

Chapter 2

Background: Cost-of-Capital in the Finance Literature

The literature review in this thesis is distributed over two chapters. The aim of Chap. 2 is to discuss literature from the field of cost-of-capital. This is necessary as a foundation for the subsequent chapter, which is more application-oriented. In Chap. 3, previous empirical results on companies' cost-of-capital practices are discussed. Research gaps will be identified at the end of that chapter.

This chapter is structured as follows: In Sect. 2.1, the broader field of *company cost-of-capital* is discussed. This includes a brief discussion of traditional seminal papers as a foundation for the rest of the literature review as well as a review of contemporary discussions about general issues of cost-of-capital, such as alternative determination models and the consideration of unsystematic risk. Section 2.2 shows how the field of cost-of-capital relates to the different sub-disciplines of Finance and for which fields of application of *Managerial Finance* it is relevant. In particular, the role of cost-of-capital in internal capital allocation, performance measurement and value-based management is discussed. In Sect. 2.3, a theoretical framework for the determination of cost-of-capital in a *company group context* that is derived from traditional Finance theory is presented as a foundation for the subsequent section. In Sect. 2.4, previous research on the determination techniques for the *cost-of-capital of business units and projects* is discussed thoroughly. This includes a detailed discussion of the techniques as well as the theoretical and empirical methods adopted by other researchers.

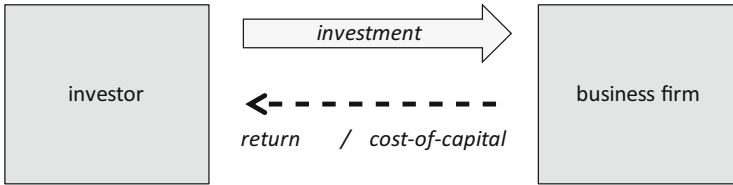


Fig. 2.1 Two perspectives on cost-of-capital (reproduced from Schlegel 2014)

2.1 Company Cost-of-Capital

2.1.1 Two Perspectives on Cost-of-Capital

2.1.1.1 The Investor Perspective

In this section and the next one, it is shown that the *required return* from the point of view of the capital market or investors is the same as the *cost-of-capital* from the point of view of the company (see Fig. 2.1). First, the capital market perspective is discussed. The discussion is limited to the extent that is necessary for an understanding of the subsequent discussion of cost-of-capital.

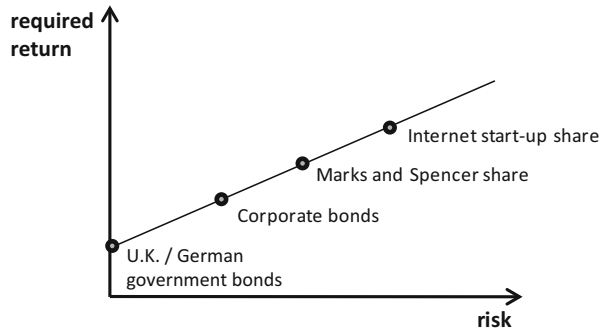
Required return is expressed as a percentage. For instance, a required return of 12 % means that the investment should at least yield a return of 12 % in order to compensate for the risk. It is generally assumed that investors are risk-averse and that the required return depends on the risk of the investment (Emery et al. 2004), i.e. the higher the risk of an investment, the higher the required return. This relationship between risk and return is illustrated in Fig. 2.2. On the very left there are government bonds of solvent countries such as the U.K. or Germany, which are generally considered as risk-free investments. They yield the risk-free rate.¹ Investments with a higher risk are remunerated with the risk-free rate plus a risk-premium.

Classical Finance theory is mostly based on the assumption of efficient markets (Schall 1972). This means that relationships such as the risk-return relationship outlined above should always hold. Otherwise, arbitrage processes would restore equilibrium (Brealey et al. 2009; Emery et al. 2004): an investment in a company is associated with an opportunity cost for the investors, i.e. they cannot invest that money into another firm (Arnold 2008). If another firm with a comparable risk offered a higher return, investors would withdraw their money and invest it into the other firm. This process would continue until the change in supply and demand at the capital markets associated with these transactions had levelled the returns. Thus, an efficient pricing of securities is ensured.

Risk is defined as the possibility that the actual return differs from the expected return (Watson and Head 2010). From a mathematical or statistical point of view,

¹ During the current European Debt Crisis, the assumption of risk-free government bonds can be challenged.

Fig. 2.2 The risk-return relationship (adapted from Arnold 2008)



risk is usually interpreted as follows: Risk is the variance of returns (Markowitz 1952), i.e. the more returns fluctuate, the more risky the investment is considered to be. Thus, for a high-risk investment, there is a certain probability of receiving no return at all or a negative return on the investment. On the other hand, there is also a certain probability of high returns (Arnold 2008).

Markowitz (1952) has shown in his seminal paper called “Portfolio Selection” that part of a stock’s variance can be eliminated by diversification, i.e. by investing in portfolios that include different stocks. This effect occurs because the stocks do not always move in the same direction to the same extent. However, not all risk can be diversified, because returns of different stocks have covariances among themselves (Markowitz 1952). This means that they have a tendency to move in the same direction in general. Therefore, Markowitz recommends investing in firms from different industries, since they have lower covariances, particularly if the industries have different economic characteristics (Markowitz 1952).

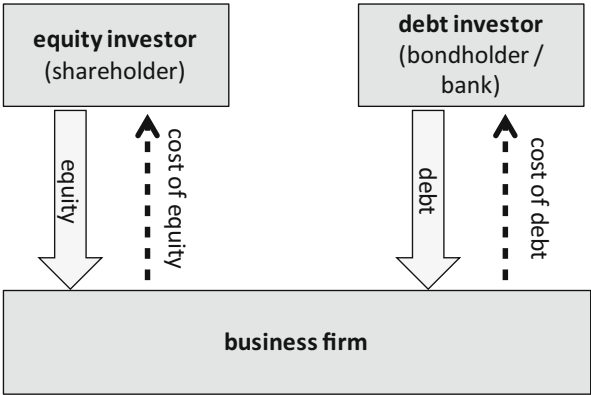
2.1.1.2 The Business Firm Perspective

From the point of view of a company, cost-of-capital is the rate of return that it has to offer to compensate its investors (shareholders and bondholders) for the capital they provide (Brealey et al. 2009; Arnold 2008; Emery et al. 2004). Following from the risk-return relationship explained in the previous section, the cost-of-capital of a business firm depends on the riskiness of the capital that is invested. Due to an increasing global mobility and flexibility of capital, companies need to ensure that they offer the required return, since they risk losing their investors otherwise. This trend is reinforced by an increased professionalism of capital market actors (Steinle et al. 2007; Pfister 2003).

A company raises capital from various funding sources. The main sources are equity and debt, which both need to be remunerated at their own cost-of-capital, as illustrated in Fig. 2.3.

Standard financial theory suggested calculating the overall cost-of-capital as a weighted average of the cost of using the different capital sources relative to the percentage usage of each source (Britzelmaier 2013; Ionici et al. 2011). This

Fig. 2.3 Equity and debt investors (reproduced from Schlegel 2014)



concept is referred to as the *Weighted Average Cost-of-capital (WACC)*. The calculation formula is shown below.²

$$WACC = w_{equity} * r_{equity} + w_{debt} * r_{debt}$$

w_{equity}	Percentage weight of equity capital
r_{equity}	Required return on equity/cost of equity
w_{debt}	Percentage weight of debt capital
r_{debt}	Required return on debt/cost of debt

Although Miller (2009a, b) has recently criticised the WACC, its use is generally accepted and uncontroversial. However, more difficulties lay in the individual components of the WACC, which are (1) the component weights, (2) the cost of debt, and (3) the cost of equity.

(1) Component Weights (Capital Structure)

Financial theory generally recommends that the component weights should reflect the target capital structure of the company (Baker et al. 2011; Ionici et al. 2011; Britzelmaier 2009; Matschke and Brösel 2007). Sometimes the use of market-value weights is also recommended. However, target weights are generally considered to be superior for the following reasons: First, because cost-of-capital should be forward-looking (Schmalenbach-Gesellschaft 1996) and second, because the market value of equity is volatile, so that the actual weights are not stable and do not permanently reflect target weights (Baker et al. 2011; Pfister 2003).

The use of book-value weights is not considered to be adequate in the literature because book-value weights continue to reflect a situation from the past and ignore

² In this thesis, no tax considerations are discussed.

current market conditions (depending on the accounting standards that are used) (Baker et al. 2011; Ionici et al. 2011).

(2) Cost of Debt

Determining the cost of debt is simpler than determining the cost of equity for two reasons. First, there is less debate over the correct methodology (Ionici et al. 2011). Second, in case of traditional bank financing, which is very common in Germany (Guserl and Pernsteiner 2011), the interest on the company's debt is contractually agreed (Pfister 2003). In practice, corporate treasurers have a good overview of the company's cost of debt (Ionici et al. 2011).

For traded debt (i.e. bonds), typically the yield-to-maturity adjusted for default probabilities is used (Berk and DeMarzo 2011; Ionici et al. 2011). In the course of this thesis, the issue of cost of debt is not considered any further. A more detailed discussion can be found in standard literature, e.g. Berk and DeMarzo (2011) or Arnold (2008).

(3) Cost of Equity

The cost of equity is probably the WACC's most difficult component to estimate (Conroy and Harris 2011) and there is also extensive debate about the correct methodology for its derivation. Therefore, cost of equity is one focus of the thesis.

The cost of equity depends on the risk of the company's stocks. Financial theory suggests using capital market models to derive the cost of equity from stock price data (see Sect. 2.1.2). The most famous model is the Capital Asset Pricing Model (CAPM).

However, these capital market models can only be directly applied if stock market data is available. That means that for non-listed companies as well as the estimation of cost-of-capital for business units or projects, the models are not applicable. In these cases, there are proxy methods that have to be used. In the field of Managerial Finance, these proxy methods are important because for managerial purposes, it is regularly necessary to work with specific cost-of-capital rates for business units or projects (see Sect. 2.2.2). Thus, these methods are discussed in detail in Sect. 2.4.

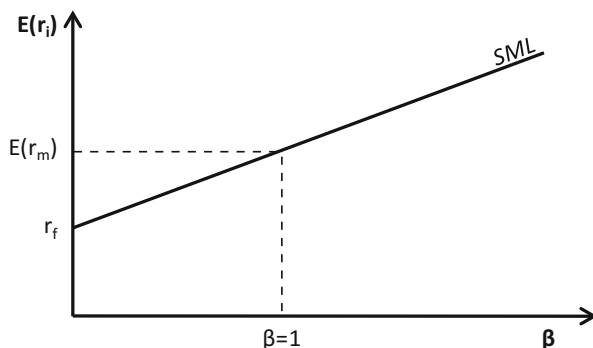
2.1.2 The Determination of Cost of Equity

2.1.2.1 The Capital Asset Pricing Model

As mentioned above, the required return (cost-of-capital) depends on the risk of an investment. For the determination of cost of equity, theoretical capital market models can be used that examine the returns on the stock market. In practice, the use of Lintner (1965) and Sharpe's (1964) *Capital Asset Pricing Model (CAPM)* prevails (Young and Saadi 2011; Hoffjan 2009). The CAPM builds, among others, on Markowitz's (1952) model of portfolio selection (Sharpe 1964). A detailed discussion of the analytical derivation is not presented in this thesis, as it can be found in the standard literature, e.g. Berk and DeMarzo (2011).

The basic idea behind portfolio theory and the CAPM is that in an efficient portfolio, an investor can diversify away the firm-specific risk (unsystematic risk).

Fig. 2.4 Security market line (adapted from Arnold 2008)



However, unless returns of stocks are perfectly negatively correlated, a complete elimination of all of a stock's risk is not possible (Markowitz 1952). The **systematic risk**, i.e. the general market risk or more technically the part of a stock's risk that is due to the correlation with the market portfolio, cannot be eliminated (Sharpe 1964).

According to the CAPM, an investor is only compensated for the systematic risk that he cannot diversify away (Sharpe 1964).³ Systematic risk is measured by the beta factor (Perridon and Steiner 2007; Perold 2004). Consequently, the required return on equity depends on the beta factor. The higher the beta factor, the higher the required return. This relationship is expressed in the security market line (SML) shown in Fig. 2.4. If the market is in equilibrium, all securities must lie on this line (Sharpe 1964). In the diagram, it can be seen that a security that is not exposed to systematic risk lies on the very left of the SML and is only compensated with the risk-free rate of return. The market portfolio, i.e. a portfolio consisting of all of an economy's assets, is exposed to average risk and has a beta factor of 1.

The SML can be expressed in the following formula, i.e. the expected return on equity is the risk-free rate plus the market risk premium times the beta factor.

$$E(r_i) = r_f + E(r_m - r_f) \beta_i$$

$E(r_i)$	Expected return on stock i
r_f	Risk-free rate
β_f	Beta factor
$E(r_m - r_f)$	Expected market risk premium (expected return on market portfolio minus risk-free rate)

Beta measures the responsiveness of a stock's returns to changes in the return of the total market (Watson and Head 2010). Stocks with beta factors greater than

³The notion that investors should only be compensated for systematic risk is increasingly questioned in more recent publications. This issue will be discussed in more detail in Sect. 2.1.2.3.

1 tend to move in the same direction as the overall movement of the market, but to a larger extent. Stocks with beta factors between 0 and 1 also tend to move in the same direction as the overall market, but to a smaller extent (Brealey et al. 2009).

Empirically, beta can be estimated ex post from financial market data. As only the stock's systematic risk and not its total risk is to be measured, the variance of returns is not the correct statistical measure. Instead, the relationship between the stock's return and the market return needs to be examined. This can be done with the help of simple linear regression (Berk and DeMarzo 2011; Watson and Head 2010; Brailsford 2007).

The CAPM has been subject to considerable **criticism**. In spite of this criticism, the CAPM still remains the standard model for cost-of-capital determination, since no workable alternative has yet been found (see Sect. 2.1.2.2). Probably the most prominent opponents of the CAPM for many years have been Fama and French, who presented an alternative model in 1993. In 2004, they published another article on the CAPM, focusing on empirical tests of the model (Fama and French 1993, 2004).

A point of criticism that is frequently raised in secondary literature is that the CAPM itself and also portfolio selection theory, from which it is derived, are based on many *unrealistic simplifying assumptions* (Fama and French 2004; Young and Saadi 2011; Berkman 2013). Examples of such assumptions are that all investors behave rationally according to their utility function, that they have homogeneous expectations and that funds can be borrowed or lent at the same interest rate (Sharpe 1964). The authors are aware that their assumptions are “highly restrictive and undoubtedly unrealistic” (Sharpe 1964, p. 434) and argue that the “proper test of a theory is not the realism of its assumptions but the acceptability of its implications” (Sharpe 1964, p. 434). Moreover, Sharpe (1964) emphasises that their model is an equilibrium model, which means that the tight assumptions are justified. Also Watson and Head (2010) state that the model should be assessed based on its empirical results, since the assumptions might not be far enough away from reality to invalidate the model.

Moreover, the model has other limitations from a theoretical point of view, such as the fact that it is a *one-period model* but investments are usually made for several years (Arnold 2008) and that it assumes that *only one factor* is relevant for the pricing of securities.

However, the most problematic issue about the CAPM is probably not the theory of the model but its empirical application and testing. In empirically applying and testing the model, technical problems occur as well as methodological problems. Moreover, there is considerable empirical evidence that does not support the CAPM, as summarized, for instance, by Dempsey (2013).

First of all, there is a *measurement difficulty* when estimating beta. For instance, beta can be estimated with daily, weekly or monthly financial data, which usually delivers differing results (Arnold 2008). Additionally, the market portfolio that is needed in the regression to estimate beta is not observable, since theoretically not only traded stocks, but all assets of an economy, including physical assets such as

consumer durables or real estate, should be included, as pointed out by Roll (1977).⁴ Usually, a stock market index is used as a proxy for the market portfolio. Besides that, another problem is that the model deals with expected returns in equilibrium, which are not observable because actual returns differ from theoretically expected returns. To reduce measurement error, a common procedure in empirical tests is to operate with portfolios of shares rather than individual shares (Fama and French 2004).

These technical problems also influence the testability of the CAPM. Another difficulty is that the CAPM is an *ex ante predictive model* (Sharpe 1964), i.e. it is forward-looking. However, it can only be tested with historical data, since future data is obviously not available (Arnold 2008). Watson and Head (2010) point out that if betas are estimated with historical data, the usefulness of the CAPM depends on the stability of betas over time. If betas tend to change a lot, it does not make sense to use past betas as a proxy for future betas. Markowitz (1952) acknowledged this limitation in his model, saying that the “probability distribution of yields (. . .) is a function of time”. Furthermore, in empirical tests, multi-period data is often used, although the CAPM is a one-period model. This also only makes sense if betas are stable over time.

In empirical tests, two main issues are tested. The first is whether the Security Market Line (SML) holds as predicted by the CAPM. This includes testing the intercept, the slope and the linearity of the SML. The second issue is the stability of betas over time (Watson and Head 2010). There are a large number of empirical studies. A detailed discussion of individual studies is not the focus of this thesis. Therefore, summarised results from secondary literature are cited in this paragraph. In general, it can be said that there is no support that the CAPM *completely* explains the observable returns on the stock markets. Known opponents of the model, such as Fama and French (2004), argue that the empirical results of the CAPM are “poor enough to invalidate the way that it is used in applications”. However, the general positive relationship between systematic risk and return is confirmed in many studies, although the slope seems to be lower than predicted (Fama and French 2004; Watson and Head 2010), i.e. the risk premium for the systematic risk is less than predicted. On the other hand, the intercept of the SML is found to be higher than predicted, which might be an indication that there are additional factors besides the systematic risk that influence return (Watson and Head 2010; Arnold 2008). For instance, a size effect, i.e. that small companies offer higher actual returns than large companies, is often reported (Brealey et al. 2009; Fama and French 2004). Concerning the stability of betas over time, there are inconclusive

⁴The unobtainable market portfolio is only one point of Roll’s famous critique. However, most authors only cite this point and do not mention the other (less straight-forward) issue that Roll pointed out: He shows that if the market-portfolio is mean-variance efficient, the CAPM equation must automatically hold (being a mathematical fact). Therefore, he argues that the CAPM is not testable and all empirical tests are invalid unless they concern the only testable hypothesis, which is the mean-variance efficiency of the market portfolio (Roll 1977). Pollard (2008) provides a short mathematical proof of Roll’s point.

results (Watson and Head 2010). Another tendency in empirical tests is worth noticing: Apparently, the CAPM is less able to explain the behaviour of returns in later decades of the twentieth century than in the 1950s/1960s/1970s (Arnold 2008).

2.1.2.2 Alternative Models for the Determination of Cost of Equity

In light of the criticism of the CAPM, alternative models have been developed that are supposed to overcome some of the CAPM's flaws. Moreover, there are also a number of extensions to the CAPM as discussed by Berkman (2013). In this thesis, the *Arbitrage Pricing Theory (APT)* by Ross (1976), the *three-factor model* by Fama and French (1993), and the more recently presented *Market-derived Capital Pricing Model (MCPM)* (McNulty et al. 2002) will be addressed briefly.

A model that has attracted a lot of attention in the academic world is the **Arbitrage Pricing Theory (APT)** that was developed by Ross (1976).⁵ The theoretical derivation of the APT is different from the CAPM's theoretical background (Ross 1976). However, this is not discussed in this thesis due to the limited relevance to the research question. The most notable difference from the CAPM is that the APT is a multi-factor model, i.e. the expected return does not only depend on one factor, such as systematic risk, but on different factors. This is expressed in the APT formula (Ross 1976) that is shown below.

$$E(r_i) = r_f + \sum_{k=1}^K E(r_{mk} - r_f) \beta_{ik}$$

$E(r_i)$	Expected return on stock i
r_f	Risk-free rate
$E(r_m - r_f)$	Expected risk premium on risk factor k (expected return on market portfolio minus risk-free rate)
β_{ik}	Sensitivity of stock i to risk factor k

However, Ross does not name any concrete risk factors. Later studies try to find influencing factors empirically. For instance, Roll and Ross (1984) name inflation, industrial production, risk premiums and the slope of the term structure of interest rates.

Although the theoretical derivation of the APT relies on fewer unrealistic assumptions than the CAPM (Brailsford 2007), general points of criticism concerning all pricing models also concern the APT, for instance that they are backward-looking instead of future-oriented (Câmara et al. 2009). However, the

⁵ Ross (1976) refers to a working paper from 1971 in which he first presented the theory. However, the article from 1976 is usually cited as the original source, since it is the first journal publication on the APT.

main problem with the APT is that there is no agreement about the factors that make up the model (Young and Saadi 2011; Arnold 2008; Brailsford 2007). Brailsford (2007) additionally points out that even if at one point in time, there was agreement about the factors, one could still not be sure that the factors would remain constant over time in a dynamic environment. The lack of agreement on the factors is probably one of the main reasons why the model is not generally accepted among academics and practitioners.

Another model that is commonly discussed but rarely applied is the **three-factor model** by Fama and French (1993). The authors have empirically tested different risk factors that explain the returns of stocks and bonds. For stocks, they identify three factors, which are an overall market factor, a factor related to firm size and one related to book-to-market ratio (Fama and French 1993).⁶

Several subsequent empirical studies cited by Brailsford (2007) support the model. However, a point of criticism that is often raised in Finance research also applies to the three-factor model: it is based only on empirical data rather than having a theoretical justification. The authors rely on testing risk factors that appeared to be relevant in previous empirical research—among others, in their own previous empirical study (Fama and French 1992). A practical problem that makes an application of the model difficult is to generally identify the risk premium values for the factors, since they will differ in each empirical study (Brailsford 2007). However, for a practical application, it will be necessary to have generally accepted values that can be used for all companies.

A more recent development is **option-based models** that use information from option prices to determine the cost-of-capital. The main advantage of such models is that they are forward-looking and thus overcome one of the major points of criticism of the traditional models—namely the reliance on historical stock data to predict the future. Option market prices reflect the market's expectations of a stock's future volatility and thus are a good indicator for future volatility of the stock (Câmara et al. 2009; McNulty et al. 2002).

A well-known option-based model is the Market-derived Capital Pricing Model (MCPM) presented by McNulty et al. (2002). The authors assume that cost-of-capital is made up of three components, namely *national confiscation risk*, *corporate default risk* and *equity return risk* (see Fig. 2.5). The yield on government bonds is used as a proxy for national confiscation risk and the risk premium of corporate bonds (compared to government bonds) is taken as a proxy for corporate default risk (McNulty et al. 2002). The equity return risk is calculated taking into account the implied volatility derived from the market prices of the stock options (McNulty et al. 2002). It has to be emphasised that the model is different from the CAPM and the APT, since it uses total volatility of an individual stock

⁶They use so-called *mimicking portfolios* to find out the determining variables. This is done by sorting the stocks according to their respective values for each variable (e.g. for size) and building two portfolios—one includes the stocks below the median of the respective variable and the other one the stocks above. By comparing the return on the two portfolios, the influence of the variable can be examined (Fama and French 1993).

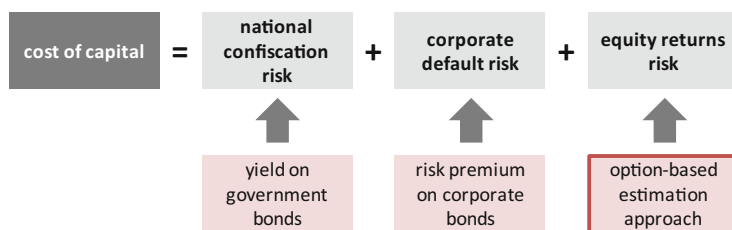


Fig. 2.5 Illustration of the Market-derived Capital Pricing Model (MCPM)

(i.e. systematic and unsystematic risk) and not only its exposure to systematic risk factors. This is a fundamentally different approach. However, a discussion of the exact calculation is beyond the scope of this thesis.

The MCPM is a straightforward approach that is easily understandable and might be useful for application by practitioners. Moreover, it is forward-looking by deriving all of its input variables from current market figures which is indeed a major improvement on the traditional models. However, as the model is quite new, empirical evidence on its usefulness is outstanding. McNulty et al. (2002) present examples of stocks for which their model produced results superior to the CAPM and say they did “similar comparisons of MCPM and CAPM numbers for hundreds of companies in a wide range of industries with the same result” (McNulty et al. 2002). However, this cannot be accepted as scientific empirical evidence, since details on their method, data and results are not disclosed. Another point of criticism against the MCPM that is also brought up by Câmara et al. (2009) is that the model lacks theoretical support.

Another type of approach that appears in the literature from time to time is **implied cost-of-capital**, which means that the cost-of-capital is estimated indirectly. Gebhardt et al. (2001) derived the cost-of-capital from the IRR of a forward-looking residual income model that explains the current market value. Borgman and Strong (2006) used analysts’ forecasts of dividends and derived the beta factor from a dividend discount model. These approaches are problematic because they are based on forecasts. Hence, they are not dealt with any further.

Besides these models, there are more recently published studies that are working on improving existing cost-of-capital models. For instance, McGowan and Rifon (2011) developed an international asset pricing model based on the APT, which adjusts indices for foreign exchange effects. Other authors have attempted to develop enhanced versions of the CAPM. For instance, Chong and Phillips (2012) developed a version of the CAPM that integrates downside risk.

As a conclusion to the discussion of alternative models, the following statement can be made: Despite the known limitations of the CAPM, it remains the standard model for the determination of cost-of-capital (see Sect. 3.2). The main reason is that there is no consensus among academics as to which model could replace the CAPM and that there is no workable alternative model for an actual application (Black et al. 2002). Sharpe’s impression from the 1960s that there is a “dearth of alternative models leading to similar results” (Sharpe 1964) still seems to be valid.

Although APT seems to be comparatively uncontroversial, the absence of commonly accepted risk factors makes it unsuitable for practical application. Arnold (2008, p. 303) states that “perhaps it will be useful to step back from high academic theory and observe the techniques that some market practitioners use”. One promising model that is at its early stage of academic discussion is the MCPM, which might be interesting, although it will have to be examined more thoroughly by academia.

2.1.2.3 Consideration of Unsystematic Risk

As explained above, the CAPM, which is still the prevailing cost-of-capital model, does not take into account unsystematic risk because it can be diversified away. Finance theory generally assumes that investors are diversified. For diversified investors, the correlation with general market movement is more relevant because they cannot diversify this systematic risk.

Recently, an increasing number of authors (Perold 2004; Petersen et al. 2006) have questioned this notion as being a justification for a lower cost of equity. Moreover, with the MCPM, a new model has emerged that does take unsystematic risk into account. The main argument put forward by proponents of a consideration of systematic risk is that the assumption of a well-diversified investor does not describe reality. For instance, Perold (2004) mentions that many workers and executives have a large concentration of investment in their employer due to retirement plans and remuneration based on stock options. Petersen et al. (2006) state that in the valuation of privately held firms, often investors are involved that are insufficiently diversified. McNulty et al. (2002) argue that corporate investors do not try to minimise risk by diversification but rather through good management.

The authors mentioned above focus their argumentation on the question of whether investors are really diversified in reality. However, the actual question of interest in the context of this thesis is whether investors that are *not* diversified should be compensated for the unsystematic risk to which they are exposed.

Perold (2004) argues that the CAPM is still useful. He states that it makes clear to undiversified investors that there is potential for improving their portfolio and that they are not being compensated for part of the risk they are taking. This thesis tries to take the discussion a little further by taking into account the aspect of whether certain types of investors have the possibility to diversify at all. For those that do not have a possibility to diversify, from their individual point of view, it does make sense to take into account unsystematic risk when making rational economic decisions. However, this does not apply to all types of investors. First of all, financial investors at the stock market—also small private investors—do have the possibility to diversify, since today’s market liquidity and range of financial products, such as mutual funds, allow everybody to diversify at low cost. Therefore, the author of this thesis follows Perold’s (2004) argumentation in this point that the CAPM makes clear to those investors the need to diversify. The second case that was discussed above concerns owners of private businesses. For

them, it makes sense to take into account the total risk of individual investments, for instance in new equipment, since they have no possibility to broadly diversify. However, one has to be careful and consider the situation of the natural person at the beginning of the investment chain. For instance, the author of this thesis disagrees with the argumentation by McNulty et al. (2002) that for a listed company that invests in certain assets, the unsystematic risk is relevant even if the company is not well-diversified. From the point of view of corporate management, the company might be undiversified. However, from a theoretical standpoint, the firm's managers are only intermediaries who invest on behalf of the original investor at the beginning of the investment chain. Consequently, the listed company is only a "conduit for shareholders to invest in the firm's assets", as Emery et al. (2004, p. 313) put it. Being only an intermediate level in the investment chain, the company need not be diversified and still only systematic risk is relevant, since the actual investor is supposed to be diversified. Other argumentations are not compatible with Finance theory, especially portfolio theory. The aspect of the investment hierarchy and a company being a portfolio of assets is dealt with in more detail in Sect. 2.3.1.2.

In brief, the discussion can be summarised as follows: There are two competing points of view that are also reflected in the cost-of-capital models. One is the individualistic point of view of a company, reflected in the MCPM, which takes into account unsystematic and systematic risk. The other is the equilibrium view, which regards the economy as a whole reflected in the CAPM. Which of these is more suitable depends on the situation of the investor.

2.1.3 Further Determinants of Cost-of-Capital

Another important direction of research in the field of cost-of-capital, which has gained considerable attention in recent research, is the impact of certain **variables on the cost-of-capital of companies**. Examples of these kinds of studies are listed in Table 2.1. The studies include both empirical and theoretical papers.

Common themes that can be found in the studies are concepts related to information quality (Chen et al. 2011; Yoo and Semenenko 2012), transparency (Barth et al. 2013) and information asymmetry (Armstrong et al. 2011), which will be briefly outlined in the subsequent paragraphs.

In general, many studies that deal with concepts related to information quality and transparency empirically examine the relationship between the information available to the stock market and the cost-of-capital. For instance, Yoo and Semenenko (2012) find that companies which provide higher quality segment reporting to the stock market have lower cost of equity. Barth et al. (2013) present evidence that companies whose earnings are more transparent have lower cost-of-capital. Their explanation is that in a firm with more transparent financial statements, "uncertainty regarding the value of its equity may be lower, and therefore it will enjoy a lower cost of capital" (Barth et al. 2013, p. 207). According to the researchers, the wider theoretical link is that transparency influences the extent of

Table 2.1 Studies on cost-of-capital values and their determinants

Author and year	Variables examined	Relationship identified
Barth et al. (2013)	Earnings transparency	Negative
Lambert et al. (2012)	Information asymmetry	No influence in perfect competition; positive in imperfect competition
Baran and King (2012)	Stock market index revision	Addition: negative Removal: positive
Boubakri et al. (2012)	Political connections of companies	Negative
Yoo and Semenenko (2012)	Quality of segment reporting	Negative
Armstrong et al. (2011)	Information asymmetry	No influence in perfect competition; positive in imperfect competition
Bloomfield and Fischer (2011)	Disagreement among investors	Positive/negative depending on type of disagreement
Chen et al. (2011)	Audit quality	Negative
Hughes et al. (2007)	Information asymmetry	No influence

information asymmetry and thereby reduces the cost-of-capital. In this context, information asymmetry refers to information asymmetry among different investors or traders in the market.⁷ Information asymmetry theory is based on the idea that there are private signals in the capital market which have implications for both systematic factors and specific assets. While informed investors use the signals directly, uninformed investors can only draw inferences about the signals from their effect on prices (Hughes et al. 2007).

However, recent studies that examine the impact of information asymmetry on cost-of-capital (Lambert et al. 2012; Hughes et al. 2007) conclude that information asymmetry only influences cost-of-capital under certain conditions.

Hughes et al. (2007) demonstrate theoretically that equilibrium risk premiums on firm level are not influenced by information asymmetry in the market. However, greater information asymmetry about systematic factors, i.e. on the level of the economy, leads to higher uncertainty and hence higher cost-of-capital. The limitation of Hughes et al.'s (2007) examination is the fact that they operate under perfect competition, showing the effect for large economies where the number of risky assets as well as the related private signals approach infinity. Also Lambert et al. (2012) show theoretically that information asymmetry does not make a difference with perfect competition. On the other hand, they also state that with imperfect competition, cost-of-capital is influenced by information asymmetry and hence point out that the degree of competition in a capital market is crucial for the question of whether or not cost-of-capital is influenced by information asymmetry. Armstrong et al. (2011) build on this theoretical foundation and show empirically

⁷ For information asymmetry in the context of agency theory, please refer to Sect. 2.3.3.

that in imperfect competition, cost-of-capital has a positive relationship with information asymmetry.

As a conclusion to this section, it can be stated that recent studies on determinants of cost-of-capital such as information asymmetry make an important contribution to knowledge. While neo-classical models like the CAPM assume that cost-of-capital is influenced by systematic risk only, they empirically show different determinants supported by theoretical explanations. However, the relevance of these issues for this thesis is limited, as the research aim of this study is not to explain cost-of-capital values at the capital markets. Instead, it is to consider how the resulting cost-of-capital rates are used internally for Managerial Finance purposes.

2.2 Cost-of-Capital in the Context of Managerial Finance

2.2.1 Cost-of-Capital in the Finance Literature

2.2.1.1 Sub-disciplines of Finance

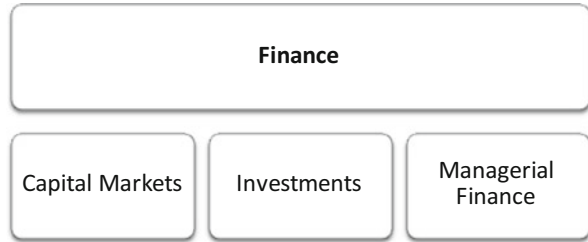
In the literature, no uniform definition of the sub-disciplines of Finance can be found. For instance, Brigham and Houston (2009) and Fabozzi and Drake (2009) divide Finance into three sub-disciplines. In contrast, Besley and Brigham (2008) divide the field into four areas, whereas Khan and Jain (2007) use four sub-categories. Additionally, different authors use different terms for the same area, which is especially the case for the sub-discipline that is referred to as Managerial Finance in this thesis.

However, if one takes a closer look at the different classifications, it turns out that they are actually quite similar. The difference between the authors is merely that some use a more detailed classification than others. Fig. 2.6 shows how the sub-disciplines referred to by the different authors relate to each other.

	Finance			
Brigham & Houston 2009	Capital Markets	Investments		Financial Management
Fabozzi 2009	Capital Markets	Investment Management		Financial Management
Besley & Brigham 2008	Financial Markets and Institutions	Financial Services	Investments	Managerial Finance
Khan & Jain 2007	Financial Services			Managerial Finance

Fig. 2.6 Areas of finance—reconciliation of definitions

Fig. 2.7 Classification of finance in this thesis (own illustration based on Brigham and Houston 2009 and Fabozzi and Drake 2009)



In this thesis, a classification is used that is similar to the one by Brigham and Houston (2009) and Fabozzi and Drake (2009). The three areas shown in Fig. 2.7 will be explained in the remaining part of this section.

(1) Capital Markets

Research in this area is concerned with the financial systems—i.e. financial markets, financial intermediaries and financial regulators—as well as the structure of interest rates and questions of derivative financial instruments (Fabozzi and Drake 2009).

Besley and Brigham (2008) point out the strong relationship between Finance and Economics. This similarity is particularly evident in the area of Capital Markets, but also in the area of Investments whereas Managerial Finance is more related to the field of Business/Management.

(2) Investments

This area focuses on the selection of financial assets—i.e. stocks and bonds, for example—for investment portfolios (Besley and Brigham 2008; Brigham and Houston 2009). This includes research on values, risks and returns of securities (Besley and Brigham 2008) but also activities like setting investment objectives and strategies (Fabozzi and Drake 2009). Many of the famous papers in Finance are concerned with research on value, risk and return—for instance Markowitz's (1952) Portfolio Selection.

(3) Managerial Finance

For this sub-discipline of Finance, there are different names that are used interchangeably by many authors. Probably the most common terms are *Corporate Finance*, *Financial Management*, *Business Finance* and *Managerial Finance*. Although only a few authors provide a clear definition of the terms, there are slight differences, which will be pointed out subsequently. Moreover, the reason why the term *Managerial Finance* has been chosen for this thesis will be explained.

A common element that can be found in many definitions is that this sub-discipline of Finance deals with *financial decisions* of organisations (Lumby and Jones 2011; Brigham and Houston 2009; Bierman 2010; Hillier et al. 2010). Furthermore, the area concerns financial decisions of *business firms*—as opposed to only financial institutions (Besley and Brigham 2008; Khan and Jain 2007). Watson and Head furthermore highlight the management focus in their definition (2010).

While there seems to be no difference between the terms *Financial Management*, *Business Finance* and *Managerial Finance*, strictly speaking the term *Corporate Finance* refers to the financial management of Corporations, which is a common form of organisation in the U.S. (Brealey et al. 2009; Fabozzi and Drake 2009), whereas the other terms include all types of businesses. However, many authors do not stick to the literal meaning of the term and say that Corporate Finance deals with the financial management of all type of businesses (Megginson et al. 2008; Khan and Jain 2007).

In this thesis, the term *Managerial Finance* is used for the following reasons:

- *Corporate Finance* is a term from the U.S., while this thesis is written from a European perspective. Interestingly, the U.S. authors Ross, Westerfield and Jaffe notice this difference and call the International Student Edition of their textbook “Modern Financial Management” (Ross et al. 2008b), while the original U.S. version with exactly the same contents is called “Corporate Finance” (Ross et al. 2008a).
- The term *Financial Management* does not make clear that the area is a sub-discipline of Finance rather than Management.
- The wording is more consistent with the field of Accounting if Managerial Finance rather than Business Finance is used because of the Accounting terminology Managerial vs. Financial Accounting.

2.2.1.2 Cost-of-Capital at the Nexus of Investments and Managerial Finance

This thesis contributes to the field of Managerial Finance. The topic addressed is the cost-of-capital of business units, focusing on the application of cost-of-capital rates for Managerial Finance purposes with a particular emphasis on performance and value-based management as well as capital allocation and capital budgeting.

Although the thesis does contribute to the field of Managerial Finance, it is based on two sub-disciplines of Finance—Managerial Finance and Investments. The reason is that the techniques used to determine the cost-of-capital originate from the field of Investments. Therefore, this literature review contains a substantial part about research on risk and returns, although the actual focus is the application of the techniques from the point of view of a business firm. It can thus be said that the research project is an interdisciplinary approach of different sub-disciplines of Finance.

In Fig. 2.8, this relationship is illustrated graphically. It can be seen that the techniques to estimate cost-of-capital are actually part of the sub-discipline Investments. However, the knowledge is used in various Managerial Finance topics, above all in *capital allocation* and *performance measurement*. The role of cost-of-capital within these two fields of application will be discussed in the next section.

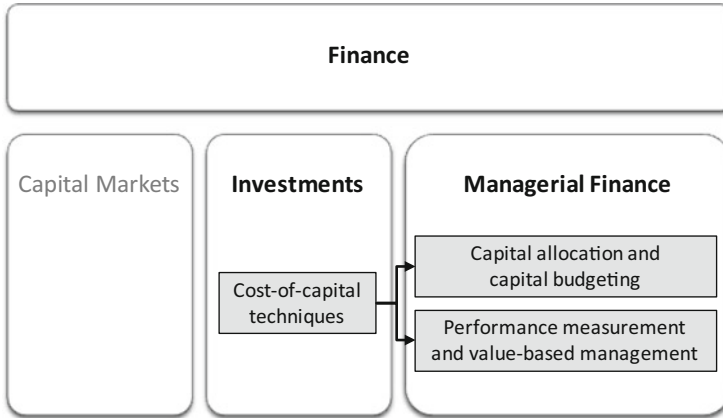


Fig. 2.8 Focus sub-disciplines of finance

2.2.2 *Fields of Application of Cost-of-Capital*

2.2.2.1 Overview of Fields of Application

Cost-of-capital is used as a discount rate or benchmark return in various fields of application. In Managerial Finance, it especially shows up in two issues: First, as hurdle rates to evaluate investments with the help of *capital budgeting* techniques in the capital allocation process (see Sect. 2.2.2.2). Second, in *performance measurement*, it is used as target returns for profitability measures or as capital charges for value-based measures (see Sect. 2.2.2.3). These two fields are in the focus of this thesis and will be discussed in the following two sections.

Moreover, cost-of-capital rates are used as discount rates for company valuation with the help of the discounted cash flow (DCF) technique (Dempsey 2013). The DCF technique can also be used for a number of other *valuation purposes*, e.g. for the valuation of intangible assets (Schlegel 2008). Since this is not part of the daily operating business, valuation purposes are not taken into further account in this thesis.

Furthermore, cost-of-capital is used in Financial Accounting, for instance according to the *International Financial Reporting Standards (IFRS)*. In IFRS, cost-of-capital is especially relevant for impairment tests according to IAS 36. This standard requires companies to regularly assess whether certain assets may be impaired. If there is any indication of impairment, the recoverable amount of the asset must be estimated. In this process, valuation techniques that use cost-of-capital as a discount factor are used under certain circumstances (KPMG International 2013; Ng Wee and Hickey 2009). Impairment tests are especially important for goodwill (Kasperzak and Wassermann 2009). As these issues are from a different discipline, they are not further discussed in this thesis.

2.2.2.2 Capital Allocation and Capital Budgeting

One of the most important tasks of Managerial Finance and also an important field of application of cost-of-capital is the **allocation of capital** in internal capital markets. According to Porter (1998, p. 442), the term ‘internal capital market’ can be defined as “the system by which corporations allocate available capital from both internal and external sources to investment projects within and across business units”. Capital allocation is necessary since capital is raised on the corporate level of the company (Conroy and Harris 2011; Harris et al. 1989; Chua et al. 2006) and needs to be invested in different projects, such as research and development projects. In the process of capital allocation, cost-of-capital rates are used as hurdle rates, i.e. minimum returns that an investment project must yield in order to be accepted (Baker et al. 2011).

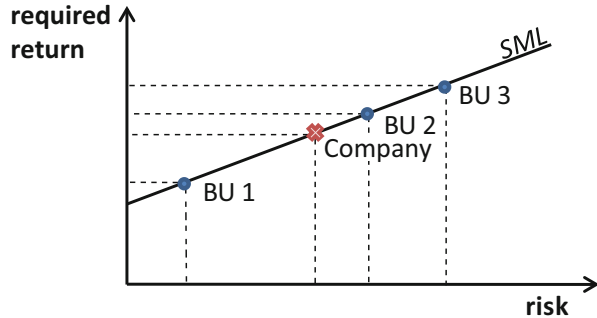
Taggart (1978) distinguishes between two systems to allocate capital within a company group: the price system and the rationing system. In the *price system*, the central company group management determines hurdle rates based on the cost-of-capital for each business unit. In the next step, the local business unit managers identify potential projects that are able to meet the hurdle rate and report the amount of capital needed back to the headquarters. Finally, the company group raises the required amount of capital from the financial markets. That means that in the price system, no limit is set for the capital that is invested in the business units, since according to Finance theory, an unlimited amount of capital can be obtained from the financial markets if the investments yield the required return. In the *rationing system*, central management applies some form of budgeting to internal capital allocation, which means that the total amount of capital allocated to the business units is limited. Taggart (1978) argues that the rationing system is to be preferred if local managers do not fully perceive the consequences of their actions for the company group as a whole, whereas the price system makes more sense if local management disposes of relevant information that is not known to corporate management.

No matter which system is chosen, a proper determination of cost-of-capital is indispensable. While the total quantity of capital allocated differs among the systems, an analysis of individual projects in terms of their profitability is required irrespective of the system.

It is often emphasised in the literature—even on the textbook level—that a **differentiated treatment of cost-of-capital** rather than using the company cost-of-capital is important if the risk of the business unit or project differs from the average risk of the company (Ionici et al. 2011; Damodaran 2011; Brealey et al. 2009). As early as 1975, Brigham (1975) stressed that a company should use different hurdle rates if its investment projects differ in terms of risk.

What might seem like a mere theoretical accounting problem has serious consequences for business, as the use of incorrect cost-of-capital can result in sub-optimal decision-making and thus failure to maximise shareholder value (Block 2005). If the individual risk of a business unit is not taken into account

Fig. 2.9 Risk and required return of business units (adapted from Brealey et al. 2009 and Brigham and Ehrhardt 2005)



and company cost-of-capital is used as a hurdle rate, this results in a misallocation of capital. Too much capital is allocated to high-risk business units that offer high potential returns because it is not taken into account that the risk is also higher. Low-risk business units that offer lower but less risky returns receive too little capital (Brealey et al. 2009; Arnold 2008). This relationship is often illustrated graphically as shown in Fig. 2.9.

It can be seen that BU 1 in the figure has a lower risk than the other business units and thus also a lower required return according to the SML. This means that the investment projects of the business unit require a lower return in order to be profitable, taking into account the risk. If these projects are evaluated with the company cost-of-capital, many of the projects are rejected, although they would have a positive NPV if they were analysed with the correct cost-of-capital. Consequently, too little capital would be allocated to BU 1 with an undifferentiated treatment of cost-of-capital. In contrast, BU 3 is more risky than the average business unit in the company group and thus requires a higher return. If the investment projects of BU3 are evaluated with the company cost-of-capital, the projects seem more profitable than they actually are because the hurdle rate used is too low. Thus, too much capital would be allocated to BU3 if its investments were analysed with the company cost-of-capital. These examples make clear why a thorough treatment of cost-of-capital is indispensable for an efficient internal capital allocation.

According to Finance Theory, all investments projects should be evaluated with **capital budgeting** techniques that are based on Net Present Value (NPV), such as the Discounted Cash Flow (DCF) approach or Internal Rate of Return (IRR), using the WACC as a hurdle rate (Adjaoud et al. 2011). If the DCF approach is used, future cash flows are discounted with the cost-of-capital. If the discounted cash flows are equal to or exceed the initial cash outflow for the investment, the project should be undertaken (Maher et al. 2012). If the IRR is calculated, the project should be undertaken if the IRR is equal or greater than the cost-of-capital of the project (Maher et al. 2012). In practice, alternative methods such as the payback period of an investment are also used in investment decisions (Arnold and Nixon 2011).

2.2.2.3 Performance Measurement and Value-Based Management

For **performance measurement**, many companies use return measures such as the return on capital employed (ROCE) to measure business performance. Return or profitability indicators are important measures because they compare a profit figure (output) with the capital invested (input) and thus make a statement about the effectiveness with which the capital has been invested (Atrill 2009).⁸

For evaluation, i.e. whether a certain return is adequate or not, or for target setting for return measures, some companies use other companies' returns as a benchmark. Another possibility is to assess the return against the required return demanded by shareholders—which equals the cost-of-capital (Dempsey 2013). Only if a return higher than the cost-of-capital is generated does the company create additional value. This is because the cost-of-capital is not considered as a cost in accounting (Conroy and Harris 2011; Wahlen et al. 2011). According to Baker et al. (2011), many firms even use the cost-of-capital as a benchmark to determine the bonuses that are paid to the management.

In **value-based management** concepts, residual income measures or economic profit measures are used that subtract the cost-of-capital from profit (Britzelmaier 2013; Dempsey 2013). The idea behind this concept is that a company only creates value if the profit exceeds the cost-of-capital (Wahlen et al. 2011; Britzelmaier 2009). This is because shareholders buy shares in the expectation of making profits and additional value is created only if their minimum required return (i.e. the cost-of-capital) is exceeded (Laier 2011).

The idea of deducting the required return on equity was already promoted by Anthony (1973) and other academics long before the concept was refined and commercially exploited by consulting firms (as discussed below). Figure 2.10 outlines the relationship between cost-of-capital and value creation: only part of the profit enhances the value of a company because part of the profit is needed to satisfy the required return of the shareholders.

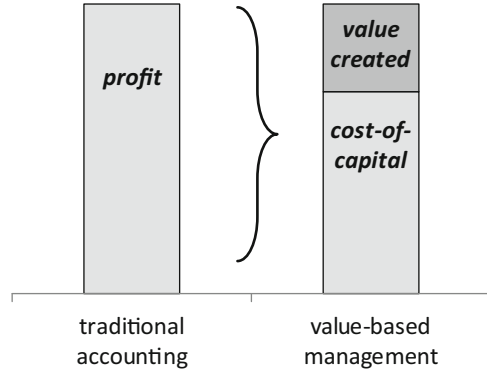
To calculate economic profit, different accounting measures for profit and capital are used in different concepts. In the author's opinion, it cannot be clearly said which measures are superior from a theoretical perspective as long as the capital measure and the profit measure are defined consistently.⁹

Anthony (1973) demonstrates his concept of cost of equity based on Net Income, Total Equity and Total Assets. Probably the most famous example of an economic profit measure, the Economic Value Added (EVA[®]), is based on Net Operating Profit After Tax (NOPAT) and Net Business Assets, as shown in the formula below (Stewart 2013).

⁸ For a detailed discussion and evaluation of return measures, see Schlegel (2011).

⁹ For instance, if the capital measure includes debt, the profit measure should be calculated before interest.

Fig. 2.10 Profit, cost-of-capital and value creation (reproduced from Schlegel 2014)



$$EVA = NOPAT - WACC * NBA$$

NOPAT Net Operating Profit After Tax
WACC Weighted Average Cost-of-Capital
NBA Net Business Assets

EVA is a registered trademark of the consulting firm Stern, Stewart & Co. As the concept is commercially distributed by Stern, Stewart & Co., a careful interpretation of the proponents' research findings is advisable. Examples of publications by authors affiliated with the company are Stewart (1991), Stern et al. (1996), O'Byrne (1997) and Young and O'Byrne (2000). However, in the meantime, a large body of research by independent academics is available. For a recent literature review and a discussion of research issues concerning EVA, see Sharma and Kumar (2010).

Another value-based measure is the Cash Flow Return on Invest (CFROI). The CFROI uses cash flow related measures. In a first step, the CFROI, which is a cash flow based return measure, is calculated based on a formula similar to an Internal Rate of Return (IRR) calculation. In a second step, this return is contrasted with the cost-of-capital (WACC) in order to calculate the Cash Value Added (CVA), which is an economic profit measure (Britzelmaier 2013).

1. $NPV = 0 = -GI + GCF \left(\frac{(1 + CFROI)^n}{(1 + CFROI)^n * CFROI} \right) + \frac{NDA}{(1 + CFROI)^n}$
2. $CVA = (CFROI - WACC) * GI$

NPV	Net Present Value
GI	Gross Investment
GCF	Gross Cash Flow
CFROI	Cash Flow Return On Invest
NDA	Non-depreciable Assets
CVA	Cash Value Added
WACC	Weighted Average Cost-of-Capital

Above, it was shown that although there are different value-based measures, the cost-of-capital (WACC) is an important element in all of the main concepts. Any further discussion of individual value-based measures is not the focus of this thesis. For a detailed discussion of the EVA and the CFROI, including a sensitivity analysis of the two measures, see Erasmus and Lambrechts (2006). For a more technical discussion of financial measures, including EVA, see Britzelmaier and Schlegel (2011).

In order to implement an effective value-based management system, managers need to know the wealth-creating potential of their actions (Arnold 2008). This means that value creation needs to be measured not only on an aggregate level of an organisation, but also on lower levels such as the business unit level, in order that effects of market-oriented decisions on value can be evaluated. Therefore, cost-of-capital also has to be determined on a business unit or even a project level, since it is needed to calculate value creation.

Value-based management is a managerial approach with the primary goal of maximising the wealth of shareholders (Arnold 2008). In Managerial Finance theory, the maximisation of shareholder value is often seen as the most important objective of financial management (Erasmus and Lambrechts 2006) and also in business firms it is widely accepted as a fundamental objective of business (Sharma and Kumar 2010; Rappaport 1986). The emphasis of the shareholder perspective in formulating corporate objectives, as advocated by shareholder theory, has often been criticised. Opponents argue that in decision-making, a firm should balance the interests of all stakeholders such as employees and customers (Danielson et al. 2008). Another point of criticism is that shareholder theory encourages short-termism, i.e. the pursuit of a course of action that maximises short-term gains but is suboptimal for the long-term (Danielson et al. 2008; Lavery 1996). Proponents argue that critics are misguided, as exploiting stakeholders and focusing on the short term only is incompatible with the goal of long-term maximisation of shareholder value (Arnold 2008; Danielson et al. 2008). Moreover, Rappaport (1986) points out that enhancing a company's financial position is beneficial for all stakeholders, since they also have financial interests in the company. As this thesis focuses on the technical point of view rather than discussing corporate governance and ethical issues, the discussion of shareholder vs. stakeholder theory is not reviewed in detail.

Besides the further development of value-based measures, recent research about value-based management seems to concentrate on an empirical examination of value-based management and its usefulness in practice. Several authors examine

the use and communication of value-based management by companies in practice. For instance, Laier (2011) examines value reporting of German companies by analysing financial statements. Britzelmaier (2010) examines similar research questions among European listed companies. A common question that is investigated is whether companies that use value-based management benefit from it, i.e. whether their financial performance is superior to that of their peers. Recently, this question was examined for German listed companies by Rapp et al. (2011), who conclude that companies using value-based management concepts do indeed show excess returns. Athanassakos (2007) found, with the help of a survey approach, that in Canada, larger companies with younger and more educated managers are more likely to use value-based management concepts. His data also suggests that companies using value-based management outperform their peers. Ryan and Trahan (2007) use longitudinal data in order to find out whether the introduction of value-based management improves economic performance. Although their overall conclusion is that this is the case, the results are somewhat mixed. In the sample, firms that tie executive compensation to value-based measures have lower performance after the introduction of this approach (Ryan and Trahan 2007), while theory would suggest the opposite development.

2.2.3 Agency Theory and Cost-of-Capital Practices

2.2.3.1 Agency Theory and Managerial Finance

The purpose of this section is to discuss the fields of application of cost-of-capital that were outlined in the previous sections in the theoretical context of agency theory.

Agency theory—also referred to as the principal-agent problem—is a concept from neo-institutional economics and became known especially through the publication by Jensen and Meckling (1976). A **principal-agent relationship** is a “contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent” (Jensen and Meckling 1976, p. 308). The relationship is assumed to have the following characteristics: First, the principal’s and the agent’s *interests are divergent* and the *agent acts opportunistically*, i.e. is likely to misuse the delegated authority for his own benefit. Second, the agent is able to enforce his own interests, since there is *information asymmetry* in favour of the agent (Britzelmaier 2013; Weber and Schäffer 2006). This creates a reduction of the principal’s welfare, which can be classified as different types of agency costs (Jensen and Meckling 1976).

The general principal-agent problem can be found in a number of different settings. In the context of large companies, there is a principal-agent relationship between shareholders and top management. Furthermore, due to delegation and decentralisation, there is a principal-agent relationship at every level within the company (Jensen and Meckling 1976). Thus, principal-agent relationships with

multiple tiers are generated, as, for instance, top management is the business unit management's principal and at the same time the shareholders' agent (Scharfstein and Stein 2000).

2.2.3.2 Agency Problems in Capital Allocation and Performance Measurement

Agency theory has implications for both capital allocation and performance measurement. Agency problems in these areas are an important field of investigation, since they result in inefficiencies and decrease of corporate performance.

Concerning **capital allocation**, corporate top management acts as an intermediary—or agent—to invest the shareholders' money (Emery et al. 2004). Thus, responsibility is delegated to a large degree to managers, who are supposed to operate the company in a manner that benefits the shareholders (Arnold and Nixon 2011). Investors have no insight into lower levels, since they invest in the whole company as a portfolio of assets, projects and business units. This is especially the case in public companies where capital is very fluid and individual investors only hold a small share in the company. Here, investors only have a little influence or insight concerning the operations of the company and evaluate its performance based on financial criteria (U.S. National Research Council 1994).

The internal situation is comparable: Top management allocates capital to business units but it is often not involved in daily activities on an operational level. They usually base their decisions on financial information and only get involved on a lower level if certain thresholds are breached (Sutcliffe and Donnellan 2007). The delegation of authority to lower hierarchical levels raises the question of how the orientation towards corporate objectives can still be ensured on all organisational levels (Horváth 2006).

Lots of recent research in the area of internal capital markets deals with the examination of inefficiencies in capital allocation as an effect of managerial agency problems. For instance, Gaspar and Massa (2011) as well as Duchin and Sosyura (2011) conduct research on the effect of the personal relationship between the central CEO and divisional managers on capital allocation. Duchin and Sosyura (2011) find that divisional managers who have stronger social connections to the CEO receive more capital. Scharfstein and Stein's (2000) results imply that weaker divisions are often subsidised by stronger ones—which also results in inefficient capital allocation. Other researchers examine the role of incentives and executive compensation in overcoming the agency problems (André et al. 2009; Yong 2007).

While the field of **performance measurement** does not have as many inherent agency problems as capital allocation, it plays an important role in overcoming principal-agent problems in general.

First of all, performance measurement systems help to overcome agency problems by aligning the agent's interests with the principal's interests. This can be done by designing performance-based compensation plans which give managers the right incentives (Brealey et al. 2009). As Brealey et al. (2009, p. 327) state: "Since you

get what you reward and you reward what you measure, you get what you measure.”

Moreover, performance measurement reduces the information asymmetry between principal and agent and thus mitigates the principal-agent problem.

2.2.3.3 Managerial Risk Preferences

In general, classical theory assumes that investors and other economic actors are risk averse. However, as Laughhunn et al. (1980, p. 1238) point out, risk preferences in reality are probably a “mixture of risk aversion and risk seeking”. Research on managerial risk preferences deals with questions concerning the risky choice behaviour of managers.

While the general discussion about risk preferences is not within the scope of this thesis, the consequences of managerial risk preferences from the perspective of agency theory and Managerial Finance are briefly discussed. From this perspective, the issue is problematic if the principal and the agent have different risk preferences. As Karake-Shalhoub and Petty (2002, p. 239) point out, the diverging interests between principals and agents also “get translated into differences in risk preferences”. The specific risk behaviour of managers—and hence the extent of the divergence problem—depend on different factors such as their compensation (Gormley et al. 2013). In the following two paragraphs, two examples of diverging risk preferences and their consequences for capital investment and financing decisions are discussed.

One example of diverging risk preferences is the relevance of **unsystematic risk**. As pointed out in Sect. 2.1.2.3, diversified investors are indifferent with regard to unsystematic risk. In contrast, unsystematic risk is relevant for managers, since they are exposed to the idiosyncratic risk of the firm. As Schroeck (2002) points out, managers often invest a large fraction of their personal wealth in the company and their human capital in particular is directly linked with the performance of the company. Therefore, they care about the volatility of cash flow and the default risk of the firm. This difference in risk preferences can lead to agency costs related to unnecessary diversification or suboptimal capital structure, as leverage is too low from a tax shield perspective.

Another example of agency costs related to diverging risk preferences is **investments below the cost-of-capital**. They can occur in a situation where managers are evaluated based on ROI (or other capital return measures) and their business unit’s current ROI is below the cost-of-capital. In order to improve the ROI, managers will invest in projects that are below cost-of-capital if they improve the business unit’s overall ROI, even if the risk of the project would require a higher ROI (Merchant and Van der Stede 2007).

Overall, it can be summarised that managerial risk preferences can lead to a situation where the agent is either too risk-averse or too risk-seeking from the principal’s point of view. This generates agency costs, for instance in the form of inefficiently invested capital.

2.2.3.4 Implications for this Study

As a conclusion to Sect. 2.2.3, it can be summarised that the research concerning principal-agent relationships in Managerial Finance topics deals with the effect of the principal-agent problem on the company's performance, policies and processes.

Previous literature does not address the impact of agency problems on cost-of-capital practices as discussed in this thesis. Nevertheless, the link to cost-of-capital practices can be summarised as follows: agency problems—such as personal relationships between CEOs and divisional managers—undermine a proper application of cost-of-capital practices as suggested by classical Finance theory. Instead of applying objective methods as discussed in this thesis, opportunistic behaviour results in inefficient capital allocation.

As this thesis is written from a technical point of view based on the classical Finance theory perspective, agency theory will not be the focus of this study. However, the findings of this thesis will briefly be discussed in the theoretical context of agency theory in order to establish a theoretical link between the findings and existing theories (cp. Sect. 8.1.4).

2.3 Cost-of-Capital in the Context of Company Groups

2.3.1 Conceptual and Theoretical Background

2.3.1.1 Definition of Business Unit

The necessity of using differentiated cost-of-capital rates for different business units was identified above. Up to this point, the term 'cost-of-capital of business units' has been used multiple times. Now a more thorough discussion of what a business unit is follows.

There are different possibilities in terms of how a company group can be divided into organisational units. First of all, there is the *legal* vs. *the management* structure: The primary structure of a company group is determined by the legal ownership structure. However, this statutory structure is overlaid by an operational management structure (Borchers 2006). In *Managerial Finance and Accounting*, the relevant point of view is economic, i.e. the operational structure is relevant. Even in Financial Accounting, with the increased importance of IFRS, a legal view on company groups is increasingly being replaced by a management-oriented view. For instance, IFRS 8 (Operating Segments) requires the reporting of segment data in the way in which they are reported to management—independent from the legal structure. Evidently, for the topic and scope of this thesis, the economic or management point of view as opposed to the legal point of view is also relevant.

However, also from an economic point of view, there are several ways to divide a company group. When differentiating cost-of-capital in a company group, two aspects have to be decided.

First, the *dimension of differentiation*: a company group can be divided into different dimensions. In practice, common dimensions that are reported in (internal or external) financial reports are the following:

- product-lines
- regions
- functions, e.g. marketing, finance etc.

In contemporary company groups, the operational structure is often a multi-dimensional *matrix organisation*, for instance with a functional, a product-oriented and a regional dimension at the same time. Thus, multidimensional performance measurement according to the respective responsibilities must also be done and a decision must be made about the dimension or dimensions into which the cost-of-capital should be differentiated.

Second, the *level of differentiation*: The second aspect refers to the level of differentiation, i.e. if the cost-of-capital is only differentiated on higher and fewer organisational levels or if the differentiation is more detailed. For example, in the region dimension, a company could decide to differentiate cost-of-capital by continents or by individual countries.

Vogel (1998) names minimum requirements which should be fulfilled for the definition of sub-units in the context of value-based management: It must be possible to evaluate them separately, i.e. cash flows (CF) and cost-of-capital must be separately identifiable. Moreover, they must be led by managers with competences and responsibility for the task of value creation. The first of Vogel's requirements is similar to the concept of a *cash generating unit (CGU)* from the International Financial Reporting Standards (IFRS), which is used for impairment tests could be applied (Epstein 2010). A CGU is "the smallest identifiable group of assets that generates cash inflows that are largely independent of the cash inflows from other assets" (IAS 36.6).

In this thesis, it is suggested that cost-of-capital should be differentiated by business units. A business unit in this thesis is a *strategic business unit (SBU)* as defined in strategic marketing. A SBU is a product-market combination which is strategically independent from other SBUs (Huch et al. 2004). SBUs fulfil both Vogel's requirements and the definition of a CGU. The term *divisional cost-of-capital* can often be found in the literature. This term also means a distinction of cost-of-capital by line of business (Harris et al. 1989) and can thus be used synonymously to *cost-of-capital of business units*.

A differentiation of cost-of-capital by business units consequently means that the suggested dimension of differentiation is the product dimension. There are several reasons why this makes sense from a theoretical point of view:

- Cost-of-capital differentiation only makes sense in a dimension that is a significant determinant for systematic risk because then the cost-of-capital rates differ from each other and therefore a differentiation is necessary. It is uncontroversial that industry affiliation is one of the major determinants of systematic risk. In

multi-industry firms, business units evidently conduct business in different industries, so that the product-lines differ in their systematic risk.

- Another reason that is stated by Harris et al. (1989) is that firms typically delegate authority to managers of business units that are differentiated by product lines. Thus it also makes sense to align value-based performance measurement with decision authority (see Vogel's argument above).

However, depending on the individual circumstances, a cost-of-capital differentiation in a different dimension might also make sense for some companies. A further differentiation of cost-of-capital on a deeper level *within* business units (e.g. for individual investment projects or products) is necessary if the risk of the project is different from the average risk of the business unit. Otherwise, it is sufficient to use the business unit cost-of-capital.

2.3.1.2 The Value Additivity Principle in Investment Theory

One of the theoretical principles upon which the determination of cost-of-capital of business units and projects is based is the value additivity principle. In this section, the general principle is discussed, and in the next section it is transferred to the question of how cost-of-capital and betas can be aggregated from a divisional level to the corporate level. The aggregation of cost-of-capital derived from the value additivity principle is a central premise in many important articles in the field of divisional cost-of-capital, for instance Fuller and Kerr (1981) and Ehrhardt and Bhagwat (1991). In particular, full-information beta approaches that use multiple regression analysis (Ehrhardt and Bhagwat 1991; Cummins and Phillips 2005; Chua et al. 2006) are based on this premise. This means that many of the empirical studies on divisional cost-of-capital also implicitly test the value additivity principle and its assumptions.

The value additivity principle is based on the “law of one price”, meaning that one and the same asset should always sell at the same price regardless of the context (Burns 1987). The value additivity principle states that if several assets are packaged together as one unit, the value of this aggregate unit must be the sum of the individual parts. This relationship should hold regardless of how the assets are combined or divided (Burns 1987; Schall 1972). Algebraically, this relation can be easily expressed as follows (Harris et al. 1989; Schall 1972):

$$V = \sum_{i=1}^n V_i$$

- V Value of aggregate unit
 V_i Value of individual asset i
 n Number of assets

The value additivity principle should hold because of arbitrage processes: if the value of a group of assets was different than the sum of the individual assets' values, traders could earn arbitrage profits. A simple example would be gaining arbitrage profits by assembling assets into a package and selling the package (if the package value was higher than the sum of the individual parts) or buying the package and selling the assets individually (if the package value was lower than the sum of the individual parts) (Burns 1987). For a detailed analytical analysis of arbitrage opportunities if the value additivity principle did not hold, the reader is referred to the explanations by Schall (1972). In efficient capital markets, arbitrage processes would be triggered as soon as the relationship ceases to hold. The arbitrage processes restore equilibrium by shifting demand and supply so that the prices change in the direction that restores the value additivity principle.

Besides the rather generic view presented above, the value additivity principle can be applied to the context of company groups. A company group can also be seen as a portfolio of assets. Consequently, according to the value additivity principle, the company value is the sum of the separate asset values. This relationship should hold for different aggregation levels. For instance, in a company group, there might be intermediate levels such as projects, divisions or business units that should also have the aggregate value of their individual assets (Brealey et al. 2009).

This also means that diversification in a company group should not have an effect on the firm's value. Until the 1960s, the prevalent opinion was that the diversification effect should be considered in corporate investment decisions (Schall 1972). However, today the irrelevancy of investment diversification on the firm level is even taught on a textbook level, for instance in Brealey et al. (2009). The reason why diversification does not add value for investors is that the investors can diversify on their own much more easily and thus are not willing to pay a premium. They can simply buy and sell any amount of shares of different companies, which is much easier and more flexible than a diversification on a firm level (Brealey et al. 2009).¹⁰

There are only a few studies that explicitly test the value additivity principle. One is by Ang and Clark (1997), who have tested the theory empirically in the banking sector. Their results are in general consistent with the value additivity principle. However, the relationship no longer holds in the later years of their data, which they explain with changes in products, technology and regulatory environment (Ang and Clark 1997). Another empirical test was done by Burns (1987), who also achieves rather mixed results. In his study based on oil security market prices, the value additivity principle does not accurately describe daily prices, but it does fit with average prices. However, Burns (1987) concludes that the results generally support the value additivity principle. A possible explanation for the misfit of daily prices could be that the arbitrage processes are lagged for instance due to

¹⁰ Note: At first glance the diversification irrelevancy might seem like a contradiction to portfolio theory. However, also in portfolio theory, the *value* does not increase with diversification. The advantage lies in the reduction of *volatility*.

transaction costs or market imperfections. This would mean that the prices only adjust in the mid-term when the differences are large enough.

Another reason why the value additivity principle might not perform too well in empirical tests is the many (partly unrealistic) assumptions upon which it is based. First of all, it is based on the general assumptions of a perfect and efficient capital market. Additionally, in a company group context, the principle is only applicable under even tighter assumptions, particularly an absence of synergies between the business units (Fuller and Kerr 1981). If there were synergies between business units, an integration of several business units within a company group could increase firm value compared to the aggregate individual values.

2.3.1.3 Value Additivity and Differentiated Cost-of-Capital

As mentioned above, the value additivity principle in the context of company groups states that the aggregated value of a company's business units must equal the total company value—as the aggregated value of individual securities in a portfolio must equal the value of the portfolio as a package. Consequently, the formula of the value additivity principle can be formulated as follows for the case of business units (Fuller and Kerr 1981):

$$V_C = \sum_{i=1}^n V_{BU,i}$$

V	Market value of company
$V_{BU,i}$	Market value of business unit i
n	Number of business units

The value additivity principle is important in the context of divisional cost-of-capital, because it has implications for the relationship between the cost-of-capital of business units or projects and the company cost-of-capital. Technically, cost-of-capital is a return measure. Thus, under the premise of value additivity and the view that a company group is a portfolio of business units, projects and assets, the same statistical principles as in Markowitz's (1952) portfolio selection theory can be applied. Just as in the case of a portfolio of securities, returns can be aggregated by calculating the average cost-of-capital weighted by the market value of the divisions.¹¹ This relationship is used in statistical tests of business unit betas and also in

¹¹ In practice and empirical research, corporate cost-of-capital is observable for listed companies, whereas the business unit cost-of-capital is not observable, so that the term "aggregate" is not meant to imply that corporate cost-of-capital is calculated from business unit cost-of-capital. The

Table 2.2 Aggregation of business unit cost-of-capital in the literature

Concept	Aggregation weight	Authors
(1) Beta aggregation	Market value of equity	Chua et al. (2006), Ehrhardt and Bhagwat (1991), Fuller and Kerr (1981), Kaplan and Peterson (1998)
(2) Total cost-of-capital aggregation	Market value of equity + debt	Harris et al. (1989)

particular techniques to determine business unit cost-of-capital, which will be addressed in Sect. 2.4.

The aggregation is theoretically applicable to the WACC as a whole or to individual parts of the WACC (for instance cost of debt, cost of equity or the beta factor). However, there are different implications in terms of weights and capital structure of the business units depending on which variables are considered. There is no diversification effect in the aggregation of systematic risk, since systematic risk depends on the correlation of the business unit’s return to the overall market development and not to other business units.

In relevant cost-of-capital literature that is based on the value additivity principle, two versions of additivity of business unit cost-of-capital can be identified: The first one is *aggregation of betas* and the second is *aggregation of total cost-of-capital*. Table 2.2 shows which authors rely on which version in their empirical studies.

Total cost-of-capital can be aggregated to the corporate level using the business unit’s market value of total capital—i.e. market value of debt and market value of equity—divided by the total company market value as a weight (see formula below) (Harris et al. 1989, p. 75).

$$WACC_C = \sum_{i=1}^n \frac{V_{BU\ i}}{V_C} * WACC_{BU\ i}$$

n	Number of business units
V _{BU i}	Market value of business unit i (equity + debt)
V _C	Market value of company (equity + debt)
WACC _C	Company cost-of-capital
WACC _{BU i}	Cost-of-capital of business unit i

If only beta is aggregated, the business unit weight is the business unit’s market value of equity divided by the total market value of equity (Brealey et al. 2009; Kaplan and Peterson 1998; Fuller and Kerr 1981).

purpose of this section is just to analyse the relationship between business unit and corporate cost-of-capital as a theoretical background to the determination techniques.

$$beta_C = \sum_{i=1}^n \frac{E_{BU\ i}}{E_C} * beta_{BU\ i}$$

beta	Beta factor
E	Market value of equity
n	Number of business units

Although this is a slightly different procedure, the two approaches are coherent and thus both theoretically valid, since they arrive at the same result, which is also possible to show mathematically.

The explanations above show the relationship between company and business unit cost-of-capital according to the value additivity principle. However, this theory is not without its problems, especially when it comes to empirical testing or a practical application in a business context. First of all, many of the variables used in the model presented above are not observable. This concerns especially market values and betas of business units. This leads to the second problem: If business unit betas and market values are estimated with the help of the proxy methods that are the subject of this thesis, they are very unlikely to match with the empirically determined company cost-of-capital. Moreover, the capital structure of business units is regularly not known because debt is raised on a company group level. This issue will be dealt with in more detail in the subsequent section.

The author of this thesis is not aware of any explicit empirical tests of the value additivity principle in the context of company groups. However, as mentioned above, the theory is often implicitly tested if empirical tests of other models are based on it.

2.3.2 *Capital Structure of Business Units*

One of the main problems associated with business unit cost-of-capital is that the necessary information to perform the calculations shown in the theoretical framework above is not available on a business unit level but only on the corporate level. This does not only concern betas but also the capital structure to be used as weights in the calculation of the WACC. The reason why capital structure information is usually not available for business units is that financing decisions are made and capital is raised at the corporate level (Conroy and Harris 2011; Harris et al. 1989; Chua et al. 2006). While it is controversial whether capital structure adjustments in the beta factor are necessary (see Sect. 2.4.1.1), the capital structure is always needed for the calculation of the WACC.

In the literature, the following capital structure figures are suggested to be used for business units: (1) the company capital structure, (2) the business unit's target

capital structure, (3) the industry capital structure and (4) a combination of company and industry capital structure.

(1) Company Capital Structure

The Schmalenbach-Gesellschaft (1996) considers acceptable the use of *company capital structure* as a proxy for business unit capital structure if the business units are not structured too heterogeneously. In contrast, Bower and Jenks (1972) consider an application of the company's overall financing structure to business units inappropriate. They emphasise the necessity of a differentiated treatment by showing analytically that failure to consider individual debt capacity leads to wrong cost-of-capital rates and thus wrong investment decisions.

(2) Target Capital Structure of Business Units

Another suggestion is the definition of a *target capital structure* for each business unit (Schmalenbach-Gesellschaft 1996; Pfister 2003). This idea originates from the notion that cost-of-capital should be forward-looking and thus also an optimal capital structure that can be realised in future should be used (see Sect. 2.1.1.2). A second argument in favour of this approach is that the observable capital structure is not necessarily the one desired by the company's financial managers, since the market value of equity is very volatile (Pfister 2003). This is a particularly relevant argument considering the high volatility of financial markets in the new millennium. In the definition of a target capital structure of business units, the capital structure of comparable companies (e.g. an industry capital structure) can be included as one factor. Moreover, typically an estimate of the current structure based on market values would be included in the analysis, as well as the financing strategy of the company (Schmalenbach-Gesellschaft 1996).

Although the approach is valid from a theoretical perspective and the argumentation in terms of a future orientation and the volatility of stock markets is evident, it might not be very suitable for practical application. First of all, there is no clear and universal method by which a target capital structure for business units should be determined. Secondly, it is hardly possible to objectively justify a target capital structure, so that there remains a lot of subjectivity and discretion in this determination.

(3) Industry Capital Structure

Another common suggestion in the literature is to use the typical *capital structure in the respective industry*. This approach implicitly assumes that the industry affiliation of a company is a significant determinant of capital structure, i.e. that there are significant differences in capital structure between industries. There are numerous empirical studies that confirm this relationship, although not all studies find that industry is a significant factor (Pfister 2003). Also, some articles that deal with cost-of-capital of business units make the assumption that there is an optimal debt-to-equity ratio for an industry (Kaplan and Peterson 1998; Ehrhardt and Bhagwat 1991). However, there are certainly differences between the companies within one industry, so that some kind of average value has to be calculated.

	company group	business unit A	business unit B
(1) debt according to industry debt ratios		1,000	500
(2) proportion of total company debt		67%	33%
(3) allocation of actual company debt with proportions	1,200	800	400

Fig. 2.11 Approach to debt allocation (own illustrated based on Chua et al. 2006)

The advantage of this approach is that it is objective and market-oriented (Pfister 2003). Furthermore, it can be integrated into a consistent methodology for the determination of business unit cost-of-capital if betas are applied with the help of the comparable company approach. On the other hand, a major drawback is that the approach completely ignores the company-specific situation. For instance, it might be favourable for a particular company for some reason to have a different overall financing structure than the theoretical optimum suggested by the industry capital structures. The assignment of industry figures to the business units would then mean that they no longer match the overall company target structure. Additionally, in an empirical application of the approach, observed values are used that are subject to volatility and thus do not meet the target structures of the industry and the company (Chua et al. 2006).

(4) Combination of Industry Capital Structure and Company Capital Structure

An approach that integrates *both industry capital structures and company capital structure* is presented by Chua et al. (2006). They argue that both should be taken into account because debt capacity depends on both the firm's inclination to finance with debt and the characteristics of the industry. They allocate corporate debt to the divisions as follows: First, they calculate the amount of debt that each business unit of a firm would be financed with according to the industry average debt ratios. Based on these debt amounts, they calculate which proportion of the company's total debt each business unit would assume. Next, this proportion is used to allocate the company's actual debt to the business units. This procedure is also illustrated in Fig. 2.11.

One of the advantages of the approach can be easily seen in the calculation above: The debt allocated to the business units matches total actual company debt. However, the problem of the determination of capital structure is not solved completely, since equity has not been allocated. Theoretically, equity could be allocated in the same way, but the problem of volatility still remains. This is due to the fact that the model operates with actual capital structure and not target capital structure.

As a conclusion to the treatment of capital structure in the calculation of business unit WACC, it can be said that there is no optimal approach. While using target capital structures is superior from a theoretical point of view, this approach has some weaknesses in terms of practical application. Therefore, an approach that includes some objective method such as industry capital structures is recommendable.

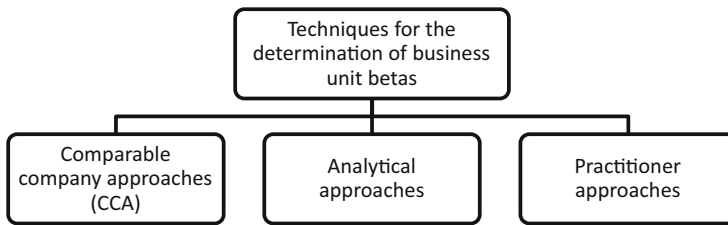


Fig. 2.12 Techniques for the determination of business unit betas (reproduced from Schlegel et al. 2012)

2.3.3 *Cost-of-Capital of Business Units and Projects*

The main challenge in estimating the cost-of-capital for a business unit is that the capital market data required for a regular determination of beta are not available (Chua et al. 2006; Ingram and Margetis 2010). The reason is that business units are normally not listed on the stock market, but only the company as a whole.

Due to the lack of data to calculate betas, proxy methods have to be used to estimate betas or the complete cost-of-capital rate of a business unit (Cotner and Fletcher 2000). In the literature, the techniques have often been classified as shown in Fig. 2.12 (Krotter 2009; Burger and Ulbrich 2005; Bufka et al. 2004). In the next sections, research concerning the three categories of methods will be discussed in detail.

The comparable company approaches as well as the analytical approaches are used to estimate *betas* of business units only, which can be used to calculate the cost-of-capital rate regularly by applying the CAPM and WACC. In contrast, some practitioner approaches intend to estimate the complete cost-of-capital rate. This has the advantage that no capital structure considerations have to be made for business units. On the other hand, estimating the complete rate is a rougher approach which is less scientific.

2.4 Determination Techniques for the Cost-of-Capital of Business Units

2.4.1 *Comparable Company Approaches*

2.4.1.1 Discussion of the Technique

The comparable company approach (CCA) was probably first mentioned in 1977 by Brigham and Van Horne (Pfister 2003). The basic idea is to use betas of listed companies that are comparable to the respective business unit as a surrogate for the beta of the business unit.

In German-language secondary literature, a distinction is sometimes made between *pure play betas*, which only use one comparable company, *industry*

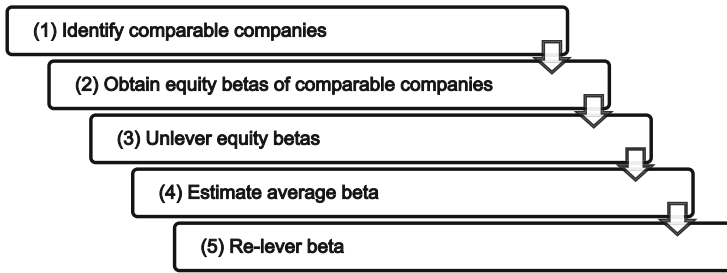


Fig. 2.13 Procedure of the comparable company approach (reproduced from Schlegel 2011)

betas, which use average betas of the respective industry sector, and *peer group betas*, which use several companies that are comparable in different characteristics (Schmalenbach-Gesellschaft 1996). However, there seems to be a confusion of definitions because the term *pure play* is used in original literature to describe companies that only have a single line of business, which does not mean that only one pure play can be used as a comparable company. In this thesis, the term ‘pure play approach to cost-of-capital’ is used according to the prevailing definition in the original American literature, i.e. using *one or more* companies that are only engaged in *one* line of business as comparable companies. This definition is, for instance, used by Fuller and Kerr (1981) and Chua et al. (2006).

The process of estimating a beta with the comparable company approach consists of five main steps (Bowman and Bush 2006). Below, the comparable company approach is explained and evaluated, taking into account results from empirical research for each step (see Fig. 2.13). An application of the approach in a case study can be found in Schlegel (2011).

(1) Identify Comparable Companies

The first step is to identify companies that are comparable in terms of systematic risk. Usually companies from the same industry are used as comparable companies (Fuller and Kerr 1981; Bowman and Bush 2006). Although this sounds easy, the first step is often a major problem in practice. The reason is that listed pure plays for business units can often not be found, depending on how specific the industry and how developed the capital market of the respective country is (Chua et al. 2006; Cummins and Phillips 2005). In Germany the stock market is comparably narrow (Bufka et al. 2004).

In narrow stock markets, where pure plays are hard to find, enhancements of the comparable company approach are useful that are able to include business units of multi-industry company groups as comparable companies. These approaches build on the relationship that the company beta is the weighted average of business unit betas. If the company betas of several multi-industry firms and the weights of their comparable business units are estimated, the determination of the business unit betas becomes a mere mathematical problem of solving the equations.

Boquist and Moore (1983) use a linear programming approach to solve the problem. However, as there are more comparable business units than companies in their sample, there is no unique optimal solution. Ehrhardt and Bhagwat (1991) propose an approach known as *full-information beta*, which uses multivariate linear regression to solve the problem. A similar approach using WACC instead of betas was applied earlier by Harris et al. (1989). However, empirical tests by Ehrhardt and Bhagwat (1991) and Chua et al. (2006) do not show that beta estimates improve significantly in the full-information approach compared to the standard approach.

Another problem in the selection of comparable companies is that there is a considerable amount of subjective judgment about which companies are comparable. Recently, Ingram and Marquetis (2010) presented a method to form groups of comparable companies with the help of cluster analysis.

The third issue to be dealt with in the selection of comparable companies is the number of companies to include in the analysis. The inclusion of more companies reduces the impact of statistical outliers and estimation errors (Brealey et al. 2009; Schmalenbach-Gesellschaft 1996). However, there is a trade-off because the more companies are considered, the less comparable to the business unit they become (Bowman and Bush 2006; Pfister 2003).

(2) Obtain Equity Betas of Comparable Companies

In a second step, the equity betas of the comparable companies are estimated regularly according to the CAPM, as described in Sect. 2.1.2.1.

(3) Unlever Equity Betas and (5) Re-lever Betas

In theory, it is often suggested to adjust equity betas for differences in financial leverage with reference to Modigliani and Miller's (1958) famous propositions (Koller et al. 2005; Brealey et al. 2009). The idea behind adjusting betas for leverage is that the return on equity becomes more risky as debt increases. However, the return on assets—i.e. the return that the company makes from its business—without consideration of the capital structure is constant. Therefore, the measured *equity* betas are transformed into *asset* betas by unlevering them and subsequently transformed back to *equity* betas, taking into account the individual financing of the company.

Apparently, Hamada (1972) was the first to derive a formula for unlevering and relevering betas. Hamada's formula was further refined by Conine and Tamarkin (1985). In the meantime, a number of formulas to adjust betas for leverage based on different theories and assumptions have been presented. A good overview is given by Fernández (2006).

In different cost-of-capital studies, researchers try to measure the impact of leverage adjustment on the estimation accuracy of betas. However, there is no conclusive empirical evidence that adjusted business unit beta estimations are superior to unadjusted comparable company approach estimates. While Chua et al. (2006) find that capital structure adjustments improve beta estimates, Butler et al. (1991, p. 899) state that the "Hamada and Conine models may serve as useful pedagogical tools" but do not provide better beta estimates. Also Fuller and Kerr (1981) find that capital structure has no influence on betas.

(4) Estimate Average Beta

In cases where several comparable companies are used, an average asset beta is calculated after the equity betas have been unlevered. In empirical studies, some authors use the median asset beta (Fuller and Kerr 1981), while others use the arithmetic mean (Bowman and Bush 2006). Another approach could be to use an average weighted by the market values of the comparable companies.

2.4.1.2 Methodology of Empirical Tests

The determination techniques—also analytical and practitioner approaches—are tested with the help of large sample analysis of financial data such as stock price returns or financial statement data. Accounting and finance data can be acquired from large *databases* that are offered by several providers. One of the best-known commercial providers of financial data is COMPUSTAT, which offers historical financial data from 1950 onward for 99 % of all listed companies world-wide. There are also other well-known providers of accounting data, for instance Datastream, Company Analysis, Worldscoop, Thomson Financial, Extel Financials, BvD Osiris, BvD BankScope and BvD Amadeus. For financial market data, the Center of Research for Security Prices (CRSP) is the most commonly used source besides COMPUSTAT (Lara et al. 2006).

The studies concerning cost-of-capital discussed below are cross-sectional studies. Typical *statistical methods* that are applied to the data are simple regression (Fuller and Kerr 1981) and multiple regression (Bowman and Bush 2006; Chua et al. 2006; Ehrhardt and Bhagwat 1991). The methods are applied in combination with parametric statistical tests, such as the Student's *t*-test to test the significant of individual factors in a multiple regression model (Ehrhardt and Bhagwat 1991; Bowman and Bush 2006), F-tests to compare the overall fit of different models (Bowman and Bush 2006) and two-tailed binomial tests (Ehrhardt and Bhagwat 1991), as well as non-parametric statistical tests such as the Wilcoxon rank sum test (Chua et al. 2006).

According to Serita (2008), the *advantage* of large sample analysis of financial data in general is that being secondary data, they are relatively easily accessible, which means that models can be tested with different datasets. In terms of databases, the articles discussed in this thesis usually only use one database. However, some authors, for instance Fuller and Kerr (1981), use data from several years for their analysis. Another advantage is the large sample sizes, which provide high levels of confidence, even if sophisticated econometric methods are used (Serita 2008).

One of the drawbacks of large sample analysis is that secondary data are used, which might not be tailored to the specific research problem. This means that proxies that are available in the data might have to be used instead of the required measures. Furthermore no information about the reasons or motivations for decisions and actions is available from the quantitative financial data (Serita 2008). Another problem is that there is a bias depending on which database is used. Lara

et al. (2006) conduct research on the effects of database choice on research results in accounting. They run a simple regression of the book value of shareholders' equity and earnings against the market values of the companies over all firms from 14 European countries covered in the respective databases (Lara et al. 2006). The parameters differ substantially across the databases, which the authors explain by the fact that the final sample size varies substantially between the databases (2006). Finally, it can be criticised that the method relies on financial data only, which is often biased due to inherent problems in accounting information (Britzelmaier and Schlegel 2011) and market imperfections in stock market data (Brealey et al. 2009; Schlegel 2011). Due to the large amount of data available, there is a certain danger of finding patterns by chance or by data mining techniques (Brealey et al. 2009) so that deductive hypothesis testing and a sound theoretical foundation are crucial for rigorous research.

As "true" betas of *business units* are not observable, empirical tests of the comparable company approach typically involve a comparison of observable *company* betas of listed companies with the respective proxy betas derived from comparable companies. A major problem with empirical studies is that it is not possible to test the comparable company approach separately from other models or theories it is based on, i.e. if the comparable company approach is rejected, it cannot be said with certainty whether this was due to the comparable company approach itself or due to problems with underlying concepts. Difficulties that might influence empirical tests include the following:

- The comparable company approach is normally tested based on the *CAPM*, which is difficult to test and has a relatively poor empirical record itself.
- Some research designs for the general comparable company approach—especially the one by Fuller and Kerr (1981)—and all research designs for the full-information approach are based on the *value additivity principle*, which is only applicable under tight assumptions.

2.4.1.3 Empirical Tests of the Pure Play Approach

The first empirical test of pure play betas was conducted by Fuller and Kerr (1981) in the U.S. They matched the divisions of 60 multi-divisional companies with 142 pure plays using data from the years 1976, 1977 and 1978.

The researchers used data from Value Line, which is a commercial research and publishing firm that followed 1,700 companies at the time of the analysis. Their *methodology* was to compare regularly observed betas of multi-divisional firms—i.e. the company beta calculated from capital market data with the *CAPM*—to the company beta aggregated from the business units' betas, estimated with the help of the pure play technique. If there was more than one comparable company, the authors used the median. They then used simple linear regression analysis to check the relationship between the observed company betas and the proxy company betas calculated from the divisions' pure plays (Fuller and Kerr 1981).

The *findings* were a regression coefficient close to one and a correlation coefficient of 0.78, which corresponds to an r-square of 0.61. The authors also calculated the average relative deviation between the two variables, which was approximately 9 %. The deviations occurred in both directions, i.e. there was no pattern of systematic overestimation or underestimation by the proxy method (Fuller and Kerr 1981). The statistical indicators suggest that there is a strong relationship between the pure play betas and the “real” betas, which seems to empirically confirm the pure play approach as well as the value additivity principle. Consequently, Fuller and Kerr (1981) conclude that the pure play technique is a valid technique for determining betas of business units.

The findings of Fuller and Kerr are an important *contribution* to the field of cost-of-capital of business units because it was the first empirical test of the comparable company approach. The approach and its underlying assumptions—especially the value additivity principle—are theoretically supported, which further increases the credibility of the results. Moreover, it is positive that the authors follow a systematic approach based on criteria to select the pure plays.

Although the results suggest that the pure play approach is empirically valid, a *limitation* is that the authors leave aside the main problem of the approach—the identification of comparable companies. From the 1,700 companies in the Value Line database, they only chose companies for which good pure plays with similar revenues could be found (Fuller and Kerr 1981). The results might have been less promising if less strict criteria for the selection had been applied, which is often necessary (and done) in practice.

Another empirical test of the CCA has been performed by Bowman and Bush (2006) using data from 2003 of 572 public U.S. companies with revenues larger than US\$10 million. Besides testing the standard CCA, the authors also test two models that include additional variables—size, operating leverage, sales growth, dividend payout ratio, price to earnings ratio and book-to-market ratio—and compare the results of the different models. Moreover, a size bias in the selection of comparable companies and the influence of the number of comparable companies on the result are examined.

Due to the complexity and comprehensive nature of the research, the *methodology and findings* are discussed simultaneously for this paper in the following paragraphs (as opposed to sequentially as for the other papers).

The authors use data from the Bloomberg database. They use an industry classification that divides the economy into 73 industries (Bowman and Bush 2006). The test is only performed for 23 industries, as their approach requires a minimum number of companies per industry.

Like Fuller and Kerr (1981), the authors estimate betas with a comparable company approach for *listed* companies, which enables them to compare the beta proxies with the regularly observed betas. For each industry, four companies (“the control group”) are used as comparable companies to estimate the betas of the other companies (“the test group”). The arithmetic mean asset beta of the four companies is used as a proxy beta for the companies of the respective industry (Bowman and Bush 2006). First, the companies are assigned to the control group according to the

following procedure in order to avoid a size bias in the estimates: the total number of companies is divided into quartiles by size and the median company of each quartile is assigned to the control group (Bowman and Bush 2006).

In a first step, the authors present a new model that estimates the beta of a company depending on the comparable company beta but also on the size of the company, the operating leverage, sales growth, the dividend payout ratio, the price-to-earnings ratio and the book-to-market ratio. In order to estimate the parameters, a multiple regression approach is applied using the regularly observed company beta as the dependent variable and the factors mentioned above, including the comparable company beta, as independent variables (Bowman and Bush 2006).

$$\beta_{ij} = a + b_1 \beta_{ccj} + b_2 Size_i + b_3 OL_i + b_4 Growth_i + b_5 Div_i + b_6 EP_i + b_7 BTM_i + \varepsilon_{ij}$$

The regression model is found to be significant ($p=0.001$) with an adjusted r-square of 0.518. Table 2.3 shows the coefficient and the p-value for the factors that are significant according to the t-statistics. Growth, operating leverage and book-to-market ratio are not significant or only marginally significant. It can be seen that the comparable company beta is highly significant with a positive coefficient, as expected. However, the coefficient is different from 1, which means that the comparable company beta alone would be an underestimate (Bowman and Bush 2006). The other significant factors have negative coefficients.

Bowman and Bush also test a variation of the model that only includes those factors that can be easily measured for private companies, with similar results.

In a second step, the models are evaluated by using them to estimate betas for the test companies and comparing the estimates to the observable betas. This is done by calculating the estimation error, i.e. the difference between the estimate and the observation. If the estimate is unbiased, the mean of the distribution errors should be zero or insignificantly different from zero (Bowman and Bush 2006). The estimation errors are compared for the following models:

- The *standard comparable company approach* with the *quartile median size* comparable companies (as explained above). The average estimation error for this approach is -0.0077 , which is not significantly different from zero.
- The *standard comparable company approach* using the four *largest companies* from each industry as comparable companies. The reason for this variation is to examine the influence of a size bias in the estimates. It is known from the literature that size is negatively correlated with beta. The problem is that in practice, the public comparable companies that are used are usually larger than the private companies for which the betas are estimated (Bowman and Bush 2006). Indeed, the data shows an average estimation error of -0.479 , i.e. a downward bias that is significant ($p = 0.001$) (Bowman and Bush 2006).
- The *new model 1*, which includes the comparable companies and all of the other factors listed above. The average estimation error is 0.0000 (Bowman and Bush 2006), which is obviously not significantly different from zero.

Table 2.3 Significant factors in the multiple regression (based on Bowman and Bush 2006)

Factor	Coefficient	p-value
Comparable company beta	0.855	0.001
Size	−0.019	0.050
Dividend payout	−0.108	0.050
Earnings-to-price ratio	−3.234	0.001

- The *new model 2*, which only includes those factors that can be measured for private companies with the same result as the new model 1.

To conclude the findings from the comparison of estimation errors, it can be said that the widespread use of the comparable company approach among practitioners is supported by the results. However, the size bias has to be kept in mind when applying the model. The two new models suggested by the authors appear to deliver even better estimates.

Another question that the authors address is how the number of companies included in the average to calculate the industry betas affects the result. Bowman and Bush test this relationship by reducing the number of companies in the control group to 3, 2 and 1 and comparing the estimates. The results suggest that the estimates improve with a larger number of comparable companies (Bowman and Bush 2006).

The article by Bowman and Bush provides a large *contribution to the body of knowledge* because it is a very comprehensive empirical evaluation of the comparable company approach. On the one hand, it provides further evidence for the empirical validity of the standard comparable company approach, which has not been tested in many previous empirical studies. On the other hand, a new model is presented and tested that improves estimates by taking into account other factors to adjust the comparable company betas. Moreover, the authors address issues that are relevant for application in practice: First of all, it is the first study that the author of this thesis is aware of that empirically examines the influence of the number of companies used to calculate the proxy betas. The authors show that the estimates improve as more companies are used. In the literature, a trade-off between less estimation error by including more companies and a better comparability by including less companies is spoken about (Pfister 2003), but no empirical evidence is presented. The second practice-relevant aspect of their research is the bias that is generated because listed comparable companies are often larger than the ones for which the beta is calculated. On the one hand, it is helpful to create awareness of the problem. On the other hand, the authors suggest an alternative model that reduces the bias.

One of the *limitations* of the article is that the alternative models that are proposed lack theoretical foundation. The authors derive the factors of the model from patterns in asset returns that have been noted in previous empirical research (Bowman and Bush 2006) without explaining why the patterns might occur. The problem is that with the large data availability in finance databases, it is possible to find patterns by chance. Therefore, it is important that empirical relationships are

substantiated by theories. Concerning the influence of the number of companies included in the mean for the industry betas, it would have been interesting to see where the optimal number of companies is, because it can be expected that the statistical advantage reverses if the number of companies is getting too high. The maximum number of companies that the authors have tested is only 4.

2.4.1.4 Empirical Tests of the Full-Information Approach

Ehrhardt and Bhagwat (1991) introduce and empirically test their full-information approach for divisional beta estimation. With the full-information approach, divisions of multi-divisional firms can be used as comparable companies and not just pure plays that only operate in a single industry. They test the model with data from 1986 for 4,287 U.S. firms.

Methodology As discussed above, the full-information approach is based on the idea that the average of segment betas weighted by the segment values is equal to the company beta. Ehrhardt and Bhagwat reflect this idea in a multiple regression model in which the observable company beta is the dependent variable, the segment weights are the independent variables and the industry betas are the coefficients. The authors use the proportion of segment sales to total sales as a proxy for the segment weights (Ehrhardt and Bhagwat 1991).

$$\hat{a}_i = \sum_{j=1}^n \frac{S_j}{S_i} * \hat{a}_j + e_i$$

S Sales

$\hat{a}_i$ Company beta

$\hat{a}_j$ Industry beta of segment j

The cross-sectional multiple regression is run with a final sample of 4,287 firms using data from the CRSP database. The industry classification is done according to the Standard Industrial Classification (SIC), truncating the four-digit codes to two digits, which is a simplification. Moreover, the estimation errors of the full-information betas are compared to those of the pure play betas. They also cross-validate the results with the help of a hold-out sample.

Findings The regression model is found to be highly significant, with an adjusted r-square of 0.69. Of the 70 industry beta estimates, four are not significant at $\alpha = 0.05$. For the comparison with the pure play approach, 43.9 pure plays per segment (i.e. per industry) could be identified in the data in contrast to 99.8 full-information comparable betas. The authors apply a slightly different approach than Fuller and Kerr (1981) by using the arithmetic mean instead of the median if several

pure plays can be identified. Thus, for 64 % of the companies, the estimates have a tighter confidence interval in the full-information approach, which is statistically significant in a two-tailed binomial test. However, the difference in the average standard error, which is 18 % lower in the full-information approach, is not significant using a *t*-test. The test with the hold-out sample also produces a mean estimation error that is lower in the full-information approach, which again is not statistically significant (Ehrhardt and Bhagwat 1991).

Ehrhardt and Bhagwat's key *contribution* is above all the introduction of a new estimation technique that can take into account segments of listed companies as comparable companies. This could be helpful in economies with smaller stock markets, such as Germany, where comparable companies are often hard to find. The strength of the approach from a scientific point of view is that it is based on an existing theoretical foundation (the value additivity principle).

However, a major *limitation* is that the researchers cannot provide evidence that the approach produces significantly better results than the less complex pure play approach, which raises the question of whether the approach is necessary at all.

As well as Ehrhardt and Bhagwat (1991) themselves, Chua et al. (2006) have also empirically tested the full information beta approach. Their focus is to discuss different variations of the approach, such as different capital structure adjustments or different divisional weights, and compare them with each other and with the standard pure play approach. They use U.S. data from Research Insight (formerly Compustat) and CRSP from 1991 to 2001 (all companies with complete data).

The general *methodology* of Chua et al. is comparable to the approach followed by Ehrhardt and Bhagwat, i.e. using multiple regression to estimate the industry betas. However, they test 24 cross-sectional regression models with different combinations of the estimation technique for the observable beta, different leverage adjustments and different proxies for the divisional weight (Chua et al. 2006).

In a second step, they compare the accuracy of the different approaches and the pure play betas by testing how well they predict the divisional betas for 1 year ahead. To compare prediction accuracies, the authors use the mean square error measure. In order to make sure that there is any useful information in the methods, they also compare the results against a "naive prediction" beta of 1. They use a Wilcoxon rank sum test on a pair-wise basis to test the statistical significance of the differences (Chua et al. 2006).

The following *findings* have been obtained: The r-squares of the regression models are all between 0.2 and 0.25 which is relatively low compared to the other studies presented above. There are no significant differences in the goodness-of-fit measures between the various models tested (Chua et al. 2006). From the comparison of the prediction accuracy with the help of mean square errors, there are three main findings: First, adjusting for capital structure improves the beta estimates. Second, there are no significant differences when using different proxies for the divisional weight. The third finding—and the most interesting one for this thesis—is that the pure play approach provides better predictions than the full-information approach (Chua et al. 2006).

The most important *contribution* of the article is further evidence on the usefulness of the full-information approach since the results of Erhardt and Bhagwat are quite ambiguous (see above). Furthermore, they test different implementation possibilities for variables where other authors just use one proxy without further discussion—for instance, for the divisional weights.

There are also some *limitations* of the study. First of all, the detailed comparison of the models was only performed for one industry due to data availability issues. The results might not be transferable to other industries. A methodological problem might be that the future betas that the estimates were tested against are also estimates obtained by the same method, since the “real” divisional betas are not observable. That means that if there are systematic errors in the procedure, they are not detected, since they are also included in the comparable figure. Chua et al. (2006) furthermore raise the point that the test period includes the stock market crash from the year 2000, so the results might be distorted.

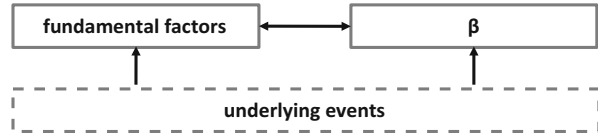
2.4.2 Analytical Approaches

2.4.2.1 Discussion of the Technique

Analytical approaches were intensely discussed in the 1970s and 1980s. The sheer number of papers published in these two decades shows that lots of attention was devoted to these approaches by academics. The basic idea behind all of the papers is the same. However, the empirical results concerning the approaches are ambiguous and diverse (see Sect. 2.4.2.3) and the practical relevance is very limited (see Sect. 3.3).

The determination of business unit cost-of-capital with analytical approaches, just like the comparable company approaches, is based on the CAPM (Pfister 2003). However, analytical approaches do not directly derive cost-of-capital from share price movements. Instead, fundamental factors—for instance accounting data—that are believed to influence share returns and thus systematic risk are used as a surrogate. The basic idea is that the fundamental factors are influenced by the same underlying events as the systematic risk (see Fig. 2.14). Therefore, they should be correlated with beta. If such a relationship can be shown, it is possible to use the fundamental data to derive systematic risk instead of stock returns. This procedure appears to make sense, since share prices depend on the fundamental factors in the long run (Jähnchen 2009). The relationship should ideally be analysed both theoretically and empirically.

Fig. 2.14 Relationship between fundamental factors and beta



In the literature, analytical approaches are often sub-divided into earning betas, accounting betas and fundamental betas depending on which fundamental factors they use (Steinle et al. 2007; Pfister 2003).

- *Earning betas* use accounting-based profit measures.
- *Accounting betas* also include other accounting-based measures, such as operating leverage, financial leverage or liquidity.
- *Fundamental betas* include different kinds of fundamental factors of the company or its environment.

However, the wording is not used consistently among authors. For instance, Bowman (1979) and Beaver and Manegold (1975) use the term *accounting* beta for a measure derived from *earnings*. In this literature review, the categories are defined as outlined above.

Once a correlation between a fundamental factor and beta has been proven with a large sample, the respective factor can be used as surrogate of stock returns to calculate beta for an individual company. As no stock market data is needed, the approach is also suitable for non-listed business units of a firm. The basic principle is shown in the formula below using the example of earning beta and works the same way as a regular beta calculation.

$$beta_{earning,i} = \frac{cov(X_i X_m)}{var(X_m)}$$

beta	Earning beta factor
X_i	Profit figure of company / business unit i
X_m	Aggregated profit figure of the market / economy

As mentioned above, analytical approaches have not become the prevalent approach to determine cost-of-capital of business units. Notwithstanding, they have some advantages over the comparable company approach:

- Concerning a practical application, the approaches are suitable if **no listed comparable companies** are available. This is especially the case in smaller economies and in economies where the proportion of listed companies is smaller (Pfister 2003).

- Analytical approaches can also be used to **forecast** betas of companies. This is because companies generally do forecast accounting figures and because forecasting accounting data is easier than forecasting stock returns. Jähnchen (2009) presents models to predict betas in his doctoral thesis.
- Pfister (2003) furthermore argues that analytical approaches help to avoid statistical **measurement errors** that occur in a direct measurement of beta.

On the other hand, there are a number of reasons why analytical approaches are less suitable for practical application:

- First of all, there are **too many different fundamental factors** presented in studies and there seems to be no consensus on the relevant factors in empirical studies. Furthermore, it is questionable whether the determinants are the same for different companies (Krotter 2009; Burger and Ulbrich 2005). Pfister (2003) speculates that risk factors might depend on the industry sector.
- Not all factors that are identified in empirical studies can be explained with a sound **theory** (see Sect. 2.4.2.2).
- The assumption that the determinants of systematic risk might depend on the company or industry raises the question of **how a relationship should be verified** for the purpose of determining cost-of-capital. Can a general relationship that is shown in one or several studies be assumed to be correct for the case of a particular company? Or has the relationship to be proven for a particular industry?
- Another practical problem is the **availability of data**. While accounting data should be available for all companies, it is mostly only available monthly or quarterly, while betas are often estimated with monthly or weekly data, so that the time series for a regression might not be long enough (Pfister 2003).
- Moreover, accounting measures are often **biased measures** of a company's true performance and leave room for manipulation (Britzelmaier and Schlegel 2011).

As a conclusion about analytical approaches, it can be said that the basic idea seems to make sense but that the practical applicability is limited, since there is no agreement on the relevant factors and the exact procedure to measure a business unit's cost-of-capital.

2.4.2.2 Theoretical Research

The focus in the discussion of analytical approaches in this thesis is *not* a detailed discussion of each of the possible fundamental factors, but a general discussion of the technique and especially a discussion of the methodology in previous research. In terms of methodology, one can especially distinguish between *theory-based papers* and those based on *empirical data*.

In theory-based papers, the fundamental factors are derived from theoretical models and can subsequently be tested empirically (Pfister 2003). Papers are

Table 2.4 Theoretical derivation of relationship between beta and other variables

Author	Relationship with systematic risk (β)
Bowman (1979)	<i>Derived</i> : firm's leverage, earnings beta <i>Rejected</i> : earnings variability, dividends, size, growth
Conine (1982)	<i>Derived</i> : business risk (combination of operating leverage, risk in demand, risk in price level, risk in variable costs)
Gordon and Halpern (1974)	<i>Derived + tested</i> : earnings beta with growth rates
Lev (1974)	<i>Derived + tested</i> : operating leverage

classified as theoretical papers in this thesis if they engage in theory-building regardless of whether the theory is empirically tested in the same paper or not.

Table 2.4 lists examples of theoretical papers and the fundamental factors addressed. Some of the papers are only based on theoretical and analytical considerations and leave the empirical testing to other researchers (Bowman 1979; Conine 1982). Other authors theoretically explain factors and subsequently also empirically test the factors in a deductive approach (Gordon and Halpern 1974; Lev 1974).

Below, the papers by Bowman (1979) and Lev (1974) are briefly discussed as representatives of theoretical papers on analytical approaches.

Bowman (1979) deals with six factors that have shown a relationship with systematic risk (beta) in prior empirical research. He shows a theoretical relationship between leverage and earnings beta in an analytical *methodology*, i.e. by rearranging and combining formulas from existing theoretical models such as the CAPM and Hamada's (1972) leverage formula. His *findings* are that these two factors have a theoretical connection to systematic risk (Bowman 1979) but that other factors (earnings variability, dividends, size and growth) do not have a direct theoretical connection (Bowman 1979).

The *contribution* of the paper is to provide a theoretical basis for the large number of empirical papers that had been published in the years before and to integrate the previous research on the topic into existing accepted theoretical models.

A *limitation* of Bowman's explanations is that the question remains as to why the other factors have shown empirical relationships with systematic risk. He appears to be aware of this shortcoming and explains the limitation with two very general reasons (Bowman 1979, p. 624): The first one is that the "assumptions may not be applicable to the universe being tested". Secondly, he states that there may be measurement errors in empirical tests of the theoretical variables. Although these are valid points, there is still no satisfying explanation for significant relationships that have repeatedly been shown by different researchers. In his analysis, Bowman mainly operates within the boundaries and assumptions of existing theoretical models, where it might be necessary to extend the models or even establish completely new theories.

Lev (1974) analytically shows the relationship between operating leverage—i.e. the proportion of fixed and variable costs—and risk. Additionally, he tests the

theory empirically for three homogeneous industries, namely the electrical utility industry, steel and oil production (Lev 1974).

In his *methodology*, Lev first analytically establishes a theoretical relationship between operating leverage and risk by integrating his formula of operating leverage into the CAPM. Subsequently, he tests the relationship empirically. As in the data obtainable from Compustat and CRSP, there is no information on the proportion of fixed and variable costs in total costs of the companies, the costs are split into their fixed and variable components first using a cross-sectional regression between costs and production output for each of the companies in the sample (Lev 1974). In a second step, the proportion of variable costs is used as an independent variable in a cross-sectional regression. The risk measures volatility and beta, which can be directly obtained from the databases, are the dependent variables (Lev 1974).

Lev's *findings* are that there is a positive association between the risk of a stock and the degree of operating leverage, i.e. the higher the proportion of fixed costs, the higher the risk. The theoretical relationship is as follows: There is a connection between a company's earnings (i.e. profit) and the stock returns, which is evident from classical capital market theory. Other things being equal, a higher proportion of fixed costs will cause a higher variability of earnings (Lev 1974). This is because in times with high sales, costs increase less because the variable part of total costs is comparably small and thus profit increases to a larger degree. The other way round, if sales are low in a bad year, if the fixed part is relatively high, total costs remain high and profit decreases to a larger degree. The relationship could also be shown to be significant at the 0.05 level in the cross-sectional regression. However, r-squares are comparably low (Lev 1974).

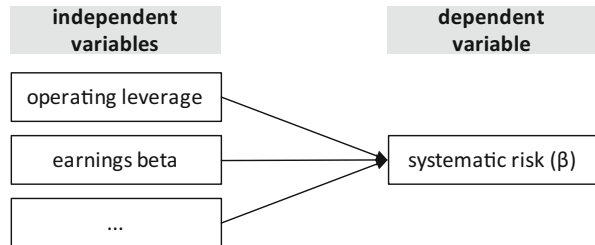
The *contribution* of the paper is that it analytically derives, theoretically explains and additionally empirically tests the relationship between operating leverage and risk. This is a rigorous deductive approach which only a few papers are able to present.

On the other hand, the paper also has some *limitations*. One is that the regression models implemented have very low r-squares ranging from 0.05 to 0.38. Even Lev himself (1974, p. 636) states that "it is evident that operating leverage is not the only (and may not even be the major) variable contributing to cross-sectional risk differentials". One reason for this might be the separation of total cost into its fixed and variable parts with the help of a regression model, which might be not very accurate. However, without internal data from the companies, it is probably not possible to do a more accurate calculation.

As an **evaluation of theoretical papers** in general, it can be said that the importance of theory to explain reality is uncontroversial (Colquitt and Zapata-Phelan 2007). In the specific case of analytical approaches, theoretical papers help to achieve a deeper understanding of the relationships between variables, instead of just showing a statistical correlation.

However, even the best theory should be subject to empirical testing. Therefore, a combination of theory and empiricism—either in a deductive or an inductive manner—is important. However, this does not necessarily mean that the same author has to deal with both parts.

Fig. 2.15 Relationship between fundamental factors and beta



2.4.2.3 Empirical Research

In pure empirical papers on analytical approaches, the factors are determined intuitively or derived from the data (Pfister 2003). Some papers also test existing theories from other authors. As illustrated in Fig. 2.15, the empirical studies are usually based on univariate or multivariate regression using systematic risk (beta) as a dependent variable and the fundamental factors as independent variables (Bildersee 1975; Thompson 1976).

There are probably significantly more empirical papers than theoretical papers on the subject. Most of them are from the U.S. Table 2.5 lists some examples and the variables they have tested.

The table reveals that there are variables that appear several times—for example operating leverage—but also that there is a large variety of variables tested in the studies. The large number of variables shows the problem that was mentioned in the discussion of the analytical approach as a technique to determine cost-of-capital: It is far from clear which factors are relevant or more important than others.

So what is the **value of empirical papers**? On the one hand, theory-based authors claim that many empirical papers are “without theoretical justification” (Conine 1982, p. 199). Considering the large amount of financial data that is available in databases and the enormous computational power of contemporary statistical software, it has to be kept in mind that some of the empirically shown relationships might just have occurred by chance or with the help of data mining techniques. Brealey et al. (2009, p. 221) state in the context of research on stock investments that “if you look long and hard at past returns, you are bound to find some strategy that just by chance would have worked in the past”. One of the papers presented above that can be criticised in this point is the one by Bildersee (1975), who uses a stepwise regression to find out the most important independent variables without testing hypotheses of specific relationships between variables (Bildersee 1975).

Because of this problem, it is important that there is a connection to theory. Colquitt and Zapata-Phelan (2007) also point out that many top journals in the field of management require authors to make a contribution to theory. Such a contribution to theory can either be done by *testing theory* or by *building theory*.

On the other hand, it has to be emphasised that not all of the empirical papers listed above operate without a theoretical background. For instance, Beaver and

Table 2.5 Empirical papers on the relationship of accounting variables with beta

Author	Independent variables
Ball and Brown (1969)	Operating income
Beaver et al. (1970)	Payout, growth, leverage, liquidity, size, earnings variability, earnings beta
Beaver and Manegold (1975)	Earnings beta
Bildersee (1975)	Financial leverage, liquidity, efficiency, coverage of fixed obligations
Steiner and Bauer (1992)	Profit variability, accounting beta, sales variability, sales beta, operating profit variability, operating profit beta, equity variability, return on equity beta, debt/equity ratio, financial leverage, machine intensity, operating leverage, dividend yield, balance sheet total, balance sheet total growth
Thompson (1976)	Dividend beta, earnings beta, earnings multiple beta, earnings yield beta, operating income, sales beta, total debt to total assets beta, cash flow to total debt beta, pre-tax interest coverage beta, current ratio beta, working capital to total assets beta, cash and receivables to expenditures for operations beta, dividend variance, earnings variance, earnings multiple variance, earnings yield variance, operating income variance, sales variance, total debt to total assets variance, cash flow to total debt variance, pre-tax interest coverage variance, current ratio variance, working capital to total assets variance, cash and receivables to expenditure for operations variance, dividend payout, growth in assets, growth in sales, growth in earnings, growth measures as mean of the factors, ratio of investments to earnings, return on investment, market volume, different means of annual ratios, size
Toms et al. (2005)	Operating leverage, financial leverage

Manegold (1975) refer to other authors as a theoretical background, although they do not *build* theory and thus their work is classified as empirical paper in this thesis. Furthermore, even if empirical papers have no link to theory at all, they might motivate other researchers to find economic interpretations or build a theory that fits the data. For instance, Bowman’s (1979) theoretical paper appears to be motivated by previous empirical papers. This can be understood as a kind of “division of labour” in an inductive approach. In any case, the necessity of empirical research with its statistical power and the importance of testing theories against reality are uncontroversial.

2.4.3 Practitioner Approaches

2.4.3.1 Traditional Practitioner Approaches

Besides the ‘academic’ approaches presented above, there are a number of techniques that have mainly been developed by practitioners. In this section, the

traditionally applied approaches *management interviews* and the *build-up method* are briefly discussed and evaluated. It is concluded that these approaches are to be rejected from a scientific point of view.

Management interviews can be used to make managers estimate the risk of their business unit. A way to make this process more objective is to make managers estimate the risk relative to other industries and to determine the risk based on the betas of the selected industries. This can be made even more effective by not stating the betas in advance (Pfister 2003). The advantage of such an approach is that it can be applied intuitively and is likely to be accepted by the managers. Moreover, only a small amount of publicly available data is needed (industry betas). However, even if a more objective procedure with a relative estimation of risk is chosen, there remains a substantial amount of subjectivity in the approach, since risk is measured by intuition rather than measurable criteria. Additionally, if business unit managers are asked to evaluate the risk, they are not neutral because the cost-of-capital estimate is likely to influence capital allocation to their business unit and the evaluation (and possibly remuneration) by value-based performance measures. They are thus expected to behave opportunistically in the estimation. Therefore, this approach has to be rejected.

In the **build-up method**, different risk surcharges are added to the risk-free rate in order to account for the higher risk. Examples of surcharges are a general equity risk premium, a firm size premium and an industry premium (Pratt 2002). Just like the management interview method, an advantage of this method is its easy application due to its minimal complexity and data requirements. The problem with the method is not the surcharges per se—the CAPM also uses surcharges to the risk-free rate based on beta. The problematic point of the build-up method is that the surcharges are usually added subjectively and lack theoretical justification. Moreover, typically the surcharges include unsystematic risk. This can be argued to be adequate (see Sect. 2.1.2.3) but if unsystematic risk is taken into account, the cost-of-capital figure is not a proxy of a CAPM measure.

2.4.3.2 Criteria-Based Approaches

Besides the traditional approaches discussed above, there are also more systematic methods that have been developed by practitioners or explicitly for a practical application. Two commonly discussed approaches are the ones developed by the *Boston Consulting Group*¹² and *Fuqua Industries* (Gup and Norwood 1982). Both approaches are based on an adjustment of the company total cost-of-capital depending on the specific characteristics of the business units measured in a scoring model.

¹² According to Pfister (2003) the approach was first published by Lewis and Stelter (1994) in Germany.

Criteria	Low risk	Value					High risk
		1	2	3	4	5	
Control	Low external influence on return						High external influence on return
Market	Stable, without cycles						Dynamic, cyclical
Competitors	Few, constant market shares						A lot, variable market shares
Products/concepts	Long life cycle, no substitutes						Short life cycle, substitutes
Barriers to entry	High						Low
Cost structure	Low fixed cost						High fixed cost

Fig. 2.16 Scoring model in Boston consulting group approach (reproduced from Bufka et al. 2004)

In the approach used by the **Boston Consulting Group (BCG)**, the management of each business unit is asked to rate the riskiness of the business unit. As shown in Fig. 2.16, the rating is based on six criteria on a scale from 1 (low risk) to 5 (high risk). The reference value of 3 represents the risk of a company group as a whole for each criterion (Pfister 2003).

The values assigned to the criteria are subsequently added up to achieve a total score. This score is divided by 18 in order to calculate a factor by which the company cost-of-capital is multiplied to receive the business unit's cost-of-capital, as shown in the formula below (Pfister 2003). The reason why it is divided by 18 is that a business unit with average risk (i.e. with the company risk) is rated 3 for each of the six criteria ($6 * 3 = 18$). So, the average business unit has a factor of 1, i.e. the company cost-of-capital.

$$WACC_{BU\ i} = WACC_C * \frac{Score\ BU\ i}{18}$$

$WACC_{BU\ i}$ Cost-of-capital of business unit i
 $WACC_C$ Company cost-of-capital

The advantage of adjusting the company group cost-of-capital is that no capital structure has to be explicitly assigned to the business units. It is implicitly assumed that the capital structure of the company group applies to all business units—with all its pros and cons. The criteria seem plausible in terms of their ability to explain systematic risk. Indeed, an independent¹³ empirical study (Bufka et al. 2004) concludes that the approach is able to explain systematic risk to a certain degree.

On the other hand, it is not clear how the criteria were developed and what the exact theoretical relationship with systematic risk should be. The major problem of

¹³ One of the study's authors even works for a competitor of Boston Consulting Group (Roland Berger Strategy Consultants) and the method is still evaluated positively, which is an indication of independence.

the approach is probably the assignment of values to the criteria, since the criteria are quite abstract and have to be operationalized. Therefore, considerable subjectivity remains in the approach. From a scientific point of view, it could also be questioned if the relationship between the score and the WACC is really proportional. However, this assumption is probably sufficient.

The approach by Gup and Norwood (1982)—commonly known as the **Fuqua industries approach**—also includes subjective risk assessment based on criteria and a scale from 1 to 5, like the Boston Consulting Group approach. It contains 14 criteria (Gup and Norwood 1982). However, there is also an objective risk assessment that measures the risk based on the variability of profit (NOPAT) compared to the previous year and also to the budgeted profit of the period. The subjective and the objective risk are weighed 50 % each to calculate the final risk class of the business unit (Gup and Norwood 1982).

The risk class of each business unit is translated into a risk index that is multiplied by the company cost-of-capital, as in the BCG approach. However, the difference is that the score is translated into a factor with the help of a table that has been derived from an analysis of comparable companies conducted by Fuqua Industries management (Gup and Norwood 1982).

While this approach might have been suitable for the specific situation of Fuqua Industries, it is very questionable whether it can be transferred to other companies, especially due to the fact that the translation table to derive the multiplication factor from the risk assessment has been compiled specifically for Fuqua Industries. Moreover, the complex calculation of a composite risk measure including its weights and its translation into a risk factor seems arbitrary, since no theoretical or empirical justification is demonstrated by the authors. Also the individual factors in the risk measures can be questioned. For instance, the deviation of profit from plan figures is no valid indicator for risk—or even systematic risk. A deviation might just have been caused because the plan was bad. Furthermore, the points of criticism mentioned for the BCG approach, such as the subjectivity in rating the criteria, are also true for this approach. This rather negative evaluation of the approach is confirmed by the empirical results of Bufka et al. (2004), which are presented in the subsequent section.

2.4.3.3 Empirical Tests of Practitioner Approaches

Practitioner approaches have not been subject to many empirical tests. The only one that the author is aware of is the study by Bufka et al. (2004). The authors empirically test the BCG method and the Fuqua industries method using data from 1997 for 87 German listed companies from the manufacturing sector and also capital-intensive firms from the service sector.

The researchers apply the following *methodology*: To measure the criteria (risk factors) that are included in the BCG and the Fuqua industries method, they use data from a questionnaire survey. The consolidated risk measures from the survey are then used as an explanatory variable in four different regression equations. Beta and

book-to-market ratio are used as dependent variables. Moreover, the factors company size, stock market trading volume and degree of diversification are included into the model as explanatory variables (Bufka et al. 2004).

The *findings* suggest that the BCG method is useful to estimate betas. In a version of the regression that only includes homogeneous companies (pure plays), the regression has an adjusted r-square of 0.35, which is significant at the 0.01 level. The risk index itself is significant at the 0.05 level (Bufka et al. 2004). However, the Fuqua industries method had to be rejected, since it has a statistically significant negative relationship with beta (2004). In order for the approach to make sense, the relationship should be positive. The authors also ran a regression of the individual criteria that aggregate into the risk measure of the BCG method. Apparently, the results indicate that not all the criteria are relevant. Unfortunately, the exact results are not reported.

The work of Bufka et al. is an important *contribution* to the field of divisional cost-of-capital, since it provides first empirical results on the validity of the heuristic-based methods that have been developed and are used by practitioners.

A *limitation* of the article is that the researchers do not disclose the detailed results of the second regression, which takes into account the individual criteria. This would have been helpful for other researchers and for practitioners to improve the technique.

2.5 Conclusion

In this chapter, a large range of theoretical and empirical literature from the field of cost-of-capital was discussed. First of all, the theoretical background of company cost-of-capital determination with the WACC and the CAPM was dealt with. Moreover, the main fields of applications of cost-of-capital in Managerial Finance—capital allocation and capital budgeting as well as performance measurement and value-based management—were addressed.

One of the main findings in this section was that different hurdle rates must be used for business units or projects that differ from average risk in order that companies can make value-creating decisions. Moreover, the theoretical background of cost-of-capital in the context of company groups was pointed out, before determination techniques for business unit cost-of-capital were discussed in detail.

As explained in the introductory section of this chapter, no identification of research gaps will be made at this point. Instead, research gaps are identified at the end of Chap. 3 for the immediate topic of this thesis.

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