A Study of Equity Valuation Models: Evidence from German Companies

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Abstract

This paper aims to test the accuracy for the period 1990 to 2006 of three well-known equity valuation models. This is done to a sample of German listed firms which diverge from the US market in accounting standards, market maturity and corporate governance culture as well as differing market movements and trends which influence main input factors and estimations. To the best of our knowledge this is the first paper to address this issue for a sample of listed firms from the largest bank-based European economy. Using different accuracy measures such as absolute prediction error (average, median and central tendency) the results show that dividend discounted and abnormal earnings models tend to provide better accuracy than the free cash flow approach. Additionally we find evidence of the importance of German accounting standards in the less accuracy performance of the abnormal earnings model compared to previous studiesdue to the conservative accounting and the influence of hidden reserves. Finally we did not find any significant valuation differences regarding the alternative values used for growth and discount rates.

Keywords: Accounting standards, Equity Valuation models, prediction error, Value of Firm

Introduction

Accurate equity valuation is of major importance for investors, analysts, managers and other stakeholders in the companies. In his Presidential Address to the American Finance Association in 2008, KennethFrench provided evidence that for the period between 1980 to 2006 investors spent on average 0.67 percent of the aggregate value of the market each year searching for superior returns. This amounts to a total spending of 101.8 billion dollars in 2006 just for the US market showing the importance of company valuation and stock price prediction has an active research area in finance. Practitioners require valuation models to make better investment decisions, reduce risk of bad choices and allocate resources efficiently. Despite this intensive research and the theoretical simplicity of most of the valuation models, literature does neither give a definitive answer regarding the superiority of a specific model nor the best practice for the implementation of these models. Although there are a number of studies that identify a specific model to be more accurate than others under certain conditions, there is no consensus and the search for a generally superior valuation model remains a puzzle. Empirical results in particular differ when different assumptions for the inputs are made and the way data comparison is drawn.

The aim of this paper is twofold: First,to test the accuracy of three well-known equity valuation models for the German stock market, which diverge from the US market in accounting standards, market maturity and corporate governance culture (bank-based in contrast to the market-based US regime) as well as differing market movements and trends which influence main input factors and estimations (e.g. market risk premium, inflation rate and GDP growth rate). Secondly, to contribute for the debate regarding the precision of valuation models and the fundamental idea behind the intrinsic value calculation.

The results suggest that thedividend discountedand abnormal earnings models tend to provide better accuracy than the free cash flow approach. Additionally we find evidence of the importance of German accounting standards in the less accuracy performance of the abnormal earnings model compared to previous studies due to the conservative accounting and the influence of hidden reserves. Finally we did not find any significant valuation differences regarding the alternative values used for growth and discount rates.

Literature Review

Previous studies tend to compare dividend discounted, discounted cash flows and abnormal earnings models as intrinsic valuation approaches (Cassia *et al*, 2009; Courteau*et al*, 2001; Francis *et al* 2000; Penman*et al* 1998, among others). Multiple based models are rather discussed separately or seen as an addition to the previous three models (Liu, Nissim and Thomas, 2002 and Kaplan *et al*, 1995). The main reason for the focus in models which value firms directly or determine the intrinsic value rather than comparing to other company or companies is related to the practical issue of identifying accurate comparable companies. Additionally there is a lack of evidence which from so many possible comparable is the most correct one to use (Kaplan *et al*, 1995).Although there is consensus that models based on discounted cash flows, discounted dividends as well as abnormal earnings should in theory provide the same valuation if applied for an infinite time horizon, empirical results shows that valuation results differ.These practical differences might occur if input factors are not consistent or a finite model horizon is applied Contrary to this Lundholm and O'Keefe (2001) reject the assumption that different models are allowed to yield different valuations even if applied in a finite rather than infinite time horizon. Differing results are driven by incorrect application of the model, forecast issues and incorrect discount rates. Thus the problematic of a finite forecasting period but an infinite payoff expectation is recognized but accepted for practical reasons. Consequently for practical reasons a comparison of the different models is sensible and important as it contributes to the understanding of company valuation. Other sources for valuation differences are violations of clean surplus accounting or inconsistent assumptions for forecasts, discount or growth rates are nor constant (Francis *et al*, 2000). Finally, another critic of company valuations based on accounting figures is given by Shiller (1981) who argues that market based values are generally too volatile to be justified by accounting figures.

The models accuracy measures differ in several aspects. Courteau*et al* (2001) and Francis *et al* (2000) use a simple approach that measures the prediction exactitude by comparing the mean intrinsic firm value with the actual market prices mean.[1] Francis *et al* (2000) additionally test the central tendency and Courteau*et al* (2001) divide the valuation in its components and analyse the skewness and standard deviation of the model outcomes. In contrast Penman *et al* (1998) measure

[1]This requires that the market price is seen as efficient and therefore as an unbiased estimation of the true value of a company (Henschke, 2009 and Vorfeld, 2009). Consequently, valuation differences between the market price and model estimation can be interpreted as a bad performance of the model itself. Empirical studies show that capital markets are rather efficient (Malkiel, 2003; Blake, 2000; Fama, 1970 and 1998).

model accuracy by forming random portfolios to eliminate market inefficiencies and average out the unpredictable component using ex-post data. A different approach is followed by Courteau*et al* (2006) who assume market price inefficiency and valuation model superiority. In this setting a model it is seen superior if generates higher abnormal return. This means the market under/overvalues stocks and investors can achieve abnormal returns by estimating the true intrinsic value.

Another important difference among previous studies is the source of data used. The main differences are whether the input factors are based on realised data (ex-post) or analysts' forecasts (ex-ante). Berkman*et al* (2000), Francis *et al* (2000) and Kaplan *et al* (1995) use analysts' forecasts as the core input data for their firm valuation models and compare it to observed market prices at the forecasted day. In contrast, Penman et al (1998) use historical data to replicate a time series of data and compare their valuation to the actual market value of the firm on the valuation date. Forecast data might not be available for all firms and all years or be biased (Francis *et al*, 2000). Easterwood et al (1999) and Easton and Sommers (2007) shown that on average an upward bias of analysts' forecast is observed. In addition Francis et al (2000) and Gode and Mohanran (2003) detected significant noise in forecasted data. However, Jorgensen *et al* (2005) highlighted that this noise decreases and valuations improve as longer forecast horizons are implemented.

Overall the empirical results are not consistent and it is observed that the model application and accuracy measurement has significant influence in the results obtained. Jorgensen *et al* (2005), Francis *et al* (2000) and Pennman*et al* (1998) observe that the abnormal earnings model is superior to the free cash flow and dividend discount models. The abnormal earnings model in particular is superior compared to other models when accounting distortion is less severe than forecasting mistakes (Francis *et al*, 2000) requiring a clean surplus accounting, which is given when all assets and liabilities changes pass through the income statement (Ohlson, 1995).[2] Studies show that the clean surplus assumption is regularly violated and significant deviations between different accounting standards can be observed (Harris *et al*, 1994, King *et al*, 1998, Isidro, O'Hanlon and Young, 2006) and as discussed in King *et al* (1998) the German accounting standards have less violations of clean surplus than other accounting standards. [3]The empirical findings from previous studies not only show different results regarding the relevance of which model but also the accuracy

[2] Clean surplus can be formally stated as $y_{t-1} = y_t + d_t - x_t$; with y equal to the net book value, x equal to earnings and d equal to net dividend (Feltham and Ohlson, 1995)

[3] Until 2004 German companies reported following the German HGB standards (additional reporting following international standards was voluntarily). Since 2005 quoted firms have to report following the IFRS standards (King *et al*, 2003 and Behringer, 2003).

is very diverse depending on the inputs factors variation, sample collection and number of forecasted periods. As reported in Faroq*et al* (2005), Francis *et al* (2000), Penman *et al* (1998) and Kaplan *et al* (1995) the estimation errors tend to be more than 50%.

Research methodology

The primary accounting data is from Worldscope database. The sample includes all companies of the DAX 30 index for the period 1990 to 2010[4], representing about 80 percent of the market capitalization of German stock market and listed at the Frankfurt Stock Exchange (Deutsche Boerse, 2010). Financial institutions and insurance companies are excluded from the sample due to their differing valuation requirements. Due to missing information the sample size was reduced to 29 unique companies and 333 valuations per model and set of assumptions (4,995 unique valuations in total). The loss of 19 percent of firm year observations follows previous studies with rates between 15 and 25 percent (Liu *et al*, 2002, Courteau*et al*, 2001, Berkman*et al*, 2000 and Francis *et al*, 2000).

The estimations for the different attributes are based on economic key figures for the German market. The firm's capital structure was assumed unchanged for the terminal value calculation and therefore a constant weighted average cost of capital and cost of equity capital is assumed for each firm[5]. Return on equity was calculated applying the Capital Asset Pricing Model using both company and industry current specific betas provided by Thomson ONE, risk free rate was proxied using the one and ten year German government bond yields for each year and the return on firm's debt as the ratio between the interest expenses and the long plus short term debt. The market risk premium was calculated as the average for the DAX 30 from the period 1974 to 2010 and stated as 4.85 percent.Table 1 summarizes the different assumptions implemented for each model used in the valuation estimation.

[4] Since the valuation models are tested with a three year forecast horizon and one year observation for the terminal value, 2006 is the last year for which valid valuations are made, using accounting and market data until 2010.
[5]Koller et al (2005) and Francis et al (2000) suggest the use of a target capital structure while Berkman et al (2000) proposes duration matched discount rates. The methodology implemented in this paper assumes that the actual discount rate and capital structure in each year in known and constant after the planning period.

Table 1: Valuation Input factors

Factor	Symbol	Definition	Value
Growth[6]	G1	Consumer price index	1.91%
	G2	Real growth, inflation adjusted GDP	1.68%
	G3	Equal to zero	0%
Corporate Tax Rate	MTR	Equal to each company and set at the average corporate tax rate of each year	
Market risk premium		Average DAX 30 market risk premium from 1974 to 2010	4.85%
Discount Rate	D1	10 year government bond yield and specific company beta	Unique per firm
	D2	10 year government bond yield and industry beta	Unique per industry
	D3	1 year government bond yield and specific company beta	Unique per firm

We use realised returns instead of analysts' forecasts to avoid forecast's bias and to achieve a more complete data set with exact inputs factors such as dividends and cash flows and the accuracy is measured following the approach by Penman et al (1998) where all individual firms in each year are assigned to a portfolio and pooled over time. To increase the explanatory power of the analysis in the different models the accuracy is measured by different indicators. Firstly, we calculate average/mean and median bias and absolute prediction error as the percentage deviation of the estimations and the observed market value at the valuation date. Secondly, the central tendency defined as the percentage of valuations that are within a range of 15 percent of the observed market value and the standard deviation of the annual average annual price estimates to the average annual observed market prices are calculated. Finally it is tested if sample adjustments influence the accuracy ranking in particular the elimination of negative value valuations and outliers.

Key Findings

Table 2reports the mean/median price estimates, standard deviation and central tendency for the three models for the five different specifications discussed previously. The central tendency measures the percentage of value estimates within 15% of the observed market price. Negative value estimates are included but set at zero which affects 1.417 of the 4.995 observations[7]. When

[6] Homburg et al (2011), Corteau et al (2001), Francis et al (2000), Penman et al (1998) and Kaplan (1995).

[7]35, 616 and 766 observations for the dividend discount, abnormal earnings and free cash flow models, respectively. The replace of negative valuations by zero assumes that a company that continues to generate negative cash flows or negative abnormal earnings will not survive (Gode et al, 2003 and Francis et al, 2000). Later these negative are excluded from the sample and their influence on the valuation accuracy is tested.

measured by the mean percentage difference the dividend discount and abnormal earnings models tend to underestimate the average stock market price (average negative predicted signed error) and the FCF model overestimates the stock price, on average. When the median is used the results show an under prediction. This is the result of the large number of negative valuations in particular for the case of the free cash flow model.

Table 2: Valuation Accuracy: Signed prediction error (values in percentage)

Free Cash Flow	Model 1	Model 2	Model 3	Model 4	Model 5
Average	69.99	56.80	93.25	66.15	47.41
Average (% Difference)	139.3%	93.6%	210.6%	126.1%	62.9%
Median	3.32	2.45	4.74	3.67	2.46
Median (% Difference)	-87.2%	-88.4%	-80.5%	-87.3%	-89.7%
Standard Deviation	75.80	58.65	100.69	71.20	49.65
Abnormal Earnings	Model	Model 2	Model 3	Model 4	Model 5
Average	20.55	17.21	28.97	20.08	18.11
Average (% Difference)	-36.4%	-46.8%	-13.75	-37.7%	-43.0%
Median	5.25	4.02	6.82	5.86	7.66
Median (% Difference)	-74.0%	-79.8%	-68.2%	-71.9%	-66.8%
Standard Deviation	19.82	17.66	30.13	19.11	15.91
Dividend Discount	Model	Model 2	Model 3	Model 4	Model 5
Average	12.86	10.71	17.57	12.49	10.43
Average (% Difference)	-55.6%	-63.2%	-41.8%	-56.9%	-64.0%
Median	8.45	7.13	10.90	8.22	7.04
Median (% Difference)	-64.2%	-69.0%	-53.9%	-64.9%	-70.4%
Standard Deviation	11.63	11.89	11.42	11.69	12.12

Table 3 provides the results for the absolute prediction error. For all the five specifications the abnormal earnings model shows the lowest bias and the absolute prediction error illustrates that the free cash flow model has the largest average price deviation for all the five different specifications. The average prediction accuracy of the dividend discount model outperforms the other two models in four of the five specifications, resulting also on a better median value estimates with an average prediction error of 66.56 percent. However, this consistency of the dividend discount model does not generally provide superior estimations if these are measured by central tendency,especially if the discount rate is high or growth expectation low (the central tendency of the dividend discount model decreases).[8]

[8] This is the case of specification/model 5 with a growth estimation of zero but also specification/model 2 where industry betas are used.

Table 3: Valuation Accuracy: Absolute Prediction Error (values in percentage)

Free Cash Flow	Model 1	Model 2	Model 3	Model 4	Model 5
Average	198.9	158.2	262.60	187.90	140.90
Median	100.00	100.00	100.00	100.00	100.00
Central Tendency	4.52	6.93	6.02	4.52	5.72
Abnormal Earnings					
Average	75.10	71.4	88.80	73.4	64.4
Median	95.60	94.70	100.00	93.90	79.0
Central Tendency	7.53	7.23	4.82	7.53	9.34
Dividend Discount					
Average	61.30	63.70	48.80	62.00%	65.80
Median	66.20	70.60	57.30	67.20%	71.50
Central Tendency	8.13	3.31	7.23	7.53%	3.31

Industry betas are on average significantly higher than firm specific betas (1.23 and 0.96 respectively)[9]and as a consequence discount rates are higher and therefore intrinsic prices are lower. This is due that industry average betas considered not only large listed firms (DAX 30) but also other listed firms in the German market with higher systematic risk. Overall the abnormal earnings model shows the highest average central tendency values followed by the dividend discounted and free cash flow models.

Table 4 reports the same information as on table 3 but with exclusion of negative estimates and extreme values.[10]The free cash flow model approach loses accuracy when measured by the average prediction error caused by a very small number of outliers in a reduced number of companies.

Table 4: Valuation Accuracy: Absolute Prediction Error (values in percentage)

Free Cash Flow	Model 1	Model 2	Model 3	Model 4	Model 5
Negative values excluded					
Average	277.20	215.80	378.10	259.10	174.70
Median	82.70	69.90	101.40	81.10	64.20
Central Tendency	8.33	12.78	11.11	8.33	10.61
Outliers excluded					
Average	55.5	45.60	73.10	52.50	46.00
Median	100.00	100.00	100.00	100.00	100.00
Central Tendency	4.57	7.01	6.12	4.57	5.79
Negative and Outliers excluded					
Average	78.70	59.60	118.20	72.00	41.30
Median	81.40	69.00	98.20	80.70	61.40
Central Tendency	8.52	13.07	11.43	8.52	10.86

[9] The difference between firma and industry betas is very consistent (25 of 31 industry betas were higher than the firm's betas). Bruner et al (1998) and Kaplan et al (1998) observed similar deviations.

[10]With this procedure 0.025% of each tail of the distribution was eliminated with a total of 25 estimates referring to 3 companies being 21 of these outliers from free cash flow model, 4 from abnormal earnings and none from dividend discounted model estimates.

Abnormal Earnings					
Negative values excluded					
Average	72.20	69.00	88.80	69.90	60.10
Median	59.40	62.70	67.70	59.90	54.70
Central Tendency	12.20	12.00	7.77	11.96	13.54
Outliers excluded					
Average	69.10	71.40	73.70	67.70	64.40
Median	95.60	94.70	100.00	93.90	79.00
Central Tendency	7.55	7.23	4.85	7.55	9.34
Negative and Outliers excluded					
Average	65.60	69.00	70.00	63.70	60.10
Median	59.40	62.70	67.20	59.60	54.70
Central Tendency	12.25	12.00	7.84	12.02	13.54
Dividend Discount					
Negative values excluded					
Average	61.00	63.40	48.50	61.70	65.50
Median	65.90	70.40	57.10	66.70	71.30
Central Tendency	8.28	3.37	7.36	7.67	3.37
Outliers excluded					
Average	61.30	63.70	48.80	62.00	65.80
Median	66.20	70.60	57.30	67.20	71.50
Central Tendency	8.13	3.31	7.23	7.53	3.31
Negative and Outliers excluded					
Average	61.00	63.40	48.50	61.70	65.50
Median	65.90	70.40	57.10	66.70	71.30
Central Tendency	8.28	3.37	7.36	7.67	3.37

The central tendency for the free cash flow and abnormal earnings models improves for all five specifications (from 5.5 to 10.2 percent and 7.3 to 11.5 percent, respectively) as these were the ones more affected by the zero valuations shown in table 2. When outliers are excluded the free cash flow model results are the most accurate, following by the dividend discounted and abnormal earnings models. Where both negative and outliers are excluded there is a general further improvement of the median valuation accuracy and central tendency. The results clearly illustrate that different specifications have a considerable influence in the models ranking. The abnormal earnings model tend to beat the others approaches for all the growth measures as far firm's specific beta and 10 year government bond yields are used with central tendency values between 12.02 and 13.54. The average bias continuously changed over the sample period. While in early 90's all three models underestimated the stock value, the underestimation decreased or moved to an overestimation for the free cash flow and abnormal earnings models.

One plausible reason for this pattern change was the different accounting standards profile during the sample period. Indeed as discussed by Wuestmann (2003) 92.8 percent of DAX 30 companies used HGB accounting standards in 1995 declined along the years to 13.33 percent in

2001. King et al (1998) and Harris et al (1984) highlighted that German accounting standards[11]are less related to market values than market based oriented IFRS and Anglo-American accounting standards. King et al (1998) reports a systematic downward bias for the value estimates based on German accounting standards caused in particular by a very conservative accounting and the influence of hidden reserves (StilleReserven).[12]

Additionally, these accounting differences might be responsible for the less accurate performance of the abnormal earnings model compared to previous studies as this model significantly relies on the book value of invested capital. Since the book value is systematically undervalued under German accounting rules the abnormal earnings model estimates are also downward biased. However a conflict between the findings of King et al (1998) who examined that HGB accounting standards has less clean surplus violations than other accounting standards and Francis et al (2000) who reports that the abnormal earnings model perform well when clean surplus can be identified. Additionally some other patterns can be identified: firstly the increase in volatility on the valuation bias during the years might also be related with the changing in the accounting standards; secondly the observed trend of a constantly increasing value estimates to market price ratio shows that the aftermath of the financial crisis from 2007-2009 are priced in these estimations; thirdly, the decrease in the corporate tax rate from 1990 to 2010 has the effect of a decline oncorporate tax shield on the one side but also the cash flow and after tax profit increase on the other side. While the cash flows and after tax profits increase have a positive influence on value estimations, the decreasing tax shield has the opposite effect due to the increase in the required rate of return.[13] Finally, the decreasing on German government bonds yield caused steadily declining in the discount rates and therefore an increase in the stock price estimates.

[11]Handelsgesetzbuch (HGB),law that governs the primary commercial code for companies in Germany. Included in the law is regulation related to the preparation of financial statements. This law is similar to GAAP, which is followed in the United States.

[12] Hidden reserves (StilleReserven) are equity assets due to the undervaluation (overvaluation) of assets (liabilities) and therefore do not arise in the balance sheet of a company. Companies use these valuation possibilities of the HGB standards to transfer tax liabilities to the future and to increase profit continuity. With IAS hidden reserves are seen as a violation of company's fair reports (Heno, 2006).

[13] Higher after tax profits directly influence the abnormal earnings model estimations due to higher abnormal returns and indirectly in the dividend discounted model estimations due to higher profits in form of dividends to the shareholders.

Conclusion

The aim of this paper was twofold: First, to test the accuracy of three well-known equity valuation models for the German stock market, which diverge from the US market in accounting standards, market maturity and corporate governance culture (bank-based in contrast to the market-based US regime) as well as differing market movements and trends which influence main input factors and estimations (e.g. market risk premium, inflation rate and GDP growth rate). Secondly, to contribute for the debate regarding the precision of valuation models and the fundamental idea behind the intrinsic value calculation.

The results suggest that the dividend discountedand abnormal earnings models tend to provide better accuracy than the free cash flow approach. Additionally we find evidence of the importance of German accounting standards in the less accuracy performance of the abnormal earnings model compared to previous studies due to the conservative accounting and the influence of hidden reserves. Moreover we did not find any significant valuation differences regarding the alternative values used for growth and discount rates. Finally the overall weak performance of the valuation models implemented in this study highlight concerns about such application in bank based countries where market maturity and corporate governance structure could play an important role in the intrinsic value calculations

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