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Relative Valuation – Accuracy of Corporate Valuation Using Multiples

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Abstract

This paper investigates the accuracy of three different methods that are used to perform a relative valuation. I also study the valuation accuracy of the three most widely used multiples used within these methods, the enterprise value to EBITDA (EV/EBITDA), the forward-looking price per share to earnings per share (P/EPS1), and the price-book (P/B). In addition, the difference between industries regarding valuation accuracy is investigated. A sample containing 246 companies listed on S&P Europe 350 during 2013-2015 is used. Method 1 uses comparable companies based on industry membership, and harmonic mean as a statistical measure to generate a multiple. Method 2 uses six companies from the same industry, that are similar in a relation to a profitability measure, using harmonic mean as a statistical measure to generate the multiple. Method 3 uses comparable companies based on industry membership and regression as a statistical measure to generate a multiple. I find that Method 2 provides the lowest valuation errors when used with the EV/EBITDA multiple and the P/B multiple. However, for the P/EPS1 multiple, all methods provide similar results. Method 1 provides the second best results, and Method 3 delivers the worst results. Regarding the multiples, I find that P/EPS1 deliver consistently best results, the EV/EBITDA comes second, and the P/B provides the worst results. Finally, the industrials and the consumer services industries have the lowest valuation error, and the financials industry highest valuation error.

Keywords: accuracy, comparable companies, EV/EBITDA, multiples, P/B, P/EPS1, relative valuation, valuation

Contents

1 Introduction

Valuation is an important concept in finance and plays a key role in decision making when choosing an investment for a portfolio, mergers, and acquisitions. In valuation practice, there are two primary models that valuation experts use according to a survey across 10 European countries, discounted cash flow (DCF) and relative valuation (RV), see Bancel and Mittoo (2014). The difference between the two methods is explained by Damodaran (2002). While discounted cash flow valuation estimates the intrinsic value, when doing relative valuation, we are more relying on the market and assume that the market is correct. He also argues that knowing the fundamentals of discounted cash flow valuation is necessary to perform relative valuation correctly. In discounted cash flow valuation the value of any company is the discounted value of expected future cash flows. In relative valuation, the value of any company can be found from the pricing of the comparable variables such as enterprise value, equity value, and share price. The variables are standardized using an appropriate variable such as earnings before interest, taxes, depreciation and amortization (EBITDA), the book value of equity, and earnings per share. The standardized variables or so-called multiples are then used to estimate the target company.

The purpose of the thesis is to examine the accuracy of corporate valuation using relative valuation. This thesis will focus on estimating the accuracy of three different methods used when valuing a company with relative valuation. To test these methods, I will use three most commonly used multiples in practice according to Bancel and Mittoo (2014). Enterprise value/EBITDA (EV/EBITDA), Price Per Share/Forward Earning Per Share (P/EPS1) and Market Value of Equity/Book Value of Equity (P/B). The reason for this investigation is the fact that relative valuation is a big part of the corporate valuation. Nonetheless, the various literature on valuation provide a short description of how to use multiples, and empirical evidence has found misleading information regarding what methods and multiples are most reliable when valuing companies with relative valuation. Considering how the relative valuation is popular, the accuracy of relative valuation is vital as it is the foundation for many financial decisions. Applying multiples to perform a valuation on a company might seem simple but in practice, doing a good valuation is harder than one might think. Schreiner (2007) argues that practitioners have a hard time using multiples, because of their lack of understanding of what the key drivers of the multiples are and how to effectively choose a peer group of comparable companies. The selection of comparable companies is imperative to increase the accuracy in the estimation. This is often performed by selecting companies in the same industry. Alford (1992) concluded that an industry appears to be a good substitute for risk and growth related to P/E multiple. However, Bhojraj and Lee (2002) find that selecting comparable companies based on profitability, growth and cost of capital improve the accuracy instead of using comparable companies from the same industry when predicting EV/SALES and P/B. Koller et al. (2015) and Kaplan and Ruback (1995) argue that relative valuation should be used to triangulate companies value and serve as a check for discounted cash flow valuation.

The objective of this thesis is to investigate the accuracy of three different methods and three different multiples EV/EBITDA, P/EPS1 and P/B regarding their ability to forecast the company enterprise value, share price and equity value. I will also look into the difference of valuation accuracy between industries. Method 1 is based on choosing comparable companies from the same industry as the target company. Harmonic mean will be used to calculate the multiple from the comparable companies. Method 2 is based on selecting six comparable companies from the same industry that have the similar prospect to profitability measures such as return on invested capital and return on equity. Harmonic mean will be used to calculate the multiple from the comparable companies. Method 3 is based on using regression to estimate the multiple and the intercept to capture the omitted factors. The data is from companies in the same industry. The ability of each method is measured by computing the absolute valuation error for each estimate, calculated by the three different methods, from the actual enterprise value, share price, and equity value. The analysis of valuation errors will be compared to previous findings. Finally, an evaluation of which of the three methods mentioned above is more accurate.

The findings show that selecting six companies in the same industry which are similar in relation to profitability measure is the preferred method (Method 2). This implies that there is a relationship between the multiples and the fundamental measures that determine the multiples. The evidence also shows that the P/EPS1 multiple is superior to the others multiples and the difference between industries regarding multiples and valuation errors have to be considered.

This thesis contributes to the previous studies in several ways. Firstly, a determination of what method provides the best accuracy. To my knowledge, previous studies have not compared these methods before. Secondly, I will be using more recent data, ranging from 2013 to 2015, while previous studies have all used data prior to 2008. This sample will provide a better insight to which method and multiple are preferable today. Finally, the dataset of companies is based on S&P Europe 350. Data from this index has not been used in similar research.

This thesis is structured as follows. Chapter 2 includes a short synopsis of previous research. Chapter 3 includes a review of relative valuation, and I will demonstrate what the fundamentals of each multiple are. Chapter 4 includes the methodology, where I will describe how to calculate my estimation for enterprise value, share price, equity value and valuation errors. In Chapter 5, I will present my empirical findings and in Chapter 6 the conclusion is presented, and further research is recommended.

2 Previous research

This chapter introduces the main findings from previous research. The first part will present the main results from previous empirical research that focuses on the selection of comparable companies. The second part will show results from previous empirical research that focuses on what multiples provide the best accuracy.

2.1 Selection of comparable companies

There are two measures that practitioners must consider when doing relative valuation. One is a selection of comparable companies that are used to estimate the target company. There is relatively little empirical research that examines the selection of comparable companies. The main reason for this is that the most frequent method when selecting comparable companies is industry classification. Although, the theory does not support it, according to Damodaran (2002) and Koller et al. (2015) a selection of comparable companies should be based on the fundamentals of what drives the multiple, such as profitability, payout ratio, growth rate and risk.

According to Alford (1992), which investigate the accuracy of the P/E multiple, when the comparable companies are selected using benchmarks such as industry, return on equity, total asset, and combinations of these factors. His main findings show that choosing companies based on industry, where the industry is determined by the first three SIC digits, and selecting companies based on the total assets as a measure of company size and return on equity, provide similar accuracy. When combining industry with total assets or return on equity, it does not perform significantly better than the industry.

Cheng and McNamara (2000) examine the valuation accuracy of two multiples, P/E, and P/B, and a combination of the multiples on different selections of comparable companies. The comparable companies are selected on industry classification, company size (based on total assets), return on equity, and the combination of industry with total assets and industry with a return on equity. Their findings show that by using the P/E and P/B multiples separately when comparable companies are selected based on a combination of industry and return on equity, is significantly more accurate than industry alone. When combining the multiples, P/E and P/B, using equal weights, the performance was better. They recommend when valuing a company which has an unknown value, using a combination of the two multiples with comparable companies in the same industry.

Bhojraj and Lee (2002) estimate the accuracy of two multiples, EV/SALES, and P/B, using a selection of comparable companies based on profitability, growth, and the cost of capital. This technique resulted in great improvements over the comparable companies that were selected by industry membership or size when predicting future EV/SALES multiple and P/B multiple.

2.2 Accuracy of multiples

The second measure which has to be considered when performing relative valuation is selecting what multiples to use. Previous research has attempted to determine what multiple provides the best accuracy. The result shows that three multiples provide the best accuracy, EV/EBITDA, forward-looking P/E and P/B.

Kaplan and Ruback (1995) investigate the valuation performance of the discounted cash flow model on high levered transaction to alternative valuation methods. They find that discounted cash flow model value these transactions considerably well. They also find that EV/EBITDA result in similar accuracy. However, Kaplan and Ruback recommend using multiples in combination with discounted cash flow model as it can help to explain the discounted cash flow model effectively.

Kim and Ritter (1999) examine the pricing of IPOs using multiples. Using relative valuation in valuing IPOs is recommended because of the difficulties in forecasting future cash flow. They find the accuracy of estimated value is highest when using forecasted number, particularly using forecasted earnings in the P/E multiple. Using historical numbers results in significant variation, and they only have modest predictive value.

Liu et al. (2001) study properties of value drivers and find that regarding relative valuation, forward earnings, measured as earnings per share (EPS), outperforms other value drivers, historical earnings come next followed by cash flow measure and book value, and sales is the worst performer. The performance is measured by looking into changes from the actual stock price and the predicted stock price. When using forward earnings, the pricing errors were within 15 % of the actual stock price for about half of their sample. They also find that the performance declines when using a residual income model and state that these results are consistent throughout industries that were examined.

Consistent with their previous results, Liu et al. (2007) focus on comparing cash flow and earning measure in 10 different countries. They find industry multiples using earnings forecasts to be most accurate which supports their previous findings.

Lie and Lie (2002) investigate multiples that practitioners use to estimate the value of the company. They state that the asset multiples provides more precise and less biased valuation, especially for financial companies. They also find that using forecasted earnings improves the estimates of the P/E multiple, and the EV/EBITDA multiple yields better estimation than the EV/EBIT multiple. Lie and Lie also state that adjustment for companies' cash level does not improve the estimated value. Moreover, company size, profitability, and the amount of intangible effect the accuracy and bias of the estimated value substantially.

Schreiner and Spremann (2007) investigate the valuation accuracy using multiples in European equity markets for a ten-year period. Their results show that: (1) equity value multiples outperform enterprise value multiples. (2) Knowledge-related multiples based on earnings number with added knowledge costs like amortization of intangible assets and research and development costs outperform traditional multiples in the science-based industry. (3) Two-year forward-looking P/E multiple provides a better valuation accuracy then trailing P/E multiple, and overall forward-looking multiples provide better accuracy than historical multiples.

Minjina (2009) compare the valuation accuracy of a number of multiples using two different set of comparable companies. When an industry membership is used as a measure to select comparable companies, he finds the Price/Cash-flow multiple provides the best accuracy, and the EV/EBITDA multiple performs the second best. When using return on equity to select comparable companies, he finds that the P/E multiple and the P/B multiple give the best accuracy.

3 Foundation of Relative Valuation

This chapter presents the theory of relative valuations. The chapter begins with a review of relative valuation, after which the fundamentals of the multiples used in this study are derived

3.1 Relative Valuation

In relative valuation according to Damodaran (2002), the basic idea behind any valuation is that similar assets should be priced similarly, and we assume that the markets are correct on average, but individual stocks are mispriced. The main benefit of relative valuation is that it uses fewer assumptions and is quicker to carry out than the discounted cash flow model. It is also easier to understand and is more likely to reflect the condition of the market. Although multiples can reflect the market condition, it can also be a disadvantage when comparable companies are overvalued or undervalued which can result in over- or underestimation of the target company. Another disadvantage is the lack of transparency in the assumption of the relative valuation which can lead to manipulation (Damodaran, 2002).

Multiples that are used in relative valuation can be divided into two categories according to Suozzo et al. (2001). First, enterprise multiples express the value of an enterprise, the value of all claims on a company. They are standardized with a variable that relates to the enterprise value, such as revenue or EBITDA. Second, equity multiples express the equity value, the value of shareholders' claims on the asset and cash flow of the company. They are standardized with a variable that relates to shareholders, such as earnings and book value of equity.

Selection of comparable companies is an important step in relative valuation. While in most empirical research, the selection of comparable companies is based on industry using either Standard Industrial Classification (SIC) codes or the Industry Classification Benchmark (ICB) codes. Both Damodaran (2002) and Koller et al. (2015) suggest selecting comparable companies based on profitability, growth potential, risk and not based on industry. They argue that comparable companies based on the industry may be a good starting point. The selection should be based on the performance measure to carry out a good valuation.

Fundamental analysis attempts to observe and forecast the true value of the company based on numbers (fundamentals) from the company's financial reports. Earnings, growth, risk and cash flow are examples of fundamentals being used. One of the primary assumptions of fundamental analysis is that any change from the true value is a signal that a stock is under- or overvalued (Damodaran, 2002). The value of a company in discounted cash flow model is a function of three fundamentals. Firstly, the potentials to generate cash flow. Secondly, the expected growth in cash flow, and thirdly, the doubt related to these cash flows. The multiple is a function of the same three variables – profitability, growth and risk respectively (Damodaran, 2002). By finding the fundamentals that drive the multiples, we can find what value drivers belong to each multiple.

3.2 Multiples

The multiples used in this study are following. First, forward-looking price-earnings ratio, calculated as market value per share divided by the expected earnings per share (P/EPS1). Second, price-to-book ratio, calculated as the market value of equity divided by the book value of equity (P/B). Third, enterprise value to EBITDA, calculated as enterprise value divided by earnings before interest, taxes, depreciation and amortization (EV/EBITDA).

3.2.1 Fundamentals determinants of P/EPS1

Use of forward earnings estimates results in better valuation according to Kim and Ritter (1999), Liu et al. (2007) and Schreiner and Spremann (2007), this is also suggested by Koller et al. (2015). The reason for this is that forward-looking multiples have lower deviation among comparable companies and are consistent with the fundamental of valuation, especially that a company's value equals the discounted value of future cash flow Koller et al. (2015).There are some drawbacks of the P/EPS multiple. Firstly, the fact earnings or net income is the last variable on the income statement which means the multiple can be distorted by different capital structures and different accounting policies. Secondly, companies that report negative earnings cannot be estimated or be a part of comparable companies. Thirdly, it can be affected by managerial discretion. Managers can affect the P/EPS multiple by increasing leverage. Interest payments decrease the earnings which can, therefore, increase the P/E multiple (Koller, et al., 2015).

Fundamentals of P/EPS multiple can be derived using stable growth dividend discount model (Damodaran, 2002):

$$V_t^{share} = \frac{DPS_{t+1}}{k_e - g} \tag{3.1}$$

$$DPS_{t+1} = PR * EPS_t * (1 + g) \tag{3.2}$$

Where DPS_{t+1} is the expected dividend per share in next period, PR is the payout ratio, EPS_t is earnings per share at time t, g is growth in stable state and k_e is the cost of equity.

Thus,
$$V_t^{share} = \frac{PR * EPS_t * (1 + g)}{k_e - g} \tag{3.3}$$

Dividing both sides of equation (3.4) by EPS leads to P/E multiple at time t.

$$\frac{V_t^{share}}{EPS_t} = \frac{PR * (1 + g)}{k_e - g} \tag{3.4}$$

The forward-looking P/E multiple is found by simplifying the formula (3.4)

$$\frac{P}{EPS_{t+1}} = \frac{PR}{k_e - g} \tag{3.5}$$

Thus,
$$\frac{P}{EPS_{t+1}} = \frac{1 - \frac{g}{ROE}}{k_e - g} \tag{3.6}$$

We can now state that forward-looking P/E multiple for company in a steady-state is a function of payout ratio, which can be expressed as a function of growth and return on equity, growth and risk.

3.2.2 Fundamentals determinants of P/B

The advantages of using P/B multiple are several. Firstly, the fact that book value of equity has a tendency to be fairly stable over time makes the comparison to the market value easier. Secondly, the P/B multiple can indicate whether companies are under- or overvalued when making a comparison across similar companies. Thirdly, companies who report negative earnings are more likely to be able to be valued with P/B multiple. The changes of a company reporting negative book value are less likely than negative earnings. The disadvantage of P/B multiple is similar to earnings. The book value of equity can be influenced by account policies and be negative, resulting in a useless measure for relative valuation. Another thing to notice is that the book value of equity may not have any interpretation for companies who do not carry a high net value of tangible assets (Damodaran, 2002).

Fundamentals of P/B multiple can be derived using the dividend discount model (Damodaran, 2002):

$$V_t^{equity} = \frac{D_{t+1}}{k_e - g} \tag{3.7}$$

$$D_{t+1} = PR * Earnings_{t+1} \tag{3.8}$$

Where D_{t+1} is the expected dividend in the next period, PR is the payout ratio, $Earnings_{t+1}$ is the forward-looking earnings, k_e is the cost of equity and g is the growth in stable state.

We can define return on equity as:

$$ROE = \frac{Earnings_{t+1}}{Book\ value\ of\ equity_t} \tag{3.9}$$

Thus,

$$V_t^{equity} = \frac{PR * ROE * BV_t}{k_e - g} \tag{3.10}$$

Dividing both side of equation (3.10) by BV_t leads to P/B multiple at time t.

$$\frac{P}{B} = \frac{PR * ROE}{k_e - g} \tag{3.11}$$

The P/B multiple of a company in a steady-state is the difference between ROE and k_e. If ROE is lower (higher) than k_e the P/B multiple will be lower (higher) than one. We can now state that P/B multiple is a function of return on equity, growth and risk, measured as the cost of equity (Damodaran, 2002).

3.2.3 Fundamentals determinants of EV/EBITDA

The main attractions of using EV/EBITDA are following. Firstly, it is less likely to be distorted by capital structure and accounting policies. Secondly, EBITDA is an operating measure, and the ideology here is that EBITDA is an approach to free cash flow. The disadvantage of EV/EBITDA is for example. Although EBITDA is a proxy for free cash flow, EBITDA can be distorted for companies that have an ongoing need for investment in fixed assets (Damodaran, 2002). Another form of the multiple is EV/EBITA, the reason for subtracting depreciation from EBITDA is that depreciation can be thought of as a measure of capital expenses in the future, and EBITA provides a better estimate of future cash flow. However, the argument for using EBITDA is that depreciation is a non-cash expense, and does not reflect future capital expenses (Koller, et al., 2015).

Fundamentals of EV/EBITDA multiple can be derived using the value driver formula (Koller, et al., 2015):

$$Value_t = \frac{NOPLAT_{t+1} * (1 - \frac{g}{ROIC})}{k_w - g} \tag{3.12}$$

Where $NOPLAT_{t+1}$ is the net operating profit less adjusted taxes, $ROIC$ is the return on invested capital, k_w is the weighted average cost of capital and g is growth in stable state.

We can rewrite $NOPLAT$ as $EBITDA * (1 - T) * (1 - D)$ and divide both sides by $EBITDA$

$$\frac{Value}{EBITDA} = \frac{(1 - T) * (1 - D) * (1 - \frac{g}{ROIC})}{k_w - g} \tag{3.13}$$

We can now state that EV/EBITDA multiple is a function of ROIC, growth, weighted average cost of capital, tax rate, and depreciation.

4 Methodology

This chapter presents the methodology used in this study. The chapter introduces how Method 1, Method 2, and Method 3 are estimated. Followed by a presentation of how valuation errors are calculated. Finally, data sample and summary statistics are presented.

4.1 Overview of research methods

The main aim of this thesis is to compare three different methods that are used in relative valuation. Finding comparable companies is an important step in relative valuation since target company value is estimated from the statistical measure of the multiple based on the comparable companies. Method 1 is based on the comparable companies in the same industry. Companies in the same industry will generate a multiple which will then be used to value the target company. Method 2 is based on comparable companies in the same industry with similar performance to profitability measure. Six companies in the same industry with a similar performance regarding profitability, measured by ROE or ROIC, will generate a multiple that will be used to value the target company. Method 3 is based on regression model from companies in same industry. This regression will generate a multiple and intercept which will be used to value the target company. In the following subsection, I will present in greater detail each step to complete the valuation for the three methods.

4.2 Estimation using Method 1 and Method 2

Selection of comparable for Method 1 is made by using the whole industry. The industry classification is based on Industry Classification Benchmark (ICB) which is collected from DataStream. Selection of the comparable companies for Method 2 is based on industry using ICB and profitability measure. The reason is that industry can be thought of as a good measure of growth and risk according to Alford (1992), and adding profitability measure, we have key fundamentals in each multiple. To do this, we need to define the criteria we base the selection for comparable companies. When estimating the EV/EBITDA for Method 2, the selection of comparable companies will be made by selecting six comparable companies from an industry that are most similar in relation to ROIC. When estimating the multiples P/E and PB for Method 2, the selection of comparable companies will be made by selecting six comparable companies from an industry that are most similar in relation to ROE. The reason for using six comparable companies is based on Alford (1992) who chooses to use six comparable companies, this also supported by Schreiner (2007), who suggests using four to eight after a conversation with academics, fund managers, and investment bankers in Europe and the United States.

To generate a multiple from comparable companies a statistical measure has to be chosen. The fact that distribution of multiples tends to be right- skewed, leads to that the arithmetic mean will overestimate the predicted value consistently (Richter & Herrmann, 2003). Researchers use mainly median or harmonic mean. (Alford, 1992; Cheng and McNamara, 2000; Lie and Lie, 2002) use median while (Baker and Ruback, 1999; Liu et al., 2001; Minjina, 2009) use harmonic mean. Schreiner (2007) recommends, taking an average of median and harmonic mean to generate multiples in a heterogeneous sample. Empirical research from Baker and Ruback (1999) and Liu et al. (2001) show the harmonic mean provides the most accuracy when estimating equity value. In this study, I will use the harmonic mean to generate a multiple for Method 1 and Method 2.

After defining the comparable companies and selecting a statistical measure to calculate the multiplier for the target companies, the estimation of predicted enterprise value, equity value or the share price can be done using formula:

$$\hat{Y}_{it} = M_t * X_{it} \tag{4.1}$$

Where $\hat{Y}_{it}$ is the predicted value for the target company i. M_t is the multiple, calculated using harmonic mean over set of comparable companies. X_{it} is the value driver for corresponding multiple, for the EV/EBITDA multiple the value driver is EBITDA, for the P/E multiple, the value driver is forward earnings per share (EPS1) and for the P/B multiple the value driver is book value of equity.

Equation 4.1 is used to estimate the predicted values for the methods described above. Method 1, the multiple M_t is calculated using harmonic mean with data from all companies in the same industry. The multiple M_t is then multiplied to the corresponding value driver X_{it} from target company i to find the predicted value for company i and time t. Method 2, the multiple M_t is calculated using harmonic mean with data from six companies in the same industry that are most similar in relation to profitability measure ROE and ROIC. The multiple M_t is then multiplied to the corresponding value driver X_{it} from the target company i to find the predicted value for company i at time t.

4.3 Estimation using Method 3

Selection of comparable companies for Method 3 is based on industry using ICB. The statistical measure used to generate a multiple is a regression. Following Liu et al. (2001) I estimate the enterprise value, equity value or the share price as a linear function of the corresponding value driver.

$$Y_{it} = a + b * X_{it} + \varepsilon_{it} \tag{4.2}$$

Where Y_{it} is either the enterprise value, equity value or the share price for company i at time t. X_{it} is the value driver or EBITDA when estimating the enterprise value, for equity value, and share price I use book value equity and 12 month forward earnings for company i at time t respectively. Using intercept takes into account the average effect of omitted factors, and should increase the estimation accuracy out of sample prediction Liu et al. (2001). To correct for heteroscedasticity and as Baker and Ruback (1999) show, using a slope equation is likely to improve efficiency, because the valuation errors ε_{it} are not likely to be independent of the value Y_{it}. I divided the equation 4.2 with the dependent variable and estimate:

$$1 = \alpha * \frac{1}{Y_{it}} + \beta * \frac{X_{it}}{Y_{it}} + \varepsilon_{it} \tag{4.3}$$

Equation 4.3 is estimated using the ordinary least squares method. This regression is done for the four industries for each year t, resulting in 36 estimations of $\hat{\alpha}$ and $\hat{\beta}$. Finally, the estimation of enterprise value, equity value and share price is found by applying following formula.

$$\hat{Y}_{it} = \hat{\alpha} + \hat{\beta} * X_{it} \tag{4.4}$$

Where $\hat{Y}_{it}$ is the estimated enterprise value, equity value, and share price for target company i at time t, $\hat{\alpha}$ is the estimated constant, $\hat{\beta}$ is the estimated slope coefficient or the multiple and X_{it} is the value driver for company i at time t.

Equation 4.4 is used to estimate the predicted values for Method 3. The multiple $\hat{\beta}$ is calculated using regression with data from all companies in the same industry. The multiple $\hat{\beta}$ is then multiplied to the corresponding value driver X_{it} from target company i. The intercept is added to that value to find the predicted value for company i at time t.

4.4 Valuation accuracy

The valuation accuracy will be found by calculating scaled absolute valuation error.

$$Valuation\ error = \left|\frac{\hat{Y}_{it} - Y_{it}}{Y_{it}}\right| \tag{4.5}$$

Where $\hat{Y}_{it}$ is the estimated value from the three different methods for the target company i. Y_{it} is the actual market value for the each target company i. The market value is calculated, taking average of actual market values over April for each year t. There are two reasons for this. Firstly, this is done to reduce the noise of the actual market value. Secondly, the companies usually publish the annual report within three months after the fiscal year and using values from April makes sure that all the information from the annual report is available and is reflected in the market values.

To measure the performance of each multiple, the mean and the median of all valuation error will be calculated. To get a more comparable result, the fraction of absolute valuation errors below 15 percent and a fraction of absolute valuation errors below 25 percent of the observed market value will be calculated. Schreiner (2007), Kaplan and Ruback (1995), Kim and Ritter (1999) and Lie and Lie (2002) have used similar performance measures, by doing this I will be able to draw a better conclusion about the performance of each method.

4.5 Data

The data is collected from Thomson Reuters DataStream. I will use companies listed on certain industries in the S&P Europe 350. The following industries will be used, consumer services, consumer goods, financials, and industrials. The reason for choosing these industries is that each industry contains at least thirty companies after unusable observations have been deleted. The data for the multiples is from 2013-2015. The data consists of enterprise value, EBITDA, the market value of equity, the book value of equity, share price, and forward earning per share. The profitability measures are from 2009-2015, consisting of return on equity (ROE), and return on invested capital (ROIC). The reason is each profitability measure will be calculated as an average over five years. The actual market values are taken each April for following years 2014, 2015 and 2016. The total number of companies used is 246. For three years and three different multiples, the total number of multiples is 2.214. Multiples that have only positive value drivers are selected, and influence of outliers is reduced by deleting multiples under the 1 percentile and over the 99 percentile of the multiple's distributions. The final sample after these adjustments consists of 1872 observations.

Table 1: Summary statistics

This table shows mean, harmonic mean and standard deviation of the multiples in the data. The harmonic mean is the multiple used to calculate the predicted value in Method 1. The mean and standard deviation show us the variation for each multiple. The P/EPS1 is the multiple that has the lowest variation, then EV/EBITDA and P/B shows the most variation.

			Industry			
Multiple	**Year**	**Descriptive statistics**	**Consumer services**	**Consumer goods**	**Financials**	**Industrials**
		Mean	14,18	14,94	11,45	14,47
P/EPS1	2013	Harmonic mean	13,32	12,84	10,29	13,19
		Standard deviation	4,27	5,41	4,05	4,59
		Number of observations	40	45	64	65
		Mean	15,22	15,69	13,47	16,81
P/EPS1	2014	Harmonic mean	14,40	14,28	12,10	15,47
		Standard deviation	3,79	4,85	5,16	6,90
		Number of observations	40	46	65	66
		Mean	18,81	19,08	15,27	19,25
P/EPS1	2015	Harmonic mean	16,92	17,45	13,81	18,07
		Standard deviation	6,91	5,58	5,97	6,31
		Number of observations	40	45	65	68
		Mean	4,33	2,86	1,11	2,99
P/B	2013	Harmonic mean	2,11	1,92	0,74	2,14
		Standard deviation	5,09	1,86	0,87	1,74
		Number of observations	41	41	69	65
		Mean	4,55	3,11	1,23	3,53
P/B	2014	Harmonic mean	2,38	2,37	0,97	2,64
		Standard deviation	5,79	1,89	0,71	1,93
		Number of observations	41	41	70	66
		Mean	4,80	3,48	1,43	3,96
P/B	2015	Harmonic mean	2,46	2,65	1,09	2,83
		Standard deviation	5,88	2,19	0,94	2,48
		Number of observations	39	42	69	65
		Mean	9,61	11,22	17,91	11,74
EV/EBITDA	2013	Harmonic mean	8,09	9,60	11,00	10,23
		Standard deviation	3,42	4,87	12,27	4,77
		Number of observations	44	42	52	67
		Mean	11,14	10,54	17,72	11,51
EV/EBITDA	2014	Harmonic mean	9,47	9,03	11,47	10,14
		Standard deviation	5,27	3,74	11,73	4,30
		Number of observations	35	40	51	65
		Mean	11,01	12,12	18,89	12,35
EV/EBITDA	2015	Harmonic mean	9,05	9,61	11,66	10,43
		Standard deviation	4,48	4,97	12,78	5,54
		Number of observations	32	40	51	55

5 Empirical Results

This chapter presents the empirical results and an analysis of these findings. The chapter begins with analyzing the cross-industry absolute valuation errors. Next, is the examination of how industry performs, followed by an investigation of the performances of each multiple. Finally, an analysis of the performances of the three methods is presented.

5.1 Analysis of absolute valuation errors

The performance of each method can be found in Table 2. The results in the table show analysis of absolute valuation errors for each method and multiple in following year. The results are calculated using data from every industry in the sample.

Method 1, the median absolute valuation errors varies between 24.11 % to 40.38% and the mean absolute valuation errors ranges from 27.45% to 50.30%, an inconsistency which could be expected since the method is sensitive to high variation in the data since it uses all companies in the industry to generate the multiple. This is best seen when looking at P/B multiple, the information from Table 1 can help us to confirm this. It can be seen that P/B multiple has the highest variation. However the low variation in P/EPS1 results in much lower absolute valuation errors. The fraction of absolute valuation error within 15% ranges from 13.89% to 32.72% and the fraction of absolute valuation error within 25% ranges from 25.00% to 51.40%. Again, I relate these relatively high differences in performance to the inability of the method to handle high variation in the P/B multiple and the EV/EBITDA multiple.

Method 2, the median absolute valuation errors varies between 24.11% to 38.42% and the mean absolute valuation errors ranges from 28.97% to 44.89%. The fraction of absolute valuation error within 15% ranges from 19.91% to 32.56% and the fraction of absolute valuation error within 25% ranges from 36.11% to 52.07%. Comparing Method 2 to Method 1, the performance using the P/EPS1 multiple is similar. However, Method 2 provides better results for both the P/B multiple and EV/EBITDA multiple. The reason for this is because the low variation in the P/EPS1 multiple leads to a small difference between the methods. However the higher variation in both P/B multiple and EV/EBITDA multiple results in much-improved results in Method 2 compared to Method 1. The fact Method 2 only uses six comparable companies that are similar in relation to profitability measure leads to a better estimation of the predicted value.

Method 3, the median absolute valuation errors varies between 25.60% to 48.18% and the mean absolute valuation errors ranges from 29.36% to 46.00%. The fraction of absolute valuation error within 15% ranges from 9.36% to 30.41%, and the fraction of absolute valuation error within 25% ranges from 19.44% to 48.62%.

Comparing Method 3 to Method 1 and Method 2, we see that Method 3 delivers worse results in almost every aspect. Method 3 underperforms both when the variation is low, e.g., when looking at the P/EPS1 multiple the Method 3 is the third best method and when the variation is high, looking at P/B multiple the Method 3 is unable to provide any improvements over Method 1 and Method 2. This is interesting, especially in comparison to Method 1. The use of regression to estimate the multiple and using an intercept is unable to perform better than the simple harmonic mean over all companies in the industry.

In Table 2, the quartiles of the absolute valuation errors are presented. The 1st quartile informs that 25% of the sample has a lower median absolute error than the variable shows. If we look at the P/EPS1 multiple for Method 1, the 1st quartile the lowest number is 11.09%, which means for 2014, the 25 % of the sample has a lower median absolute valuation error than 11.09%. The 3rd quartile informs that 75% of the sample has a lower median absolute error than the variable shows. If we look again at the P/EPS1 multiple for Method 1, the 3rd quartile the lowest number is 38.04%, which means for 2013, the 75% of the sample has a lower median absolute valuation error than 38.04%. It is observed that Method 2 does offer the best results, especially for the P/B and EV/EBITDA multiples.

When comparing the results of the accuracy of the multiples to results from previous research. The median absolute valuation error ranges from 24.41% to 49.1% see, (Alford, 1992; Lie and Lie, 2002; Schreiner, 2007; Minjina, 2009). Fraction within 15% varies between 16.7% to 36.09% see, (Lie and Lie, 2002; Schreiner, 2007; Minjina, 2009) and fraction within 25% varies between 37.33% to 51.52% see, Schreiner (2007). Overall the methods that are used in this thesis are providing similar results as in previous research. This was expected because similar methods were used in previous research. Knowing that the results of this study are comparable to the previous finding confirms the model behind each method is working properly.

To summarize the analysis of absolute valuation errors from Table 2, it is observed the Method 2 does provide preferable results. Moreover, Method 2 does handle the high variation in the P/B multiple and the EV/EBITDA multiple best, and shows that there is a connection between the multiples and the profitability measures.

Table 2: Absolute valuation errors

This table shows analysis of absolute valuation errors for the three methods over three years for P/EPS1, P/B, and EV/EBITDA. The analysis is measured by median and means of absolute valuation errors, 1st and 3rd quartile of the absolute valuation errors and a fraction of errors under 15% and 25%. Note: The structure of this table is from Schreiner (2007: 100).

			Analysis of absolute valuation errors				Fractions	
Multiple	**Year**	**Method**	Median	Mean	1st quartile	3rd quartile	Fraction < 15%	Fraction < 25%
P/EPS1	2013	Method 1	24,11%	27,45%	13,02%	38,04%	29,44%	51,40%
	2014		24,43%	27,84%	11,09%	39,13%	32,72%	50,69%
	2015		29,38%	37,06%	15,94%	49,13%	22,94%	42,20%
P/EPS1	2013	Method 2	25,22%	28,97%	10,82%	41,28%	32,56%	49,77%
	2014		24,11%	27,79%	13,10%	40,08%	31,80%	52,07%
	2015		29,95%	37,58%	13,86%	50,33%	27,06%	43,12%
P/EPS1	2013	Method 3	30,97%	30,74%	14,94%	43,43%	25,23%	41,59%
	2014		27,19%	29,36%	13,36%	41,69%	30,41%	45,16%
	2015		25,60%	31,12%	13,22%	42,10%	27,52%	48,62%
P/B	2013	Method 1	40,38%	42,80%	25,19%	59,05%	13,89%	25,00%
	2014		35,89%	41,64%	18,50%	59,15%	19,27%	33,49%
	2015		35,51%	50,30%	17,98%	67,27%	21,86%	38,14%
P/B	2013	Method 2	38,42%	38,54%	19,24%	50,51%	19,91%	36,11%
	2014		31,73%	37,38%	15,09%	49,94%	24,89%	39,82%
	2015		33,53%	44,89%	16,64%	56,90%	21,30%	39,35%
P/B	2013	Method 3	48,18%	46,00%	32,34%	62,90%	9,26%	19,44%
	2014		40,84%	40,32%	19,80%	57,50%	19,27%	30,73%
	2015		38,61%	40,12%	20,41%	55,76%	19,53%	32,09%
EV/EBITDA	2013	Method 1	33,89%	40,32%	18,89%	50,76%	18,54%	39,51%
	2014		30,05%	37,42%	16,63%	50,03%	23,04%	41,36%
	2015		33,50%	44,32%	16,10%	58,17%	24,72%	34,83%
EV/EBITDA	2013	Method 2	29,61%	37,74%	12,71%	47,49%	28,29%	42,44%
	2014		31,07%	36,77%	14,79%	44,98%	25,65%	40,84%
	2015		30,89%	41,44%	16,78%	49,52%	22,47%	40,45%
EV/EBITDA	2013	Method 3	35,63%	38,30%	18,04%	51,99%	20,98%	31,71%
	2014		35,20%	36,95%	15,82%	53,95%	22,51%	35,08%
	2015		38,48%	40,09%	16,12%	56,57%	21,91%	35,39%

5.2 Analysis of absolute valuation errors for the four industries

In Table 1A, Table 2A, and Table 3A from Appendix A, we can see an analysis of absolute valuation error within each industry. If we look at P/EPS1 multiple in Table 1A, we can see financials industry has the highest median absolute valuation error, as it varies from 26.13% to 40.21% compared to the other industries were the range is from 16.23% to 34.39%. Consumer services and industrial provides the lowest median absolute valuation error and highest fraction within 15% and 25%. In Table 2A, we can see an analysis of P/B multiple between industries. The P/B multiple is rather stable between industries and no industry consistently provides the lowest median absolute valuation error. All industries deliver at least two times the lowest median absolute valuation error. In Table 3A, we can see the analysis of EV/EBITDA between industries. Similar to P/EPS1 multiple the financials industry provides the highest median absolute valuation error, with a range of 35.44% to 59.95%. Industrial industry delivers lowest median absolute valuation error with a range of 23.24% to 28.16% and the highest fraction within 15% and 25%.

The difference between each industry can be rather high, and the results show that the methods used in this study are not suitable for financials industry. Overall the two industries that provide the lowest median absolute valuation error are the industrials and the consumer services. Financials industry does consistently deliver the highest median absolute valuation error.

5.3 Analysis of absolute valuation errors for the three multiples

Table 3 shows how each multiple perform against each other. The results are found by analyzing Table 1A, Table 2A, and Table 3A from Appendix A. Table 3 compares each multiple in every industry over three years, resulting in 36 observations for each measure. The multiple that provides the lowest error or the highest fraction receives value one, then the total number of ones is calculated for all multiple in each measurement. The comparison shows that P/EPS1 is by far the most accurate multiplier. The P/EPS1 multiple delivers the highest fraction within 15% and 25% in 72% of the total observation and over 80% of total observation in lowest median error and mean error. The second most accurate multiple is the EV/EBITDA and the multiple which provides the least accurate results is the P/B.

Table 3:
This table shows how often each multiple provided the lowest median error, lowest mean error, highest fraction within 15% and highest fraction within 25%

	Lowest median error	Lowest mean error	Highest fraction < 15%	Highest fraction < 25%
P/EPS1	**29**	**32**	**26**	**26**
P/B	2	1	3	3
EV/EBITDA	5	3	7	7

5.4 Analysis of absolute valuation errors for the three methods

The main goal of this thesis was to compare three different methods. In Table 4 we can see a comparison between the methods using different multiples over three year period. Information in Table 4 is found by analyzing Table 1A, Table 2A, and Table 3A from Appendix A.

Table 4:
This table shows how many times each method was able to provide the lowest median error, lowest mean error, highest fraction within 15% and highest fraction within 25%. Note: Highest fraction within 15% and 25% can be higher than total observation of twelve. The reason for this is if both two methods provide the same highest fraction within 15% and 25% the both methods get value one as their result is superior to the other method.

		Lowest median error	Lowest average error	Highest fraction < 15%	Highest fraction < 25%
P/EPS1	Method 1	**5**	3	**4**	5
	Method 2	4	3	**4**	**6**
	Method 3	3	**6**	**4**	4
P/B	Method 1	3	2	3	3
	Method 2	**8**	**7**	**9**	**9**
	Method 3	1	3	1	1
EV/EBITDA	Method 1	4	2	4	5
	Method 2	**8**	**5**	**7**	**7**
	Method 3	0	**5**	3	1

Looking at the P/EPS1 multiple, we can see that Method 1 delivers the lowest median error most often over the three year period while Method 3 had the lowest mean error. All methods are equal when it comes to producing results for highest fraction within 15%. However, the Method

2 provides most frequently the highest fraction within 25%. The relatively low variation in the P/EPS1 multiple leads to similar performance for all methods.

For the P/B multiple, the Method 2 provides the most accurate performance. Method 2 is able to produce the lowest median error times and highest fraction within 15% in eight times out of twelve observations. Here is an obvious connection between the P/B multiple and return on equity as expected. Method 1 provides the second best results, and Method 3 is not able to produce accurate estimation, only able to deliver lowest median error one time. The high variation in the P/B multiple is not suitable for Method 1 or Method 3.

For the EV/EBITDA multiple, the Method 2 gives the most accurate results. It is observed that Method 2 gives lowest median error eight times out of twelve, same as for P/B multiple. The Method 2 is also able to produce highest or at least the same number of the other measurements. The connection between EV/EBITDA multiple and return on invested capital does show in more precise results in Method 2. Method 1 provides the second best result and Method 3 fails to deliver lowest median error and only has the highest fraction within 25% one time. However, Method 3 has the lowest mean error five times, which indicates that Method 3 has the lowest dispersion in the absolute valuation error.

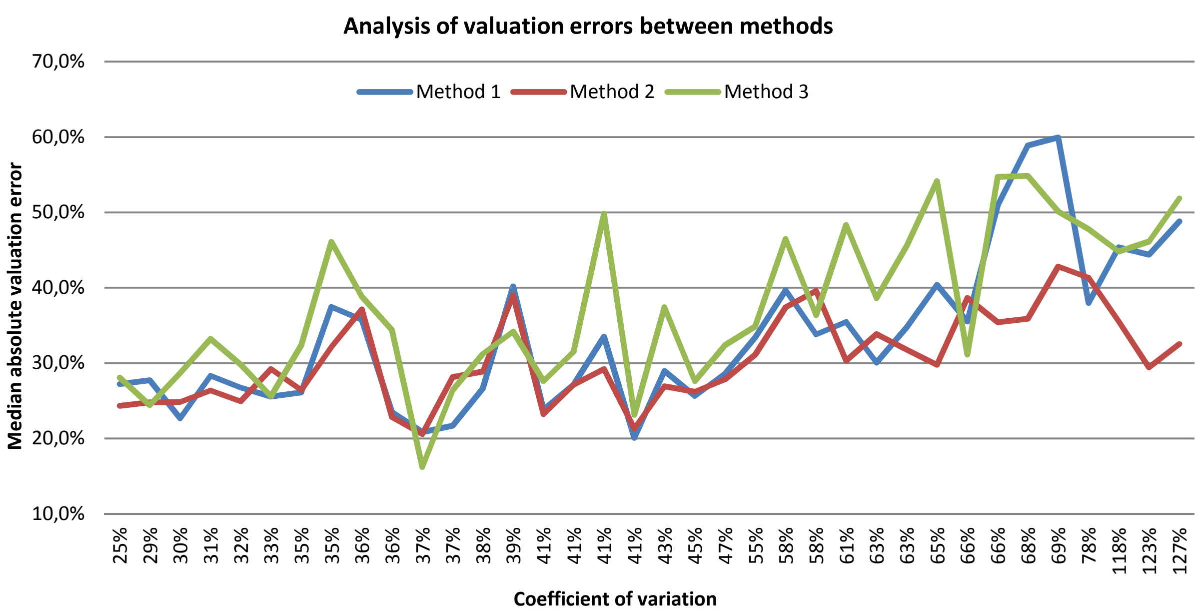

Figure 1

In Figure 1, we can see how median of absolute valuation error changes as the variation in the multiples increases. The coefficient of variation is calculated using Table 1. It is a standardized measure of variation for each multiple or the standard deviation of the multiple divided by the mean of the multiple. The total observation for each multiple is 36. The median of absolute valuation errors is from Table 1A, Table 2A, and Table 3A from Appendix A. It can be observed using Table 4, that Method 2 is able to be lower than Method 1 and Method 3 for 20 observations in Figure 1. Although it is interesting to see how close Method 1 and Method 2 regarding valuation error, only when the coefficient of variation is above 63% the advantage of Method 2 start to show. However, Method 2 is consistently able to deliver the most accurate valuation.

6 Conclusion

In this thesis, the accuracy of three different methods is examined by using three different multiples. I answer which method and which multiple provides most accurate results. This paper also briefly compares the relative valuation in different industries. The data from four industries in S&P Europe 350 over a period of three years is used.

The main finding of this thesis regarding which method is more accurate is that Method 2 is the most accurate method to use when performing a relative valuation. It is observed that Method 2 can reduce the valuation errors when the variation in the multiples is high. This is particularly noticeable for EV/EBITDA multiple and P/B multiple. The use of ROIC and ROE with only six companies that are similar to the profitability measure results in lower valuation errors, compared to the other methods, and increases the fraction within 15% and 25%. However, for the P/EPS1 multiple, the forward earning estimate seems to decrease the relationship between the multiple and ROE, as the all the methods deliver similar accuracy.

This study also shows that Method 1 is more accurate than Method 3. Analyzing the data from Table 4 we see that Method 3 is able to produce lower mean absolute valuation error more often. However, Method 1 provides lower median absolute valuation error, and it has higher numbers when analyzing the highest fraction within 15% and 25% from Table 4. The conclusion here is that by using Method 3 on data with relatively high dispersion, especially for the EV/EBITDA multiple and the P/B multiple in this study, leads to lower variation in the valuation errors. However, this leads to consistently higher median absolute valuation errors compared to Method 1. Another thing to notice is that both these methods use the same data. It can be concluded that using harmonic mean as a statistical measure provides better results than using a regression as a statistical measure

This is the first study, to my knowledge, to compare the accuracy of Method 3 to Method 1 and Method 2. The empirical results show that Method 2 is the most accurate method. The evidence clearly illustrates how Method 2 provides more stable results and handles the variation in the multiples better, leading to more accurate valuations compared to other methods. The use of six comparable companies in the same industry which are similar in relation to profitability measures is recommended. However, the limitation of the study is that the significance of this finding is unclear.

When analyzing what multiple produces the best accuracy, this study demonstrates that the P/EPS1 multiple is superior to other multiples. The fact that the use of a forward estimate of earnings reduces the dispersion in the sample leads to more accuracy. This is supported by (Kim and Ritter, 1999; Liu et al., 2007; Schreiner, 2007). The EV/EBITDA multiple provides the second best accuracy. The reason for not getting a better result from the EV/EBITDA multiple could be that when using EV/EBITDA multiple within companies in the same industry leads to a high variation in the multiple. The use of forward EV/EBITDA would be more reliable as it can be expected, similar to P/EPS1 multiple that the variation would decrease. On the other hand, my recommendation for using EV/EBITDA is that prospect for ROIC and growth is more important when it comes to selecting comparable companies than industry. The least reliable multiple is the P/B. The high variation in the multiple, especially in the consumer services industry, indicates that using P/B multiple with companies within the same industry can lead to bad valuation. The reasons for this are. Firstly, many subsectors under each industry may have different capital structure. Secondly, the fact that the P/B multiple can have difficulties estimating companies that do not carry significant tangible assets can lead to high variation in the P/B multiple within the industry. My results show that using the industry as a selection for comparable companies does not work well for the P/B multiple. My recommendation when using P/B multiple would be selecting companies in the same subsector, as it is more likely that the capital structure would be more similar and use return on equity to select comparable companies.

This study demonstrates that valuation accuracy varies between industries. If we look at Table 1, it is worth noticing the difference in multiples across industries. We see for example how multiples for financials industry are different compared to the other industry. The conclusion can be drawn here that combining financial companies and the other industry used in this study should not be suggested. Meaning using companies from the financial industry to estimate companies from another industry could lead to a bad valuation. Damodaran (2002) argues that companies from financials industry can be hard to value because of problems of outlining their debt and reinvestment as well as noting that companies in the financials industries are likely to be highly regulated, and the influence of these regulations have to be considered. Another thing to notice is the high variation in the P/B multiple for consumer services. This is not suitable for relative valuation, and the solution for this problem could be defining the consumer services industry into more detailed sectors, at least for the P/B multiple. The main findings are that industrials industry provides the lowest median absolute valuation error than followed by consumer services, the third is consumer goods, and finally, the industry that provides the lowest valuation accuracy is the financials.

Several questions remain to be resolved; in particular for the enterprise multiple. Koller et al. (2015) recommend using adjusted EV/EBITA multiple. The adjustment is made by excluding any non-operating items within enterprise value and EBITA, for example, excess cash, and operating leases. When the adjustments have been made the selection of peers should be selected on prospects for ROIC and growth. There is no research available that uses this multiple and selection of comparable companies, and it would be interesting to see how it compares to other results and if there is any benefit from these adjustments compared to EV/EBITDA.

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Appendices

Appendix: A. Analysis of absolute valuation errors

Table 1A: This table shows analysis of absolute valuation errors for the three methods over three years for P/EPS1. The analysis is divided between industries and shows median and means of absolute valuation errors, 1st and 3rd quartile of the absolute valuation errors and a fraction of errors under 15% and 25%. Note: The structure of this table is from Schreiner (2007: 100).

				Analysis of absolute valuation errors				Fractions	
	Multiple	**Year**	**Industry**	Median	Mean	1st quartile	3rd quartile	Fraction < 15%	Fraction < 25%
Method one	P/EPS1	2013	Consumer services	22,68%	28,88%	12,93%	35,03%	30,00%	57,50%
			Consumer goods	23,49%	27,01%	16,04%	31,66%	22,22%	55,56%
			Financials	26,13%	27,35%	9,64%	41,46%	35,94%	48,44%
			Industrials	26,77%	26,99%	13,63%	37,91%	27,69%	47,69%
	P/EPS1	2014	Consumer services	27,21%	31,11%	11,46%	39,03%	30,00%	47,50%
			Consumer goods	28,35%	29,21%	16,03%	37,23%	23,91%	45,65%
			Financials	26,64%	29,74%	9,26%	49,26%	33,85%	46,15%
			Industrials	20,10%	23,58%	10,95%	31,47%	39,39%	60,61%
	P/EPS1	2015	Consumer services	20,88%	28,15%	9,80%	40,24%	37,50%	60,00%
			Consumer goods	27,72%	31,83%	12,57%	40,27%	31,11%	46,67%
			Financials	40,21%	51,69%	26,50%	75,68%	12,31%	23,08%
			Industrials	25,57%	31,78%	16,49%	39,22%	19,12%	47,06%
Method two	P/EPS1	2013	Consumer services	24,86%	27,53%	12,39%	39,28%	27,50%	50,00%
			Consumer goods	22,87%	26,96%	7,05%	42,22%	42,22%	53,33%
			Financials	26,44%	30,12%	12,48%	43,34%	29,23%	47,69%
			Industrials	24,94%	29,39%	12,66%	37,69%	29,23%	50,77%
	P/EPS1	2014	Consumer services	24,33%	30,97%	14,39%	41,12%	32,50%	50,00%
			Consumer goods	26,40%	27,67%	15,18%	37,11%	23,91%	47,83%
			Financials	28,86%	29,51%	12,24%	45,39%	30,77%	47,69%
			Industrials	21,34%	24,25%	12,45%	32,34%	37,88%	60,61%
	P/EPS1	2015	Consumer services	20,61%	27,33%	8,90%	33,25%	40,00%	57,50%
			Consumer goods	24,80%	36,35%	13,04%	42,74%	28,89%	51,11%
			Financials	38,99%	48,32%	19,93%	65,40%	18,46%	29,23%
			Industrials	29,23%	34,15%	14,61%	49,85%	26,47%	42,65%
Method three	P/EPS1	2013	Consumer services	28,67%	25,95%	9,83%	37,68%	32,50%	47,50%
			Consumer goods	34,39%	33,62%	22,13%	42,94%	17,78%	28,89%
			Financials	32,41%	31,17%	13,91%	45,42%	28,13%	42,19%
			Industrials	29,84%	30,28%	14,63%	43,58%	26,15%	44,62%
	P/EPS1	2014	Consumer services	28,07%	30,82%	17,64%	36,68%	22,50%	37,50%
			Consumer goods	33,23%	30,96%	13,72%	42,61%	28,26%	43,48%
			Financials	31,21%	31,34%	12,88%	43,59%	30,77%	41,54%
			Industrials	23,16%	25,15%	11,03%	34,65%	36,36%	54,55%
	P/EPS1	2015	Consumer services	16,23%	23,33%	9,02%	30,41%	42,50%	67,50%
			Consumer goods	24,41%	29,32%	14,63%	38,07%	26,67%	51,11%
			Financials	34,21%	39,41%	16,08%	55,60%	23,08%	36,92%
			Industrials	25,60%	28,97%	16,81%	37,31%	23,53%	47,06%

Table 2A: This table shows analysis of absolute valuation errors for the three methods over three years for P/B. The analysis is divided between industries and shows median and means of absolute valuation errors, 1st and 3rd quartile of the absolute valuation errors and a fraction of errors under 15% and 25%. Note: The structure of this table is from Schreiner (2007: 100).

				Analysis of absolute valuation errors				Fractions	
	Multiple	Year	Industry	Median	Mean	1st quartile	3rd quartile	Fraction < 15%	Fraction < 25%
Method one	P/B	2013	Consumer services	45,37%	49,86%	27,04%	75,97%	12,20%	21,95%
			Consumer goods	40,38%	41,70%	25,59%	55,05%	12,20%	24,39%
			Financials	37,99%	40,28%	24,95%	52,74%	15,94%	26,09%
			Industrials	39,66%	41,72%	24,94%	57,61%	13,85%	26,15%
	P/B	2014	Consumer services	48,81%	55,78%	25,50%	79,12%	14,63%	24,39%
			Consumer goods	35,46%	38,99%	23,65%	51,32%	17,07%	29,27%
			Financials	33,81%	36,55%	16,63%	51,33%	24,29%	40,00%
			Industrials	33,44%	39,92%	18,88%	58,36%	18,18%	34,85%
	P/B	2015	Consumer services	44,39%	55,81%	19,66%	76,82%	23,08%	33,33%
			Consumer goods	34,79%	45,25%	20,82%	53,46%	19,05%	35,71%
			Financials	35,51%	55,18%	19,07%	69,24%	21,74%	39,13%
			Industrials	30,06%	45,09%	15,93%	62,09%	23,08%	41,54%
Method two	P/B	2013	Consumer services	35,56%	45,48%	20,42%	53,04%	19,05%	38,10%
			Consumer goods	29,78%	34,49%	16,21%	50,54%	21,95%	41,46%
			Financials	41,33%	40,76%	23,45%	55,08%	15,94%	28,99%
			Industrials	37,43%	34,17%	16,25%	46,75%	23,44%	39,06%
	P/B	2014	Consumer services	32,56%	45,03%	20,20%	55,99%	19,05%	40,48%
			Consumer goods	30,34%	31,22%	18,38%	44,69%	23,81%	38,10%
			Financials	39,60%	40,36%	14,68%	51,86%	25,35%	38,03%
			Industrials	31,12%	33,23%	12,96%	42,77%	28,79%	42,42%
	P/B	2015	Consumer services	29,45%	41,04%	15,99%	47,04%	22,50%	47,50%
			Consumer goods	31,76%	38,92%	17,32%	53,23%	23,81%	40,48%
			Financials	38,66%	55,66%	16,80%	75,66%	20,29%	36,23%
			Industrials	33,84%	39,68%	17,39%	57,51%	20,00%	36,92%
Method three	P/B	2013	Consumer services	44,82%	43,90%	24,33%	60,06%	12,20%	26,83%
			Consumer goods	54,18%	48,09%	32,05%	64,66%	12,20%	19,51%
			Financials	47,79%	47,78%	35,91%	63,31%	2,90%	14,49%
			Industrials	46,46%	44,11%	31,77%	60,49%	12,31%	20,00%
	P/B	2014	Consumer services	51,87%	50,96%	22,18%	64,74%	17,07%	26,83%
			Consumer goods	48,34%	41,01%	21,51%	58,97%	21,95%	29,27%
			Financials	36,38%	37,90%	19,92%	55,69%	15,71%	31,43%
			Industrials	34,89%	36,90%	18,75%	55,64%	22,73%	33,33%
	P/B	2015	Consumer services	46,15%	45,95%	25,19%	61,11%	15,38%	25,64%
			Consumer goods	45,57%	41,31%	22,33%	54,51%	21,43%	28,57%
			Financials	31,12%	36,60%	16,56%	45,15%	24,64%	39,13%
			Industrials	38,61%	39,59%	20,95%	55,88%	15,38%	30,77%

Table 3A: This table shows analysis of absolute valuation errors for the three methods over three years for EV/EBITDA. The analysis is divided between industries and shows median and means of absolute valuation errors, 1st and 3rd quartile of the absolute valuation errors and a fraction of errors under 15% and 25%. Note: The structure of this table is from Schreiner (2007: 100).

				Analysis of absolute valuation errors				Fractions	
	Multiple	Year	Industry	Median	Mean	1st quartile	3rd quartile	Fraction < 15%	Fraction < 25%
Method one	EV/EBITDA	2013	Consumer services	35,76%	40,64%	17,85%	49,39%	22,73%	43,18%
			Consumer goods	28,97%	32,67%	18,96%	37,18%	14,29%	38,10%
			Financials	59,95%	56,78%	32,36%	72,02%	11,54%	21,15%
			Industrials	23,83%	32,13%	15,89%	43,17%	23,88%	52,24%
	EV/EBITDA	2014	Consumer services	28,63%	32,77%	13,01%	42,04%	28,57%	45,71%
			Consumer goods	37,46%	36,91%	17,95%	46,96%	20,00%	35,00%
			Financials	50,93%	52,16%	25,91%	65,92%	15,69%	23,53%
			Industrials	21,71%	28,66%	13,94%	38,38%	27,69%	56,92%
	EV/EBITDA	2015	Consumer services	27,13%	36,79%	11,21%	39,49%	31,25%	46,88%
			Consumer goods	33,50%	46,88%	20,20%	47,62%	22,50%	30,00%
			Financials	58,86%	62,19%	42,43%	71,55%	11,76%	17,65%
			Industrials	25,67%	30,27%	12,49%	40,85%	34,55%	47,27%
Method two	EV/EBITDA	2013	Consumer services	37,12%	42,21%	13,69%	49,95%	27,27%	36,36%
			Consumer goods	26,91%	32,91%	13,71%	35,88%	26,19%	42,86%
			Financials	42,83%	49,54%	17,68%	60,50%	23,08%	28,85%
			Industrials	23,24%	28,66%	10,14%	34,69%	34,33%	56,72%
	EV/EBITDA	2014	Consumer services	27,87%	31,03%	14,99%	40,99%	25,71%	42,86%
			Consumer goods	32,15%	32,72%	12,00%	41,51%	30,00%	40,00%
			Financials	35,44%	49,11%	18,59%	59,85%	15,69%	35,29%
			Industrials	28,16%	32,69%	12,85%	41,97%	30,77%	44,62%
	EV/EBITDA	2015	Consumer services	27,15%	39,11%	20,45%	46,60%	16,67%	46,67%
			Consumer goods	29,21%	37,20%	9,76%	41,31%	37,50%	42,50%
			Financials	35,91%	51,73%	23,59%	51,14%	13,73%	31,37%
			Industrials	26,21%	36,35%	16,05%	50,22%	23,64%	45,45%
Method three	EV/EBITDA	2013	Consumer services	38,82%	40,22%	19,28%	52,99%	18,18%	29,55%
			Consumer goods	37,43%	35,05%	15,87%	46,79%	26,19%	33,33%
			Financials	50,14%	50,79%	30,67%	76,98%	9,62%	15,38%
			Industrials	27,63%	29,40%	14,43%	39,70%	28,36%	44,78%
	EV/EBITDA	2014	Consumer services	32,40%	31,92%	18,83%	45,29%	20,00%	42,86%
			Consumer goods	46,08%	40,95%	25,52%	54,52%	17,50%	25,00%
			Financials	54,73%	48,89%	26,27%	73,50%	13,73%	21,57%
			Industrials	26,41%	27,91%	10,36%	36,53%	33,85%	47,69%
	EV/EBITDA	2015	Consumer services	31,54%	33,40%	12,95%	46,13%	28,13%	46,88%
			Consumer goods	49,83%	46,08%	17,22%	56,59%	20,00%	30,00%
			Financials	54,84%	49,70%	25,60%	73,45%	17,65%	25,49%
			Industrials	27,59%	30,82%	15,58%	41,34%	23,64%	41,82%

Appendix: B. Results from regression model in Method 3

Table 1.B: This table shows results for the estimated coefficient $\hat{\alpha}$ and $\hat{\beta}$ for consumer services industry

Consumer services

Multiple	Year	Coefficient	Result	P-value
P/E	2013	$\hat{\alpha}$	1,07	0,00
		$\hat{\beta}$	12,22	0,00
	2014	$\hat{\alpha}$	1,65	0,01
		$\hat{\beta}$	13,04	0,00
	2015	$\hat{\alpha}$	2,14	0,09
		$\hat{\beta}$	14,33	0,00
P/B	2013	$\hat{\alpha}$	1.242.912	0,00
		$\hat{\beta}$	1,10	0,00
	2014	$\hat{\alpha}$	1.190.294	0,01
		$\hat{\beta}$	1,33	0,00
	2015	$\hat{\alpha}$	505.411	0,30
		$\hat{\beta}$	1,49	0,00
EV/EBITDA	2013	$\hat{\alpha}$	1.742.542	0,00
		$\hat{\beta}$	4,66	0,00
	2014	$\hat{\alpha}$	763.380	0,10
		$\hat{\beta}$	7,37	0,00
	2015	$\hat{\alpha}$	1.680.002	0,00
		$\hat{\beta}$	5,54	0,00

Table 2.B: This table shows results for the estimated coefficient $\hat{\alpha}$ and $\hat{\beta}$ for consumer goods industry

Consumer goods

Multiple	Year	Coefficient	Result	P-value
P/E	2013	$\hat{\alpha}$	-0,13	0,94
		$\hat{\beta}$	1,07	0,00
	2014	$\hat{\alpha}$	1,23	0,63
		$\hat{\beta}$	12,73	0,00
	2015	$\hat{\alpha}$	7,59	0,06
		$\hat{\beta}$	14,75	0,00
P/B	2013	$\hat{\alpha}$	1.572.446	0,07
		$\hat{\beta}$	1,06	0,00
	2014	$\hat{\alpha}$	1.312.200	0,11
		$\hat{\beta}$	1,65	0,00
	2015	$\hat{\alpha}$	1.663.098	0,07
		$\hat{\beta}$	1,83	0,00
EV/EBITDA	2013	$\hat{\alpha}$	1.357.358	0,06
		$\hat{\beta}$	7,11	0,00
	2014	$\hat{\alpha}$	-28.484	0,97
		$\hat{\beta}$	7,51	0,00
	2015	$\hat{\alpha}$	2.324.107	0,08
		$\hat{\beta}$	5,86	0,00

Table 3.B: This table shows results for the estimated coefficient $\hat{\alpha}$ and $\hat{\beta}$ for financials industry

Financials

Multiple	Year	Coefficient	Result	P-value
P/E	2013	$\hat{\alpha}$	-2,08	0,04
		$\hat{\beta}$	12,79	0,00
	2014	$\hat{\alpha}$	-0,27	0,80
		$\hat{\beta}$	14,63	0,00
	2015	$\hat{\alpha}$	1,73	0,08
		$\hat{\beta}$	16,74	0,00
P/B	2013	$\hat{\alpha}$	1.521.767	0,00
		$\hat{\beta}$	1,13	0,00
	2014	$\hat{\alpha}$	2.142.151	0,00
		$\hat{\beta}$	1,44	0,00
	2015	$\hat{\alpha}$	2.708.468	0,00
		$\hat{\beta}$	1,44	0,00
EV/EBITDA	2013	$\hat{\alpha}$	946.455	0,01
		$\hat{\beta}$	7,88	0,00
	2014	$\hat{\alpha}$	777.971	0,04
		$\hat{\beta}$	8,13	0,00
	2015	$\hat{\alpha}$	341.251	0,52
		$\hat{\beta}$	8,58	0,00

Table 4.B: This table shows results for the estimated coefficient $\hat{\alpha}$ and $\hat{\beta}$ for industrials industry

Industrials

Multiple	Year	Coefficient	Result	P-value
P/E	2013	$\hat{\alpha}$	0,19	0,41
		$\hat{\beta}$	9,23	0,00
	2014	$\hat{\alpha}$	0,94	0,00
		$\hat{\beta}$	10,58	0,00
	2015	$\hat{\alpha}$	0,54	0,18
		$\hat{\beta}$	12,51	0,00
P/B	2013	$\hat{\alpha}$	1.547.519	0,00
		$\hat{\beta}$	0,42	0,00
	2014	$\hat{\alpha}$	1.441.155	0,00
		$\hat{\beta}$	0,67	0,00
	2015	$\hat{\alpha}$	2.124.445	0,00
		$\hat{\beta}$	0,68	0,00
EV/EBITDA	2013	$\hat{\alpha}$	1.179.137	0,14
		$\hat{\beta}$	6,54	0,00
	2014	$\hat{\alpha}$	154.371	0,85
		$\hat{\beta}$	7,98	0,00
	2015	$\hat{\alpha}$	-141.607	0,85
		$\hat{\beta}$	8,05	0,00