

EQUITY VALUATION USING BENCHMARK MULTIPLES: AN IMPROVED APPROACH USING REGRESSION-BASED WEIGHTS

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Abstract

This paper examines the improvement in multiple-based valuations from using a composite of price to earnings (P/E) and price to book (P/B) ratios and firm-specific regression-based weights. The results support that composite benchmark multiples lead to improved valuations over single multiples and further improvement is achieved by incorporating firm characteristics to derive firm-specific regression-based weights. The unrestricted regression-weighted composite multiples perform better than other approaches in predicting year one to year three share prices. Our results remain unchanged when the analysis is conducted using different estimation regressions, different sample periods and subsamples based on firm size, age and the book to market ratio. This research provides a comprehensive comparison between single, equal-weighted and regression-weighted composite multiples that reflect cross-sectional variations in firm growth, profitability and cost-of-capital in equity valuation. The results highlight the usefulness of composite multiple-based valuation in settings where current market prices are not readily available.

Keywords: Equity Valuation, Benchmark Multiples, Regression-Based Weights

JEL Classification: J33, M41

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1. INTRODUCTION

Accounting-based market multiples are widely used by practitioners in valuation activities associated with investment analysis, initial public offerings, leveraged buyouts, and mergers and acquisitions. The major benefit of relative valuation¹⁰, which values assets based on how similar assets are currently priced in the market, over direct valuation is the simplicity of application, though it also forfeits the potential benefits of a more complete fundamental analysis. Despite the widespread usage of relative valuation by market participants, with few exceptions, most published research in the literature examines the valuation accuracy of different single market multiples against the stock price of sample firms in specific contexts (Kim & Ritter 1999) and mostly uses industry membership as the selection criterion for comparable firms.¹¹ However, a potential practical problem is that the P/E and P/B ratios might yield conflicting valuations. More importantly, as Penman (1998) points out, the use of each ratio is likely to overlook relevant information for valuation contained in the other. In fact, there is little published research that documents the absolute and relative performance of composite multiples in equity valuation.

This paper examines the improvement in

multiple-based valuations from using a composite of price to earnings (P/E) and price to book (P/B) ratios and firm-specific regression-based weights over the respective individual ratios. In particular, we examine whether the combination of P/B and P/E multiples and allowing the weights combining the P/B and P/E ratios to vary across firms based on firm characteristics result in improved predictive values against a performance benchmark based on subsequent actual market values.

To address these research questions, we rely on the Ohlson and Juettner-Nauroth's (2005) abnormal earnings growth model and the residual income model to form the basis for the development of the composite valuation based on the P/E and P/B ratios. Specifically, we first estimate a series of annual cross-sectional regressions of either the P/B or P/E ratio on eight explanatory variables chosen to reflect cross-sectional variations in firm growth, profitability and cost-of-capital. The estimated coefficients obtained from these regressions are used in conjunction with each firm's next year accounting information to generate a 'benchmark multiplier' for each firm. This selection method assumes that firms with similar valuation fundamentals such as risk, growth and profit potential will have similar cost of capital as they compete in the capital market for funding.

We then use the two benchmark multiples generated through this approach to calculate two valuations for each target firm - one based on the P/E ratio, the other based on the P/B ratio.

¹⁰ Relative valuation, multiple-based valuation and benchmark valuation are used interchangeably throughout the paper.

¹¹ For example, it is common that market participants apply either the P/E or P/B ratios individually.

Combining these into a single valuation requires weights to be applied to each. We employ several approaches to developing such weights. The first approach is an equally-weighted average of valuations based on the P/E and P/B ratios, where weights are common to all firms and years. Second, we generate annual weights common to all firms in a specific year by regressing price on the two individual valuations, restricting the coefficients to sum to one. Under this scheme weights vary across years but not across firms. Third, we extend the regression approach to allow the estimated annual weights to vary across firms and years.

The results in relation to estimating benchmark multiples indicate that comparable firms' benchmark multiples selected in this manner show significant improvements in terms of adjusted r-squares, against other alternative definitions of comparable firms such as industry and size matches in forecasting subsequent actual multiples of the target firms. To facilitate comparison with prior studies, the valuation errors of the individual benchmark multiples are then compared against other selection methods based on industry-size matching and the harmonic mean of the actual multiples selected from four firms within the industry with the closest benchmark multiples. The results support the use of the benchmark multiples based on the regression approach in forming composite valuations.

To assess whether the resulting composite valuations result in an improvement over individual valuations, we then compare their respective predictive abilities with respect to subsequent actual price one, two and three years after the valuation date. The results indicate that regression-based multiples exhibit smaller valuation errors than equal-weighted and single multiples. In particular, the composite multiples valuation using firm-specific regression-based weights is found to have the smallest mean and median absolute valuation errors. This findings support the view that composite benchmark multiples lead to improved valuations over single multiples and further improvement is achieved by incorporating firm characteristics in the construction of composite benchmark multiples. Our results remain unchanged when the analysis is based on December fiscal year end firms and using a parsimonious model in the estimation regression. Further analyses on sub-samples of 'value' vs. 'glamour' stocks, large, medium and small firms, and old vs. new economy firms reveal similar results.

This study contributes to the literature in at least two ways. First, we select comparable firms based on a multiple regression approach that reflect cross-sectional variations in firm characteristics for two important value drivers (P/E and P/B) acknowledged by both relative valuation and fundamental analysis literature rather than by industry membership. Bhojray and Lee (2002) adopt this approach but only examine the P/B and enterprise-value-to-sales ratios individually. We extend their research and investigate the P/E ratio which underpins analysts' recommendations (Bradshaw 2002, 2004; Demirakos et al 2004). Second, we develop a composite multiple based on two key ratios (P/E and P/B) that theoretically link to direct valuation and allow the estimated weights

between them to vary with firm characteristics. Empirically, equal weighting has been adopted to combine the P/E and P/B ratios by Cheng and McNamara (2000), Henschke and Homburg (2009). Cheng and McNamara (2000) and Yoo (2006) employ industry membership as the selection criterion for comparable firms. This study extends this line of research by adopting Bhojray and Lee (2002)'s, henceforth BJ, comparable firm selection process, and by investigating several approaches to forming composite multiple-based valuations.

Our results provide important insights into three practical problems faced by financial analysts using relative valuation models. First, applying a P/E multiplier or a P/B multiplier typically produces two valuations and the analyst is left with the question of how to combine them into one valuation. Second, which multiple to use as different multiples yield different valuations. Third, relative valuation is being criticised by its vulnerability to manipulation and the lack of transparency regarding the underlying assumptions. This study proposes a composite multiple based on the P/E and P/B ratios to address the first two problems. The selection of comparable firms is based on risk, growth and future cash flow potential factors which reflect the fundamental concepts that underpin equity valuation. Analysts can cross check their own valuation against this systematic approach or use it as an initial estimate in the valuation process associated with IPOs, leveraged buyout, seasoned equity offerings, and merger and acquisition activities.

The rest of this paper is organized as follows. Section 2 reviews the existing literature. Research design, sample construction, descriptive statistics and correlation analysis are discussed in Section 3. Section 4 presents the results of evaluating the performance of different valuation approaches. Further robustness analyses are considered in Section 5. Section 6 concludes.

2. LITERATURE REVIEW

The valuation literature discusses three broad approaches to equity valuation. The first approach is direct valuation, which relates to the valuation of an asset based on the present value of expected future cash flows generated by the asset. The second approach is relative valuation which estimates the value of an asset by looking at the pricing of comparable assets relative to a common variable such as earnings, book value, cash flows or sales. The third one is contingent claim valuation based on option pricing theory for pricing traded assets with finite lives (Damodaran 2002).

This study focuses on 'relative valuation' using the P/E and P/B ratios. Most equity research reports and acquisition valuations are based on accounting-based market multiples because the focus is on the firm's earnings rather than its cash flows when generating a sense whether the firm is making money for their investors and acquirers (Penman 2007). However, applying a P/E multiplier or a P/B multiplier typically produces two valuations and the analyst is left with the question of how to combine them into one valuation. In addition, each ratio potentially overlooks relevant valuation information contained in the other (Penman 1998). As a result, to

combine the P/B and P/E ratios into a composite valuation warrants empirical investigation.

Accounting-based market multiples are widely used by practitioners in valuation activities associated with investment analysis, initial public offerings, leveraged buyouts, seasoned equity offerings, court valuation of private firms and mergers and acquisitions. The major benefit of relative valuation over direct valuation is the simplicity of application, though it also forfeits the potential benefits of a more complete fundamental analysis. In fact, evidence suggests that relative valuation generally yield values that are closer to market prices than discounted cash flow valuation (Damodaran 2002) and avoid the difficulties inherent in implementing complex valuation models which are sensitive to a host of underlying assumptions (Myers 1984; Block 1999)¹². Prior studies also find that most analysts' recommendations are more likely to be justified by the P/E ratio and expected growth and some analysts who construct explicit multi-period valuation models still adopt a comparative valuation model as their preferred model (Bradshaw 2002, 2004; Demirakos et al 2004).

Despite the widespread use by market participants, with a few exceptions, most existing research provides little evidence on how or why certain individual multiples or certain comparable firms should be selected (Boatsman & Baskin 1981; Alford 1992; Kim & Ritter 1999). By focusing on specific contexts, the majority of these studies do not examine how relative valuation performs across firms with differing financial positions and growth prospects. Further, there is little previous research that documents the absolute and relative performance of composite multiples in equity valuation (Penman 1998; Cheng & McNamara 2000; Yoo 2006). This study attempts to fill the gap from prior research and provides a more comprehensive examination of the efficacy of composite multiples in equity valuation.

Early studies mainly investigate the effect of comparable firm selection on relative valuation or examine the factors driving cross-sectional variation in certain single multiples. For example, Boatsman and Basking (1981) compare the accuracy of value estimates based on the earnings to price (E/P) ratio of two sets of comparable firms from the same industry. They find that valuation errors are smaller when comparable firms are chosen based on similar historical earnings growth, relative to when they are chosen randomly. Zarowin (1990) examines the cross-sectional determinants of the E/P ratio. He finds that the dominant source of variation in the E/P ratio is forecasted long-term earnings, and other factors such as risk, historical earning growth, forecasted short-term growth, and differences in accounting methods seem to be less important. Alford (1992) examines the relative valuation accuracy of the P/E multiple when comparable firms are selected on the basis of industry, size, leverage and earnings growth. He finds that valuation errors decline when the industry definition is narrowed from two- to three-digit SIC codes, but there is no further improvement when a four-digit classification

is used.

In a more general setting, Liu, Nissim and Thomas (2002) examine the valuation accuracy of a list of multiples. They show that multiples derived from forward earnings explain stock prices remarkably well, followed by historical earnings measures, and that sales performs worst. Similar results are obtained across different industries and sample years. This is contrary to general perceptions and research findings that different industries are associated with different best multiples (Tasker 1998). The explanatory power for current prices declines when more complex measures of intrinsic value are used based on short-cut residual income models.

Importantly, none of these studies address the choice of comparable firms beyond industry groupings. BL develop a benchmark multiple for each sample firm from annual cross-sectional regressions of either EV/S or P/B ratios on eight explanatory variables and in turn the estimated coefficients from last year's regression are used in conjunction with each firm's current year information to generate a prediction of the target firm's current and future ratios. BL rely on the assumption that firms with similar valuation fundamentals such as risk, growth and profit potential will have similar cost of capital as they compete in the capital market for funding. They identify peer firms as those having the closest benchmark multiple and test this approach by examining the efficacy of the selected comparable firms in predicting future EV/S and P/B ratios against other selection methods based on industry membership and size proxy by market value of equity. Their study shows that the accuracy of EV/S and P/B ratios improves significantly against other selection methods. However, BL do not investigate the P/E ratio which is commonly used by analysts and fund managers as a basis from which to conduct fundamental analysis and to make investment decisions (Barker 1999; Block 1999; Bradshaw 2002 and 2004; Demirakos et al 2004). In addition, Liu et al. (2002 and 2007) found reported earnings dominated reported cash flows as summary measures of value in the United States.

Composite valuation research relies on the assumption that equity value can be represented by the combination of the reported accounting numbers such as book value of equity and earnings. The valuation model can have either earnings or book values as an anchor which represents the first components of the Ohlson and Juettner-Nauroth (2005) model and the present value of future earnings growth as the premium represents the second component of the OJ model. Using earnings (book value) as an anchor and re-expressing the terms, we can obtain the abnormal earnings growth (AEG) model and the residual income (RE) model respectively (Ohlson 1995; Feltham & Ohlson 1995; Ohlson & Juettner-Nauroth 2005; Penman 2007).

Three recent studies that provide some insights in this area are Cheng and McNamara (2000), Yoo (2006) and Henschke and Homburg (2009). Cheng and McNamara (2000) extend Alford (1992) and evaluate the P/B ratio and an equally weighted combined multiple of P/E and P/B in addition to the P/E ratio. Their results suggest that, when a firm's intrinsic value is unknown, the combined P/E and

¹² The Discount cash flow analysis is not helpful in valuing companies with significant growth opportunities due to the task of projecting future earnings and determining an appropriate discount rate.

P/B ratio is the best among all the approaches they evaluated.

Yoo (2006) extends Liu et al. (2002) by examining the valuation outcomes of five value drivers (book value of equity, sales, actual earnings reported by I/B/E/S, earnings before interest, tax and depreciation and three-year-out analysts' earnings forecast). His findings indicate that the composite approach using historical multiples reduces the valuation errors over each single historical multiple. However, the comparison between combined historical multiples and combined stock price multiples using forward earnings shows no incremental valuation accuracy from forward earnings multiples.

Henschke and Homburg (2009) develop signed and biased peer scores from financial ratios that capture risk, growth and profitability as measures to select comparable firms. Their findings indicate that financial ratios rather than industry membership appear to be crucial for selecting peer groups. Equal-weighted composite multiples do not lead to improved value estimates when compared to their selection method based on financial ratios.

This study extends prior research by incorporating appropriate firm characteristics to improve the estimation of weights when combining these single multiples other than equally-weighted. The above-mentioned first two studies use industry membership for the selection of comparable firms but findings in BL indicate that the selection method based on multiple regression approach provides better valuation accuracy than industry membership. In addition, results from Henschke and Homburg (2009) indicate that book value of equity and earnings multiples perform differently, but equal-weighted composite multiples do not lead to improved value estimates when compared to their selection method.

3. RESEARCH DESIGN

3.1. Estimation of Benchmark Multiples and Weights

The basic approach we use to combine valuations based on the P/E and P/B ratios is to form a single valuation using the following expression:

$$\text{VALUE}_{it} = (1 - w_{it})M_{it}^{P/B}B_{it} + w_{it}M_{it}^{P/E}E_{it} \quad (1)$$

where, VALUE_{it} is the valuation for firm i at time t , $M_{it}^{P/B}$ and $M_{it}^{P/E}$ are benchmark P/B and P/E multiples for firm i at time t , B_{it} and E_{it} are book value and earnings for firm i at time t , and w_{it} is the weight placed on the P/E multiple valuation for firm i at time t .

The valuation in (1) represents a weighted average of individual valuations based on the P/B and P/E ratios, and requires benchmark multiples, $M_{it}^{P/B}$ and $M_{it}^{P/E}$, and weights w_{it} , to be implemented. When w_{it} is set to one (zero), (1) collapses to valuation based on the P/E (P/B) ratio alone.

We follow the approach in BL to estimate

benchmark P/B and P/E multiples, $M_{it}^{P/B}$ and $M_{it}^{P/E}$. This involves estimating the following two equations:

$$P/B_{it} = \alpha_t^{P/B} + \sum_{j=1}^9 \delta_{jt}^{P/B} C_{ijt} + u_{it} \quad (2)$$

$$P/E_{it} = \alpha_t^{P/E} + \sum_{j=1}^9 \delta_{jt}^{P/E} C_{ijt} + u_{it} \quad (3)$$

where, the dependent variables P/B_{it} and P/E_{it} are the price to book and price to earnings ratios for firm i 's at time t respectively. The constant and coefficient terms are represented by $\alpha_t^{P/B}$, $\alpha_t^{P/E}$, $\delta_{jt}^{P/B}$ and $\delta_{jt}^{P/E}$ respectively. The eight explanatory variables ($C_{i,j,t}$) are:

- HM_P_B – the industry harmonic mean of the P/B ratio based on two-digit SIC codes;
- HM_P_EPS – the industry harmonic mean of the P/E ratio;
- IAPM – the difference between the firm's profit margin and the industry profit margin where profit margin is defined as operating profit divided by sales;
- IAPMLF – IAPM multiplied by an indicator variable defined as 1 if the profit margin is less than zero and 0 otherwise;
- ILTG – the difference between the analysts' consensus forecast of a firm's long term growth rate and the industry average;
- LEV – long term debt scaled by book value of equity;
- ROE – net income before extraordinary items as a percentage of book value of equity;
- RD – the research and development expense as a percentage of sales.

BL do not examine the P/E ratio which underpin analysts' recommendations. As a result, we replace HM_EV_S with HM_P_EPS and seven out of the eight explanatory variables are same as those used in BL which are proxy variables for firms' growth, risk and profit potentials. The dependent and independent variables are also summarized and described in more detail in Table 1.

Equations (2) and (3) are estimated each year across the sample of firms, generating a set of coefficient estimates for each year. In turn, these coefficient estimates are used in conjunction with each firm's next year accounting information to generate 'benchmark' P/B and P/E multipliers respectively for each firm. That is,

$$M_{it}^{P/B} = \hat{\alpha}_{t-1}^{P/B} + \sum_{j=1}^9 \hat{\delta}_{j,t-1}^{P/B} C_{ijt} \quad \text{and} \quad M_{it}^{P/E} = \hat{\alpha}_{t-1}^{P/E} + \sum_{j=1}^9 \hat{\delta}_{j,t-1}^{P/E} C_{ijt},$$

where the hats denote estimates based on the prior year's regression. $M_{it}^{P/B}$ and $M_{it}^{P/E}$ are the benchmark multiples used in (1).

To validate this approach to generating benchmark multiples, we replicate BL and compare the predictive ability of benchmark multiples based on (2) and (3) with that of standard industry average multiples. We assess the predictive ability with respect to actual current, one-, two- and three-year-ahead P/B and P/E ratios. These results are presented in section 4.3.

We estimate the weights in (1) by regressing actual price on benchmark multiples for each firm's

book value and earnings respectively. We use two approaches. First, we estimate weights that are common to all firms in a specific year based on the following regression:

$$P_{it} = (1 - w_t) M_{it}^{P/B} B_{it} + w_t M_{it}^{P/E} E_{it} + e_{it} \quad (4)$$

where, P_{it} is the stock price for firm i at time t , and e_{it} is the regression error term.¹³

This results in a single pair of weights applicable to all firms in a specific year.¹⁴ To provide a point of comparison, we also run the regression unrestricted with an intercept term.

To facilitate comparison with prior studies, we also estimate the weights in (1) to include the following:

- Set $w_t = 0$ which is valuation based on the P/B benchmark multiple only.
- Set $w_t = 1$ where is valuation based on the P/E benchmark multiple only.
- Set $w_t = 0.5$ which is equally weighted between the P/B and P/E composite benchmark multiples.

3.2. The Sample

Our empirical analyses require stock price information, financial statement information and analysts earnings forecast data. Financial statement information is extracted from the COMPUTSTAT fundamental annual file, excluding ADRs and REITs. Analyst earnings forecast data are extracted from the Institutional Brokerage Estimate System (I/B/E/S) summary files and stock prices from the Center for Research on Security Prices (CRSP) database. The analysis is conducted as of June 30th of each year.¹⁵ To be included in the analysis, a firm (and year) must be U.S. domiciled with sales above \$100 million. In addition, each firm must have at least one analyst consensus forecast of long-term growth during the 12 months ended June 30th. The accounting information is based on the most recent fiscal-year end, and stock prices as of the end of June. Firms with negative book value, prices below \$3 per share, or missing price and accounting data needed for the estimation regression are eliminated. We eliminate firms in an industry based on 2-digit SIC code if there are less than five member firms which is the minimum required number to calculate the industry harmonic means for P/B and P/E for the estimation regressions. We also eliminate firms in the top and bottom one percent of all firms ranked by P/B and P/E and other explanatory variables.

The final sample consists of 28,604 firm-year

observations. As described above, the coefficient estimates from the annual estimation regressions are used in conjunction with each firm's next year accounting information to generate benchmark P/B and P/E multipliers respectively for each firm. These benchmark multiples are compared against other standard industry average multiples with respect to actual current, one-, two- and three-year-ahead P/B and P/E ratios. This process reduces total firm-year observations to 27,096, 20,892, 17,499 and 14,937 for current, one-, two- and three-year-ahead predictions respectively. To have the same number of firms throughout the forecasting periods, the total firm-year observations are further reduced to 13,277. To restrict the sample firms to firms with a December fiscal-year end, total firm-year observations are further reduced to 16,118, 12,285, 9,618 and 7,659 for current, one-, two- and three-year-ahead predictions respectively.

3.3. Descriptive Statistics and Correlation Analysis

Table 2 presents the summary statistics for the variables employed in estimating benchmark multiples. The overall mean (median) of P_B and P_EPS are 2.50 (1.95) and 17.76 (15.59) respectively. The overall average of P_B is comparable but slightly higher than the BL study. Consistent with prior studies, accounting-based multiples and total R & D expenditures increase over time with the exception of the 2001 to 2003 period. The decrease during years 2000 to 2003 is most noticeable for the industry-adjusted P/EPS multiple which could reflect the impact of poor performing new economy sample firms. The accounting-based rates of return (RNOA and ROE) and book leverage (LEV) are relatively stable and share the same decrease in the later period as other multiples. Industry-adjusted profit and growth variables (IAPM, IAPMLP, ILTG) have means and medians close to zero. Industry adjusted long term growth (ILTG) has higher negative values in the years 2000 to 2002. Industry-adjusted profit margin (IAPM) reaches its peak in year 2000 and gradually declines in the following two years. This decrease is not observed in BL which reports up to 1998 only and is mainly driven by the general economic conditions of the time.

13 Estimation of (4) involves no intercept and a restriction across the two coefficients to sum to one. I provide tests of the extent to which imposing these restrictions affects the resulting estimated weights.

14 Benchmark multiples, $M_{it}^{P/B}$ and $M_{it}^{P/E}$ are developed by multiplying the coefficient estimates with each firm's next year accounting information as discussed above.

15 We follow Bhojray and Lee (2002) and Guay and Kothari (2005) to conduct the analysis as of June 30th of each year. To avoid potential measurement problems discussed by Guay and Kothari (2005), we conduct sensitivity analysis using December fiscal-year end firms to ensure all accounting data is available at a common point in time prior to the June 30th date.

Table 1. Variable Measurement

Variable	Description	Calculation
P_B	Price to book ratio (P/B)	The market value of equity (D199*D25) over total common equity (D60).
P_EPS	Price to earnings per share ratio (P/E)	Stock price (D199) over earnings per share (D58).
HM_P_B	Industry price to book ratio	Harmonic mean of the price to book ratio for firms in the same industry based on 2-digit SIC code
HM_P_EPS	Industry price to earnings per share ratio	Harmonic mean of the price to earnings per share ratio for firms in the same industry based on 2-digit SIC code
IAPM	Industry-adjusted profit margin	The difference between the firm's profit margin and the industry profit margin, where profit margin is defined as operating profit divided by sales, where profit margin is operating profit after depreciation (D178) over net sales (D12).
IAPMLF	IAPM*indicator variable	The product of IAPM and an indicator variable, where the indicator variable is equal to one if profit margin is less than zero and 0 otherwise.
ILTG	Industry-adjusted long-term growth forecast	The difference between consensus analyst forecast of long-term growth for the firm from IBES and the median consensus analyst forecast in the industry based on 2-digit SIC code.
LEV	Leverage	Total long-term debt (D9) over total stockholder's equity (D216).
ROE	Return on equity	Net income before extraordinary items (D18) over Common equity (D60).
RD	Research and development expenditures	Research and development expenditure (D46) over net sales (D12).

All accounting and forecast variables are based on the most recent information available from Compustat, CRSP and IBES as of June 30th each year. Compustat data items are reported in parentheses.

Table 2. Summary Statistics of Estimation Variables

This table presents the summary statistics of the variables used in the analysis. All accounting variables are from the most recent fiscal year end publicly available by June 30th. P_B is the price to book ratio, and P_EPS is the price to earnings per share ratio. HM_PB and HM_P_EPS are the industry harmonic mean of P_B and P_EPS ratio respectively. IAPM is the difference between the firm's profit margin and the industry profit margin, where profit margin is defined as operating profit divided by sales. IAPMLF is the product of IAPM and an indicator variable, where the indicator variable is equal to one if profit margin is less than zero and 0 otherwise. ILTG is the difference between the analysts' consensus forecast of the firm's long-term growth and the industry average. LEV is the total long-term debt scaled by book value of stockholders' equity. ROE is return-on-equity, measured as net income before extraordinary items as a percentage of book value of stockholders equity. RD is a firm's research and development expense expressed as a percentage of net sales.

	Pooled sample		Time series Average	
	Mean	Median	Mean	Median
P_B	2.620	2.000	2.500	1.950
P_EPS	18.260	15.810	17.760	15.590
HM_P_B	1.750	1.680	1.690	1.640
HM_P_EPS	146.320	20.860	121.770	20.530
IAPM	0.010	0.010	0.010	0.010
IAPMLF	-0.020	0.000	-0.020	0.000
ILTG	-0.360	-1.100	-0.330	-1.080
LEV	0.600	0.380	0.580	0.390
ROE	0.110	0.120	0.110	0.120
RD	0.020	0.000	0.020	0.000

Table 3 summaries the average annual pairwise correlation coefficients between variables with the upper triangle reporting Spearman rank correlation coefficients and the lower triangle reporting Pearson correlation coefficients. The Spearman correlation coefficients are generally higher than the Pearson correlations. P_B is positively correlated with the two accounting-based rates of returns (RNOA and ROE). To a lesser degree it is also positively correlated with

industry-adjusted price to book (HM_P_B) and profit margin (IAPM) ratios, as well as the expected growth rate (ILTG), profit margin among loss firms (IAPMLF) and R&D expense (RD). The results are similar for the P_EPS ratio. None of the average pairwise correlations exceed 0.60, suggesting that the explanatory variables are not likely to result in severe multicollinearity difficulties.

Table 3. Correlation Coefficients

This table provides the correlation between the variables. The upper triangle reports the Spearman correlation estimates and the lower triangle reports the Pearson correlation coefficients. All accounting variables are from the most recent fiscal year end publicly available by June 30th. P_B is the price to book ratio, and P_EPS is the price to earnings per share ratio. HM_PB and HM_P_EPS are the industry harmonic mean of P_B and P_EPS ratio respectively. IAPM is the difference between the firm's profit margin and the industry profit margin, where profit margin is defined as operating profit divided by sales. IAPMLF is the product of IAPM and an indicator variable, where the indicator variable is equal to one if profit margin is less than zero and 0 otherwise. ILTG is the difference between the analysts' consensus forecast of the firm's long-term growth and the industry average. LEV is the total long-term debt scaled by book value of stockholders' equity. ROE is return-on-equity, measured as net income before extraordinary items as a percentage of book value of stockholders equity. RD is a firm's research and development expense expressed as a percentage of net sales. Coefficients highlighted in bold represents significant level at 0.05 or less.

	P_B	P_EPS	HM_P_B	HM_P_EPS	IAPM	IAPMLF	ILTG	LEV	ROE	RNOA	RD
P_B		0.41	0.36	0.08	0.43	0.37	0.26	-0.20	0.60	0.59	0.13
P_EPS	0.16		0.22	0.10	0.13	0.10	0.20	-0.17	-0.02	0.10	0.08
HM_P_B	0.32	0.09		0.18	0.01	-0.03	-0.06	-0.18	0.13	0.24	0.22
HM_P_EPS	-0.01	0.02	-0.02		0.00	0.02	-0.02	-0.10	0.01	0.06	0.14
IAPM	0.37	0.07	0.03	0.00		0.92	0.09	-0.16	0.51	0.51	0.07
IAPMLF	0.22	0.08	-0.04	0.01	0.77		0.07	-0.14	0.48	0.50	0.03
ILTG	0.26	0.10	-0.04	0.00	0.06	0.00		-0.10	0.07	0.10	0.02
LEV	-0.04	-0.05	-0.10	-0.01	-0.11	-0.09	-0.04		-0.13	-0.28	-0.28
ROE	0.37	0.08	0.09	-0.01	0.40	0.42	0.04	-0.11		0.72	-0.01
RNOA	0.52	0.04	0.26	-0.01	0.47	0.43	0.06	-0.17	0.50		0.04
RD	0.16	0.04	0.18	0.01	0.06	-0.07	0.15	-0.21	-0.07	-0.04	

4. RESULTS

4.1. Model for Benchmark Multiples

Tables 4 and Table 5 report the results of annual cross-sectional regressions for each accounting multiple over the sample period. Each accounting-based multiple is regressed on eight explanatory variables as discussed above. Table 4 reports the results of annual cross-sectional regressions where the dependent variable is the price-to-book ratio. The annual-adjusted r-square averages 39.9% and ranges from a low of 22.3% to a high of 54%. In comparison, BL reports a higher annual-adjusted r-square averaging 51.2%, and ranging from 32.8% to 61.0%. The poor performance of the new-economy firms in the early 2000s that is not included in the sample of BL is a contributing factor to the difference in the explanatory power of the model. All

explanatory variables except the industry-adjusted earnings ratio (HM_P_EPS) have consistent signs across years and are significant at 1% significance level.

Collectively, these results suggest that growth, profitability and risk factors are incrementally important in explaining the P/B ratio, even after controlling for industry means. The estimated coefficients of several key explanatory variables change systematically over time. For example, both the estimated coefficient on industry-adjusted profit margin (IAPM) and forecasted growth rate (ILTG) show an upward trend over time which indicates that the estimated coefficients from the most recent years are likely to perform better than a rolling average of past years. These patterns support the method adopted by BL using estimated coefficients from each prior year's regression to forecast the current year's benchmark multiple.

Table 4. Annual Estimation Regressions for Benchmark Price-to-Book

This table reports the result from the following annual estimation regression:

$$P/B_{i,t} = \alpha_i + \sum_{j=1}^9 \delta_{j,t} C_{j,i,t} + \mu_{i,t}$$

All accounting variables are from the most recent fiscal year end publicly available by June 30th. P_B is the price to book ratio, and P_EPS is the price to earnings per share ratio. HM_PB and HM_P_EPS are the industry harmonic mean of P_B, P_EPS and the enterprise-value-to-sales ratio respectively. IAPM is the difference between the firm's profit margin and the industry profit margin, where profit margin is defined as operating profit divided by sales. IAPMLF is the product of IAPM and an indicator variable, where the indicator variable is equal to one if profit margin is less than zero and 0 otherwise. ILTG is the difference between the analysts' consensus forecast of the firm's long-term growth and the industry average. LEV is the total long-term debt scaled by book value of stockholders' equity. ROE is return-on-equity, measured as net income before extraordinary items as a percentage of book value of stockholders equity. RD is a firm's research and development expense expressed as a percentage of net sales. The average coefficients are time-series averages of cross-sectional estimates, where the t-statistics reported in the corresponding column are adjusted for autocorrelation and conditional heteroskedasticity (Newey and West 1987). Figures in parentheses are t-statistics. *** (**, *) indicates significant at the 1% (5%, 10%) level for two tailed test.

	Time series average		Pool sample	
	Coefficient	t-stat	Coefficient	t-stat
Intercept	-0.223***	(-3.16)	-0.465***	(-8.33)
HM_P_B	1.367***	(28.24)	1.500***	(48.34)
HM_P_EPS	0.000	(0.94)	0.000**	(-2.11)
IAPM	10.275***	(16.18)	11.577***	(28.89)
IAPMLF	-9.513***	(-11.71)	-12.136***	(-15.37)
ILTG	0.073***	(13.23)	0.077***	(28.44)
LEV	0.235***	(4.69)	0.388***	(14.75)
ROE	2.888***	(9.90)	2.251***	(7.47)
RD	2.761***	(4.91)	4.129***	(11.04)
Adj. R ²	0.399		0.331	
N			28,604	

Table 5 presents the results of annual cross-sectional regressions for the price-to-earnings ratio. The explanatory variables are similar to those used for the P_B regression. Most explanatory variables are significant with consistent signs except the industry-adjusted earnings ratio (HM_P_EPS) and the research and development expense (RD). The insignificance of RD is consistent with the view that investment in research and development will not

generate any economic income in the short run. The annual-adjusted r-squares average 4% and range from a low of 3% to a high of 7%. The low explanatory power for the P/EPS ratio coincides with Alford (1992) that the valuation errors for the P/E multiple decline when the industry classification is narrowed from two- to three-digit SIC codes, and further controls for firm size, leverage and earnings growth do not reduce the valuation errors.

Table 5. Annual Estimation Regressions for Benchmark Price-to-Earnings

This table reports the result from the following annual estimation regression:

$$P/E_{i,t} = \alpha_t + \sum_{j=1}^9 \delta_{j,t} C_{j,i,t} + \mu_{i,t}$$

All accounting variables are from the most recent fiscal year end publicly available by June 30th. P_B is the price to book ratio, and P_EPS is the price to earnings per share ratio. HM_PB and HM_P_EPS are the industry harmonic mean of P_B, P_EPS and the enterprise-value-to-sales ratio respectively. IAPM is the difference between the firm's profit margin and the industry profit margin, where profit margin is defined as operating profit divided by sales. IAPMLF is the product of IAPM and an indicator variable, where the indicator variable is equal to one if profit margin is less than zero and 0 otherwise. ILTG is the difference between the analysts' consensus forecast of the firm's long-term growth and the industry average. LEV is the total long-term debt scaled by book value of stockholders' equity. ROE is return-on-equity, measured as net income before extraordinary items as a percentage of book value of stockholders' equity. RD is a firm's research and development expense expressed as a percentage of net sales. The average coefficients are time-series averages of cross-sectional estimates, where the t-statistics reported in the corresponding column are adjusted for autocorrelation and conditional heteroskedasticity (Newey and West 1987). Figures in parentheses are t-statistics. *** (**, *) indicates significant at the 1% (5%, 10%) level for two tailed test.

	Time series average		Pool sample	
	Coefficient	t-stat	Coefficient	t-stat
Intercept	10.830***	(10.24)	8.417***	(11.38)
HM_P_B	4.074***	(7.06)	5.253***	(10.98)
HM_P_EPS	0.002	(1.40)	0.000	(0.16)
IAPM	-7.726	(-1.47)	8.165*	(1.77)
IAPMLF	65.333***	(4.96)	58.588***	(6.48)
ILTG	0.453***	(9.88)	0.469***	(11.05)
LEV	-1.468***	(-4.02)	-1.498***	(-4.74)
ROE	5.700***	(3.85)	7.316***	(6.65)
RD	11.497	(1.28)	1.302	(0.19)
Adj. R ²	0.040		0.035	
N			28,604	

4.2. Valuation Errors for Alternative Definitions of Comparable Firms

Prior studies generally compute the valuation errors (BL; Liu et al. 2002) for the various prediction measures, expressed as a proportion of the actual price-per-share. To facilitate comparison with prior studies and provide validating evidence whether the regression-based approach to select comparable firms is more appropriate in developing the composite multiples, we first present valuation errors for the P/B and P/E multiples based on three approaches to choosing comparable firms. For each

accounting multiple the three approaches are: (1) models based on industry-size-matched firms (MVEPB and MVEPEPS); (2) benchmark multiples based on prior year's estimated regression coefficients multiplied by the current year's accounting information (WPB and WPEPS); and (3) the harmonic mean of the actual multiples selected from four firms within the industry with the closest benchmark multiples (IWPB and IWPEPS). Table 6 reports descriptive statistics for valuation errors (actual price minus the predicted price, scaled by actual price) for each accounting multiple, where the pricing errors are reported for current year, as well

as one-year, two-year and three-year horizons.

Table 6. Valuation Errors against Alternative Definition of Comparable Firms

This table presents the mean and median of valuation errors for various prediction measures, expressed as a proportion of actual price-per-share. PB k and PEPS k are k year ahead of the P/B and P/EPS ratios respectively. The explanatory variables are: MVEPB, the harmonic mean of the actual P/B for the four closest firms matched on size after controlling for industry, measured as of the current year ($k=0$); WPB, the firm's benchmark P/B ratio, is determined using the coefficients derived from last year's estimation regression ($k= -1$) and current year accounting and market-based values ($k=0$); and IWPB, the harmonic mean of the actual P/B ratios for the four closest firms matched on WPB after controlling for industry. The variables for Panel B are defined analogously, replacing PB with PEPS respectively.

Panel A: Price-to-Book

	PBO		PBI		PB2		PB3	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
MVEPB	0.4118	0.3224	0.4939	0.3619	0.5487	0.3904	0.5902	0.3993
WPB	0.5221	0.3186	0.6128	0.3562	0.6563	0.3761	0.6861	0.3866
IWPB	0.3904	0.2954	0.4700	0.3440	0.5229	0.3789	0.5552	0.3884

Panel B: Price-to-EPS

	PEPS0		PEPS1		PEPS2		PEPS3	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
MVEPEPS	9.1373	0.4499	7.2591	0.4978	7.2679	0.5192	2.3044	0.5295
WPEPS	0.7452	0.3725	0.7465	0.4100	0.8091	0.4503	0.8240	0.4558
IWPEPS	1.9121	0.3755	1.9226	0.4186	2.0027	0.4556	2.4245	0.4612

The overall results are as expected. The median absolute errors for the current period are lower than for one, two- and three-year price horizons. Panel A indicates that the median absolute error for the industry-size-matched firms for the P/B ratio is 0.32 for the current year and 0.40 for year three, slightly lower than the results reported by BL (0.38 and 0.44). Importantly, the median absolute errors for the estimated price based on benchmark multiple models (WPB and IWPB) are slightly lower (0.31 and 0.29 respectively) for the current period than those using the industry-size-matched firms. This trend continues for one-, two- and three-year ahead prediction interval. Comparing the differences for the median absolute errors among the three different models, we find that the harmonic mean of the actual multiples selected from four firms within the industry with the closest benchmark multiples (IWPB) has the lowest pricing errors. Overall, the P/B ratio results suggest single-multiple valuations based on benchmark multiples formed using the BL's approach appear to exhibit lower valuation errors.

However, the results reported in Panel B of Table 6 indicate that both the benchmark multiple and industry-adjusted benchmark multiple models for the P/E ratio generally have lower median absolute errors than the model based on industry-size-matched firms. The median (mean) absolute pricing error for the benchmark multiple (WPEPS) model is almost indistinguishable from (much lower than) the industry-adjusted benchmark multiple (IWPEPS) model. This indicates that the benchmark multiple implicitly controls for industry differences via the explanatory variables employed to explain the P/E ratio. Overall, the results suggest that combining the P/B and P/E ratios into a composite measure might reduce the conflicting results and lead to an improved valuation.

4.3. Comparison of Valuation Errors for Individual and Composite Multiples-based Valuations

The main objective of this research is to investigate whether composite valuations combining the P/B and P/E ratio (P/B/E) based on the regression-weighted approach result in improved predictive value with respect to actual, current, one-, two- and three-year ahead prices. Thus, there are two types of weighting schemes used in combining the single ratios into a composite valuation: equally-weighted and regression-weighted. To provide a point of comparison, two approaches are adopted in the regression-weighted scheme: (1) unrestricted regression, with an intercept term, that allows the estimated weights to vary across firms (P/B/E Unrestrict); and (2) restricted regression, with no intercept, and a restriction across the two estimated weighting coefficients to sum to one (P/B/E Restrict). In total, there are two individual multiple-based valuation (P/B ratio and P/E ratio), one equal-weighted composite multiples (P/B/E Eq Wt.) and two regression-weighted composite multiples (P/B/E Unrestrict and P/B/E Restrict).

Table 7 reports the distribution of valuation errors for both single and composite multiple valuations against the current, one-, two- and three-year ahead share price. As expected, the median absolute errors for current period prices are lower than one-, two- and three-year horizon prices. For four different prediction prices, the mean and median absolute errors for the composite multiples combining the P/B and P/E using unrestricted regression-weights (P/B/E Unrestrict) have lower errors than other single and composite multiples. The results also suggest that the two regression-based composite multiples (P/B/E Unrestrict and P/B/E Restrict) exhibit smaller absolute mean and median valuation errors than equal-weighted and single multiples. Overall, the results confirm that composite benchmark multiples lead to improved

valuations over single multiples, and the use of regression-based weights can enhance the predictive ability of the composite multiples.

Table 7. Comparison of Valuation Errors between Individual and Composite Multiples

This table presents the mean and median of valuation errors for various prediction measures, expressed as a proportion of actual price-per-share. There are two individual multiple-based valuations (P/B and P/E ratios), one equal-weighted composite multiples (P/B/E Eq. Wt.) and two regression-based composite valuations (P/B/E Restrict and P/B/E Unrestrict). P/B/E Restrict involve no intercept and a restriction across the coefficients to sum to one. P/B/E Unrestrict include the intercept and the coefficients are not restricted to sum to one.

	Price 0		Year 1 Price		Year 2 Price		Year 3 Price	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
P/B ratio	0.5221	0.3186	0.6127	0.3562	0.6381	0.3698	0.6447	0.3738
P/E ratio	0.7452	0.3725	0.7465	0.4101	0.7734	0.4388	0.7703	0.4385
P/B/E Eq Wt.	0.5205	0.2979	0.5900	0.3469	0.6378	0.3741	0.6525	0.3792
P/B/E Unrestrict	0.4397	0.2774	0.5135	0.3229	0.5374	0.3394	0.5435	0.3447
P/B/E Restrict	0.4893	0.3037	0.5846	0.3465	0.6195	0.3631	0.6313	0.3694

5. SENSITIVITY TESTS

5.1. Parsimonious Model

Results from the estimated regression reported in section 4.1 reveal several insignificant explanatory variables among the two ratios. As a result, this section investigates whether using a parsimonious model, based on including only variables with significant explanatory power in the benchmark forming regressions generates valuations of improved accuracy to those reported above. In particular, the industry harmonic mean of the P/E ratio (HM_P_EPS) is removed from the development of the P/B benchmark multiple, while the industry harmonic mean of the P/E ratio (HM_P_EPS), the industry profit margin (IAPM) and the research and development expense (RD) are removed from the development of the P/E benchmark multiple. The results on the distribution of valuation errors indicate similar findings and trends for one-, two- and three-year horizons to those reported in Table 7 using the full model. Overall results for pricing errors are slightly smaller except for year three prices where the pricing errors are almost identical to the full model. These results suggest that inclusion of insignificant explanatory variables in the formation of benchmark portfolios can inject noise into the benchmarks and marginally impair the resulting valuation performance. However, the main conclusion remains unchanged.

5.2. Value and Glamour Stocks

Prior research indicates that firm characteristics such as growth and size have caused differences in returns between 'value' stocks (low P/B ratio) and 'glamour' stocks (high P/B ratio).¹⁶ For example, Fama and French (1993, 1996) suggest that the extra return to value stocks is simply compensation for their higher risk. Alternatively, Lakonishok, Shleifer and Vishny (1994) claim that value stocks produce superior returns because investors consistently

overestimate the future earnings of growth stock relative to value stocks. Chan et al (2003) argue that expectations about long-term earnings growth are crucial to valuation models and cost of capital estimates and it is possible that consistency in growth varies across firms. For example, firms with a record of sustained, strong past growth in earnings are heavily represented among those trading at high multiples. Alternatively, stocks with a history of disappointing past growth are shunned by the investment community and priced at low multiples.

Given the important role of 'value' and 'glamour' in valuation, we examine whether the composite multiple valuation using regression-based weights varies across 'value' and 'glamour' stocks. We classify the value and glamour firms following Chan et al. (2003). A value stock is defined as a firm ranked in the top three deciles of firms by book-to-market value of equity. A glamour stock is defined as a firm ranked in the bottom three deciles by book-to-market value of equity. Tables 8 reports the pricing errors for the December year end value and glamour stocks using I/B/E/S growth rate respectively. The overall results indicate that the unrestricted composite multiples continue to be superior to other single and composite multiples valuation approach.

5.3. Large, Mid-cap and Small Firms

Chan and Chen (1991) report small firms on the NYSE during the 1956 to 1985 period tend to be firms that have not been performing well. They become relatively inefficient or have higher costs and consequently decrease in relative size. To examine whether the role of valuation approach is subject to firm size, we repeat our analyses for large, mid-cap and small firms. Large firms are defined as those ranked in the top two deciles by market value of equity, mid-cap firms comprise stocks ranked in the third through seventh decile and small firms are ranked in the bottom three deciles by market value of equity.

¹⁶ Fama and French (1993, 1994), Black (1993), MacKinlay (1995), Kothari, Shanken and Sloan (1995) and Chan, Jagadeesh and Lakonishok (1995).

Table 8. Comparison of Valuation Errors between Individual and Composite Multiples – Value vs. Glamour Stocks

This table presents the mean and median of valuation errors for various prediction measures, expressed as a proportion of actual price-per-share. There are two individual multiple-based valuations (P/B and P/E ratios), one equal-weighted composite multiples (P/B/E Eq. Wt.) and two regression-based composite valuations (P/B/E Restrict and P/B/E Unrestrict). P/B/E Restrict involve no intercept and a restriction across the coefficients to sum to one. P/B/E Unrestrict include the intercept and the coefficients are not restricted to sum to one.

Panel A: Value stocks

	Price 0		Year 1 Price		Year 2 Price		Year 3 Price	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
P/B ratio	0.5848	0.3577	0.6801	0.3916	0.7332	0.3991	0.7632	0.3907
P/E ratio	0.8971	0.4400	0.8851	0.4871	0.9267	0.5169	0.9585	0.5006
P/B/E Eq Wt.	0.6111	0.3421	0.6957	0.4051	0.7631	0.4290	0.8114	0.4387
P/B/E Unrestrict	0.4485	0.2940	0.5333	0.3382	0.5598	0.3557	0.5768	0.3613
P/B/E Restrict	0.5773	0.3329	0.6751	0.3878	0.7178	0.4039	0.7495	0.4062

Panel B: Glamour stocks

	Price 0		Year 1 Price		Year 2 Price		Year 3 Price	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
P/B ratio	0.4507	0.2885	0.5251	0.3220	0.5550	0.3423	0.5828	0.3491
P/E ratio	0.6311	0.3582	0.6499	0.3810	0.6830	0.4104	0.7068	0.4107
P/B/E Eq Wt.	0.4495	0.2777	0.5141	0.3158	0.5626	0.3492	0.5917	0.3431
P/B/E Unrestrict	0.3602	0.2433	0.4283	0.2883	0.4684	0.3171	0.4815	0.3083
P/B/E Restrict	0.4356	0.2737	0.4926	0.3151	0.5421	0.3463	0.5721	0.3521

Tables 9 report the mean and median pricing errors for large, mid-cap and small firms. All three sub-samples have smaller mean and median absolute errors than the total sample firms. For current period valuation errors and for the unrestricted composite multiples, the large firm sample has smaller (mean and median) absolute errors (0.3178 and 0.2301) than mid-cap (0.3590 and 0.2316) and small firms (0.3498 and 0.2394).

However, for other prediction horizons, mid-cap firms are found to have the smallest mean and median absolute errors. Collectively, the sensitivity analysis suggests that the restricted composite multiple valuation approach is valid for not only large and stable firms, but tends to have even less prediction errors in forecasting future period prices for mid-cap firms and small firms than large firms.

Table 9. Comparison of Valuation Errors between Individual and Composite Multiples – Large, Mid-cap and Small Firms

This table presents the mean and median of valuation errors for various prediction measures, expressed as a proportion of actual price-per-share. There are two individual multiple-based valuations (P/B and P/E ratios), one equal-weighted composite multiples (P/B/E Eq. Wt.) and two regression-based composite valuations (P/B/E Restrict and P/B/E Unrestrict). P/B/E Restrict involve no intercept and a restriction across the coefficients to sum to one. P/B/E Unrestrict include the intercept and the coefficients are not restricted to sum to one.

Panel A: Large firms

	Price 0		Year 1 Price		Year 2 Price		Year 3 Price	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
P/B ratio	0.3695	0.2798	0.4551	0.3184	0.4899	0.3398	0.5157	0.3361
P/E ratio	0.5295	0.3248	0.5938	0.3567	0.6082	0.3725	0.6291	0.3781
P/B/E Eq Wt.	0.3805	0.2644	0.4659	0.3022	0.5010	0.3307	0.5217	0.3266
P/B/E Unrestrict	0.3178	0.2301	0.4078	0.2791	0.4500	0.2960	0.4701	0.2946
P/B/E Restrict	0.3504	0.2696	0.4356	0.3137	0.4801	0.3340	0.4326	0.2458

Panel B: Mid-Cap firms

	Price 0		Year 1 Price		Year 2 Price		Year 3 Price	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
P/B ratio	0.4684	0.3004	0.5300	0.3243	0.5352	0.3300	0.5468	0.3425
P/E ratio	0.7338	0.3625	0.6859	0.3873	0.6951	0.4043	0.6967	0.4100
P/B/E Eq Wt.	0.4973	0.2806	0.5238	0.3138	0.5553	0.3412	0.5679	0.3460
P/B/E Unrestrict	0.3590	0.2316	0.3950	0.2656	0.4062	0.2778	0.4098	0.2835
P/B/E Restrict	0.4873	0.2883	0.5070	0.3179	0.5293	0.3333	0.5381	0.3403

Panel C: Small firms

	Price 0		Year 1 Price		Year 2 Price		Year 3 Price	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
P/B ratio	0.7110	0.4163	0.7651	0.4249	0.7802	0.4089	0.7911	0.3992
P/E ratio	0.9613	0.4990	0.9250	0.5285	0.9302	0.5439	0.9350	0.5268
P/B/E Eq Wt.	0.6643	0.3866	0.7269	0.4304	0.7646	0.4305	0.8002	0.4434
P/B/E Unrestrict	0.3498	0.2394	0.4222	0.2850	0.4393	0.3120	0.4568	0.3120
P/B/E Restrict	0.6983	0.3851	0.7788	0.4046	0.7622	0.4153	0.7622	0.4185

5.4. Old and New Economy Firms

Collins, Pincus and Xie (1999) and Givoly and Hayn (2000) document a monotonic increase in the frequency of losses over the last five decades. Hayn (1995) shows that the market reaction to a loss is systematically different to the response to positive earnings. Given the increasing number of loss firms in recent times, we divide the sample into old and new economy firms to examine whether the two regression-weighted composite multiples apply equally well for the old and new economy firms. Following BL, we define new economy firms within the following four-digit SIC code categories as those characterised by a higher proportion of growth and not currently earning a profit. These are firms in the biotechnology (2833-2836 and 8731-8734), computers (3570-3577 and 7371-7379), electronics

(3600-3674), and telecommunications (4810-4841) SIC classifications.

The results are reported in Tables 10. The old economy firms have a much higher number of firms than new economy firms, representing 82% of the whole sample. We find that the valuation errors for new economy firms are substantially higher than old economy firms. In fact, the results of new economy firm for single composite valuation approach such as the P/B or P/E ratio indicate higher valuation errors than those in BL where their sample period ended in 1998. It is likely that our results are driven by the collapse of the Dot-com firms after 1998. However, the inferences discussed above are not affected. The predictive ability of the unrestricted composite multiples valuation approach is found to have smallest pricing errors among other approaches for both old and new economy firms.

Table 10. Comparison of Valuation Errors between Individual and Composite Multiples - Old vs. New Economy Firms

This table presents the mean and median of valuation errors for various prediction measures, expressed as a proportion of actual price-per-share. There are two individual multiple-based valuations (P/B and P/E ratios), one equal-weighted composite multiples (P/B/E Eq. Wt.) and two regression-based composite valuations (P/B/E Restrict and P/B/E Unrestrict). P/B/E Restrict involve no intercept and a restriction across the coefficients to sum to one. P/B/E Unrestrict include the intercept and the coefficients are not restricted to sum to one.

Panel A: Old economy firms

	Price 0		Year 1 Price		Year 2 Price		Year 3 Price	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
P/B ratio	0.5150	0.3157	0.5810	0.3450	0.5979	0.3524	0.6083	0.3587
P/E ratio	0.7116	0.3777	0.7265	0.4051	0.7481	0.4336	0.7529	0.4315
P/B/E Eq Wt.	0.5073	0.2993	0.5781	0.3397	0.6167	0.3687	0.6315	0.3667
P/B/E Unrestrict	0.4280	0.2701	0.4939	0.3149	0.5076	0.3274	0.5064	0.3297
P/B/E Restrict	0.4983	0.3047	0.5628	0.3389	0.5915	0.3592	0.6017	0.3638

Panel B: New economy firms

	Price 0		Year 1 Price		Year 2 Price		Year 3 Price	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
P/B ratio	0.5507	0.3524	0.6901	0.3892	0.7416	0.4043	0.7698	0.4006
P/E ratio	0.9878	0.4268	0.9000	0.4809	0.9164	0.4808	0.8901	0.4536
P/B/E Eq Wt.	0.6006	0.3173	0.6381	0.3673	0.7131	0.3900	0.7231	0.3882
P/B/E Unrestrict	0.5071	0.2895	0.6053	0.3445	0.6447	0.3704	0.6605	0.3774
P/B/E Restrict	0.5105	0.3193	0.6113	0.3650	0.5768	0.3074	0.7171	0.3999

6. CONCLUSION

This study investigates whether accounting-based composite multiples can lead to improved valuations. The results support that composite benchmark multiples lead to improved valuations over single multiples and further improvement is achieved by incorporating firm characteristics to derive firm-specific regression-based weights. The unrestricted regression-weighted composite multiples perform better than other approaches in predicting year one to year three share prices. Findings remain unchanged when the analysis is conducted using different estimation regression,

different sample periods and subsamples based on firm size, age and book-to-market ratio.

This research contributes to the literature of relative valuation and capital market research in at least two respects. First, this study is one of the first to examine how relative valuation performs across firms with firm-specific weights varying with firm characteristics. Second, it provides a comprehensive comparison between single, equal-weighted and regression-weighted composite multiples that reflect cross-sectional variations in firm growth, profitability and cost-of-capital in equity valuation. In terms of practical implications, the results suggest that composite multiple-based valuation is

useful in settings where no current market prices exist, for example in initial public offering and the valuation of private companies.

REFERENCES

- Aleksanyan, M. 200,. "Value relevance of book value, retained earnings and dividends: premium vs discount firms", Working paper, University of Glasgow, UK.
- Alford, A. W. 1992, "The effect of the set of comparable firms on the accuracy of the price-earnings valuation method", *Journal of Accounting Research*, 30, pp.94-108.
- Ali, A., Lee-Seok Hwang & M.A. Trombley, 2003, "Arbitrage risk and the book-to-market anomaly", *Journal of Financial Economics*, 69, pp.355-73.
- Altman, E.I. 1968, "Financial Ratios, Discriminant Analysis and Prediction of Corporate Bankruptcy", *The Journal of Finance*, September, pp.589-609.
- Altman, E.I. 1993 *Corporate Financial Distress and Bankruptcy: a complete guide to predicting & avoiding distress and profiting from bankruptcy*, 2nd ed., John Wiley & Sons, Inc. United States.
- Baker, M. & Ruback, R. 1999, "Estimating Industry Multiples", Working Paper, Harvard University.
- Barbee, W.C. Jr., Mukherji, S. & Raines, G.A. 1996, "Do Sales-Price and Debt-Equity Explain Stock Returns Better than Book-Market and Firm Size?" *Financial Analyst Journal*, Mar/Apr, 52, 2, pp.56-60.
- Barker, R.G. 1999, "The role of dividends in valuation models used by analysts and fund managers", *The European Accounting Review*, 8:2, pp.195-218.
- Barth, M., Beaver, W., Landsman, W. & Wayne, R. 1998, "Relative valuation roles of equity book value and net income as a function of financial health", *Journal of Accounting and Economics*, 25, pp.1-34.
- Barth, M., Beaver, W., Landsman, W. & Wayne, R. 2001, "The relevance of the value relevance literature for financial accounting standard settings: another view", *Journal of Accounting and Economics*, 31, pp.77-104.
- Beatty, R., Riffe, S. & Thompson, R. 1999, "The method of comparables and tax court valuation of private firms: an empirical investigation", *Accounting Horizons*, 13, no.3, 179-99.
- Berger, P., Ofek, E. & Swary, I. 1996, "Investor valuation of abandonment option", *Journal of Financial Economics*, 42: pp.257-87.
- Bhojraj, S. & Lee, C.M.C. 2002, "Who is my peer? A valuation-based approach to the selection of comparable firms", *Journal of Accounting research*, 40, pp.407-39.
- Block, S.B. 1999, "A Study of Financial Analysts: Practice and Theory", *Financial Analysts Journal* (July/August), pp.86-95.
- Boatsman, J.R. & Baskin, E.F. 1981, "Asset Valuation with incomplete markets", *The Accounting Review*, 56, pp.38-53.
- Bradshaw, M.T. 2002, "The Use of Target Prices to Justify Sell-Side Analysts' Stock Recommendations?" *Accounting Horizons*, Vol.16, No.1, pp.27-41.
- Bradshaw, M.T. 2004, "How do Analysts Use Their Earnings Forecasts in Generating Stock Recommendations?" *The Accounting Review*, Vol.79, No.1, pp.25-50.
- Burgstahler, D. & Dichev, I. 1997, "Earnings, adaptation and equity value", *The Accounting Review* 72, pp.187-215.
- Chan, K.C. & Chen, N. 1991, "Structural and Return Characteristics of Small and Large Firms", *Journal of Finance*, 4, September, pp.1467-84.
- Chan, L.K.C., Jegadeesh, N. & Lakonishok, J. 1995, "Evaluating the performance of value versus glamour stocks The impact of selection bias", *Journal of Financial Economics*, 38. pp.269-96.
- Chan K., Karceski, J. & Lakonishok, J. 2003, "The Level and Persistence of Growth Rates", *Journal of Finance*, 58, 643-84.
- Chan, L.K.C., & Lakonishok, J. 2004, "Value and Growth Investing: Review and Update", *Financial Analysts Journal*, Jan/Feb, 60, pp.71-86.
- Cheng, C.S.A. & McNamara, R. 2000, "The Valuation Accuracy of the Price-Earnings and Price-Book Benchmark Valuation Methods", *Review of Quantitative Finance and Accounting*, 15, pp.349-70.
- Cheng, Q. 2005, "The Role of Analysts' Forecast in Accounting-based Valuation: A Critical Evaluation", *Review of Accounting Studies*, 10, pp.5-31.
- Collins, D.W. & Kothari, S.P. 1989, "An analysis of intertemporal and cross-sectional determinants of earnings response coefficients", *Journal of Accounting and Economics*, 11, pp.143-81.
- Collins, D.W., Maydew, E.L. & Weiss, I.S. 1997, "Changes in the value-relevance of earnings and book values over the past forty years", *Journal of Accounting and Economics*, 24, pp.39-67.
- Collins, D.W., Pincus, N. & Xie, H. 1999, "Equity Valuation and Negative Earnings: The Role of Book Value of Equity", *The Accounting Review*, 74, No.1, pp.29-61.
- Courteau, L., Kao, J.L., O'Keefe, T. & Richardson, G.D. 2003, "Gains to Valuation Accuracy of Direct Valuation over Industry Multiplier Approaches", Working Paper, Eastern Mediterranean University, University of Alberta, University of Oregon and University of Toronto.
- Demirakos, E.G., N.C. Strong and M. Walker, 2004, "What Valuation Models Do Analysts Use?" *Accounting Horizons* 18, pp.221-240.
- Dhatt, M.S., Kim, Y.H. & Mukherji, S. 2001, "The Efficiency of Individual and Composite Measures for Identifying Value Stocks", Working paper, University of Minnesota, University of Cincinnati and Howard University, June.
- Damodaran, A. 2002, "Investment Valuation", 2nd ed., J. Wiley and Sons, New York.
- Danielson, M.G. & Dowdell, T.D. 2001, "The Return-Stages Valuation Model and the Expectations Within a Firm's P/B and P/E ratios", *Financial Management*, Summer 2001, pp.93-124.
- Doukas, J.A., Kim, C. & Pantzalis, C. 2004, "Divergent Opinions and the Performance of Value Stocks", *Financial Analysts Journal*, Nov/Dec, 60, pp.55-64.
- Fama, E.F. and French, K.R. 1992, "The Cross Section of Expected Stock Returns", *Journal of Finance*, 47, no.2 (June), pp.427-65.
- Fama, E.F. & French, K.R. 1993, "Common risk factors in returns on stocks and bonds", *Journal of Financial Economics*, 33, no.1 (February), pp.3-56.
- Fama, E.F. & French, K.R. 1996, "Multifactor explanations of asset pricing anomalies", *Journal of Finance*, 51, no.1 (March), pp.55-84.
- Fama, E.F. & French, K.R. 1998, "Value versus Growth: The International Evidence", *Journal of Finance*, 53, no.6 (December), pp.1975-99.
- Fairfield, P. 1994, "P/E, P/B and the Present Value of Future Dividends", *Financial Analysts Journal*, 50, pp.23-33.
- Feltham, G.A. & Ohlson, J.A. 1995, "Valuation and clean surplus accounting for operating and financial activities", *Contemporary Accounting Research* 11, pp.689-731.
- Fernandez, P. 2001, "Valuation using multiples. How do analysts reach their conclusions?", Working

- paper, IESE Business School.
41. Frank, K. 2002, "The effect of growth on the value relevance of accounting data", *Journal of Business Research*, 55, pp.69-78.
 42. Frankel, R., & Lee, C.M.C. 1998, "Accounting Valuation, Market Expectation, and Cross-sectional Stock Returns", *Journal of Accounting and Economics*, 25, pp.283-319.
 43. Gaver, J.J., & Gaver, K.M. 1993, "Additional evidence on the association between the opportunity set and corporate financing, dividend, and compensation policies", *Journal of Accounting and Economics*, 16, pp.125-60.
 44. Gebhardt, W.R., Lee, C.M.C. & Swaminathan, B. 2001, "Toward an implied cost of capital", *Journal of Accounting Research*, 39, pp.135-76.
 45. Givoly, D., & Hayn, C., 2000, "The changing time-series properties of earnings, cash flows and accruals: Has financial reporting become more conservative?" *Journal of Accounting and Economics*, 29, pp.287-320.
 46. Gode, D. & Mohanram, P. 2004, "Inferring the Cost of Capital Using the Ohlson-Juettner Model", *Review of Accounting Studies*, 8 (4), pp.399-431.
 47. Gode, D. & Ohlson, J.A. 2006, "A Unified Valuation Framework for Dividends, Free-Cash Flows, Residual Income, and Earnings Growth Based Models", Working Paper, New York University and Arizona State University.
 48. Guay, W., Kothari, S.P. & Shu, S. 2005, "Properties of Implied Cost of Capital Using Analysts' Forecast", Working Paper, MIT Sloan School of Management.
 49. Hayn, C., 1995, "The information content of losses", *Journal of Accounting and Economics*, 20, pp.125-153.
 50. Henschke, S. & Homburg, C. 2009, "Equity Valuation using Multipliers: Controlling for Differences amongst Peers", Working Paper, University of Cologne.
 51. Holthausen, R.W., & Watts, R.L. 2001, "The relevance of the value relevance literature for financial accounting standard settings", *Journal of Accounting and Economics* 31, pp.3-75.
 52. How, J. J. Lam & J. Yeo, 2007, "The use of the comparable firm approach in valuing Australian IPOs", *International Review of Financial Analysis*, 16, pp.99-115.
 53. Jensen, G.R. Johnson, R.R. & Mercer, J.M. 1997, "New Evidence on Size and Price-to-Book Effects in Stock Returns", *Financial Analysts Journal*, Nov/Dec, 53, pp.34-42.
 54. Kaplan, S.N. & Ruback, R.S. 1995, "The Valuation of Cash Flow Forecasts: An Empirical Analysis." *Journal of Finance* 50, pp.1059-93.
 55. Kim, M. & Ritter, J. 1999, "Valuating IPO's", *Journal of Financial Economics*, 53, pp.409-37.
 56. LaKonishok, J., Shleifer, A. & Vishny, R.W. 1994, "Contrarian investment, extrapolation and risk", *Journal of Finance*, 49, pp.1541-78.
 57. Lee, C.M.C. 1999, "Accounting-based valuation: Impact on business practice and research", *Accounting Horizons*, 13, pp.413-25.
 58. Lev, B. 1989, "On the usefulness of earnings and earnings research: Lessons and directions from two decades of empirical research", *Journal of Accounting research*, 27, 3, pp.153-92.
 59. Liu, J., Nissim, D. & Thomas, J. 2002, "Equity Valuation Using Multiples", *Journal of Accounting Research*, 40, pp.135-72.
 60. Liu, J., Nissim, D. & Thomas, J. 2007, "Is Cash Flow King in Valuation?" *Financial Analysts Journal*, vol.63, No.2, pp.1-13.
 61. Myers, S.C. 1984, "Financial Theory and Strategy", *Interfaces*, vol.14, no.1 (January/February), pp.126-37.
 62. Nissim, D., & Penman, S.H. 2001, "Ratio Analysis and Equity Valuation: from research to practice", *Review of Accounting Studies*, 6, pp.109-54.
 63. Ohlson, J. 1995, "Earnings, Book Values and Dividends in Equity Valuation", *Contemporary Accounting Research*, 11, pp.661-87.
 64. Ohlson, J.A. & Juettner-Nauroth, B.E. 2005, "Expected EPS and EPS growth as determinants of value", *Review of Accounting Studies*, 10, pp.349-65.
 65. Penman, S. 1996, "The Articulation of Price-Earnings Ratios and Price-Book Ratios and the Evaluation of Growth", *Journal of Accounting Research*, 34, pp.235-59.
 66. Penman, S. 1998, "Combining Earnings and Book Value in Equity Valuation", *Contemporary Accounting Research*, 15, pp.291-324.
 67. Penman, S., 2003. *Financial Statement Analysis and Security Valuation*, McGraw_Hill, New York.
 68. Purnanandam, A.K. & B. Swaminathan, 2004, "Are IPOs Really Underpriced? The Review of Financial Studies", vol.17, no.3, pp.811-48.
 69. Rau P.R. & Vermaelen, T. 1998, "Glamour, value and the post-acquisition performance of acquiring firms", *Journal of Financial Economics*, 49, pp.223-53.
 70. Rhodes-Kropf, M., D.T. Robinson & S. Viswanathan, 2005, "Valuation waves and merger activities: The empirical evidence", *Journal of Financial Economics*, 77, pp.561-603.
 71. Richardson, G. & Tinaikar, S. 2004, "Accounting based valuation models: what have we learned?" *Accounting and Finance*, 44, pp.223-55.
 72. Shleifer, A., and R. Vishny, 1997, "The limits of arbitrage", *Journal of Finance*, 52, pp.35-55.
 73. Skinner, D. 1993, "The investment opportunity set and accounting procedure choice", *Journal of Accounting and Economics*, 16, pp.407-45.
 74. Skinner, D. & R. Sloan, 2002, "Earnings surprises, growth expectations, and stock returns, or, don't let an earnings torpedo sink your portfolio", *Review of Accounting Studies*, 7, pp.289-312.
 75. Sloan, R. 2002, "Discussion of Who Is My Peer? A Valuation-Based Approach to the Selection of Comparable Firms", *Journal of Accounting research*, 40, pp.441-44.
 76. Smith, C.W., & Watts, R.L. 1992, "The investment opportunity set and corporate financing, dividend, and compensation policies", *Journal of Financial Economics*, 32, pp.263-92.
 77. Subramanyam, K.R. & Wild, J.J. 1996, "Going-Concern Status, Earnings Persistence, and Informativeness of Earnings", *Contemporary Accounting Research*, 13 no.1, pp.251-73.
 78. Tasker, S.C. 1998, "Industry Preferred Multiples in Acquisition Valuation", Working paper, Cornell University, Ithaca, NY.
 79. Yee K.K. 2004, "Combining Value Estimates to Increase Accuracy", *Financial Analysts Journal*, 60, 4, pp.23-8
 80. Yoo, Y.K. 2006, "The valuation accuracy of equity valuation using a combination of multiples", *Review of Accounting and Finance*, 5, 2, pp.108-23.
 81. Zarowin, P. 1990, "What determines earnings-price ratio: Revisited", *Journal of Accounting, Auditing and Finance* 5, pp.439-57.
 82. Zhang, X. 2000, "Conservative accounting and equity valuation", *Journal of Accounting and Economics*, 29, pp.125-49.