Equity Valuation

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Abstract

This paper conducted an empirical examination of two theoretically equivalent models: the dividend discounted model and the free cash flow to equity model. The paper explored and assessed the relative performance of these valuation models under different circumstances by comparing actual traded prices with the intrinsic values calculated over different horizons. The study population includes all firms in the service and industry stock listed in Amman Stock Exchange (ASE) during the time period (2002-2004). We find that the dividend discounted model using either individual securities approach or portfolio approach outperforms the free cash flow to equity model in all versions. These results of the empirical analysis are consistent with previous studies.

Keywords: Equity Valuation Model, Discounted Cash Flow Model, Dividend Discounted Model, Intrinsic Values.

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1. Introduction

Valuation is the process of forecasting the present value of the expected payoffs to shareholders and of converting this forecast into one number that corresponds to the fundamental-intrinsic firm value.

This study seeks to conduct an empirical examination of two valuation techniques, the discounted dividends model and the free cash flow model, by comparing actual traded prices with intrinsic values calculated using portfolio and individual securities approaches in different horizon analyses. Furthermore, this study aims to assess the performance of these valuation models under different circumstances[2] where the relative performance of these models varies along with the changes in the key assumptions of the fundamental parameters such as cost of equity as well as the growth rate calculations.

Theoretically, the dividend discounted model and the free cash flow model are equivalent, but the practical implementation issues create differences in these valuation model. That is, the fundamentalists need to forecast several common factors: first, the required rate of return which is the most important factor for all models, and second, the cash flow's growth rate. Analysts use different approaches to estimate these two variables depending on their forecasts' perspectives. As a result, different analysts using the same valuation technique will derive different value estimates for stock. Therefore, these differences make empirical comparisons of these models worthwhile.

This study provides us with empirical evidence of the reliability of estimated intrinsic value derived from theoretical evidence on the reliability of estimated intrinsic value derived from theoretically equivalent valuation models, dividend discounted model (DDM) and the free cash flow model (FCFM)

The remainder of the paper is as follows: Section 2 reviews previous studies that have discussed the comparison of the different valuation models. Section 3 presents the data used in this study as well as the study methodology. Section 4 presents the empirical analysis and results. Section 5 presents the sensitivity analysis and finally section 6 concludes.

2. Literature Review

Several authors have shown that there is a theoretical equivalence between the free cash flow model, the dividend discount model and the residual income model. Plenborg (2000) states that these valuation techniques should give consistent and identical estimates of intrinsic firm value, provided that all the forecasts of the different items 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 produce the same valuation when infinite-horizon forecasts are used. Thus, the dividend, cash flow and residual

1. The study assumes different circumstances for beta coefficient as well as the growth rate estimates. First, the study assumes that the growth rate is unified in the DDM and the CFM and then it will be different. Second, the study assumes that the fundamental attributes will be discounted by the cost of equity based on firm's beta and then they will be discounted by the cost of equity based on firm industry's beta.

income approaches are equivalent when the respective payoffs are predicted to infinity.

However, these zero-error conditions are very restrictive. In practice, forecasts are made over finite horizons so different accounting principles yield different estimates 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. Specifically, Levin and Olsson (2000) argue that the steady state conditions ensure that the company's forecasted performance remains stable after the valuation horizon and that its expected development, as described by its parameters, holds indefinitely. They also claim that a steady state is a necessary condition for the three models to yield identical results when terminal values are used. Therefore, any steady state condition violation can cause internal inconsistencies in valuation models and thus have a significant effect on the equity value estimates.

Penman and Sougiannis (1998) and Francis, Olsson and Oswald (2000) do not take into account the fact that the same assumptions must be applied to the models so that they yield identical valuations. The use of simplifying assumptions in both studies makes the link between the forecasted financial statements and the input in the different valuation approaches most likely inconsistent. Based on these distinct assumptions, both studies suggest that RIM is superior to the other models. Therefore, these two studies indicate that if the internal coherence between the three valuation models is violated, the RIM yields more accurate firm value estimates than the FCF or the DDM, most likely due to the use of different assumptions.

Fernandez (2003) compares theoretically the residual income model for the equity valuation with the discounted cash flow model. The results of the comparison indicate that residual income models, economic profit (EP), economic value added (EVA), and the cash flow added (CFA), yield always the same intrinsic value estimates for a stock as the discounted cash flow model, and he also proved that the accounting information required to estimate value is the same regardless of whether the three residual income models or the discounted cash flow model are used in the valuation.

Gentry et al (2003) provide 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 changes on the value of a stock. Moreover, they introduce theoretically the conditions when the DDM value estimates are equal to the CFM value estimates. They state that the only time for the equivalent condition is when the payout ratio is equal to one as well as the return on investment equals the cost of equity.

Benada (2003) provides us with a proper and useful model (the free cash flow model) to estimate the fundamental value for start up as well as growth companies. He introduces several motivations or strengths to use the free cash model to value the growth companies instead of the dividend discounted model.

Different studies have appeared based on the commonly-held belief that practical implementation of the DDM and the CFM yield different estimates for the stock's value such as Penman et al (1998), Francis et al (2000), and Courtea et al (2001). Consequently, the comparison of these valuation models will be worthwhile. Furthermore, these studies follow different approaches to the comparison as well as the nature of data. The purpose of their study is to assess empirically whether, over five year valuation horizon, the DDM, FCFM, and the RIM are empirically equivalent. Furthermore, they present a comparison between the CFM and the RIM from using a different perspective from Penman et al (1998) and Francis et al (2000). They compare the pricing error of the RIM and the CFM that employ Value Line forecasted price in the terminal value with the non price-based valuation models for the CFM as well as the RIM.

Their results introduce empirical support for these predictions of equivalence between these three price-based valuation models. Furthermore, they find that the price-based valuation models, within each class of the CFM and the RIM, outperform the non price-based valuation model accompanied with the dominance of the RIM over CFM in both approaches.

Lundholm et al (2001) have critiqued previous studies (e.g. Penman et al (1998), Francis et al (2000), and Courteau et al (2000)) that introduce empirical support to make the comparison of the three theoretically equivalent valuation models, the DDM, FCFM and the RIM worthwhile, and they concluded that there is nothing to be learned from an empirical comparison of these models. The previous studies find empirical support for these valuation models because of the implementation errors resulting from applying them.

Consequently, they refute the commonly-held belief that practical implementation issues lead to differences in the value estimate. Furthermore, they state that the research efforts in equity valuation should be concerned with more accurate forecasts of financial data.

Gentry et al (2002) compare the explanation of the accounting approach for estimating the capital gains rates with the free cash flow to equity approach on American and Japanese equities. The results indicate that a strong statistical relationship exists between net earnings and capital gains for both American and Japanese stocks than FCFE.

Vardavaki and Mylonakis (2007) presented the theoretical framework for the process of equity valuation and investigates the relative explanatory power of alternative linear equity valuation models when applied to firms in the UK food and drug retail sector. The results of the empirical analysis support precious studies that the combined valuation model is more informative by providing better and more accurate estimations of equity market values. This can be explained by the fact that this model incorporates both the economics and the accounting characteristics of the examined firms.

Berkman et al (2000) compare estimates of value derived from conventional discounted cash flow and price earnings valuation methods to the market price. They suggest that the best discounted cash flow method and the best price earnings comparable method have similar accuracy. The median absolute pricing error is around 20% and the models explain around 70% of the cross-sectional variation in market price scaled by book value.

3. The General Setting

The discounted cash flow approach is one of the most commonly used tools among financial analysts for equity valuation. All models under this approach have foundations in the present value rule, where the value of any asset is the present value of expected future cash flow:
This section aims to present the theoretical framework of the dividend discounted model (DDM) and the free cash flow model (CFM). Further, this section presents the data used in this study as well as the study methodology.

3.1 Data and Research Methodology

The empirical analysis in this study compares the valuations of the non-price models, the DDM and the CFM, over various horizon t+1, t+2, and t+3, where t = 2002. These fundamental values are then compared with the actual traded prices to infer the valuation errors either by the individual securities value estimate approach or the portfolio analysis approach[3].
Previous literature proposed three approaches to estimate the terminal value. First, the terminal value is calculated by liquidating the firm's assets in the terminal year. The other two approaches value the firm as an ongoing concern based on the presumption that the firm will continue indefinitely at the time of the terminal value estimate. One implements a multiple approach to estimate the value in the terminal year. The other assumes that the cash flows will grow at constant rate indefinitely. Consequently, we can estimate the terminal value using a perpetual growth model. This study follows the third procedure where the terminal value is estimated as a constant growth rate. This study assumes that the terminal value turns into stable growth rate three years ahead.
Furthermore, the sensitivity analysis of the DDM and the CFM to different circumstances is included in this study. That is, the study investigates how the relative performance of the DDM and the CFM varies along with changes in the key assumptions on which the valuation is based. In this study, this kind of analysis examines how changes in underlying assumptions change the outcome represented by the fundamental values and thereafter the changes in the valuation error in the individual securities approach as well as the portfolios approach.
Therefore, the empirical analysis in this study includes: (**1**) the sensitivity analysis of the DDM and the CFM to the cost of equity based on different estimates of beta coefficient. All fundamental attributes in the valuation techniques are discounted by cost of equity based on capital asset pricing model (CAPM). The CAPM states that the risk premium on any asset or portfolio is a function of risk premium on the market portfolio and the beta coefficient (Rose, 2003). The regression analysis to estimate the beta coefficient requires several factors such as stock and market returns.
This study examines two approaches of beta coefficient estimate. First, beta on a single firm with the assumption that the firm's beta will be stable over time. Second, the firm's industry beta basis; this approach is estimated by the

2. These two approaches will be explained later on in the study.

average beta across all of the firms in the same industry. That is, the industry is a portfolio of individual firms with the same operations. To apply this approach, we assume that the firm has no significant amount of business in more than one industry. Moreover, the financial leverage of the firm is not different than the industry average. Furthermore, the interval of beta estimation will be unified in both models; it represents 60 monthly observations over a five year period of stock returns as well as the market returns.

The empirical evidence suggests that the error in beta estimation on a single stock is greater than the errors for a portfolio of securities in the same industry. Therefore, the firm's beta industry basis is more accurate than the beta on a single stock. The sensitivity analysis to the cost of equity aims to infer the impact of the beta estimation approach on the relative performance of the DDM and the CFM over horizon *t+1, t+2, and t+3.*

(**2**) The sensitivity of the two models to the growth rate estimates. First, we assume that the growth rate estimate in the dividends is the same as the growth rate estimate in the free cash flow.

Second, we assume the two growth rates are different. The growth rate estimate represents the second main parameter to the valuation techniques which has significant impact on the fundamental value estimates as well as the cost of equity.

The empirical analysis includes two growth rate estimates. First, we assume that the growth rate is unified in both models. Second, we assume that the growth rate isn't unified in both models. The sensitivity analysis of the DDM and the CFM seeks to find the effect of growth rate estimates on the relative performance of these models, and thereafter the valuation error over horizon *t+1, t+2, and t+3.*

(**3**) The empirical analysis of this study implements two approaches to comparison to infer the relative performance of the two models: first, the comparison based on individual securities values' estimate[4] and second, the comparison based on portfolios analysis approach[5].

The individual securities approach depends on the average of the sample as a whole; all of the fundamental attributes are estimated based on a time series of these attributes. Furthermore, according to the validation of the DDMs and the CFMs, different samples in size are formulated to infer the relative performance of the DDM and the CFM under different circumstances. This procedure excludes all conditions which may affect the performance metrics (bias and accuracy), such as size of the firm or market-to-book ratio.

The portfolios approach avoids the shortcomings included in the individual securities approach where the performance metrics may be affected by some observations. Furthermore, it provides different circumstances where the size of the firm and the market-to-book ratio may affect the performance of the DDM and the CFM over horizon *t+1, t+2, and t+3.*

The study population includes all firms in the service and industry sectors listed in Amman Stock Exchange (ASE) during the time period (2002-2004).

3. This approach is consistent with Francis et al (2000).
4. This approach is consistent with Penman et al (1998).

4. The empirical analysis

The empirical analysis of this study includes two approaches to inspect the relative performance of the DDM and the CFM: valuation error comparison based on individual securities approach as well as the portfolios analysis approach.

4.1 Individual securities approach

This section aims to contrast the reliability of the value estimates of the DDM and the CFM applying the first approach, valuation error comparison based on individual securities approach
over horizon t+1, t+2, and t+3. Furthermore, the sensitivity analysis is embodied in the analysis. That is, it focuses exclusively on different circumstances in which the changes in the fundamental parameters such as cost of equity and growth rate estimates may affect the performance metrics of the DDM as well as the CFM over horizon t+1, t+2, and t+3.

4.1.1 Valuation Error Comparison Based on Firm's Beta and Unified Growth Rate Calculation.

A- Zero Growth Model

Panel A of Table 1 shows that the DDM has mean of valuation error (MVE) -0.004, 0.269, and 0.099 over horizon *t+1, t+2, and t+3,* respectively. Further, it shows that the CFM has mean of valuation error of -1.586, -0.594, and -0.519 over horizon *t+1, t+2, and t+3*, respectively. Therefore, on average, the DDM is less bias than the CFM (0.418 for the DDM versus -0.9 for the CFM). Note that since valuation error is (MV-FV)/MV, a negative valuation error implies market prices are overvalued by the fundamental valuation model.

Table 1 displays the two models, in terms of bias, using another measure of central tendency, the median of valuation error. The results show that the DDM has median of valuation error of 0.038, 0.331, and 0.989 over horizon *t+1, t+2, and t+3*, respectively, whilst the CFM has median of valuation error of -0.781, -0.245, and -0.521 over horizon *t+1, t+2, and t+3*, respectively. Therefore, the DDM, on average, is less bias than the CFM (0.453 for the DDM versus -0.516 for the CFM).

B- Constant Growth Model

Panel B of Table 1 presents the results of the second version of the DDM and the CFM. The results show that the DDM has mean of valuation error of -1.158, -0.347, and -0.425 as well as median of valuation error of -0.985, -0.358, and -0.072 over horizon *t+1, t+2, and t+3*, respectively. The CFM has mean of valuation error of -4.659, -2.059, and -1.344 as well as median of valuation error of -4.659, -1.409, and -0.072 over horizon *t+1, t+2, and t+3*, respectively. Therefore, on average, the DDM is less bias, in terms of mean valuation error, than the CFM (-0.644 for the DDM versus 2.687 for the CFM), and that the DDM is also less bias, in term of median valuation error, than the CFM model (-0.472 for the DDM versus -2.0472 for the CFM).

C- The Two-Stage Model

Panel C of Table 1 reports the results of the third version of the DDM and the CFM, respectively. The results show that the DDM has mean of valuation error of -1.005, -0.256, and -0.163 as well as median of valuation error of -0.780, -0.239, and 0.040 over horizon *t+1, t+2, and t+3,* respectively. The CFM has mean of valuation error of 1.373, -1.619, and -2.546 as will as median of valuation error of 1.216, -1.060, and -1.362 over horizon *t+1, t+2, and t+3,* respectively.

Therefore, on average, the DDM is less bias, in terms of mean valuation error and median valuation error, than the CFM (-0.475 for the DDM versus -0.931 for the CFM) and (-0.394 for the DDM versus -0.797 for the CFM, respectively).

In terms of accuracy, Table 2 presents the results of the accuracy test for the DDM and the CFM using different measures of accuracy such as absolute forecast error (AFE), square forecast error (SQFE) and root square forecast error (RSQFE).

Panel A of Table 2 shows that the zero DDM is more accurate than the zero CFM in terms of AFE, SQFE, and RSQFE for the mean valuation error (0.418, 0.175, and 0.647 for the DDM versus 0.900, 0.809, and 0.948 for the CFM). The median valuation error is 0.450, 0.203, and 0.671 for the DDM versus 0.512, 0.262, and 0.716 for the CFM, respectively.

Panel B of Table 2 shows that the constant DDM is more accurate than the constant CFM in terms of AFE, SQFE, and RSQFE (0.644, 0.414, and 0.802 for the DDM versus 2.687, 7.222, and 1.639
for the CFM) and (0.472, 0.223, and 0.687 for the DDM versus 2.047, 4.189, and for the 1.431 CFM) for both mean and median of the valuation error, respectively.

Panel C of Table 2 shows that the two-stage DDM is more accurate than the two-stage CFM in term of AFE, SQFE, and RSQFE (0.475, 0.225, and 0.689 for the DDM versus 0.931, 0.887, and 0.965 for the CFM) and (0.394, 0.155, and 0.628 for the DDM versus 0.797, 0.635, and 0.893 for the CFM) for both mean and median of the valuation error, respectively. Furthermore, the results indicate that the zero growth model is dominant in the DDM whilst that two-stage model is dominant in the CFM in terms of bias of accuracy.

4.2 Portfolio Analysis Approach

This section aims to lay out the empirical analysis of the comparison implementing another procedure: the portfolio analysis approach. Broadly interpreted, the portfolios analysis approach doesn’t contradict the individual securities approach in the performance metrics or the main circumstances for the beta coefficient and the growth rate estimates. It attempts to inspect the relative performance for the DDM and the CFM, providing addition conditions in which the accounting measure, such as size of the firm represented by the market capitalization and market-to-book ratio, may affect the reliability of the value estimate of the DDM and the CFM. Furthermore, it provides differently formed portfolios over horizon t+1, t+2, t+3 to avoid the problem of the individual securities approach. .

The portfolios analysis approach includes two types of analysis. First, unconditional portfolio analysis approach. Second, conditional portfolios analysis approach. These two approaches compare the DDM and the CFM over t+1, t+2, and t+3.

4.2.1 Empirical Results Based on Unconditional Portfolios

4.2.1.1 Valuation Error Comparison Based on Firm's Beta and Unified Growth Rate Calculation.

A- Zero Growth Model

Table 3 shows that the 3 portfolios indicate that the DDM has mean of valuation errors of 0.085, -0.092, -0.011, 0.094, 0.338, 0.368, 0.991, 0.989, and 0.987 over horizon t+1, t+2, and t+3, respectively. The CFM has mean valuation error of -0.347, -2.326, -2.183, -0.443, -0.839, -0.505, -0.199, -0.200, and -1.195 for the three portfolios over horizon t+1, t+2, and t+3, respectively. Further, it displays that the DDM has median of valuation errors of 0.180, 0.131, -1.285, 0.188, 0.389, 0.250, 0.993, 0.984, and 0.989 versus -0.304, -0.688, -1.285, 0.020, -0.498, -0.650, 0.044, 0.124, and -0.900 for the CFM for the three portfolios over t+1,t+2, and t+3, respectively. Consequently, the DDM is less bias, on overage, than the CFM (0.417 for the DDM versus -0.915 for the CFM) and (0.452 for the DDM versus 0.460 for the CFM) in terms of mean and median forecast errors, respectively.

B- Constant Growth Model

Table 4 shows that the 3 portfolios indicate that the DDM has mean of valuation errors of -0.831, -1.351, 1.283, -0.529, -0.246, -0.246, -0.118, -0.949, and -0.284 over horizon t+1,t+2, and t+3, respectively. The CFM has -1.684, -5.686, -4.418, -1.469, -2.862, -2.139, 0.663,-2.210, and -2.483 for the three portfolios over horizon t+1,t+2, and t+3, respectively. In addition, it shows that the DDM has median of valuation errors of -0.576, -0.920, -1.284, -0.535, -0.163, -0.333, -0.118, -0.949, and -0.284 for the three portfolios versus -1.474, -2.661, 0.565, -4.739, 1.901, -2.168, -1.105, -0.848, and -2.4 for the CFM for the three portfolios over t+1,t+2, and t+3, respectively. Consequently, the DDM is less bias, on overage, than the CFM (-0.649 for the DDM versus -2.476 for the CFM) and (-0.416 for the DDM versus -1.984 for the CFM) in terms of mean and median forecast errors, respectively.

C- The Two-Stage Model

Table 5 presents the results of the third version of the DDM and the CFM. The 3 portfolios indicate that the DDM has mean of valuation errors of -0.557, -1.280, -1.073, -0.458, -0.210, -0.111, -0.304, -0.050, and -0.126 over horizon t+1,t+2, and t+3, respectively. The CFM has 1.152, 1.336, 1.582, 1.157, -

2.560, -1.891, -2.483, -2.995, and -2.166 for the three portfolios over horizon t+1,t+2, and t+3, respectively. Further, it shows that the DDM has median of valuation errors of -0.439, -0.932, -1.136, -0.290, -0.248, -0.229, 0.40, 0.125, and 0.002 versus 1.119, 1.203, 1.432, -0.231, -1.709, -1.928, -1.233, -0.786, and -2.137 for the CFM for the three portfolios over t+1, t+2, and t+3, respectively. Consequently, the DDM is less bias, on overage, than the CFM (-0.463 for the DDM versus -0.763 for the CFM) and (-0.345 for the DDM versus -0.474 for the CFM) in terms of mean and median forecast errors, respectively.

In terms of accuracy, Table 6 shows that the dividend discount model is more accurate than the free cash flow model in all versions in terms of accuracy measurements based on unconditional portfolios approach.

Panel A of Table 6 shows that the zero DDM is more accurate than the zero CFM in terms of AFE, SQFE, and RSQFE of mean forecast error (0.417, 0.174, and 0.645 for the DDM versus 0.915, 0.838, and 0.957 for the CFM) as well as in terms of AFE, SQFE, and RSQFE of median forecast error (0.452, 0.205, and 0.672 for the DDM versus 0.460, 0.211, and 0.678 for the CFM), respectively.

Further, Panel B of Table 6 shows that the constant DDM is more accurate than the constant CFM in terms of AFE, SQFE, and RSQFE (0.649, 0.421, and 0.805 for the DDM versus 2.589, 6.704, and 1.609 for the CFM) and (0.416, 0.173, and 0.645 for the DDM versus 1.984, 3.938, and 1.409 for the CFM) for both mean and median forecast error, respectively.

Panel C of Table 6 shows that the two-stage DDM is more accurate than the two-stage CFM (0.463, 0.214, and 0.681 for the DDM versus 0.763, 0.582, and 0.874 for the CFM) and (0.345, 0.119, and 0.588 for the DDM versus 0.474, 0.225, and 0.689 for the CFM) in terms of AFE, SQFE, and RSQFE for both mean and median forecast error, respectively. Furthermore, the results indicate that the zero growth model in the dominant in the DDM whilst the two-stage model is the dominant in the CFM in terms of bias and accuracy.

4.2.2 Conditional analysis

The conditional analysis of the valuation techniques follows another procedure to construct portfolios. Firms are assigned based on two accounting measures: the firm's size and market-to-book ratio. Size of firm is represented by the market capitalization. Furthermore, the market-to-book ratio (M/B) is the market price per share divided by book value per share. The firms are ranked based on theses ratios, then 3 portfolios based on each approach are formed to average the unpredictable component of value over horizon t+1, t+2, and t+3.

4.2.2.1 Conditional Analysis Based on Market Capitalization

4.2.2.1.1 Valuation Error Comparison Based on Firm's Beta and Unified Growth Rate Calculation.

A- Zero Growth Model

Table 7 shows the relative performance of the DDM and the CFM portfolios. The results indicate that the DDM portfolios has mean of valuation error of 0.025, 0.002, -0.035, 0.028, 0.381, 0.391, 0.995, 0.995, and 0.988 versus -1.900, -1.254, -1.606, -0.830, -0.709, -0.235, -0.519, -0.442, and 0.002 for the CFM as well as median of valuation error of 0.018, -0.001, 0.149, 0.182,0.479, 0.333, 0.989, 0.996, and 0.989 for the DDM versus -1.545, -1.086, -0.429, -0.498, -0.772, -0.223, -0.107, 0.044, and 0.081 for the CFM over horizon t+1, t+2, and t+3, respectively. Therefore, the DDM is, on average, less bias than the CFM in terms of mean and median of forecast error (0.419 for the DDM versus -0, 832 for the CFM) and (0.459 for the DDM versus -0.504 for the CFM), respectively.

B- Constant Growth Model

Table 8 presents the relative performance of the DDM as well as the CFM. The results show that the DDM portfolios has mean valuation error of -1.227, -1.007, -0.773, -0.773, -0.181, -0.104, -1.372, 0.021, and -0.0001 versus -5.333, -3.139, -2.771, -2.448, -2.503, -1.278, -3.461, -1.079, and -1.507 for the CFM as well as median of valuation error of -1.317, -1.050, -0.852, -0.479, -0.027, 0.098, -0.711, -0.052, and 0.110 for the DDM versus -3.959, -2.861, -2.074, -2.095, -2.168, -0.304, -2.828, -1.105, and -1.145 for the CFM over horizon t+1, t+2, and t+3, respectively. Consequently, the DDM is, on average, less bias than the CFM in terms of mean and median of forecast error (-0.609 for the DDM versus -2.613 for the CFM) and (-0.476 for the DDM versus -2.060 for the CFM), respectively.

C- The Two Stage-Growth Model

Table 9 shows that the DDM portfolios has mean valuation error of -1.011, -1.427, -0.616,-0.669, -0.072, -0.042, -0.513, -0.127, and 0.148 versus 1.389, 1.595, 1.157, -1.792, -1.843, -1.249, -4.354, -2.091, and -1.227 for the CFM as well as median of valuation error of -1.144, -1.113, -0.550, -0.361, 0.071, 0.217, -0.404, 0.040, and 0.210 for the DDM versus 1.366, 1.349, 1.145, -1.258, -1.709, -0.246, -2.824, -1.307, and -0.847 for the CFM over horizon t+1, t+2, and t+3, respectively. Consequently, the DDM is, on average, less bias than the CFM in terms of mean and median of forecast error (-0.481 for the DDM versus -0.935 for the CFM) and (-0.337 for the DDM versus -0.481for the CFM), respectively.

In terms of accuracy, Table 10 shows that the DDM outperform the CFM portfolios in all accuracy measures. Panel A of Table 10 shows that the zero DDM has AFE, SQFE, and RSQFE of 0.419, 0.175, and 0.647 versus 0.832, 0.693, and 0.912 for the zero CFM as well as 0.459, 0.211, and 0.678 for the DDM versus 0.504, 0.254, and 0.710 for the CFM for both mean and median forecast error, respectively. Therefore, the DDM value estimate is more reliable value than the CFM value estimate.

Panel B of Table 10 displays that the constant DDM is more accurate than the constant CFM in terms AFE, SQFE, and RSQFE (0.602, 0.362, and 0.776 for the DDM versus 2.613, 6.829, and 1.617 for the CFM) as well as (0.476, 0.226, and 0.690 for the DDM versus 2.060, 4.242, and 1.435 for the CFM) for both mean and median forecast error, respectively. Panel C of Table 10 shows that the two-stage DDM is more accurate than the two -stage CFM in terms of AFE, SQFE, and RSQFE for both mean and median forecast error (0.481, 0.231, and 0.694 for the DDM versus 0.935, 0.874, and 0.697 for the CFM) and (0.337, 0.114, and 0.581 for the DDM versus 0.481, 0.232, and 0.694 for the CFM), respectively. As a result, the DDM outperforms the CFM in all versions in terms of bias and accuracy. And the zero model in the DDM and the CFM is superior in terms of bias and accuracy.

5. The Sensitivity Analysis[6]

A sensitivity analysis locates the variables that have the greatest impact on the validity of the valuation models; therefore, the advantage of conducting a sensitivity analysis is to show the assessment of the DDM and CFM under different circumstances, and the effects of these circumstances on the reliability of the value estimates resulting from these two models.
Sensitivity analysis of the DDM and the CFM to the cost of equity has significant impact on the intrinsic value estimates yielding from these two models, thereby resulting in fluctuations in the valuations errors. The main parameter in the cost of equity is the beta coefficient; it represents a measure of the sensitivity of a security's returns to the measurement in the market returns. It’s a measured of systematic risk.
The sensitivity analysis of the two paths of the discounted cash flow approach to the growth rate estimate have been examined; we assume that the fundamental attributes are discounted by the cost of equity based on firm's beta and different growth rate calculation for both the DDM and the CFM . The results indicate that the DDM is still the dominant model in term of bias and accuracy.
We also examined the sensitivity analysis assuming that the fundamental attributes are discounted by the cost of equity based on industry's beta basis and different growth rate calculation for both the DDM and the CFM . The results indicate that the DDM is more value estimate than the CFM in terms of accuracy and bias.
Moreover, the sensitivity analysis, under conditional and unconditional approach, to growth rate calculation as well as beta coefficient estimate asserts these results. On further analysis, we note that the relative performance of the DDM is more a reliable value's estimate for the high size firms than the small size firms as well as the market-to-book ratio.

6. Conclusion

The main objective of this study was to conduct an empirical examination of the two theoretically equivalent models, the dividend discounted model and the free cash flow to equity model. Furthermore, this study aimed to explore and to assess the relative performance of these valuation models under

[6] Note that the results of this section are not tabulated here, however, tables are available upon request.

different circumstances by comparing actual traded prices with the intrinsic values calculated over different horizons.

We have used two approaches, portfolio analysis approach and individual securities approach. The empirical examination of the DDM as well as the CFM applying the individual securities approach shows that the dividend discounted model outperforms the free cash flow to equity model in all versions.

Portfolio analysis approach involving conditional and unconditional portfolio shows that the DDM, on average, outperforms the CFM in terms of accuracy and bias for both mean and median of valuation error, respectively.

As a result of the previous approaches, we conclude that the dividend discounted model using either individual securities approach or portfolio approach outperforms the free cash flow to equity model in all versions.

Furthermore, the sensitivity analysis to beta coefficient estimate as well as growth rate estimate indicates that the dividend discounted model dominate the free cash flow model in term of bias and accuracy.

The empirical evidence proves that the firm's industry beta is more accurate than the firm's beta. We note that the relative performance of the DDM is a more reliable value estimate for the large sized firms than the small sized firms as well as for the market-to-book ratio basis.

The empirical results indicate that the DDM outperforms the CFM in all performance metrics as well as in all versions under different circumstances. Thus, the empirical examination proves that financial analysts should use the DDM in the valuation process because of its superiority over the CFM. On the other hand, this superiority must be accompanied by research efforts on how to make the fundamental parameters more accurate forecasts.

References

- Beneda, N. (2003). "Estimating Free Cash Flows and Valuing a Growth Company". Journal of Asset Management, 4(4): 247-257.
- Berkman, H., M.E. Bradbury, and J. Ferguson. (2000)."The Accuracy of Price to Earning and Discounted Cash Methods of IPO Equity Valuation". Journal of International Financial Management and Accounting, 2(11): 71-83.
- Courteau, L. J. Kao, and G.K. Richardson. (2000). "The Equivalence of Dividend, Cash Flows and Residual Earnings Approaches to Equity Valuation Employing Ideal Terminal Value Expressions". Working paper. Level University.
- Fernandez, P. (2003)." The Residual Income Valuations Methods and Discounted Cash Flow Valuation". Working Paper. University of Navarra.
- Francis, J., P.Olsson, and D. Oswald. (2000)."Comparing the Accuracy and Explainability of Dividend, Free Cash Flow and Abnormal Earnings Equity Value Estimates". Journal of Accounting Research, 38(1):45-75.
- Gentry, A., F. K. Reilly, and M. J. Sandreho. (2003)." Learning about Intrinsic Valuation with the help of an Integrated Valuation System". Working Paper. University of Illions at Urbana.
- Gentry, A., D. T. Whitford, T. Sugiannis, and S. Aoki. (2002). "Do Accounting Earnings or Free Cash flows Provide a Better Estimate of Capital Gain Rates of Return on Stock?". Working Paper, University of Ilinois.
- Levin, J. and Olsson, P. (2000), “Terminal Value Techniques in Equity Valuation: Implications of the Steady State Assumption”, SSE/EFI Working Paper Series in Business Administration No 2000:7
- Lundholm, R., and T.O'keefee. (2001). "Reconciling Value Estimates from the Discounted Cash Flow model and the Residual Income Model". Contemporary Accounting Research 18(2): 311-350
- Penman, S. 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. (2000), “ Firm Valuation: Comparing the Residual Income and Discounted Cash Flow Approaches”. Accounting and Business Research.
- Rose. P.S. (2003). Money and Capital Markets, 8th Edition, McGraw-Hill Company, New York.
- Vardavaki, A. and Mylonakis, J. (2007), “Empirical Evidence on Retail Firms’ equity Valuation Models”. International Research Journal of Finance and Economics”. ISSN 1450-2887. Issue 7 (2007).

Table (1)
Valuation Error by Comparing the Models Estimated Value with
Actual Traded Prices (Bias). Based on Firm's Beta and Unified Growth Rate Calculation,
over horizon *t+1*, *t+2*, and *t+3*

Specification	t+1		t+2		t+3			
	MVE	MEVE	MVE	MEVE	MVE	MEVE	MVE	MEVE
Panel A								
Zero DDM	(0.004)	0.038	0.269	0.331	0.990	0.989	0.418	0.453
Zero FCFE	(1.586)	(0.781)	(0.594)	(0.245)	(0.519)	(0.521)	(0.900)	(0.516)
Panel B								
Constant DDM	(1.158)	(0.985)	(0.347)	(0.358)	(0.425)	(0.072)	(0.644)	(0.472)
Constant FCFE	(4.659)	(4659)	(2.059)	(1.409)	(1.344)	(0.072)	(2.687)	(2.047)
Panel C								
Two-stage DDM	(1.005)	(0.780)	(0.256)	(0.239)	(0.163)	0.040	(0.475)	(0.394)
Two-stage FCFE	1.373	1.216	(1.619)	(1.060)	(2.546)	(1.362)	(0.931)	(0.797)

Unified growth rate means that the growth rate in dividends is equal to the growth rate in free cash to equity, where g=ROE* Retention ratio.
Firm's beta is estimated based on a single stock using 60 monthly returns for stock as well as the market returns.
MVE: Mean Valuation Error, where VE=(Market value-Fundamental value)/Market value.
MEVE: Median Valuation Error, where VE=(Market value-Fundamental value)/Market value.
MFE is the average of MVE over horizon t+1, t+2, and t+3.
MEFE is the average of MEVE over horizon t+1, t+2, and t+3.
MFE: Mean Forecast Error.
MEFE: Median Forecast Error.

Table(2)
Signed Prediction Error (Accuracy) of Valuation Techniques,
Based on Firm's Beta and Unified Growth Rate calculation, overall horizon

Specification	MFE	AFE	SQFE	RSQFE	MEFE	AFE	SQFE	RSQFE
Panel A								
Zero DDM	-0.418	0.418	0.175	0.647	0.453	0.450	0.203	0.671
Zero FCFE	(0.900)	0.900	0.809	0.948	(0.516)	0.512	0.262	0.716
Panel B								
Constant DDM	(0.644)	0.644	0.414	0.802	(0.472)	0.472	0.223	0.687
Constant FCFE	(2.687)	2.687	7.222	1.639	(2.047)	2.047	4.189	1.431
Panel C								
Two-stage DDM	(0.475)	0.475	0.225	0.689	(0.394)	0.394	0.155	0.628
Two-stage FCFE	(0.931)	0.931	0.867	0.965	(0.797)	0.797	0.635	0.893

Firm's Beta is estimated based on a single stock using 60 monthly returns for stock and market returns .
Unified growth rate means that the growth rate in dividends is equal to the growth rate in free cash flow to equity, where g=ROE* Retention ratio
MFE is average of MVE over horizon t+1, t+2, and t+3.
MEFE is the average of MEVE over horizon t+1, t+2, and t+3.
MFE: Mean Forecast Error.
AFE: Absolute Forecast Error.
RSQFE: Root Mean Square Error.
SQFE: Mean Square Forecast Error.
MEFE: Median Forecast Error.
RSQFE: Root Median Square Error.
SQFE: Median Square Forecast Error

Table (3)
Mean and Median Valuation Errors, Based on Firm's Beta and Unified Growth Rate Calculation, for Selected Horizon for Portfolios Formed from a Ranking Randomly.

	Specification	t+1		t+2		t+3			
		MVE	MEVE	MVE	MEVE	MVE	MEVE	MVE	MEVE
1.Zero Growth Model									
Portfolios									
1	**DDM**	0.085	0.180	0.094	0.188	0.991	0.993		
	FCFE	(0.347)	(0.304)	(0.443)	0.020	(0.199)	0.044		
2	**DDM**	(0.092)	0.131	0.338	0.389	0.989	0.984	0.417	0.452
	FCFE	(2.326)	(0.688)	(0.839)	(0.498)	(0.200)	0.124	(0.915)	(0.460)
3	**DDM**	(0.011)	(0.033)	0.368	0.250	0.987	0.989		
	FCFE	(2.183)	(1.285)	(0.505)	(0.650)	(1.195)	(0.900)		

Firm's beta is estimated based on a single stock using 60 monthly returns for stock as well as the market returns.
Unified growth rate means that the growth rate in dividends is equal to the growth rate in free cash flow to equity, where g=ROE* Retention ratio.
MVE: Mean Valuation Errors of portfolio.
MEVE: Median Valuation Error of portfolio.
MFE is the average of MVE of portfolios over horizon t+1, t+2, and t+3.
MEFE is the average of MEVE of portfolios over horizon t+1, t+2, and t+3.

Table (4)
Mean and Median Valuation Errors, Based on Firm's Beta and Unified Growth Rate Calculation, for Selected Horizon for Portfolios Formed from a Ranking Randomly.

	Specification	t+1		t+2		t+3			
		MVE	MEVE	MVE	MEVE	MVE	MEVE	MVE	MEVE
2.Constsnt Growth Model									
Portfolios									
1	**DDM**	(0.831)	(0.576)	(0.529)	(0.535)	(0.118)	0.260		
	FCFE	(1.684)	(1.474)	(1.469)	(0.565)	0.663	(1.105)		
2	**DDM**	(1.351)	(0.920)	(0.246)	(0.1630	(0.949)	(0.052)	(0.649)	(0.416)
	FCFE	(5.686)	(2.661)	(2.862)	(1.901)	(2.210)	(0.848)	(2.476)	(1.984)
3	**DDM**	(1.283)	(1.284)	(0.246)	(0.333)	(0.284)	(0.145)		
	FCFE	(4.418)	(4.739)	(2.139)	(2.1680	(2.483)	(2.400)		

Firm's beta is estimated based on a single stock using 60 monthly returns for stock as well as the market returns.
Unified growth rate means that the growth in dividends is equal to growth in free cash flow to equity, where g=ROE* Retention ratio.
MFE is the average of MVE of portfolios over horizon t+1, t+2, and t+3.
MEFE is the average of MEVE of portfolios over horizon t+1, t+2, and t+3.
MVE: Mean Valuation Errors of portfolio.
MEVE: Median Valuation Error of portfolio.

Table (5)
Mean and Median Valuation Errors, Based on Firm's Beta and Unified Growth Rate Calculation, for Selected Horizon for Portfolios Formed from a Ranking Randomly.

Specification		t+1		t+2		t+3			
		MVE	MEVE	MVE	MEVE	MVE	MEVE	MVE	MEVE
3.**The Two-Stage model**									
Portfolios									
1	**DDM**	(0.557)	(0.439)	(0.458)	(0.290)	(0.304)	0.040		
	FCFE	1.152	1.119	1.157	(0.231)	(2.483)	(1.233)		
2	**DDM**	(1.280)	(0.932)	(0.210)	(0.248)	(0.050)	0.125	(0.463)	(0.345)
	FCFE	1.336	1.203	(2.560)	(1.709)	(2.995)	(0.786)	(0.763)	(0.474)
3	**DDM**	(1.073)	(1.136)	(0.111)	(0.229)	(0.126)	0.002		
	FCFE	-1.582	1.432	(1.891)	(1.928)	(2.166)	(2.137)		

Firm's beta is estimated based on a single stock using 60 monthly returns for stock as well as the market returns.
Unified growth rate means that the growth rate in dividends is equal to growth rate in free cash flow to equity, where g=ROE* Retention ratio.
MFE is the average of MVE of portfolios over horizon t+1, t+2, and t+3.
MEFE is the average of MEVE of portfolios over horizon t+1, t+2, and t+3.
MVE: Mean Valuation Errors of portfolio.
MEVE: Median Valuation Error of portfolio.

Table(6)
Signed Prediction Errors of Valuation Techniques, Based on Firm's Beta and Unified Growth Rate calculation, overall Horizon for Portfolios Formed from a Ranking Randomly.

Specification	MFE	AFE	SQFE	RSQFE	MEFE	AFE	SQFE	RSQFE
Panel A: Zero Growth Model								
DDM	0.417	0.417	0.174	0.645	0.452	0.452	0.205	0.672
FCFE	(0.915)	0.915	0.838	0.957	(0.460)	0.460	0.211	0.678
Panel B: Constant Growth Model								
DDM	(0.649)	0.649	0.421	0.805	(0.416)	0.416	0.173	0.645
FCFE	(2.589)	2.589	6.704	1.609	(1.984)	1.984	3.938	1.409
Panel C: The Two-Stage model								
DDM	(0.463)	0.463	0.214	0.681	(0.345)	0.345	0.119	0.588
FCFE	(0.763)	0.763	0.582	0.874	(0.474)	0.474	0.225	0.689

Firm's beta is estimated based on a single stock using 60 monthly returns for stock as well as market returns .
Unified growth rate means that the growth rate in dividends is equal to the growth rate in free cash flow to equity, where g=ROE* Retention ratio.
MFE is the average of MVE overall portfolios over horizon t+1, t+2, and t+3.
MEFE is the average of MEVE overall portfolios over horizon t+1, t+2, and t+3.
MFE: Mean Forecast Error.
AFE: Mean Absolute Error.
SQFE: Median Square Forecast Error.
RSQFE: Root Mean Square Error.
MEFE: Median Forecast Error.
SQFE: Median Square forecast Error.
RSQFE: Root Median Square Error.
AFE: Absolute Forecast Error.

Table (7)
Mean and Median Valuation Errors, Based on Firm's Beta and Unified Growth Rate Calculation, for Selected Horizon for Portfolios Formed from a Ranking on Market Capitalization

	Specification	t+1		t+2		t+3			
		MVE	MEVE	MVE	MEVE	MVE	MEVE	MVE	MEVE
1.Zero Growth Model									
Portfolios									
1	DDM	0.025	0.018	0.028	0.182	0.995	0.989		
	FCFE	(1.900)	(1.545)	(0.830)	(0.498)	(0.519)	(0.107)		
2	DDM	0.002	(0.001)	0.381	0.479	0.995	0.996	0.419	0.459
	FCFE	(1.254)	(1.086)	(0.709)	(0.772)	(0.442)	0.044	(0.832)	(0.504)
3	**DDM**	(0.035)	0.149	0.391	0.333	0.988	0.989		
	FCFE	(1.606)	(0.429)	(0.235)	(0.223)	0.002	0.081		

Firm's beta is estimated based on a single stock using 60 monthly returns for stock as well as market returns .
Unified growth rate means that the growth in dividends is equal to the growth in free cash flow to equity, where g=ROE* Retention ratio.
MFE is the average of MVE of portfolios over horizon t+1, t+2, and t+3.
MEFE is the average of MEVE of portfolios over horizon t+1, t+2, and t+3.
MVE: Mean Valuation Errors of portfolio.
MEVE: Median Valuation Error of portfolio.

Table (8)
Mean and Median Valuation Errors, Based on Firm's Beta and Unified Growth Rate Calculation, for Selected Horizon for Portfolios Formed from a Ranking on Market Capitalization.

	Specification	t+1		t+2		t+3			
		MVE	MEVE	MVE	MEVE	MVE	MEVE	MFE	MEFE
2.Constsnt Growth Model									
Portfolios									
1	DDM	(1.227)	(1.317)	(0.773)	(0.479)	(1.372)	(0.711)		
	FCFE	(5.333)	(3.959)	(2.448)	(2.095)	(3.461)	(2.828)		
2	DDM	(1.007)	(1.050)	(0.181)	(0.027)	0.021	(0.052)	(0.602)	(0.476)
	FCFE	(3.139)	(2.861)	(2.503)	(2.168)	(1.0790	(1.105)	(2.613)	(2.060)
3	**DDM**	(0.773)	(0.852)	(0.104)	0.098	(0.000)	0.110		
	FCFE	(2.771)	(2.074)	(1.278)	(0.304)	(1.507)	(1.145)		

Firm's beta is estimated based on a single stock using 60 monthly returns for stock as well as the market returns.
Unified growth rate means that the growth in dividends is equal to growth in free cash flow to equity, where g=ROE* Retention ratio.
MFE is the average of MVE of portfolios over horizon t+1, t+2, and t+3.
MEFE is the average of MEVE of portfolios over horizon t+1, t+2, and t+3.
MVE: Mean Valuation Errors of portfolio.
MEVE: Median Valuation Error of portfolio.

Table (9)
Mean and Median Valuation Errors, Based on Firm's Beta and Unified Growth Rate Calculation, for Selected Horizon for Portfolios Formed from a Ranking on Market Capitalization.

Specification		t+1		t+2		t+3			
		MVE	MEVE	MVE	MEVE	MVE	MEVE	MFE	MEFE
3.The Two-Stage model									
Portfolios									
1	DDM	(1.011)	(1.144)	(0.669)	(0.361)	(0.513)	(0.404)		
	FCFE	1.389	1.366	(1.792)	(1.258)	(4.354)	(2.824)		
2	DDM	(1.427)	(1.113)	(0.072)	0.071	(0.127)	0.040	(0.481)	(0.337)
	FCFE	1.595	1.349	(1.843)	(1.709)	(2.091)	(1.307)	(0.935)	(0.481)
3	**DDM**	(0.616)	(0.550)	(0.042)	0.217	0.148	0.210		
	FCFE	1.157	1.145	(1.249)	(0.246)	(1.227)	(0.847)		

Firm's beta is estimated based on single stock using 60 monthly returns for stock as well as the market returns.
Unified growth rate means that the growth in dividends is equal to growth in free cash flow to equity, where g=ROE* Retention ratio.
MFE is the average of MVE of portfolios over horizon t+1, t+2, and t+3.
MEFE is the average of MEVE of portfolios over horizon t+1, t+2, and t+3.
MVE: Mean Valuation Errors of portfolio.
MEVE: Median Valuation Error of portfolio.

Table(10)
Signed Prediction Errors of Valuation Techniques, Based on Firm's Beta and Unified Growth Rate calculation, overall Horizon for Portfolios Formed from a Ranking on Market Capitalization.

Specification	MFE	AFE	SQFE	RSQFE	MEFE	AFE	SQFE	RSQFE
Panel A: Zero Growth Model								
DDM	0.419	0.419	0.175	0.647	0.459	0.459	0.211	0.678
FCFE	(0.832)	0.832	0.693	0.912	(0.504)	0.504	0.254	0.710
Panel B: Constant Growth Model								
DDM	(0.602)	0.602	0.362	0.776	(0.476)	0.476	0.226	0.690
FCFE	(2.613)	2.613	6.829	1.617	(2.060)	2.060	4.242	1.435
Panel C: The Two-Stage model								
DDM	(0.481)	0.481	0.231	0.694	(0.337)	0.337	0.114	0.581
FCFE	(0.935)	0.935	0.874	0.967	(0.481)	0.481	0.232	0.694

Firm's beta is estimated based on single stock using 60 monthly returns for stock as well as market returns .
Unified growth rate means that the growth rate in dividends is equal to the growth rate in free cash flow to equity, where g=ROE* Retention ratio.
MFE is the average of MVE overall portfolios over horizon t+1, t+2, and t+3.
MEFE is the average of MEVE overall portfolios over horizon t+1, t+2, and t+3.
MFE: Mean Forecast Error.
AFE: Mean Absolute Error.
SQFE: Median Square Forecast Error.
RSQFE: Root Mean Square Error.
MEFE: Median Forecast Error.
SQFE: Median Square forecast Error.
RSQFE: Root Median Square Error.
AFE: Absolute Forecast Error