Some Refinements to the Stock Valuation Models Based on Accounting Variables

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Stock valuation has always been an enigma even for the most analytically equipped investor or fund manager because numerous factors determine the worth of a stock. A review of business periodicals suggests that valuation models are of interest to the investment community. Different models were proposed and are used by practitioners. This paper investigates the practical utility of two models—P/E and P/B. The study employs Seemingly Unrelated Regression (SUR) technique using BSE prices for the period 1996-2000. Results indicate that the conventional models need to be modified by including the current value drivers namely sales growth rate and Operating Profit Growth (OPG). The study finds that when OPG is included in the PEM model, the unexplained variation has reduced to a statistically significant extent, while sales growth and operating profit growth rate explain a significant portion of the variability in the P/B model.

Valuation is at the core of success in stock market investing. Security valuation models are a significant aid to the investors in providing a benchmark for comparison while detecting mispriced securities (if any). But ascertaining the worth of an asset—in particular a financial asset—is a very intriguing and subjective process, often involving consideration of several factors. Stock valuation procedures have ranged from simple mechanical techniques to esoteric and sophisticated models that incorporate a comprehensive set of factors that are considered to be influencing stock prices. New valuation techniques are being developed; older ones are being modified with the aim of achieving success consistently.

The Price-Earnings Multiple (PEM) or Price-Earnings Ratio—first reported in the *Wall Street Journal* on October 3, 1972 (Ken, 1995)—is a keenly followed metric in the investment community. Stock valuation models based on PEM occupy a pre-eminent position in the analytical paraphernalia of security analysts and investment advisors. The P/E is computed by dividing the current market price of a company's share by the EPS forecasted for the next year. The price-earnings multiple shows the price the market is willing to pay for each rupee of a company's earnings thereby reflects the earnings quality and the growth potential. It is often used as a basis for comparing one stock with another. A P/E of 10 implies the security is twice as expensive as a security with a P/E of 5 *ceteris paribus*.

Ever since Wilcox (1984) has shown the P/B-ROE model's superiority over P/E model, P/B ratio became part of the everyday jargon of analysts and investors alike. The book value (per share) is calculated by adding up all the assets, subtracting all liabilities and then dividing the resultant number by the number of outstanding shares. An important attribute of Book Value (B) is its ease of computation and it is particularly useful in valuing financial institutions, non-banking financial companies and banks, since the book value of the (financial) assets of these firms will be largely similar to their market values.

The purpose of this study is to provide an empirical perspective on the practical usefulness of these two valuation models in the Indian context.

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Overview of Prior Studies

Stock valuation has attracted the attention of researchers for a long time. From the mid-1980s, the works of Fuller and Hsui (1984); Wilcox (1984); Rosenberg *et al.* (1985); Sorenson and Williamson (1985); Estep (1989); Mcqueen and Thorley (1991); Fama and French (1992); Agrawal *et al.* (1996); Chui and Wei (1998); and Ahmadu *et al.* (1999) *inter alia* need to be mentioned. A characteristic of all these studies is that they were carried out in either developed or ASEAN stock markets. In India, Balakrishnan (1984) finds that current dividend and book value are important determinants of market price. Chawla and Srinivasan (1987) investigated the determinants of share prices in the Indian context. Sharma (1989) identified factors that influence P/E ratios in cotton textile firms in India over the period 1976-80. Barua and Raghunathan (1990) showed that P/E ratios during the 1990s were on the higher side using Gordon's model. Zahir (1992) established that approximately two-thirds variation in equity prices could be explained by fundamental factors. Gupta *et al.* (1998) focused on the relationship between P/E ratio and company size; while Tuli and Mittal (2001) examined the factors influencing the P/E ratio.

Need for this Study

The reasons for the study are twofold: First, the wheel has completed a full circle as the technology stocks, which defied fundamentals *albeit* transitorily, lost their sheen and market fancy. Once again 'value investing' is gaining ground. Fund managers and investors are looking back at stocks from traditional sectors and the customary accounting variables-based models of valuation. This change warrants an examination of the applicability and adequacy of these models. Second, the literature review highlights (1) the paucity of empirical work in the Indian context, with particular reference to the P/B valuation model; (2) with regard to P/E valuation model, most of the existing works are based on data[1] during the pre-liberalization period. After the 1990s the Indian markets underwent a structural change. There is a need to examine the utility of these valuation models using the current period's data. These reasons motivated the researcher to undertake this work.

Theoretical Development of the Models

In the P/E approach to stock valuation, security analysts first estimate the EPS for the upcoming period and a 'normal' P/E ratio, the product of these two numbers yields an estimate of future stock price. The success of this method depends to a large extent on the appropriateness of the P/E ratio. Therefore, it is important to identify the fundamental determinants of the P/E ratio that are used in its estimation. Conceptually, both P/E and P/B valuation models have their bases in the well-known Gordon's dividend discount model:

$$P_0 = \frac{Div_1}{k-g} \qquad (1)$$

Equation (1) can be rewritten as:

$$P_0 = \frac{E_1.b}{k-g} = \frac{E_0.b.(1+g)}{k-g} \qquad (2)$$

Where,

Div_1 = expected dividend after one period;

k = required rate of return;

g = growth rate of dividends;

E_1 = forecasted EPS after one period;

E_0 = EPS for the current year; and

b = payout ratio

By dividing equation (2) with E_0 on both sides, we get:

$$\frac{P_0}{E_0} = \frac{b.(1+g)}{k-g}$$

A perusal of P/E ratio indicates that it is a function of sustainable growth in dividends, payout ratio and the required rate of return (in consonance with the risk implied by the security). Thus an analyst can estimate a normal P/E to use in stock valuation by using such fundamental factors. Similarly, the P/B model can also be derived from the Gordon's model by dividing both sides of equation (1) by book value (B_0).

$$\frac{P_0}{B_0} = \frac{Div_1 / B_0}{k-g}$$

Where, B_0 = current book value per share and the other terms are as defined earlier. Hence the fundamental determinants of Price-to-Book value are the ratio of

[1] Even recently reported work of Tuli and Mittal (2001) is based on data spanning from 1988-89 to 1992-93.

dividend to book value, required rate of return and dividend growth rate.

In both these models required rate of return for the stock 'j' can be determined in accordance with CAPM i.e., $K_j = R_f + \beta_j (K_m - R_f)$. Where, K_j = required rate of return; R_f = risk-free return; K_m = market rate of return; and β_j = risk as measured by the security's beta coefficient. The betas can be estimated from the characteristic line $K_j = \alpha + \beta_j . K_m$.

Test Models

The degree of association between the accounting variables and the P/B or P/E multiples was assessed by estimating the following regression equations

$$P_0/E_0 = a_0 + a_1 \text{ (payout)} + a_2 (k - g) + a_3 (D/NW) + \varepsilon_1 \quad (3)$$

$$P_0/B_0 = b_0 + b_1 (D_1/B_0) + b_2 (k - g) + b_3 (D/NW) + \varepsilon_2 \quad (4)$$

It may be noted that a new variable debt-to-net worth ratio (D/NW) is introduced in the test models. An important unresolved debate in financial economics is the relevance of leverage in stock valuation. Hence, D/NW is also included in the multiple regression analysis. Appendix 1 contains the definitions and the measurement details of the variables used in the above equations. The coefficients are expected to have the following signs:

a1: Positive—because higher the payout ratio, higher the P/E;

b1: Positive—because higher the dividend, greater the price;

a_2, b_2: Negative—since greater the value of $(k-g)$, lower the price. Also $(k - g)$ will be greater when: (i) 'g' is lower i.e., firm has low growth rate; or when, (ii) 'k' is higher implying the risk associated with the security is higher *ceteris paribus*, both of these are undesirable for an investor.

a_3, b_3: Positive or negative—depending on whether the firm has an optimal debt level. Scott and Martin (1975) has shown that every firm has an optimal debt to net worth ratio. If the debt exceeds the optimum level, the additional debt will cause a decline in stock price and vice-versa.

The present study uses panel data hence it is imperative to use special techniques of estimation (Maddala, 2000). This study uses Seemingly Unrelated Regression (SUR) estimation procedure as suggested by Zellner (1962). In this procedure, first each of the N equations (for cross-section units) is estimated by OLS. Now, we obtain the residuals ($\hat{u}_i$) and then the covariance is computed as

$$\sigma_{ij} = \frac{1}{T-k} \sum \hat{u}_{it} \hat{u}_{jt} .$$

where, k is the number of regressors and T is the number of time periods. Thereafter, the parameter estimates are obtained by using Generalized Least Squares on all the N equations jointly.

Sample and Data Description

For this study, we took the data of stock prices quoted on BSE for the period January 1, 1996 to December 31, 2000. The sample was limited to the current sensex scrips (as on January 1, 2002) and the stock price data was obtained from Prowess (CMIE database). As dividend payout is one of the explanatory variables, payment of dividend by the firm over the last five years is a pre-requisite. One scrip, Reliance Petroleum Limited, didn't meet this hence it was omitted. Consequently, the effective sample size was 29 scrips. For estimating equations 3 and 4, we had used annual observations, while the betas are estimated using the daily stock price data.

Results from Statistical Analysis

The results obtained from estimating equation (3) are given in Table 1[2]. Although the 'F' value is significant, implying the overall significance of the regression equation, a low R^2 indicates the inadequacy of the independent variables in explaining the variations in P/E ratios to a reasonable extent. It may be noted that the signs of the coefficients are as expected $(k - g)$ and D/NW ratio terms are statistically significant at the conventional 10% level, whereas payout was not found to be statistically significant. Following Scott and Martin (1975) the negatively signed D/NW ratio implies that the sample companies are operating above the optimal debt level. The mean D/NW ratio is about 0.816. It is to be noted that technology majors like Infosys has no debt in the past four years while NIIT has a zero position in 2000. So to even out this the mean D/NW excluding the technology companies namely Infosys, NIIT, Satyam Computers and Zee was computed (which is 0.884); although it seems reasonable that the market feels it is above the optimal level, the result is rather perplexing.

Table 2 depicts the results from the estimation of equation 4. A higher 'F' value indicates the overall

[2] In all the tables, basic inputs means variables as in equations 3 and 4 for P/E and P/B models respectively.

Table 1
P/E Model with Basic Inputs

	Coefficient	t-value	p-value
Payout	0.275	1.63	0.1025
$k - g$	3.746	3.44	0.0005
D/NW	-9.997	-2.45	0.0143
Constant	-44.418	-2.01	0.0449
R^2 = 0.11, F-value = 5.727, p-value = 0.0010			

significance of the regression equation. The adjusted R^2 is better *vis-à-vis* that obtained for P/E model reflecting the ability of accounting variables in explaining the variations in the dependent variable. From the table, one can observe that Div_1/B_0, $(k - g)$ and D/NW are statistically significant. Therefore, it may be inferred that Div_1/B_0 is a value driver. The inferences about leverage will remain same as discussed in the P/E model above.

Implications for Security Analysts

The purpose of this study is to investigate the relevance of stock valuation models based on accounting variables in the Indian context. The findings of this study will be interesting for security analysts and individual investors who accord considerable importance to P/E and P/B models. The empirical results indicate that these models don't provide a complete key to investment success. Even though the market prices depend on factors like growth rate and leverage, they fail to capture substantial variations in P/E and P/B valuation models. To be of considerable use, these models need to be modified by including variables that are considered (by the market) to be value drivers. The researcher has experimented by including two more variables—the sales growth rate (SG) and growth in operating profits (OPG)—separately and collectively in these models. The reason for choosing sales growth is that in a growing industry, higher the growth of

Table 3
P/E Model with Basic Inputs and SG

	Coefficient	t-value	p-value
Payout	0.356	2.11	0.0352
$k - g$	3.593	3.35	0.0008
D/NW	-10.152	-2.53	0.0112
SG	0.423	2.33	0.0201
Constant	-54.091	-2.44	0.1454
R^2 = 0.14, F-value = 4.814, p-value = 0.0299			

Table 2
P/B Model with Basic Inputs

	Coefficient	t-value	p-value
D/B	5.227	5.58	0.0000
$k - g$	1.084	4.49	0.0000
D/NW	-1.684	-2.08	0.0371
Constant	-16.641	-3.36	0.0007
R^2 = 0.24, F-value = 14.737, p-value = 0.0000			

revenue more valuable the company is for the shareholders hence sales growth is considered as an important figure. Operating profit is otherwise known as 'pure profits' since they measure only the profits earned on operations and ignore any financial and government charges. Investors prefer higher operating profits because in a competitive market operating profit margin indicates the firm's ability to penetrate the market and reflects its ability to control costs while generating the surplus.

Table 4
P/E Model with Basic Inputs and OPM

	Coefficient	t-value	p-value
Payout	0.735	4.65	0.0000
$k - g$	3.146	3.35	0.0007
D/NW	-7.676	-2.18	0.0289
OPG	2.285	7.18	0.0000
Constant	-103.752	-5.01	0.0000
R^2 = 0.34, F-value = 17.773, p-value = 0.0000			

Table 5
P/E Model with Basic Inputs, SG and OPM

	Coefficient	t-value	p-value
Payout	0.747	4.72	0.0000
k - g	3.114	3.33	0.0008
D/NW	-7.800	-2.22	0.0261
OPG	2.213	6.74	0.0000
SG	0.140	0.86	0.3916
Constant	-105.095	-5.07	0.0000
R^2 = 0.35, F = 14.754, p-value = 0.0000			

From Tables 3 and 4 it can be noted that the inclusion of OPG in the P/E model has increased the explanatory power of the independent variables by almost three times. But inclusion of sales growth has increased the R^2 only marginally. Contrary to the general perception, it is found

that OPG explains the variation more than what sales growth does (although both are statistically significant). Table 5 depicts the results when both the variables are included, but the improvement in R^2 is not substantial (*vis-à-vis* that obtained from the basic P/E model with OPG as the extra regressor) also, the t statistic of sales growth is found to be not significant.

Table 6
P/B Model with Basic Inputs and OPM

	Coefficient	t-value	p-value
D/B	5.533	6.27	0.0000
$k - g$	0.997	4.39	0.0000
D/NW	-1.327	-1.74	0.0819
OPG	0.303	4.40	0.0000
Constant	-22.621	-4.67	0.0000
R^2 = 0.33, F = 17.116, p-value = 0.0000			

Table 7
P/B Model with Basic Inputs and SG

	Coefficient	t-value	p-value
D/B	5.107	5.76	0.0000
$k - g$	1.009	4.41	0.0000
D/NW	-1.708	-2.23	0.0255
SG	0.151	4.09	0.0000
Constant	-18.663	-3.96	0.0000
R^2 = 0.32, F-value = 16.353, p-value = 0.0000			

Similarly in the case of P/B model, the inclusion of OPG and SG (both separately) has improved R^2 to a similar extent. While the inclusion of both the terms as a group has further improved the R^2, these results are presented in Tables 6, 7 and 8. To test whether the improvement in R^2 is due to data mining or the reduction in unexplained portion is statistically significant, we had performed the F-test to see the significance of the incremental contributions of SG, OPG and both together. From Tables 9 and 10, it becomes clear that SG and OPG together account for considerable portion of the unexplained variations.

Table 8
P/B Model with Basic Inputs, SG and OPM

	Coefficient	t-value	p-value
D/B	5.377	6.27	0.0000
$k - g$	0.961	4.35	0.0000
D/NW	-1.422	-1.92	0.0548
OPG	0.237	3.37	0.0007
SG	0.111	2.97	0.0029
Constant	-22.809	-4.85	0.0000
R^2 = 0.37, F-value = 16.210, p-value = 0.0000			

The results of this study suggest that security analysts may include OPG as an independent variable in the conventional P/E model to achieve better results. While inclusion of OPG and SG in the P/B model is suggested to arrive at forecasts.

Conclusions

Stock valuation is the process that relates risk and return to determine the worth of a security. In this paper, an attempt is made to further our understanding of the utility of P/E and P/B approaches to stock valuation. The P/E approach is a popular technique to estimate stock's price and it is done by multiplying the firm's expected EPS by a justified or normal P/E for the firm. Here, we examined empirically the determinants of P/E and P/B using SUR technique. The study finds that the independent variables as depicted from the theoretical considerations have rather limited explanatory power. An attempt is made to refine the conventional valuation models by including the current value drivers namely sales growth rate and operating profit margin growth rate. A substantial portion of variation in P/E ratio can be explained by including OPG in the traditional P/E valuation model while SG and OPG together reduce the residual variation in the P/B model. The contribution of this study lies in drawing the attention of the investment community to look beyond the variables from which the conventional valuation models are derived from. These results may be appropriately used by the investors and security analysts to improve their trading at the marketplace.

Table 9
Effect of Inclusion of SG and OPG in the P/E Model

	F-value	p-value
Case I*	4.814	0.0299
Case II'	48.091	0.0000

Table 10
Effect of Inclusion of SG and OPG in the P/B Model

	F-value	p-value
Case I*	16.353	0.0000
Case II'	18.672	0.0000
Case III@	14.238	0.0000

* Case I: Basic model vs. Basic model and SG
' Case II: Basic model vs. Basic model and OPG
@ Case III: Basic model vs. Basic model, SG and OPG

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Appendix

The definitions of various variables used in the study are as follows:

P_0	The stock price is computed as the average of monthly high-low BSE market prices for the year.
E_0	It is defined as the EPS reported by the firm for that year.
B_0	It is calculated by adding up all the assets, subtracting all liabilities and then dividing the resultant number by the number of outstanding shares.
K_j	K_j is the required rate of return estimated from CAPM using 18% market rate of return. R_f is assumed to be the annualized 90-day T-bill rate for that year.
g	Dividend growth rate is computed as $D_t - D_{(t-1)}/D_{(t-1)}$
NW	Net worth of the firm is computed as the sum of equity, reserves and surpluses for the year.
Payout	It is calculated as percentage of dividend paid to the EPS for that year.
Sales growth	It is defined as the year on year growth rate of sales revenue.
Operating profit	It is defined as the earnings before interest and taxes.