

Tiwari, Ranjit

**Article**

## Intrinsic value estimates and its accuracy: Evidence from Indian manufacturing industry

Future Business Journal

**Provided in Cooperation with:**

Faculty of Commerce and Business Administration, Future University

*Suggested Citation:* Tiwari, Ranjit (2016) : Intrinsic value estimates and its accuracy: Evidence from Indian manufacturing industry, Future Business Journal, ISSN 2314-7210, Elsevier, Amsterdam, Vol. 2, Iss. 2, pp. 138-151, <https://doi.org/10.1016/j.fbj.2016.10.001>

This Version is available at:

<https://hdl.handle.net/10419/187945>

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Full Length Article

# Intrinsic value estimates and its accuracy: Evidence from Indian manufacturing industry

Ranjit Tiwari

*Chandragupt Institute of Management Patna, Mithapur Institutional Area, Patna, Bihar 800001, India*

Received 30 May 2016; received in revised form 16 October 2016; accepted 24 October 2016

Available online 22 November 2016

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## Abstract

The purpose of this article is to empirically examine the comparative accuracy of income oriented (Free cash flow to equity, Residual income model) and market oriented (Price to earnings multiple, Price to book value multiple and Price to sales multiple) valuation models for the Indian manufacturing industry, and propose a composite valuation model (CV) to explore whether combining value estimates may improve valuation accuracy. Data are drawn from a sample of 3756 Bombay Stock Exchange (BSE) listed manufacturing companies from 1997 to 2012. Findings from the empirically analysis indicate that residual income model is better than free cash flow to equity model under income oriented valuation model, whereas both Price to earnings multiple and Price to book value multiple are superior to Price to sales multiple and are equally likely under market oriented valuation model. Finally, the empirical findings suggest that CV provides better value estimates for Indian manufacturing industry. Further, lag of PE and profitability are the two probable determinants of prediction error of the model.

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*Keywords:* Financial forecasting; Valuation models; Prediction error; Panel data; India

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## 1. Introduction

Intrinsic value refers to the actual value of a firm determined through fundamental analysis without reference to its market value, which then becomes the barometer of decision making regarding over and under valuation of firms stock. Various valuation models (income oriented and market oriented models) have been prescribed for estimation of intrinsic values but which is most accurate of all is an issue of debate in finance community.

Several studies have been conducted to investigate the ability of one or more of these valuation models to generate reasonable estimates of market values, but the results are fragmented. While, analysing the related literature in this regard it is found that there exist different views on accuracy of valuation models. Proponents of income oriented models differ among themselves like [Kaplan and Ruback \(1995\)](#), [Berkman, Bradbury, and Ferguson \(2000\)](#) supported discounted cash flow model, whereas [Bernard \(1995\)](#) supported dividends discount model. On the other hand [Frankel and Lee \(1995, 1996\)](#), [Penman and Sougiannis \(1998\)](#), [Francis, Olsson, and Oswald \(2000\)](#), [Plenborg \(2002\)](#), [Levin and Olsson \(2000\)](#), and [Jennergren \(2008\)](#), [Beneda \(2003\)](#), [Jiang and Lee \(2005\)](#), [Gleason, Johnson,](#)

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*E-mail address:* [ranjit0701@gmail.com](mailto:ranjit0701@gmail.com)

Peer review under responsibility of Faculty of Commerce and Business Administration, Future University.

and Li (2012), Imam, Chan, and Ali-Shah (2013), Tiwari and Singla (2015) among others, where in support of abnormal earnings / residual income model. Proponents of market oriented models are also fragmented Berkman et al. (2000), Liu, Nissim, and Thomas (2002), Liu, Nissim, and Thomas (2007) and Demirakos, Strong, and Walker (2010) supported price earnings multiples. Gill (2003), Dhankar and Kumar (2007), Sehgal and Pandey (2010) have reported similar findings for Indian firms. On the other hand, Nissim (2011) supported book value multiples, earlier, Deng, Easton, and Yeo (2009) and Lie and Lie (2002) also suggested similar findings. Yee (2004) and Vardavaki and Mylonakis (2007) suggested that combining value estimates may result in better valuation accuracy. Yee (2004) asserted that combining value estimates makes sense, because every bona fide estimate provides information, so relying on only one estimate may ignore information. On the contrary Lundholm and O’Keefe (2001) and Fernandez (2003) have criticised previous studies and concluded that there is nothing to be learned from an empirical comparison of these theoretically equivalent valuation models. But Levin and Olsson (2000) and Plenborg (2002), have asserted that these models should give consistent and identical estimates of intrinsic value provided that the forecasts of different items are consistent with each other within a clean surplus<sup>1</sup> relationship and that all the assumptions are identical. Gentry, Reilly, and Sandreho (2003) stated that the only time for the equivalent condition is when the pay-out ratio is equal to one, as well as, the return on investment equals the cost of equity. Though, the claims of Lundholm and O’Keefe (2001) and Fernandez (2003) were valid, but empirical investigations fail to meet the above assumptions put-forth by Levin and Olsson (2000) and Plenborg (2002), therefore, it is worth examining the accuracy of valuation models.

Having surveyed, the wide-range of literature available on valuation, the study finds conflicting results regarding the most suitable valuation model. It is also noticed that majority of the studies concentrate on developed economies, and we are using those models as a proxy for valuing companies in developing nations. Even after knowing the fact that developing economies have varied socioeconomic and political settings. Thus, there is a clear need to examine the comparative accuracy of these models in developing economies at present, when global prosperity and stability is increasingly dependent on these economies.

The purpose of this study is to empirically examine the comparative accuracy and explanatory performance of the income oriented (FCFE: Free cash flow to equity model and RIM: Residual income model) and market oriented (PE\_M: Price to earnings multiple, PB\_M: Price to book value multiple, and PS\_M: Price to sales multiple) valuation models. Past studies have also suggested that no single procedure is conclusively the most precise and accurate in all situations because as things are different valuation procedures applied to the same company often yield disparate results. Hence the study proposes to come up with a composite valuation model (CV) to see whether combining value estimates increase valuation accuracy. The study also attempts to identify the probable determinants of prediction error (PE) of the most suitable model.

Though the issue is so vibrating, but strikingly, little academic studies (Gill, 2003; Dhankar and Kumar, 2007; Sehgal and Pandey, 2010; Tiwari and Singla, 2015) have explored the comparative accuracy of these models in India. To my knowledge this is among the few studies that provide large scale evidence on the accuracy of valuation models in India. The contribution of this paper is to add empirical evidence to this research area. Rest of the study is organised as follows. In Section 2, we discuss the data and sample used in the study. Methodology is provided in Section 3. Section 4, deals with empirical results and finally, we conclude the study in Section 5.

## 2. Data, sample selection and research hypotheses

### 2.1. Data, sample selection

Data are drawn from a sample of 3756 Indian publicly traded manufacturing companies listed on Bombay Stock Exchange for the period March 1997 to March 2012. The data has been collected from CMIE’s (Centre for Monitoring Indian Economy) prowws data base. The final usable sample comprises of only those companies with available positive book value, adjusted closing price and firms with minimum two years of data. Based on above criterion, 1404 firms are selected for empirical analysis. Further, the data has been winsorized by 2.5 percentage top

<sup>1</sup>Ending book value = beginning book value + net income – dividends.

and bottom to control outlier effect. The data for the study has been split into parts; first part includes data from March 1997 to March 2007 for the purpose of earnings estimation and computation of forecasted<sup>2</sup> intrinsic values. Second part includes data for price i.e. our proxy for market values from March 2008 to March 2012 for the purpose of comparison between computed intrinsic values and observed market values.

## 2.2. Research hypothesis

To test the accuracy of the models and identify the determinants of prediction error, three research hypotheses have been constructed. Firstly, it is hypothesized that there is a significant difference between the value estimates of models from the benchmark market value. Secondly, it is hypothesized that combining value estimates do increase valuation accuracy because we are trying to reach at a value estimate with more informative variables in the model. Lastly, in order to identify the determinants of prediction error it is hypothesized that the independent variables (size and profitability) helps to explain the variation of the dependent variable (prediction error) about its mean.

## 3. Methodology

The study provides an empirical assessment of FCFE and RIM valuation models under income oriented approach and PE\_M, PB\_M and PS\_M valuation models under market oriented approach. Further, the study combines the valuation models to arrive at composite value estimate. But before doing the comparison, at first the intrinsic values are estimated using these models. Further, the comparisons of the models are based on prediction errors and the explanatory performance of market value on value estimates. The study also attempts to identify the probable determinants of prediction error (PE) of the most suitable model. Details of the models and econometric techniques are discussed below.

### 3.1. Free cash flow to equity method

Under free cash flow to equity (FCFE) method the future expected cash flows are discounted to arrive at the intrinsic value. The free cash flow model used by Francis et al. (2000) is applied here which they abstracted from the work of Copeland, Koller, and Murrin (1994).

Free cash flow to equity = Net income – (Change in Capital expenditure – epreciation) – Change in working capital + (New debt raised – Debt repayment).

$$IV_t = \sum_{i=1}^t \frac{\epsilon_i}{(1+r_e)^i} + \frac{TV}{(1+r_e)^i} \quad (1)$$

$$TV = \frac{\epsilon_i}{r_e - g} \quad (2)$$

where  $IV$  is intrinsic value,  $\epsilon_i$  is free cash flow to equity,  $r_e$  is cost of equity [ $r_e = r_{ft} + \beta_t * \{E(r_{mt} - r_{ft})\}_{constant}$ ; where  $\beta$  is the beta (we have taken ten years average beta for the purpose of the study);  $r_m$  is the market return (we have considered ten years average return of the S&P Sensex as a proxy for market return for the purpose of the study);  $r_f$  is the risk free rate of return (the study uses ten years average of annual interest rate on government Securities as proxy for risk free rate)],  $g$  is the growth rate (ten years average growth rate in the economy i.e. 6.5%),  $TV$  is terminal value.

### 3.2. Residual income method

The residual income model (RIM) of Edward and Bell (1961) and Ohlson (1995) are used in explaining the relation between value estimates and observed market prices. Residual income method also known as future economic profit is generally defined as operating earnings less a capital charge for the equity capital ( $e_i$ ) used by the

<sup>2</sup>Forecast horizon is generally divided into two phases, the first phase represents an explicit forecast period and the second phase describes the terminal value of the firm. This study assumes an explicit forecast period of five years for first phase and perpetuity for second phase to compute the intrinsic values (Copeland et al., 2000; Gross, 2006).

company, as described by the equation:

$$RI = ROE_{t+i} * e_t - r_e * e_t \quad (3)$$

where RI is the residual income, ROE is return on equity,  $r_e$  is the cost of equity,  $e_t$  is the equity capital.

Intrinsic value of the firm under residual income model at time  $t$  is equal to the current equity i.e. book value of equity ( $B_t$ ), plus the present value of future economic profits as described by the model below.

$$IV_t = B_t + \sum_{i=1}^t \frac{E_t[(ROE_{t+i} - r_e) * B_{t+i-1}]}{(1+r_e)^i} + \frac{TV}{(1+r_e)^i} \quad (4)$$

$$TV = \frac{RI_i}{r_e - g} \quad (5)$$

where IV is intrinsic value,  $B_t$  is book value at time  $t$ ,  $E_t(\cdot)$  is the expectation based on information available at time  $t$ ,  $ROE_{t+i}$  is after tax return on equity for  $t+1$ ,  $r_e$  is cost of equity [ $r_e = r_{ft} + \beta_t * \{E(r_{mt} - r_{ft})\}_{constant}$ ]; where  $\beta$  is the beta (we have taken ten years average beta for the purpose of the study);  $r_m$  is the market return (we have considered ten years average return of the S&P Sensex as a proxy for market return for the purpose of the study);  $r_f$  is the risk free rate of return (the study uses ten years average of annual interest rate on government Securities as proxy for risk free rate)],  $g$  is the growth rate (ten years average growth rate in the economy i.e. 6.5%),  $TV$  is terminal value.

### 3.3. Price to Earnings per share multiple (PE\_M)

$$PE\_M_{i,t} = \frac{Price_{i,t}}{EPS_{i,t}} \quad (6)$$

$$IV_{i,t} = FPE\_M_{i,t} * FEPS_{i,t} \quad (7)$$

where, PE\_M is price to earnings per share multiple, Price is market price, EPS is earning per share, IV is intrinsic value, FPE\_M is forecasted price to earnings per share multiple, FEPS is forecasted earnings per share.

### 3.4. Price to Book value multiple (PB\_M)

$$PB\_M_{i,t} = \frac{Price_{i,t}}{BV_{i,t}} \quad (8)$$

$$IV_{i,t} = FPB\_M_{i,t} * FBV_{i,t} \quad (9)$$

where, PB\_M is price to book value multiple, Price is market price, BV is book value, IV is intrinsic value, FPB\_M is forecasted price to book value multiple, FBV is forecasted book value.

### 3.5. Price to Sales multiple (PS\_M)

$$PS\_M_{i,t} = \frac{Price_{i,t}}{S_{i,t}} \quad (10)$$

$$IV_{i,t} = FPS\_M_{i,t} * FS_{i,t} \quad (11)$$

where, PS\_M is price to sales multiple, Price is market price,  $S$  is net sales, IV is intrinsic value, FPS\_M is forecasted price to sales multiple, FS is forecasted sales.

Table 1

Explicit forecast estimates (Sample size, 1997–2007,  $N=1404$ ).

Source: Author's estimation.

Statistic	CF	ROE	EPS	SALES	PE	PB	PS
Constant	2.8897*	2.6793*	0.5281*	35.6336*	4.1284*	0.1207*	0.0451*
Coefficient	0.9718*	0.7221*	0.8941*	1.0633*	0.5596*	0.8821*	0.8341*
R-square	0.8177	0.5327	0.7514	0.9720	0.6120	0.7249	0.6242
Model Significance	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

\*\* Statistically significant at the 5 percent level.

\*Statistically significant at the 1 percent level.

### 3.6. Explicit forecast estimates

Calculation of intrinsic values using FCFE, RIM, PE\_M, PB\_M and PS\_M valuation models requires forecast estimates of the parameters, which are forecasted using first order stochastic process (Lee, Myers & Swaminathan, 1999) (Table 1). The study examines the ability of value estimates to explain cross-sectional variation in the observed market values, for the purpose the study uses panel regression with cross section weights to estimate a feasible GLS specification assuming the presence of cross section heteroskedasticity (Gross, 2006). But before applying the proposed method a comparative analysis is also conducted to examine the applicability of the proposed method (cross section weight model, here after CSW) with other methods in use such as panel OLS, fixed effects (FE), and random effects (RE). The diagnostic tests revealed that CSW is a better method for this study (Appendices A and B).

$$x_{i,t} = \beta_0 + \beta_1 x_{i,t-1} + \varepsilon_{i,t} \quad (12)$$

where,  $x$  is parameter specific to individual models,  $t-1$  is lagged term,  $\beta_0$  is constant,  $\beta_1$  is coefficient and  $\varepsilon$  is error term.

### 3.7. Composite valuation models (CV)

Composite value estimates are computed in order to examine whether these estimates can provide better accuracy than individual valuation models. Composite value estimates for the study is computed using simple average method (Eq. (13)). For the purpose of combining it is decided to select the models based on their prediction error. Since PS\_M has the highest prediction error of all five, we out rightly reject PS\_M (Table 3) and create two models: Model 1, that considers all the remaining four models (here after CV\_M1) and Model 2, that considers, two most suitable models, one from income oriented approach (i.e. RIM) and one from market oriented approach (i.e. PE\_M) based on prediction error (here after CV\_M2).

$$IV_{cv} = (IV_{Model\ x} + IV_{Model\ y} + \dots + IV_{Model\ n}) / \text{Number of models} \quad (13)$$

### 3.8. Accuracy and explanatory performance of the models

Once the intrinsic values are estimated the comparison of the models are performed using signed and absolute prediction error to measure the accuracy of the models. Explanatory performances of the models (FCFE, RIM, PE\_M, PB\_M, PS\_M, CV\_M1 and CV\_M2) are estimated using univariate regression of market value on value estimates. Similar to Section 3.6 the study employs cross section weights to estimate a feasible GLS specification, and conducts comparative analysis to examine the applicability of the proposed method (Appendices C and D).

$$\text{Signed prediction error} = (MV - IV) / MV \quad (14a)$$

Table 2

Multivariate regression of determinants of prediction error (Sample size, 2008–2012,  $N=1404$ ).

Source: Author's estimation.

Statistic	Panel OLS	Fixed effects	Random effects	GMM
PE L_1	–	–	–	–0.49793*
Size	–0.00004*	0.00001	–0.00002**	–0.00003
Profitability	–0.00347	–0.00024	–0.00106	–0.00795*
R-square	0.00546	0.63494	0.00077	–
Model significance	0.00000	0.00000	0.09270	0.00000

\*Statistically significant at the 1 percent level.

\*\*Statistically significant at the 5 percent level.

Table 3

Prediction error of valuation models (Sample size, 2008–2012,  $N=1404$ ).

Source: Author's estimation.

Statistic	Income Oriented Models		Market Oriented Models			Composite Value Models	
a. Signed prediction error							
	PE_FCFE	PE_RIM	PE_PE_M	PE_PB_M	PE_PS_M	PE_CV_M1	PE_CV_M2
Mean	–1.935	–1.0816	–1.1538	–1.7977	–2.0498	–1.4336	–1.0980
Median	–0.275	–0.1485	–0.1988	–0.4526	–0.5558	–0.4045	–0.1906
Std. Dev.	7.3909	3.8227	4.8404	6.2	9.008	4.4554	3.9861
Interquartile	2.7331	1.7946	1.8642	1.9103	2.102	1.9866	4.1767
b. Absolute prediction error							
	APE_FCFE	APE_RIM	APE_PE_M	APE_PB_M	APE_PS_M	APE_CV_M1	APE_CV_M2
Mean	2.4453	1.5725	1.7558	2.1715	2.2902	1.8052	1.6376
Median	0.8519	0.6889	0.7501	0.708	0.722	0.6984	0.6844
Std. Dev.	7.2381	3.6483	4.0755	6.0792	8.9499	4.3182	3.7963
Interquartile	1.7182	1.0413	1.3650	1.5237	1.6877	1.4401	3.1119

Note 1: PE\_FCFE is prediction error of FCFE, PE\_RIM is prediction error of RIM, PE\_PE\_M is prediction error PE\_M, PE\_PB\_M is prediction error of PB\_M, PE\_PS\_M is prediction error of PS\_M, PE\_CV\_M1 is prediction of composite value model 1 and PE\_CV\_M2 is prediction error of composite value model 2.

Note 2: APE\_FCFE is absolute prediction error of FCFE, APE\_RIM is absolute prediction error of RIM, APE\_PE\_M is absolute prediction error PE\_M, APE\_PB\_M is absolute prediction error of PB\_M, APE\_PS\_M is absolute prediction error of PS\_M, APE\_CV\_M1 is absolute prediction of composite value model 1 and APE\_CV\_M2 is absolute prediction error of composite value model 2.

where, MV is Market value; IV is Intrinsic value of FCFE/RIM/PE\_M/PB\_M/PS\_M/ CV\_M1/CV\_M2.

$$\text{Absolute prediction error} = |MV - IV|/MV \quad (14b)$$

where, MV is Market value; IV is Intrinsic value of FCFE/RIM/PE\_M/PB\_M/PS\_M/ CV\_M1/CV\_M2.

$$MV_{i,t} = \beta_0 + \beta_1 IV_{i,t} + \varepsilon_{i,t} \quad (15)$$

where, MV is market value;  $IV_{i,t}$  is intrinsic value of FCFE/RIM/PE\_M/PB\_M/PS\_M/ CV\_M1/CV\_M2;  $i$  is firms;  $t$  is time;  $\beta_0$  is constant;  $\beta_1$  is coefficient;  $\varepsilon_i$  is error.

### 3.9. Determinants of the prediction error

In this section, the study attempts to identify the probable determinants of prediction error (PE). The study looks for differences of the results by firm size (market capitalization, here after MC) and profitability (return on equity, here after ROE), (Gross, 2006). Based on the general principles of capital markets and corporate finance, we work out two hypotheses regarding the characteristics of the prediction errors in relation to these probable determinants.

It is anticipated that the prediction error of the value estimates to be correlated to firm size and firm profitability, as probable determinants of the predictive power of the market. While analysing the relation between PE and firm size, we expect the predictive ability of market to be higher for larger firms because larger firms are more efficient because of high liquidity and low transaction cost. Therefore, it is hypothesized (H) that the prediction error for larger firms ( $MC_{i_2}$ ) will be closer to zero than for smaller firms ( $MC_{i_1}$ ), as described in H1.

$$H1: PE_{i_1,t} \geq PE_{i_2,t} \text{ for } MC_{i_1,t} \leq MC_{i_2,t}$$

Analysing the relationship between the PE and firm profitability, we apprehend the predictive ability of the market for profitable firms ( $ROE_{i_2}$ ), to be higher than low profitable firms ( $ROE_{i_1}$ ). The underlying rationale is that higher profitability implies both higher investor interest and higher coverage by analysts. Therefore, it is hypothesized that the prediction error will be inversely correlated to ROE as a measure of firm profitability, as described in H2.

$$H2: PE_{i_1,t} \geq PE_{i_2,t} \text{ for } ROE_{i_1,t} \leq ROE_{i_2,t}$$

Eq. (16) examines the validity of the above-formulated hypotheses based on the regression analysis on these potential drivers of the prediction error.

$$PE_{i,t} = \alpha_0 + \beta_1 MC_{i,t} + \beta_2 ROE_{i,t} + \mu_{i,t} \quad (16)$$

where, PE is absolute prediction error, MC is logarithm of market capitalisation, ROE is return on equity,  $\alpha_0$  is intercept,  $\beta_1$  &  $\beta_2$  is coefficients, i is firm, t is time,  $\mu$  is error term.

The study uses three different regression models (OLS, Fixed effects and Random effects) to overcome the issues of model specification. To further verify the consistency of the results the study uses GMM<sup>3</sup> test.

## 4. Empirical results

### 4.1. Comparative accuracy of the models

In this section, we compare the accuracy of value estimates using signed prediction errors and absolute prediction errors discussed in Section 3.8. Signed prediction errors of value estimate from income oriented models revealed that PE of RIM (−1.08) is comparatively lower than PE of FCFE (−1.93). Same has been confirmed by median errors (RIM: −0.15; FCFE: −0.28). Furthermore, the results from the two valuation models differ significantly in terms of dispersion (RIM: 3.82; FCFE: 7.39). The interquartile range of the prediction errors of the value estimates from the residual income model is 1.79, whereas the result from the free cash flow to equity model is significantly wider spread with an interquartile range of 2.73. Absolute prediction error confirms the findings of signed prediction error that RIM is a superior model (Table 3a).

Similarly, under market oriented models the value estimates of PE of PE\_M (−1.15) is comparatively lower than PE of PB\_M (−1.79) and PE of PS\_M (−2.04). Same has been confirmed by median errors (PE\_M: −0.20; PB\_M: −0.45; PS\_M: −0.56). The results from the three valuation models also differ significantly in terms of dispersion with PE\_M (4.84) having low dispersion compared to PB\_M (6.20) and PS\_M (9.00). Furthermore, the interquartile range of the prediction errors of the value estimates from the PE\_M is 1.86, whereas the results from PB\_M and PS\_M models are significantly wider spread with an interquartile range of 1.91 and 2.10. Absolute prediction errors confirm the findings of signed prediction errors that PE\_M is a superior model (Table 3b). In summary, the preferred model is RIM in case of income oriented models and PE\_M in case of market oriented models (Table 3).

<sup>3</sup>GMM is an estimation process that allows economic models to be specified while avoiding often unwanted or unnecessary assumptions, such as specifying a particular distribution for the errors (Sheppard, 2010).



Table 4

Univariate regression of market value on value estimates (Sample size, 2008–2012,  $N=1404$ ).

Source: Author's estimation.

Statistic	Income Oriented Models		Market Oriented Models			Composite value estimates	
	IV_FCFE	IV_RIM	IV_PE_M	IV_PB_M	IV_PS_M	IV_CV_M1	IV_CV_M2
Coefficient	0.6843*	1.5552*	1.21*	0.8349*	0.8856*	1.2795*	1.5066*
R-square	0.2342	0.5306	0.5017	0.6935	0.6862	0.6015	0.6243
Model Significance	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

\*\* Statistically significant at the 5 percent level.

\*Statistically significant at the 1 percent level.

#### 4.2. Explanatory performance of the models

To test the explanatory performance of the value estimates, we examine the ability of the value estimates to explain cross-sectional variation in the observed market values. The explained variability of the univariate regressions is higher for the RIM with  $R^2$  explaining 53 percent of the variation in market value compared to 23 percent for the FCFE model. Similarly, the explained variability of the univariate regressions is higher for PB\_M model with  $R^2$  explaining 69 percent of the variation in market value compared to 50 and 68 percent for PE\_M and PS\_M models. The coefficient estimates for all the models are significant at 1 % level. In summary, the preferred model is RIM in case of income oriented models and PB\_M in case of market oriented models (Table 4).

Finally, we observe the superiority of the residual income model in terms of both accuracy and explanatory power for income oriented models. On the other hand, we observe the superiority of the PE\_M model in terms of accuracy whereas PB\_M has a better explanatory power than PE\_M and PS\_M. Hence, we conclude that both PE\_M and PB\_M are superior to PS\_M and are equally likely for market oriented models. However, among the two approaches RIM appears to be the best model with high accuracy. The results are in line with the theory of highly volatile Asian markets (Gross, 2006).

#### 4.3. Composite valuation models

This section provides comparative analysis of the composite valuation models (CV\_M1 and CV\_M2) discussed in section 3.7. Comparative analysis reveals that CV\_M1 is individually better than FCFE, PB\_M and PS\_M models in terms of both prediction error and dispersion except RIM and PE\_M. CV\_M2 is individually better than FCFE, PE\_M, PB\_M and PS\_M in terms of both prediction error and dispersion except RIM (Table 3a and b). On the other hand if we look at the explanatory power of the two models (CV\_M1 and CV\_M2) it is evident that the explained variability is higher than FCFE, RIM and PE\_M with  $R^2$  explaining 60 and 62 percent of the variation in market value compared to 23, 53 and 50 percent for FCFE, RIM and PE\_M models except PB\_M and PS\_M (Table 4). Though, the accuracy of RIM & PE\_M and explanatory power of PB\_M & PS\_M are better than CV\_M1 & CV\_M2, but in composite valuation models we are trying to reach at a value estimate with more informative variables in the model. Thus, the study considers both CV\_M1 and CV\_M2 to be better models for Indian manufacturing industry following a midway path, that overcomes the issue of extreme values which may arise in case of volatile emerging economies like India. Among the two composite valuation models, CV\_M2 is better than CV\_M1.

#### 4.4. Determinants of the prediction error

In this section the study measure the determinants of prediction error from CV\_M2 (best model in our case) with the help of three different regression techniques. Firstly, the study estimates the regression model with ordinary least

squares (OLS), assuming homogeneity of the parameters and abstracting from heteroscedasticity and autocorrelation. The coefficient for size is statistically significant at 1% level of significance (Table 2), with expected negative sign. The results therefore accept hypotheses H1 (that size is negatively correlated with prediction error). The coefficient for profitability is statistical not significant. The results therefore reject hypotheses H2 (that higher profitability leads to lower prediction error). The low  $R^2$  of 0.005 implies that the independent variables only explain a small part of the variation of the dependent variable. The  $F$ -statistic is 16.86, which rejects the null hypothesis of joint insignificance of coefficients and therefore suggests that the regression model is well-specified.

The omission of entity specific features might lead to a bias in the resulting estimates. In fixed effects (FE) model the study relax the restrictive assumption of parameter homogeneity and introduce heterogeneity of the intercepts to our model to gain further insights into the hypothesized relationships. We find that both the coefficients for size and profitability are not significant (Table 2). The results therefore reject hypotheses H1 and H2. The  $R^2$  of 0.63 is an improvement over OLS and implies the incremental explainability of the model. The  $F$ -statistic is 6.08, which rejects the null hypothesis of joint insignificance of coefficients and therefore suggests that the regression model is well-specified.

Further the study analyses the impact of random effects (RE) model to rip the benefits of increased efficiency in absence of effect endogeneity. The study finds that the model is not significant at 5% and the resultant  $F$ -statistic is 2.37, which accepts the null hypothesis of joint insignificance of coefficients and therefore suggests that the regression model is not well-specified. As a result, the random effects model does not produce efficient estimates and the fixed effects model stays the preferred estimator for our model. To further verify the consistency of the results of fixed effect model we conduct GMM test, and find that profitability has significant relation with prediction error at 1% level. The results therefore accept hypotheses H2 (that higher profitability leads to lower prediction error) (Table 2). Hence, the study concludes that the estimates based on GMM are more reliable than FE and RE as it produces efficient estimates utilising all the moment conditions that the simple FE and RE estimators use in restricted form (So et al., 1999).

## 5. Conclusions

While measuring the accuracy of intrinsic value estimates of select models it is noticed that residual income model is better than free cash flow to equity model under income oriented valuation models and under market oriented valuation models both PE\_M and PB\_M are superior to PS\_M and are equally likely. Finally, taking up the question that whether combining value estimates increase valuation accuracy, it is observed that both CV\_M1 and CV\_M2 are better models for Indian manufacturing industry, following a midway path and among the two CV\_M2 is better than CV\_M1 in terms of both accuracy and explanatory power. As far as the determinants of the prediction errors are concerned, it is noticed that lag of PE and profitability are the two probable determinants of prediction error. However, future studies may incorporate other firm specific variables for better understanding of the probable factors of prediction errors such as age, brand image etc.

Comparison to prior research on fundamental value estimates revealed that results of this study are consistent with Bernard (1995), Penman and Sougiannis (1998), Francis et al. (2000), Subrahmanyam and Venkatachalam (2004) Imam et al. (2013), , on superiority of residual income model over FCFE in case of income oriented method, whereas in case of market oriented method the superiority of PE\_M and PB\_M over PS\_M is consistent with the findings of Liu et al. (2007), Deng et al. (2009), Demirakos et al. (2010), and Nissim (2011). As far as composite value estimates are concerned the results support Yee (2004) and Vardavaki and Mylonakis (2007) argument that every bona-fide estimate provides information. Therefore, composite value estimate provides an intrinsic value with more informative variables in the model.

This paper provides academicians and practitioners with an overview of the applicability of income oriented and market oriented valuation models to arrive at a better value estimate for manufacturing firms in India. Superiority of composite valuation model also adds empirical evidence to the unresolved issue of superiority of valuation models.

## Appendix A

See Table A1.

Table A1

Comparison of different regression methods in estimating forecast parameters (sample size, 1997–2007,  $N=1404$ ).

Source: Author's estimation.

Statistic	OLS	FE	RE
CF			
Constant	23.2168*	53.3375*	23.2168*
Coefficient	0.9048*	0.5661*	0.9048*
R-square	0.6674	0.7305	0.6674
Model Significance	0.0000	0.0000	0.0000
ROE			
Constant	3.8088*	5.4543*	3.8088*
Coefficient	0.6020*	0.3939*	0.6020*
R-square	0.3463	0.444	0.3463
Model Significance	0.0000	0.0000	0.0000
EPS			
Constant	1.3842*	3.3063*	1.3842*
Coefficient	0.8232*	0.5116*	0.8232*
R-square	0.6413	0.7111	0.6413
Model Significance	0.0000	0.0000	0.0000
SALES			
Constant	147.3702*	318.5739*	160.5572*
Coefficient	1.0405*	0.9684*	1.0361*
R-square	0.9624	0.9690	0.9443
Model Significance	0.0000	0.0000	0.0000
PE			
Constant	6.4341*	9.6448*	6.5077*
Coefficient	0.4987*	0.2191*	0.4933*
R-square	0.2393	0.4506	0.2342
Model Significance	0.0000	0.0000	0.0000
PB			
Constant	0.2742*	0.5085*	0.2742*
Coefficient	0.8390*	0.6309*	0.8390*
R-square	0.6403	0.6998	0.6403
Model Significance	0.0000	0.0000	0.0000
PS			
Constant	0.1313*	0.2611*	0.1313*
Coefficient	0.8112*	0.5328*	0.8112*
R-square	0.5891	0.6658	0.5891
Model Significance	0.0000	0.0000	0.0000

\*\* Statistically significant at the 5 percent level.

\* Statistically significant at the 1 percent level.

## Appendix B

See [Table B1](#).

Table B1

Diagnostic tests to identify best method in estimating forecast parameters.

Source: Author's estimation.

*F*-test for fixed effects ( $H_0$ : parameter homogeneity = > fixed effects model is misspecified)

Statistic	CF OLS & FE	ROE OLS & FE	EPS OLS & FE	SALES OLS & FE	PE OLS & FE	PB OLS & FE	PS OLS & FE
<i>F</i> -statistic	18.80	15.00	18.50	18.20	20.60	14.40	19.30
<i>P</i> -value	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Breusch and Pagan LM test for random effects ( $H_0$ : the variances across entities is zero)

Statistic	CF OLS & RE	ROE OLS & RE	EPS OLS & RE	SALES OLS & RE	PE OLS & RE	PB OLS & RE	PS OLS & RE
Chi-statistic	0.00	0.00	0.00	172.82	28.97	17.50	0.00
<i>P</i> -value	1.00	1.00	1.00	0.00	0.00	0.00	1.00

Hausman test statistic ( $H_0$ : regressors are not correlated with c = > random effects)

Statistic	CF FE & RE	ROE FE & RE	EPS FE & RE	SALES FE & RE	PE FE & RE	PB FE & RE	PS FE & RE
Chi-statistic	1937.11	1809.80	1958.10	169.65	850.33	1053.15	2052.14
<i>P</i> -value	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note:

1. If, *F*-test for fixed effects is significant ( $P$ -value < 0.5), fixed effects is better.
2. If, Breusch and Pagan LM test for random effects is significant ( $P$ -value < 0.5), random effects is better.
3. If, Hausman test statistic is significant ( $P$ -value < 0.5), fixed effects is better.
4. Finally, the best of above three is compared with cross section weight method, and the statistic with high explainability is considered the best.

## Appendix C

See Table C1.

Table C1

Comparison of different regression methods in computing explanatory power of value estimates. (Sample size, 2008 - 2012,  $N=1404$ ).

Source: Author's estimation.

Statistic	OLS	FE	RE
FCFE			
Coefficient	0.6882*	0.1725	0.6456*
R-square	0.1504	0.8833	0.0389
Model Significance	0.0000	0.0000	0.0000
RIM			
Coefficient	1.5313*	1.4222**	1.5260*
R-square	0.3656	0.8892	0.1580
Model Significance	0.0000	0.0000	0.0000
PE_M			
Coefficient	1.3369*	-0.6811*	0.4713*
R-square	0.3777	0.4882	0.0302
Model significance	0.0000	0.0000	0.0000
PB_M			
Coefficient	0.7231*	0.8456*	0.7364*
R-square	0.5134	0.6858	0.2335
Model Significance	0.0000	0.0000	0.0000
PS_M			
Coefficient	0.8097*	-0.0997*	0.6884*
R-square	0.4291	0.5622	0.1382
Model Significance	0.0000	0.0000	0.0000
CV_M1			
Coefficient	1.3426*	0.0151	1.3047*
R-square	0.4862	0.5831	0.1969
Model Significance	0.0000	0.0000	0.0000
CV_M2			
Coefficient	1.5746*	-0.8445*	1.2502*
R-square	0.4101	0.4845	0.1115
Model Significance	0.0000	0.0000	0.0000

\*Statistically significant at the 1 percent level.

\*\*Statistically significant at the 5 percent level.

## Appendix D

See [Table D1](#).

Table D1

Diagnostic tests to identify best method in computing explanatory power of value estimates.

Source: Author's estimation.

*F*-test for fixed effects ( $H_0$ : parameter homogeneity = > fixed effects model is misspecified)

Statistic	FCFE OLS & FE	RIM OLS & FE	PE_M OLS & FE	PB_M OLS & FE	PS_M OLS & FE	CV_M1 OLS & FE	CV_M2 OLS & FE
<i>F</i> -statistic	24.45	18.39	17.77	12.70	15.02	13.22	15.99
<i>P</i> -value	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Breusch and Pagan LM test for random effects ( $H_0$ : the variances across entities is zero)

Statistic	FCFE OLS & RE	RIM OLS & RE	PE_M OLS & RE	PB_M OLS & RE	PS_M OLS & RE	CV_M1 OLS & RE	CV_M2 OLS & RE
Chi-statistic	8768.87	7942.81	6091.41	6412.19	6775.35	6538.21	6953.82
<i>P</i> -value	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Hausman test statistic ( $H_0$ : regressors are not correlated with c = > random effects)

Statistic	FCFE FE & RE	RIM FE & RE	PE_M FE & RE	PB_M FE & RE	PS_M FE & RE	CV_M1 FE & RE	CV_M2 FE & RE
Chi-statistic	14.64	2.05	1530.96	2.11	255.10	79.08	463.57
<i>P</i> -value	0.00	0.15	0.00	0.16	0.00	0.00	0.00

Note:

1. If, *F*-test for fixed effects is significant ( $P$ -value < 0.5), fixed effects is better.
2. If, Breusch and Pagan LM test for random effects is significant ( $P$ -value < 0.5), random effects is better.
3. If, Hausman test statistic is significant ( $P$ -value < 0.5), fixed effects is better.
4. Finally, the best of above three is compared with cross section weight method, and the statistic with high explainability is considered the best.

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