A COMPARISON OF FORECAST ACCURACY AMONG STOCK PRICING MODELS: EVIDENCE FROM MALAYSIAN LISTED COMPANIES

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Abstract

Discovering the best model that is able to predict equity values that most closely approximate the actual equity values observed in the market place has always been an area of concern for financial analysts and other stakeholders. This paper tackles this issue by comparing various stock valuation models in terms of their relative forecast accuracy in the Malaysia context. The findings reveal that PE (Price-to-Earnings) model produced the lowest mean absolute forecast error for the overall sample companies as well as in the perspective of large firm size. The results indicate that PE model generally outperforms DGM (Dividend Growth) model and OCF (Operating Cash Flow) model and hence conclude that PE model is the most robust model among stock pricing models. As such, all stakeholders should focus more on information conveyed by earnings in order to enhance their forecast of stock prices.

Keywords *Forecast accuracy, Stock pricing models.*

Introduction

The fact that the various stock valuation models were developed in the olden days and yet these models are still being used by investors in the stock market until today proves that these models indeed serve practical importance in assessing the true value of stocks. Several popular stock valuation models used by investors today are discussed as follows:

Dividend Growth Model (DGM)

In 1959, Gordon from University of Toronto published a method for valuing a stock or business, now known as Gordon model. This model assumes that the company issues a stock that has a current value of dividend, D, that grows at a constant rate of, g, and

the required rate of return for the stock remains constant at, *k*. It involves summing the infinite series.

$$\sum_{t=1}^{\infty} D \times \frac{(1+g)^t}{(1+k)^t}$$

The current price of the above stock should be:

$$P = \frac{D_0(1+g)}{k-g}$$

With this model, users are able to forecast the stock prices in order to make decisions. The usual practice would be buying the stock when it is undervalued, and selling the stock when it is overvalued.

In addition, this model has several assumptions:

1. The firm is an all equity firm. No external financing is used and investment programmes are financed exclusively by retained earnings

2. The firm has perpetual life
3. Constant growth rate
4. k > *g*.
5. Investors are risk adverse.

However, this model has its limitations. The restrictions are:

1. The model requires one perpetual growth rate

- that is constant (if dividends are expected to grow at a constant growth rate *g*, then earnings and the stock price are also expected to grow at that rate)
- greater than (negative 1) and
- less than the required rate of return on equity, *k*.

Nevertheless, for many growth stocks, the current growth rate can vary with the cost of capital significantly year by year. Besides, in reality the growth is hardly constant. In this case this model is not suitable for estimation of share prices.

2. If the stock does not pay a dividend currently, like many growth stocks, a more general version of the dividend discounted model must be used to value the stock.
3. Sensitivity to the estimation of $(k - g)$.

Since the establishment of DGM, the model became very popular in practice, as many investment analysts believed that valuation should be based on dividends rather than earnings. However, as investors begin to realise the flaws of the model, which one of them could be due to the taxability of dividends, they started to realise the diminishing relevance of DGM in predicting stock prices and look toward the importance of PE ratio in assessing firm's value (Yardeni, 2003). Moreover, in Malaysia's market, the listed companies tend to pay low and constant dividends over the years which will result in abnormally lower DGM forecasted stock price; hence this may be the reason why investors in Malaysia started to pay less attention to dividends (Tee & Ng, 2009).

As people realised the flaws in one model, they searched for models which can outperform the former model. Judging on the non taxability of capital gains from reinvested earnings, investors have started to pay more attention to the earnings announcements. In Malaysia, there was empirical evidence gathered by Shamsher, Annuar and Chotigeat (as cited in Imbarine & Annuar, 2007) that there were 30 percent more analysts who employed PE approach than DGM to estimate share prices in Malaysia.

Price-to-Earnings Model (PE Model)

Founded by Graham and Dodd in 1934, the PE ratio is how much a company's share is currently worth on the market, divided by the earnings per share (EPS). The predicted stock price under this model is simple and calculated by industry average PE ratio multiply with EPS. This model also has its limitations as follow:

1. It is based on reported earnings, "accounting profits" which may be prone to manipulation.
2. Different industries typically have different historical growth rates, risk levels and so on. Hence, there are different average PE ratios for each industry.
3. PE ratios ignored a variety of other important factors i.e. a firm's projected future growth rate.
4. P/E ratios ignored critical items such as risk and volatility.

Having said that PE model has its improvement of relevancy in forecasting stock price, OCF model may also be another useful model because investors have accommodated cash flow information into their analysis. In Malaysia, ever since disclosure of the cash flow statement became mandatory as of 1996, investors started to place elevating significance on information conveyed by cash flow figures.

Price-to-Operating Cash Flow Model (PCF Model)

Price to FCF is one of the most recent models developed by Jokipii and Vahamaa (2006). Specifically, PCF model uses the market price per share divided by the OCF of a particular firm and multiply with the industry average OCF to calculate the predicted stock price. PCF represents the amount of money an investor is willing to pay for a dollar of cash generated from a company's operations. It shows the ability of a business to generate cash and can be an effective gauge of liquidity and solvency. Due to the nature of this model that deals with cash flow, the effects of depreciation and other non-

cash factors are removed. Nevertheless, this model also has its limitations:

1. Operating cash flow is subjected to more fluctuations than earnings.
2. Reported cash from operations, cash for investments, and cash from financing are also affected by accounting choice.
3. Similar to PE model, there are different average P/OCF ratios for different industries.

A great deal of literature has focused on investigating the superiority of Dividend Growth Model (DGM) and Price-to-Earnings Model (PE model) in terms of relative accuracy. However, contradiction aroused in the previous empirical studies as researchers do not seem to arrive at one final conclusion on which model is of higher superiority. Traditional approaches to value equities have largely focused on DGM. Shiller (1984) and Fama and French (1988) have supported DGM as the more superior model as they claimed that earnings are more variable than dividends. However, Lamont (1998) claimed that the higher variability of earnings does not constitute "noise" in forecasting returns, but rather, the correlation of earnings with business conditions provides information about future returns that is not captured by other variables. Several other studies which compared the models' accuracy in forecasting the stock price have generally concluded that the PE approach produces higher forecast accuracy than other models (see, for example, Courteau, Kao, & Richardson, 2001; Francis, Olsson, & Oswald, 2000). Recently, a research study conducted in Malaysia by Imbarine and Annuar (2007) revealed that both valuation models show practical usefulness depending upon economic conditions. However, they concluded that DGM tends to exhibit more superiority based on cross sectional and panel data results. On the contrary, Shamsher, Annuar, and Chotigeat's study (as cited in Imbarine & Annuar, 2007) found that in practice about 86% of analysts employed PE approach as a tool in appraising stock values while only 56% of the analysts used DGM to estimate share prices in Malaysia. Due to the differences in assumptions and subjective judgments underlying each of these models, there is an increasing need to further examine which stock valuation model will produce the highest relative accuracy in forecasting stock price in developing Malaysian stock market. This paper differs from previous studies in that it attempts not only to improve on the evidence from traditional use of DGM and PE model (by examining PCF model which had not been extensively documented in previous stock pricing literature) but also to investigate whether relative forecast accuracy of stock pricing models varies with industries and firm size categories.

This paper is organised as follows. Section 2 provides some arguments on stock pricing. Section 3 describes the data and methodology. Section 4 contains summary of the results and discussion, and Section 5 concludes.

Literature Review

EMH (Efficient Market Hypothesis) developed by Fama (1970) assumes the market is efficient in the sense that stock prices changes instantly and reflects new information already known to public. Thus, one should not be able to predict the stock prices to gain benefit from undervalued stocks using the publicly known information, except

through luck. Essentially, DGM does not assume there is an efficient market. Rozeff's study (as cited in Goetzmann & Jorion, 1993) has regarded the apparent predictability of market returns from dividend yields as "support for the rejection of the random walk model of stock prices". The model claims the market prices follow a random path up and down, without any influence by past price movements. In fact, if random walk theory holds, any equity valuation model is not needed as it is impossible for anyone to predict with accuracy which direction the market will move at any point. Hence, the DGM which predicts the future dividends (D_1) from current dividends (D_0) using the same growth rate to arrive at the forecasted stock price, supports the rejection of random walk model.

Closely linked with EMH is signaling theory which was first proposed by Bhattacharya (1979). According to this theory, dividend declared or paid today will signal about the future level of dividend (DGM has implicitly taken into account the future dividends). If a company declares a dividend larger than that anticipated by the market, this will be a signal that the future prospects of the firms are brighter than expected. Borde, Byrd, and Atkinson's (1999) study in U.S. has supported this theory, with the results indicated that the announcement of dividend increases did cause a significant positive stock price reaction.

However, this is not the case for current year earnings as current year earnings do not signal any future earnings (earnings in future period are independent of current year earnings). This can be attributed to the fact that earnings are more variable than dividends (Fama & French, 1988) and earnings are more subjective and ambiguous, hence they are prone to manipulation (Yardeni, 2003). Current year cash flows too, do not convey information about future period cash flows. Perhaps, when there is a substantial initial outlay spent on a new investment plan, the cash outflows may signal future cash inflows generated by the new investment. Nevertheless, McCluskey, Burton, Power, and Sinclair (2006) found that announced changes in earnings significantly rendered changes in actual share price while announced changes in dividends did not cause such significant changes. Hence, there is an apparent need to further investigate the appropriateness of signaling theory.

In essence, since investors generally perceive that dividends are more stable and predictive of a firm's future value, dividend approach is believed to be able to better forecast stock price with lower forecast error. In contrast, earnings and cash flows do not reflect much information about stock price, therefore, using earnings approach and cash flow approach to forecast stock price is believed to result in higher forecast error.

Data and Methodology

The sample is drawn from all the companies listed on the Main Board of Bursa Malaysia from 2004 to 2008. Penman and Sougiannis (1998) and Lundholm and O'Keefe (2001) have suggested that 5 years would be sufficient to demonstrate the models' forecast accuracy and hence the sample selection is truncated to 2004 in order to allow a time period that is sufficient to reduce the lagging impact from the infamous 1997 Asian financial crisis. The sample selection criteria include: from 1999 to 2008 selected companies must: 1) be listed and provide annual report every year; 2) pay

dividends every year; 3) have no change in financial year ends or experience mergers to avoid complication in estimation of stock prices. The reason why criteria 1) and 2) are needed is because the average growth rate of a firm's dividends under DGM is calculated based on a rolling basis, over the last five years. For instance, the growth rate for a company's predicted stock price in 2004 is retrieved from yearly dividend of 1999 to 2003. While from 2004 to 2008, 4) companies must have positive reported earnings and OCF and 5) the required rate of return (k) for stock must be greater than the growth rate (g). Criteria 4) and 5) are needed because if these criteria are not met, it will result in negative predicted stock prices. Besides, 6) listed companies which are classified as PN4 and PN17 by Bursa Malaysia will be excluded from the sample because these companies typically have negative book values (liabilities more than assets) and accumulated losses over the years, plus there is minimal trading in the stock market for these companies hence their share prices tend to be constant. The last criteria would be 7) an industry must have at least 10 companies to avoid sampling bias. These selection criteria resulted in a final sample of 55 companies. Details of the relationship between the initial and final sample are provided in Table 1.

Table 1 Selection criteria and final sample included in this study

Population	862
Selection criteria:	
(i) Listed and provide annual report (1999-2008)	292
(ii) Pay yearly dividends (1999-2008)	219
(iii) No change in financial year ends (1999-2008)	6
(iv) Positive earnings and OCF (2004-2008)	173
(v) $k < g$ (2004-2008)	71
(vi) PN4 and PN17 companies	13
(vii) Each industry have at least 10 companies	33
Final sample	55

Financial variables such as dividend paid, net income after tax and weighted average number of ordinary shares outstanding and cash flow from operations are obtained from the companies' annual reports. Market share price is collected from Datastream database, while the government T-bill rates are sourced from Bank Negara Malaysia (Central bank of Malaysia) statistical database.

Following Stickel (1990) and Clement (1999), the forecast error of each model is provided by the mean absolute forecast error as the comparison between the forecasted stock prices and the actual stock prices of all sample companies under the three models. This study separates the sample companies into its respective industry according to the Bursa Malaysia sectors. The measurement of firm size is by evaluating market capitalization (MC), which is the actual share price of a company times the number of shares outstanding. If the MC of a company is below the average MC which is the average firm size of all companies, it is categorised as small firm, otherwise, it is considered as large firm. With this, the sample is segregated into small and large firms. A point to note here is that, initially, this study was intended to research on FCF model

instead of OCF model. However, results showed that most of the sample companies do not have a positive FCF. For instance, in 2004, 106 out of 146 companies have negative FCF, hence rendering the FCF model to be not feasible for this study. The reason why most of the Malaysian sample companies do not have a positive FCF could be attributed to the fact there were high investments on fixed assets. This could be one of the companies' strategies to reduce their taxable profit and ultimately minimizing their income tax payable to IRB (Inland Revenue Board).

Findings

The results in Table 2 show that the mean forecast error of PE model is the lowest for the overall sample companies, ranging from 43 percent to 168 percent. DGM's mean forecast error was exceptionally high in 2004 which amounted to 710 percent, however, the figures were reduced to a more favourable condition in the consecutive years and arrived at only 105 percent in 2008. PCF model's mean forecast error generally varied from 284 percent to 481 percent over the five years and marked the highest mean forecast error among the three models in 2005, 2007 and 2008. Further test of one-way ANOVA reveal that at least one pair of the models has significant difference in these years. A closer examination by Tukey Post Hoc test indicates a significant difference in the pair of PE v PCF in these years. The negative outcomes obtained throughout the five years implied that PE model has lower forecast error as compared to PCF model, suggesting the PE model is more accurate in forecasting stock price in Malaysia. In contrast, the findings indicate that PCF model tends to have significantly larger forecast error as compared to PE or DGM respectively.

Table 2 Absolute forecast error for overall sample companies (N = 55)

Year		**2004**	**2005**	**2006**	**2007**	**2008**
PE	Mean FE	54.594	103.524	167.913	43.304	73.624
	Min	2.24	0.47	0.70	0.11	0.88
	Max	267.76	676.36	1798.74	504.04	561.48
	Std Dev	62.008	134.605	308.012	69.510	86.497
DGM	Mean FE	709.895	298.178	308.312	129.535	104.876
	Min	0.19	2.22	1.64	3.01	0.00
	Max	17812.63	2437.14	3850.00	1261.16	919.48
	Std Dev	2564.289	483.058	633.147	200.922	132.340
PCF	Mean FE	474.959	455.485	284.006	480.939	396.032
	Min	6.68	0.03	0.06	1.37	13.94
	Max	3632.93	3761.63	2960.16	5215.08	3400.43
	Std Dev	803.057	873.348	601.180	900.434	693.825
One-way ANOVA						
F-statistics		2.513	5.057	1.084	10.325	10.302
p-value		0.084	0.007	0.341	0.000	0.000

Tukey Post Hoc Tests Difference in Mean					
DGM v PE	655.301	194.654	140.399	85.231	31.251
DGM v PCF	234.937	-157.307	24.306	-351.403*	-291.156*
PE v PCF	-420.364	-351.961*	-116.093	-436.634*	-322.407*

* Significant at the 5% level.

Table 3 shows the results of Tukey Post Hoc tests on the mean difference of stock pricing models in different industries. Judging by the majority significant difference is obtained in the pair of PE v PC and outcomes were all negative for different industries throughout the sample period (except for industrial companies in 2006), the findings suggest that the relative forecast accuracy of stock pricing models does vary with industries (except for the plantation companies) and PE model is more accurate than PCF model in stock pricing.

Table 3 Tukey Post Hoc tests for different industries

Year	**2004**	**2005**	**2006**	**2007**	**2008**
Tukey Post Hoc Tests Difference in Mean					
Consumer Product (N = 17)					
DGM v PE	66.978	53.616	44.238	34.671	50.759
DGM v PCF	-92.115	-156.514	-5.322	-54.544	-113.572
PE v PCF	-159.094*	-210.131*	-49.561	-89.215	-164.332*
Industrial (N = 14)					
DGM v PE	666.272	195.621	127.026	146.450	-50.547
DGM v PCF	273.376	170.009	502.296	-506.133*	-235.065*
PE v PCF	-392.896	-25.612	375.271	-652.583*	-184.518*
Trading & Services (N = 16)					
DGM v PE	425.168	202.342	215.719	122.691	93.021
DGM v PCF	-209.117	-630.926	-394.041	-677.362	-511.721
PE v PCF	-634.284	-833.268*	-609.760*	-800.053*	-604.741*
Plantation (N = 8)					
DGM v PE	2346.554	477.289	217.501	10.615	9.406
DGM v PCF	1750.760	215.440	87.474	-59.538	-325.550
PE v PCF	-595.794	-261.849	-130.028	-70.153	-334.956

* Significant at the 5% level.

Generally, the results in Table 4 show that the mean forecast error of small firms was higher than large firms under the DGM model and PE model. However this is not the case for PCF model as the mean forecast error of small firms was exceptionally lower than large firms for all the five years.

Table 4 Mean forecast error for different firm sizes

Year	2004	2005	2006	2007	2008
DGM					
Small	819.351	334.492	288.405	132.030	90.115
Large	272.073	180.855	366.612	122.881	148.104
PE					
Small	56.608	120.776	199.842	36.182	88.618
Large	46.540	47.786	74.409	65.965	29.715
PCF					
Small	321.321	270.126	85.067	210.062	185.602
Large	1089.511	1054.339	866.615	1203.275	1012.291

Further analysis in Table 5 shows that the relative forecast accuracy of PE model and PCF model does vary with firm size categories. On the contrary, no adequate evidence is found to demonstrate the mean forecast error of two groups (large and small firms) is statistically different from each other under the DGM model.

Table 5 Independent sample t-test for different firm sizes

Year	2004	2005	2006	2007	2008
DGM					
t-statistics	0.630	1.703	-0.396	0.149	-0.926
Significant (2-tailed)	0.532	0.095	0.694	0.882	0.370
PE					
t-statistics	0.478	2.870	2.100	-0.920	3.658
Significant (2-tailed)	0.634	0.006	0.041	0.373	0.001
PCF					
t-statistics	-2.296	-2.027	-2.942	-2.602	-2.696
Significant (2-tailed)	0.041	0.063	0.011	0.021	0.018

Conclusion

This study concludes that the PE model holds the least forecast error regardless of industries in Malaysia while PCF model has significantly higher forecast error than DGM and PE model in stock pricing. These findings are consistent with those past literatures which supported PE approach as the most superior stock pricing model. These literatures includes studies conducted in U.S. by Penman and Sougiannis (1998) who concluded that PE model outperforms both DGM and DCF (Discounted Cash Flow) models, Courteau et al.'s (2001) study which reproduced the same findings, as well as Tee and Ng's (2009) study in Malaysia which found that PE model is generally

more accurate than DGM. Therefore, all stakeholders should pay careful attention to the earnings announcement in Malaysia as earning is more predictive of a firm's value as revealed in this study.

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