | (0.044) | | (0.001) | | |
| P/EBITDA | 0.211 | *** | 0.004 | *** | 0.139 |
| | (0.044) | | (0.001) | | |
| P/SALES | 0.208 | *** | 0.005 | *** | 0.140 |
| | (0.044) | | (0.001) | | |
| P/EPS_COM | 0.213 | *** | 0.003 | *** | 0.139 |
| | (0.044) | | (0.001) | | |
| P/EPS_IBES | 0.177 | *** | 0.033 | *** | 0.140 |
| | (0.045) | | (0.005) | | |
| P/EPS1 | 0.164 | *** | 0.047 | *** | 0.141 |
| | (0.046) | | (0.007) | | |
| P/EPS2 | 0.149 | *** | 0.062 | *** | 0.141 |
| | (0.046) | | (0.009) | | |
| P/EPS3 | 0.145 | *** | 0.066 | *** | 0.141 |
| | (0.046) | | (0.009) | | |
| P/EG | 0.178 | *** | 0.034 | *** | 0.141 |
| | (0.045) | | (0.006) | | |
| BVPS | 0.215 | *** | 0.004 | | 0.139 |
| | (0.044) | | (0.003) | | |
| RIM1 | 0.222 | *** | -0.008 | | 0.139 |
| | (0.045) | | (0.006) | | |
| RIM2 | 0.213 | *** | 0.007 | | 0.139 |
| | (0.044) | | (0.005) | | |

| Panel D: Regression of Return (5 Years) on Estimate Ratio and Market Capitalization | | | | | |
|---|---|---|---|---|---|
| | Intercept | | Ratio | | $R^2$ |
| P/BV | 0.622 | *** | 0.016 | *** | 0.054 |
| | (0.167) | | (0.005) | | |
| P/CFO | 0.597 | *** | 0.025 | *** | 0.056 |
| | (0.167) | | (0.004) | | |
| P/EBITDA | 0.610 | *** | 0.025 | *** | 0.055 |
| | (0.167) | | (0.004) | | |
| P/SALES | 0.608 | *** | 0.022 | *** | 0.055 |
| | (0.167) | | (0.004) | | |
| P/EPS_COM | 0.626 | *** | 0.010 | *** | 0.054 |
| | (0.168) | | (0.004) | | |
| P/EPS_IBES | 0.515 | *** | 0.106 | *** | 0.055 |
| | (0.170) | | (0.029) | | |
| P/EPS1 | 0.414 | *** | 0.205 | *** | 0.056 |
| | (0.172) | | (0.034) | | |
| P/EPS2 | 0.334 | * | 0.281 | *** | 0.057 |
| | (0.174) | | (0.041) | | |
| P/EPS3 | 0.302 | * | 0.316 | *** | 0.058 |
| | (0.174) | | (0.042) | | |
| P/EG | 0.392 | ** | 0.235 | *** | 0.059 |
| | (0.171) | | (0.031) | | |
| BVPS | 0.615 | *** | 0.061 | *** | 0.054 |
| | (0.167) | | (0.018) | | |
| RIM1 | 0.609 | *** | 0.052 | * | 0.054 |
| | (0.168) | | (0.029) | | |
| RIM2 | 0.586 | *** | 0.108 | *** | 0.055 |
| | (0.168) | | (0.028) | | |

**Table 8**
**Adjusted Standard Deviation**

Details of accounting values are explained in Table 1. Adjusted standard deviation is calculated as standard deviation divided by mean. It represents the size of standard deviation for each unit of estimates.

| YEAR | P/BV | P/CFO | P/ EBITDA | P/ SALES | P/EPS_ COM | P/EPS_ IBES | P/EPS1 | P/EPS2 | P/EPS3 | P/EG | BVPS | RIM1 | RIM2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1987 | 0.960 | 1.222 | 1.139 | 1.161 | 1.600 | 0.848 | 1.202 | 1.144 | 1.111 | 0.945 | 0.919 | 0.916 | 0.955 |
| 1988 | 1.002 | 1.286 | 1.044 | 1.192 | 1.022 | 0.952 | 0.897 | 0.807 | 0.789 | 0.779 | 0.959 | 0.738 | 0.785 |
| 1989 | 2.106 | 1.793 | 1.628 | 1.620 | 1.632 | 1.212 | 0.904 | 0.859 | 0.836 | 0.812 | 2.397 | 0.821 | 1.494 |
| 1990 | 1.252 | 1.348 | 1.097 | 1.275 | 1.184 | 0.832 | 0.782 | 0.764 | 0.749 | 0.760 | 1.261 | 0.803 | 0.902 |
| 1991 | 1.070 | 1.250 | 1.044 | 1.320 | 1.076 | 0.834 | 0.757 | 0.748 | 0.739 | 0.755 | 0.948 | 0.771 | 0.788 |
| 1992 | 1.018 | 1.083 | 0.956 | 1.198 | 0.923 | 0.822 | 0.749 | 0.721 | 0.708 | 0.717 | 0.926 | 0.865 | 0.785 |
| 1993 | 1.222 | 1.742 | 1.608 | 1.515 | 2.136 | 0.759 | 0.698 | 0.675 | 0.664 | 0.690 | 1.302 | 0.823 | 0.890 |
| 1994 | 1.011 | 1.294 | 0.950 | 1.320 | 0.948 | 0.776 | 0.738 | 0.711 | 0.695 | 0.687 | 1.062 | 0.853 | 0.809 |
| 1995 | 1.262 | 1.952 | 1.776 | 1.344 | 1.797 | 0.830 | 0.686 | 0.651 | 0.633 | 0.626 | 1.182 | 0.903 | 0.816 |
| 1996 | 1.481 | 1.628 | 1.608 | 2.406 | 1.516 | 0.762 | 0.675 | 0.643 | 0.627 | 0.654 | 1.438 | 0.748 | 0.908 |
| 1997 | 1.497 | 1.658 | 1.476 | 1.955 | 1.632 | 0.697 | 0.647 | 0.614 | 0.600 | 0.649 | 1.340 | 0.729 | 0.844 |
| 1998 | 2.345 | 2.456 | 2.158 | 2.346 | 2.405 | 0.708 | 0.659 | 0.621 | 0.607 | 0.623 | 2.249 | 0.686 | 1.291 |
| 1999 | 1.866 | 1.740 | 1.789 | 1.979 | 1.977 | 0.708 | 0.669 | 0.642 | 0.625 | 0.622 | 1.672 | 0.654 | 1.030 |
| 2000 | 2.382 | 2.762 | 2.301 | 2.247 | 2.874 | 0.717 | 0.671 | 0.619 | 0.607 | 0.666 | 1.680 | 0.702 | 1.023 |
| 2001 | 2.513 | 2.214 | 2.501 | 2.756 | 1.956 | 0.666 | 0.634 | 0.603 | 0.593 | 0.641 | 1.804 | 0.727 | 1.155 |
| 2002 | 2.267 | 2.491 | 2.864 | 2.846 | 2.881 | 0.688 | 0.649 | 0.608 | 0.598 | 0.635 | 1.792 | 0.784 | 1.209 |
| 2003 | 2.166 | 2.418 | 2.650 | 2.598 | 2.669 | 0.728 | 0.644 | 0.607 | 0.596 | 0.638 | 1.857 | 0.823 | 1.221 |
| 2004 | 1.712 | 2.067 | 2.092 | 2.180 | 2.215 | 0.702 | 0.636 | 0.600 | 0.588 | 0.634 | 1.617 | 0.822 | 1.044 |
| 2005 | 1.732 | 1.933 | 2.254 | 2.221 | 2.242 | 0.713 | 0.667 | 0.619 | 0.605 | 0.666 | 1.987 | 0.751 | 1.261 |
| 2006 | 2.029 | 2.640 | 2.235 | 2.467 | 2.510 | 0.729 | 0.671 | 0.637 | 0.628 | 0.731 | 2.062 | 0.742 | 1.197 |
| 2007 | 1.850 | 1.987 | 2.178 | 2.240 | 2.642 | 0.798 | 0.739 | 0.705 | 0.699 | 0.855 | 1.741 | 0.781 | 1.137 |
| 2008 | 1.432 | 2.031 | 1.998 | 1.754 | 2.123 | 0.727 | 0.747 | 0.689 | 0.685 | 0.835 | 1.261 | 0.813 | 0.900 |
| 2009 | 1.848 | 2.111 | 2.359 | 2.442 | 2.242 | 0.787 | 0.727 | 0.685 | 0.681 | 0.847 | 1.852 | 0.796 | 1.179 |
| 2010 | 1.686 | 2.060 | 2.185 | 2.820 | 2.373 | 0.764 | 0.718 | 0.676 | 0.669 | 0.903 | 1.649 | 0.750 | 1.076 |
| Total | 1.974 | 2.232 | 2.306 | 2.459 | 2.498 | 0.820 | 0.767 | 0.727 | 0.717 | 0.831 | 1.846 | 0.874 | 1.193 |