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Optimal Multiple Valuation Method Considerations Using European Companies

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Abstract

The Multiple Valuation Method has proven itself to be a capable and competent valuation method, in practice and in the academic literature. However, despite its widespread usage in practice, it lacks a clear and stringent manual on how to compute multiples optimally. This study tries to contribute to the literature with a comprehensive study on the Multiple Valuation Method, using European companies Using a dataset that consists of around 3,000 European companies per year, I construct 24 types of multiples for an eleven-year horizon from 1999 to 2009. Based on the existing literature, I assume the identification of comparable companies by industry membership and return on assets, classification of the industry by using 3-digit ICB grouping code, and estimating synthetic multiples by using the harmonic mean is optimal. Assuming these factors constant, I investigate five optimal considerations for when applying the Multiple Valuation Method. This study investigates the optimal value driver, the optimal value relevant base, the optimal time reference of the value driver, and the optimal size of the peer group. Also, the performance of an adjusted approach is tested.

The results suggest that, when the objective is to estimate the equity value of a company in an accurate and relative simple way, that is easy to comprehend and communicate, one should apply the traditional Multiple Valuation Method, using 2-year forward-priced EPS equity value multiples. Moreover, identify five to ten comparable companies to form a peer group for the target company. In addition, when the objective is to determine the enterprise value of companies, one should consider alternative valuation techniques. Furthermore, when the objective is to determine the equity value of company in the a more accurate way, with disregard to any additional complexity to the model, it is recommended to apply the Intercept Adjusted Multiple Valuation Method, using 2-year forward-priced EPS equity value multiples. It results in more accurate valuations than the traditional approach, however it is also more complex. In this case one should identify ten comparable companies to form a peer group for the target company.

This study has succeeded deriving optimal considerations that are somewhat consistent with the existing literature and has shown that the Multiple Valuation Method is capable of producing acceptable estimates of value. However, it is important to point out that the developments of the Multiple Valuation Method so far is not (yet) capable of replacing a thorough analysis of a company's fundamentals.

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1 Introduction

The introduction of this study is separated in three parts to ease the reading. The first part introduces the topic of this study, the Multiple Valuation Method. It discusses the literature on the Multiple Valuation method in general, and serves as the take-off for the next part, the research questions and motivation for this study. This part explains how and why I have come up with the research questions. Also, It discusses how this study differs from existing literature. The introduction ends with presenting the outline of this study.

1.1 Multiple Valuation Method

In the corporate valuation field, there are many techniques to assess the equity / enterprise value of a company. Among existing techniques, valuation through market accounting-based multiples is the most commonly used equity valuation method (Bhojraj & Lee, 2001). The so-called Multiple Valuation Method (MVM) typically uses a peer group of companies, which are considered to be comparable to the target company being valued.[1] In a relatively simple analysis of the market values and value drivers of the peer group companies, ratios are calculated, the peer group multiples. [2] The equity / enterprise value of the target company is estimated by multiplying the target company's value driver by the synthetic peer group multiple.[3] The synthetic peer group multiple is obtained by averaging the peer group multiples to one number (Suozzo et al., 2001).[4]

In practice, multiples are widely present in investment bankers' fairness opinions and analysts' reports (DeAngelo, 1990). They also appear in valuations associated with leveraged buyout transactions, initial public offerings (IPOs), seasoned equity offerings and

[1] The comparable companies are identified based on criteria such as industry membership, return on total assets, return on equity, or long-term growth indicators.

[2] The market value is the market price variable of the multiple. It is the numerator of the ratios / multiples. Using stock prices or market capitalization of companies will results in equity value multiples, and using the market capitalization plus the market value of net debt results in enterprise value multiples.

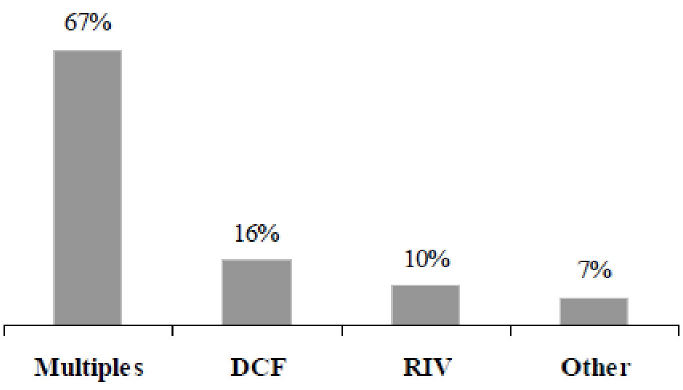
The value drivers are the denominator of the ratios / multiples. Value drivers are value relevant measures that enables multiples to explain equity / enterprise value, such as earnings, book value of common equity, sales, cash flows, or dividends.

[3] The equity value of a company is the value of common equity. The enterprise value is the value of common equity plus the market value of net debt.

[4] Averaging the peer group multiples to obtain the synthetic peer group multiple has various methods. It is possible to use the median, arithmetic mean, or harmonic mean.

other merger, and acquisition activities (Bhojraj & Lee, 2001).[5] Figure 1.1 shows usage of various valuation models in analysts' reports. We can see that the Multiple Valuation Method is most widely used model (Demirakos, Strong & Walker (2004). In the academic literature, these models are investigated in empirical studies such as Kaplan and Ruback (1995) and Gilson, Hotchkiss & Ruback (2000), who have found support for the effectiveness of the Multiple Valuation Method. The popularity of the Multiple Valuation Method is due to its relative simplicity and intuitive approach. Unlike other valuation techniques, such as the Discounted Cash Flow (DCF) approach, the Dividend Discount Model (DDM), or the Residual Income Valuation model (RIV), the Multiple Valuation Method does not need multi-period forecasts of cash flows, dividends or residual incomes.[6]

Figure 1.1: Various employed valuation models by analysts



Source: Demirakos, Strong & Walker (2004), p. 230-231.

Despite the widespread application of the Multiple Valuation Method among the practitioners, it has only been just more than a decade that the Multiple Valuation Method has become the subject of extensive academic study (Liu, Nissim & Thomas, 2002). Studies have empirically shown that the Multiple Valuation Method manages to produce valuations that are similar to the Discounted Cash Flow model valuations in terms of accuracy. For a dataset containing U.S. highly levered transactions, Kaplan & Ruback (1995) show that the Multiple Valuation Method using EBITDA multiples is as accurate as the Discounted Cash

[5] For example, Kaplan & Ruback (1995) studied alternative valuation techniques, including multiples in highly levered transaction. Kim & Ritter (1999) examined the use of multiples in IPOs

[6] Appendix I, at the end of this study, contains a list of the abbreviations and acronyms used in this study.

Flow model. Other studies also presented strong theoretical support for the use of the Multiple Valuation Method (Feltham & Ohslon, 1995).

Surprisingly, among the huge finance and accounting literature there is relative little theory available regarding the Multiple Valuation Method (Lie & Lie, 2002, Schreiner, 2007, and Cooper & Cordeiro, 2008). With a few exceptions, the academic literature provides little evidence on how and why certain type or certain comparable companies should be chosen in specific contexts (Bhojraj & Lee, 2001). Among the few exceptions, most of the empirical studies focus on the accuracy of different types of multiple and statistical measures to obtain the synthetic peer group multiples (Dittmann & Weiner, 2005).[7] Summarized, these studies concluded that equity value multiples based on the value driver earnings, performs better than multiples based on cash flow, or sales.[8] In addition, multiples based on forecast data from analysts outperform multiples based on historic data. Despite the prevalent use of equity value multiples in practice, many practitioners raise the question whether to use the market capitalization or the enterprise value of a company in the numerator of a multiple (Schreiner, 2007). The latter appeals in theory, because it is less affected by capital structure. Academic literature on this matter is rare and does not offer much consensus. Liu, Nissim & Thomas (2002) and Schreiner (2007) find that enterprise value multiples exhibit poor performance. Furthermore, empirical studies show that using the harmonic mean to estimate the synthetic peer group multiples leads to more accurate valuation than the using other statistical measures, such as the median, arithmetic mean, or weights that are obtained by linear approximation.[9] The accuracy of the valuation is measured by the deviation of the estimated value of the target company from its market value.

Beside the optimal type of multiple and synthetic peer group multiples, another factor that affects the accuracy of the Multiple Valuation Method is the identification of the comparable companies that forms the target company's peer group. However, there is only little existing empirical research on this matter (Dittmann & Weiner, 2005). For a sample of U.S. companies, Alford (1992) shows that industry membership or a combination of return on equity (ROE) and total assets (TA) are good criteria for indentifying comparable companies. In Addition, Cheng & McNamara (2000) and Bhojraj & Lee (2002) improve the results of

[7] A type of multiple refers to the combination of value relevant measures used to construct a multiple. The value relevant measures are the market price variables (equity value or enterprise value) and the value drivers (e.g. EBITDA, earnings, sales, or cash flows). For example, EPS equity value multiples, EBITDA enterprise value multiples, or SALES equity value multiples.

[8] This optimal type of multiple is based on the findings of Kim & Ritter (1999), Cheng & McNamara (2000), Lie & Lie (2002), Liu, Nissim & Thomas (2002), and Herrman & Richter (2003).

[9] The harmonic mean of n multiples is defined as the inverse of the arithmetic mean of the inverse multiples and is mathematically always smaller than the arithmetic mean itself (Herrmann & Richter, 2003).
This optimal methodology estimate synthetic peer group multiples is studied by Boatsman & Baskin (1981), Beatty, Riffe & Thompson (1999), Baker & Ruback (1999), Liu, Nissim & Thomas (2002) and Herrman & Richter (2003).

Alford (1992) by using a combination of industry membership with total assets and further company characteristics as identification criteria. However, the results are based on U.S. data only. Because size, institutional background, and accounting standards differ from country to country, it seems not right that there is a single optimal method for the identification of comparable companies for each country. The great majority of empirical studies are exclusively dealing with U.S. datasets only.[10] The study of Dittmann & Weiner (2005) is among the first that addressed to this question by using a European dataset to verify whether the results found by previous studies for the U.S. are also valid for European countries. Not surprisingly, for the optimal Multiple Valuation Method results, they find that for the U.K. and U.S. companies in the data, the comparable companies should be selected from their native market. For most of the European companies, identifying comparable companies from the countries of the European Union leads to better valuation. Additionally, for all countries (including the U.S.), valuation errors are minimized when using the return on assets (ROA) as the identification criterion for identifying the comparable companies to form peer groups.

Further in the context of identifying comparable companies to form peer groups, Cooper & Cordeiro (2008) examine how a change in the quantity of comparable companies in the peer group affects the accuracy of the Multiple Valuation Method valuation. Using a global dataset based on the S&P 500 industry groupings and a comparable companies identification criterion based on growth rates, Cooper & Cordeiro (2008) find that using a set of ten comparable companies is, on average, as accurate as using all the companies in an industry. The loss in accuracy when using five comparable companies compared to ten comparable companies is minimal. However, the accuracy of the Multiple Valuation Method still heavily depends on the degree of similarity of the target company to its comparable companies. As in practice, in the case that there are a few comparable companies in the same industry with growth rates very similar to the target company, it is more beneficial to use a small number of comparable companies. The inclusion of more comparable companies, on average, just adds more noise and takes a toll on accuracy.

The study of Cooper & Cordeiro (2008) is interesting because it is motivated by a contrast between the practical and theoretical approaches. Practitioners usually apply the Multiple Valuation Method by carefully identifying a small number of similar comparable companies, taking into account situation-specific factors, to estimate the value of a couple of

[10] Alford (1992), Cheng & McNara (2000) and Bhojraj & Lee (2002), and Liu, Nissim & Thomas (2002) are based on U.S. data only. Herrman & Richter (2003) wat the first to consider U.S. and European datasets.

target companies.[11] Academic studies usually identify comparable companies in a more mechanic way, which is only natural since empirical studies deal with large sets of target companies to investigate considerations for the Multiple Valuation Method that are optimal, on average. Therefore, there are academic studies that typically use all companies in an industry as the peer group for the target company.[12] This academic approach has two main advantages. It does not require additional comparable companies identification criteria to further filter down the possible list of comparable companies, and it uses all the information contained in the entire industry. However, Cooper & Cordeiro (2008) shows that the inclusion of more information does not necessarily lead to a better valuation.

The Multiple Valuation Method has proven itself to be a capable and competent valuation method, in practice and in the academic literature. However, there are no clear stringent guidelines available to compute multiples. As clear from the preceding sections, there are still open issues regarding the Multiple Valuation Method. A set of open issues has been identified and summarized by Schreiner (2007):

- Which value drivers should we use (e.g. EBITDA, earnings per share, sales)?
- Should we use equity value multiples, or enterprise value multiples?
- Should we use trailing data or forward-looking data for the value drivers?
- How should we identify comparable companies?
- How should we define an industry for identifying comparable companies to form peer groups?
- How can the comparability of the peer group to the target company be further improved?
- What is the optimal size of a peer group?
- What is the optimal way to estimate synthetic peer group multiples?
- How can we improve the traditional Multiple Valuation Method methodology to improve the results (alternative multiple valuation methods)?

[11] Examination of analyst reports shows that practitioners typically use a sample size of four to six companies (Cooper & Cordeiro, 2008).
[12] Alford (1992) reports that the procedure of identifying comparable companies by using all companies in an industry is relatively effective where the industry is defined by the first three SIC code digits. Liu, Nissim & Thomas (2002) conclude that using the entire sample of companies in an industry is better than using the entire cross-section of companies in the entire market.

1.2 Research questions and motivation for this study

Most of the issues mentioned in paragraph 1.1 have already been investigated, although there is no real consensus on these matters. For this reason, I try to add to the financial academic literature on the Multiple Valuation Method, by re-investigating a subset of the open issues. As mentioned before, there is a clear difference in the way the multiple valuation method is applied in practice and academic literature. The application of the Multiple Valuation Method in practice is often a delicate task in which the practitioner assesses the value of a small set of target companies by carefully indentifying a set of four to six comparable companies based on extensive examination of underlying financial value drivers. The academic researcher however, is seeking answers on open issues by investigating a large dataset, and therefore has a more 'mechanical' way of indentifying comparable companies, also by using 'appropriate' value drivers. The academic researcher provides guidelines for the Multiple Valuation Method that are, on average, appropriate or optimal for application in practice. With this study, I try to contribute to these guidelines.

This study differs from most existing studies because it investigates various aspects of the Multiple Valuation Method simultaneously, instead of focusing on one aspect. Also, it is designed to be comparable with other major studies, such as Liu, Nissim & Thomas (2002) and Schreiner (2007). To somewhat limit the scope of this study, I re-investigate a subset of the open issues and keep a few issues / factors constant. The first constant is the identification of the comparable companies. Considered by Cheng & McNamara (2000), Bhojraj & Lee (2002), and Dittmann & Weiner (2005) as the optimal comparable companies identification criteria, I identify comparable companies and form peer groups first using industry membership, and then further improve comparability by using the return on assets. The second constant is the definition of an industry. Empirical studies have shown that different industry classification definition seems to have different consequences for the valuation accuracy.[13] Presented by Bhojraj, Lee & Oler (2003), Eberhart (2004), and Schreiner (2007) as the optimal industry definition, I define the industries in my dataset using 3-digit ICB industry classification codes. The third constant is the statistical measure to estimate the synthetic peer group multiple for the target company. Considered by studies such as Baker & Ruback (1999), Liu, Nissim & Thomas (2002), Herrmann & Richter (2003), and Schreiner (2007) as the optimal measure to estimate the synthetic multiples, I use the harmonic mean.

[13] Studies such as Bhojraj, lee & Oler (2003), Eberhart (2004), Schreiner (2007) investigated the effects of different industry classification systems.

While keeping these three factors constant, I re-investigate the remaining issues using a European dataset consisting of fifteen West-European countries.[14] I have selected a subset, which I, after studying the literature on the MVM, still consider an open issue. I re-investigate the optimal value relevant measures (value driver and value relevant base) for multiples to determine the optimal type of multiple.[15] Since, empirical studies on the optimal value relevant base are quite rare and there is no consensus, I include a comparison of the performance of equity value versus enterprise value multiples. The empirically determined optimal type of multiple can be considered a guideline for both practitioners and academic studies. Moreover, the optimal time reference of the value drivers (trailing data or forward-looking data) is also investigated. Inspired by the innovative study of Cooper & Cordeiro (2008), I also investigate the optimal size of the peer groups. The optimal size of the peer group is especially interesting for academic studies, because of their 'mechanic' approach for large quantities of target companies. On the question how to improve the results of the traditional Multiple Valuation Method, Liu, Nissim & Thomas (2002) first introduced an adjusted approach of the Multiple Valuation Method using U.S. companies. In short, in the traditional Multiple Valuation Method approach there is a directly proportional relation between the equity value of the target company and its value driver. The adjusted approach of Liu, Nissim & Thomas (2002) relaxes this relation by introducing an intercept into the relation. The intercept can make the relation explain more information and therefore result in lower pricing errors.[16] The so-called intercept adjusted exhibits improved equity valuation results over the traditional approach. To test the Intercept Adjusted Multiples, I introduce this adjusted approach to a European dataset.

Based on the considerations above, I have come to the following research questions for a European dataset:[17]

- Which value relevant base in the numerator of multiples is optimal? Equity value or enterprise value?
- Which value driver multiple in the denominator of multiples is optimal? Earnings per share, EBITDA, EBIT, dividends (D), cash flow from operations (OCF), or sales?
- Which time reference of the value drivers is optimal? Trailing-priced, 1- year forward-priced, or 2-year forward-priced?
- What is the optimal number of comparable companies to form a peer group?

[14] The West-European countries includes: The Netherlands, Germany, France, The United Kingdom, Belgium, Italy, Denmark, Ireland, Portugal, Spain, Finland, Austria, Sweden, Switzerland and Norway

[15] With the optimal value relevant measures, I mean the optimal value driver (EBITDA, EPS, Sales, etc.) and market price variable (equity value or entity value).

[16] This was a short description of the adjusted approach, a more complete description is provided in Chapter 3, paragraph 3.4.

[17] The research question are discussed in details in Chapter 3, paragraph 3.2.

- Can Intercept Adjusted Multiples outperform traditional multiple valuation in terms of equity valuation accuracy?

Good empirical research should have an element of originality (Brooks, 2002). First, the study in general differs from other studies because it tackles various open issues simultaneously, whereas most studies deal with one or two issues. Also, I include a comparison of equity value versus entity value multiples, because this has only been investigated by two studies and deserves more attention.[18] In addition, the European dataset of this study boosts the comparable European dataset of Schreiner (2007) from 600 companies per data-year to about 3,000 companies per data-year, by pooling together companies from fifteen European countries. Moreover, whereas Schreiner's (2007) underlying index, the Dow Jones STOXX Europe 600, mainly consists of mid and large cap companies, my dataset covers small capitalization companies as well. Furthermore, I'm the first to introduce an Intercept Adjusted Multiples approach to a European dataset. The Intercept Adjusted Multiples has the potential to outperform the traditional Multiple Valuation Method.

[18] From the identified studies that focused on the optimal type of multiples, only Liu, Nissim & Thomas (2002) and Schreiner (2007) included enterprise value multiples in their empirical research.

1.3 Outline of this study

The design of this study is as follows. The study starts with an extensive literature part, which is chapter 2. This chapter is divided in a standard literature part and an academic literature part. The standard literature part consists of a standard literature review and a theoretical background section for the Multiple Valuation Method. The standard literature review discusses the coverage of the Multiple Valuation Method in the standard literature, and the theoretical background section highlights important and essential theory for understanding the Multiple Valuation Method. The academic literature part consists of an academic literature review. It discusses the academic studies that have investigated the Multiple Valuation Method so far, and how they have contributed to the knowledge of the Multiple Valuation Method today.

Chapter 3 is dedicated to the methodology of the empirical research. It discusses my approach to answer each of the research questions and provides insight in the dataset.

Chapter 4 presents the empirical results obtained by following the methodology of chapter 3.

The study concludes with a summary and conclusion regarding the research questions. Also, it discusses the limitations of this study and some recommendations for future study.

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2 Literature

2.1 Introduction

Despite the prevalent usage in practice, not much theoretical foundation is available to guide the practical application of the Multiple Valuation Method. With some exceptions, the finance and accounting literature gives inadequate evidence on how to apply multiples or why specific multiples or comparable companies should be picked in specific contexts. Standard corporate valuation textbooks tend to put more focus on the Discounted Cash Flow (DCF) model and the Residual Income Valuation (RIV) approach and devote relatively little attention on discussing the Multiples Valuation Method (MVM).[19]

The majority of these textbooks does mention and confirm the importance of the Multiples Valuation Method in practice, along with its strong supporting role in investment decisions and complex valuations, although, they lack in presenting the reader a clear and functional manual (Schreiner, 2007). Therefore, it is not surprising that some practitioners argue that the approach of the Multiples Valuation Method can be considered an art form, which should be left to professionals only. From an academic point of view however, the degree of subjectivity involved in their approach is rather bothersome (Bhojraj, Lee & Ng, 2003).

Still, both standard textbook literature and academic studies provide useful information and insights regarding various aspects of the Multiples Valuation Method. In fact, a comprehensive understanding of how to apply the multiples approach can be achieved by putting together the fractured pieces of information (Schreiner, 2007).

Putting together the fractured pieces of information on the Multiples Valuation Method is the aim of this chapter. This chapter discusses the literature on the multiples valuation method. The existing literature consists of the standard textbooks and academic studies. In paragraph 2.2, I review the coverage of the Multiples Valuation Method in standard textbooks and highlight theoretical background that is useful for understanding the Multiples Valuation Method. Paragraph 2.3 aims to present the rather fractured picture of the empirical findings

[19] Standard textbooks such as Benninga & Sarig (1997), Palepu et al. (2000), Damodaran (2001, 2002 & 2006), Penman (2004), Lundholm & Sloan (2004), Arzac (2005), Koller et al. (2005), Spremann (2002, 2004 & 2005), Ballwieser (2004) and Richter (2005).

on the Multiple Valuation Method. I will review the academic studies and present their contribution to the literature on the Multiple Valuation Method.

2.2 Standard textbook literature

The first section of this paragraph discusses and highlights the coverage of the Multiple Valuation Method in the major standard textbooks. The textbooks do not provide the readers a clear and extensive manual on how to appropriately use multiples. However, they do provide theoretical background and mathematical explanations of multiples. Certain theoretical background, which I find useful and essential for understanding the Multiple Valuation Method, are presented in the second section of this paragraph.

2.2.1 Standard textbook literature review

From all the standard textbook authors, Damodaran (2001, 2002 & 2006) is one of the few authors that devotes considerable space to discussing and explaining the characteristics and determinants of different multiples, which he expands with descriptive statistics over time for various industries and countries. In addition, Damodaran (2006) provides the reader with basic steps of how to use multiples in a proper way. Another textbook that also helps to understand the determinants of various equity value multiples, such as the price to earnings (P/E), price to earnings growth (PEG) and the price to book value of common equity (P/B) multiple is Lundholm & Sloan (2004). His explanations include mathematical relations between those multiples and the RIV model.

Spremann (2002) discusses a crucial difference between transaction and trading multiples. As the name already shows, transaction multiples are used to determine the value of corporate transactions, and trading multiples are used for trading purposes. This topic is important in practice, because the magnitude of a transaction depends on this difference. Transaction multiples are higher than trading multiples, since corporate transactions change ownerships, control, and management structure. During favorable market conditions, the premium that is required in corporate transactions can be as large as fifty percent.[20]

Richter (2005) shows how to relate equity value multiples to the DCF model with his theoretical approach. His theoretical approach is built on the idea that multiples use specific information of a company's value drivers, such as the growth, earning power and risk, which are also implied in the DCF valuation equation. Richter demonstrates under which conditions this information can be aggregated into one single factor. To estimate the equity value of a

[20] In the summer of 2006, Falconbridge fell prey to foreign mining giants. In the end, in August 2006, Xstrata Plc, a Swiss-based mining company, acquired it, which had formerly been a major shareholder. The acquisition process did not go without a high intensive bidding game. The result: a stunning 90% premium (Hayward & Hambrick, 1997).

target company, that aggregated factor must be multiplied with the current free cash flow. Following this theoretical approach, Richter is convinced that multiples are just an arithmetic alternative of the DCF method.

Arzac (2005) and Koller, Goedhart & Wessels (2005) focus on a more practical aspect of the MVM, the identification of comparable companies. In the ideal scenario, comparable companies have cash flows, growth potential, and risk profiles similar to the company being valued. However, in practice we find that even in finely defined industries, 'true' comparable companies are not always available. For this reason, Koller, Goedhart & Wessels (2005) suggest that we should first form a list of companies based on the finest available industry classification definition, and then exclude companies with different growth or profit potential relative to the target companies to reduce the list. The result then is a group of at most five comparable companies, which is, according to the authors, acceptable. Arzac (2005) however, suggests an alternative method to obtain correct multiples for all companies of the same size and industry. Arzac (2005) presents how to adjust observed P/E multiples for inconsistencies in growth and leverage, by using valuation theory.

Finally, with multiples analysis it is important to be consistent in the use of the data definitions. The value of a multiple depends on the type and the definition of the data.[21] Benninga & Sarig (1997) and Penman (2004) discuss this often-ignored issue. Penman (2004) suggests readers to work with raw data and determine the values of the multiples themselves. Using the already calculated multiples provided by data providers can make an analysis worthless, because the applied underlying data definitions are often unknown.

The fractured picture of the MVM presented by the academic literature and the absence of a clear manual on the appliance of MVM in the standard textbook literature was observed by Schreiner (2007), and therefore, he puts together the existing literature to develop a comprehensive multiples valuation framework. His book, which focuses on the MVM only, gives answers on many open issues, which must be clarified in order to come up with sound and convincing multiples valuations in practice. Schreiner (2007) investigates the theoretical foundations of equity valuation using multiples and develops a set of criteria for the selection of value relevant measures and identification of comparable companies. In addition, his book contributes to the research on multiples with an extensive empirical study of European and U.S. stock markets. The results of this study provide evidence on the relevance of the multiples valuation framework. The work of Schreiner (20007) made an

[21] For example, we may use historical, trailing, or forward-looking data. These type of data have various data definitions provided by various data providers.

influential contribution to the theory and practice of corporate valuation using multiples (Spremann, 2007).

2.2.2 Theoretical background

This section intends to highlight the background from the standard textbook literature that is useful and important for understanding the Multiple Valuation Method. First, I discuss four fundamental equity valuation models from the literature of Accounting and Finance, and show that each model has practical problems. The models have in common that they involve forecasting of future payoffs to arrive at a company's value. In contrast, the Multiple Valuation Method is a technique that per se does not require forecasting pro forma financial statements and discounting future payoffs. However, it would be incorrect to think that multiples therefore have no economic meaning (Schreiner, 2007) To prove this, I show how the Multiple Valuation Method is related to fundamental equity valuation methods by introducing the intrinsic multiples. Finally, we focus on the form of the multiples that is widely used in practice and empirical studies, the market multiples.

Fundamental equity valuation models.

The MVM is one of the few valuation methods that does not involve forecasting.[22] However, the value of a company's equity is based on the future payoffs that are expected to deliver, so when doing a thorough job in valuing companies it is unavoidable that one must forecast future payoffs. Payoffs are forecasted by analyzing information. Such practice is called fundamental analysis, it involves analyzing company information in current and historic financial statements, in combination with other company specific, industry, and macroeconomic data to forecast future payoffs, and eventually come to a value that is the intrinsic value of the company (Penman, 2004).

There are various equity valuation methods used practice, and discriminating among them is difficult (Penman, 1998). Most of the models involve forecasting the future but the different lies in what is to be forecasted. It ranges from forecasting of payoffs such as dividends, cash flows, residual income to earnings growth. The approaches of these models are similar to each other when the respective payoffs are forecasted to infinity, although only the calculation of a finite number of years has practical meaning, which introduces some practical problems.

[22] Screening analysis and asset-based valuation are also valuation methods that do not involve forecasting.

In appendix II, I cover four essential fundamental equity valuation models from the literature Accounting and Finance: the Dividend Discount Model (DDM), the Discounted Cash Flow (DCF) model, the residual income model (RIV) and the Abnormal Earnings Growth (AEG) model. All of these models are covered in valuation textbooks such as Penman (2004 & 2006). The latter model is a development of Ohlson (2005) and Ohlson & Juettner-Nauroth (2005). The models are included in this study to provide a general background on equity valuation, and to show why the MVM has become such a popular valuation tool among practitioners.[23]

Intrinsic multiples.

The preceding section discussed the fundamental equity valuation models, in which the company's value is approximated directly from its expected future payoffs without appeal to the current market value of other companies (Schreiner, 2007). The following shows how the MVM, which is also known as relative valuation, is related to the fundamental equity valuation models. In fact, commonly used multiples can be derived from the DCF, DDM and RIV framework.

This fundamental analysis of multiples can also provide insight into the determinants of a multiple and ease the interpretation of observed pattern in multiples.[24] In this section, to show the derivation of using each of the four fundamental model, I present the intrinsic P/E, EV/EBIT, and the P/B multiple.[25] The explicit expressed multiples are named as 'intrinsic multiples' because they are derived from fundamental equity valuation models that aim to approximate intrinsic values of companies.

The intrinsic multiples derived from the fundamental valuation models are presented in table 2.1. The actual derivation process of the intrinsic multiples are placed the Appendix III. The intrinsic multiples are based on restrictive assumptions and should therefore be used with care. They are most useful in indentifying which factors affect the multiple for which you already have a value (Suozzo et Al., 2001).

[23] The coverage of the four fundamental equity valuation models are placed in appendix II. The fundamental equity models are included in this study to improve the understanding of the MVM, but are not directly related to valuation using multiples.
[24] Observed patterns, such as, why growth companies and industries have higher earnings multiples than stable companies and industries (Schreiner, 2007).
[25] The derivations are from the study of Schreiner (2007), which in turn are based on textbooks such as, Beaver & Morse (1978), Penman (1996), and Koller, Goedhart & Wessels (2005)

Table 2.1: Fundamental valuation models and the derived intrinsic multiples

	DDM	DCF	RIV
Valuation equation	$v_t^{equity} = \sum_{i=1}^{\infty} \frac{E_t(D_{t+i})}{(1+r_{t+i}^{equity})^i}$	$v_t^{equity} = \sum_{i=1}^{\infty} \frac{E_t(FCF_{t+i})}{(1+r^{wacc})^i}$	$v_t^{equity} = B_t + \sum_{i=1}^{\infty} \frac{E_t(RI_{t+i})}{(1+r^{equity})^i}$
Simplified equation	$v_t^{equity} = \frac{D_{t+1}}{r^{equity} - g^D}$	$v_t^{equity} = \frac{FCF_{t+1}}{r^{wacc} - g^{FCF}}$	$v_t^{equity} = B_t + \frac{RI_{t+1}}{(r^{equity} - g^D) * (1 + r^{equity})}$
Multiple	P/E multiple	EV/EBIT multiple	P/B multiple
Intrinsic multiple	$\frac{v_t^{equity}}{NI_t} = \frac{PR * (1+g^{NI})}{r^{equity} - g^{NI}}$ (2.14)	$\frac{v_t^{equity}}{EBIT_t} = \frac{(1+g^{FCF}) * (1-t) * \left(1 - \frac{g^{FCF}}{ROIC_t}\right)}{r^{WACC} - g^{FCF}}$ (2.1)	$\frac{v_t^{equity}}{B_t} = 1 + \frac{(ROCE_{t+1} - r^{equity})}{(r^{equity} - g^B) * (1 + r^{equity})}$ (2.16)

The starting point to relate the P/E ratio to fundamental factors is the GGM formula that converts a constantly growing infinite stream of dividends to the price of common equity, when the term structure of both interest rates and risk premiums is flat (Bonadurer, 2003).[26] The intrinsic P/E multiple is derived using the DMM model. Under strong simplifying assumptions; a constant payout ratio (PR), a constant growth rate of net income g^{NI}, a constant cost of equity, and a constant risk free rate, the result of the derivation, equation (2.14), uncovers the fundamental factors of the P/E multiple. It shows that the growth of future net income has a positive effect on the P/E multiple, whereas risk, which is represented by the cost of equity, has a negative effect. Equation (2.14) also shows that a higher payout ratio has positive effect on the intrinsic P/E multiple, but according to Thomas & Zhang (2004), this effect is not large. This analysis implicitly introduces the problem of properly interpreting the P/E ratio, because besides the relative pricing of stocks, the ratio also reflects the uncovered fundamental factors such as differences in risk, growth and

[26] In many situations it is not reasonable to assume that historic growth rates are indications of future growth. In such situations, it is more appropriate to use non-dividend related information for the estimation of future growth rates. A common applied method is $g = retention\ ratio * ROE = (1 - dividend\ pay\ out\ ratio) * ROE$. Growth is assumed to be financed exclusively by internally generated funds. The rationale behind this method is that the growth of earnings is driven by the retained earnings and the ROE on these additional investments.

financial policies. Therefore, a low P/E ratio does not necessarily indicate a low stock price, since it may as well indicate low-growth potential or high risk (Benninga & Sarig, 1997).

Among the investment bankers, the EV/EBIT multiple has gained popularity these years. Using two similar assumptions from the DCF model, it is possible to derive the intrinsic EV/EBIT multiple from the DCF model, although it is somewhat more complex than the derivation of the intrinsic P/E multiple (Schreiner, 2007). Assuming a constant growth rate of NOPAT and a constant proportion of NOPAT that a company re-invests each year, the growth rate of FCF is implicitly constant (Koller, Goedhart & Wessels, 2005). The result of the derivation, equation (2.15), the intrinsic EV/EBIT multiple, reveals the fundamental determinants. It shows that the EV/EBIT multiple is positively related to the growth rate of FCF and profitability measure ROIC, whereas it is negatively related to taxes and risk. From equations (2.14) and (2.15), we can conclude that, ceteris paribus, companies with higher growth potential and lower risk should have a higher P/E and EV/EBIT multiple than companies that don't have these characteristics.

The P/B multiples is a frequently utilized multiple when valuing banks and financial companies. By assuming a constant growth rate of the residual income g^{RI}, which also implies a constant growth in dividends g^{D}, and book value of equity g^{B}, the intrinsic form of the P/B multiple can be derived using the RIV model. The intrinsic P/B multiple, equation (2.16), shows that it has a positive relation with the expected profitability and growth rate of the book value of equity, and again, negatively related to risk. Regarding equation (2.16), Penman (1996) refers to specific situations as the 'normal' P/B multiple, that is if a company expects to earn no residual income ($ROCE_{t+1} - r^{equity} = 0$), its intrinsic P/B multiples is equal to one. Any premium above this 'normal' P/B multiple is due to expected non-zero income and growth in book value of equity. The P/B multiple therefore provides useful general information about the market's view on the key value drivers of the company (Schreiner, 2007).[27]

The analysis above is subject to strict assumptions, which are rarely fulfilled in reality, and for this reason not suitable for practical valuation purposes (Herrmann & Richter, 2003). However, they are helpful when we try to understand the variables that may cause multiples to vary across companies in the same sector. Just as important is to understand how multiples are affected by fundamental changes. Bonadurer (2003) illustrate an example in which thinking that higher growth companies have higher P/E ratios is not a sufficient insight,

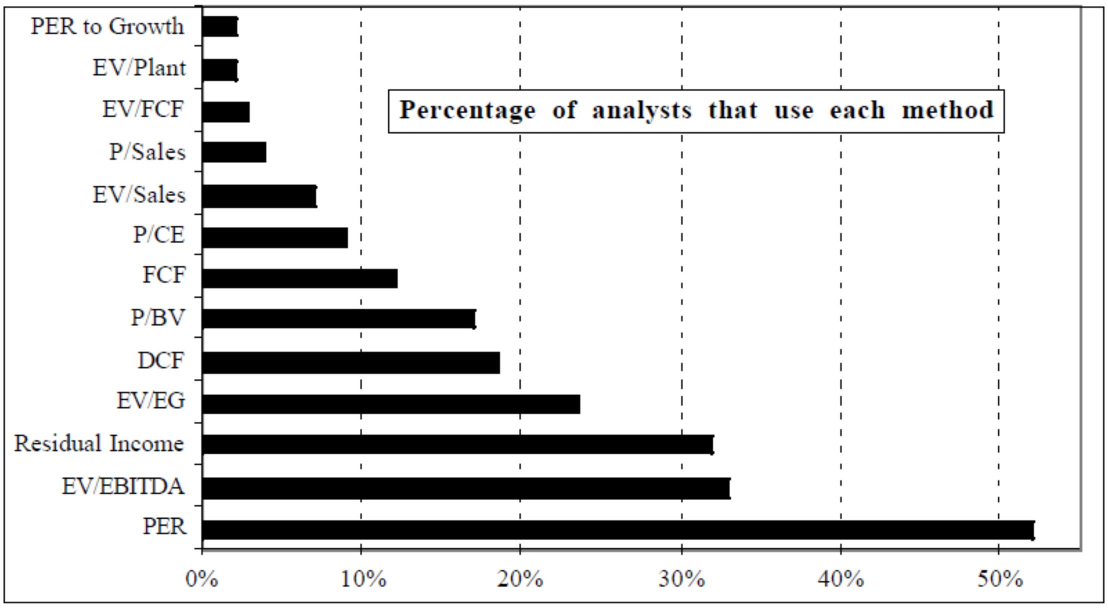
[27] With the key value drivers of a company, I mean growth, profitability, and risk.

if the objective is to analyze a company with a growth rate that is twice as high as the average growth for the sector. The question is, should such a company have a P/E multiple that is 1.5, 2, or 2.5 times the average P/E multiple for the sector? To make an appropriate judgment, it is essential to have insight into the 'delta' of this multiple, so we need to know how the multiple changes as the growth rate changes (Bonadurer, 2003). The intrinsic P/E and P/B multiple have both shown to be dependent on risk. However, the P/E multiple is mainly positively related to expected future earnings, whereas major drivers of the P/B multiple are future ROCE and growth in book value of equity (Penman, 1996). Regarding the observation that the P/B multiple is important in the financial sector and its underlying fundamental determinants, we might now understand why executives of a great number of banks seems to worry more about being profitable and becoming 'big' than concentrating only on earnings and its growth as it is common in other industries (Schreiner, 2007).

Market multiples.

Intrinsic multiples are useful to form more than a general understanding of a multiple's underlying fundamental factors. However, when practitioners apply multiples in their valuation process, it is typically not the intrinsic multiples. The focus then lies on market multiples. With market multiples, it is the market value, not the intrinsic value, that determines the value of a specific multiple. As empirical studies are based on market multiples, this paragraph provides general information, such as the definition, types, and (dis)advantages, of market multiples. Market multiples belong to the most popular valuation methods used in practice by investment bankers and analysts. In the research of Morgan Stanley Dean Witter (1999), the graph in figure 2.1 shows that the application of market multiples is even more common than the DCF model, with the enterprise value to EBITDA multiples and equity value to earnings per share multiples being the most popular multiples.

Figure 2.1: most widely used valuation methods



Source: Morgan Stanley Dean Witters (1999).

Definition and overview of the types of multiples.

There are generally two broad approaches to estimating a company's value in the theory. The first is 'direct' valuation', in which company value is estimated directly from its expected cash flows without appeal to the current price of other companies (Bhojraj & Lee, 2001). Most direct valuation methods are covered in paragraph 2.2.2, fundamental equity valuation models. In short, these models are based on projected dividends, earnings, or cash flows, and require a present value calculation of the projected forecasts, as we have seen with the DDM, RIV and DCF model.[28] The second approach is 'relative valuation'. As the name suggests, in this approach company value estimates are determined by examining the market value of comparable assets. Relative valuation uses market multiples in its approach to obtain company value estimates. Using market value in the numerator separates multiples from financial ratios, which aim to inform about a company's financial health and operating performance.[29] Penman (2004) defines the market multiple as the ratio of a market value variable to a certain value driver of a company. Hence, multiples are summary measures, which provide information on the market's opinion of a company's market valuation compared to its competitors (Schreiner, 2007).

[28] There is another type of valuation, named liquidation valuation. As the name predicts, a company is valued at the 'breakup value' of its assets. This type of valuation is commonly used in valuing real estate and distressed companies. However, this method is not appropriate for most going concern companies, and therefore excluded from this study.
[29] Financial ratios can provide insight regarding the liquidity, leverage, growth, or profitability of a company.

The equity value multiple $\lambda_{i,t}^{equity}$, of company i at time is t, is calculated as follow:

$$\lambda_{i,t}^{equity} = \frac{p_{i,t}^{equity}}{x_{i,t}} \quad (2.17)$$

where $p_{i,t}^{equity}$ stands for the stock price or market value of common equity and $x_{i,t}$ for the underlying value driver the multiple.

Almost the same way, the enterprise value multiple of the same company *i* at time is *t*, can be defined as

$$\lambda_{i,t}^{ent\,erprise} = \frac{p_{i,t}^{enterprise}}{x_{i,t}} = \frac{p_{i,t}^{equity} + \hat{p}_{i,t}^{net\ debt}}{x_{i,t}} \quad (2.18)$$

where $p_{i,t}^{enterprise}$ stands for the enterprise value, which is equal to the sum of the market value of common equity and a proxy of the market value of net debt $\hat{p}_{i,t}^{net\ debt}$, and $x_{i,t}$ stands for the underlying value driver of the multiple.[30]

Considering the definition of multiples, the two value relevant bases, and the large number of possible value drivers for a given company, theoretically, we can establish a long list of different multiples for a company. Although not every possible multiple is calculated by practitioners, the list is still long and diverse (Löhnert & Böckman, 2005). To provide a categorical overview, Schreiner (2007) presents an overview of the most commonly applied multiples. The overview is based on categorization frameworks presented by Richter (2005) and Krolle, Schmitt & Schwetler (2005). Both studies categorize multiples based on value relevant base and the value driver used to calculate the multiple. A two dimensional categorization overview is presented in table 2.2 (Schreiner, 2007). The following sections will discuss the general contents of table 2.2.

[30] Since the market value of net debt is usually not publicly available, following Koller, Goedhart & Wessels (2005), $\hat{p}_{i,t}^{net\ debt}$ is estimated with the book value of net debt, plus the book value of preferred stock, minus cash and equivalents, which is deemed reasonable.

Table 2.2: Overview and categorization of multiples

	Accrual flow multiples	Book value multiples	Cash flow multiples	Alternative multiples	Forward looking multiples
Equity value multiples	P/SA P/GI P/EBITDA P/EBIT P/EBT P/E P/EPS	P/TA P/IC P/B	P/OCF P/D	PEG	P/SA 1 P/SA 2 P/EBITDA 1 P/EBITDA 2 P/EBIT 1 P/EBIT 2 P/EBT 1 P/EBT 2 P/E 1 P/E 2 P/EPS 1 P/EPS 2 EV/SA 1 EV/SA 2 EV/EBITDA 1 EV/EBITDA 2 EV/EBIT 1 EV/EBIT 2
Enterprise value multiples	EV/SA EV/GI EV/EBITDA EV/EBIT	EV/TA EV/IC	EV/OCF		EV/SA 1 EV/SA 2 EV/EBITDA 1 EV/EBITDA 2 EV/EBIT 1 EV/EBIT 2

Source: Schreiner (2007), which in turn, is based on Richter (2005) and Krolle, Schmitt & Schwetzler (2005). Notes: P is the value of common equity, which is the market capitalization. In the case with the P/EPS multiple, P is the stock price. EV is the enterprise value. A list of the used abbreviations for the value drivers is provided in appendix I.

Equity value and enterprise value multiples.

As the name suggests, an equity value multiple is the expression of the market value of equity holders' stake in an enterprise, relative to a key statistic to that value (Suozzo et al., 2001). Since shareholders are subordinate to all other claimants of cash flow and assets of a company, any statistic used in an equity multiple must be presenting residual claims such as residual profit, cash flow, assets, or another residual measure. However, all senior claims must be deducted first (Suozzo et al., 2001).

From the huge diversity of multiples than can be computed, P/E and P/B multiples are among the most popular in practice and academic discussions. These equity value multiples were first introduced in the early 1930s with the investment style by Benjamin Graham, and they are still the most commonly used multiple (Spremann, 2005). Among the most commonly used valuation methods of analysts from Morgan Stanley to valuate European companies, Fernandez (2001) find that the P/E multiple ranks first, being used by more than 50% of the analysts, and the P/B multiple ranks sixth with 15%. The popularity of the P/E and P/B multiple has also been mentioned by Spremann (2006) and Schreiner (2007).

Although widely used in practice, the P/E multiple have two major flaws.[31] First, they are systematically affected by capital structure (Goedhart, Koller & Wessels, 2005). Different capital structures will affect P/E multiples because of the gearing effect on earnings. For companies whose unlevered P/E is larger than one over the cost of debt, their P/E multiple will rise with leverage (Goedhart, Koller & Wessels, 2005). This issue may also introduce arbitrary behavior of managers, who may lever up the P/E multiple by modifying the capital structure of the company by putting more debt (Frykman & Tolleryd, 2003). Second, the P/E multiple is based on earnings, which in the financial statements include many non-operating items, such as write-offs and restructuring charges. Since these items are often one-time events, multiples can therefore be misleading. In addition, it is sensitive to different accounting policies, as the policies affect net income (Schreiner, 2007). Furthermore, P/E multiples have no meaning in cases where the earnings are negative (Goedhart, Koller & Wessels, 2005). From a theoretical perspective, the application of P/E multiples is most appropriate in industries, in which the companies report solid earnings, have similar accounting policies, and have uniform capital structures (Schreiner, 2007). Despite of its flaws, the P/E multiple stays popular even now, and the expectation is that it will continue to be like this, just because it is used by everyone (Schreiner, 2007).

The equity value to book value of equity multiple, P/B multiple, is most appropriate in capital-intensive industries, where (financial) tangible assets are the source of value generation (Suozzo et al., 2001). The application of this measure on industrial companies however requires some care, because the reported net assets are based on historical cost book values, which are typically an unreliable indicator of economic value (Suozzo et al., 2001). Furthermore, book values are not directly comparable where accounting policies would be influential.[32] Ideally, book values should be adjusted to eliminate accounting distortions. In addition, a company's earnings power or cash flow is not reflect by means of P/B multiples (Schreiner, 2007). The P/B multiple is most widely applied when valuing financials, especially banks. These multiples are relatively constant and that eases the comparability over time (Schreiner, 2007).

[31] Earnings are defined as the net income.

[32] For example, book value is affected and therefore not comparable if a company revalues its assets (which is permitted by international accounting standards) and the other company does not (revaluation is not permitted under U.S. GAAP standards).

The enterprise value (EV) of a company is the cost of purchasing the right to the complete enterprise's core cash flow (Suozzo et al., 2001). The EV equals market capitalization plus the market value of seasonally adjusted net debt, pension provisions, and the value of minorities and other provisions deemed debt. EV based multiples measure the company as a whole, resulting in more comprehensive valuation than equity value multiples, which concentrate on the value of the equity holders' claims only. EV multiples are less sensitive to capital structures, as they measure the unlevered value of a company. Also, they are less affected by differences in accounting standards, because they allow value drivers such as EBITDA. EV multiples also allow exclusion of certain items such as non-core assets, which may distort comparability (Suozzo et al., 2001). Taken altogether, relative to equity multiples, enterprise value multiples are more comparable among companies.

However, the largest advantage of enterprise value multiples is also a serious practical limitation. The enterprise level definition induces a problem in the construction of enterprise multiples. It is the simple fact that the enterprise values of companies are not observable, whereas for equity multiples, the market capitalization or stock prices are directly observable (Koller, Goedhart & Wessels, 2005). To obtain the enterprise value for the enterprise multiples, we have to approximate the enterprise value using the market capitalization plus the book value of net debt.[33] According to Koller, Goedhart & Wessels (2005) this approximation is not a flawless approximation, especially in a market situation with fluctuating interest rates and default risk.

The enterprise value to sales multiple (EV/SALES) is an useful measure when valuing companies in cyclical industries, where net income and EBIT are often negative during a negative cycle phase (Geddes, 2003). Also, it is frequently applied to young or technology companies, which are likely to have negative cash flows and/or earnings during their initial growth phase, because in this phase they typically invest more than they earn (Suozzo et al., 2001). In addition, EV/SALES multiples are useful when accounting differences among comparable companies are extremely large, because they are least susceptible to accounting idiosyncrasies of individual companies, in comparison to other values in financial statements (Schreiner, 2007). As suggested by Liu, Nissim & Penman (2001), sales is an important value driver because the growth of future payoffs depends on the sales growth when profit margin and asset turnover are stable. The main drawback of sales multiples is that the value of sales in the income statement ignores all information on the operating efficiency of a company, contained in the values below the sales value (Benninga & Sarig, 1997).[34] Despite this major flaw, the sales multiples were quite popular during the rise of the

[33] The book value of net debt is usually not publicly available.
[34] The top number in the income statement is the value for sales.

technology and internet stocks in the 1990s, but lost popularity due to the burst of the dot-com bubble in 2001 (Schreiner, 2007). Within an industry, the gross margins and operating efficiency are intuitively supposed to be similar. However, in reality, this is often not the case (Schreiner, 2007).

EBIT and EBITDA are a proxies for operating cash flow, and its multiple form, the EV/EBIT and EV/EBITDA multiples are probably the most popular EV multiples (Suozzo et al., 2001). In the recent past, these two multiples became the favorite measurements tools for investment bankers when preparing pitch books for industry deals (Evans & Bishop, 2001). Its popularity stems from the fact that it is not affected by differences in amortization, depreciation, and tax policy. They also appear to be less affected by differences in capital structure, relative to equity multiples. (Suozzo et al., 2001). EBITDA multiples are most useful for comparing companies with a selected peer group that has a similar level of capital intensity, whereas using EBIT is advantageous when the capital intensity varies (Löhnert & Böckmann, 2002). The drawback however is that both multiples leave out information further down in the income statement such as income from minority holdings or cash earnings (Damodaran, 2006). Furthermore, they ignore the value added due to a skilled tax management (Schreiner, 2007).

Trailing and forward-looking multiples.

In the standard multiple approach, the numerator and denominator of the multiple always refers to the latest available numbers. The numerator is the latest available market price number, market capitalization or (calculated) enterprise value. The denominator refers to the latest number of the value driver, usually found in the financial statement for the latest fiscal quarter or year. These multiples are called trailing multiples because the numbers of the numerator and denominator are based on historic data. Most of the multiples discussed so far, belong to this category. However, it has long been recognized in the literature that historical data does not have the potential to fully capture the value relevant data of prices. Analysts' forecasts of forward information meet this shortcoming. Liu, Nissim & Thomas (2000) found that revisions in analysts' earnings forecasts and changes in interest rates explain a major part of the stock returns. If the value driver in the denominator in the multiple refers to a forecast, typically a one-year or two-year out forecast, the multiple is called a forward-looking or leading multiple.

In the valuation theory, it is known that a company's value is equal to its discounted stream of expected future payoffs. Following this knowledge, it is clear that forward-looking multiples are more appropriate for valuation applications (Schreiner, 2007). However, there are some practical problems with gathering the value driver forecast estimates for all companies within the peer group or industry (Schreiner, 2007). Analysts do not have this problem because they can use their own forecasts covering a whole industry. However, all the others rely on the consensus forecasts provided by commercially available data services such as I/B/E/S or Worldscope. These data services usually provide analysts' forecasts for a limited coverage of companies and limited value drivers such as earnings, sales, EBIT(DA) and net income.

Alternative multiples.

The price to earnings to earnings growth multiple (PEG) is equal to a P/E multiple divided by an earnings growth rate. This ratio has become well known in recent years (Schreiner, 2007). The choice of the form of the P/E multiple and earnings growth rate may differ, depending on the analysts preference (Easton, 2004).[35] The underlying assumption of the PEG multiple is that a P/E ratio is positively correlated to the expected growth rate in earnings (Suozzo et al., 2001). Unfortunately, this assumption is unrealistic because a company with constant earnings, no matter low or high, would then have an undefined value (Schreiner, 2007). Nevertheless, PEG multiples are useful in certain circumstances. They are notably more stable and less sensitive to fluctuations in growth than P/E ratios, which make them most suitable for valuing high growth companies, under the condition that the industry already reached the stage where companies are profitable (Schreiner, 2007). This particularly applies to companies within the same sector, however it is less suitable for comparisons across markets and sectors (Suozzo et al., 2001).

Advantages and disadvantages of market multiples.

Despite the widespread usage of market multiples, as with all the discussed valuation models, valuation using market multiples also has it weaknesses. First, the open issues in the academic literature presented in an overview in paragraph 1.1 are disadvantages of the applicability of the MVM. In addition, there are a number of more conceptual critics levied against multiples. First, according to Suozzo et al. (2001) the MVM approach is too simplistic. Multiples are in fact a distillation of large amount of information into single numbers. By combining many value drivers into a point estimate, the MVM approach makes it difficult to disaggregate the effect of different levels of profitability, growth or risk among companies on

[35] i.e., price to trailing earnings or price to forward earnings for the P/E multiples and one-year historical growth rate or average expected annual growth rate for two years in the future.

value (Suozzo et al, 2001). Second, a multiple is a static snapshot of where a company is at a certain point in time and assumes the key value drivers of that company to remain in a steady state from that date onwards, so it fails to capture the dynamic and ever-changing nature of businesses and markets (Suozzo et al., 2001). This makes multiples somewhat shortsighted. Third, multiples are difficult to compare. Multiples are primarily used to make comparisons of relative value. However, comparing among multiples is another thing, because there are so many reasons why two multiples can differ from each other, which does not necessarily relate to true differences in value. Accounting policies, for example, can be the cause of different multiples for otherwise identical operating businesses (Suozzo et al., 2001). Fourth, Damodaran (2006) points out that, although there are always potential biases for any valuation model, the lack of transparency with respect to the chosen inputs of a MVM model leaves a vulnerable spot for manipulation. For example, a biased analyst can provide justification for almost any value of a company by arbitrarily choosing a ‘correct’ multiple and a ‘comparable’ peer group (Damodaran, 2006). Finally, market conditions are reflected by valuations based on multiples. This has a drawback, because it implies that value estimates can be too high in ‘hot’ markets or too low when the market is down. Therefore, valuing companies with multiples, instead of forecasting and discounting expected future payoffs, promotes the rise of market bubbles (Eccles et al., 2002).

However, the MVM would not be the most common valuation technique among practitioners, if it’s not backed by great advantages. The main advantage of the MVM is its simplicity of application (Schreiner, 2007). Using multiples takes considerately less time than other valuation techniques such as the DCF or RIV model, because the methodology requires only four steps and fewer assumptions. Its simplicity also makes the valuation easier to understand and to present to clients and customers (DeAngelo, 1990). This is an important feature for sell-side analysts and sales staff who have sell their analysis and investment recommendations to potential investing clients with tight time schedules (Schreiner, 2007). The third strength of multiples is their accessibility for investors through sources such as the financial newspapers, online platforms, and magazines (Schreiner, 2007). The multiples of a huge number of companies are published daily in these sources and regularly updated. Also, the process of fundamental screening on multiples is made much easier (Schreiner, 2007). Quick and dirty comparisons between companies, sectors and markets are made possible. Fundamental screening is also used to detect undervalued stocks, which is based on the idea of supposedly inefficient markets. Similar companies in the same peer group trading on different multiples are considered mispriced (Penman, 2006). Furthermore, no matter the market situation, application of multiples often yield valuations that are much closer to stock prices than other fundamental valuation models, since the mood of the market is reflected by multiples (Damodaran, 2001). This feature allows investors getting a feeling for the market value of privately held enterprises and helps investment bankers to determine the right prices or price ranges for M&A deals (Schreiner, 2007).

2.3 Academic literature

As with the coverage in the standard textbooks, the studies on the Multiple Valuation Method are relatively small in numbers. Since most academic studies focus on a specific aspect of the Multiple Valuation Method, this paragraph presents the fragmented picture of the research on the Multiple Valuation Method in general. Also, the majority of the studies investigate a limited set of companies or time period, mostly using equity value multiples. Furthermore, the differences in their used methodologies result in diverse empirical results and make comparisons across studies difficult.

In this paragraph, I review influential academic studies conducted so far. In addition, I present an overview of the issues that are still considered to be open in the academic literature.

2.3.1 Academic literature review

The following subsections will discuss various aspects of the MVM that are relevant to this study. It provides background to the research questions of this study and supports the methodology of this study. The overview is divided in six subsections, each discussing a different aspect of the studies on the Multiple Valuation Method.

Relative accuracy of the MVM.

The accuracy of the MVM relative to other valuation techniques has been investigated and evaluated by several studies. Most studies present the accuracy of the MVM in numbers. However, there are a few studies that are more interesting because they measure the accuracy of the MVM approach relative to fundamental equity valuation approaches.

Kaplan & Ruback (1995 & 1996) examine the valuation properties of the DCF model for highly leveraged transactions and management buy-outs. While they find that the DCF valuations estimate transaction values quite well, they also find that simple EV/EBITDA multiples achieve the same valuation accuracy. About 40 percent of the MVM approximated transaction values has a 15 percent pricing error or less. Berkman, Bradbury & Ferguson (2000) replicate the study of Kaplan & Ruback (1995 & 1996) using a sample of 45 IPOs in New Zealand for the time period 1989 to 1995. They report similar results.

In Gilson, Hotchkiss & Ruback (2000), the market value of a sample of 63 bankrupt companies, taken from 1984 to 1993, is examined using the DCF method and the MVM. The results are quite similar to the studies above; both the DCF and MVM approach have approximately the same level of accuracy. However, the variance of the pricing errors is very high, it varies from less than 20 percent to 250 percent.

More generally, Liu, Nissim & Thomas (2002) examined the valuation performance of an extensive list of value drivers for the U.S. equity market and find that equity value multiples based on forward earnings explain stock prices remarkably well. Using the 2-year forward earnings per share forecasts (EPS), the generated pricing errors are within 20 percent of observed prices for approximately half of their sample. Again, this result is comparable to the pricing errors reported in Kaplan & Ruback (1995 & 1996). Additionally, Liu, Nissim & Thomas investigate complex measures of intrinsic value based on the short-cut residual income model (RIV). Contrary to what they expected, the RIV model caused the valuation performance to decline.

Selection of value relevant measures.

Corporate valuation is in fact a process of translating information into value (Flostrand, 2006). Succeeding to understand what information is relevant and useful in this process significantly determines the valuation accuracy. So is the case with selecting multiples based on relevant value drivers. There are quite a number of studies on this topic, with some studies providing very useful insight on this topic. These are Kim & Ritter (1999), Baker & Ruback (1999), Liu, Nissim & Thomas (1999, 2002 & 2007).

Despite the prevalent use of equity value multiples in practice, many practitioners raise the question whether to use the market capitalization or the enterprise value of a company in the numerator of a multiple (Schreiner, 2007). The latter appeals in theory, because it is less affected by capital structure. Academic literature on the optimal value relevant base is rare. Liu, Nissim & Thomas (2002) and Schreiner (2007) find that enterprise value multiples exhibit poor performance. However, Baker & Ruback (1996) find that EV/EBITDA multiples perform quite well, even on par with DCF valuation. There is no real consensus on the optimal relevant base.

Kim & Ritter (1999) investigate how initial public offering (IPO) prices are set using multiples. The study recommends the use of accounting information in conjunction with comparable company multiples for valuing IPOs. They find that equity value multiples based on earnings (P/E), book value of equity value (P/B), and sales exhibit modest performance, due to the wide variation of these ratios, especially for the young companies in their dataset. Multiples based on forward-looking information outperform all other multiples in terms of valuation accuracy. Among the forward-looking earnings multiples, the 2-year forward EPS forecasts outperforms the one-year forecast and trailing EPS.

Using a dataset based on the S&P 500, Baker & Ruback (1999) show that EBITDA is a more value relevant value driver than EBIT or revenue in the industries they examine.

Liu, Nissim & Thomas (2002) examine the ability of equity value multiples to estimate observed stock prices using an international dataset. Across 10 countries, they show that multiples based on earnings outperform all other, dividend and cash flow multiples show intermediate performance, and those based on sales are the weakest. Furthermore, consistent with Kim & Ritter (1999), using forward-looking information improves the valuation accuracy over trailing multiples, with the largest improvement credited to earnings. They concluded that multiples based on forward-looking earnings are reasonably accurate, since the valuation of more than half of the dataset lies within 30% of the observed value. In a more recent study, Liu, Nissim & Thomas (2007) extend their previous study. They use a global dataset to extend equity value multiple valuation analysis to other markets, and employ forecasts of cash flows, dividends and earnings. They again find that moving from trailing to forward-looking data improves the performance for all multiples, with the greatest improvement to be found with earnings multiples. In all five countries, earnings forecasts prove to be a substantially better measure of value then operating cash flows forecasts and dividend forecasts.

Using a dataset consisting of companies covered by the Compustat North America database, Lie & Lie (2002) examine the valuation accuracy of a set of multiples that is commonly used in practice. Consistent with the previous studies, they find that equity value multiples based on forward-looking earnings exhibit superior performance. Liu, Nissim & Thomas (2002) show that the performance of equity value multiples based on book value measures are relatively poor. Lie & Lie (2002) on the other hand, show that when using trailing data, equity value multiples based on book values in their sample are more accurate than multiples based on EBITDA, EBIT, sales and earnings.

Schreiner (2007) examines the scaled absolute valuation accuracy of equity value multiples, using a dataset of 600 European companies. The empirical results show that P/EBT multiples outperform P/E multiples, which he explains by the fact that corporate tax rates vary within Europe. When comparing book values and earnings, the two most popular accounting value drivers, the study finds that multiples based on earnings clearly dominates those based on book values. Book values, as well as cash flow measures, disappoint in terms of valuation accuracy. Furthermore, throughout the cross-section, forward-looking multiples exhibit a better ability to explain market values than trailing multiples.

In sum, the results of the academic studies on the selection of appropriate value drivers are quite diverse, which is likely the result of different research settings. However, the academic findings seem to favor, in particular, equity value multiples based on earnings and forward-looking information.

Identification of comparable companies.

Most empirical research on the MVM focuses on the optimal value driver. Altogether, these studies establish that multiples based on earnings and forecast data are optimal. On the other hand, there is relatively little research on the issue of identifying the optimal set of comparable companies to form the peer groups. The identification of comparable companies has a significant effect on the accuracy of the MVM (Schreiner, 2007).

Alford (1992) examines P/E multiples when the comparable companies are identified on criteria such as industry membership, risk (measured by company size), and earnings growth, all individually and in pairs. A theoretical model of stock prices and practical guidelines motivates the choice for these criteria. The study finds that the widespread use of selecting comparable companies by industry membership is relatively effective. When using industry membership, he finds that valuation accuracy increases when the fineness of the industry definition used to identify comparable companies is narrowed from broad 1-digit Standard Industrial Classification (SIC) codes to 2-digit and 3-digit SIC codes. However, there are no further improvements in accuracy when narrowed to 4-digit SIC codes. In addition, Alford (1992) finds that adding controls for leverage, size and earnings growth does significantly increases valuation accuracy.

Cheng & McNamara (2000) evaluates the valuation accuracy of P/E and P/B multiples. Like Alford (1992), their P/E multiples analysis shows that the identification of comparable companies by industry membership outperforms all other methods. In contrast to Alford (1992), the combination of industry membership and return on equity performs significantly better than only industry membership. Alford (1992) reports that same performance, although it is not significant.

Bhojrai & Lee (2002) extends the Alford’s (1992) idea of identifying comparable companies based on similar underlying economic variables, rather than industry membership alone. Their methodology includes a multiple regression model to predict a ‘warranted’ multiple for each company, which relies on valuation theory. Then, using the companies with the closest warranted multiple, which are identified by the regression model, they form the target company’s peer group. Bhojraj & Lee (2002) manage to show that selecting comparable companies using their methodology results in more accurate valuation than the use of two digits SIC codes. Bhojraj & Lee (2003) further confirm the performance of their methodology in an international context.

Herrmann & Richter (2003) test an approach for estimating the potential price of future equity investments. Using an approach based on a binomial process and risk neutral valuation, they relate the identification of the comparable companies to fundamentals. Their results suggest that identifying comparable companies based on fundamentals, such as proxies for growth and profitability, is superior, in terms of valuation accuracy, to identification based on SIC industry codes. The studies, Bhojraj & Lee (2002 & 2003), and Herrmann & Richter (2003), present evidence that suggests we should consider fundamental factors related to growth, risk and profitability, instead of relying on SIC codes.

Furthermore, two more recent studies, Bhojraj, Lee & Oler (2003) and Eberhart (2004) find that the SIC codes classification, which most studies use for identifying comparable companies by industry membership, is not an optimal industry classification system choice. The first study, by Bhojraj, Lee & Oler (2003), compares four broadly available industry classification schemes in a variety of applications common to empirical capital market research.[36] The result show that GICS classifications are significantly better at explaining stock return movements, forecasted and realized growth rates, research and development expenditures, various key financial ratios, and what is most important to this study: cross-sectional variations in valuation multiples. For example, they achieve, on average, a ten to thirty percent increase in the R-squared statistic for the P/B, the EV/SALES and P/E multiple, when using GICS codes rather than SIC, NAICS, or FFIG codes. This performance improvement is consistent from year to year and is most notable among large companies. The performance of the other three classification systems does not differ much among each other.

The study of Eberhart (2004) adds five more industry classification systems to the investigation of the MVM for a smaller sample of U.S. companies.[37] He finds consistent evidence that the Industry Classification Benchmark (ICB) classification system results in the

[36] i.e., SIC, North American industry Classification System (NIACS), Global Industry Classification Standard (GICS) and Fama & French (1992) industry groupings (FFIG)

[37] Additional systems: Morningstar, Industry Classification Benchmark (ICB), the Value Line Investment Survey, Wilshire and Yahoo

most accurate valuations.[38] The Value Line classification system is nearly as accurate as the ICB system.

So far, most findings on the MVM have been derived from U.S. data only, except for Herrmann & Richter (2003) and Dittmann & Weiner (2005). Dittmann & Weiner (2005) investigate which peer group identification method leads to the most accurate valuation when valuing European companies using the EV/EBIT multiple. They establish that comparable companies should be identified from the same country as the target company's for the U.S., the U.K., Denmark, and Greece. For all remaining European countries, comparable companies should be identified from the EU15, or from the OECD. Moreover, they find that for all countries (and the U.S.) that valuation is most accurate when identifying companies on the basis of similar return on assets (ROA), it outperforms identification based on SIC codes industry membership.

While standard valuation textbooks and academic studies somewhat agree that comparable companies should be identified from the same industry, they often do not indicate how such an industry should be defined. The extensive empirical study of Schreiner (2007) therefore includes an investigation of the performance of multiples depending on the industry fineness. The empirical results of this study suggest that forming a smaller but more homogenous peer group by narrowing the industry definition from-1 digit down to 2-digit or 3-digit industry codes improves the valuation accuracy of the MVM.[39] Out of 54 comparison tests, the 3-digit codes rank 44 times first, 2-digit codes rank 6 times first, and 3-digit codes 4 times first.

A recent study by Cooper & Cordeiro (2008) introduced the topic of choosing the optimal size of the peer group. They empirically examine how the performance of a MVM based valuation varies as the number of comparable companies in the peer group of a target company increases. This research question is interesting because it is motivated by a contrast between the approach followed by practitioners and academic researchers. Practitioners typically use a small number of closely related comparable companies, whereas the academic literature often uses the entire industry (Cooper and Cordeiro, 2008). Based on a peer group identification rule with growth rates, they find that using ten comparable companies is, on average, as accurate as using the entire industry. However, a peer group of five closely related companies shows slightly better performance, because adding more companies, on average, simply means adding more noise. Schreiner (2007) suggests that a

[38] During the time of Eberhart's study (2004), it was named the Dow Jones industry classification system.

[39] Schreiner (2007) use the proprietary ICB system provided by Dow Jones and the FTSE Group, as suggested by studies such as Guenther & Rosman (1994), Kahle & Walkling (1996), Bhojraj, Lee & Oler (2003) and Eberhart (2004).

peer group with four to eight comparable companies is the ideal size. His conclusion is derived from various interviews with practitioners and academics.

Taken together, the most recent studies suggest that we should utilize the IBC and the GICS industry classification systems, which are both widely used in practice by analysts and investment bankers. These systems deliver superior industry classifications for valuation studies and fundamental analysis purposes. Regarding the ideal size of a peer group, studies have indicated that five companies are optimal. Plus or minus two peers is still acceptable.

Industry-preferred multiples.

The existence of industry-preferred multiples is common in practice, however empirical studies offer little support (Schreiner, 2007). Tasker (1998) examines patterns of corporate valuation in practice. From patterns in the estimations of acquisition in practice, fairness and research reports, Tasker (1998) finds a systematic application of industry-preferred multiples.[40] She explains her observation by the variation in the effectiveness of accounting standards throughout the industries, which is consistent with different multiples being more appropriate in different industries (Liu, Nissim & Thomas, 2002). Barker (1999) also finds evidence for the existence of industry-preferred multiples in practice, obtained from surveys such as interviews and questionnaires. Both studies, Tasker (1998) and Barker (1999) show that in practice, analysts and investment bankers prefer using the P/B and P/E multiples when valuing financials, price to operating cash flow multiple (P/OCF) with consumer services companies or P/D multiples in the utilities industry.

However, the evidence on the application of industry-preferred multiples by Tasker (1998) and Barker (1999) does not provide information about their ability to explain market values. To examine this ability, Schreiner (2007) performs MVM using two performance rankings. The first ranking is limited to trailing equity value multiples and the second adds forward-looking equity value multiples. His empirical results show indeed that for different industries, there exist different optimal multiples. However, when forward-looking multiples are included, this perception is refuted as it reveals a clear superior performance of the two-year forward-looking earnings multiples. This result is in line with the results of Kim & Ritter

[40] Note that it is not completely clear what the analysts' and investment bankers' objective is in terms of achieving the most accurate valuation (is it for example in terms of smallest dispersion?), we should be cautious in putting weight on Tasker's finding. (Liu, Nissim & Thomas, 2002).

(1999) and Liu, Nissim & Thomas (2002), which suggests that a considerable portion of value is captured in the information contained in two-year analysts' forecast. The performance ranking of the multiples results of Liu, Nissim & Thomas (2002) shows remarkable consistency across all industries. The performance of the two-year forward-looking earnings multiple ranks first in 77 of 81 industries.

Estimation of the synthetic peer group multiple.

The MVM has a drawback in three of its implementation challenges (Baker & Ruback, 1999). The first is when selecting the value relevant measures for constructing the multiple (such as equity value or enterprise value and revenue, sales, EBITDA or cash flow). The second challenge is identifying the comparable companies, as discussed in the preceding subsection. The last implementation challenge is estimating the synthetic multiple. Generally, practitioners use the simple mean or median to compress the multiples of the comparable companies in the peer group to a single number, which is the synthetic multiple for the target company (Baker & Ruback, 1999). Most empirical studies consider the median as the best measure for eliminating possible outliers and at the same time accounting for the underlying skewness and kurtosis of the distribution.

Baker & Ruback (1999) concentrate on the last challenge, the largely unexplored implementation challenge of reducing the set of multiples of comparable companies to the synthetic multiple for the target company. The study analyzes industry multiples for the S&P 500 in 1999, and examine econometric problems that occur when computing industry multiples in different ways. Using econometric techniques such as Gibbs sampling and small sample minimum variance as benchmarks, they evaluate the performance of the simple mean, the harmonic mean, the value-weighted mean, and the median.[41] Finally, they find that synthetic multiples estimated using the harmonic mean are nearly as accurate as minimum variance estimates based on Monte Carlo simulation.[42] In addition, when using the minimum variance estimator as benchmark, they find that the harmonic mean outperforms all other alternative simple estimators.

The extensive study of Liu, Nissim & Thomas (2002) includes a comparison of three estimators: the simple mean, median and the harmonic mean. The findings are consistent with the findings of Baker & Ruback (1999) and Beatty, Riffe & Thompson (1999), since they

[41] The harmonic mean of n multiples is defined as the inverse of the arithmetic mean of the inverse multiples and is mathematically always smaller than the arithmetic mean itself (Herrmann & Richter, 2003).
[42] Using Monte Carlo simulation baker & Ruback (1999) draw random inverse multiples from a normal distribution.

find that the absolute performance of the simple mean and median loses to the harmonic mean. The improvement for forward earnings multiples is small.

As suggested by Baker & Ruback (1999), Herrmann & Richter (2003) utilize the harmonic mean in their study of the MVM. According to Hermann & Richter (2003), many empirical studies assume that they should use the arithmetic mean. Nevertheless, it appears that due to the skewed multiple distribution, the arithmetic mean is not an optimal choice, for then it tends to overestimate values. To eliminate the distorting effect of outliers in multiple valuation, one should use the median or the harmonic mean as an alternative estimator.[43] The results showed that the median or the retransformed mean of logged multiples is a suitable estimator if the underlying sample shows a significant degree of skewness.[44] The harmonic mean shows similar performance, but requires the sample to be more homogeneous.

Alternative Multiple Valuation approaches.

Under the traditional multiple valuation approach, we select only one value relevant measure (value driver), and then convert it into an equity / enterprise value estimate simply through the multiplication of the corresponding synthetic equity / enterprise value multiple of the peer group (Palepu et al., 2000). Combining several traditional multiple valuations together may be desirable, because each traditional multiple valuation is likely to explain value with common information, but each may also contain incremental information useful to improve the accuracy of the valuation (Yoo, 2006). Although there is a large interest in this approach, the combination of multiples is generally an unexplored area (Schreiner, 2007).

For a U.S. equity dataset, Beatty, Riffe & Thompson (1999) examines several valuation approaches that reflect important features of regulatory prescriptions and legal precedents for the method of comparable companies as applied in estate and gift tax cases. Their examination includes methodologies of how to actually combine P/E and P/B multiples. They show that equal weighting of P/E and P/B multiples is inferior to calculating specific industry weights.

[43] For example, if we have the following sample of values: {4, 5, 4.5, 5.5, 5.3, 4.3, 12, and 24}. I purposely selected values around five, and added two outliers to distort the sample. Using the simple mean, we obtain: (4+5+4.5+5.5+5.3+4.3+12+24)/8 = 8.075. Using the harmonic mean: 8/((1/4+1/5+1/4.5+1/5.5+1/5.3+1/4.3+1/12+1/24)) ≈ 5.71. With this example I have shown that the harmonic means assigns smaller weight to extreme value.

[44] The retransformed mean is calculated by taking the natural logarithms of the multiples, then taking the average of those transformed ratios and eventually retransforming the log average by using the exponential function (Herrmann & Richter, 2003).

Cheng & McNamara (2000), examine MVM accuracy of P/E and P/B multiples and a benchmark of using equal weights to combine both multiples. They show that the combined model of P/E and P/B multiples performs better than the P/E and the P/B approaches alone. The result implies that both earnings and book values are value relevant, and one does not substitute perfectly for the other.

The results of the Riffe & Thompson (1999) and Cheng & McNamara (2000) seem promising, but the result of Liu, Nissim & Thomas (2002 and 2005) however indicated that a combination of two or more multiples shows only modest valuation accuracy improvements over the results of forward-looking P/E multiples. Yoo (2006) investigates comprehensive valuation approach, which combines several traditional multiple valuations. In order to combine the valuations, Yoo (2006) conducts regression of stock prices on several traditional multiple valuations to calculate weights. He finds that combining several traditional multiple valuation outcomes, which are based on historical multiples, outperforms traditional multiple valuation based on historical multiples. However, further analysis shows that the combination of multiples based on historical information or forward-looking earnings do not improve the accuracy of traditional multiple valuation using forward earnings. The findings imply that a historical multiple contains incremental information not reflected by another historical multiple. However, the historical multiples have no incremental information beyond a forward earnings multiple (Yoo, 2006).

Schreiner (2007) tests the accuracy of a two-factor model by combining identified industry-preferred multiples from five European key industries with the P/B multiple.[45] The optimal weights of each multiple are obtained by minimizing the median absolute error. The outcome shows mixed results; it appears that the inclusion of the P/B multiple contains value relevant information for the oil & gas, health care and banking industry. However, it does not significantly improve the valuation of telecommunication and industrial goods & service companies. Schreiner (2007) proposes a couple of optimal allocations of the weights. A simple fifty-fifty allocation improves the valuation of the oil & gas industry and banks (if forecasts are not available). A ninety-ten allocation of the weightings is optimal for health care and banks (if forecasts are available).[46] The market values of Telecommunications and industrial goods & service companies are best estimated using solely (100%) the industry-preferred multiple.

Another, but more promising alternative approach of the traditional MVM, are the Intercept Adjusted Multiples, introduced by Liu, Nissim & Thomas (2002). This approach

[45] The identification of the industry-preferred multiples is based on the methodology of Schreiner (2007) as described in section 2.1.2.4.

[46] The weightings are 90% industry preferred multiple and 10% P/B multiple.

relaxes the implied assumption of the traditional approach that the equity value of the company is directly proportional to the corresponding value driver of that company, by allowing an intercept in the relation.[47] The idea behind the inclusion of an intercept is that many factors, besides the value driver under investigation, are determining value, and the average effect of such excluded factors is unlikely to be zero. Since an intercept in the relation can capture the average effect of such excluded factors, allowing for an intercept should improve the valuation accuracy of the predictions (Liu, Nissim, & Thomas, 2002). The empirical results of this approach by Liu, Nissim & Thomas (2002) indeed show that Intercept Adjusted Multiples improves the valuation results of all the multiples in their sample.

2.3.2 Overview of the issues in the literature

Based on the various discussed aspects of the literature on the MVM in the preceding section and the open issues of the standard multiples method identified by Schreiner (2007) in paragraph 1.1, this paragraph provides an overview. The overview is categorized using the four steps valuation process as presented by Schreiner (2007). As visible, my research questions show overlap with a selection of these issues.

Table 2.3: Overview of the issues in the literature

Step 1: Selection of value relevant measures	Step 2: Identification of comparable companies
➢ Which value drivers result in optimal valuation? ➢ Should we use equity value or enterprise value multiples? ➢ Should we use multiples based on trailing or forward-looking information? ➢ Should we use industry-preferred multiples?	➢ How should we define an industry ➢ How can we further improve the quality of an industry peer group? ➢ What is the optimal size of the peer group?
Step 3: Estimation of synthetic peer group multiples	**Step 4: Actual valuation**
➢ What is the optimal measure of central tendency to estimate the synthetic peer group multiples?	➢ How can we improve the performance of the (traditional) MVM valuation methodology?

[47] A more detailed explanation of this approach is provided in Chapter 3, paragraph 3.4.

2.4 Summary of this chapter

Despite the prevalent usage of in practice, not much theoretical foundation is available to guide the practical application of the Multiple Valuation Method. With some exceptions, the finance and accounting literature gives inadequate evidence on how to apply multiples or why specific multiples or comparable companies should be picked in specific contexts. Standard corporate valuation textbooks tend to put more focus on the Discounted Cash Flow (DCF) model and the Residual Income Valuation (RIV) approach and devote relatively little space on discussing the Multiples Valuation Method (MVM).[48] The majority of these textbooks does mention and confirm the importance of the Multiples Valuation Method in practice, along with its strong supporting role in investment decisions and complex valuations, although, they lack in presenting the reader a clear and functional manual (Schreiner, 2007). The existing academic literature has identified a number of open issues regarding the Multiple Valuation Method. There are academic studies investigating these issues, but most of the knowledge they provide are rather fractured and there is still no real consensus.[49]

Still, both standard textbook literature and academic studies provide useful information and insights regarding various aspects of the Multiples Valuation Method. In fact, a comprehensive understanding of how to apply the multiples approach can be achieved by putting the pieces of research together.

The textbooks do not provide the readers a clear and extensive manual on how to appropriately use multiples. However, they do provide theoretical background and mathematical explanations of multiples. Corporate finance textbooks often focus on fundamental valuation models. The models have in common that they involve forecasting of future payoffs to arrive at a company's value. In contrast, the Multiple Valuation Method is a technique that per se does not require forecasting pro forma financial statements and discounting future payoffs. However, it would be incorrect to think that multiples therefore have no economic meaning (Schreiner, 2007). To show this, this chapter presents how the Multiple Valuation Method is related to fundamental equity valuation methods by introducing the intrinsic multiples. However, intrinsic multiples are subject to strict assumptions, which are rarely fulfilled in reality, and for this reason not suitable for practical valuation purposes (Herrmann & Richter, 2003). However, they are helpful when we try to understand the

[48] Standard textbooks such as Benninga & Sarig (1997), Palepu et al. (2000), Damodaran (2001, 2002 & 2006), Penman (2004), Lundholm & Sloan (2004), Arzac (2005), Koller et al. (2005), Spremann (2002, 2004 & 2005), Ballwieser (2004) and Richter (2005).

[49] Fractured in the sense that the empirical studies provide evidences for different issues, in different contexts, and with different approaches. The empirical research on the MVM is rather deficient and incomparable.

variables that may cause multiples to vary across companies in the same sector. Just as important is to understand how multiples are affected by fundamental changes. The multiples we know, and used by practitioners and the academic research, are typically apply are the market multiples.

As with the coverage in the standard textbooks, the studies on the Multiple Valuation Method are relatively small in numbers, the knowledge provided by academic studies are rather fractured. Also, the majority of the studies investigates a limited set of companies or time period, mostly using equity value multiples. Since most academic studies focus on a specific aspect of the Multiple Valuation Method, the existing academic literature on the Multiple Valuation Method is rather fractured. The results are often difficult to compare due to different research contexts. However, there are developments. A thorough literature research shows that there is somewhat cohesion of the results. The academic findings seem to favor, in particular, multiples equity multiples based on earnings and forward-looking information. Also, empirical studies on the identification of appropriate value drivers are quite diverse, which is likely the result of different research settings. In addition, the most recent studies suggest that we should utilize the ICB and the GICS industry classification systems, which are both widely used in practice by analysts and investment bankers. These systems deliver superior industry classifications for valuation studies and fundamental analysis purposes. Regarding the ideal size of a peer group, studies have indicated that five companies are optimal.[50] Plus or minus two peers is still acceptable. The synthetic multiple is the aggregated multiples of the comparable companies into one multiple for the target company. The study of Baker & Ruback (1999), Beatty, Riffe & Thompson (1999) and Liu, Nissim & Thomas (2002) find that using the harmonic mean to estimate the synthetic multiple is most suitable and optimal for the Multiple Valuation Method.

[50] E.g. Schreiner (2006) and Cooper & Cordeiro (2008)

3 Methodology

3.1 Introduction

This chapter describes the methodology of this study. It sheds light on the process needed to obtain the results, derive the conclusions, and to answer the research questions introduced in the first chapter. Paragraph 3.2 of this chapter describes the four steps required to perform the Multiples Valuation Method. Each step is discussed thoroughly to describe its implications and considerations. Whereas paragraph 3.2 focus on how to obtain the valuation results, paragraph 3.3 is dedicated to the measurement of the pricing errors. This is a crucial part of the empirical study, because the pricing errors need to be measured appropriately to evaluate the Multiple Valuation Method. Paragraph 3.4 presents the methodology of an adjusted approach of the traditional Multiple Valuation Method, the Intercept Adjusted Multiples. The last paragraph, paragraph 3.5 provides insight into the constructed European dataset and the used sample for this study.

3.2 Valuation process of the traditional multiple valuation method

According to Schreiner (2007), the multiple valuation method consists of four steps, independent of the specific context. This study will follow these steps, as Schreiner (2007) summarizes the whole comprehensive multiple valuation process to a simple schematic overview. The MVM, presented in four steps:

- Step 1: Selection of the value relevant measures;
- Step 2: Identification of the comparable companies;
- Step 3: Estimation of peer group multiples;
- Step 4: Actual valuation.

Each step will be discussed and specified for this study in the following sections. Since the first four research questions are related to certain steps of the valuation process, the approach to answer these questions is also discussed.[51]

3.2.1 Step 1: Selection of the value relevant measures

Step 1 is the selection of the value relevant measures. To run the MVM we need to select which kind of value relevant base (equity value or enterprise value) and which kind of value driver (i.e., earnings per share, book value of common equity, or EBIT(DA)) is of interest. In practice, equity value multiples are usually preferred because the value relevant base does not need to be further adjusted for the market value of net debt, as it is in the case with enterprise value.[52] As described in the previous chapter, the list of possible value drivers is long, therefore an appropriate selection is important. Among the most widely used equity multiples in practice are the P/E, P/B, P/SALES and P/OCF multiples, which scale the market price of common equity by the most important summary numbers in the financial reports, net income, book value of common equity.[53] Also, we should consider the time reference of these value drivers (i.e., trailing or forward looking data). The first three research questions involve the optimal value driver, optimal value relevant base, and optimal time reference to

[51] The research questions in short are: 1st: optimal value driver / multiple; 2nd: entity vs. equity value; 3rd: trailing vs. forward looking data; 4th: optimal size of the peer group, and 5th: traditional vs. intercept adjusted multiples.
[52] The equity value multiples does not need to be adjusted for the market value of net debt, however this can affect the value of the multiple. See appendix VIII for more details.
[53] As mentioned before, a list of the used abbreviations in this study is provided in Appendix I.

construct multiples, and are related to this first step of the MVM valuation. It results in a pool of 24 multiples to be investigated, as presented in table 3.1

Table 3.1: Overview and categorization of the selected multiples for this study

	Accrual flow multiples	Cash flow multiples	Forward looking multiples
Equity value multiples	P/EPS P/EBIT P/EBITDA P/SA	P/OCF P/D	P/EPS 1 P/EPS 2 P/EBIT 1 P/EBIT 2 P/EBITDA 1 P/EBITDA 2 P/SALES 1 P/SALES 2
Enterprise value multiples	EV/EBIT EV/EBITDA EV/SA	EV/OCF	EV/EBIT 1 EV/EBIT 2 EV/EBITDA 1 EV/EBITDA 2 EV/SALES 1 EV/SALES 2

Notes: P is the value of common equity, which is the market capitalization. In the case with the P/EPS multiple, P is the stock price. EV is the enterprise value. A list of the used abbreviations for the value drivers is provided in appendix I.

The optimal type of value driver.

The first research question is which type of value driver multiple results in optimal valuation results. Out of the long list of possible type of multiples, I have selected the following value driver / multiples:

- Accrual flow multiples that are based on earnings per share (EPS)[54], earnings before interest and taxes (EBIT), earnings before interest, taxes, depreciation and amortization (EBITDA), and sales (SALES);
- Cash flow multiples that are based on operating cash flow (OCF) and dividends (D).[55]

This selection of multiples is the same as Liu, Nissim & Thomas (2002 & 2007), their motivation is that this selection is by far the most commonly used in practice. Other possible

[54] Following Cooper & Cordeiro (2008), I use EPS instead of the not scaled E, because EPS is the financial measure that most forecast analysts focus on. Using EPS therefore results in less missing values in the dataset.
[55] The exact variable definitions of the multiples for this study is provided in appendix

multiples from table 2.2 are excluded from the selection because of weak empirical performance or data limitations. The accrual flow multiples based on the value drivers EPS, EBITDA, EBIT, and sales have already been discussed in paragraph 2.2, the market multiples.

The application of cash flow multiples in practice is motivated by the implicit assumption that reported cash flows are the best available indicator for the future cash flows that underlie stock prices, and also the idea that they less susceptible to manipulation by the management. Following Liu, Nissim & Thomas (2002 & 2007), I use Cash Flows from Operations (CFO) as the value driver to construct cash flow multiples. The use of dividends in valuation models is often considered, because dividends may be used by the management as a signaling method to convey private information (Liu, Nissim & Thomas, 2006). This value driver was used by Liu, Nissim & Thomas (2007), to test the hypothesis that dividends based multiples outperform earnings based multiples.

The optimal value relevant base.

Despite the prevalent use of equity multiples in practice, many practitioners raise the question whether to use the market price of common equity or the enterprise value of a company in the numerator of a multiple (Schreiner, 2007). The latter appeal in theory, because it is less affected by capital structure. The academic literature does not offer much consensus on this matter, for this reason, the second research question involves a comparison of the empirical performance of equity value versus enterprise value multiples.

When using enterprise value multiples it is important to pay attention to the matching principle that certain value drivers should reflect an investment base that includes debt and equity (Liu, Nissim & Thomas, 2001). The internal consistency of pairing up the correct numerator with the denominator is also suggested to be preserved by Pereiro (2002). Value drivers that satisfy the matching principle with enterprise value include, for example, income statement items that are before interest payments, sales, total assets, and total invested capital from the balance sheet or measures of cash flow that exclude cash flows from financing activities (e.g., free cash flow or cash flow from operating activities) (Schreiner, 2007). However, enterprise value multiples induces the problem that the numerator, the enterprise value, is unobservable in practice, and therefore must be approximated. (Liu, Nissim & Thomas, 2002). The enterprise value is defined as the market capitalization plus the market value of net debt. The market capitalization is directly observable, however the market value of net debt must be approximated. To approximate the market value of net debt, I start with the book value of debt, then add book value of preferred stock and deduct cash & equivalents. The matching principle also applies to the equity value multiples. The market value of common equity is directly observable because it is equal to the market capitalization.[56] The value drivers that match this value relevant base should be defined at an equity holder's level (Schreiner, 2007). Such value drivers are book value of equity from the balance sheet, income statement items after interest payments to debt holders, or dividends measures.

However, following Schreiner (2007), I will ignore the matching principle for equity multiples to directly evaluate the valuation performance of equity value multiples versus the enterprise value multiples. Each enterprise level value driver therefore will have an equity value multiple form.[57] In practice, the matching principle is also often violated with the P/SALES, P/EBIT(DA), or P/OCF multiples, which is quite accepted among practitioners (Schreiner, 2007).[58]

The optimal time reference.

The third research question is about the optimal choice of the time reference of the value drivers. Should we use multiples based on trailing or forward-looking information, as described in the preceding chapter? From a theoretical perspective, forward-looking information is appealing because it is consistent with the principles of valuation theory that the value of a company is equivalent to the present value of future payoffs (Moxter, 1983). Also, empirical researches have confirmed that forward looking multiples are indeed more accurate estimators of value than multiples based on trailing information.[59]

To test the robustness of forward looking multiples outperforming trailing multiples in my European sample, I include a comparison of the valuation performance of trailing versus forward looking multiples. Since analysts' practice is to make point in time estimates of earnings measures for up to two years ahead, I will include one-year and two-year ahead multiples of the value drivers EPS, EBIT(DA) and SALES.[60] The value drivers OCF and D are left out, because Datastream could not provide sufficient data points.

[56] Note that for equity value drivers that are defined per share, such as the EPS, one should use the stock price (instead of the market capitalization) as the value relevant base.
[57] See table 3.1.
[58] Yoo (2006) also ignores the matching principle.
[59] See chapter 2.1, literature review, for more details.
[60] See table 3.1.

3.2.2 Step 2: Identification of the comparable companies

Step 2 is the identification of comparable companies. This step of the process involves the identification of the peer group. Rappaport (1981) defines the peer group as a basket of companies or corporate transactions with profiles of expected future free cash flows that are comparable to the target company's profile. The definition of Palepu, Healy & Bernard (2000) requires the companies in the peer group to have comparable operating and financial characteristics as the target company. Both definitions implicate appropriate identification criteria to identify a peer group. In addition, the size of the peer group affects the valuation accuracy (Cooper & Cordeiro, 2008).

The fourth research question of this study is related to this step of the valuation process. Following Cooper & Cordeiro (2008), I will investigate the optimal number of comparable companies to form a peer group.

Forming the peer group.

On the question how comparable companies should be identified to form the peer group for the target firm, there is relatively little existing research. Most studies rely on industry membership only, which are usually based on industry classification systems (Schreiner, 2007). Bhojraj & Lee (2002) show that a combination of industry membership with total assets and further company characteristics results in better valuation, rather than using industry membership alone. According to the study of Alford (1992) and Dittmann & Weiner (2005), a combination of industry membership and return on total assets is an effective criterion for identifying comparable companies. For this reason, the choice for this study is a combination of industry membership and the return on assets (ROA) as a comparable companies identification criterion.[61]

The first condition for the comparable companies is industry membership. By nature, companies with a finer industry grouping are more similar with respect to their current operating characteristics. Moreover, the more similarity the comparable companies in the peer group show to the target company, the greater the level of comparability and the more information they provide (Eberhart, 2001). For this reason, I will use 3-digit ICB industry grouping codes.[62] Schreiner (2007) finds 3-digit ICB industry grouping codes to be the optimal grouping code.

[61] As shown in appendix V, the definition of the used variables, ROA is defined as the EBIT divided by total assets.
[62] The ICB grouping code has proven to an effective and accurate selection criterion. For more details, see chapter 2.

The second condition is to further increase the degree of comparability by further filter down the peer group of comparable companies by their absolute closeness to the target company. This criterion has proven to be the most optimal comparable companies identification rule for a dataset of European companies by the study of Dittmann & Weiner (2005).

First we need to determine the industry peer group of target company i on basis of 3-digit ICB codes. Then, given target company i, year t and peer group size n, we select n comparable companies from the same industry as company i with the smallest absolute difference in its return on assets (ROA) from company i.[63] I rank the comparable companies of the industry peer group of target company i according to the condition below (3.1) and select the top n comparable companies to form the peer group:

$$\min\left|ROA_{j,t} - ROA_{i,t}\right| \tag{3.1}$$

where $ROA_{j,t}$ is the ROA of comparable j and $ROA_{i,t}$ is ROA of target company i.

In the case that comparable companies have equal absolute difference (3.1), we apply the following additional condition to rank these comparable companies:

$$\min\left|size_{j,t} - size_{i,t}\right| \tag{3.2}$$

where $size_{j,t}$ is the size of comparable j and $size_{i,t}$ is the size of target company i. Size is defined as the market capitalization.

The optimal size of the peer group.

The fourth research question investigates the optimal size of a peer group. It is in fact a replication of Cooper & Cordeiro (2008), but on a smaller scale. The study of Cooper & Cordeiro (2008) examines how the accuracy of a MVM based valuation varies as the number

[63] For almost the entire study, assume a peer group size of $n = 5$, more details is provided in the next subsection, the optimal peer group size.

of comparable companies in the peer groups increases. Their research is motivated by a contrast observed between the approach of theory and practice. Practitioners typically use a small number of closely related comparable companies, whereas academic studies often use all the companies in the entire industry. It is interesting to find out which number of comparable companies, on average, results in more accurate valuation.

The entire study, that is research question one to three and five, is based on a peer group size of five comparable companies. This number is not arbitrarily chosen, but based on the findings of several studies. Schreiner (2007) suggests a peer group size of four to eight, which is derived from various conversations with academics, (hedge) fund managers, and investment bankers in Europe and the U.S. Cooper & Cordeiro (2008) provide evidence that using about ten comparable companies is optimal, using a comparable companies identification rule based on growth rates. To investigate research question four, the number of comparable companies, n comparable companies, is varied. The dispersion of scaled absolute pricing errors of the entire pool of multiples is investigated for n $= 2, 5, 10, \text{and } 20$.

3.2.3 Step 3: Estimation of synthetic peer group multiples

Step 3 is the estimation of the synthetic peer group multiples. This step compresses the peer group companies' multiples of step 2 into single numbers. This procedure is carried out by estimating the synthetic peer group multiples according to a statistical measure of central tendency. The choice of the statistical measure can significantly influence the accuracy of the valuation results (Schreiner, 2007).

Academic studies on this issue have found the median or harmonic mean to be the optimal statistical measures of central tendency.[64] For this study, I have chosen for the harmonic mean. The harmonic mean is a measure of central tendency, which is less sensitive to outliers than the arithmetic mean (Fahrmeir et al., 1999). Baker and Ruback (1999) show that the magnitude of pricing errors increases with the prices. Since the methodology of harmonic mean results in assigning smaller weights to companies with relatively high stock prices, the harmonic mean is a better estimator for the multiples than the arithmetic mean or median (Liu, Nissim and Thomas, 2007). Other studies also confirm that the harmonic mean performs well in terms of minimizing errors caused by high stock prices.[65]

[64] For more details, see chapter 2, paragraph 2.3. An example of the harmonic mean is provided in the footnote of page 36.
[65] e.g. Beatty, Riffe & Thompson (1999) and Liu, Nissim & Thomas (2002).

The estimation of the synthetic peer group multiple is as follows. Determined in step 2, each target company i has a peer group i, consisting of n comparable companies j, with $j = 1, \ldots, n$. To estimate a synthetic peer group multiple ($\hat{\lambda}_{i,t}$) for target company i in year t, which is based on the harmonic mean, we need to build the inverse of the arithmetic mean of the inverses of the comparable companies' multiples ($\lambda_{j,t}$): [66]

$$\hat{\lambda}_{i,t}(n) = \frac{n}{\sum_{j=1}^{n} \frac{1}{\lambda_{j,t}}} \tag{3.3}$$

where $\lambda_{j,t}$ can be either equity value multiples $\lambda_{j,t}^{equity}$ or enterprise value multiples $\lambda_{j,t}^{enterprise}$, resulting in respective $\hat{\lambda}_{i,t}^{equity}$ and $\hat{\lambda}_{i,t}^{enterprise}$.

The equity value multiple $\lambda_{j,t}^{equity}$ of comparable j at time is t, is calculated as follows:

$$\lambda_{j,t}^{equity} = \frac{p_{j,t}^{equity}}{x_{j,t}} \tag{3.4}$$

where $p_{j,t}^{equity}$ stands for the market value of common equity of comparable j and $x_{j,t}$ for the underlying value driver of the multiple.[67]

Almost in the same way, the enterprise value multiple of that same comparable j at time is t, is defined as:

$$\lambda_{j,t}^{enterprise} = \frac{p_{j,t}^{enterprise}}{x_{j,t}} = \frac{p_{j,t}^{equity} + \hat{p}_{j,t}^{net\ debt}}{x_{j,t}} \tag{3.5}$$

[66] This formulation implicitly assumes that the expected pricing error is equal to zero (Liu, Nissim & Thomas, 2002).
[67] For the value driver EPS, we cannot use the market value of common equity, because EPS is a per share value driver. We must use the stock price as the $p_{j,t}^{equity}$.

where $p_{j,t}^{enterprise}$ stands for the enterprise value of comparable j and is equal to the sum of the market value of common equity and a proxy of the market value of net debt $\hat{p}_{i,t}^{net\ debt}$, and $x_{i,t}$ again stands for the underlying value driver of the multiple.[68]

3.2.4 Step 4: Actual valuation

Step 4 is the actual calculation of the equity value. After the selection of the value relevant measures, the identification of the comparable companies and the estimation of the synthetic peer group multiples, we finally arrive at the last step, the value estimation of the target companies value of common equity $\hat{p}_{i,t}^{equity}$. In this case, with traditional multiple valuation, this value is determined by taking the product of the synthetic peer group multiple and the value driver of the company being valued.

To estimate the equity value of the target companies $\hat{p}_{i,t}^{equity}$, I follow the procedure of Liu, Nissim and Thomas (2002) in general. First the assumptions. In the traditional MVM, the implied assumption is that the value of common equity of target company i in year t ($p_{i,t}^{equity}$), is directly proportional to the value driver of that company i in year t ($x_{i,t}$):

$$p_{i,t}^{equity} = \hat{\lambda}_{i,t}^{equity} * x_{i,t} + \mathcal{E}_{i,t} \tag{3.6}$$

$$p_{i,t}^{equity} = \hat{\lambda}_{i,t}^{enterprise} * x_{i,t} - \hat{p}_{i,t}^{net\ debt} + \mathcal{E}_{i,t} \tag{3.7}$$

where $\hat{\lambda}_{i,t}$ is the estimated synthetic peer group multiple for target company i in year t, calculated using the harmonic mean (3.3) and $\mathcal{E}_{it}$ is the pricing error of the target company i in year t. Equation (3.6) is for when using equity multiples, whereas (3.7) is for when using enterprise value multiples. The enterprise value is transformed to equity value,

[68] Since the market value of net debt is usually not publicly available, following Koller, Goedhart & Wessels (2005), $\hat{p}_{i,t}^{net\ debt}$ is estimated with the book value of net debt, plus the book value of preferred stock, minus cash and equivalents, which is deemed reasonable.

by deducting the approximation of the market value of net debt, to ease the performance evaluation in the next section.

We now finally arrive at step 4, the actual valuation. To obtain a prediction for the equity value of $\hat{p}_{i,t}^{equity}$ of company i (according to traditional MVM), we need to take the product of the estimated synthetic peer group multiple $\hat{\lambda}_{i,t}$ from step 3 and the equivalent value driver $x_{i,t}$ of the company being valued:

$$\hat{p}_{i,t}^{equity} = \hat{\lambda}_{i,t}^{equity} * x_{i,t} \tag{3.10}$$

$$\hat{p}_{i,t}^{equity} = \hat{\lambda}_{i,t}^{enterprise} * x_{i,t} - \hat{p}_{i,t}^{net\ debt} \tag{3.11}$$

3.3 Measurement and evaluation of the pricing errors

This section adopts the performance evaluation approach of Liu, Nissim & Thomas (2001) and Schreiner (2007). To measure the performance of the different value drivers of multiples, value relevant bases of the multiples, time reference of the value drivers, and optimal peer group size of the multiples, I examine the distribution of its scaled absolute pricing errors $\left|\frac{\varepsilon_{i,t}}{p_{i,t}^{equity}}\right|$. The scaled absolute pricing error $\left|\frac{\varepsilon_{i,t}}{p_{i,t}^{equity}}\right|$ is the difference between the estimated equity value and actual equity value, divided by actual equity value. It represents the valuation accuracy of the equity value estimation in equation (3.10) and (3.11), and is calculated as follows:

$$\left|\frac{\varepsilon_{i,t}}{p_{i,t}^{equity}}\right| = \left|\frac{\hat{p}_{i,t}^{equity} - p_{i,t}^{equity}}{p_{i,t}^{equity}}\right| \tag{3.12}$$

The performance is evaluated by using performance indicators. The first performance indicators are common measures of central tendency such as the arithmetic mean and median of the absolute pricing errors. In addition, I will report the fraction of absolute pricing errors below 15 percent and 25 percent of observed market values. The latter measure improves comparability with other related studies.[69]

Notice that, without insight on the dispersion of the pooled distribution of the scaled absolute pricing errors, common measures of central tendency may be misleading (Aczel, 2002). To ensure reliability, I therefore consider dispersion measures for the scaled absolute pricing errors, such as the standard deviation and three non-parametric dispersion measures. I will focus on the latter, the three non-parametric measures, since they are more resistant to extreme observations than other measures such as the standard deviation. The non-parametric measures are the inter-quartile range (IQR) or the 75th percentile minus the 25th percentile, the 90th percentile minus the 10th percentile and the 95th percentile minus the

[69] In particular, Kaplan & Ruback (1995 & 1996), Kim & Ritter (1999), Gilson, Hotchkiss & Ruback (2003), Lie & Lie (2002), Liu, Nissim & Thomas (2002 & 2006), Hermann & Richter (2003), and Schreiner (2006 & 2007).

5th percentile. The ranges contain information on the distance between the two percentiles only, the standard deviation however, uses the information contained in the entire pooled distribution (Brooks, 2002). For this reason, I also report the standard deviation. However, the focus is on the IQ ranges when it comes to the measurement of dispersion.

Following Liu, Nissim & Thomas (2002), when comparing two variables, I also report the relative improvement (%IMP) of variable 2 over variable 1 by calculating the percentage change in the performance indicator (PI). The relative improvement of variable 2 over variable 1 using any kind of performance indicator (PI) is calculated as follows:[70]

$$\%IMP = ((PI_1 - PI_2)/PI_1)) * 100\% \tag{3.13}$$

To indicate significant %IMP values, I provide t-statistics. The differences of the values of variable 1 and 2 for the valued companies in the sample are calculated to create a new variable. This new variable has a mean and standard deviation, which is used to determine whether the difference between variable 1 and 2 is significantly different from zero by utilizing the paired t-test (van Dalen & de Leede, 2008).

High performance of the multiples in terms of valuation accuracy is indicated by low values for the measures of central tendency (i.e. arithmetic mean and median) and measures of dispersion (i.e. percentile ranges and standard deviation) of the scaled absolute pricing errors. Moreover, high valuation accuracy is indicated by high numbers for the fractions of the sample with absolute pricing errors below 15 percent and 25 percent. Any performance indicator for a multiple is calculated first for each year and then aggregated into one number using the average.

In table 3.2, I present an overview of the performance indicators for the scaled absolute pricing errors. The indicators are categorized in measures of central tendency and dispersion.

[70] This study uses the IQR and fraction of the sample with scaled absoloute pricing errors <0.15, as performance indicators (PI) to measure the relative performance of shifting from variable 1 to variable 2. For example, the relative improvement of using forward-looking data instead of trailing data.

Table 3.2: Overview of the performance indicators

Measures of central tendency	Measure of dispersion
➢ Arithmetic mean ➢ Median	➢ Standard deviation ➢ Inter-quartile range $q_{0.75} - q_{0.25}$ ➢ Percentile range $q_{0.90} - q_{0.10}$ ➢ Percentile range $q_{0.95} - q_{0.05}$ ➢ $\%IMP = ((PI_1 - PI_2)/PI_1)) * 100\%$

Notes: PI_1 and PI_2 stand for the performance indictor of variable 1 and variable 2.

3.4 Intercept Adjusted Multiples method

This paragraphs presents the methodology to answer my last research question. The last research question compares the performance of traditional equity value multiples to an adjusted equity value multiples valuation approach, the Intercept Adjusted Multiples method. The Intercept Adjusted Multiples method was introduced by Liu, Nissim & Thomas (2002) and is a less restrictive approach than traditional MVM because it allows for an intercept in equation (3.10). The methodology presented in this study is mainly adopted from Liu, Nissim & Thomas (2002).

The Intercept Adjusted Multiples method follows step 1 and step 2 of the traditional MVM unchanged. However, instead of *n=5* comparable companies, for this methodology we use *n=10* comparable companies. This increase of the peer group size is because the methodology involves a minimum variance approach. Aczel (2002) recommends to use more observations for minimum variance techniques, if possible. From step 3 onward, the estimation of the synthetic peer group multiples, it differs from the traditional MVM. Therefore, I only present steps 3 and 4 for the Intercept Adjusted Multiples method. In addition, the performance evaluation method is presented. Note that the methodology is specified for the performance of equity value multiples only.

This alternative approach of the MVM relaxes the implied assumption of the traditional approach that the equity value of the company is directly proportional to the corresponding value driver of that company by allowing an intercept $\alpha_{i,t}$:

.

$$p_{i,t}^{equity} = \alpha_{i,t} + \lambda_{i,t}^{equity} * x_{i,t} + \varepsilon_{i,t} \tag{3.14}$$

The idea behind the inclusion of an intercept is that many factors besides the value driver under investigation, are determining value, and the average effect of such excluded factors is unlikely to be zero. Since the intercept $\alpha_{i,t}$ in equation (3.14) captures the average effect of such excluded factors, allowing for an intercept should improve the valuation accuracy of the predictions (Liu, Nissim, & Thomas, 2002).

Following Beatty, Riffe, & Thompson (1999), Easton & Sommers (2002) and Liu, Nissim and Thomas (2002) we scale equation (3.14) by the value of equity to improve the efficiency of estimation:

$$1 = \alpha_{i,t} * \frac{1}{p_{i,t}^{equity}} + \lambda_{i,t} * \frac{x_{i,t}}{p_{i,t}^{equity}} + \frac{\varepsilon_{i,t}}{p_{i,t}^{equity}} \tag{3.15}$$

3.4.1 Step 3: Estimation of synthetic peer group multiples

Following Liu, Nissim & Thomas (2002), we estimate the intercept $\hat{\alpha}_{i,t}$ and synthetic peer group multiple $\hat{\lambda}_{i,t}$ from equation (3.15), such that the variance of the pricing error $\frac{\varepsilon_{i,t}}{p_{i,t}^{equity}}$ is minimized and subject to the restriction that the expected pricing error is zero, $E\left[\frac{\varepsilon_{i,t}}{p_{i,t}^{equity}}\right] = 0$. Thus we need to solve the following constrained minimization problem:

$$\min var\left(\frac{\varepsilon_{i,t}}{p_{i,t}^{equity}}\right) = var\left[\frac{p_{i,t}^{equity} - \alpha_{i,t} - \lambda_{i,t} * x_{i,t}}{p_{i,t}^{equity}}\right]$$

$$= var\left[1 - \alpha_{i,t} * \frac{1}{p_{i,t}^{equity}} - * \lambda_{i,t} \frac{x_{i,t}}{p_{i,t}^{equity}}\right] \tag{3.16a}$$

Subject to:

$$E\left[\frac{\varepsilon_{i,t}}{p_{i,t}^{equity}}\right] = 0 \tag{3.16b}$$

Appendix VI shows that the estimates of the parameters $\hat{\alpha}_{i,t}$ and $\hat{\lambda}_{i,t}$ for step 3 that satisfy both equations (3.16a) and (3.16b) are as follows:

$$\hat{\lambda}_{i,t} = \frac{E\left[\frac{x_t}{p_t^{equity}}\right] * var\left(\frac{1}{p_t^{equity}}\right) - cov\left(\frac{1}{p_t^{equity}}, \frac{x_t}{p_t^{equity}}\right) * E\left[\frac{1}{p_t^{equity}}\right]}{E\left[\frac{1}{p_t^{equity}}\right]^2 * var\left(\frac{x_t}{p_t^{equity}}\right) + E\left[\frac{x_t}{p_t^{equity}}\right]^2 * var\left(\frac{1}{p_t^{equity}}\right) - 2 * E\left[\frac{1}{p_t^{equity}}\right] * E\left[\frac{x_t}{p_t^{equity}}\right] * cov\left(\frac{1}{p_t^{equity}}, \frac{x_t}{p_t^{equity}}\right)} \quad (3.17)$$

$$\hat{\alpha}_{i,t} = \frac{1 - \hat{\lambda}_{i,t} * E\left[\frac{x_t}{p_t^{equity}}\right]}{E\left[\frac{1}{p_t^{equity}}\right]} \quad (3.18)$$

.

where $E[.]$, $var(.)$, and $cov(.)$ represents the mean, variance and covariance of those expression for the peer group of target company i.

3.4.2 Step 4: Actual valuation

Now that the intercept $\hat{\alpha}_{i,t}$ and synthetic peer group multiple $\hat{\lambda}_{i,t}$ are estimated in step 3, we can start with the estimation of the value of target company i, $\hat{p}_{i,t}^{equity}$:

$$\hat{p}_{i,t}^{equity} = \hat{\alpha}_{i,t} + \hat{\lambda}_{i,t} * x_{i,t} \quad (3.19)$$

3.4.3 Measurement and evaluation of the pricing errors

The pricing errors for the Intercept Adjusted Multiples are computed using the equation (3.20). The performance indicators are the same as presented in table 3.2.

$$\left|\frac{\varepsilon_{i,t}}{p_{i,t}^{equity}}\right| = \left|\frac{\hat{p}_{i,t}^{equity} - p_{i,t}^{equity}}{p_{i,t}^{equity}}\right| = \left|\frac{\left(\hat{\alpha}_{i,t} + \hat{\lambda}_{i,t} * x_{i,t}\right) - p_{i,t}^{equity}}{p_{i,t}^{equity}}\right| \tag{3.20}$$

3.5 Sample and data

This study investigates the valuation accuracy of MVM using European companies. The custom dataset is constructed by pooling companies from fifteen West European countries that are covered by the data provider I/B/E/S.[71] Since this study incorporates an investigation of forward looking data, which is provided by I/B/E/S, choosing for European indices such as the Dow Jones STOXX Europe 600 would result in many missing values for the forward-looking data investigation. Many Dow Jones STOXX Europe 600 companies are not covered by the I/B/E/S forecast consensus database. Moreover, the existing indices are large enough to satisfy the requirements of this study. The empirical study of Schreiner (2007) was based on the Dow Jones STOXX Europe 600 index, which consists of about 600 companies and represent about 88 percent of the total market capitalization in Western Europe (Dow Jones, 2006). Hence, the Dow Jones STOXX Europe 600 index is a reliable proxy for the total market (Schreiner, 2007). My custom dataset shows about 75% overlap with the Dow Jones STOXX Europe 600 dataset, but consists of about 3000 companies. It is a broader dataset than the Dow Jones STOXX Europe 600, because it covers more small and mid capitalization companies.

To categorize the companies in the dataset into industries, I use the Industry Classification Benchmark (ICB) classification system. More specific, I will use the 3-digit ICB classification codes, resulting in 39 industries, as suggested by recent literature.[72] This classification system for industries offers 4-digit codes for all companies within the dataset and consists of four levels (increasing in fineness): 10 industries, 18 supersectors, 39 sectors, and 104 supersectors,[73] Selecting 3-digit industry is optimal because the 1 or 2-digit codes are too broad to allow the identification of homogenous companies, the 4-digit codes are too narrow to include sufficient comparable companies (Liu, Nissim & Thomas, 2002).

Following Schreiner (2007), for the I/B/E/S covered companies, I further construct my dataset by merging data from three sources: market prices from the Datastream database, historical accounting figures from the Worldscope database, and analysts' forecasted figures from the I/B/E/S database. The investigation horizon for the research questions is eleven years, from January 1999 through December 2009. For each target company i in year t, I estimate its equity and enterprise value for using each of the twenty-four multiples.[74] The

[71] The West-European countries includes: The Netherlands, Germany, France, The United Kingdom, Belgium, Italy, Denmark, Ireland, Portugal, Spain, Finland, Austria, Sweden, Switzerland and Norway

[72] For more details, see chapter 2, paragraph 2.2, academic literature review.

[73] A complete overview of the ICB structure is presented in Appendix IV.

[74] The twenty-four types of multiples are presented in table 3.1.

accounting numbers and analysts' mean consensus forecasts are gathered from the beginning of January in each year, and the market prices four months later, from the beginning of April, to ensure that all year-end information is publicly available and is reflected by the market prices. The use of various databases and markets resulted in inconsistent data in terms of currency and units, which had to be adjusted to EUR and millions of units. The characteristics of the data sample is presented in table 3.3. The unrestricted data sample covered about 40,131 company-year combinations, with about 3,620 companies each year. However, subject to the conditions presented in the next subsection, the restricted dataset reduces to these numbers to about 26,487 company-years combinations, with about 2,400 companies each year.

Table 3.3: Characteristics and descriptive statistics of the sample

Characteristics of the data sample	
Countries coverage	The Netherlands, Germany, France, The United Kingdom, Belgium, Italy, Denmark, Ireland, Portugal, Spain, Finland, Austria, Sweden, Switzerland and Norway
Currency	EURO
Industry classification system	ICB
Total company years	26,487
Study Horizon	1999-2009, 11 years

To ensure that the dataset is unambiguous and reliable I impose several restrictions. The restrictions resulted in the elimination of a large fraction of the dataset of about 34%. Following are the restrictions:

- the computed multiples must be positive, therefore the value drivers and value relevant bases must be positive, also the approximate value of net debt is positive;
- the market value of the companies must be at least 20 million EUR and stock prices must be at least 1.5 EUR;
- all industry-year pairs must have at least 25 companies;
- for the multiples, the numbers of the value drivers must be positive and lie within the smallest 1% and largest 99% percentile of its respective pooled distribution;
- for individual companies, there are no more than two types of stock, i.e. common stock and preferred stock traded at the domestic stock exchange.

The first condition is to avoid negative multiples (Liu, Nissim & Thomas, 2001). The second condition is to avoid large pricing errors, especially in the Intercept Adjusted Multiples part. The third condition ensures that each industry in the dataset has a reasonable size, so that statistical outliers cannot distort the empirical results. Additionally, the analysis is performed out-of-the-sample, which indicates that the target company is not part of the peer group (Schreiner, 2007). The fourth requirement is to mitigate the effect of influential observations on the distribution, which could be deemed unrealistic low or high. The last requirement is to eliminate ambiguous data (Liu, Nissim and Thomas, 2002).[75]

The descriptive statistics of the resulting sample is presented in table 3.4. Not surprising, the descriptive results show that the data sample is quite similar to that of Dittmann & Weiner (2005) and Schreiner (2007), except that most values are lower. The explanation is that my dataset covers more small and mid capitalization companies than Schreiner's (2007) Dow Jones Stoxx Europe 600 index based dataset.[76] Note that all of the value drivers are strongly skewed to the right, which is shown by the large differences between the means and medians. In my broad dataset, many large companies cause the mean of the values to be substantially higher than the median.[77] Therefore, I follow other studies by mainly focusing on the mean values for the measures of central tendency. Table 3.4 shows that the European companies in the dataset are, on average, financed with 60% equity and 40% debt, which is somewhat consistent with the survey evidence, for the capital structure policies in Europe, by Brounen, de Jong & Koedijk (2005). In addition, most of the forward looking data have lower values than its trailing version. It seems that the analysts' pessimism due to the financial crisis these years, negatively affects the distribution of the forward-looking data.

The identification criterion of the comparable companies is based on similar industry membership and on the return on (total) assets (ROA). This accounting ratio is provided by Worldscope, although it seems to contain a lot of missing values. Instead, using Worldscope I calculated the ROA by dividing the earnings before interest and tax (EBIT) by the total assets, which results in far less missing values (Brealey & Myers, 2008). A complete overview of the definition of the variables in this study is presented in appendix V.

[75] Companies that are listed as both holding company and subsidiary, are excluded. For this reason I exclude Fresenius (Germany), Heineken (Netherlands), Reed Elsevier (Netherlands), and Unilever (Netherlands).
[76] The wide coverage of my dataset is indicated by the large difference in the 75% percentile and the 25% percentile (IQR).
[77] Although, the distribution is strongly skewed to the right, it is not as skewed as the distribution of Dittmann & Weiner (2005) and Schreiner (2006), because the inclusion of many small and mid capitalization companies lowers the mean substantially.

Table 3.4: Descriptive statistics of the sample

In millions of EUR	Mean	Median	25%	75%	N
Market values:					
P (Stock price (in EUR))	80	14	5	91	25,998
P (Market Capitalization)	905	202	123	1,201	25,954
EV	1,531	345	245	1,853	24,129
Value drivers:					
EPS (in EUR)	6.1	1.2	0.5	7.1	25,301
EPS 1 (in EUR)	5.8	1.1	0.4	6.5	22,142
EPS 2 (in EUR)	6.2	1.2	0.5	7.1	22,873
EBIT	186	35	18	214	22,126
EBIT 1	164	32	15	197	20,154
EBIT 2	188	36	11	220	20,654
EBITDA	210	42	24	370	24,998
EBITDA 1	204	39	17	384	20,548
EBITDA 2	219	43	26	368	20,841
OCF	178	29	9	225	25,992
D	46	7	2	68	21,023
SALES	1,293	198	62	1,635	26,381
SALES 1	1,065	179	55	1,321	21,764
SALES 2	1,224	201	65	1,608	21,124

Notes: P is the value of common equity, which is the market capitalization. In the case with the P/EPS multiple, P is the stock price. EV is the enterprise value. A list of the used abbreviations for the value drivers is provided in appendix I. EPS is displayed in units of EUR, because it is a per share measure, the corresponding value relevant measure therefore must be the share price (in units of EUR). N is the sample size. 25% and 75% represent the quartiles. The value drivers are measured at the end of each year. The Market values are measured four months later, at the end of April, each year.

Table 3.5 presents the descriptive statistics of the equity value and entity value multiples for this study. Again, the distribution of the multiples is heavily skewed to the right. The multiples seem to have realistic values, and generally comparable to the multiples of Dittmann & Weiner (2005) and Schreiner (2007). Furthermore, we can see that the 1-year analysts' forecasted numbers are usually higher than the corresponding trailing numbers and 2-year forecasted numbers. The I/B/E/S analyst forecast consensus numbers are only available for a limited set of companies, and therefore resulted in more missing values. Consistent with the conclusion of Fernandez (2001), the statistics also show that the multiples have a broad dispersion, which is indicated by large difference of the inter-quartile statistics (75% percentile minus the 25% percentile).

To obtain the empirical results for this study, the entire methodology is translated into a programming algorithm and language for MATLAB. MATLAB stands for MATrix LABoratory and is a highly advanced numerical computing environment, which is widely used by econometricians. The reason for using MATLAB to assist in my empirical study is that it is almost impossible to valuate more than 26,000 companies by hand. This study computes multiples in an academic, mechanical way to investigate optimal multiples valuations decisions, on average, and therefore is most suitable for a programming algorithm. The MATLAB algorithm and program syntaxes are presented in appendix VII.

Table 3.5: Descriptive statistics of the multiples

	Mean	Median	25%	75%	N
Equity value multiples:					
P / EPS (in EUR)	13.1	11.7	6.3	21.6	24,904
P / EBIT	4.8	5.8	3.2	7.9	24,754
P / EBITDA	4.3	4.8	2.1	7.2	22,995
P / OCF	5.1	7.0	3.9	9.1	24,991
P / D	19.7	28.8	13.5	32.2	20,823
P / SALES	0.7	1.0	0.6	1.5	25,845
P / EPS 1 (in EUR)	13.8	12.7	6.5	21.5	20,126
P / EPS 2 (in EUR)	12.9	11.7	5.4	19.2	20,498
P / EBIT 1	5.5	6.3	2.9	9.2	21,354
P / EBIT 2	4.8	5.6	2.4	8.9	21,458
P / EBITDA 1	4.4	5.2	2.3	8.1	19,381
P / EBITDA 2	4.1	4.7	2.2	7.2	19,398
P / SALES 1	0.8	1.1	0.5	1.6	19,972
P / SALES 2	0.7	1.0	0.5	1.5	19,745
Enterprise value multiples:					
EV / EBIT	8.2	9.9	4.3	13.2	19,262
EV / EBITDA	7.3	8.2	3.5	11.8	18,998
EV/ OCF	8.6	11.9	5.9	14.5	17,023
EV / SALES	1.2	1.7	0.8	1.9	22,992
EV / EBIT 1	9.3	10.8	5.1	13.4	16,523
EV / EBIT 2	8.1	9.6	4.6	11.8	16,543
EV / EBITDA 1	7.5	8.8	3.9	12.5	16,123
EV / EBITDA 2	7.0	8.0	4.1	10.8	16,343
EV / SALES 1	1.4	1.9	0.9	2.1	15,301
EV / SALES 2	1.3	1.7	0.8	1.9	15,381

Notes: P is the value of common equity, which is the market capitalization. In the case with the P/EPS multiple, P is the stock price. EV is the enterprise value. A list of the used abbreviations for the value drivers is provided in appendix I. 25% and 75% represent the quartiles. The equity value multiples are scaled as follows: market value of common equity (in millions of EUR) divided by value driver (in millions of EUR). The equity value EPS multiples are scaled as follows: Stock price (in units of EUR) divided by EPS (in units of EUR). The enterprise value multiples are scaled as follows: enterprise value (in millions of EUR) divided by the value driver (in millions of EUR).

3.6 Summary of this chapter

This chapter describes the methodology of this study. It sheds light on the process needed to obtain the results, derive the conclusions, and to answer the research questions introduced in the first chapter. According to Schreiner (2007), the multiple valuation method consists of four steps, independent of the specific context. This study will follow these steps, as Schreiner (2007) summarizes the whole comprehensive multiple valuation process to a simple schematic overview.

Step 1 is the selection of the value relevant measures. To run the MVM we need to select which kind of value relevant base (equity value or enterprise value) and which kind of value driver (i.e., earnings per share, book value of common equity, or EBIT(DA)) is of interest. In practice, equity value multiples are usually preferred because the value relevant base does not need to be further adjusted for the market value of net debt, as it is in the case with enterprise value.[78] As described in the previous chapter, the list of possible value drivers is long, therefore an appropriate selection is important. Among the most widely used equity multiples in practice are the P/E, P/B, P/SALES and P/OCF multiples, which scale the market price of common equity by the most important summary numbers in the financial reports, net income, book value of common equity.[79] Also, we should consider the time reference of these value drivers (i.e., trailing or forward looking data). The first three research questions involve the optimal value driver, optimal value relevant base, and optimal time reference to construct multiples, and are related to this first step of the MVM valuation. It results in a pool of 24 multiples to be investigated, as presented in table 3.1

Step 2 is the identification of comparable companies. This step of the process involves the identification of the peer group. Based on existing academic literature, the considerations in this step are considered optimal. Palepu, Healy & Bernard (2000) definition of the peer group requires the companies in the peer group to have comparable operating and financial characteristics as the target company. Following Dittmann and Weiner (2005), this study identifies comparable companies based on industry membership and ROA. Moreover, following Eberhart (2004) and Schreiner (2006), the industries are defined using 3-digit ICB grouping codes. In addition, the size of the peer group affects the valuation accuracy, which is investigated in this study by varying the size of the peer group. (Cooper & Cordeiro, 2008)

[78] The equity value multiples does not need to be adjusted for the market value of net debt, however this can affect the value of the multiple. See appendix VIII for more details.
[79] As mentioned before, a list of the used abbreviations in this study is provided in Appendix I.

Step 3 is the estimation of the synthetic peer group multiples. This step compresses the peer group companies' multiples of step 2 into single numbers. This procedure is carried out by estimating the synthetic peer group multiples according to a statistical measure of central tendency. The choice of the statistical measure can significantly influence the accuracy of the valuation results (Schreiner, 2007). Academic studies on this issue have found the median or harmonic mean to be the optimal statistical measures of central tendency.[80] Therefore, I have chosen for the harmonic mean. The harmonic mean is a measure of central tendency, which is less sensitive to outliers than the arithmetic mean (Fahrmeir et al., 1999). Baker and Ruback (1999) show that the magnitude of pricing errors increases with the prices. Since the methodology of harmonic mean results in assigning smaller weights to companies with relatively high stock prices, the harmonic mean is more suitable estimator for the multiples than the arithmetic mean or median (Liu, Nissim and Thomas, 2007). Other studies also confirm that the harmonic mean performs well in terms of minimizing errors caused by high stock prices.[81]

Step 4 is the actual calculation of the equity value. After the selection of the value relevant measures, the identification of the comparable companies and the estimation of the synthetic peer group multiples, we finally arrive at the last step, the value estimation of the target company's value of common equity $\hat{p}_{i,t}^{equity}$. In this case, with traditional multiple valuation, this value is determined by taking the product of the synthetic peer group multiple and the value driver of the company being valued. In addition, the enterprise value is calculated back to equity value by deducting the equity value with the approximation of the net debt, to ease the performance evaluation in the next stage.

The next stage is the measurement and evaluation of the pricing errors. To measure the performance of the different value drivers of multiples, value relevant bases of the multiples, time reference of the value drivers, and optimal peer group size of the multiples, I examine the distribution of its scaled absolute pricing errors $\left|\frac{\varepsilon_{i,t}}{p_{i,t}^{equity}}\right|$. The scaled absolute pricing error $\left|\frac{\varepsilon_{i,t}}{p_{i,t}^{equity}}\right|$ is the difference between the estimated equity value and actual equity value, divided by actual equity value. It represents the valuation accuracy of the equity value estimation. The performance is evaluated by using performance indicators. The first performance indicators are common measures of central tendency such as the arithmetic mean and median of the absolute pricing errors. In addition, I will report the fraction of the value estimates that has absolute pricing errors below 15 percent and 25 percent of its

[80] For more details, see chapter 2, paragraph 2.3. An example of the harmonic mean is provided in the footnote of page 36.
[81] e.g. Beatty, Riffe & Thompson (1999) and Liu, Nissim & Thomas (2002).

observed market values. The latter measure improves comparability with other related studies.[82] Notice that, without insight on the dispersion of the pooled distribution of the scaled absolute pricing errors, common measures of central tendency may be misleading (Aczel, 2002). To ensure reliability, I therefore consider dispersion measures for the scaled absolute pricing errors, such as the standard deviation and three non-parametric dispersion measures. I will focus on the latter, the three non-parametric measures, since they are more resistant to extreme observations than other measures such as the standard deviation. The non-parametric measures are the inter-quartile range (IQR) or the 75^{th} percentile minus the 25^{th} percentile, the 90^{th} percentile minus the 10^{th} percentile and the 95^{th} percentile minus the 5^{th} percentile. The ranges contain information on the distance between the two percentiles only, the standard deviation however, uses the information contained in the entire pooled distribution (Brooks, 2002). For this reason, I also report the standard deviation. However, the focus is on the IQ ranges when it comes to the measurement of dispersion. Following Liu, Nissim & Thomas (2002), when comparing two variables, I also report the relative improvement (%IMP) of variable 2 over variable 1 by calculating the percentage change in the performance indicator (PI).

High performance of the multiples in terms of valuation accuracy is indicated by low values for the measures of central tendency (i.e. arithmetic mean and median) and measures of dispersion (i.e. percentile ranges and standard deviation) of the scaled absolute pricing errors. Moreover, high valuation accuracy is indicated by high numbers for the fractions of the sample with absolute pricing errors below 15 percent and 25 percent. Any performance indicator for a multiple is calculated first for each year and then aggregated into one number using the average.

The last research question compares the performance of traditional equity value multiples performance to an adjusted equity value multiples valuation approach, the Intercept Adjusted Multiples method. The Intercept Adjusted Multiples method was introduced by Liu, Nissim & Thomas (2002) and is a less restrictive approach than traditional MVM because it allows for an intercept in equation (3.10). The methodology presented in this study is mainly adopted from Liu, Nissim & Thomas (2002). The Intercept Adjusted Multiples method follows steps 1 and 2 of the traditional MVM unchanged. Athough, instead of *n=5* comparable companies, for this methodology we use *n=10* comparable companies. This increase of the peer group size is because the methodology involves a minimum variance approach. Aczel (2002) recommends to use more observations for minimum variance techniques, if possible. From step 3 onward, the estimation of the synthetic peer group multiples, it differs from the

[82] In particular, Kaplan & Ruback (1995 & 1996), Kim & Ritter (1999), Gilson, Hotchkiss & Ruback (2003), Lie & Lie (2002), Liu, Nissim & Thomas (2002 & 2006), Hermann & Richter (2003), and Schreiner (2006 & 2007).

traditional MVM. This alternative approach of the MVM relaxes the implied assumption of the traditional approach that the equity value of the company is directly proportional to the corresponding value driver of that company by allowing an intercept. The idea behind the inclusion of an intercept is, that many factors besides the value driver under investigation, are determining value, and the average effect of such excluded factors is unlikely to be zero. Since the intercept $\alpha_{i,t}$ in equation (3.14) captures the average effect of such excluded factors, allowing for an intercept should improve the valuation accuracy of the predictions (Liu, Nissim, & Thomas, 2002).

This study investigates the valuation accuracy of the MVM using European companies. The custom dataset is constructed by pooling the companies from fifteen West European countries that are covered by the data provider I/B/E/S.[83] The investigation horizon for the empirical research eleven years, from January 1999 through December 2009. For each target company i in year t, I estimate its equity and enterprise value using each of the twenty-four multiples.[84] The accounting numbers and analysts' mean consensus forecasts are gathered from the beginning of January in each year, and the market prices four months later, from the beginning of April, to ensure that all year-end information is publicly available and is reflected by the market prices. Subject to restrictions, the dataset contains 26,487 company-years combinations, with around 2,400 companies each year.

[83] The West-European countries includes: The Netherlands, Germany, France, The United Kingdom, Belgium, Italy, Denmark, Ireland, Portugal, Spain, Finland, Austria, Sweden, Switzerland and Norway

[84] The twenty-four types of multiples are presented in table 3.1.

4 Empirical Results

4.1 Introduction

This chapter presents the empirical results that are obtained by following the methodology from chapter 3. The results are computed by translating the entire methodology into an MATLAB compatible algorithm and syntax, which is provided in appendix VII. Each paragraph of this chapter presents and discusses the results of each research question.

4.2 The optimal value driver

The method of valuation using multiples allows a large number of possible multiples. For a given company, we can establish a long list of different multiples, using different value drivers. The first research question investigates which of these value drivers result in the most accurate valuation. Of course, not every possible multiple is investigated, but a subset of multiples that has shown to be widely used in practice.[85]

The results of this investigation using European companies are reported table 4.1. I report the following statistical performance indicators that describe the distribution of the scaled absolute pricings errors: two measures of central tendency, the mean and median, and four measures of dispersion, the standard deviation, the inter-quartile range, the 90%-10% percentile range, and the 95%-5% percentile range. Also, I report the proportion of the sample that has scaled absolute pricing errors below 15% and 25%. The multiples are separated into in four categories: equity value multiples, enterprise value multiples, trailing-priced multiples, and forward-priced multiples.

Examination of the mean and median of the scaled absolute pricing error distribution, shows that pricing errors are skewed to the right, indicated by the medians smaller than the means. In general, the values of the measures of central tendency are smaller than Schreiner's (2007) comparable European dataset. The range of the median of the scaled absolute pricing errors has a minimum of 19.3% and a maximum of 47.5%, versus the 21.7 to 48.8% range of Schreiner (2007), and the 28.7% to 70.9% range of Herrmann & Richter (2003). The only difference in the approach with Schreiner (2007), is in the identification of the comparable companies and the size of the dataset. This might indicate that the identification method of Dittmann & Weiner (2005), which identifies comparable companies from the same industry, and then further filters down the selection by using the return on assets as a criterion, is indeed a better selection process than solely selecting comparable companies based on industry membership.

Again, if we look at the second column of table 4.1, we can see that for 15 out of 24 pooled examined multiples, the scaled absolute pricing error lies below 35%, which means that more than half of the value estimates lies no more than 35% below or above the actual market value. As shown in the last two columns of table 4.1, the fraction of the scaled absolute pricing errors within 15% of the actual market value for the equity value multiples varies from 21.0% to 44.5%. This performance is just a little better than comparable studies,

[85] The subset of the value drivers for this study is presented in table 3.1

Lie & Lie for example reports a range of 22.4% to 35.2% using a set of ten different U.S. multiples and Schreiner report a range of about 22.4% to 40.0%.

Examination of the standard deviation and the three non-parametric dispersion measures in table 4.1, suggests that for almost every multiple category, multiples using the EBIT as value driver exhibit the most accurate valuations. For the trailing-priced equity value multiples, trailing-priced enterprise value multiples, and forward-priced enterprise value multiples, the value driver EBIT ranks first in terms of valuation accuracy, indicated by low values of the dispersion measures. The value drivers EPS and EBITDA rank second and third, respectively. The only exception where the value driver EBIT is outperformed by EPS is for the trailing-priced multiples category. Moreover, both value drivers EPS and EBIT outperform the EBITDA multiples. These findings show that the U.S. results are not always robust when it comes to European countries. Most of the studies that are based on a U.S. dataset, find that the EPS as value driver outperforms all other value drivers.[86] Nevertheless, the outperformance of the value driver EPS by EBIT is not surprising, because the corporate tax rates vary across Europe, which lowers the comparability of the companies across Europe.[87] The EBIT is a pre-tax measure that is better suited for differences in corporate tax rates than EPS, and also when the capital intensity vary across the companies. This makes the EBIT value driver the best performer. The EBITDA value driver is more suitable in a dataset where the capital intensity is more stable, and therefore is outperformed by the EBIT multiple in all cases. The only exception where the value driver EPS ranks first is in the case of forward-priced equity multiples. This is consistent with the idea that analysts mostly focus on earnings for their forecasts (Suozzo et al., 2001), which means the better availability and quality of earnings makes it the winning value driver when it comes to forecasts. The poor performance of cash flow, dividends and operational cash flow, is consistent with the finding of Liu, Nissim, and Thomas (2007), and rejects the belief that cash flow measures are better representatives for future payoffs (Schreiner, 2007). The worst performer is the sales multiples, which is also consistent with the findings in the academic literature.

[86] E.g. Kim & Ritter (1999), Lie & Lie (2002), Liu, Nissim & Thomas (2002 & 2007), and Cooper & Cordeiro (2008).

[87] The superior results of EPS multiples are typically studies that are based on U.S. data, such as Liu, Nissim & Thomas (2002). A U.S. dataset is therefore more homogenous due to the homogeneity of accounting and tax regulation.

Table 4.1: Distribution of the scaled absolute pricing errors for Traditional Multiples

	Mean	Median	SD	75-25%	90-10%	95%-5%	<0.15	<0.25
Equity value multiples:			**Absolute pricing errors:**				**Fractions:**	
Trailing:								
P / EPS	0.442	0.295	0.254	0.454	1.115	1.387	0.275	0.472
P / EBIT	**0.475**	**0.255**	**0.141**	**0.394**	**0.974**	**1.125**	**0.321**	**0.481**
P / EBITDA	0.554	0.301	0.212	0.479	1.012	1.421	0.274	0.459
P / OCF	0.681	0.371	0.210	0.749	1.645	1.947	0.296	0.464
P / D	0.593	0.314	0.218	0.512	1.201	1.478	0.245	0.412
P / SALES	0.733	0.394	0.257	0.762	1.732	2.274	0.219	0.345
Forward looking:								
P / EPS 1	**0.399**	**0.221**	**0.197**	**0.334**	**0.521**	**0.845**	**0.412**	**0.513**
P / EPS 2	**0.324**	**0.193**	**0.145**	**0.318**	**0.541**	**0.821**	**0.445**	**0.589**
P / EBIT 1	0.451	0.238	0.199	0.364	0.721	1.019	0.345	0.512
P / EBIT 2	0.401	0.224	0.198	0.358	0.681	0.941	0.425	0.574
P / EBITDA 1	0.544	0.284	0.112	0.437	1.009	1.247	0.294	0.475
P / EBITDA 2	0.489	0.242	0.101	0.371	0.745	1.078	0.314	0.499
P / SALES 1	0.723	0.452	0.294	0.775	1.799	2.354	0.210	0.321
P / SALES 2	0.754	0.469	0.201	0.779	1.811	2.478	0.209	0.314
Enterprise value multiples:			**Absolute pricing errors:**				**Fractions:**	
Trailing:								
EV / EBIT	**0.621**	**0.333**	**0.194**	**0.559**	**1.289**	**1.624**	**0.234**	**0.417**
EV / EBITDA	0.654	0.341	0.241	0.658	1.345	1.801	0.212	0.394
EV / OCF	0.724	0.384	0.244	0.758	1.721	2.241	0.249	0.387
EV / SALES	0.791	0.475	0.297	0.843	1.874	2.597	0.214	0.334
Forward looking:								
EV / EBIT 1	**0.599**	**0.329**	**0.239**	**0.556**	**1.165**	**1.610**	**0.265**	**0.410**
EV / EBIT 2	**0.598**	**0.312**	**0.388**	**0.551**	**1.146**	**1.517**	**0.275**	**0.421**
EV / EBITDA 1	0.644	0.354	0.211	0.694	1.487	1.854	0.234	0.401
EV / EBITDA 2	0.641	0.339	0.399	0.645	1.299	1.700	0.244	0.418
EV / SALES 1	0.858	0.495	0.202	0.855	1.910	2.874	0.181	0.298
EV / SALES 2	0.884	0.501	0.294	0.871	1.954	2.941	0.201	0.312

Notes: P is the value of common equity, which is the market capitalization. In the case with the P/EPS multiple, P is the stock price. EV is the enterprise value. A list of the used abbreviations for the value drivers is provided in appendix I. SD represents the standard deviation, 75-25%, 90%-10%, and 95%-5% represents the distances between the percentiles. <0.15 and <0.25 represent the proportion of the sample that has a scaled absolute pricing error below 15% and 25%, respectively. The formation of the peer group is based on five comparable companies.

4.2 The optimal value relevant base

There is still no consensus on the optimal choice of the value relevant base. With a few exceptions, most studies focus only on one value relevant base in the numerator of multiples, and do not compare and evaluate the performance of both bases. The exceptions are Kim & Ritter, Liu, Nissim & Thomas (2002) and Schreiner (2007), who do include a comparison and find that equity value multiples outperform enterprise value multiples. The first two studies find the results surprising, but are unable to provide any rationale for why such a result is observed. Schreiner (2007) conclude that adjusting for differences in leverage does not improve valuation accuracy, because the estimation of the market value goes hand in hand with distorting noise. [88]

Financial theory supports the use of enterprise value over equity value multiples, because they are less sensitive to different capital structures among the comparable companies. However, in practice we observe that portfolio managers mostly prefer utilizing equity value multiples, investment bankers prefer enterprise value multiples, and equity analysts use both for their research reports (Schreiner, 2007).[89] From a theoretical and practical point of view, it is therefore interesting to compare the performance of equity and enterprise value multiples, to add to optimal the value relevant base debate, using a European dataset.

The results of the performance comparison of equity and enterprise value multiples are presented in table 4.2. The value drivers that do not satisfy the matching principle with respect to an enterprise value base are excluded from this comparison. The remaining value drivers are used to construct both equity and enterprise value multiples. Although most of the value drivers left are more related to an enterprise value relevant base, these equity multiples are still constructed for the comparison.[90] The matching principle is ignored, following Schreiner (2007) and practitioners. To evaluate performance of the two value relevant bases, I report the IQR values, the absolute difference, and the relative difference of the equity and enterprise value multiples. Furthermore, I report the t-statistics on the significance of the relative differences (%IMP). The t-statistics indicate that all the %IMP values are statistically significant.

[88] The equity value multiple does not need to be adjusted for the market value of net debt, however different gearing ratios can affect the value of the multiple. See appendix VIII for more details.
[89] These results were derived from interview with practitioners.
[90] For example, EBITDA is a value driver that is more suitable for enterprise value bases, however its equity value multiples form, P/EBITDA are also used in practice by investment bankers, equity analysts, portfolio managers (Liu, Nissim & Thomas, 2002).

The comparison results using the IQR indicator in table 4.2 shows that equity value multiples strongly outperform enterprise value multiples. The decline in performance when using enterprise value multiples instead of equity value multiples varies from 1.2% to 73.9%. While the decline in performance is clearly present in the trailing priced multiples category, it is even more present in the forward priced category. Besides the noise when estimating the enterprise value, forward looking data seems to even more distort the quality of enterprise value multiples. Multiples based on cash flow from operational activities seems to be the least affected by the change in value base. The average performance results shows that equity value multiples are 35.2% better in valuing than enterprise value multiples. These results are in line with the findings of Kim & Ritter (1999), Liu, Nissim & Thomas (2002), and Schreiner (2007) that equity multiples outperform enterprise value multiples. Moreover, the reported outperformance of 35.2% is higher than Schreiner’s comparable statistic of 22.51%.

Table 4.2: Value relevant base performance comparison using IQR

Value driver	Equity value IQR	Enterprise value IQR	Absolute difference	%IMP	t-stat	N
Trailing:						
EBIT	0.394	0.559	0.165	41.878%	162.6	16,723
EBITDA	0.479	0.658	0.179	37.700%	186.3	15,992
OCF	0.749	0.758	0.009	1.202%	13.5	14,288
SALES	0.762	0.843	0.081	10.630%	68.2	21,396
Forward looking:						
EBIT 1	0.364	0.556	0.192	52.747%	237.3	14,391
EBIT 2	0.358	0.551	0.193	53.912%	310.0	13,923
EBITDA 1	0.437	0.694	0.257	58.810%	254.7	14,236
EBITDA 2	0.371	0.645	0.274	73.854%	398.4	14,819
SALES 1	0.775	0.855	0.080	10.323%	25.5	13,928
SALES 2	0.779	0.871	0.092	11.810%	13.2	14,231
Average Equity value multiples vs. Enterprise value multiples:			0.152	35.165%	166.9	15,392

Notes: A list of the used abbreviations for the value drivers is provided in appendix I. IQR stands for the inter-quartile range of the scaled absolute pricing error, which is the 75% percentile minus the 25% percentile of the distribution. Low values of IQR indicate high performance, therefore a positive absolute difference means a decline in performance when shifting from equity value multiples to enterprise value multiples. %IMP stands for the relative improvement when shifting from equity value multiples to enterprise value multiples. A positive %IMP indictes an increase in IQR, thus a decline of performance. The high values for the t-statistics indicate that all the %IMP are statistically significant at 5% confidence level. The formation of the peer group is based on five comparable companies.

To further compare the equity and enterprise value multiples and increase the comparability of the results with Schreiner (2007), I include a comparison using the fraction <0.15 indicator. This indicator shows proportion of the value estimates that has a scaled absolute pricing error below 15%. The results of this comparison are shown in table 4.3, and again, favors the equity value multiples. Table 4.2 suggest that, relative to equity value multiples, when using enterprise value multiples the proportion of the value estimates that have a scaled absolute pricing error of 15% shrinks with 18.6%. Again, this value is extremer than Schreiner's reported value of 1.22%. It seems my more advanced comparable companies identification method, and extended European dataset, does not improve the enterprise value multiples.

Table 4.3: Value relevant base performance comparison using Fraction <0.15

Value driver	Equity value Fraction <0.15	Enterprise value Fraction <0.15	Absolute difference	%IMP	t-stat	N
Trailing:						
EBIT	0.321	0.234	-0.087	-27.103%	-87.2	16,723
EBITDA	0.274	0.212	-0.062	-22.628%	-106.7	15,992
OCF	0.296	0.249	-0.047	-15.878%	-91.6	14,288
SALES	0.219	0.214	-0.005	-2.238%	-24.6	21,396
Forward looking:						
EBIT 1	0.345	0.265	-0.080	-23.188%	-235.4	14,391
EBIT 2	0.425	0.275	-0.150	-35.294%	-173.9	13,923
EBITDA 1	0.294	0.234	-0.060	-20.408%	-135.5	14,236
EBITDA 2	0.314	0.244	-0.070	-22.293%	-174.6	14,819
SALES 1	0.210	0.181	-0.029	-13.810%	-88.4	13,928
SALES 2	0.209	0.201	-0.008	-3.82775%	-16.9	14,231
Average Equity value multiples vs. Enterprise value multiples:			-0.059	-18.588%	-113.5	15,392

Notes: A list of the used abbreviations for the value drivers is provided in appendix I. Fraction <0.15 stands for the proportion of the value estimates that have a scaled absolute pricing error below 15%. High values of 'fraction <0.15' indicate high performance, therefore a negative absolute difference means an decrease in performance when going from equity value multiples to enterprise value multiples. %IMP stands for the relative improvement when going from equity value multiples to enterprise value multiples. A negative %IMP indicate that the fraction shrinks, thus indicate a decrease of performance. The high values for the t-statistics indicate that all the %IMP are statistically significant at 5% confidence level. The formation of the peer group is based on five comparable companies.

It is already known that we face a tradeoff between capital structure independence and noise when estimating the enterprise value of a company, however, the results show that it is wiser to choose equity value multiples above enterprise value multiples, on average. The use of equity value multiples can result in a considerably more accurate and reliable valuation. This result might be explained by the noise that comes with the estimation of the enterprise value. To be more precise, it is the approximation of the market value of net debt with the book value of net debt, that produces considerable noise, which distorts the quality of the enterprise value multiples. Equity value multiples do not suffer from this noise because the market capitalization can be observed directly from market values. We should note that equity value multiples are not completely noise-free, since they can be affected by different gearing ratios.[91] However, the superior results of the equity value multiples suggest that this distorting effect is significantly smaller than the noise when estimating the market value of net debt for the enterprise value multiples. The explanation might be that the comparable companies have relative similar comparable gearing ratios to the target company, due to the selection criteria based on industry membership and ROA. This is consistent with the literature on capital structure, in which Harris & Raviv (1991) noted that it is generally accepted that firms in a given industry have similar gearing ratios, while this ratio vary across industries.[92]

Considering the distorted valuation results of the enterprise value multiples, these multiples are excluded from the coming empirical research issues in the next paragraphs.

[91] This point has been made by my supervisor, Marc Schauten. See appendix VIII for more details.

[92] Harris & Raviv (1999) summarized four studies (Bowen, Daly & Huber (1982), Bradley, Jarrell & Kim (1984), Long & Malitz (1985) and Kester (1986), which finds that companies in the same industry tends to have a common gearing ratio.

4.3 The optimal time reference of the value drivers

It has long been recognized in the academic literature that multiples based on analysts' consensus forecasts has more potential to reflect value relevant data than historical data (Liu, Nissim & Thomas, 2002). The explanation is that such multiples follow principles of value generation (Schreiner, 2007). The support for forward-looking multiples is mostly based on U.S. IPOs and U.S. equities, to test the robustness of these findings, I include a performance comparison of European equity multiples based on different time references. So far, only Schreiner (2007) has investigated trailing-priced multiples versus forward-priced multiples, using a European dataset.

The performance comparison is carried out in the same way as with the comparison of the value relevant bases in paragraph 4.2. Examination of the results in table 4.4 shows that forward-looking multiples outperform trailing multiples, in terms of lowest dispersion. Using 1-year forecast data instead of trailing data results in, on average, 10.2% more accurate equity valuation estimates. Furthermore, choosing for 2-year forecast data instead of trailing data even results in 14.9% more accuracy. Moving from 1-year forecast data to 2-year forecast data improves the accuracy with 7.4%. The results in table 4.4 definitely favor the forward-looking multiples, especially the 2-year forecasts. This conclusion is in line with the findings of Kim & Ritter (1999), Lie & Lie (2002), Liu, Nissim & Thomas (2002 & 2007), and Schreiner (2007), which show the superiority of forward-looking multiples. Also, it is consistent with the finding of Penman (2006), who promotes the utilization of 2-year forward-looking data in valuation models, because according to him the 2-year forward-looking data is the equity analysts' most powerful communication instrument in the perception of market participants.

Inspection of the individual performance of the multiples in table 4.4 shows that the magnitude of the outperformance of forward-looking multiples depends on the value driver of the multiple. The largest improvement in equity valuation accuracy, when using forecasts instead of trailing data, comes from using EPS multiples. The valuation accuracy gains a boost of 26.4% when using 1-year forecasts, and 29% when using 2-year forecasts. EBITDA multiple surprisingly benefits more from forecast data than EBIT multiples, however the values lie nowhere close to the EPS. With sales multiples, I observe a reversed result. It seems that the shift to forecast data causes a decline in performance for the sales multiples. These findings can be explained by the observation of Schreiner, that equity analysts focus most of their effort towards the estimation of earnings forecasts. The equity analysts are motivated to do so, because it is industry practice to determine an analyst's performance by his ability to forecast earnings accurately. Subsequently, the market focuses on the forecasts of earnings and market values adjust accordingly (Schreiner, 2007).

Table 4.4: Time reference performance comparison using IQR

Value driver	IQR:	vs. IQR:	Absolute difference	%IMP	t-stat	N
	Trailing:	**1-year forecast:**				
EPS	0.454	0.334	-0.120	-26.431%	-137.1	19,421
EBIT	0.394	0.364	-0.030	-7.614%	-46.8	21,045
EBITDA	0.479	0.437	-0.042	-8.768%	-39.4	19,324
SALES	0.762	0.775	0.013	1.706%	8.3	20,086
Average trailing-priced vs. 1-year forward-priced:			-0.045	-10.277%	-53.75	19,969
	Trailing:	**2-year forecast:**				
EPS	0.334	0.318	-0.136	-29.956%	-152.6	19,345
EBIT	0.364	0.358	-0.036	-9.137%	-57.4	21,441
EBITDA	0.437	0.371	-0.108	-22.547%	-110.7	19,127
SALES	0.775	0.779	0.017	2.231%	11.5	20,142
Average trailing-priced vs. 2-year forward-priced:			-0.0656	-14.852%	-77.3	20,014
	1-year forecast:	**2-year forecast:**				
EPS	0.334	0.318	-0.016	-4.790%	-21.7	19,124
EBIT	0.399	0.358	-0.041	-10.276%	-61.2	21,117
EBITDA	0.437	0.371	-0.066	-15.103%	-64.8	19,109
SALES	0.775	0.779	0.004	0.516%	2.4	20,078
Average 1-year forward-priced vs. 2-year forward-priced:			-0.0298	-7.413%	-36.3	19,857

Notes: A list of the used abbreviations for the value drivers is provided in appendix I. IQR stands for the inter-quartile range of the scaled absolute pricing error, which is the 75% percentile minus the 25% percentile of the distribution.. Low values of IQR indicate high performance, therefore a negative absolute difference means an increase in performance when choosing for forecasts instead of trailing data. %IMP stands for the relative improvement. A negative %IMP means than an increase in performance, because the IQR shrinks. The high values for the t-statistics indicate that all the %IMP are statistically significant at 5% confidence level. The formation of the peer group is based on five comparable companies.

Again, to further compare the time reference of multiples and increase the comparability of the results with Schreiner (2007), I include a comparison using the fraction <0.15 indicator. The results in table 4.5 suggest similar findings as in table 4.4. Forward-looking data is superior, especially the two-year forecasts with an improvement of the fraction of 26.1%. The largest improvement lies with the EPS multiples, with 49.8% improvement with 1-year forecasts and 61.8% with 2-year forecasts. Again, a reversed effect is observed for sales multiples. Except for some larger magnitudes of the EPS improvements, the results are generally consistent with Schreiner (2007).

Table 4.5: Time reference performance comparison using Fraction <0.15

Value driver	Fraction <0.15: vs.	Fraction <0.15:	Absolute difference	%IMP	t-stat	N
	Trailing:	**1-year forecast:**				
EPS	0.275	0.412	0.137	49.818%	268.9	19,421
EBIT	0.321	0.345	0.024	7.477%	48.6	21,045
EBITDA	0.274	0.294	0.02	7.300%	37.1	19,324
SALES	0.219	0.210	-0.009	-4.110%	-51.3	20,086
Average trailing-priced vs. 1-year forward-priced:			0.043	15.117%	75.8	19,969
	Trailing:	**2-year forecast:**				
EPS	0.275	0.445	0.17	61.818%	324.8	19,345
EBIT	0.321	0.425	0.104	32.399%	199.7	21,441
EBITDA	0.274	0.314	0.04	14.599%	71.5	19,127
SALES	0.219	0.209	-0.01	-4.566%	-57.3	20,142
Average trailing-priced vs. 2-year forward-priced:			0.076	26.063%	134.7	20,014
	1-year forecast:	**2-year forecast:**				
EPS	0.412	0.445	0.033	8.010%	44.5	19,124
EBIT	0.345	0.425	0.08	23.188%	141.5	21,117
EBITDA	0.294	0.314	0.02	6.803%	30.8	19,109
SALES	0.210	0.209	-0.001	-0.476%	4.7	20,078
Average 1-year forward-priced vs. 2-year forward-priced:			0.033	9.381%	55.4	19,857

Fraction <0.15 stands for the proportion of the value estimates that has a scaled absolute pricing error below 15%. High values of 'fraction <0.15' indicate high performance, therefore a positive absolute difference means an increase in performance. %IMP stands for the relative improvement. A positive %IMP indicate that the fraction grows, thus indicate a increase in performance. The high values for the t-statistics indicate that all the %IMP are statistically significant at 5% confidence level. The formation of the peer group is based on five comparable companies.

4.4 The optimal size of the peer group

Schreiner (2007) suggests that a peer group with four to eight comparable companies is the ideal size. His conclusion is derived from various interviews with practitioners and academics. While some studies somewhat agree on this optimal size of the peer group, so far only one study has done empirical investigation on this topic. The study of Cooper & Cordeiro (2008) examines how the accuracy of a MVM based valuation varies as the number of comparable companies in the peer groups increases. Their research is motivated by a contrast observed between the approach of theory and practice. Practitioners typically use a small number of closely related comparable companies, whereas academic studies often use all the companies in the entire industry. Using U.S. companies, Cooper & Cordeiro (2008) find that using a peer group of ten companies is optimal, and five companies is only slightly less accurate. This aspect of valuation accuracy using multiple valuation is rarely empirically investigated, therefore, I include a comparison of MVM valuations with different peer group sizes. It is in fact a replication of Cooper & Cordeiro (2008), but on a smaller scale. It is interesting to find out which number of comparable companies, on average, results in more accurate valuation.

The performance of $n = 2, 5, 10,$ and 20 comparable companies is evaluated. The performance of the different numbers of comparable companies is indicated by a measure of central tendency, the median, and a dispersion measure, the IQR. The average performance is the mean of the performance of the entire set of multiples.

Inspection of table 4.6 shows an interesting finding. Looking at the average performance in terms of lowest dispersion, five comparable companies are optimal. The inclusion of more comparable companies increases dispersion. The dispersion for a peer group of two comparable companies is higher than one with five comparable companies. The dispersion for a peer group of five and ten comparable companies is almost the same. The increase in dispersion when moving from ten to twenty comparables is large. From *n = 2* comparable companies to *n=5* comparable companies, it seems that inclusion of more comparable companies has the benefit of adding more value relevant information. However, from n=5 comparable companies onwards, adding more comparable companies comes at the cost of adding more noise to the distribution, which increases the dispersion of the distribution. The inaccuracy of small samples is caused by the higher probability of the occurrence of extreme errors, as the number of comparable companies increases, so does the frequency of small errors (Cooper & Cordeiro, 2008). There is a trade-off between the extra information contained in the market values of additional companies and probability of introducing additional pricing errors.

Table 4.6: Performance comparison for different number of comparables using IQR

	n=2		n=5		n=10		n=20	
Value driver	Median	IQR	Median	IQR	Median	IQR	Median	IQR
Trailing:								
P / EPS	0.249	0.441	0.295	0.454	0.296	0.454	**0.301**	**0.403**
P / EBIT	**0.261**	**0.401**	**0.255**	**0.394**	**0.257**	**0.395**	0.268	0.462
P / EBITDA	0.264	0.432	0.301	0.479	0.304	0.481	0.321	0.493
P / OCF	0.343	0.759	0.371	0.749	0.373	0.753	0.387	0.772
P / D	0.311	0.513	0.314	0.512	0.318	0.514	0.322	0.534
P / SALES	0.345	0.765	0.394	0.762	0.386	0.763	0.422	0.789
Forward looking:								
P / EPS 1	0.195	0.389	0.221	0.334	0.223	0.338	0.230	0.446
P / EPS 2	**0.177**	**0.320**	**0.193**	**0.318**	**0.195**	**0.320**	**0.204**	**0.340**
P / EBIT 1	0.247	0.368	0.238	0.364	0.239	0.366	0.262	0.385
P / EBIT 2	0.219	0.368	0.224	0.358	0.228	0.362	0.228	0.372
P / EBITDA 1	0.275	0.423	0.284	0.437	0.289	0.441	0.309	0.452
P / EBITDA 2	0.266	0.412	0.242	0.371	0.247	0.374	0.254	0.398
P / SALES 1	0.571	0.810	0.452	0.775	0.460	0.792	0.487	0.819
P / SALES 2	0.602	0.834	0.469	0.779	0.479	0.782	0.493	0.845
Average performance:	0.310	0.5174	0.304	0**.506**	0.308	0.509	**0.320**	0.5292

Notes: P is the value of common equity, which is the market capitalization. In the case with the P/EPS multiple, P is the stock price. A list of the used abbreviations for the value drivers is provided in appendix I. For n= 2, 5, 20, and 20 comparables, the median and IQR of the absolute scaled pricing errors are used as performance indicators. The IQR stands for the inter-quartile range, which is the 75% percentile minus the 25% percentile. The average performance is the mean of performance indicators of all multiples.

I suggest an optimal peer group range of five to ten companies, because table 4.6 shows that additional comparable companies comes at the cost of just a little more dispersion. This optimal range for the size of the peer group may be not very useful to the practitioner, because the practitioners typically identify a peer group as small as possible. The target company being valued is usually a company that he knows thoroughly. For the academic researcher however, this range is useful because he has to determine fixed rules to handle large datasets. Although the result of this study is not directly comparable to other studies due to the different comparable companies identification methods and data contexts, there is some consistency. Cooper & Cordeiro (2008) use long-term growth indicators as the identification rule and a U.S. dataset. His suggested optimal number therefore differs from mine, but the recommended range does show overlap. Schreiner's (2007) recommended size of four to eight comparable companies is also within my suggested optimal range.

Furthermore, table 4.6 shows that the performance of the individual multiples is quite consistent, relative to the peer group size of five companies. For all numbers of comparable companies, the forward-priced EPS multiple is the most accurate multiple. With the trailing-priced multiples however, the best performing multiple switches from the EBIT to EPS multiple when *n=20* comparable companies. While the ranking may vary, the top three performers are always EPS, EBIT and EBITDA multiples.

4.5 Traditional MVM versus Intercept Adjusted MVM

In the traditional MVM, the equity / enterprise value of the target firm is directly proportional to the value driver.[93] Liu Nissim & Thomas (2002) first introduced an adjusted methodology, where they relax the direct proportionality requirement and allow for an intercept in the valuation equation. Their motivation is that besides the value driver that is included in the equation, many other factors affect the value of the target company, and the average effect of such excluded factors is unlikely to be zero. The inclusion of an intercept should improve the valuation accuracy of the estimates. And indeed, as predicted, the results of this adjusted methodology by Liu, Nissim & Thomas (2002) improves the performance of all equity value multiples. The study of Liu, Nissim & Thomas (2002) is based on a U.S. dataset. To test whether the intercept-adjusted multiples can also improve the valuation accuracy of European companies, I apply the Intercept Adjusted Multiples methodology to my dataset.[94]

Inspection of the equity value multiples in table 4.7 shows no obvious changes, relative to traditional MVM in table 4.1. The standard deviation and the three non-parametric dispersion measures in table 4.7 still suggests that for the trailing multiples category, the EBIT multiples exhibit the most accurate valuations, as indicated by low values of the dispersion measures. The EPS and EBITDA multiples ranks second and third, respectively. For the forward-priced equity value multiples category, the EPS multiples outperform the EBIT multiples. Moreover, both EPS and EBIT multiples outperform the EBITDA multiples. Cash flow multiples, the dividends multiple and operational cash flow multiple, and sales multiples, are still the weakest performers among the equity value multiples. The ranking of the performers are consistent with the results for traditional MVM.

Whereas table 4.7 shows us the overall performance of Intercept Adjusted Multiples, table 4.8 compares its performance to traditional multiples. Like for the preceding comparisons, I report the IQR values, the absolute difference, and the relative difference of traditional and Intercept Adjusted Multiples. Furthermore, I report the t-statistic on the significance of the relative difference (%IMP). The t-statistic indicate that the %IMP values are statistically significant, except for the two-year forward P / EBIT multiple.

The comparison results, using the IQR indicator, in table 4.8 show that the introduction of an intercept does improve the overall valuation accuracy with 2.5%. While most of the multiples perform better, the trailing-priced EBITDA and two year forward EBIT multiples show a little decline in performance, with 0.7% decline and an insignificant 0.3%

[93] For more details, see chapter 3, the methodology.
[94] The intercept adjusted multiples methodology is thoroughly described in chapter 3, paragraph 3.5.

decline, respectively. The EPS multiples show minor improvements of 0.4% to 1.2%. Also the EBIT and EBITDA multiples, show minor improvements and a few cases of declines in accuracy. The OCF and sales multiples however show large improvements of 3.3% to 10.3%. We can conclude from table 4.8 that poor performing multiples in table 4.1, such as the OCF and sales multiples, benefit more from the inclusion of an intercept than those that performed well. These results are not entirely consistent with Liu, Nissim & Thomas (2002). Whereas all the multiples in Liu, Nissim & Thomas (2002) gains an increase in performance, only 11 out of 14 multiples in this study improved due to an intercept. However, the overall result is the same. That is, Intercept Adjusted Multiples do exhibit improved equity valuation results. Although the adjusted MVM methodology results in more accurate equity valuation results, I doubt that they will outperform the traditional MVM methodology, in terms of popularity. The popularity of traditional multiples in practice is largely due to its simplicity to apply, comprehend, and communicate, and the additional complexity by the inclusion of an intercept may be larger than these benefits.

Table 4.7: Distribution of the scaled absolute pricing errors for Intercept Adjusted Multiples

	Mean	**Median**	**SD**	**75-25%**	**90-10%**	**95%-5%**	**<0.15**	**<0.25**
Equity value multiples:			**Absolute pricing errors:**				**Fractions:**	
Trailing:								
P / EPS	0.440	0.290	0.148	0.452	1.110	1.379	0.279	0.484
P / EBIT	**0.473**	**0.251**	**0.134**	**0.391**	**0.968**	**1.116**	**0.325**	**0.493**
P / EBITDA	0.553	0.302	0.114	0.481	1.016	1.426	0.274	0.462
P / OCF	0.681	0.342	0.188	0.724	1.602	1.893	0.303	0.421
P / D	0.584	0.297	0.178	0.508	1.193	1.456	0.236	0.440
P / SALES	0.716	0.336	0.204	0.701	1.708	2.154	0.246	0.365
Forward looking:								
P / EPS 1	**0.398**	**0.215**	**0.102**	**0.330**	**0.516**	**0.837**	**0.417**	**0.529**
P / EPS 2	**0.322**	**0.189**	**0.109**	**0.316**	**0.531**	**0.816**	**0.452**	**0.594**
P / EBIT 1	0.450	0.231	0.120	0.361	0.703	1.010	0.354	0.532
P / EBIT 2	0.401	0.222	0.137	0.359	0.678	0.944	0.427	0.561
P / EBITDA 1	0.546	0.286	0.124	0.440	1.012	1.253	0.289	0.450
P / EBITDA 2	0.486	0.242	0.127	0.367	0.737	1.069	0.320	0.502
P / SALES 1	0.699	0.401	0.231	0.705	1.689	2.283	0.252	0.384
P / SALES 2	0.640	0.402	0.221	0.699	1.702	2.298	0.249	0.415

Notes: P is the value of common equity, which is the market capitalization. In the case with the P/EPS multiple, P is the stock price. A list of the used abbreviations for the value drivers is provided in appendix I. SD represents the standard deviation, 75-25%, 90%-10%, and 95%-5% represents the distances between the percentiles. <0.15 and <0.25 represent the proportion of the sample that has a scaled pricing error below 15% and 25%, respectively. The formation of the peer group is based on ten comparable companies.

Table 4.8: Traditional versus Intercept Adjusted MVM performance comparison using IQR

Value driver	Traditional IQR	Intercept IQR	Absolute difference	%IMP	t-stat	N
Trailing:						
P / EPS	0.454	0.452	-0.002	-0.441%	-4.6	23,723
P / EBIT	**0.394**	**0.391**	**-0.003**	**-0.761%**	**-6.8**	**23,546**
P / EBITDA	0.479	0.481	0.002	0.418%	2.5	21,920
P / OCF	0.749	0.724	-0.025	-3.338%	-32.2	23,043
P / D	0.512	0.508	-0.004	-0.782%	-3.7	19,523
P / SALES	0.762	0.701	-0.061	-8.005%	-57.4	24,972
Forward looking:						
P / EPS 1	**0.334**	**0.330**	**-0.004**	**-1.198%**	**-9.5**	**18,861**
P / EPS 2	**0.318**	**0.316**	**-0.002**	**-0.629%**	**-4.9**	**18,123**
P / EBIT 1	0.364	0.361	-0.003	-0.824%	-2.6	20,762
P / EBIT 2	0.358	0.359	0.001	0.279%	1.2*	20,281
P / EBITDA 1	0.437	0.440	0.003	0.687%	5.3	18,421
P / EBITDA 2	0.371	0.367	-0.004	-1.078%	-9.2	18,397
P / SALES 1	0.775	0.705	-0.070	-9.032%	-45.5	19,538
P / SALES 2	0.779	0.699	-0.080	-10.270%	-53.8	19,634
Average Traditional vs. Intercept Adjusted Multiples:			0.018	-2.500%	-17,1	19,358

Notes: P is the value of common equity, which is the market capitalization. In the case with the P/EPS multiple, P is the stock price. A list of the used abbreviations for the value drivers is provided in appendix I. IQR stands for the inter-quartile range of the scaled absolute pricing error, which is the 75% percentile minus the 25% percentile of the distribution. Low values of IQR indicate high performance, therefore a negative absolute difference means an increase in performance. %IMP stands for the relative improvement. A negative %IMP means than an increase in performance, because the IQR shrinks. The high values for the t-statistics indicate that most of the %IMP are statistically significant. The t-statistic with an asterisk is not significant. The formation of the peer group is based on ten comparable companies.

As with the preceding comparisons, to further compare the performance of traditional versus intercept adjusted MVM, I include a comparison using the fraction <0.15 indicator. The results in table 4.9 further confirm the findings of table 4.8. The fraction of the sample with a scaled absolute pricing error below 15% increases with an average of 18.6% by introducing an intercept. However, this average improvement is mainly contributed by the large improvement in the sales multiples. The sales multiples gain a 12.3% to 20% improvement, whereas the improvement for other multiples is just 0.4% to 2.4%. Unlike Liu, Nissim & Thomas (2002), not all multiples improve by the introduction of an intercept. The trailing-price EBITDA multiples and 1-year forward EBITDA multiples show a drop of performance of 0.7% and 1.7%, respectively. We can again conclude from table 4.9 that poor performing multiples in table 4.1, such as the sales multiples, benefit more from the inclusion of an intercept than those that performed well, such as the EPS and EBIT multiples.

Table 4.9: Traditional versus Intercept Adjusted MVM performance comparison using Fraction <0.15

Value driver	Traditional Fraction <0.15	Intercept Fraction <0.15	Absolute difference	%IMP	t-stat	N
Trailing:						
P / EPS	0.275	0.279	0.004	1.454%	14.3	23,723
P / EBIT	**0.321**	**0.325**	0.004	1.246%	11.6	**23,546**
P / EBITDA	0.276	0.274	-0.002	-0.730%	-3.8	21,920
P / OCF	0.296	0.303	0.007	2.365%	21.3	23,043
P / D	0.236	0.245	0.009	3.673%	34.1	19,523
P / SALES	0.219	0.246	0.027	12.323%	83.2	24,972
Forward looking:						
P / EPS 1	**0.412**	**0.417**	0.005	1.214%	9.6	**18,861**
P / EPS 2	**0.445**	**0.452**	0.007	1.573%	11.9	**18,123**
P / EBIT 1	0.345	0.354	0.009	2.609%	7.8	20,762
P / EBIT 2	0.425	0.427	0.002	0,471%	1.9*	20,281
P / EBITDA 1	0.294	0.289	-0.005	-1.701%	-12.9	18,421
P / EBITDA 2	0.314	0.320	0.006	1.911%	15.7	18,397
P / SALES 1	0.210	0.252	0.042	20.000%	97.6	19,538
P / SALES 2	0.209	0.249	0.040	19.139%	98.6	19,634
Average Traditional vs. Intercept Adjusted Multiples:			-0.059	18.588%	-113.5	15,392

Notes: P is the value of common equity, which is the market capitalization. In the case with the P/EPS multiple, P is the stock price. A list of the used abbreviations for the value drivers is provided in appendix I. Fraction <0.15 stands for the proportion of the value estimates that have a scaled absolute pricing error below 15%. High values of 'fraction <0.15' indicate high performance, therefore a positive absolute difference means a decrease. %IMP stands for the relative improvement when going from equity value multiples to enterprise value multiples. A positive %IMP indicates that the fraction grows, thus indicate a increase of performance. The high values for the t-statistics indicate that most of the %IMP are statistically significant at 5% confidence level. The t-statistic with an asterisk is not significant. The formation of the peer group is based on ten comparable companies.

4.6 Summary of this chapter

This chapter presents the empirical results that are obtained by following the methodology from chapter 3. The results are computed by translating the entire methodology into an MATLAB compatible algorithm and syntax, which is provided in appendix VII.

Examination of the standard deviation and the three non-parametric dispersion measures in table 4.1, suggests that for almost every multiple category, multiples using the EBIT as value driver exhibit the most accurate valuations. For the trailing-priced equity value multiples, trailing-priced enterprise value multiples, and forward-priced enterprise value multiples, the value driver EBIT ranks first in terms of valuation accuracy, indicated by low values of the dispersion measures. The value drivers EPS and EBITDA rank second and third, respectively. The only exception where the value driver EBIT is outperformed by EPS is for the trailing-priced multiples category. Moreover, both value drivers EPS and EBIT outperform the EBITDA multiples. Nevertheless, the outperformance of the value driver EPS by EBIT is not surprising, because the corporate tax rates vary across Europe, which lowers the comparability of the companies across Europe.[95] The EBIT is a pre-tax measure that is better suited for differences in corporate tax rates than EPS, and also when the capital intensity vary across the companies. This makes the EBIT value driver the best performer. The EBITDA value driver is more suitable in a dataset where the capital intensity is more stable, and therefore is outperformed by the EBIT multiple in all cases. The only exception where the value driver EPS ranks first is, in the case of forward-priced equity multiples. This is consistent with the idea that analysts mostly focus on earnings for their forecasts (Suozzo et al., 2001), which means the better availability and quality of earnings makes it the winning value driver when it comes to forecasts. The poor performance of cash flow, dividends and operational cash flow, is consistent with the finding of Liu, Nissim, and Thomas (2007), and rejects the belief that cash flow measures are better representatives for future payoffs (Schreiner, 2007). The worst performer is the sales multiples, which is also consistent with findings in the academic literature,

The comparison results using the IQR indicator in table 4.2 shows that equity value multiples strongly outperform enterprise value multiples. The decline in performance when using enterprise value multiples instead of equity value multiples varies from 1.2% to 73.9%. While the decline in performance is clearly present in the trailing priced multiples category, it is even more present in the forward priced category. Besides the noise when estimating the enterprise value, forward looking data seems to even more distort the quality of enterprise

[95] The superior results of EPS multiples are typically studies that are based on U.S. data, such as Liu, Nissim & Thomas (2002). A U.S. dataset is therefore more homogenous due to the homogeneity of accounting and tax regulation.

value multiples. Multiples based on cash flow from operational activities seems to be the least affected by the change in value base. The average performance results shows that equity value multiples are 35.2% better in valuing than enterprise value multiples. It is already known that we face a tradeoff between capital structure independence and noise when estimating the enterprise value of a company, however, the results show that it is wiser to choose equity value multiples above enterprise value multiples, on average. The use of equity value multiples can result in a considerably more accurate and reliable valuation. This result might be explained by the noise that comes with the estimation of the enterprise value. To be more precise, it is the approximation of the market value of net debt with the book value of net debt, that produces considerable noise, which distorts the quality of the enterprise value multiples. Equity value multiples do not suffer from this noise since the market capitalization can be observed directly from market values. However, we should note that equity value multiples are not completely noise-free, since can be affected by different gearing ratios.[96] However, the superior results of the equity value multiples suggest that this distorting effect is significantly smaller than the noise when estimating the market value of net debt for the enterprise value multiples. The explanation might be that the comparable companies have relative similar comparable gearing ratios to the target company, due to the selection criteria based on industry membership and ROA. This is consistent with the literature on capital structure, in which Harris & Raviv (1991) noted that it is generally accepted that firms in a given industry have similar gearing ratios, while this ratio vary across industries.[97]

Examination of the results in table 4.4 shows that forward-looking multiples outperform trailing multiples, in terms of lowest dispersion. Using 1-year forecast data instead of trailing data results in, on average, 10.2% more accurate equity valuation estimates. Furthermore, choosing for 2-year forecast data instead of trailing data even results in 14.9% more accuracy. Moving from 1-year forecast data to 2-year forecast data improves the accuracy with 7.4%. The results in table 4.4 definitely favor the forward-looking multiples, especially the 2-year forecasts. Furthermore, inspection of the individual performance of the multiples in table 4.4 shows that the magnitude of the outperformance of forward-looking multiples depends on the value driver of the multiple. The largest improvement in equity valuation accuracy, when using forecasts instead of trailing data, comes from using EPS multiples. The valuation accuracy gains a boost of 26.4% when using 1-year forecasts, and 29% when using 2-year forecasts. EBITDA multiple surprisingly benefits more from forecast data than EBIT multiples, however the values lie nowhere close

[96] This point has been made by my supervisor, Marc Schauten. See appendix VIII for more details.
[97] Harris & Raviv (1999) summarized four studies (Bowen, Daly & Huber (1982), Bradley, Jarrell & Kim (1984), Long & Malitz (1985) and Kester (1986), which finds that companies in the same industry tends to have a common gearing ratio.

to the EPS. With sales multiples, I observe a reversed result. It seems that the shift to forecast data causes a decline in performance for the sales multiples. These findings can be explained by the observation of Schreiner, that equity analysts focus most of their effort towards the estimation of earnings forecasts. The equity analysts are motivated to do so, because it is industry practice to determine an analyst's performance by his ability to forecast earnings accurately. Subsequently, the market focuses on the forecasts of earnings and market values adjust accordingly (Schreiner, 2007).

Inspection of table 4.6 shows an interesting finding. Looking at the average performance, In terms of lowest dispersion, five comparable companies are optimal. The inclusion of more comparable companies increases dispersion. The dispersion for a peer group of two comparable companies is higher than one with five comparable companies. The dispersion for a peer group of five and ten comparable companies is almost the same. The increase in dispersion when moving from ten to twenty comparables is large. From *n = 2* comparable companies to *n=5* comparable companies, it seems that inclusion of more comparable companies has the benefit of adding more value relevant information. However, from *n=5* comparable companies onwards, adding more comparable companies comes at the cost of adding more noise to the distribution, which increases the dispersion of the distribution. The inaccuracy of small samples is caused by the higher probability of the occurrence of extreme errors, as the number of comparable companies increases, so does the frequency of small errors (Cooper & Cordeiro, 2008). There is a trade-off between the extra information contained in the market values of additional companies and probability of introducing additional pricing errors. I suggest an optimal peer group range of five to ten companies, because table 4.6 shows that additional comparable companies comes at the cost of just a little more dispersion.

The comparison of the performance of traditional versus intercept adjusted shows that, on average, the allowance of an intercept in traditional MVM can significantly improve equity valuation accuracy. This average improvement is mainly contributed by the large improvement in the sales multiples. The sales multiples gain a 8% to 10% improvement, whereas the improvement for other multiples is just 0.2% to 3.3%. Unlike Liu, Nissim & Thomas (2002), not all multiples improve by the introduction of an intercept. The trailing-price EBITDA multiples and 1-year forward EBITDA multiples show a drop of performance of 0.4% and 0.6%, respectively. We can conclude from tables 4.8 and 4.9 that poor performing multiples in table 4.1, such as the sales multiples, benefit more from the inclusion of an intercept than those that performed well, such as the EPS and EBIT multiples.

5 Conclusion

5.1 Summary of this study

The Multiple Valuation Method has proven itself to be a capable and competent valuation method, both in practice and in the academic literature. However, despite its widespread usage in practice, it lacks a clear and stringent manual on how to compute multiples optimally. The existing literature has identified a number of open issues regarding the Multiple Valuation Method. There are academic studies investigating these issues, but most of the knowledge they provide are rather fractured and there is still no real consensus.[98] However, we are getting closer. This study tries to contribute to reaching this consensus with a comprehensive study on the Multiple Valuation Method, using European companies. It investigates five open issues simultaneously and is designed to be comparable with the major studies on the Multiple Valuation Method, such as Liu, Nissim & Thomas (2002) and Schreiner (2007).

The literature part of this study tries to bring together the pieces of knowledge provided by the standard textbook literature and academic studies. The standard literature mainly provides theoretical background information on the MVM and its derivation from fundamental equity valuation models to identify its underlying drivers. This academic study does empirical research on practical problems and optimal valuation accuracy considerations. The empirical part of this study investigates five open issues on the MVM, to determine optimal considerations when applying the MVM. This study uses a dataset consisting of about 3,000 European companies per year and constructs 24 types of multiples for an eleven-year horizon from 1999 to 2009. To realize this study, I had to limit the scope of this study by the assuming optimality of number of factors. I considered these factors optimal because multiple empirical studies agreed on its optimality. The identification of comparable companies by industry membership and return on assets, is such a constant factor. Moreover, I classified industry by using 3-digit ICB grouping codes. The synthetic multiples for the target companies are estimated using the harmonic mean. Assuming these factors constant, I investigate the optimal value driver, value relevant base, time reference of the value driver, size of the peer group, and MVM methodology.

[98] Fractured in the sense that the empirical studies provide evidences for different issues, in different contexts, and with different approaches. The empirical research on the MVM is rather deficient and incomparable.

5.2 Summary of the findings

Throughout the empirical study, I find that using the EBIT as the value driver in the denominator of an equity value, or entity value, multiple is optimal. However, when using forward-looking equity multiples, I recommend EPS as the value driver. EBITDA value drivers exhibit intermediate performance, but it is still acceptable. However, I would not recommend OCF, dividends and sales, as they perform relatively poor. The superior performance of the EBIT value driver is largely due to a European dataset, as it is not homogenous in terms of accounting and tax regulation.

As for the optimal value relevant base, I recommend using the equity value in the numerator of the multiple. In contrast to what the financial theory suggests, the empirical comparison of both value relevant bases shows that equity value multiples clearly outperform enterprise value multiples. The relatively poor performance of enterprise value multiples is due to noise when estimating the market value of net debt for determining the enterprise value. As long as identification of comparable companies is based on reliable criteria, such as industry membership and ROA, the peer group shows relative similar gearing ratios with the target firm. This results in accurate equity value estimation.

Consistent with the financial literature that using forward-looking data for multiples follows the principles of value generation, I find that the forward-priced value drivers in the denominator of multiples result in more accurate equity valuation than trailing-priced value drivers. More specifically, 2-year forward-priced information is better than 1-year forward-priced and trailing-priced information.

The results of optimal size of the peer group suggest that using five comparable companies to form a peer group is optimal. A peer group size smaller or larger than five comparable companies results in less accurate equity valuation. Nevertheless, I recommend an optimal range of five to ten comparable companies, because additional comparable companies may contain relevant information, at the cost of just a little more dispersion.

The comparison of traditional MVM versus the Intercept Adjusted MVM shows that the inclusion on an intercept in the traditional MVM significantly improves the equity valuation, on average. Moreover, the poorest performing types of equity value multiples, such as sales and dividends equity value multiples, benefits more of an inclusion than best performing equity value multiples, such as EPS equity value multiples.

Altogether, assuming a number of optimal factors in accordance with the existing academic literature, I can recommend the following optimal considerations when using the Multiple Valuation Method on European companies:[99]

- when the objective is to estimate the equity value of a company in an accurate and relative simple way, that is easy to comprehend and communicate, one should apply the traditional Multiple Valuation Method, using 2-year forward-priced EPS equity value multiples. Moreover one should identify five to ten comparable companies to form a peer group for the target company;
- when the objective is to determine the enterprise value of companies, one should consider alternative valuation techniques;
- when the objective is to determine the equity value of company in the a more accurate way, with disregard to any additional complexity to the model, it is recommended to apply the Intercept Adjusted Multiple valuation Method, using 2-year forward-priced EPS equity value multiples. In this case on should identify ten comparable companies to form a peer group for the target company.

This study has succeeded deriving optimal considerations that are somewhat consistent with the existing literature and has shown that the Multiple Valuation Method is capable of producing acceptable estimates of value. However, it is important to point out that the developments of the Multiple Valuation Method so far constitute a useful alternative valuation technique in addition to the fundamental valuation models only. With an emphasis on the purposely stated 'in addition' and not 'instead of', because the Multiple Valuation Method is not (yet) capable of replacing a thorough analysis of a company's fundamentals.

[99] The assumed optimal factors are presented in paragraph 5.1.

5.3 Limitations and suggestions for further research

As with all empirical studies, this study has its limitations. The first limitation might lie in the assumptions of the empirical research of this study. To realize an investigation of a broad selection of issues, I had to limit the amount of variable factors in my study. Therefore, I assume the identification of comparable companies by industry membership and return on assets, classification of the industry by using 3-digit ICB grouping code, and estimating synthetic multiples by using the harmonic mean to be optimal. These assumptions are based on the findings of various empirical studies. However, as long as there is no official consensus on the optimality of these factors, it might be possible that the results of this study are not reliable.

More limitations that might reduce the reliability of the results are related to the dataset. Whereas dataset of U.S. companies are subject to somewhat uniform accounting and tax regulations, my dataset of companies from different countries are less homogenous and in terms of accounting and tax regulations. This might affect the level of comparability of the companies across the sample, and therefore affects the valuation results. Furthermore, the financial crisis that started in 2007 is an economic crisis that is triggered by a liquidity crisis in the U.S. banking system. This crisis has significantly affected European markets. The inclusion of market values, trailing data, and forecasts of the year 2007, 2008, and 2009 can therefore affect the time stability of the results and the overall results of this study. However, inclusion of this period has been done because it significantly increases the amount of data. The data provider of forward-looking information, I/B/E/S, is only available from 2003 on, for European companies. In addition, the common motivation for using SALES and gross income as the value driver for constructing multiples, is that for some companies the earnings measure and / or cash flow measures are negative. It is typical for young or cyclical companies to have negative earnings. Since one of the restrictions for my dataset is to include positive value drivers only, the sample might produced biased results for young or cyclical companies.

Considering the fact that there is no real consensus on many issues of the Multiple Valuation Method, there is space for further investigation on the optimal Multiple Valuation Method considerations.[100]

[100] Note, that it has only been just more than a decade that the Multiple Valuation Method has become the subject of extensive academic study (Liu, Nissim & Thomas, 2002). For the financial literature, this is a relative young subject.

This study focuses on optimal considerations for a dataset consisting of small, mid, and large cap Europeans companies of various industries. The resulting optimal considerations are therefore optimal on average. The same set of research questions can be explored on an industry level to identify preferred industry multiples and its optimal considerations when applying them. Moreover, the same can be done on each capitalization level (i.e. small, mid and large capitalization companies).

Furthermore, enterprise value multiples are theoretically more appealing and justified, although empirical studies seem skeptical. Not surprisingly, practitioners often prefer equity value multiples. The problem with enterprise value is the estimation of the enterprise value, and more specifically, the approximation of the market value of net debt. There is only little existing research on enterprise value multiples and this area can be further explored.

In addition, the Intercept Adjusted Multiple Valuation Method has shown that an alternative approach proves to be useful. The traditional approach has the advantage that it is relatively simple, it is restricted in the sense than the equity / enterprise value of a company is directly proportional to its value driver. Other alternative approaches such as a combination of multiples has shown to outperform single multiples, under certain circumstances.[101] Again, many combinations of factors can be investigated here in this largely unexplored area, for example the optimal methodology to estimate the weights for the combined multiples, the optimal value driver, or the optimal industry classification.

[101] Studies such as Yoo (2006) and Schreiner (2007).

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Appendices

Appendix I: List of abbreviations and acronyms

AE	Book value of common equity
AEG	Abnormal earnings growth
B	Book value of common equity
CAPEX	Capital expenditures
CAPM	Capital asset pricing model
D	Dividends
DCF	Discounted cash flow
DDM	Dividends discount model
DS	Datastream
E	Earnings
EBIT	Eanings before interest and taxes
EBITDA	Earnings before interest, taxes, depreciation and amortization
EBT	Earnings before taxes / pre-tax income
e.g.	Exempli gratia (for example)
EPS	Earnings per share
Et al.	Et alii (and others)
EUR	Euro
EVA	Economic Value Added
EV	Enterprise value
FCF	Free cash flow
FFIG	Fama and French industry groupings
GAAP	Generally Accepted Accounting Principles
GGM	Gordon growth model
GI	Gross income
GICS	Global Industry Classification Standards
IC	Invested Capital
OCF	Operating cash flow
I/B/E/S	Institutional Brokers Estimate Service
ICB	Industry Classification Benchmark
i.e.	Id est (that is)
IFRS	International Financial Reporting Standards
IPO	Initial Public Offering
P	Market capitalization / stock price
M&A	Mergers & acquisitions
MSCI	Morgan Stanley Capital International
MVM	Multiple Valuation Method
n	Number of observations
NAICS	North American Industry Classification Standard
PEG	Price to earnings growth
PR	(Dividends) Pay-out ratio
R&D	Research & development
RI	Residual income
RIV	Residual income valuation
ROA	Return on assets
ROCE	Return on common equity
ROE	Return on equity
ROIC	Return on invested capital
$	U.S. Dollar
S&P	Standards & Poor
SIC	Standard Industry Classification
t	Time / period
U.S.	United States
U.K.	United Kingdom
TA	Total assets
WACC	Weigthed average cost of capital
WS	Worldscope

Appendix II: Derivation of the intrinsic multiples

Dividend Discount Model.

The DDM is covered by many valuation textbooks in their fundamental analysis chapters. At first sight, the model is very appealing. Dividends are the cash flows that shareholders get from the company during the holding period; the distributions to the shareholders that are reported in the cash flow statement (Penman, 2006). Together with the market value of the shares when selling them, they form the shareholder's payoff. Therefore, the DDM values the equity of the company based on the stream of expected future dividends $D_1, D_2, \ldots, D_T$ plus the market value of common equity p_T^{equity} at the end of the forecast horizon T. The DDM, which is generally attributed to Williams (1938), who defines the intrinsic value of a company v_0^{equity} as the present value of expected future dividends $E(D_t)$, discounted at their risk adjusted expected rate of return r_1^{equity}. If the forecast horizon is assumed infinite then it is defines as:

$$v_0^{equity} = \frac{E(D_1)}{1+r_1^{equity}} + \frac{E(D_2)}{1+r_2^{equity}} + \frac{E(D_3)}{1+r_3^{equity}} + \frac{E(D_4)}{1+r_4^{equity}} + \cdots \qquad \text{(II.1)}$$

The DDM model is technically correct, because it is simply the present value of all the payoffs from an investment, as the model describes. However, for a finite horizon forecast of T years, we need the payoff for T years, which includes forecasts of the dividends and the terminal price P_T, the price at which the shares might be sold. This can be problematic. The problem is that the value of equity at time zero is determined by its expected value in the future, which it is the value we are trying to assess. Gordon (1962) suggests a simplification of the assumptions for both the dividend process and discount rates, which is referred to as the Gordon growth model (GGM). This model assumes that the cost of equity remains constant over time and the dividends grow geometrically at a constant rate, then:

$$v_t^{equity} = \frac{D_{t+1}}{r^{equity} - g^D} \quad \text{(II.2)}$$

The DDM and its adjusted version, the GGM, are known to have two weaknesses. Both weaknesses are caused by the same problem, the methodology of the DDM targets the actual cash flow to the shareholders, but unfortunately dividends are not necessarily tied to value generation (Penman, 2006).[102] The first problem is that the models ignore internal growth of companies through retained earnings. Most young companies with a high growth potential, in practice, tend to retain most of their earnings or do not pay any dividends within a finite forecast horizon (Spremann, 2002). With such companies, the DDM and GGM value the intrinsic value usually much lower than their proxy, the market value. Second, the Miller & Modigliani (1961) dividends irrelevance proposition states that value is unrelated to the timing of expected payouts prior to, or after any finite horizon, however the DDM requires forecasts of dividends to infinity for going companies. Therefore, forecasts of dividends (or their growth rate) are uninformative about value (Schreiner, 2007).

The rather failing aspect of the DDM is remedied by analyzing features inside a company that do create value, like investing and operating activities. The Discounted cash flow model does just that.

Discounted cash flow model.

The value of the company is the value of its investing and operating activities and this value is divided among the claimants, the debt holders and shareholders. The equity value of the company can be calculated by forecasting cash flows to equity holders, as with the DDM. However, it is also possible to calculate the equity value by forecasting the cash flowing from the company's investing and operating activities, and then subtract the value of the net debt. This method is known as the discounted cash flow (DCF) model (Penman, 2006). The DCF model moves away from cash distribution to cash generation. However, this means that the DCF model deals with a narrow aspect of the company's value, because it focuses on cash, ignoring other assets and liabilities. That is, instead of looking at value generation, the DCF model focuses only on cash generation (Gode & Ohlson, 2006).

The idea behind the DCF model is to calculate the present value of the free cash flows (FCF), which a company is expected to earn in the future (Schreiner, 2007). Hereby,

[102] For example, companies can simply borrow money to pay dividends, which is totally unrelated to value creation through investing or operating activities (Penman, 2004)

the FCF earned in time t is defined as the cash flows from operations (inflows) minus the cash investments (outflows). The inflows consist of the net operating profits after taxes (NOPAT) and the outflows are the changes in invested capital.[103] The expected FCFs are then discounted at the weighted cost of capital (WACC).

$$NOPAT_t = EBIT_t * (1 - tax\ rate) \tag{II.3}$$

Using the information contained in financial statements, the FCF can be calculated. Koller, Goedhart & Wessels (2005) determine the FCF by starting with the NOPAT calculated from the income statement using the equation (2.3) above, plus depreciation and amortization, minus changes in working capital and minus capital expenditures (CAPEX). Aboody (2006) determines the FCF by an alternative way, where FCF is equal to operational cash flow (OCF) minus CAPEX, plus interest net of income taxes. We can interpret Aboody's (2006) approach as the FCF equals the amount of dividends, which a company could pay if it had no leverage, and a dividend payout ratio of one (full payout). In practice, the FCF is used by companies to distribute dividends, pay the debt holders or retained.

$$FCF_t = NOPAT_t - \Delta invested\ capital_t \tag{II.4}$$

$$FCF_t = NOPAT + depreciation + ammortization_t - \Delta working\ capital_t - CAPEX_t$$

$$FCF_t = OCF_t - CAPEX_t + interest_t * (1 - tax\ rate)$$

The present value of the expected FCFs discounted at the WACC rate represents the intrinsic value of common equity, plus the market value of the net debt including preferred stock, less cash & equivalents, which simply stand for the value of the company (Schreiner,

[103] The cumulative amount of resources a company has invested in its core operations is an example of the change in invested capital.

2007).[104] The equity claimants must share the company's operations payoffs with the debt claimants, so the value of the common equity is the value of the company less the value of the net debt (including preferred stock less cash & equivalents). Formally,

$$v_t^{equity} = \sum_{i=1}^{\infty} \frac{E_t(FCF_{t+i})}{(1 + r^{wacc})^i} - p_t^{net\ debt} \tag{II.5}$$

where v_t^{equity} is the equity value at time t which is calculated by discounting the expected future FCF in period $t+1$ conditional on information available at time t, $E_t(FCF_{t+i})$, at the weighted average cost of capital, r^{wacc}, and then minus the value of the net debt, $p^{net\ debt}$ at time t.

As can be seen from equation (II.5) above, like the DDM, the DCF model requires forecasting over an infinite horizon. If we are to value the equity value for a finite horizon, we need to value after the forecast horizon of T years (Penman, 2006). This value is known as the continuing value (CV) and is to be discounted at $(1 + r^{wacc})^T$ and added to the equation (2.5. The CV allows us to reduce an infinite horizon forecasting problem to a finite horizon problem. The CV is determined as:

$$CV_T = \frac{E_T(FCF_T)}{r^{wacc} - g} \tag{II.6}$$

where CV_T is the continuing value at the end of forecast horizon T, FCF_T is free cash flow at the end of forecast horizon T, r^{wacc} is the weighted average cost of capital and g is the growth rate of the forecasted FCF.

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[104] The WACC is the discount rate that is appropriate for the riskiness of the cash flows from all projects. The WACC itself calculated as $WACC = r_D(1 - T_c)\frac{D}{V} + r_P\frac{P}{V} + r_E\frac{E}{V}$, where r_D is cost of debt, r_P is investor's expected rate of return, r_E is cost of equity, T_c is the marginal corporate tax rate, D is long-term debt, P is preferred stock, E is Equity and V is the company's value (Brealey & Myers, 2008).

As with the DDM and the GGM, the DCF model also has specific aspects, which are considered deficient. The first one is that FCF does not measure value added from operations over a period (Penman, 2006). In the definition of FCF, OCF increases as a company sells more products, but is reduced by cash investments. Therefore, if a company invests more cash than it generates from operations, its FCF is negative. Regardless of a zero or positive NPV, free cash flow is reduced, and so is its present value. This way, investments are treated as 'bad', rather than 'good'. Of course, for extended horizons, the return to investments is captured within this horizon and this ultimate matching of cash outflow and cash inflow captures the value added (Schreiner, 2007). However, the more investing the company does for a longer period in the future, the longer the forecasting horizon may have to be to match and capture these cash inflows. Penman & Sougiannis (1998) find indeed that many 'good' companies have negative FCF for a long time when their cash investments exceed OCF each year. In addition, the concept of FCF may introduce managerial moral hazard, because managers are given an arbitrary way to manipulate short term by postponing new investments (Schreiner, 2007)

Second, in some cases, measuring the FCF may be difficult, because the separation between operating, investing and financing activities is often not clear. For example, when a retail bank receives deposits, this cash inflow is excluded from FCF, because it is treated as cash flow from financing activities. This is arguable, because receiving deposits is one of a retail bank's core business activities and therefore should included in the FCF as cash inflow from operating activities (Schreiner, 2007).

Third, FCFs are not what analysts forecast. Analysts usually forecast earnings because forecasting FCF is difficult. The reason is that FCFs are not contemporaneous with value generation and not really a measure of success in operations. To convert an analyst's forecast to a valuation using the DCF model, we have to convert the earnings forecast to a FCF forecast, which has consequences for the change in invested capital (Gode & Ohlson, 2006)

Residual Income Model.

Fundamental analysis anchors valuation in financial statements. More specifically, book value provides such an anchor. Practitioners anchor their valuation with the value that is recognized in the balance sheet, the book value, and then continue to assess value that is not recognized, the premium over book value.[105] This leads to another fundamental equity

[105] Penman (2006) states: Value = Book value + Premium

valuation model: the residual income valuation (RIV) model. This model derives forecasts for its key measure residual incomes (RI) directly from earnings forecasts (Schreiner, 2007).[106]

A measure to capture the value added to book value, or premium, is residual earnings or residual income. The RI is the amount of net income in excess of the capital charge on the book value of equity. The charge for using capital can be interpreted as the opportunity cost of invested capital (Peasnell, 1981). The RI, also referred as to as abnormal earnings or excess profit, is defined by Ohlson (1995) as

$$RI_t = NI_t - r^{equity} * B_{t-1} \tag{II.7}$$

where RI_t, the residual income at time t, is calculated by NI_t, the net income for the period ending at time t, minus the product of r^{equity} and B_{t-1}, the cost of equity and the book value of common equity at time $t - 1$.

However to arrive at the value of the company using RI, there's an accounting relation needed. With the DDM, the intrinsic value of a company's equity is equal to the present value of future expected dividends. By applying an accounting relation between dividends, net income, and changes in book value of equity, we can again express the value of the company as the present value of net income and book value of equity. This conditional accounting relation is known as the clean surplus relation, which states that all changes in the book value of equity within a fiscal year are reflected in that period's net income or dividends that are distributed to common shareholders (O'Hanlon & Peasnell, 2002). It is defined as

$$B_t - B_{t-1} = NI_t - D_t \tag{II.8}$$

[106] Residuals income is also referred to as abnormal earnings (AE).

where B_t stands for the book value of common equity at time t, NI_t stands for the net income during time $t-1$ to t and D_t equals the dividends that is paid to common shareholders at time t.

Ohlson (1995) shows how to determine the value common equity by solving D_t in the clean surplus relation and substituting it into the DDM model. The results is the RIV model,

$$v_t^{equity} = B_t + \sum_{i=1}^{\infty} \frac{E_t(RI_{t+i})}{(1 + r^{equity})^i} \quad \text{(II.9)}$$

where the v_t^{equity} equals the intrinsic value of common equity at time t, B_t is the book value of common equity at time t, $E_t(RI_{t+i})$ stands for the expected future residual earnings in period $t+i$ which is conditional of the information at time t and r^{equity} is the cost of equity.

As we can see, the equation above is for an infinite horizon. For an infinite forecasting horizon, the RIV model always yields the same value, as we would get from forecasting dividends using the DDM. The two models are related because share value is based on the dividends the share is ultimately expected to pay. (Penman, 2006). Practical valuation often requires valuing for a finite horizon T, therefore we need a continuing value. This is the value of residual earnings beyond the horizon T (Penman, 2004). When the continuing value is assumed in the RIV model, it is defined as

$$v_t^{equity} = B_t + \sum_{i=1}^{T} \frac{E_t(RI_{t+i})}{(1+r^{equity})^i} + \left[\frac{E_T(RI_T)}{r^{equity} - g}\right] / \, r^{equity\ T} \quad \text{(II.10)}$$

where g is the one plus the rate of growth.[107]

Whereas the focus of the DCF model lies on cash generation, the RIV model focuses on value generation by book value of equity and net income. Empirical studies such as Lee (1996), show that the concept of the RIV model is similar to that of the Economic Value Added (EVA), which is used nowadays by a lot of large companies as the standard method for value based management.[108] However, as with the other fundamental equity valuation models, there are two disadvantages to the RIV model, which identifies residual income to measure a company's ability to create value (Penman, 2006). First, the methodology of the RIV model relies heavily on accounting numbers. The RIV model determines the intrinsic value of a company by the sum of the book value of equity and the premium for its future growth in the book value of equity. It anchors on book value. When the book value approximates market value reasonably accurate, the anchoring is justified. Generally, this applies to financials, but it is not the case with companies in other industries, especially when the accounting is done in a conservative way (Gode & Ohlson, 2006). In such cases, the anchoring on book value may lead to misplaced accuracy. Also, Ohlson (2002) notes that the RIV model does not conform to principles of equity valuation as we generally observe them in practice. There are not much practitioners that consider current book value of equity as a starting grid in valuation. Most practitioners concentrate on (future) earnings and earnings growth in valuation.

The second problem is that the clean surplus relation does not always hold. This accounting relation only holds if equity related capital transactions do not affect value and are measured by their market value.[109] However, in practice we observe that capital transactions are often driven by inefficiencies in the market and therefore affect the value of the company (Schreiner, 2007). Furthermore, regulations in the U.S. GAAP and IFRS violate the measurement by market value condition for a few capital transactions.[110]

Abnormal Earnings Growth model.

The valuation model in this section, the abnormal earnings growth (AEG) model, complements the preceding RIV model. Rather than anchoring valuation on book value, the

[107] The growth rate must me smaller than the cost of equity or else the continuing value may 'blow' up. It is unexpected that a company's residual income to grow at a rate larger than the cost of equity indefinitely (Penman, 2006).
[108] The model of Economic Value Added is popularized by Steward (1991).
[109] Equity related capital transactions are, for example, transaction related with issuance and buyback of shares, convertible bonds or employee stock options.
[110] Under both U.S. GAAP and IFRS, capital transactions such as convertible bonds when converted and employee stock options when exercised, are not measured by market value.

methodology of the AEG model here anchors valuation on the prediction of earnings. However, the form of the valuation is similar. With the RIV model, we add value to equity book value for the expected growth in the book value of equity. With the AEG model, we add value to capitalized earnings for earnings in excess of normal earnings at the required rate of return, on prior earnings. Abnormal earnings growth, earnings growth in excess of the normal earnings growth, is the central concept in this section's valuation model. Despite that forecasted earnings and earnings growth are popular tools among practitioners, this concept of abnormal earnings growth in valuation rarely has theoretical cognition (Schreiner, 2007). The studies, Ohlson (2005) and Ohlson & Juettner-Nauroth (2005), show how to convert analysts' earnings forecasts to a valuation equation, which does not rely on the clean surplus relation, nor on the book value of equity.

The AEG does not rely on the clean surplus relation, even though, it is derived from the clean surplus relation. The AEG model requires that for each company as a going concern, there is a point in time where it does not have abnormal earnings. This is the steady state. If this was not the case, then intrinsic value would be infinite (Jennergren & Skogsvik, 2007). When in steady state, then $RI_t = 0$ and

$$B_{t-1} = \frac{NI_t}{r^{equity}} \tag{II.11}$$

Now, given the clean surplus relation equation (II.11), AEG at time t equals the change in residual earnings during the period $t-1$ to t. Assuming a constant cost of equity, we can rearrange the term to eliminate the book value of equity from the equation. Formally,

$$\begin{aligned}
AEG_t &= RI_t - RI_{t-1} \\
&= NI_t - r^{equity} * B_{t-1} - (NI_{t-1} - r^{equity} * B_{t-2}) \\
&= NI_t - r^{equity} * B_{t-1} - (NI_{t-1} - r^{equity} * (B_{t-1} - NI_{t-1} + D_{t-1})) \\
&= NI_t - r^{equity} * B_{t-1} - NI_{t-1} + r^{equity} * B_{t-1} - r^{equity} * NI_{t-1} + r^{equity} * D_{t-1} \\
&= NI_t + r^{equity} * D_{t-1} - NI_{t-1} * \left(1 + r^{equity}\right) && \text{(I.12)}
\end{aligned}$$

Ohlson (2005) and Ohlson & Juettner-Nauroth (2005) use the RIV model equation (II.9) and apply the AEG identity (II.12) to derive the AEG valuation model. It is the mathematical equivalent to the RIV model (Schreiner, 2007). The AEG valuation model runs as follow:

$$v_t^{equity} = \frac{E_t(NI_t)}{r^{equity}} + \frac{\left[\sum_{i=2}^{\infty} \left(1 + r^{equity}\right)^{i-1} * E_t(AEG_{t+i})\right]}{r^{equity}} \qquad \text{(II.13)}$$

where $v_t^{equit\,y}$v^equity equals the intrinsic value of common equity at time t, $E_t(NI_t)$ equals the expected net income for period $t+i$, $E_t(AEG_{t+1})$ stands for the expected growth in abnormal earnings for period $t=i$ which is dependent on information at time t, and the cost of equity is denoted by r^{equity} .

From a theoretic perspective, the AEG model has the distinctive advantage that it does not bear the main disadvantages of the RIV model. First, The AEG model does not assume the clean surplus relation, resulting in more consistency with accounting rules (Penman, 2005). Clean surplus accounting requires that an equity statement has no other income than net income from the income statement (Penman, 2006). The AEG is also more practically orientated than the RIV model, because the AEG model is based on earnings rather than on the distribution of wealth. This coincides with investment practice, where earnings and their subsequent growth important indicators are essential (Jennergren & Skogsvik, 2007).

Second, the AEG valuation model outcome is identical to the RIV model, but it cancels out the balance sheet, as we do not need to forecast book value of equity. The growth in book value of equity in the RIV model, is simply net income less dividends. As shown in equation (3.12), by predicting future values of net income and dividends, we obtain abnormal earnings growth and do not need book values of equity.

Even though the AEG valuation model is attractive to practitioners, it comes with weaknesses, as any other fundamental equity valuation model. The equation $B_t = \frac{E_t(NI_{t+i})}{r^{equity}}$ is technically set arbitrarily by Ohlson (2005) and Ohlson & Juettner-Nauroth (2005). In reality, there is not really an economic justification to start a valuation at the steady state of a company, and then allow for abnormal earnings in subsequent periods (Schreiner, 2007). Also, the value for the anchor in the AEG model, $\frac{E_t(NI_{t+i})}{r^{equity}}$, cannot be determined with financial statements. It is a prediction, analysts' forecasts based on speculation. The RIV framework, however, is in line with the fundamentalists' point of view that we should distinguish information what is known (in the financial statements) from speculation, because the RIV model anchors on book value of equity and then adds speculative information regarding residual earnings (Schreiner, 2007). Furthermore, there is not much empirical evidence on the accuracy for the AEG model, or its simplified version, presented by Ohlson & Juettner-Nauroth (2005).

As the preceding sections show, the presented fundamental equity valuation models all have theoretical, and especially, practical limitations. Therefore, it is hard to pick just one of the fundamental models for the practitioners to rely on when it comes to their real world investment decisions. This section is included in my study to provide a general background on equity valuation, and show why the MVM has become such a popular valuation tool among practitioners.

Appendix III: Derivation of the intrinsic multiples

The preceding appendix II discussed the fundamental equity valuation models. This appendix aims to shed light on the actual derivation process of the intrinsic P/E, EV/EBIT, and P/B multiples from respective, the DMM, DCF, and the RIV model. The intrinsic multiples help to understand the underlying fundamental drivers of the multiple. The presented derivations are based on the study of Schreiner (2007).

Intrinsic P/E multiple derived from the DDM

We assume a constant payout ratio (PR), thus dividends at time t are fixed proportion of the net income at time is t:

$$D_t = PR * NI_t \tag{III.1}$$

Net income for the next year NI_{t+1} is determined by this year's net income NI_t and its constant growth rate g^{NI}:

$$NI_{t+1} = NI_t * (1 + g^{NI}) \tag{III.2}$$

Substituting equation (III.2) into (III.1) gives the one year ahead dividends:

$$D_{t+1} = PR * NI_t * (1 + g^{NI}) \tag{III.2}$$

Further substituting equation (III.2) into the GGM model equation (2.1), found in chapter 2.2.1 gives:

$$v_t^{equity} = \frac{PR * NI_t * (1 + g^{NI})}{r^{equity} - g^{NI}} \tag{III.3}$$

To arrive at the intrinsic P/E multiple at time t, the equation (III.3) must be divided by net income NI_t:

$$\frac{v_t^{equity}}{NI_t} = \frac{PR * (1 + g^{NI})}{r^{equity} - g^{NI}} \tag{III.4}$$

Intrinsic EV/EBIT multiple derived from the DCF model

The derivation of the EV/EBIT multiple requires a few assumptions: NOPAT grows at a constant rate each year and the percentage of NOPAT that a firm re-invest is constant. Implicitly, the FCF also grows at a constant rate g^{FCF}.

Using the same perpetuity relation as in the GGM, we can write the value of the firm as:

$$v_t^{entity} = \frac{FCF_{t+1}}{r^{WACC} - g^{FCF}} \tag{III.5}$$

In order to arrive at the intrinsic form of the EV/EBIT multiple, we need to define and transform two new terms. The first one is the return on invested capital (ROIC) at time is t is the rate of return a firm earns on each dollar invested in its core operations from $t-1$ to t:

$$ROIC_t = \frac{NOPAT_t}{invested\ capital_{t-1}} \tag{III.6}$$

The second term we need is the is investment rate (IR), this is the proportion of NOPAT a firm re-invests back into it core operation each period $t-1$ to t. Using the two new presented term, we can express the growth in FCF at time is t:

$$g_t^{FCF} = ROIC_t * IR_t \tag{III.7}$$

The FCF equation (2.4) can be rearranged into a new equation, using equations (2.3), (III.5), (III.6), and (III.7):

$$FCF_t = NOPAT_t - \Delta invested\ capital_t$$

$$= NOPAT_t - (NOPAT_t * IR_t)$$

$$= NOPAT_t * (1 - IR_t) \tag{III.8}$$

$$= EBIT_t * (1 - taxrate) * \left(1 - \frac{g_t^{FCF}}{ROIC_t}\right)$$

When we substitute this newly written FCF equation (III.7) into the DCF entity value equation (I.5) we get:

$$v_t^{equity} = \frac{EBIT_{t+1} * (1 - tax\ rate) * \left(1 - \frac{g^{FCF}}{ROIC_t}\right)}{r^{WACC} - g^{FCF}} \tag{III.9}$$

Eventually, to create the intrinsic EV/EBIT multiple, we divide equation (III.8) by $EBIT_t$:

$$\frac{v_t^{equity}}{EBIT_t} = \frac{(1 + g^{FCF}) * (1 - t) * \left(1 - \frac{g^{FCF}}{ROIC_t}\right)}{r^{WACC} - g^{FCF}} \tag{III.10}$$

Intrinsic P/B multiple derived from the RIV model

The derivation of the P/B multiple requires the following assumptions: $g^{RI} = g^D = g^B$. As with the intrinsic EV/EBIT multiple, we apply the growing perpetuity relationship to the RIV model:

$$v_t^{equity} = B_t + \frac{RI_{t+1}}{(r^{equity} - g^{RI}) * (1 + r^{equity})} \tag{III.11}$$

Again, we need to introduce a new term: the return on common equity (ROCE) at time is t is the rate of return a firms earns on each dollar of its common shareholders' invested capital from period $t-1$ to t:

$$ROCE_t = \frac{NI_t}{B_{t-1}} \tag{III.12}$$

By substituting equation (III.11) into the RI equation (3.7), we see an rearranged RI definition:

$$g_t = NI_t - r^{equity} * B_{t-1} \tag{III.13}$$

$$= \left(ROCE_t - r^{equity}\right) * B_{t-1}$$

When we enter this definition (III.12) into the GGM expression of the RIV model (III.10) and substitute g^{RI} with g^B:

$$v_t^{equity} = B_t + \frac{\left(ROCE_t - r^{equity}\right) * B_{t-1}}{(r^{equity} - g^B) * (1 + r^{equity})} \tag{III.14}$$

Finally by dividing equation (III.13) by B_t, we have the intrinsic P/B multiple:

$$\frac{v_t^{equity}}{B_t} = 1 + \frac{(ROCE_{t+1} - r^{equity})}{(r^{equity} - g^B) * (1 + r^{equity})} \tag{III.15}$$

Appendix VI: ICB industry classification structure

This appendix shows the ICB industry classification structure. All four levels of the classification structure are presented, however this study uses the 3-digit level industry code only. The contents of table II below is obtained from ICB.

Table VI: ICB classification structure

ICB industry 1-digit code		**ICB supersector 2-digit code**		**ICB sector 3-digit code**		**ICB subsector 4-digit code**	
Code	Name	Code	Name	Code	Name	Code	Name
0001	Oil & Gas	0500	Oil & Gas Basic Materials	0530	Oil & Gas Producers Oil	0533	Exploration & Production
						0537	Integrated Oil & Gas
				0570	Equipment, Services & Distribution	0573	Oil Equipment & Services
						0577	Pipelines
1000	Basic Materials	1300	Chemicals	1350	Chemicals	1353	Commodity Chemicals
						1357	Specialty Chemicals
		1700	Basic Resources	1730	Forestry & Paper	1733	Forestry
						1737	Paper
				1750	Industrial Metals	1753	Aluminum
						1755	Nonferrous Metals
						1757	Steel
				1770	Mining	1771	Coal
						1773	Diamonds & Gemstones
						1775	General Mining
						1777	Gold Mining
						1779	Platinum & Precious Metals
2000	Industrials	2300	Constructions & Materials	2350	Construction & Materials	2353	Building Material & Fixtures
						2357	Heavy Construction
		2700	Industrial Goods & Services	2710	Aerospace & Defense	2713	Aerospace
						2717	Defense
				2720	General Industrials	2723	Containers & Packaging

						2727	Diversified Industrials
				2730	Electronic & Electrical equipment	2733	Electrical Components & Equipment
						2737	Electronic Equipment
				2750	Industrial Engineering	2753	Commercial Vehicles & Trucks
						2757	Industrial Machinery
				2770	Industrial Transportation	2771	Delivery Services
						2773	Marine Transportation
						2775	Railroads
						2777	Transportation Services
						2779	Trucking
				2790	Support Services	2791	Business Support Services
						2793	Business Training & Employment
						2795	Financial Administration
						2797	Industrial Suppliers
						2799	Waste & Disposal Services
3000	Consumer Goods	3300	Automobiles & Parts	3350	Automobiles & Parts	3353	Automobiles
						3355	Auto Parts
						3357	Tires
		3500	Food & Beverage	3530	Beverages	3533	Brewers
						3535	Distillers & Vintners
						3537	Soft Drinks
				3570	Food Producers	3573	Farming & Fishing
						3577	Food Products
		3700	Personal & Household Goods	3720	Household Goods	3722	Durable Household Products
						3724	Nondurable Household Products
						3726	Furnishings
						3728	House construction
				3740	Leisure Goods	3743	Consumer Electronics
						3745	Recreational Products
						3747	Toys

				3760	Personal Goods	3763	Clothing & Accessories
						3767	Footwear
						3767	Personal Products
				3780	Tobacco	3785	Tobacco
4000	Health Care	4500	Health Care	4530	Health Care Equipment & Services	4533	Health Care Providers
						4535	Medical Equipment
						4537	Medical Supplies
				4570	Pharmaceuticals & Biotechnology	4573	Biotechnology
						4577	Pharmaceuticals
5000	Consumer Services	5300	Retail	5330	Food & Drug Retailers	5333	Drug Retailers
						5337	Food Retailers & Wholesalers
				5370	General Retailers	5371	Apparel Retailers
						5373	Broadline Retailers
						5375	Home Improvement Retailers
						5377	Specialized Consumer Services
						5379	Specialty Retailers
		5500	Media	5550	Media	5553	Broadcasting & Entertainment
						5555	Media Agencies
						5557	Publishing
		5700	Travel & Leisure	5750	Travel & Leisure	5751	Airlines
						5752	Gambling
						5753	Hotels
						5755	Recreational Services
						5757	Restaurant & Bars
						5759	Travel & Tourism
6000	Telecommunications	6500	Telecommunications	6530	Fixed Line Telecommunication	6535	Fixed Line Telecommunication
				6570	Mobile Telecommunication	6575	Mobile Telecommunication
7000	Utilities	7500	Utilities	7530	Electricity	7535	Electricity
				7570	Gas, Water & Multi-utilities	7573	Gas Distribution
						7575	Multi-utilities
						7577	Water

8000	Financials	8300	Banks	8350	Banks	8355	Banks
		8500	Insurance	8530	No-life Insurance	8532	Full Line Insurance
						8534	Insurance Brokers
						8536	Property & Casualty Insurance
						8538	Reinsurance
				8570	Life Insurance	8575	Life Insurance
		8700	Financial Services	8730	Real Estate	8733	Real Estate & Development
						8737	Real Estate Investment Trust
				8770	General Financial	8771	Asset Managers
						8773	Consumer Finance
						8775	Specialty Finance
						8777	Investment Services
						8779	Mortgage Finance
				8980	Equity Investment Instruments	8985	Equity Investment Instruments
				8990	Non-equity Investment Instruments	8995	Non-equity Investment Instruments
	Technology	9500	Technology	9530	Software & PC Services	9533	Computer Services
						9535	Internet
						9537	Software
				9570	Hardware & Equipment	9572	Computer Hardware
						9574	Electronic Office Equipment
						9576	Semiconductors
						9578	Telecommunications Equipment

Appendix V: Definition of the used variables

This appendix presents the definition of the variables that are used to construct the variables. The #s in parentheses refer to data items from of Datastream (DS), Institutional Brokers Estimate Service (I/B/E/S) and Worldscope (WS)

Value relevant bases:

P: the market value of common equity or stock price (P) is from Datastream (DS #MV), as of April each year in EUR.

EV: Enterprise value (EV) is calculated by taking the market value of common equity (DS #MV) plus the book value of total debt (WS #03255), minus cash & short term investments (WS#02001), plus preferred stock (WS #03451). (DS #MV) is displayed in millions of units of EUR, (WS #03255) in thousands of EUR, (WS#02001) in thousands of EUR, and (WS#02001) also in thousands of EUR.

Identification of comparable companies criterion variables:

ROA: Return on total assets (ROA). This ratio is calculated by dividing the earnings before interest and tax (EBIT) by total assets (TA). EBT (WS #18191) is pre-tax income and displayed in thousands of EUR. TA represents the sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, other investments, net property plant and equipment, and other assets (WS #02999), displayed in thousands of EUR.

Cash Flow multiples variables:

OCF: Operating cash flow or cash flow from operating activities (OCF). It stands for the net cash receipts and disbursements resulting from operations of a firm (WS #04680), displayed in thousands of EUR.

D: Dividends (D). It represents the total cash dividends paid on a firm's common stock during a fiscal year, including extra and special dividends (WC #18192), displayed in thousands of EUR.

Accrual flow multiples variables:

SALES: Sales (SALES) or (net) revenues. This represents the gross sales and other operating revenue less discounts, returns and allowances (WS #01001), displayed in thousands of EUR.

EBIT: Earnings before interest and taxes (EBIT) (WS #18191), displayed in thousands of EUR.

EBITDA Earnings before interest, taxes, depreciation and amortization (EBITDA) (WS #18198), displayed in thousands of EUR.

EPS Earnings per share (I/B/E/S #EPS), represents net income after all operating and non-operating income and expense, reserves, income taxes, minority interest, and extraordinary items, scaled by the number of shares.

Forward-looking multiples:

Forward-looking multiples are computed for four value drivers, already mention above: EBIT, EBITDA, SALES, and E. The numbers indicate the forecast period (FPI). If FPI=1, then the forecast is for the current fiscal year and if FPI=2, then it is the forecast for the next year. The following forward-looking multiples are used for this study:

EBIT1 and EBIT2 (I/B/E/S #SAL1 and I/B/E/S #SAL2), displayed in millions of EUR.

EBITDA1 and EBITDA2 (I/B/E/S #EBD1 and I/B/E/S #EBD2), displayed in millions of EUR.

EBIT1 and EBIT2 (I/B/E/S #EBT1 and I/B/E/S #EBT2), displayed in millions of EUR.

EPS1 and EPS2 (I/B/E/S #F1MN and I/B/E/S #F2MN), displayed in millions of EUR.

Appendix VI: Derivation of the parameters of the Intercept Adjusted Multiples

The Intercept Adjust Multiples approach has been introduced by Liu, Nissim & Thomas (2002). The study of Deng, Easton & Yeo (2009) followed the same methodology as Liu, Nissim & Thomas, and provided the exact derivation process of the parameters of the Intercept Adjusted Multiples approach. The derivation process is as follows:

$$\min var\left(\frac{\mathcal{E}_{i,t}}{p_{i,t}^{equity}}\right) = var\left[\frac{p_{i,t}^{equity} - \alpha_{i,t} - \lambda_{i,t} * x_{i,t}}{p_{i,t}^{equity}}\right]$$

$$= var\left[1 - \alpha_{i,t} * \frac{1}{p_{i,t}^{equity}} -* \lambda_{i,t} \frac{x_{i,t}}{p_{i,t}^{equity}}\right] \quad \text{(VI.1)}$$

Subject to:

$$E\left[\frac{\mathcal{E}_{i,t}}{p_{i,t}^{equity}}\right] = 0$$

$$= \sum\left(1 - \alpha_{i,t} * \frac{1}{p_{i,t}^{equity}} - \lambda_{i,t} * \frac{x_{i,t}}{p_{i,t}^{equity}}\right) = 0 \quad \text{(VI.2)}$$

Note that:

$$var\left(1 - \alpha_{i,t} * \frac{1}{p_{i,t}^{equity}} - \lambda_{i,t} * \frac{x_{i,t}}{p_{i,t}^{equity}}\right)$$

$$= \sum \left(1 - \alpha_{i,t} * \frac{1}{p_{i,t}^{equity}} - \lambda_{i,t} * \frac{x_{i,t}}{p_{i,t}^{equity}} \right)^2 \quad \text{(VI.3)} \quad \text{(3.16b)}$$

Because:

$$E\left(1 - \alpha_{i,t} * \frac{1}{p_{i,t}^{equity}} - \lambda_{i,t} * \frac{x_{i,t}}{p_{i,t}^{equity}} \right) = 0 \quad \text{(VI.4)}$$

To ease the derivation interpretation, we substitute: $\frac{1}{p_{i,t}^{equity}} = m$, $\frac{x_{i,t}}{p_{i,t}^{equity}} = n$, and $\lambda_{i,t} = \beta$ in equations (VI.1) and (VI.2). The minimization problem now is:

$$min \sum (1 - \alpha * m - \beta * n)^2 \quad \text{(VI.5)}$$

Subject to:

$$\sum (1 - \alpha * m - \beta * n) = 0 \quad \text{(VI.6)}$$

This problem can be solved by using the Lagrangian:

$$L = \sum (1 - \alpha * m - \beta * n)^2 - \lambda * \sum (1 - \alpha * m - \beta * n) \quad \text{(VI.7)}$$

Taking derivatives with respect to $\alpha, \beta,$ and λ gives:

$$\frac{\delta L}{\delta \alpha} = 2 * \sum (1 - \alpha * m - \beta * n) * m - \lambda * \sum m = 0$$

$$= \sum m - \alpha * \sum (m)^2 - \beta * \sum m * n - \frac{\lambda}{2} * \sum m = 0 \qquad \text{(VI.8)}$$

$$\frac{\delta L}{\delta \beta} = 2 * \sum (1 - \alpha * m - \beta * n) * n - \lambda * \sum n = 0$$

$$= \sum n - \alpha * \sum (mn) - \beta * \sum (n)^2 - \frac{\lambda}{2} * \sum n = 0 \qquad \text{(VI.9)}$$

$$\frac{\delta L}{\delta \lambda} = \sum (1 - \alpha * m - \beta * n) = 0$$

$$= \sum -\alpha * \sum (m) - \beta * \sum n = 0 \qquad \text{(VI.10)}$$

Assuming that there are N samples in the population (population is $\sum N$) and solving the three equations at the same time, we obtain:

$$\alpha_{i,t} = \frac{N(\sum m * \sum (n)^2 - \sum n * \sum m * n)}{(\sum n)^2 * \sum (m)^2 + (\sum m)^2 * \sum (n)^2 - 2 * \sum m * \sum n * \sum mn} \qquad \text{(VI.11)}$$

$$\beta_{i,t} = \frac{\mathrm{N}(\sum n * \sum (m)^2 - \sum m * \sum m * n)}{(\sum n)^2 * \sum (m)^2 + (\sum m)^2 * \sum (n)^2 - 2 * \sum m * \sum n * \sum mn} \qquad \text{(VI.12)}$$

Given:

$$E[x] = \frac{\sum x}{n}$$

$$var = E[x^2] - (E[x])^2$$

$$var = E[x * y] - E[x] * E[y]$$

The parameter $\beta_{i,t}$ is:

$$\beta_{i,t} = \frac{E[n] * var(m) - cov(m,n) * E[m]}{E[m]^2 * var(n) + E[n]^2 * var(m) - 2 * E[m] * E[n] * cov(m,n)} \quad \text{(IV.13)}$$

Substituting back $m = \frac{1}{p_{i,t}^{equity}}$, $n = \frac{x_{i,t}}{p_{i,t}^{equity}}$ and β=$\hat{\lambda}_{i,t}$ in equation (IV.13) results in:

$$\hat{\lambda}_{i,t} = \frac{E\left[\frac{x_t}{p_t^{equity}}\right] * var\left(\frac{1}{p_t^{equity}}\right) - cov\left(\frac{1}{p_t^{equity}}, \frac{x_t}{p_t^{equity}}\right) * E\left[\frac{1}{p_t^{equity}}\right]}{E\left[\frac{1}{p_t^{equity}}\right]^2 * var\left(\frac{x_t}{p_t^{equity}}\right) + E\left[\frac{x_t}{p_t^{equity}}\right]^2 * var\left(\frac{1}{p_t^{equity}}\right) - 2 * E\left[\frac{1}{p_t^{equity}}\right] * E\left[\frac{x_t}{p_t^{equity}}\right] * cov\left(\frac{1}{p_t^{equity}}, \frac{x_t}{p_t^{equity}}\right)} \quad \text{(IV.14)}$$

Then the parameter estimate $\hat{\alpha}_{i,t}$ is:

$$\hat{\alpha}_{i,t} = \frac{1 - \hat{\lambda}_{i,t} * E\left[\frac{x_t}{p_t^{equity}}\right]}{E\left[\frac{1}{p_t^{equity}}\right]} \quad \text{(IV.15)}$$

Appendix VII: MATLAB algorithm and program syntaxes

Here I present the MATLAB syntaxes used to compute the multiples and estimate the equity value of the target company. The appendix is separated in the syntaxes for the traditional and intercept adjusted approach. The green sentences indicated with '%..........' are explanations.

Traditional Multiple Valuation Method:

```
clear

clc

%	read in the data. 'Data' is a matrix with 5 columns (company name, industry, ROA,
	value driver, market value). The number of rows is equal to the number of companies
	in the sample:

Data = xlsread('data.xls');

%	n=5 is the size of the peer group, and this number is used for most of the research
	questions, except for the investigation of the optimal size of the peer group. Then I
	vary n=2, 5, 10, and 20:

n = 5;

%	p = 1 means the first target company in the sample:

p = 1;


%	============================================================


%	empty the temporary matrices and vector for the next cycle. Then define variables
	vectors and matrices.:

for i = 1:size(Data,1)

   i

   test = [];

   Vectortemp = [];

   Vectortemp2 = [];

   Matrixtemp = [];

   Matrixtempnew = [];

   AbsROA = [];
```

```
AbsMarkettemp = [];

Rij = [];

%       The industry peer group is determined here. Companies with the same industry code
        as the target company p are put in a matrix named 'Matrixtemp'. They the differences
        between the ROA and market values of the target company p and the industry peer
        group are  calculated:

Industrytemp = Data(i,2);

Rij = find(Industrytemp == Data(:,2));

Matrixtemp = Data(Rij,:);

ROAtemp = Data(i,3);

Marketcaptemp = Data(i,5);

Matrixtemp(:,3) = Matrixtemp(:,3) - ROAtemp;

Matrixtempnew = Matrixtemp;

Matrixtemp(:,5) = Matrixtemp(:,5) - Marketcaptemp;

%       The industry peer group for target company p must contain more than 25 companies,
        or else skip this target company and start with the next one. If target company p
        satisfy the restriction then, select five (=n) comparable companies with the smallest
        absolute difference in ROA. If the smallest absolute difference is equal, focus on the
        smallest absolute difference in the market value. The result is an matrix with 5
        columns and five (=n) rows, that is the peer group:

if size(Matrixtemp,1) > 25

   AbsROA = abs(Matrixtemp(:,3));

   AbsMarkettemp = abs(Matrixtemp(:,5));

   for j = 1:n

      RijROA = find(min(AbsROA) == AbsROA);

      if size(RijROA,1) == 1

         Vectortemp(j,:) = Matrixtemp(RijROA,:);

         Vectortemp(j,5) = Matrixtempnew(RijROA,5);

      else

         Marketcaptemp2 = AbsMarkettemp(RijROA,1);

         RijMarket = find(min(Marketcaptemp2) == Marketcaptemp2);

         Vectortemp(j,:) = Matrixtemp(RijROA(RijMarket,1),:);

         Vectortemp(j,5) = Matrixtempnew(RijROA(RijMarket,1),5);

      end
```

```
            Matrixtemp(RijROA,:) = [];
            AbsROA(RijROA,:) = [];
            AbsMarkettemp(RijROA,:) = [];
            RijROA = [];
            Matrixtempnew(RijROA,:) = [];
        end
        Vectortemp2 = Vectortemp(:,5)./Vectortemp(:,4);
        for j = 1:n
            test(j,1) = 1/Vectortemp2(j,1);
        end
%       take the harmonic mean of the ( market value divided by value driver ), which result in
        one value: the synthetic multiple of the peer group:
        Harmonischemean(p,1) = n/sum(test);
%       estimate the value of target company p by taking the product of the synthetic multiple
        and the value driver  of company p:
        Value(p,1) = Harmonischemean(p,1)*Data(i,4);
%       calculate the absolute pricing errors:
        Absdiff(p,1) = abs(Value(p,1) - Data(i,5));
        Error(p,1) = Absdiff(p,1)/Data(i,5);
%       go to the next target company p:
        p = p + 1;
    end
end
klaar = 'goed'
```

Intercept Adjusted Multiple Valuation Method:

```
clear

clc

Data = xlsread('TEST.xls');

%       read in the data. ‘Data’ is a matrix with 5 columns (company name, industry, ROA,
        value driver, market value). The number of rows is equal to the number of companies
        in the sample.

n = 10;

%       n=10 is the size of the peer group, and this number is fixed for the Intercept Adjusted
        Multiple Valuation Method.


p = 1;

%       p = 1 means the first target company in the sample.


%       ==============================================================


%       empty the temporary matrices and vector for the next cycle. Then define variables
        vectors and matrices.

for i = 1:size(Data,1)

   i

   test = [];

   Vectortemp = [];

   Vectortemp2 = [];

   Matrixtemp = [];

   Matrixtempnew = [];

   AbsROA = [];

   AbsMarkettemp = [];

   Rij = [];

%       The industry peer group is determined here. Companies with the same industry code
as the target company p are put in a matrix named ‘Matrixtemp’. They the differences
between the ROA and market values of the target company p and the industry peer group
are  calculated.

   Industrytemp = Data(i,2);

   Rij = find(Industrytemp == Data(:,2));
```

```
  Matrixtemp = Data(Rij,:);
  ROAtemp = Data(i,3);
  Marketcaptemp = Data(i,5);
  Matrixtemp(:,3) = Matrixtemp(:,3) - ROAtemp;
  Matrixtempnew = Matrixtemp;
  Matrixtemp(:,5) = Matrixtemp(:,5) - Marketcaptemp;

%   The industry peer group for target company p must contain more than 25 companies,
    or else skip this target company and start with the next one. If target company p
    satisfy the restriction then, select five (=n) comparable companies with the smallest
    absolute difference in ROA. If the smallest absolute difference is equal, focus on the
    smallest absolute difference in the market value. The result is an matrix with 5
    columns and five (=n) rows, that is the peer group.

 if size(Matrixtemp,1) > 15
     AbsROA = abs(Matrixtemp(:,3));
     AbsMarkettemp = abs(Matrixtemp(:,5));
     for j = 1:n
        RijROA = find(min(AbsROA) == AbsROA);
        if size(RijROA,1) == 1
           Vectortemp(j,:) = Matrixtemp(RijROA,:);
           Vectortemp(j,5) = Matrixtempnew(RijROA,5);
        else
           Marketcaptemp2 = AbsMarkettemp(RijROA,1);
           RijMarket = find(min(Marketcaptemp2) == Marketcaptemp2);
           Vectortemp(j,:) = Matrixtemp(RijROA(RijMarket,1),:);
           Vectortemp(j,5) = Matrixtempnew(RijROA(RijMarket,1),5);
        end
        Matrixtemp(RijROA,:) = [];
        AbsROA(RijROA,:) = [];
        AbsMarkettemp(RijROA,:) = [];
        RijROA = [];
        Matrixtempnew(RijROA,:) = [];
     end
```

```
% Calculate the multiples of the comparable companies in the peer group and estimate the parameters 'alpha' and 'beta' using the derived minimum variance formula in Chapter 3.

Vectortemp2 = Vectortemp(:,4)./Vectortemp(:,5);

Vectortemp3 = 1./Vectortemp(:,5);

Covar = cov(Vectortemp2,Vectortemp3);

Cov23 = Covar(1,2);

Teller = mean(Vectortemp2)*var(Vectortemp3)-Cov23*mean(Vectortemp3);

    Noemer =
    mean(Vectortemp3)^2*var(Vectortemp2)+mean(Vectortemp2)^2*var(Vectortemp3)-
    2*mean(Vectortemp3)*mean(Vectortemp2)*Cov23;

    beta(p,1) = Teller/Noemer;

    alpha(p,1) = (1-beta(p,1)*mean(Vectortemp2))/mean(Vectortemp3);

% Estimate the value of target company p using the estimated parameters 'alpha' and 'beta'

    Value(p,1) = alpha(p,1) +beta(p,1)*Data(i,4);

% Calculate the absolute pricing errors

    Absdiff(p,1) = abs(Value(p,1) - Data(i,5));

    Error(p,1) = Absdiff(p,1)/Data(i,5);

%       go to the next target company p:

    p = p + 1;

  end

end

klaar = 'goed'
```

Appendix VIII: An example of how the gearing ratio affects the EPS multiple.

Academic studies such as Liu, Nissim & Thomas and Schreiner (2007) praise the equity value multiples for being more accurate in estimating value than enterprise value multiples. The explanation is that, when calculating the enterprise value multiples, one must approximate the market value of net debt with the book value of debt. This approximation can introduce noise in the calculation of the enterprise value. Equity value multiples however, do not suffer from this noise, because their value relevant base is directly observable from market values, the market capitalization. Marc Schauten, my supervisor noted that equity value multiples are not completely noise-free, as they can be affected by the gearing ratio. I explain this with an example using P/EPS multiples.

Consider two companies A and B, both with the same enterprise value of 1000, and both earning of 10% of its enterprise value. However, company A is 100% financed with equity, and company B is 50% financed with equity and 50% with debt.

Company A

A 1000	E 1000

Company B

A 1000	E 500
	D 500

Company A has 100 outstanding shares, with a price of 10 per share. Its earnings are 0.1*1000 = 100, the EPS is therefore 100/100 = 1. The P/EPS multiples of company A is therefore 1/10 = 0.1

Company B has 10 outstanding shares, with a price of 50 per share. Assuming the cost of debt (interest) is 5%, the earnings of company B are 0.1*1000 = 100, minus the cost of debt of 0.05*500 = 25, is 75. The EPS is 75/10 = 7.5 The P/EPS multiple of company B is 7,5/50 = 0.15

This simple example shows that equity value multiples are not completely noise free; they can be affected by differences in the gearing ratios.