Pertanika J. Soc. Sci & Hum. 1(2): 179-186 (1993) ISSN: 0128-7702
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Factors Associated with Stock Price Volatility and Evaluation of Gordon's Share Valuation Model on the Kuala Lumpur Stock Exchange*

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Keywords: Share price volatility, share valuation model, dividend yield, payout ratio, earnings variability, asset growth, debts to asset ratio, firm size, return to equity

ABSTRAK

Peningkatan kemudahubahan harga saham di pasaran saham di seluruh dunia pada masa ini telah merangsang peningkatan usaha penyelidikan kearah memahami faktor-faktor yang mempengaruhi kemudahubahan harga saham. Justeru itu, objektif kajian ini adalah (i) untuk mengasingkan dan mengenalpasti faktor-faktor yang dicadangkan oleh teori dan amalan pelaburan dan mengkaji keupayaan faktor-faktor secara bersama dalam menghuraikan kemudahubahan harga saham di Bursa Saham Kuala Lumpur (BSKL); (ii) untuk menilai kebolehgunaan model penilaian harga saham Gordon di BSKL. Penemuan kajian menunjukkan lima dari enam faktor yang dicadangkan berhasil menghuraikan 23 peratus perubahan harga saham di BSKL dan dua dari faktor-faktor ini adalah signifikan pada paras keertian 0.05. Hasil kajian juga menunjukkan model Gordon sesuai digunakan untuk menilai harga saham di BSKL dengan statistik F yang signifikan, R2 bernilai 70 peratus dan tanda koefisyen pembolehubah dividen dan pertumbuhan perolehan adalah sepertimana yang diramal oleh teori. Berbeza dengan kepercayaan umum, adalah didapati faktor-faktor asas merupakan kuasa penentu yang menguasai perubahan harga saham di BSKL.

ABSTRACT

The worldwide increase in share price volatility in recent years has stimulated an abundance of research in an effort to understand individual share price volatility in international markets. The objectives of this study are: (i) to isolate factors suggested by investment theories and practices and to observe their ability to jointly explain share price volatility on the developing Kuala Lumpur Stock Exchange (KLSE) and (ii) to evaluate the applicability of Gordon's share valuation model on the KLSE. The findings suggest that five of the six suggested variables jointly explain 23 per cent of price changes on the KLSE for the period 1975 to 1990, and two of these factors were significant at 5 per cent level. Gordon's model holds well with F-statistics significant at 5 per cent level, R-squared is 70 per cent, and the signs of the coefficient of dividend and earnings growth variables are in the predicted direction. Contrary to popular belief, fundamental factors appear to be a significant force influencing share price changes on the KLSE.

INTRODUCTION

All investors, be they institutional or individual, hold one common objective when they invest in the share market; they all hope to maximise expected returns at some preferred level of risk. For investment in common stocks, not much is known about what causes the changes in share prices except the vague idea that some fundamental variables and other unsystematic factors affect share prices. These create great concerns to investors and others such as stockbrokers, fund managers and investment analysts. Due to worldwide increases in share price volatility in recent years (for example, the Black Monday or October 1987 market crash), studies on share price changes have received increasing attention: Williams and Pfeifer (1982); Baskin (1989); and Downs (1991). Ariff and

* The main findings were presented at the 5th Annual Pacific Basin Finance Conference in Kuala Lumpur on June 22-25 1992.

Johnson (1990) report the standard deviations of the rate of change in returns in the last ten years to 1990 of London (8%), Tokyo (12%), New York (13%), Singapore (27%) and Kuala Lumpur (31%). Whether the various factors suggested by valuation theories and practices are in fact *jointly* related to share price volatility is still unresolved. An important example is a recent study by Fama and French (1992) which revealed that share price returns are explained more by factors such as size and book-to-price ratio rather than the capital asset pricing model (CAPM) suggested beta factors.

Another related issue which has received much coverage since the mid-1980s is the search for factors that change the values of firms which in turn lead to changes in the share prices of firms. If these factors can be identified, then it makes sense to consider changes in the values of firms to have been driven by these factors.

Share price volatility may ultimately be due to changes in the values of firms arising from changes in the fundamental factors that are associated with changes in values of firms. Consequently increased volatility in share prices may be a result of increased volatility in these value-drivers. Some of these probable long-term value-drivers are inferred from theoretical and practitioner guidelines. Recent examples of such studies include, among others, Wilcox (1984), Rappaport (1986), Baskin (1989) and Downs (1991).

The objective of this paper is first to address two related questions of share price volatility and firm value changes as essentially being determined by factors which are responsible for creating changes in the value of firms. This is done by referring to related theories and practices and building empirical models to specify and isolate the value-drivers associated with share price volatility and price changes. Six key variables are identified from accepted valuation theories and practices. These are elucidated in the next section. This is followed by the findings on the price volatility of Malaysian common stock prices. The paper also aims to test the empirical validity of Gordon's share valuation model on the Malaysian equity market; the model is discussed and the findings presented, followed by the conclusion.

STOCK PRICE VOLATILITY FACTORS AND THE TEST MODEL

There have been attempts to investigate share price volatility by relating share price changes to one or more independent factors suggested by valuation theories in finance and accounting.

The derivation of the relationship between price volatility and value-drivers is discussed by Williams and Pfeifer (1982) and Baskin (1989). The relationship derived from several studies using this line of inquiry can be generalised as follows:

$$PV_i = a + \sum_{j=1}^{k} b_j (X_j)_i + e_i$$

where

- PV_i : the cross-sectional observed values of share price volatility of a representative sample of i = 1, ... n shares;
- a, b_i : respectively the intercept and the coefficents of theory-suggested independent variables j = 1, ... k. Six factors were observed for each firm in the sample of 100 firms over each year of the test period from 1975 to 1990;
- x_j : a matrix of six independent variables observed over each year for each firm in the sample; and
- e_i : the i.i.d. residual term satisfying zero expectation, constant variance unrelated to the independent variables.

The model tested in this paper is specified as a linear model. If in fact the relatonship is non-linear, further work is necessary to test other functional forms of this model.

The values of the dependent (PV_i) and independent (x_j) variables are obtained as the averages of the individual firm variables over an annual cross-section of time and then expressed as averages over the test period of sixteen years. That is, each variable is a simple average over sixteen individual years for each firm and the sample size is 100 firms listed on the Kuala Lumpur Stock Exchange. The sample represents more than fifty per cent of the capitalisation of the market. The financial data set is obtained from the annual reports in the *Companies Annual Handbook*. The share price volatility was measured by the Parkinson's extreme value method

(Garman and Klass 1980) in order to have an efficient estimate of this dependent variable. Specifically:

$$PV = \frac{1}{2}\left(\frac{AP\ (High) - AP\ (Low)}{0.5[AP\ (High) + AP\ (Low)]}\right)^2$$

The capitalisation-adjusted high, AP(High), and low, AP(Low), prices of each firm's share were observed. The volatility is then the square of the price difference between the high and low prices in each year divided by the firms' average price of shares in each financial year. The square root of this variable is the standard deviation, which is the share price volatility variable, PV, in this study. Thus share price volatility is represented as the extent of variation of share prices in the market.

The first of the six independent variables is the dividend yield, DY, which Gordon's (1962) theory suggests to be inversely related to share price volatility. Gordon's share valuation theory can be extended to show that dividend yield and payout ratio are inversely related to share price volatility (Williams and Pfeifer 1982; Baskin 1989). The dividend yield is measured for each year as the ratio of the sum of interim and final dividends for the year divided by the closing share price at the end of each financial year over the test period for each firm. The cross-sectional average is the simple average of the variable for each of the firms over the sixteen-year period. The second variable, the payout ratio, POR, is calculated similarly but with dividends divided by the after-tax net earnings of the firm.

The third variable suggested by evidence on the now well-entrenched efficient market theory (Annuar *et al.* 1992) for Kuala Lumpur is the earnings variable which should be related to share price changes and thus to volatility. Share prices react directly to changes in the reported or predicted earnings changes. Therefore, it is logical to suggest a direct relationship between share price volatility and earnings volatility, EV. It is measured by the standard deviation of the earnings per share of firms over the test period.

The fourth variable, rate of asset growth, AG, suggests that the greater the asset growth the greater the share price changes. AG is positively related to volatility: Gordon's dividend valuation theory for firms with dividend growth suggests growth as an important variable. Though this relates to dividend growth, it is assumed that this is monotonically related to growth in assets of a firm over a long period for it is the growth potential that sustains the long-term dividend growth. The asset growth is measured as follows;

$$AG = \left[\frac{TA_t}{TA_{t-1}}\right]^{\frac{1}{n}} - 1 \qquad TA: \text{total assets}$$

The values for this ratio for each year are calculated and the average over the test period is a simple average of the time series for the sampled firms.

The fifth variable, debt-to-assets ratio, DA, is a ratio of total borrowings-to-assets of a firm at the end of each year averaged over the test period. Corporate finance theory predicts that increases in debt-asset ratios should lead to a greater rate of change in the firm's value provided the firms had unused debt capacity. Thus this variable should be positively related to price volatility. The positive effect of financial leverage must be balanced against the costs arising from increased financial distress. In either case price changes are likely to be directly related to debt-to-asset changes. Trade debt is excluded as it is not a leverage-related variable.

Larger firms, being more diversified have lower risk and earnings are likely to be stable. This suggests that the size of firms may inhibit price volatility (Atiase 1985). Consequenty, the sixth variable is the firm size, SZ. The size is observed as the size of total assets using equity measured at market values at the end of each year for each firm, averaged over the test period. Since these are levels data, the firm size is observed in Malaysian ringgit and specified as logarithm to the base of 10. The reason for including the size variable is that studies have shown that it appears to matter in almost all tests of theories (Basu 1977; Reingaum 1981; Fama and French 1992). At worst, this variable is also important as a control for the firm size factor but less as a value driver in the model.

In the absence of multicollinearity and assuming residuals are normally distributed, equation (1) predicts a somewhat deterministic relationship between the fundamental variables, X_j, and the share price changes represented by the extreme value volatility measure. The power of Gordon's theory is judged by the overall fit of the tested model or whether it describes the

actual behaviour of the market (significant F-ratio), the extent to which it explains the stock price variability (large R-squared value) and significance of its individual variables. The hypotheses are:

H0 : There is no significant joint relationship between the fundamental variables and share price volatility

H1 : There is a significant joint relationship between the fundamental variables and share price volatility.

Rejection of the null hypothesis would suggest that the model explains the relationship between share price volatility and the factors determining the share prices. The proposition of the model is true if the alternate hypothesis is accepted. Tests can be done by examining the F (k, N-k) value for significance of the postulated relationship where k = 6 and N = 100. After testing the general model with six independent variables a parsimonious model is developed by controlling for multicollinearity and using step-wise regression. Pair-wise regression would be run to detect multicollinearity between variables by: for example, POR and DY are by definition multicollinear. Some of these variables will be dropped to improve reliability of the test results. The parsimonious model is built using Akaike's procedure as in Mendenhall and Sincich (1989).

The predicted relationship between each of the independent variables is specified by the theory developed in Williams and Pfeifer (1982) and Baskin (1989). The relationships are postulated as follows: $DY < 0$; $POR < 0$; $AG > 0$; $EV > 0$; $DA > 0$; and $SZ < 0$. That is, the dividend yield, payout ratio and firm size should be negatively related to price changes measured as volatility; earnings volatility, asset growth and leverage should be positively related. Hypothesis tests will be done by examining the signs of the coefficients with t-values providing test statistics for significance of the predicted relationships. The extent of the joint relationship in the model will be quantified by computing the adjusted R-squared value as a measure of the proportion of variation in share price volatility explained by the fundamental variables entering the model.

FINDINGS ON PRICE VOLATILITY

Information on the behaviour of the dependent and the independent variables in the Kuala Lumpur market is summarised in Table 1.

The volatility is 65.37 per cent, which is not surprising for a developing market which had the dramatic experience of two recessions (1975-76 and 1985-86), the October 1987 crash and a number of share scandals (Pan Electric crisis, the collapse of brokerage houses, Bank Bumiputera and the Hong Kong-based BMF crisis, and lately the Malaysian Industrial Development Finance Consultancy Services [MIDFCS] crisis). The dividend yield was 3.98 percent but a high payout ratio of 74 per cent is observed. The earnings volatility was 0.18 percent, the asset growth rate was 36.83 per cent and the debt rate was 14.17 per cent. The average behaviour of the firms as suggested by these numbers is consistent with the public knowledge about this market.

Next, the value drivers associated with share price volatility are isolated and the findings are presented in Tables 2 and 3.

Table 2 is a summary of results from fitting the general model to the data from the hundred firms in the market prior to parsimonious model selection. Overall, the general model fits and the six fundamental variables do appear to jointly describe the share price variability. The null hypothesis cannot be accepted as the F-ratio was significant at 0.05 confidence level. However, only 22 per cent of the variation in price changes are explained by the model. Except for the earnings and size variables, the direction of the

TABLE 1
Descriptive statistics of fundamental variables in Kuala Lumpur: 1975 – 1990
(N = 100, variables are in percentages)

	PV	DY	EV	POR	SZ	DA	AG
Mean	65.37	3.98	0.18	74.34	18.45	14.17	36.83
Standard Deviation	16.00	3.06	0.22	44.21	1.21	12.71	20.36

TABLE 2
Share price volatility and fundamental variables in Kuala Lumpur: 1975 – 1990
(General model)[1]

	DY	POR	EV	AG	DA	SZ
Regression Coefficients	–0.008	–0.001	–0.020	0.211	0.002	0.014
t-values of Coefficients	–1.14	1.51	–0.238	1.827**	2.355*	1.052
Regression F-Ratio	5.76*					
Adjusted R-Squared	22.39					

Significant at 0.10** and 0.05* confidence level

TABLE 3
Share price volatility and fundamental variables in Kuala Lumpur: 1975 –1990
(Parsimonious model)[2]

	Intercept	DY	POR	DA	AG	SZ
Regression Coefficients	0.378	–0.009	–0.001	0.002	0.212	0.014
t-values of Coefficients	1.602	–1.445	–1.503	2.591*	1.846***	1.067
Regression F-Ratio	6.97*					
Adjusted R-Squared	23.17					

Significant at 0.10** 0.05* confidence level

variables are as predicted by theory. The coefficients of asset growth and debt to asset variables are significant at the 0.10 and 0.05 confidence levels respectively. These results are not reliable as multicollinearity is not controlled in the test. Table 3 reports the results of a parsimonious model after controlling for multicollinearity.

The F-ratio is 6.97 and significant at 0.05 confidence level and the adjusted R-squared improved slightly to 23 per cent suggesting that twenty three per cent of the changes in common stock prices in the Kuala Lumpur market are jointly explained by five of the six fundamental factors: dividend yield, payout ratio, debt usage, asset growth and firm size. Except for the size variable, the signs of the other four variables are in the predicted direction. Higher debt usage suggests higher price volatility, hence the observed positive relationship which was significant at 0.05 confidence level with t = 2.591. Higher asset growth leads to higher price changes, the coefficient being significant at 0.10 confidence level with t = 1.846. The effect of firm size, dividend yield and payout ratio on the share price change was negligible.

EVALUATION OF GORDON'S VALUATION MODEL

The theory of the firm suggests that the objective of a firm is to maximise its value through positive net present value investment. For listed firms, these opportunities should be reflected in their share prices. Therefore, the variations of common stock prices do signal profitable investment opportunities and influence the firm's financial plans. In an efficient market, excess returns are possible only if stocks are mispriced, probably because the current price does not reflect unanticipated future growth.

[1] Similar findings were found for the samples of blue chip and speculative firms.

[2] Similar results were found for the blue chip and speculative samples, except that for the speculative sample only the DY coefficient is significant at 0.05 confidence level for both the general and simpler model.

Investors in their effort to locate the mispriced stocks can use valuation models to add efficiency and value by focusing scarce resources on those investments that are likely to earn above-average returns in the future. Therefore, valuation models can provide an avenue for investors to translate their judgements into investment decisions and one such valuation model was developed by Gordon (1962).

Gordon's model explains the variation in price of common stocks in the following manner:

$$P = \frac{Y(1-b)}{k-br} \text{ or } P = \frac{D}{k-g}$$

where the value of a share (P) is the present value of its expected future dividends, which are given by the firm's current income (Y), the return on equity investment the firm is expected to earn (r), the retention rate (b) and the returns required by investors (k). The value of the stock should be greater, the greater the earnings power and capacity of the corporation to pay out dividends, D. Corrrespondingly, the higher the growth rate of dividends, br or g, the greater the value of the firm's stock. The greater the risk of the firm or the required rate of returns, k, the lower the value. There is evidence (Fama and French 1992) that the book value version explains the variation in prices better than the market value measure.

This model is used to find the investment rate that maximises the share value and assumes that dividend policy *per se* has no influence on share price. Other assumptions are: that an investor buying shares purchases a dividend expectation, and that in placing a value on the expectation, the rate of profit the investor requires is an increasing function of the rate of growth of dividends; one growth rate is appropriate forever, this is suitable for valuing stable and mature firms.

Gordon (1962) tested the refined version of the model on US data and reported that it did a creditable job of explaining the variation in price of common stocks in different sectors of the economy with the R-squared ranging from 0.80 to 0.92 over the different sectors.

The empirical version of the model is estimated as follows:

$$\text{Log } P_o = a + b_1 \text{ Log DPS} + b_2 \text{ Log } (k\text{-}g)$$

Some variations of the model are examined to develop a parsimonious model suitable in the Malaysian context. The empirical version of Gordon's model was run on 100 listed firms using k based (i) on book value (ROE) and (ii) market (CAPM) value measures. The findings are summarised in Tables 4 and 5 respectively.

FINDINGS ON GORDON'S MODEL

Findings reported in Tables 4 and 5 show that Gordon's model is able to explain 70 per cent of the variations in prices of common stocks of firms listed on the Kuala Lumpur Stock Exchange. In both tables the model holds well with the F-statistic significant at 0.05 confidence level. The sign of the regression coefficients of the independent variables is in the predicted direction, except that the coefficent of the k-g variable in Table 5 is not significantly different from zero. This finding is consistent with Fama and French's (1992) suggestion that book value measures explain the variation in common stock prices better than market value measures, although no direct test was performed on this hypothesis.

TABLE 4
Validation of Gordon's model using k based on book value measure[3]:
Log P = log a + log DPS + log (k–g)

	DPS	(k-g)
Regression Coefficients	0.443	–0.094
t-value of Coefficients	12.910*	–1.835**
Regression F-ratio	84.65*	
Adjusted R-squared	69.33	

Significant at 0.10** and 0.05* confidence level

[3] Similar results were found for the samples of blue chip and speculative firms.

TABLE 5
Validation of Gordon's model using k based on market value:
Log P = log a + log DPS + log (k-g)

	DPS	(k-g)
Regression Coefficients	0.347	–0.062
t-value of Coefficients	10.138*	–0.754
F-ratio 89.86*		
Adjusted R-squared 70.88		

* Significant at 0.05 confidence level

CONCLUSION

To recapitulate, the objectives of this study are: (1) to isolate the the value-drivers associated with stock price volatility and (2) to evaluate the relevance of Gordon's share valuation model to firms listed on the Kuala Lumpur Stock Exchange (KLSE). With respect to the first objective, factors suggested by valuation theories and investment practices were isolated and then related to price changes in a test model with share price volatility at firm levels. Both the general and a parsimonious model were examined. It appears that dividend yield, payout ratio, debts to assets ratio, asset growth and firm size variables explained 23 per cent of the price changes in the Kuala Lumpur market for the period 1975 to 1990. Only the asset growth and debt usage variables were significant at 0.05 confidence level, and the other three variables were not significant in the model fitted for the Kuala Lumpur market. These findings are consistent with the leverage theory's prediction about the magnifying effects on value of a firm by leverage and the positive effect of asset growth on price changes. A limitation of this study on price volatility is that linear relation is assumed in the test. Though theory does not provide any cue on this issue, it might be that the relationship is non-linear. If firms experience an increase in competition from other firms for maintaining their higher rates of return, it is more difficult to maintain higher rates than moderate or small rates of abnormal returns. This suggests that the relation is unlikely to be monotonically increasing as modelled by a linear relation and the relation may well be concave. This issue will be addressed in the next phase of this research.

With regard to the applicability of Gordon's model in valuing shares, the findings suggest that the model holds well. For both the book and market value version of k, the model holds well as the F-statistic was significant at the 5 per cent level and the adjusted R-squared is about 70 per cent. The signs of the dividend and earnings growth variables are in the predicted direction and significant at the 0.05 confidence level. However, for the market value measure of k, the variable k-g is not significantly different from zero. This implies that Gordon's model with a book value measure of k can be reliably used by investors to value common stock prices of listed firms on the KLSE in their effort to identify mispriced stocks.

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(Received 4 November 1992)