THE USE OF THE DIVIDEND DISCOUNT MODEL TO MEASURE STOCK PRICE VOLATILITY

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Abstract: The dividend discount model, shortly characterized at the beginning of the paper, belong among many models used to stock valuation. Various situations associated with zero, constant or variable dividend growth rate are described, including case of zero-dividend firm. The aim of the paper is to present the way how to use the dividend discount model to measure stock price volatility. Many subjects on financial market whether they generally analyse concrete stock markets or they directly create investment recommendations, can use this option in the practice. Findings resulting from realized empirical analysis can be rather beneficial for these subjects. Author also presents other ways how to use this model in the practice. It is also possible to compare the volatility and return related to one state with the same parameters related to other state, as it is mentioned in concrete examples.

Keywords: dividend discount model, stock price volatility, fundamental analysis, stock valuation, intrinsic value of a stock

1 Introduction

Many stock exchanges enable investors to invest in various securities including stocks. To find required information about stock, investors use various investment analyses including fundamental analysis. Many methods for estimating the intrinsic value of a stock is used. This value is described by Gottwald (2011) as the „justified price", which stock ideally should have and it express the real value of a stock. Investors use often the dividend discount model to calculate the intrinsic value of a stock. Based on it, they buy, hold or sell the stock. Stock price varies about the intrinsic value of a stock. To find the intrinsic value of a stock, financial analytics can choose from various models. Fundamental analysis provides itself a set of methods how to calculate the intrinsic value of a stock. Their choice depends on many parameters, which are needed for certain model.

The dividend discount model provides a means of developing an explicit expected return for the stock market. It is a way of valuing based on theory that a stock is worth the discounted sum of all its future dividend payments. In other words, the intrinsic value of a stock is expressed like present value of future dividends. The stocks are evaluated based on the net present value of the future dividends. The forecasting of future dividends is sometimes rather problematic.

Various types of the dividend discount model are used by the financial analytics. In the simplest case, the value of a stock equals to the value for a perpetual anuity with a constant level of payments. Other types depend on increasing, stagnation or decreasing of dividends. The increasing or decreasing of dividends can be linear or nonlinear. Financial analytics can estimate probabled increase rate of dividends by means of financial indicators of companies or historical data analysis. To analyse historical data, it is needed to find the availability of such data. The probabled increase rate depends on factors like dividend policy, margin of profit, return of equity capital and indebtedness.

The paper is structured as follows: At the first, author exactly defines objective and used methodology in Chapter 2. The dividend discount model, its modifications and various dividend policies are characterized in Chapter 3. This chapter also consists of empirical analysis focused on the use of the model to measure volatility of stock price. Author comments and discusses about the founded results in Chapter 4. Significant findings about using of the dividend discount model are concluded in Chapter 5. At the end, author mentions how it is possible to continue in the research in the future.

2 Objective and Methodology

The objective of this paper is to present the way how to use the dividend discount model to measure stock price volatility. The reason why is the objective so formulated consists in an effort to find out what is the real role of the dividend discount model, widely whether is it able to apply this model to this situation. The contribution is in using of presented method by subjects on financial markets. Analyzing stock prices by this method, subjects can more exactly create investment policy. As for the methodology, at the first various variance bound frameworks is used. Cross-sectional data are simulated from the general equilibrium asset pricing model. Also different time series paths of data corresponding to different state realizations are simulated.

Exact hypothesis is formulated. This hypothesis of the validity of the dividend discount model is further tested. As for statistical evaluation, F-tests are used in an effort to confirm or disprove that the variance of the actual price series is significantly greater than the variance of the perfect foresight price series. These statistical methods, described in the paper, are obviously used in these situations. Further, it is tested, whether markets are efficient, concretely, whether can be inferred any conclusions about market efficiency from variance bounds tests used within the research. Founded results from cited empirical researches are analyzed by analytical method. The dividend discount model including its various modifications are described by descriptive method. This model is used for illustration why stock prices may be highly volatile even though investors act in a perfectly rational way.

3 Results

3.1 Various Modifications of the Dividend Discount Model

Financial analytics use various modifications of the dividend discount model in the practice. The process for valuing stocks is commented by Blackwell, Griffiths and Winters (2007). The comment relates to stocks that pay dividends and stocks that do not pay a dividend. An investor in a dividend paying stock expects to recese two sets of future cash flows: a stream of future dividends and a sales price when the stock is sold.

To value a dividend paying stock, three various assumptions about dividend growth can be used: no growth in dividends, constant growth in dividends or nonconstant growth in dividends. However, the assumption of no growth in dividends may seem unrealistic. The assumption of constant dividends fits perfectly with the characteristics of preffered stock, which carries a stated dividend of a fixed amount. All preferred stock dividends must be fully paid before any dividend on common stock can be paid. Assumption of constant growth in dividends is reasonable for the large, stable, dividend-paying companies, which are often referred to as „blue chip" firms. By assumption of nonconstant growth in dividends is the growth rate in dividends generally assumed to decline to a rate of growth that is sustainable over the long run. Three-stage nonconstant growth in dividends is possible, too. Modifications like three-stage model or four-stage model are used in the practice. An intermediate stage of earnings growth exists between high growth and mature growth.

The use of the dividend discount model in case of no dividend payment by company is rather problematic. The value of the stock that do not pay a dividend is based on an infinite stream of expected capital gains. A standard conceptual method for valuing non-dividend-paying stock is the sum of cash flows from assets in place and cash flows from growth opportunities. It is also possible to use the indicator earnings per share to estimate the value of the stock. Nawalkha (2007) presents pricing zero-dividend and positive-dividend stocks. He derives stock valuation formulas for pricing positive-dividend and zero-

dividend stocks using alternative wealth creation models given as following: the residual income model, the EVA model and the franchise factor model. The dividends are obtained endogenously under these models, whereas in wealth distribution models like dividend discount model the dividends are obtained exogenously.

The assumption of the dividend discount model is that the value of an equity firm equals to the present value of all distributed dividends and this model focuses on the wealth distribution of the firm's resources in the valuation equation. The residual income model and the EVA model suggest that the price of the equity is the sum of the book value of equity and the present value of the residual incomes generated by the firm's returns exceeding its cost of equity. These models require the projections of future returns on the book equity. The franchise factor model requires the projections of future franchise returns on the increments to book equity. The techniques of estimating the growth variables under these three models are different.

Since book value growth variables may reflex fundamentals more accurately than the dividend growth variable, these three models may lead to better stock valuation than the standard dividend discount model. Nawalkha also derives formulas for zero-dividend paying stocks and dividend paying stocks under multiple growth rates.

Stock valuation is the theme, which Ross, Westerfield and Jaffe (2008) focuse on. They mention differences among common, growth and preferred stocks. They also describe some special cases which depend on dividends growth, mainly zero growth, constant growth, nonconstant and supernormal growth. Capital gains yield and dividend yield are the components of the required return. Some features of common and preferred stocks, among others important characteristics of dividends are described, too. The choice of the suitable dividend discount model depends on dividend policy of a company. Ross and others describe standard method of cash dividend payment and the chronology of dividend payment. This theoretically explained chronology can be applied in the practice. They also identify the real-world factors which favor a high payout and a low payout of dividends. Described compromise dividend policy is often used in the practice by joint-companies.

3.2 Stock Price Volatility Measurement by Means of the Dividend Discount Model

Finding whether the stock price volatility can be justified by the dividend discount model and finding how big is the market efficiency, Salih, Akdeniz and Ok (2006) use cross-sectional data simulated from the general equilibrium asset pricing model. The model used in the study does not incorporate behavioral aspects of investors into asset prices. The model is solved for the optimal investment functions and for a given set of parameters, concretely for three firms and eight states of the economy using functional forms. In the end, 1000 different sample paths of market price data for 100 years is obtained. In each simulation, the computer starts from the same state. The perfect foresight price is calculated at discount factors from 1 % to 5 %. The descriptive statistics for the sample related to ratios used in testing are presented in Tab. 1.

Tab. 1: The Descriptive Statistics Related to Ratios

Discount Factor	Ratio Mean	Ratio Standard Deviation	Minimum Ratio	Maximum Ratio
0.01	6.29	3.50	1.61	20.38
0.02	3.70	1.75	1.07	10.58
0.03	2.81	1.14	0.91	7.23
0.04	2.36	0.83	0.84	5.40
0.05	2.08	0.65	0.81	4.39

Source: Salih, Akdeniz and Ok (2006)

Four parameters are analysed for each discount factor from 1 % to 5 %. The descriptive statistics for the sample related to other parameters used in testing are presented in Tab. 2.

Tab. 2: The Descriptive Statistics Related to Other Parameters

Discount Factor	Utility Discount Factor	Number of Violations	Number of F Statistics
0.01	0.99	1000	1000
0.02	0.98	1000	990
0.03	0.97	986	953
0.04	0.96	984	910
0.05	0.95	980	885

Source: Salih, Akdeniz and Ok (2006)

Based on results, number of F statistics relates to significant F statistics at 1 %. Furthermore, other parameters are founded, like production function parameters, distribution of ratio of standard deviation of price to standard deviation of perfect-foresight price and distribution of actual price. It is clear that the conditional variance bounds hold. Formulated hypothesis of the validity of the dividend discount model cannot be rejected, because the variance bound is not violated. Other important finding is that markets are efficient and stock prices are neither affected by herd psychology nor by the outcome of noise trading by naive investors. F-tests confirm that the variance of the actual price series is significantly greater than the variance of the perfect foresight price series in a majority of replications. The violation of the unconditional variance bound relationship does not necessarily indicate market inefficiency. Moreover, the variance bound relationship is essentially a cross-sectional restriction and should only be tested using cross-sectional data. That is the way how to measure stock price volatility.

Stock price volatility relates to stock market returns. The stock market mean returns and volatility spillover between stock markets of political and friendly countries are analyzed by Choudhry (2004). He selects potential friends and foes according to the political situations in the past ten years. The three pairs of foes tested are Israel–Jordan, India–Pakistan, and Greece–Turkey. The United States has been friendly toward these six countries. Spillover between the United States and these countries is also investigated. Nonlinear GARCH-t model is used to empirical tests. Based on results, there exists bidirectional mean and volatility spillover between two countries not on friendly terms. This spillover takes place from a larger distant friendly country - the United States - to these smaller emerging markets, but not much the other way around.

4 Discussion

The dividend discount model is usually used to stock valuation, in the practice. Various modifications of the dividend discount model were presented in this paper. These modifications depend on ways of dividend payments. New formulas for special cases of dividend payments can be derived from the basic formulas. Stock valuation of zero-dividend firms is also analysed. The relation between stock price volatility and the dividend discount model is researched by several researchers. There mentioned researchers used various models in their empirical analyses, especially the dividend discount model, the CAPM model, the residual income model, the EVA model, the franchise factor model and the Miller and Modigliani dividend irrelevance model. Theoretical explanation of changes in stock prices, in other words, volatility, is difficult, because many factors influence stock price volatility in the practice.

The surmise, whether is possible to use the results from the dividend discount model to measure stock price volatility, was researched. Based on used methodics nad founded results, this hypothesis was not rejected. Another look on the relation between the dividend discount model and volatility is described by Cuthbertson and Nitzsche (2008). At the first, analysing stock valuation, the dividend discount model is presented like rather simple model of valuation, which can be quite useful in

obtaining at least a ball-park estimate of the value of equity. This model can be used to illustrate why stock prices may be highly volatile even though investors act in a perfectly rational way and the market always prices stocks correctly. The stock market is excessively volatile, as the observed volatility in actual prices is greater than would occur if the markets were efficient and investors were always rational.

To analyse efficient markets hypothesis, the discount rate, which is used in the dividend discount model can be calculated. The rate is calculated using CAPM model. The research published in this paper can continue by various ways. To analyse the relation between the intrinsic value of a stock and stock price volatility, following models used to estimate the intrinsic value of a stock can be, in author´s opinion used: the profit model, combination of the dividend discount model and the profit model, the free cash flow to equity model (FCFE) and the historical model. The using of other statistical methods is also possible.

5 Conclusion

This paper confirms that the changes in stock prices can be measured by the dividend discount model. The way how to use the model is clearly presented. To describe dividend policy of companies, it is need sometimes to modify this model. Author completely describes various situations related to various dividend payment strategies. Methodics used in the paper can be beneficial for many subjects on financial market. These subjects can more exactly create their investment policy. The testing of the market efficiency is described, too. The dividend discount model is also used to illustrate of high volatility of stock prices even though investors act in a perfectly rational way. It is possible to continue in the research by other applications of the dividend discount model in various situations.

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