Comparative Accuracy and Explanatory Performance of Valuation Models: Evidence from India

Ranjit Tiwari and Harish Kumar Singla

Abstract

The purpose of this paper is to empirically examine the comparative accuracy and explanatory performance of discounted cash flow (DCF), residual income model (RIM), equity dividend (ED), P/E multiple (PE_M) and P/B multiple (PB_M) valuation models for the Indian banking sector and come up with a composite valuation model (CV) to see whether combining value estimates increase the valuation accuracy. To achieve the objective of the study we determined the intrinsic values using all the six models. Further, we compared the models based on prediction errors and the explanatory performance of market value on value estimates. The study uses panel regression to forecast estimates of earnings and measure explanatory performance. The study uses annual data points starting from March 31, 2002 to March 31, 2012.The comparative framework shows that the most appropriate method for value estimate is provided by RIM and ED models and therefore has higher ability to account for long term market expectations for the banking sector whereas composite value estimates stay in between DCF, RIM and ED models (best three) and prescribes a middle path. Hence, combining make sense because in volatile emerging economies it is always good to follow a midway path to avoid extreme values. This paper provides academicians and practitioners with a snapshot of the applicability of DCF, RIM, ED, PE_M and PB_M valuation models for Indian banking industry and also shows how a composite value (CV) estimate can improve valuation accuracy.

Keywords: Financial forecasting, Valuation models, Prediction error, Panel data, India.

1. Introduction

Valuation has always been an essential element in financial decision making whether it is choosing investments for a portfolio, in deciding on the appropriate price to pay or receive in a takeover/merger/acquisitions and in making investment, financing and dividend choices when running a business. Being a developing nation with huge growth prospects the assessment of valuation models becomes important as these models are used by a multitude of investment bankers, money managers, securities analysts, and regulators to accurately value equity assets. Thus, the accuracy of these methods in determining the value of an equity asset is an issue of utmost importance to have a more realistic value estimate. The immediate question arises as to which valuation methods to use which is most appropriate in terms of accuracy and explanatory power?

However, having surveyed wide-range of literature available on valuation, we find that even after having the standard-setting work (Copeland, Koller, Timothy and Murrin, 1990) on valuation, the empirical studies (Dermine, 2010; Francis et al., 2000; Frankel and Lee, 1995, 1996; Gross, 2006; Jiang and Lee, 2005; Kaplan and Ruback, 1995; Levin and Olsson, 2000; Penman and Sougiannis, 1998; Plenborg, 2002) have shown conflicting results regarding the most suitable valuation model. On the other hand most of the studies concentrate on the accuracy of valuation models to industrial companies and we have little empirical evidence for banking industry. We also find that almost all the studies in the literature are conducted in respect to developed nations and we are using those models as a proxy for valuing companies in developing nations. Getting motivated with these issues prevailing in previous research, we decided to empirically examine the comparative accuracy and explanatory performance of DCF (discounted cash flow), RIM (residual income model), ED (equity dividend), P/E multiple (PE_M) and P/B multiple (PB_M) valuation models for the Indian banking sector and come up with a composite valuation model (CV) to see whether combining value estimates increase valuation accuracy because past literature shows that no single procedure is conclusively precise. Hence, combining value estimates makes sense because every bona fide estimate provides information, so relying on only one estimate ignores information.

Though the issue is important strikingly little academic studies have explored the comparative accuracy of these models for banking industry in India. This paper attempts to provide academicians and practitioners with a snapshot of the applicability of valuation models by comparing estimated values derived from the prescribed models to the observed market values to arrive at a better value estimate for banking sector companies in India. The contribution of this paper is to add empirical evidence to this research area.

The empirical findings of the paper suggest that RIM and ED are superior to DCF, PE_M and PB_M valuation models. CV estimate is also better than DCF, PE_M and PB_M valuation models. Though it has not outperformed RIM and ED but it is more informative than RIM and ED individually because CV is the combined value estimate of RIM, ED and DCF (best three models). Hence, combining value estimates do make sense because in volatile emerging economies it is always good to follow a midway path to avoid extreme values. Our results could motivate academicians and practitioners to use composite valuation model as an alternative to individual models to arrive at a more realistic value estimate.

2. Literature Review

Several studies have investigated the ability of one or more of these valuation methods to generate reasonable estimates of market values. Kaplan and Ruback (1995) provided evidence that cash flow estimates significantly outperform estimates based on comparable or multiple approaches. Frankel and Lee (1995; 1996) found that the value estimates based on Abnormal earnings (AE) explain significantly larger portion of the fluctuation in security prices than value estimates based on earnings, book values, or a combination of the two. Bernard (1995) compared the ability of forecasted dividends and forecasted abnormal earnings to explicate fluctuations in current security prices. He found that dividends explain 29% of the variation in share prices, compared to 68% for the combination of current book value and abnormal earnings forecasts. Penman and Sougiannis (1998) also provided a comparative analysis of dividend, cash flow, and abnormal earnings-based value estimates using infinite life assumptions. Irrespective of the length of the time horizon, Penman and Sougiannis found that abnormal earnings (AE) value estimates have significantly smaller (in absolute terms) mean signed prediction errors than free cash flow (FCF) value estimates, with dividend discount (DIV) value estimates falling in between. Francis et al. (2000) extended previous investigations by comparing the reliability of intrinsic value estimates obtained from DIV, FCF and AE model. They contrast the reliability of value estimates in terms of their accuracy and explainability. Their results revealed that AE value estimates perform significantly better than DIV or FCF value estimates. Berkman, Bradbury, and Ferguson (2000) in their study compared the estimates of value obtained from conventional discounted cash flow and price earnings valuation methods to the market price. They suggested that the best discounted cash flow method and the best price earnings comparable method have similar level of accuracy.

Levin and Olsson (2000) discussed that the company's forecasted performance stays stable after the valuation horizon and that its expected development, as described by its parameters, holds indefinitely if the steady state condition is maintained. They also claim that the steady state condition is necessary for the three models to yield identical estimates when terminal values are used. Therefore, any violation in the steady state condition can cause internal inconsistencies in valuation models and thus have a significant impact on the equity value estimates. Plenborg (2002) also argued that Cash flow model (CFM), Dividend discount model (DDM), and Residual income model (RIM) valuation methods should provide consistent and identical estimates of intrinsic firm value, provided that the forecasts of the different variables are consistent with each other within a clean surplus relationship and all the assumptions are identical. Moreover, for all sets of accounting rules, these models provide similar estimates of value when infinite horizon forecasts are employed. However, these zero-error conditions are very restrictive. Practically, forecasts are made over finite horizons so different accounting principles yield different estimates of value with finite-horizon forecasts. For this reason, steady state terminal values, which usually have considerable weight in equity valuation, are calculated in practice to correct for error introduced by the truncated forecast horizon, and such calculations are necessary for all clean-surplus accounting methods. Gentry, Reilly and Sandreho (2003) provided an integrated valuation system (IVS) that allows for academia and practitioners to simulate changes in the firm's financial strategy and the effects of these modifications on the value of a stock. Moreover, they presented theoretically the conditions when the dividend discount model value estimates are equal to the cash flow model value estimates. They also stated that the only time for the equivalency condition is when the pay-out ratio is equal to one as well as the return on investment equals the cost of equity. Benada (2003) assessed empirically whether, over five year valuation horizon, the DDM, FCF, and the RIM are empirically equivalent. Their results introduced empirical support for these predictions of equivalence between these three price-based valuation models. Furthermore, they found that the price-based valuation models, within each class of the CFM and the RIM, outperformed the non-price based valuation model accompanied with the dominance of the RIM over CFM in both the approaches. Jiang and Lee (2005) also suggest that for equity valuation, book value and accounting earnings in residual income model contain more useful information than dividends alone.

Lundholm and O'Keefe (2001), Fernandez (2003), have criticised previous studies (e.g. Penman et al. (1998), Francis et al. (2000), and Courteau et al. (2000)) that introduced empirical support to make the comparison of the three theoretically equivalent valuation models (DDM, FCF and the RIM), and they concluded that there is nothing to be learned from an empirical comparison of these models. Though, Lundholm & O'Keefe (2001) and Fernandez (2002) both were theoretically correct but issues related to forecast horizons and steady state conditions put forward by Planborg (2002), Levin and Olsson (2000), and Jennergren (2008), where overlooked, which empirically support the comparison of valuation models because of these implementation issues resulting from applying them.

Xavier and Vinolas (2003) proposed a new corporate valuation method "Financial and Economic value added," (FEVA) that integrates the Economic value added (EVA), DCF, and Modigliani and Miller (MM) approaches and allows a detailed analysis of financial and economic corporate value drivers. They suggest that the new formula is mathematically consistent with previous methodologies, and holds the principle of one value and superior value estimates. Kenton (2004) said that no single procedure is conclusively the most precise and accurate in all situations. Therefore, financial analysts very often run through more than one methodology when asked to value a company. Kenton aims to fill the gap and inspires further research on this question by proposing simple rules for combining value estimates. Combining makes sense because every bona fide estimate provides information, so relying on only one estimate may ignore information. He therefore proposed five rules of thumb for combining two or more value estimates into a superior value estimate. Yoo (2006), found that combining several simple multiple valuation estimates of a firm, each of which is based on a stock price multiple to a historical accounting performance measure of the comparable firms improves the valuation accuracy. Vardavaki and Mylonakis (2007) introduced the theoretical framework for the systematic series of actions required for equity valuation and examined the relative explanatory power of various equity valuation models when applied to firms in the UK food and drug retail sector. Their results supported the findings of previous studies that the combined valuation model is more informative because the accuracy of equity value estimate is higher for combined valuation model. This can be substantiated by the fact that this model takes into account both the economics and the accounting characteristics of the investigated firms.

Liu, Nissim and Thomas (2007) examined whether valuations based on cash flow multiples are better than earnings multiple and found that despite intuitive claims that operating cash flows are superior than earnings as a measure of value, security prices are better explained by reported earnings than by reported operating cash flows. Imam,Barker and Clubb (2008), revealed that analysts use both earnings multiples and DCF. However, book value multiples are less preferred by the analysts in their study. Demirakos, Strong and Walker (2010) suggested that earnings multiples outperform DCF models. Further, Nissim (2011) in their study found that book value multiple performs relatively better than other multiples and conditioning the book value multiples on ROE significantly enhances the valuation accuracy of book value multiples. He also concluded that over the past decade book value multiples have performed better than earnings multiples. Earlier, Deng, Easton and Yeo (2009) and Lie and Lie (2002) also suggested similar findings.

As far as banks are concerned only few studies have been performed to empirically examine the accuracy of these models. As in the case of non-banks, however, the DCF approach is the standard valuation model that is generally focused on bank valuation literature, with only few contributions such as Uyemura, Kantor and Pettit (1996), and MSDW (2001) included the residual income approach in their discussion. In recent studies Gross (2006) and Dermine (2010) have supported the use of residual income model over discounted cash flow and dividend discount model.

It is evident from the above literature review that majority of the work concentrates on the valuation of industrial companies: Though the number of articles and research papers in the area of bank valuation have increased recently only a few contributions give a detailed and comprehensive overview of the performance of bank valuation models. Hence, the comparison of these valuation models will be worthwhile in understanding the most suitable valuation model for Indian banking industry to have a more realistic value estimate. It is also observed that since no single procedure is conclusively the most precise and accurate in all situations, we go a step further and combine the value estimates of different models to empirically examine whether combining value estimates increase valuation accuracy.

3. Data and Methodology

3.1 Data

We take our sample of banking sector companies from CMIE's (Centre for Monitoring Indian Economy) prowess data base. We have considered all 40 BSE (Bombay Stock Exchange) listed banking companies for the purpose of the study. The study uses 11 years data starting from March 2002 to March 2012. Further, we split the data into two parts; first part includes data from March 2002 to March 2007 for the purpose of earnings estimation and computation of 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.

3.2 Methodology

The study provides an empirical assessment of DCF, RIM, ED, P/E multiple and P/B multiples techniques of valuation. But before doing the comparison we need to arrive at the intrinsic values using these approaches. Further, comparisons of the models are based on prediction errors and the explanatory performance of market value on value estimates. Details of the models are discussed below.

3.2.1. Residual Income Model

The residual income model of Edward-Bell-Ohlson is used in explaining the relation between value estimates and observed market prices. Residual income (RI) is generally defined as operating earnings less a capital charge for the equity capital (e_t) used by the company, as described by Equation.

$$RI = ROE_{t+i} * e_t - r_e * e_t \qquad ...1$$

Intrinsic value of the firm 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:

$$IV_t = B_t + \sum_{i=1}^{t} \frac{E_t\left[\left(ROE_{t+i} - r_e\right) * B_{t+i-1}\right]}{\left(1+r_e\right)^i} + \frac{TV}{\left(1+r_e\right)^i} \qquad ...2$$

$$TV = \frac{RI_i}{r_e - g} \quad ...3$$

Where: RI is residual income; IV is intrinsic value; B_t is book value at time t; $E_t(.)$ is expectation based on information available at time t; ROE_{t+i} is after tax return on equity at t+i; r_e is cost of equity; TV is terminal value.

3.2.2. Discounted Cash Flow Model

The discounted 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). Since our study is concentrating on equity part of the valuation we will be using FCFE (free cash flow to equity).

$$IV_t = \sum_{i=1}^{t} \frac{\in_t}{(1+r_e)^i} + \frac{TV}{(1+r_e)^i} \quad ...4$$

$$TV = \frac{\in_i}{r_e - g} \quad ...5$$

Where: IV is intrinsic value; $\in_t$ is free cash flow to equity; r_e is cost of equity; g is minimum growth rate; TV is terminal value.

3.2.3. Equity Dividend Model

The discounted dividend model attributed to Williams, 1938, equates the value of a firm's equity with the sum of the discounted expected dividend payments to shareholders over the life of the firm, with the terminal value equal to the liquidating dividend:

$$IV_t = \sum_{i=1}^{t} \frac{DIV_t}{(1+r_e)^i} + \frac{TV}{(1+r_e)^i} \quad ...6$$

$$TV = \frac{DIV_t}{r_e - g} \quad ...7$$

Where: IV is intrinsic value; DIV_t is forecasted dividend; r_e is cost of equity; g is the minimum growth rate(average of inflation from 1991 to 2007); TV is terminal value.

3.2.4. Multiples Valuation Model

Equity multiples have been very popular among analysts as it is less time consuming and a simple straight forward method of calculating value. In an informal study, Damodaran found that the ratio of use of DCF to Multiples is 1:10. We have used equity multiples for the purpose of the study as we are focusing on equity valuation. The multiples used are:

Price to Earning per share ratio (PE_M)

$$PE\_M_{i,t} = \frac{Price_{i,t}}{EPS_{i,t}} \quad ...8$$

$$IV_{i,t} = FPE\_M_{i,t} * FEPS_{i,t} \quad ...9$$

Where: PE_M is price to earning per share, Price is market price, EPS is earning per share, IV is intrinsic value, FPE_M is forecasted price to earning per share, FEPS is forecasted earning per share.

Price to Book value ratio (PB_M)

$$PB\_M_{i,t} = \frac{Price_{i,t}}{BV_{i,t}} \quad ...10$$

$$IV_{i,t} = FPB\_M_{i,t} * FBV_{i,t} \quad ...11$$

Where: PB_M is price to book value, Price is market price, BV is book value, IV is intrinsic value, FPB_M is forecasted price to book value, FBV is forecasted book value.

3.2.5. Forecast Horizon

We assume an explicit forecast period of five years to compute the intrinsic values that correspond to the length of forecast period put forward in literature (see Copeland et al., 2000; Rappaport, 1986). Forecast horizon is divided into two phases, the first phase represents an explicit forecast period for the first four years and the second phase describes the terminal value of the firm (i.e. the remaining life of the firm) after fourth year.

3.2.6.Explicit Forecast Estimates

Future earnings and other parameters of the respective models are forecasted using first order stochastic process following Charles M. C. Lee et al. (1999).We use panel regression with cross section weights to estimate a feasible GLS specification assuming the presence of cross section heteroskedasticity.

Earnings and Book value forecast under RIM model:

$$ROE_{it} = \beta_0 + \beta_1 ROE_{i,t-1} + \varepsilon_{i,t} \quad ...12$$

Where: ROE is return on equity; t–1 is lagged term; β_0 is constant; β_1 is coefficient; ε is error term.

$$BV_{i,t+1} + FEPS_{i,t+1} - FDPS_{i,t+1} \quad ...13$$

Where: BV is book value; FEPS is forecasted earnings per share *($FEPS_{i,t} = \beta_0 + \beta_1 FEPS_{i,t-1} + \varepsilon_{i,t}$)*; FDPS is forecasted dividend per share *($FEPS_{i,t+1} = FEPS_{i,t+1} * POR$)*; POR is dividend payout ratio; t-1 is lagged term; t+1 is forecast period.

Cash flow forecast under FCFE model:

$$CF_{i,t} = \beta_0 + \beta_1 CF_{i,t-1} + \varepsilon_{i,t} \quad ...14$$

Where: CF is cash flow; t-1 is lagged term; β_0 is constant; β_0 is coefficient; ε is error term.

Equity dividend forecast under ED model:

$$ED_{i,t} = \beta_0 + \beta_1 ED_{i,t-1} + \varepsilon_{i,t} \quad ...15$$

Where: ED is equity dividend; t-1 is lagged term; β_0 is constant; β_1 is coefficient; ε is error term.

PE_M and PB_M forecast under Multiples valuation model:

$$PE\_M_{i,t} = \beta_0 + \beta_1 PE\_M_{i,t-1} + \varepsilon_{i,t} \quad ...16$$

Where: PE_M is price earning per share ratio; t-1 is lagged term; β_0 is constant; β_1 is coefficient; ε is error term.

$$PB\_M_{i,t} = \beta_0 + \beta_1 PB\_M_{i,t-1} + \varepsilon_{i,t} \quad ...17$$

Where: PB_M is price book value ratio; t-1 is lagged term; β_0 is constant; β_1 is coefficient; ε is error term. (Table1)

3.2.7. Estimation of Cost of Equity

Models under consideration calls for a discount rate that corresponds to the riskiness of future cash flows to shareholders. Discount rate for the purpose of study has been calculated using Capital asset pricing model (CAPM):-

$$r_e = r_{ft} + \beta_t * [E(r_{mt} - r_{ft})]_{constant} \quad ...18$$

Where: r_e is cost of equity; β is beta (we have taken ten years average beta for the purpose of the study); r_m is market return (we have considered ten years average return of the industry as market return for the purpose of the study); r_f is risk free rate of return (the study uses average of annual weighted average interest rate on government Securities).

3.2.8.Accuracy and Explanatory Value of the Model

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 model. Explanatory values of the models are performed using univariate regression of market value on value estimates. The study will use panel regression with cross section weights; it will estimate a feasible GLS specification assuming the presence of cross section heteroskedasticity.

$$MV_{i,t} = \beta_0 + \beta_1 IV_{i,t} + \varepsilon_{i,t} \quad ...19$$

Where: MV is market value; IV is intrinsic value; β_0 is constant; β_1 is coefficient; ε_i is error.

3.2.9. Composite Value Estimates (CV)

Composite value estimates for the study is computed using two different methods. Under first method, we combine the value estimates by averaging the best three models (i.e. DCF RIM and ED in our case).Under second method, we combine the models using weighted average accuracy of the models. First we calculate the prediction error (PE) of the models, next we compute the weighted average prediction error (WAPE), *($WAPE_{DCF}$ = PE of DCF / (PE of DCF + PE of RIM +PE of ED); $WAPE_{RIM}$ = PE of RIM / (PE of DCF + PE of RIM +PE of ED); $WAPE_{ED}$ = PE of ED / (PE of DCF + PE of RIM +PE of ED))*. Finally we take the weighted average accuracy (WAA), *(WAA = 1 – WAPE)* to combine the models.

$$IV_c = (IV_{DCF} + IV_{RIM} + IV_{ED})/3 \quad ...20$$

$$IV_c = IV_{DCF}*WAA_{DCF} + IV_{RIM}*WAA_{RIM} + IV_{ED}*WAA_{ED} \quad ...21$$

where IV_c is combined value estimate, IV_{DCF} is intrinsic value from DCF, IV_{RIM} is intrinsic value from RIM, IV_{ED} = is intrinsic value from ED, *WAA* is weighted average accuracy of the model.

3.2.10. Determinants of the Prediction Error

This part of our analysis studies the determinants of the prediction error of the value estimates from the most suitable valuation model. We search for differences of the results by bank size and profitability as potential determinants of the prediction error of the value estimates. Based on the general principles of capital markets and corporate finance, we formulate two hypotheses concerning the characteristics of the prediction errors in relation to these potential determinants.

We foresee the prediction error of the value estimates to be related to bank size (market capitalization, here after MC) and profitability (return on equity, here after ROE), as potential drivers of the predictive power of the market. We expect the stock prices of banks with a high market capitalization to be on average more efficient assuming a constant free float and ownership structure. We therefore hypothesize that the prediction error for larger banks *(MC_{i2})* will be closer to zero than for smaller banks *(MC_{i1})*, as described in hypothesis H1.

$$\text{H1: } PE_{i_1,t} \geq PE_{i_2,t} \text{ for } MC_{i_1,t} \leq MC_{i_2,t} \qquad \text{...22}$$

Examining the relationship between the prediction error and bank profitability, we expect the predictive power of the market for profitable banks *(ROE_{i_2})* to be higher than for banks with low profitability *(ROE_{i_1})*. The underlying rationale is that higher profitability implies both higher investor interest in a bank and higher coverage by analysts. We hypothesize the prediction error to be negatively correlated to return on equity as a measure of bank profitability, as described in hypothesis H2.

$$\text{H2: } PE_{i_1,t} \geq PE_{i_2,t} \text{ for } ROE_{i_1,t} \leq ROE_{i_2,t} \qquad \text{...23}$$

The following sections examine the validity of the above-formulated hypotheses based on the regression analysis on these potential drivers of the prediction error.

$$PE_{i,t} = \alpha_0 + \beta_1 MC_{i,t} + \beta_2 ROE_{i,t} + \mu_{i,t} \qquad \text{...24}$$

We define the absolute prediction error (PE) as the dependent variable of our regression model. The independent variables are ROE as a measure of profitability and the logarithm of market value (MC) as a measure of bank size. As extreme results may distort the true picture of the relationship between the dependent variable and independent variables, we control 5 percent of the outliers from the dependent and the independent variables. We run 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 we conduct GMM (Generalized Method of Moments) test. It is an advanced econometric tool in use over fixed effects and random effects, it accounts for the unobserved time-invariant bilateral specific effects and it can deal with potential endogeneity arising from the inclusion of the lagged dependent variables and other potential endogenous variables.

4. Empirical Results

The prediction error of the value estimates describes the relative error and is defined as market value minus intrinsic value scaled by Market value.

4.1 Comparative Accuracy of the Models

In the following section, we compare the accuracy of the value estimates from the RIM, DCF, ED, PE_M and PB_M valuation models. To measure the accuracy, we look at the signed and absolute prediction errors of the value estimates from the five alternative valuation models, as displayed in Table 2.

We first look at the signed prediction errors of the value estimates. As already described in Section 3.2.8, we find a mean prediction error of -0.48 for the value estimates from the equity dividend model (see, Table 2a). We thus observe a biased result with observed market values being on average 48 percent lower than the value estimates from the equity dividend model. For the residual income model, discounted cash flow model, P/B multiple and P/E multiple the resulting undervaluation is significantly higher with a mean prediction error of -0.78, -1.83, -2.76 and -2.86. The median values of the models reveals the fact that there is concentration of high negative values in DCF, RIM, PE_M and PB_M models than that of ED model which reflects high undervaluation in case of PE_M, PB_M,DCF and RIM respectively. Furthermore, the results from the valuation models differ significantly in terms of dispersion. Equity dividend model is preferred because of its low dispersion (1.98). As far as interquartile range is concerned we find that discounted cash flow model, PE_M and PB_M have higher interquartile range of 1.96, 2.57 and 2.18 respectively. The interquartile range of the prediction errors of the value estimates from the equity dividend model and residual income model are 0.99 and 0.97.

In order to get a better understanding of the accuracy of the results from the models, we next study the absolute prediction errors of the value estimates (see, table 2b). Again, the results from the equity dividend model show a lower average prediction error (dispersion) compared to the results from DCF, RIM, PE_M and PB_M. We observe a mean absolute prediction error (dispersion) for the equity dividend value estimates of 1.23 (1.62). The absolute prediction errors (dispersion) for the results from DCF, RIM, PE_M and PB_M are significantly higher with a mean error (dispersion) of 2.28 (3.87), 1.30 (2.27), 2.92 (5.94) and 2.90 (4.99) respectively. Absolute prediction error and dispersion confirms the findings of signed prediction error that ED is an improvement over DCF, RIM, PE_M and PB_M model. But it can be observed from table 2 that the difference between ED and RIM has narrowed down.

As far as the central tendency of the results from the models are concerned we find that 13.17%, 14.37%, 22.56%, 6.15% and 17.44% of the observations of ED, DCF, RIM, PE_M and PB_M respectively are within 20% of the prediction error and 50% of the prediction error lies between 31.14%, 40.12%, 49.74%, 14.36% and 33.33% of the sample observation for ED, DCF, RIM, PE_M and PB_M respectively. Hence, the accuracy of the results from RIM is significantly higher than that of ED, DCF, PE_M and PB_M model (see, table 3).

When comparing the mean prediction error and central tendency of the prediction error we observe that ED is better in case of mean prediction error and RIM appears to be more suitable under central tendency of the errors. Therefore to further confirm the results we measure the explanatory performance of the models in section 4.2.

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. Table 4 reports the results of the univariate regressions of market value on the value estimates from the six valuation models.

The explained variability of the univariate regressions is higher for the residual income model with R^2 explaining 19 percent of the variation in market value compared to 12 percent for discounted cash flow model, 14 percent for equity dividend model, 1 percent for PE_M and 12 percent for PB_M. The coefficient estimates for all models are significant. The smaller coefficient for the discounted cash flow model, PE_M and PB_Mare in line with the larger bias in the results from this model. The coefficients of RIM and ED models are more or less same but RIM is slightly better than ED model in terms explainability (see, table 4).

Summarizing the results for the accuracy and explanatory performance of the value estimates from the alternative valuation models, so far, we observe the superiority of the equity dividend model in terms of accuracy whereas RIM has a slightly better explanatory power than DCF, ED, PE_M and PB_M. Hence, we can say that both ED and RIM are superior to DCF, PE_M and PB_M, and are equally likely.

4.3. Do Combining Value Estimates Increase Valuation Accuracy

To empirically examine the fact that whether combining value estimates increase valuation accuracy, we prefer average method over weighted average accuracy of the models to compute the value estimates, because, the prediction error is low in case of average method (see, section 3.2.9). Prediction error of composite value estimates presented in table 3a, 3b reveals that both signed prediction error and absolute prediction error alone with their dispersion stay in between the prediction errors and dispersions from DCF, RIM and ED model, whereas the explained variability of the univariate regression of market value on value estimates stay in between DCF, RIM and ED model with R^2 explaining 14 percent of the variation in market value (see, table 4). Though composite value estimates do not outperform RIM and ED models in particular but in volatile emerging economies like India it is always good to follow a midway path to avoid extreme values.

4.4. Determinants of the Prediction Error

In the following section we measure the determinants of prediction error of the value estimates from the residual income valuation model (most suitable model in our case) with the help of three different regression models. First we estimate 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 not significant (see, Table 5), with expected negative sign. The results therefore reject hypotheses H1 (that size is negatively correlated with prediction error). The coefficient for ROE is statistical not significant. The results therefore reject hypotheses H2 (that higher profitability leads to lower prediction error). The low R^2 of 0.04 implies that the independent variables only explain a small part of the variation of the dependent variable. The F-statistic is 3.58, 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 model we relax the restrictive assumption of parameter homogeneity and introduce heterogeneity of the intercepts to our model to gain further insights into the hypothesized relationships. The coefficient for size is statistically not significant (see, Table 5), with expected negative sign. The results therefore reject hypotheses H1. The coefficient for ROE is statistical not significant. The results therefore reject hypotheses H2. The R^2 of 0.75 is an improvement over OLS and implies the incremental explainability of the model. The F-statistic is 11.00, which rejects the null hypothesis of joint insignificance of coefficients and therefore suggests that the regression model is well-specified.

Further we analyse the impact of random effects model to rip the benefits of increased efficiency in the absence of effect endogeneity. But we find that the model is not significant and 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, which confirms the findings of fixed effect model (see, table 5), hence, the results are robust.

5. Conclusion

We conducted the empirical study to examine the comparative accuracy and explanatory performance of DCF, RIM, ED, PE_M and PB_M for the Indian banking sector. We find that equity dividend model is superior to discounted cash flow model, residual income model, PE multiple and PB multiple estimates in terms of accuracy (see, table 2). But the explanatory power of RIM value estimate is slightly better than ED model (see, table 4). As far as the central tendency of the prediction errors are concerned RIM is better than other valuation models (see, table 3). About 22.56% and 49.74% of the sample observations of RIM are within 20% and 50% of the prediction error respectively. Our results are in line with the theory of highly volatile Asian markets. Gross (2006) in his study of Banks and shareholder value reported high dispersion for Asian markets. Otherwise also he reported prediction error of 1.92 for DDM (Dividend Discount Model). The probable determinants of prediction error i.e. size and profitability have no significant relationship with prediction error except intercept, which accounts for firm specific characteristics in the model.

In comparison to prior research on fundamental value estimates, we find that our results are consistent with Bernard (1995), Penman and Sougiannis(1998), Francis et al. (2000), Subrahmanyan et al. (2004), and Kenton (2004), on superiority of residual income value estimates over DCF, PE_M and PB_M. But we also find that ED model which was empirically proved to be less accurate then RIM and DCF has better accuracy than RIM and DCF for Indian banking sector. Our results support the superiority of ED and RIM over DCF, PE_M and PB_M and therefore have higher ability to account for long term market expectations for the banking sector. Composite value estimates though do not outperform RIM and ED in particular, but have more information content (Kenton, 2004) then the individual models. So, combining value estimates make sense because in volatile emerging economies it is always good to follow middle path to avoid extreme values. The present study provides empirical evidence regarding accuracy of valuation models for banking industry from one of the fastest growing emerging economies in the world.

Appendix

Table 1: Univariate Regression of Forecast Estimates

Year = 2003 -2007; N = 40						
Statistic	**CF**	**ED**	**ROE**	**EPS**	**PE_M**	**PB_M**
Constant	2517.7310*	46.3917*	10.0051*	2.5737*	-2.9374*	0.0993*
OLS Coefficient	1.0482*	1.1809*	0.4679*	1.0649*	1.6339*	1.0791*
OLS R-square	0.4551	0.9624	0.2153	0.4460	0.1199	0.9932
Model Significance	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

Source: Own calculation

Table 2: Prediction error

a. Signed	**PE_DCF**	**PE_RIM**	**PE_ED**	**PE_PE_M**	**PE_PB_M**	**PE_CV**
Mean	-1.8295	-0.7784	-0.4769	-2.8568	-2.7642	-1.0908
Median	0.0335	0.1199	0.3978	-0.9360	-0.8624	0.1339
Std. Dev.	4.1090	2.4982	1.9785	6.3046	5.0768	2.8659
Interquartile	1.9696	0.9730	0.9972	2.5694	2.1792	1.3406
b. Absolute	**APE_DCF**	**APE_RIM**	**APE_ED**	**APE_PE_M**	**APE_PB_M**	**APE_CV**
Mean	2.2974	1.2982	1.2344	2.9240	2.9015	1.6059
Median	0.5908	0.5104	0.6558	0.9748	0.9130	0.5460
Std. Dev.	3.8654	2.2707	1.6156	5.9422	4.9992	2.6107
Interquartile	1.1890	0.6188	0.4932	2.2268	1.9999	0.5826

Source: Own calculation

Table 3: Central tendency of value estimates

Details	**DCF**	**RIM**	**ED**	**PE_M**	**PB_M**	**CV**
IV within 20% of the MV (percent)	14.37	22.56	13.17	6.15	17.44	14.87
* The central tendency is defined as the percentage of observations with value estimates within 20% of observed market value.						
Details	**DCF**	**RIM**	**ED**	**PE_M**	**PB_M**	**CV**
IV within 50% of the MV (percent)	40.12	49.74	31.14	14.36	33.33	37.95
* The central tendency is defined as the percentage of observations with value estimates within 50% of observed market value.						

Source: Own calculation

Table 4: Univariate Regression of Market value on Value Estimates

Year = 2008 - 2012; N = 40						
Statistic	**DCF**	**RIM**	**ED**	**PE_M**	**PB_M**	**CV**
OLS Coefficient	0.0367*	0.0720*	0.0764*	0.0004	0.0444*	0.0531*
OLS R-square	0.1241	0.1869	0.1420	0.0124	0.1242	0.1414
Model Significance	0.0000	0.0000	0.0000	0.1216	0.0000	0.0000

* statistically significant at the 5 percent level

** statistically significant at the 1 percent level

Source: Own calculation

Table 5: Panel multivariate Regression of determinants of prediction error

Year = 2008 - 2012; N = 40				
Statistic	**OLS**	**Fixed effect**	**Random effect**	**GMM**
Intercept	0.6393*	1.8311*	1.5811*	2.4564*
Size	0.0000	0.0000	0.0000	0.0000
Profitability	0.0670	-0.0129	0.0053	-0.0040
Model R-square	0.0363	0.7492	0.0160	---
Model Significance	0.0297	0.0000	0.7899	0.0000

* statistically significant at the 5 percent level

** statistically significant at the 1 percent level

Source: Own calculation

End Note

An earlier version of the manuscript was published in the proceeding of 6th Conference on Excellence in Research and Education held at IIM Indore in 2014.

References

Baltagi, B. H. (2001). *Econometric analysis of panel data*. 2nd edition, Chichester.

Berkman, H., Bradbury, M.E., and Ferguson, J. (2000). The accuracy of price to earning and discounted cash methods of IPO equity valuation. *Journal of International Financial Management and Accounting*, 2(11), 7183.

Beneda, N. (2003). Estimating free cash flows and valuing a growth company. *Journal of Asset Management*, 4(4), 247-257.

Bernard, V. (1995). The feltham ohlson framwork: Implication for empiricists. *Contemporary Accounting Research*, 11(2), 733-747.

Charles, M. C. L., Myers, J., and Swaminathan, B. (1999). What is the intrinsic value of dow?. *Journal of Finance*, 54(5), 1693-1741.

Copeland, T. E., Koller, T., Timothy, M. and Murrin, J. (1990). *Valuation: Measuring and managing the value of companies*. 1st edition. New York.

Copeland, T. E., Koller, T., Timothy, M. and Murrin, J. (2000). *Valuation: Measuring and managing the value of companies*. 3rd edition. New York.

Courteau, L. J. K., and Richardson, G. K. (2000). *The equivalence of dividend, cash flows and residual earnings approaches to equity valuation employing ideal terminal value expressions*. Working paper, Level University.

Damodaran, A. (1994). *Damodaran on valuation: Security analysis for investment and corporate finance*. New York.

Damodaran, A. (2004). Valuing Financial Service Firms. Stem Business School, New York Univ., http://pages.stem.nyu.edu/~adamodar/New_Home_Page/papers.

Demirakos, E. G., Strong, N. C. and M. Walker (2010). Does valuation model choice affect target price accuracy? *The European Accounting Review*, 19(1), 35-72.

Deng, M., Easton, P., and Yeo, J. (2009). *Another look at equity and enterprise valuation based on multiples*. Working paper, University of Notre Dame.

Dermine, J. (2010). *Bank valuation and value based management*. TataMcGraw-Hill, India.

Edwards, E., and Bell, P. (1961). *The Theory and Measurement of Business Income*. Berkeley, CA: University of California Press.

Fama, E. F. (1991). Efficient capital markets II. *Joumal of Finance*, 46(5), 1575-1617.

eltham, G. A., and Ohlson, J. A. (1995). Valuation and clean surplus accounting for operating and financial activities. *Contemporary Accounting Research*, 11(2), 689-731.

Fernandez, P. (2002), *Valuation methods and shareholder value creation*, San Diego.

Francis, J., Olsson, P. and Oswald, D. R. (2000). Comparing the accuracy and explainability of dividend, free cash flow, and abnormal earnings equity value estimates. *Journal of Accounting Research*, 38(1), 45-70.

Frankel, R., and Lee, C. (1998). Accounting valuation, market expectation, and cross-sectional stock returns. *Journal of Accounting and Economics*, 25(3), 283-319.

Gentry, A., Reilly, F. K., and Sandreho, M. J. (2003). *Learning about intrinsic valuation with the help of an integrated valuation system*. Working paper, University of Illions, Urbana.

Gross, S. (2006). *Banks and shareholder value: An overview of bank valuation and empirical evidence on shareholder value for banks*. DeutscherUniversitats-Vlg.

Heffernan, S. (1996). *Modern banking in theory and practice*. John Wiley & Sons.

Imam, S., Barker, R. and Clubb, C. (2008). The use of valuation models by U.K. investment analysts. *The European Accounting Reivew*, 17(3), 503-535.

Jennergren, P. (2008). Countinuing value in firm valuation by the discounted cash flow model. *European Journal of Operation Research*, 185, 1548-1563.

Jiang, X., and Lee, B. S. (2005), An empirical test of accounting based residual income model and the traditional dividend discount model. *The Journal of Business*, 78(4), 1465-1504.

Kaplan, S., and Ruback, R. (1995). The valuation of cash flow forecasts: An empirical analysis. *Journal of Finance*, 4(4), 1059-1093.

Kenton, K. Y. (2004). Combining value estimates to increase accuracy. *Financial Analysts Journal*, 60(4), 23-28.

Lie, E. and Lie, H.J. (2002). Multiples used to estimate corporate value. *Financial Analysts Journal*, 58(2),44-54.

Liu, J., Nissim, D., & Thomas, J. (2007). Is cash flow king in valuations. *Financial Analyst Journal*, 63(2), 56-65.

Lundholm, R., and O'Keefe, T. (2001). Reconciling value estimates from the discounted cash flow model and the residual income model. *Contemporary Accounting Research*, 18(2), 311-335.

MSDW (2001). Valuing financial stocks with residual income. Morgan Stanley Dean Witter, Equity Research North America.

Nissim, D. (2011). *Relative valuation US insurance companies*. Working paper, Columbia Business School.

Penman, S. H., and Sougiannis, T. (1998). A Comparison of dividend, cash flow, and earnings approaches to equity valuation. *Contemporary Accounting Research*, 15(3), 343-383.

Plenborg T. (2002). Firm valuation: Comparing the residual income and discounted cash flow approaches. *Scandinavian Journal of Management*, 18(3), 303-318.

Rappaport, A. (1986). *Creating shareholder value: The new standard for business performance*. New York.

Uyemura, D. G., Kantor, C. C., and Pettit, J. M. (1996). EVA for banks: Value creation, risk management and profitability measurement. *Journal of Applied Corporate Finance*, 9(3), 94-112.

Vardavaki, A., and Mylonakis, J. (2007). Empirical evidence on retail firms' equity valuation models. *International Research Journal of Finance and Economics*, No. 7.

Xavier, A., and Vinolas, P. (2003). FEVA: A financial and economic approach to valuation. *Financial Analysts Journal*, 59(2), 80-87.

Yoo, Y. K. (2006). The valuation accuracy of equity valuation using a combination of multiples. *Review of Accounting and Finance*, 5(2), 108-123.

Ranjit Tiwari is a Sr. Research Fellow at National Institute of Financial Management, Faridabad. He specializes in empirical finance. He has presented research papers in India and abroad (IIMs,IITs, IISc, University of Economics - Czech Republic etc). He has also published research papers in national and international journals.

Harish Kumar Singla is an Assistant Professor at School of Behavioural Sciences and Business Studies, Thapar University, Patiala. After completing his MBA with specialization in Finance from IIMT, Meerut in 1999 he worked for a brief period in corporate sector but soon joined academics. He has over 14 years of working experience in academics. He has earned his Ph.D. from MDS University, Ajmer in the year 2009. His current research area is Behavioural Finance. He has taught various Accounting and Finance related courses such as Security Analysis and Portfolio Management, Financial Risk Management, Financial Statement Analysis, Financial Management and Management Accounting. He has conducted more than 25 Management Development Programmes for the officers in State and central governments and conducted one International Training programme for Royal Institute of Management, Bhutan. He has presented many research papers in National conferences and has more than 20 research paper publications to his credit. He is also doing a project on the assessment of impact of TUFS on textile cluster of Ludhiana, India, under seed grant scheme of Thapar University, Patiala.