Operating Leverage – Is Cost Structure Rigidity a Characteristic of Risk?

The Impact of Cost Structure Rigidity on Returns under Consideration of BM Ratio and Size

DISSERTATION
of the University of St. Gallen,
School of Management,
Economics, Law, Social Sciences
and International Affairs
to obtain the title of
Doctor of Philosophy in Management

submitted by

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Dissertation no. 4241

Difo-Druck GmbH, Bamberg 2014

The University of St. Gallen, School of Management, Economics, Law, Social Sciences and International Affairs hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St. Gallen, October 21, 2013

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Preface

During the economic turbulences of 2008 and 2009, an abundance of interesting research issues emerged in the realm of corporate finance. The decision to commit to a dissertation was thus taken with only a bare outline of the topic, but a strong desire to engage in the rigours of academic thought and a conviction that scientific theories must be substantiated by empirical investigation. In the process of critically examining a theory, the mind is opened to a wealth of new considerations and possibilities. While remaining focused of the research question was at times a challenge, this thesis proved an inestimable opportunity for learning and discovery beyond the topic itself.

My supervisor, Professor Andreas Grüner, was crucial to the success of this work. I would like to thank him warmly for his patience and skill in guiding my focus to the core of the topic, without absolving my responsibility for independent thought and action. Sincere thanks are also due to my co-supervisor, Professor Markus Schmid, whose many inputs, in particular regarding the definition of the research design, proved invaluable.

Juggling the demands of a dissertation with working life would be unthinkable without understanding colleagues and a patient employer. In this regard, I thank Irene Schläpfer, Dr. Silvio Hutterli and Nathalie Pool. In particular, I warmly thank my superior and mentor Dr. Konrad Hummler. Among his many words of advice to me over the years, his comment that conducting a dissertation is a unique privilege taught me to approach the project with the necessary humility and gratitude. For taking the time to discuss specific professional and technical aspects of this dissertation, I thank Holger Frisch, Reto Sonderegger and Ireneus Stanislawek.

My family and friends contributed significantly to the success of this work in a variety of ways. I thank my parents, Cornelia and Robert, not only for their emotional support throughout the course of researching and writing this thesis, but for their love and generosity. I also thank my grandparents, Franz, Hermine and Meta, whose pride in my decision to conduct a dissertation motivated me to bring it to a completion, and my brothers, Mischa and Simon, who instinctively knew when diversion and when discipline was required. For the many years of support at my side with no complaints but many sacrifices, I give my heartfelt thanks to Sybille Schoch. Further, I was privileged to have the support of many friends, especially Roger Prinz, Simon Meier and Nicolas Härtsch, who help make life such a joy.

St. Gallen, December 2013 Fabian Schönenberger

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Executive Summary

The research idea of this dissertation is to explore the extent to which a company's cost structure impacts on its level of riskiness via changes in sales on the operating income. To this end, correlation coefficients obtained by regressing operating costs on sales are used in empirical assessments. These are based on a data sample of companies listed on the NYSE, Nasdaq and Amex with a total of 17590 observations during the time period 1984-2009. Regression analyses use indicator variables and point estimates at the firm and portfolio level, whereby the regressions at firm level apply time and industry dummies and cluster residuals for companies.

The empirical investigations are structured into five parts. In the first, cost structure proxies are related to commonly accepted operating leverage measurements, with the results indicating that Costr(absolute) explains between 4% and 56% of variations in proxies at the firm level and between 6% and 38% at the portfolio level. The outcomes of the second part confirm that rigid cost structure portfolios reveal large accounting return volatilities. The differences in Margin(sd) are about 50% between the extreme deciles. Profitability volatilities seem to be U-shaped across deciles, i.e. the most rigid and flexible deciles exhibit large volatilities. Regression analyses confirm the significance of the proxies together with Sale(change), which is robust with positive coefficients in all tests. In the third part, rigid cost structure portfolios show stock return volatilities between 13.3% and 16.9% with an average sample volatility of 11.6%. Regression analyses reveal that Costr(absolute) and Costr(change) are significant at the firm and portfolio level to explain unlevered beta. Models for beta consider financial leverage and business risk. The fourth part demonstrates that rigid cost structure portfolios are smaller than their counterparts, with an average size between 215 and 4038. Both portfolios consisting of rigid cost structure companies and those comprising high BM ratio companies reveal consistently low ROE. Further, ROE of SMB and HML explain ROE of portfolios with small companies and rigid cost structures. The coefficients of SMB and HML are nearly double those of companies with flexible cost structures. In the fifth part, portfolios comprising rigid cost structure companies prove to be more volatile, but the relation to returns depends on the type of proxy used. For example, the top Costr(SGA) portfolio shows average monthly returns of 1.7% compared to 2.0% for high BM ratio and 1.8% for small capitalization portfolios. The three-factor model developed by Fama and French (1993) explains all portfolio returns. In regressions explaining future returns, cost structure proxies lose significance when including BM ratio and size. However, COGS and SGA exhibit opposite impacts on returns.

The results are used to develop an approach to estimate more precisely the level of a company's riskiness within industries through the consideration of Sales(sd) and cost structure rigidity. Further, the findings are applied to control for the cost structure impact in value investing.

Executive Summary (German)

Die Forschungsfrage dieser Dissertation ist, ob und in welchem Ausmass die Kostenstruktur eines Unternehmens mit dem Risiko in Beziehung steht, da die Volatilität des Umsatzes und die Kostenstruktur die Volatilität der Gewinne bestimmen. Die Regression von operativen Kosten mit den Umsätzen ergibt Koeffizienten, die als Proxies der Kostenstruktur verwendent werden. Das Sample besteht aus Unternehmen kotiert an den Börsen NYSE, Nasdaq und Amex mit total 17590 Beobachtungen für die Zeitperiode 1984-2009. Das Forschungsdesign besteht aus Regressionen mit Indikator-Variablen und Punktschätzungen für Unternehmen und Portfolios. Die Regressionen mit Unternehmen berücksichtigen Zeit- und Industrie-Dummies, wobei die Residuen auf Unternehmensebene angepasst werden.

Die empirischen Untersuchungen strukturieren sich in fünf Bereiche. Erstens zeigen Tests, dass die Kostenstruktur-Proxies häufig verwendete Operating Leverage-Proxies erklären, z.B. erklärt Costr(absolute) zwischen 4% und 56% auf Unternehmensebene und zwischen 6% und 38% auf Portfolioebene. Im zeiten Teil wird ersichtlich, dass die Kostenstruktur mit der Volatilität von Gewinnen und Profitabilitätskennzahlen in Beziehung steht. Zusammen mit Sales(change), dieser Faktor ist signifikant mit positiven Koeffizienten in allen Regressionen, erklären die Proxies diese Volatilitäten. Der dritte Teil verdeutlicht, dass die Kostenstruktur mit dem totalen und systematischen Risiko von Unternehmen korreliert. Die Erklärungskraft der Kostenstruktur-Proxies ist am stabilsten für das unlevered Beta. Der vierte Teil untersucht die Verbindung mit den Faktoren BM ratio und size. Es zeigt sich, dass Unternehmen mit starren Kostenstrukturen deutlich kleiner sind als der Durchschnitt. Die betriebswirtschaftlichen Renditen der Portfolios SMB und HML erklären die Renditen von kleinen Unternehmen mit starren Kostenstrukturen. Die Koeffizienten dieser Faktoren sind fast doppelt so gross, wie für andere Portfolios. Im letzten Teil zeigt sich, dass Portfoliorenditen deutlich volatiler sind, für Portfolios bestehend aus Unternehmen mit starren Kostenstruktur. Die Verbindung zu den Renditen ist abhängig von den Proxies. Das Modell von Fama and French (1993) erklärt die Portfoliorenditen zum grössten Teil. Sobald BM ratio und size in Regressionen für zukünftige Renditen berücksichtigt werden, verlieren die Kostenstruktur-Proxies ihren Einfluss. Es bestehen Anzeichen, dass COGS und SGA unterschiedlichen Einfluss ausüben.

Mittels eines klar definierten Prozesses, der die Kostenstruktur mitberücksichtigt, werden vier Risikokategorien erstellt. So kann das Risiko eines Unternehmens innerhalb einer Industrie besser abgeschätzt werden. Dies ermöglicht die Definierung der passenden Vergleichsgruppe in Bezug auf die Risikoneigung des Unternehmens. Die Ergebnisse werden zudem genutzt, um den Effekt der Kostenstruktur in Value Investing zu kontrollieren.

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Notations and Abbreviations

AMEX	American Stock Exchange
BEP	Breakeven point
BF	Big flexible
BH	Big high
BM	Big medium
BM ratio	Book to market ratio
BL	Big low
BR	Big rigid
CAPM	Capital asset pricing model
CFO	Chief financial officer
COGS	Costs of goods sold
cor	Coefficient of correlation
Costr	Cost structure
Costr(1y)	Specific proxy of cost structure
Costr(5ya)	Specific proxy of cost structure
Costr(absolute)	Specific proxy of cost structure
Costr(change)	Specific proxy of cost structure
Costr(SGA)	Specific proxy of cost structure
CUSIP	Committee on Uniform Security Identification Procedures
DOL	Degree of operating leverage
DOL(5ya)	Specific proxy of degree of operating leverage
DOL(ela)	Specific proxy of degree of operating leverage
DOL(MR)	Specific proxy of degree of operating leverage
DOL(OV)	Specific proxy of degree of operating leverage
EBIT	Earnings before interest and taxes
EBITDA	Earnings before interest, taxes, depreciation, and amortization
e.g.	Exempli gratia (for example)
EV	Enterprise value
FC	Fixed costs
HML	High minus low portfolio
i.e.	Id est (that is)
Nasdaq	National Association of Securities Dealers Automated Quotations
NBER	National Bureau of Economic Research
NYSE	New York Stock Exchange
Opcosts	Operating costs
OL	Operating leverage
p	Price per unit
p.	Page

PE ratio	Price to earnings ratio
Q	Quantity
Q_{BEP}	Breakeven point quantity
R&D	Research and development
ROA	Return on assets
RONOA	Return on net operating assets
ROE	Return on equity
sd	Standard deviation
SF	Small flexible
SGA	Selling, general and administration costs
SH	Small high
SM	Small medium
SMB	Small minus big portfolio
SL	Small low
S&P 500	Standard & Poor's 500
SR	Small rigid
TC	Total costs
TR	Total return
TV	Total variable costs
ul	Unlevered (beta)
v	Variable costs per unit

a	Intercept
β	Coefficient of regression
ϵ	Error term
$E(R_j)$	Expected return of company
$E(R_M)$	Expected return of market portfolio
i	Refers to portfolios
j	Refers to companies
r_j	Return of company
r_M	Return of market portfolio
$r_{risk-free}$	Risk-free rate
t	A point in time or a specific time period
y	Dependent variable
Z	Dummy variable

1. Introduction

1.1. Motivation

The world of finance has made a great leap forward during the last four or five decades. In particular, technical innovation and the ever increasing amount of available data have facilitated empirical investigation of finance topics. Further, powerful statistical tools now enable researchers to conduct investigations with more statistical precision and tailor them to the research design. The result is an immense number of finance papers that each adds a further information puzzle to the fascinating world of finance.

Despite this progress, however, theoretical achievements developed years ago and important empirical findings are still the subject of investigation. The CAPM, a one-factor model explaining expected returns, and factors influencing CAPM's beta, for example, remain frequently discussed topics in finance research. Moreover, analysts still use multiples to value companies, although the first academic paper about the usage of multiples goes back to Molodovski (1953). Sometimes, it makes sense to go back a couple of decades in order to reconstruct the development of certain commonly accepted practices. And sometimes interesting topics, waiting for further discussions, are slumbering in dusty textbooks or finance journals. One such topic is the operating leverage, or more generally speaking, the characteristics of a company's cost structure. In many finance textbooks, the operating leverage is discussed alongside breakeven analysis, as its proper interpretation and computation demand basic understanding of the latter. These concepts stem from management accounting but have found their way into more finance-oriented discussions, primarily through the achievements of Lev (1974) and others who used the operating leverage as an explanatory variable of CAPM's beta. More recent articles, for instance Garcia-Feijoo and Jorgensen (2010) or Novy-Marx (2011), use the operating leverage as an explanatory variable for capital market anomalies. Another field of application are corporate finance topics such as financial management policies. In this area, the interaction between the operating and financial leverage is of interest, for instance Kahl, Lunn, and Nilsson (2011). This dissertation strives to give a comprehensive overview of the properties of a company's cost structure and its place in the world of (corporate) finance. In particular, it aims to revive interest in the operating leverage. The motivations for this are manifold.

The impact of a company's cost structure on operating income is partly dependent on economic conditions. It is thus unsurprising that renewed interest in the operating leverage emerged during the financial crisis of 2008 and 2009. Within just a few months, global trade had declined rapidly and companies were challenged to deal with lower demand. Yet many companies – small and large alike – were able to navigate through this financial storm. They adapted quickly. They introduced cost cutting programs to preserve earnings. Where possible, they shifted their supply to still prospering regions in Asia and unlocked cash reserves when necessary through disinvestments. The capability of businesses to adapt to new situations is fascinating, and best observable during periods of economic difficulty. Moreover, such competencies are also crucial for sustainable success. Every decision to invest has an impact on the cost structure. Building a new facility in Asia to serve customer needs more directly causes costs, for example personnel expenses for local employees or shipping costs if raw materials come from abroad. Therefore, the operating leverage plays a critical role in generating shareholder value and is of interest during recessions but also during periods of economic prosperity and growth.

The properties of the cost structure are a conscious decision of the executive. Of particular interest are the level of fixed costs and the relation between operating costs and business activity. In order to stay competitive, executives need enough foresight to determine the level of production capacities. If executives anticipate growing demand and the company is producing near capacity limits, investments to extend production capacities are justified. However, if sales do not grow and their original prognosis proves wrong, idle capacities still cause costs. Such costs are considered fixed because they accrue even when no production takes place. These fixed costs become problematic since margins drop and the pressure to act increases with each period of unsatisfactory sales growth. Executives have to take into account the expected sales, the exposure of the company to the operating leverage and available reserves to bypass time periods with poor sales growth. The interrelationship between expected sales, capacity decisions and the cost structure is relevant for many stakeholders: Shareholders have to be able to estimate the impact of changes in sales on the bottom line, because the value of their investment is dependent on the cash flows the company generates and analysts are interested in knowing the properties of the cost structure because estimating a company's earnings is more difficult if the cost structure amplifies changes in sales. The demands of these stakeholders and the interrelationship between different management responsibilities show that discussions about the operating leverage are highly relevant to the tough challenges companies face. Thus, the operating leverage is well worth further investigation.

The risk implied by the operating leverage can be differentiated from the risk arising from financial leverage. The operating leverage captures a company's business risk resulting from the properties of the cost structure. The level of financial leverage is a result of various managerial considerations; i.e. how does a company want to fund its activities? If it cannot fund future projects with retained earnings, the company raises either its debt level or equity share. Because both types of leverage are beneficial in good times – but have an adverse impact on the bottom line in bad times – it is of great interest for executives and shareholders to know the exposure of the company to the two leverages. Measuring the financial leverage is much easier than estimating the operating leverage. The reason is simple: All information necessary to estimate the financial leverage is available from the balance sheet and the income statement. Further, information about the capital structure, for instance debt maturities, is available in the appendix of financial reports. But, information about the cost structure is sparse. Shareholders face problems when gathering information about the relation of fixed to variable costs. This weakness of financial reports could be overcome if it were possible to approximate the properties of the cost structure with public information.

This differentiation between financial and operating leverage is also interesting from a capital market perspective. The relation between risk and reward implies that an increase in risk is associated with rising expected return. Thus, empirical investigations to assess if both the financial and the operating leverage are relevant to the level of riskiness of a company are part of this dissertation. Because it is easier to estimate the exposure to financial leverage, the liability side of a balance sheet is more often the subject of finance research. Estimating the business risk, however, is difficult. Often, the correlation between the demand structure and a broader index of economic activity is used as a proxy.

There is a second aspect of interest from a capital market perspective. Since Fama and French (1992), CAPM's beta has been replaced as a risk factor by BM ratio and company size. Companies with a high BM ratio generally earn higher returns, as do small companies compared to large ones. However, the true risk drivers behind these two variables are unknown. There is ongoing debate in finance research as to whether exposure to these two factors is associated with higher risk or market inefficiency. Expanding the base of empirical evidence that considers the relationship between the cost structure and these factors is thus another motivation of this dissertation.

Management textbooks differentiate between fixed and variable costs. Fixed costs do not vary with a company's output. If demand decreases, the company's fixed costs do not adjust proportionally to the lower output. In contrast, variable costs are driven by input factors which are generally linked to the units sold. A drop in demand causes a proportional decline in variable costs. Often, the proportion of fixed to variable costs is mentioned as a criterion in defining the operating leverage; i.e. a high proportion of fixed costs means distinct exposure to the operating leverage. But this derivation is too simplistic because it neglects the influence of the distance to the breakeven point. For these reasons, the research design of this dissertation is based on a thorough explanation of the properties of the operating leverage. Finally, the transfer of management accounting issues to finance topics is also considered to address the cross-disciplinary potential of the findings.

1.2. Research Questions

Although the operating leverage never disappeared from finance textbooks and it is often part of discussions about breakeven analysis, renewed interest and research in recent years has brought the topic into the realm of modern finance. According to Spremann (2004), the term modern finance summarizes three key aspects of finance: return, risk and valuation of uncertain cash flows. All three aspects are relevant to capturing the versatility of the operating leverage.

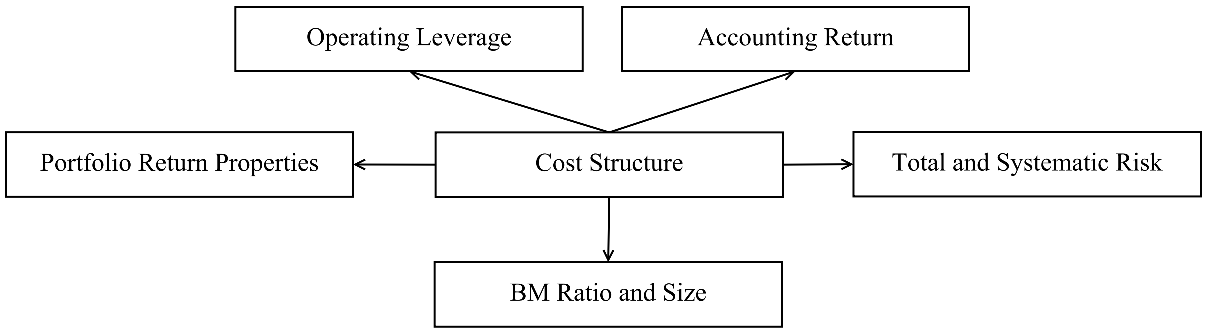


Figure 1: Research idea
Figure 1 illustrates the aspects investigated in this dissertation: relation between cost structure and operating leverage – first research question, influence of the cost structure on accounting returns – second research question, implications of cost structure on total and systematic risk, its relation to BM ratio and size and portfolio return properties – third research question.

Figure 1 explains the research idea. The underlying research idea of this dissertation is to use the improved databases and additional findings from various research fields to test the properties of the cost structure in regard to the three principal elements of modern finance. The result is a comprehensive explanation of cost structure and its impact on finance-related topics. The relations to operating leverage and accounting returns refer to the element cash flow in modern finance. Additional to sales growth, the operating leverage influences the properties of accounting returns. The categories total and systematic risk and BM ratio and size in figure 1 consider the element risk of modern finance. The investigation of portfolio return properties refers to the element return of modern finance. The following explanations present the research questions.

Figure 1 graphically illustrates the subject parts of this dissertation. The relation between the approximation of the characteristics of the cost structure and commonly accepted definitions of the operating leverage is tested. This is an important aspect, because focusing on the cost structure slightly differentiates from operating leverage proxies, which aim to capture the elasticity of operating income. The developed proxies build the core of each empirical investigation. Often, they serve as a right-hand-side variable in regressions or as a factor in portfolio construction. So, these considerations lead to the first research question:

Is there a relationship between the degree of cost structure rigidity and commonly accepted operating leverage figures?

The cost structure stands between a company's revenues and operating income. To calculate the operating income, operating costs are subtracted from revenues. Since the value of an asset is dependent on the income stream it generates, the cost structure has to be an essential part of any valuation model. This aspect is considered in a detailed investigation of the relationship between a company's cost structure and the properties of accounting returns. At the center of these investigations are the volatility of earnings and the volatility of profitability measures. Volatility is a measure for the degree of uncertainty. Highly volatile cash flows are problematic for investors because they hinder reliable prognoses for future developments. There are several reasons why companies with volatile earnings are riskier from a shareholder perspective. Yet, modern finance teaches that shareholders cannot expect to be compensated for taking company-specific – so-called unsystematic – risks. Consequently, arguing that the volatility of earnings has an influence on the riskiness of firms does not automatically explain if investors are compensated for bearing risks resulting from rigid cost structures. Thus, the second research question is:

Is there a relationship between the degree of cost structure rigidity and the volatility of earnings and profitability figures?

Separating CAPM into its factors shows that there is a link between risk, captured by beta, and the cost structure. So, beyond the impact of cost structure rigidity on the volatility of earnings, it also has a theoretical connection to the CAPM. This increases the relevance of the cost structure from a capital market perspective. In their seminal paper Fama and French (1992) challenge the CAPM. They conclude that beta is able to explain differences among stock returns only during a restricted time period. They extend the one-factor model to a multi-factor model and replace beta with the BM ratio and size. So, a comprehensive investigation of the cost structure and riskiness must take the Fama and French (1992) results into account. The BM ratio factor captures the financial distress risk of a company. The size factor captures various sources of risk; for example, small companies tend to be more dependent on the general economy. If there is a relation between cost structure rigidity and BM ratio and/or size, the operating leverage qualifies as a factor explaining the riskiness of a company. These considerations lead to the last research question:

Is there a relationship between the degree of cost structure rigidity and risk factors from a capital market perspective (i.e. volatility of returns, beta, unlevered beta, BM ratio, and size)? Based on the positive expected association: Is there a relation between cost structure rigidity and return, and do portfolios consisting of companies with rigid cost structures reveal the potential for excess returns?

Ultimately, the investigations culminate in a comprehensive judgment of the characteristics of cost structure and its applications in the field of finance. This research idea is of significance for various market players. First, understanding the characteristics of the cost structure allows management to estimate the impact of changes in sales on the bottom line. Because the bottom line is the key variable for financial analysts, more exact earnings prognoses are helpful for them, too. Conversely, analysts who understand the link between sales, operating leverage and earnings are in a better position to judge the capabilities of management. Lastly, analysts and investors are interested in knowing the drivers of accounting and stock market return volatility. Because the cost structure acts as an amplifier on the bottom line, their recommendations and investment decisions should take this aspect into account, too. The answering of these three research questions is feasible but the approximation of the cost structure rigidity bases on certain assumptions. Such assumptions are necessary and common in the context of operating leverage. The main reason is the data source. Because the empirical investigations use information from financial reporting, some parameters for the direct measurement of the operating leverage are unknown.

1.3. Outline

The dissertation is structured into four parts. The first part (chapter 2) comprises an extensive literature review of key discussions on the operating leverage. While the main focus remains the operating leverage, related financial topics are also briefly described to give the necessary context to the later empirical investigations. The literature review concludes with the description of the research gap and shows how the empirical investigations add value to the discussions about the operating leverage. In the second part (chapter 3), theoretical considerations regarding the properties of the operating leverage are outlined. Accounting relations expressed in formulas form an essential part of these discussions. To better illustrate the behavior of the operating leverage, a fictitious example is also given in this theoretical chapter. This chapter lays the foundations for the development of the own approximations and provides also insights relevant for the research designs. The third part (chapters 4 to 9) comprises empirical investigations based on the preceding theoretical discussions. It commences with the explanation of the research hypotheses, continues with the description of the research design and the data used, and also describes the approximations of characteristics of the cost structure. Each empirical investigation starts with an explanation of the null hypotheses and the considered factors. The fourth part (chapter 10) transfers the research conclusions to financial matters. Chapter 11 summarizes the findings of the empirical investigations and outlines future research possibilities. Table 1 summarizes the contents of the dissertation.

Chapter	Title
1	Introduction
2	Literature Review
3	Theoretical Considerations
4	Research Hypotheses, Study Design and Data
5	Empirical Part I: Cost Structure and Operating Leverage
6	Empirical Part II: Earnings Analyses
7	Empirical Part III: Total and Systematic Risk
8	Empirical Part IV: BM Ratio and Size
9	Empirical Part V: Portfolio Return Properties
10	Transfer of Findings to Financial Matters
11	Conclusion

Table 1: Outline of dissertation
Table 1 gives a brief table of contents indicating main chapter headings.

2. Literature Review

2.1. Structure of Literature Review

Contrary to the usual structure of a literature review which groups related topic areas together, this literature review is in chronological order. While the chronological structure makes it more difficult to delineate the topics discussed, this is outweighed by other advantages. Moreover, because there are only three main topic areas, a short description of these mitigates this difficulty.

The first topic area is the operating leverage as a characteristic influencing the riskiness of a company. Early papers discuss the relationship between the operating leverage and CAPM's beta. The development of this relation and empirical investigations proving this theoretical connection are part of many research papers. The second topic area, discussed in early as well as recently published papers, is the properties of the operating leverage itself. Major points of discussion in this respect include the determining factors of a company's operating leverage and considerations about the approximation of the operating leverage. Treating these aspects together make sense because the definition of operating leverage drivers and approximation methods are interrelated. The third topic area comprises questions regarding the relation between the operating leverage and other company characteristics. The tradeoff hypothesis between operating and financial leverage is key to this area. Table 85 on page 190 summarizes the literature discussed in section 2.2 and considers the three before-mentioned topic areas.

In respect of the dissertation topic, the chronological structure of the literature review has distinct advantages. In particular, chronological order better illustrates how the focus among the topic areas has varied over time. It is also interesting to see how a single characteristic of a company is transferred to various aspects of finance. But most importantly, each research paper deserves to be discussed in detail. For instance, the abundance of approximations of the operating leverage can be identified only when each method utilized in a research paper is mentioned and explained. Because each approximation has its advantages and disadvantages, a short discussion of adjustments in the method itself or the resulting proxies is important too. Because the approximation of characteristics of cost structure is an important part of this dissertation, these aspects are critical. Such details are obscured if the structure of the literature review follows strictly predefined topic areas.

Section 2.2 summarizes the relevant literature about the operating leverage. To better demonstrate the link between management accounting and finance topics, important developments in the finance research field are summarized, too. Short descriptions of the portfolio theory and CAPM are part of the explanations. Such discussions are relevant for defining sound research designs and correct interpretation of the ensuing results. Section 2.3 summarizes the literature relevant to those topics. Finally, section 2.4 explains the research gap on which the dissertation is based.

2.2. Literature on Operating Leverage

In their paper, Kelly and Sussman (1966) exemplarily show that the definition of operating leverage drivers in the context of cost-volume-profit analysis is not unambiguous. In order to derive this ambiguity they differentiate between absolute and relative viewpoints. The absolute approach considers the influence of fixed costs on the relation between operating income and sales, while the relative viewpoint considers the relative change of operating income regarding changes in sales. The role of fixed costs in respect of the absolute viewpoint is clear: A high level of fixed costs increases operating income when sales are rising. However, they cast doubt on the common assumption that higher fixed costs magnify the relative changes of operating income regarding changes in sales (Kelly & Sussman, 1966). With the substitution of fixed costs in the formula (1), they prove that operating leverage is a function of the breakeven point of a firm[1]. Because sales, variable costs and fixed costs determine the breakeven point, it is insufficient to conclude that fixed costs are the sole variable influencing the operating leverage. Furthermore, Kelly and Sussman (1966) explain that two firms with equal breakeven points have the same operating leverage regardless of the proportion of fixed to variable costs. These are major lessons regarding the operating leverage because they explain the important difference between the elasticity of operating income and the absolute approach. To illustrate this, section 3.3 demonstrates how approximation methods differ between these viewpoints. Further, the proxies developed in section 4.5 belong to the absolute approach.

Rubinstein (1973) explains that the expected return for shareholders is a function of the risk-free rate plus the operating and financial risk of the firm. Additionally, he describes the components of operating risk. According to Rubinstein (1973), the operating risk

[1]Formula (1) on page 32 is explained in detail in chapter 3.

consists of the operating leverage, simply defined as the difference between price and variable costs, the demand-related behavior of customers and the operating efficiency of the firm. The definition of the operating leverage is a simplification of formula (1) because it neglects fixed costs. Deriving a direct connection between operating leverage and the expected return lays the theoretical foundation for testing the influence of the operating leverage on stock returns. Other researchers, for instance Lev (1974) or Mandelker and Rhee (1984) further develop these thoughts.

Like Rubinstein (1973), Lev (1974) assesses the relationship between operating leverage and the riskiness of a firm. According to Lev (1974), it is important for managers and investors alike to know the true risk drivers in capital markets. He assumes that the true driver of overall risk, which he defines as the volatility of stock returns, and systematic risk is the operating leverage. The starting point for his derivation is the calculation of the operating income; i.e. the difference between sales and variable and fixed costs. Because fixed costs are not related to the quantity of units sold, they vanish after differentiating with respect to quantity of units sold. Under the assumption that in competitive industries all companies sell their products at the same price, the sales variable vanishes too. Only variable costs remain in his formula. Thus, the operating leverage is large for companies with low amounts of variable costs. This leads to volatile earnings regarding fluctuations in demand, which makes the company more risky (Lev, 1974). He limits his empirical investigations to three industries: utility, steel and oil. The advantage of this industrial focus is the combination of large deviations in the ratio of fixed to variable costs, caused by strongly varying input factors among companies from these three industries, and the similar economic environments with comparable supply and demand dynamics that these companies operate in. The results of regressing total costs on quantity sold are used as a proxy for the operating leverage. The regression coefficient measures the variability of total costs in respect of changes in quantity sold. Lev (1974) runs time-series regressions for each firm, assuming that the proportion of variable and fixed costs of each firm does not change over time. He splits the time period into two subsamples to control for this assumption. The regression coefficients prove much larger for the steel and oil industries compared to the electric utilities industry. The coefficients serve as independent variables in cross-sectional regressions with volatility and beta as dependent variables. The coefficients exhibit the expected negative sign and are statistically significant in most regressions. He concludes that there is a negative association between variable costs and both overall and systematic risk (Lev, 1974). However, the sample size is quite small and the assumption of stable cost structures seems to hold for the three industries considered, but would be a quite strong restriction for empirical investigations with a broader set of industries. Another shortcoming is that Lev (1974) uses absolute values instead of logarithms of the variables considered to approximate the degree of cost structure rigidity.

Ferri and Jones (1979) investigate the relation between a firm's financial structure and its operating characteristics. They consider industry affiliation, size of the firm, variability of income and the operating leverage. They assume a negative relation between the operating leverage and financial leverage and calculate the operating leverage according to the elasticity approach; i.e. change in operating income divided by change in sales[2]. The authors mention that this formula assumes that external factors, such as input prices, do not change over the time period (Ferri & Jones, 1979). Further, the traditional formula measures changes across time periods, and not within periods. To adequately assess this approach, they additionally measure the ratio of fixed assets to total assets and the five-year average of these. They find that the operating leverage varies significantly among the different leverage groups. Furthermore, they confirm a negative relation between the operating leverage and the financial leverage. However, they emphasize that the balance sheet formula exhibits a continuously negative association from one leverage group to the other, whereas the elasticity measurements result in a more erratic relationship. They attribute this finding to measurement problems of the elasticity formula.

Like Lev (1974), Gahlon (1981) argues that sales variability and the operating leverage are important factors in explaining the systematic risk of a company. The reduction of the operating leverage definition to the level of variable costs, see Rubinstein (1973), is insufficient according to Gahlon (1981). Further, he considers the omission of fixed costs in the derivations of Lev (1974), while comprehensible, counter-intuitive because without fixed costs, the operating leverage has no impact on a company's earnings. In his model, the covariance of stock returns and the return of the market portfolio is driven by sales volatility and the operating leverage. He defines the operating leverage according to the traditional textbook equation, i.e. the ratio of contribution margin and operating income, but his formula uses expected sales and not actual figures (Gahlon, 1981). This difference is important compared to previous definitions in deriving the theoretical relation between systematic risk and operating leverage. However, most researchers work with real data for reasons of simplicity or because the actual parallel influence of the operating leverage on certain company aspects is of paramount interest.

Gahlon and Gentry (1982) continue the work of Gahlon (1981). They purport that traditional CAPM does not capture the real determinants of business risk and aim to define a model for the systematic risk of a company that considers financial and operating leverage. To develop their own derivation of the relation between financial and operating leverage and the systematic risk of a firm, they utilize the investment opportunities approach (Gahlon & Gentry, 1982). This approach splits the value of a company's equity into existing assets and growth opportunities. They limit their derivations to the risk share inherent to cash flows generated by existing assets. Their derivation of the investment opportunities approach reveals that beta is driven by macroeconomic variables, which are the same for all companies, and business risks. The business risk (or real-assets risk) con-

[2]In chapter 3 the formula (10) on page 40 is explained in detail. This approach is equivalent with the relative viewpoint of Kelly and Sussman (1966).

sists of the operating and financial risk as well as the variation of sales and the relation of sales to economic developments. They apply the findings of their derivations in a fictitious example in which they define the operating leverage as the ratio of the contribution margin to the operating income[3]. Gahlon and Gentry (1982) further develop the theoretical foundation for empirical investigations of the relation between the systematic risk and the business risk of a company. Their model is restricted to the risk of assets-in-place.

Mandelker and Rhee (1984) expand on the findings of Gahlon and Gentry (1982) and others, which analyze the relation of systematic risk and business risk. Additionally, they address a possible tradeoff between operating and financial leverage. According to the authors, systematic risk consists of risks arising from business activities and the financial situation of a company (Mandelker & Rhee, 1984). By replacing the return of shareholders with the ratio of EBIT and shareholder's equity, their derivation results in a formula that confirms the decomposition of systematic risk into operating and financial risk. Financial leverage is calculated as the yearly change in earnings after interests and taxes divided by the yearly change in earnings before interests and taxes. Operating leverage is calculated as the yearly change in earnings before interests and taxes divided by the yearly change in units sold. Because companies do not provide information about units sold, they use revenues as a proxy in their model. The sample used in their empirical investigations is limited to manufacturing companies. Both types of leverage are estimated with regression analysis based on the variables described earlier[4]. They test for stationarity by comparing the coefficients calculated for two different time periods, but cannot confirm it. To reduce errors-in-variables bias they apply a portfolio-grouping approach with operating leverage as the defining portfolio construction factor. Regressions at portfolio level as well as cross-sectional regressions at the individual firm level confirm the positive relation between systematic risk and operating and financial risk. Correlation analysis of various portfolios sorted according to the operating leverage, financial leverage and beta reveal a negative correlation between operating and financial leverage, thus confirming the tradeoff hypothesis. The findings of Mandelker and Rhee (1984) show the significance of accounting-related factors in explaining the systematic risk of firms. The regression approach to approximate the operating leverage is one of their most important achievements.

In contrast to the previously mentioned articles, McDaniel (1984) focuses solely on the characteristics of the operating leverage. He analyses the operating leverage as a business characteristic and excludes questions regarding the relation of the operating leverage and other variables. Like Kelly and Sussman (1966), McDaniel (1984) states that the operating leverage of two firms is the same if their breakeven points are equal, whereby the

[3]Formula (1) on page 32 is explained in detail in chapter 3.

[4]Formula (14) on page 45 is explained in detail in chapter 3. It describes the approach developed by Mandelker and Rhee (1984), which is tested in many other research papers.

proportion of fixed to variable costs may vary among the two companies. He proves these findings mathematically as well as graphically based on simplified examples. McDaniel (1984) concludes that the operating leverage is driven by the breakeven point, variable costs and fixed costs. The application of an example to explain specific interactions is also part of section 3.2.

O'Brien and Vanderheiden (1987) describe their own approach to calculating the operating leverage and compare it with the approach of Mandelker and Rhee (1984). To compute the degree of operating leverage they apply two steps. First, they calculate the residuals of two regressions with operating income and sales as the two dependent variables, and the first-year observation of operating income and sales plus each variables' growth rates as right-hand-side variables. The resulting residuals are the input variables for the second regression; namely the earnings residuals form the left-hand-side and the sales residuals the right-hand-side variable. The coefficient of the second regression is the proxy for the operating leverage[5]. With this approach they consider the common trend in sales and operating income which dominates the regression of Mandelker and Rhee (1984). Furthermore, they appraise other more static proxies of the operating leverage. These proxies lack theoretical foundation because they limit the operating leverage to the ratio of fixed and variable costs. They suggest that future research should focus on theoretically sound proxies (O'Brien & Vanderheiden, 1987). The approach belongs to the relative viewpoint according to Kelly and Sussman (1966). No other researcher further develops the approach by O'Brien and Vanderheiden (1987).

Prezas (1987) investigates the relation between the financial and operating leverage. Contrary to the findings of Ferri and Jones (1979), he denies a strict negative relation between the two types of leverage. Prezas (1987) argues that because of large interactions between the liabilities side of the balance sheet and the business operations, the degree of operating leverage and the degree of financial leverage are related. The nature of this relation is dependent on debt elasticities and on the contribution margin (Prezas, 1987).

Chung (1989) investigates the real determinants of the systematic risk of a firm and extends the work of Rubinstein (1973) and Lev (1974). Referring to Mandelker and Rhee (1984), Chung (1989) considers the cyclicality of a firm's business and analyses the relation of the financial and operating leverage to this business risk. The degree of operating leverage is measured according to the elasticity formula; i.e. change in operating income divided by change in sales. The model development results in a formula that defines the systematic risk of a firm as the demand beta times financial and operating leverage. The degree of financial and operating leverage have a nonlinear multiplicative effect on the level of riskiness (Chung, 1989). For the empirical investigation, he changes the computa-

[5]Formula (17) on page 46 is explained in detail in chapter 3. It describes the approach developed by O'Brien and Vanderheiden (1987), which is a further development of the approach by Mandelker and Rhee (1984)

tion of the operating leverage. Like Mandelker and Rhee (1984), Chung (1989) conducts a regression with operating income as the dependent variable and sales as the independent variable. Afterwards, the coefficient is multiplied by the ratio of sales and operating income. The regression to explain the systematic risk shows a highly significant operating leverage. In robustness tests, Chung (1989) utilizes the variability of operating income adjusted by its mean as a proxy for the operating leverage. Additionally, Chung (1989) tests the variables in different regressions for portfolios instead of a single firm basis. Overall, Chung (1989) confirms the significance of the operating leverage in explaining the systematic risk of a company.

Dugan and Shriver (1989) argue that the broad variety of proxies for the operating leverage is a result of the absorption costing method. Contrary to direct costing, under absorption costing companies do not reveal the proportion of fixed and variable costs. Due to this lack of segregation, it is not possible to compute the breakeven point for external stakeholders[6]. Dugan and Shriver (1989) compare different proxies for the operating leverage. They conclude that the proxy used by Mandelker and Rhee (1984) fits to the traditional definition of operating leverage as a measure of elasticity of operating income regarding changes in sales. Their empirical investigation, based on a small sample with companies from few industries, compares the correlations of three different proxies, which are tested over three time periods. In comparing the correlation results, they conclude that an elasticity measure is the appropriate approach. The paper is the first to focus on an appraisal of different operating leverage proxies. However, they argue: "Determining the accuracy of those proxies is not possible from an empirical standpoint because of the lack of accessible accounting data suitable for calculating a *true* DOL coefficient" (Dugan & Shriver, 1992, p. 320). This conclusion highlights a crucial aspect of the operating leverage: It is not observable with public data. Therefore, only proxies with a clear relation to theoretical considerations qualify for empirical investigations.

Huffman (1989) conducts an update of the study by Mandelker and Rhee (1984) to assess the relation between operating and financial risk to systematic risk. The sample universe also includes manufacturing firms. He addresses the problem of calculating operating and financial leverage when a company generates losses, and applies the correction described by Chung (1989). Again, the approach assumes constant elasticities over the sample time period. Huffman (1989) conducts robustness tests with a portfolio approach to consider the assumption of constant elasticities and the error-in-variables bias. Huffman (1989) neither finds a positive association between operating leverage and systematic risks, nor a negative correlation between financial and operating leverage. Furthermore, he doubts that the definitions of financial and operating leverage are reasonable because some industries reveal low financial leverage but exhibit high debt-to-assets ratios (e.g. utilities). Because these findings contradict Mandelker and Rhee (1984), Huffman (1989)

[6]Section 3.1 discusses the differences between absorption and direct costing.

questions the calculation of the operating and financial leverage.

Like Kelly and Sussman (1966) and McDaniel (1984), Dran (1991) discusses the drivers of operating leverage and questions if an increase in fixed costs directly raises a company's risk profile. According to Dran (1991), a company's distance to the breakeven point – and not the proportion of fixed to variable costs – is the main driver of the operating leverage. In other words, two companies with the same distance to breakeven point exhibit the same degree of operating leverage regardless of the structure of their operating costs (Dran, 1991). Like Kelly and Sussman (1966), Dran (1991) substitutes fixed costs with the breakeven formula in the traditional operating leverage equation[7]. Thus, a company's risk profile will not necessarily increase with a rising share in fixed costs if the distance to the breakeven point does not alter. Dran (1991) measures the risk as the coefficient of the variation in operating income. The considerations of Dran (1991) are important and support the findings of Kelly and Sussman (1966). However, Dran (1991) does not address whether it is realistic that changes in the proportion of fixed and variable costs do not alter the distance to the breakeven point. Yet, the substitution between variable and fixed costs has to work properly to keep the breakeven point constant.

Further to their work in Dugan and Shriver (1989), Dugan and Shriver (1992) compare two different operating leverage proxies. This time, they compare the approaches of Mandelker and Rhee (1984) and O'Brien and Vanderheiden (1987). The main difference between these two approaches is that O'Brien and Vanderheiden (1987) consider the common trend in operating income and sales. They argue that in the regression conducted by Mandelker and Rhee (1984) the relation between operating income and sales is driven by this mutual trend. Dugan and Shriver (1992) test if the coefficients are similar within industries and different time periods. Additionally, they compare the proportion of coefficients above 1 (Dugan & Shriver, 1992). Because the regression of Mandelker and Rhee (1984) is dominated by the growth rates of operating income and sales, Dugan and Shriver (1992) expect industry coefficients around 1. They confirm significant differences between the coefficients of the two approaches and measure a larger proportion of coefficients above 1 for the measurement method of O'Brien and Vanderheiden (1987). Because the traditional theory of the operating leverage demands that coefficients are larger than 1 if a company operates with fixed costs, Dugan and Shriver (1992) support the O'Brien and Vanderheiden (1987) approach. While Dran (1991) argues that the true operating leverage is not observable, the assessment of the two approaches by Dugan and Shriver (1992) shows that there are at least some approaches for appraising different proxies.

Lev and Thiagarajan (1993) test several accounting fundamentals while considering macroeconomic factors to explain a company's excess returns. One of these is the difference between the percentage change in sales and gross margin. According to Lev and Thiagarajan (1993), this difference is driven by the operating leverage and disproportionate de-

[7] Formula (1) is explained in detail in chapter 3.

creases are interpreted negatively. This factor is statistically significant in cross-sectional regressions with negative coefficients for all years considered. The negative coefficients show that a large difference between sales and gross margin has a negative impact on the excess return (Lev & Thiagarajan, 1993). In order to test the variables under different macroeconomic conditions, they split the time period and rerun the regressions. The gross margin remains significant with negative coefficients for all time periods. The introduction of the difference between changes in sales and changes in gross margin extends the number of operating leverage proxies. This proxy assumes that parts of production costs are fixed, which causes the unwanted disproportionate difference. Beside this variable, Lev and Thiagarajan (1993) also compare the changes in sales with changes in SGA. Regarding this type of costs, Lev and Thiagarajan (1993) are interested in cost control abilities of the management. Because these costs are supposed to be fixed, they should not vary with changes in sales. The empirical results show that the coefficients of this second variable are larger during time periods with low growth. This means that the investor reaction is negative if a company does not control its fixed costs. The research design of Lev and Thiagarajan (1993) is interesting because it tests the influence of the operating leverage and characteristics of the cost structure on excess returns.

Petersen (1994) investigates the relation between a firm's choice of pension plan and the variability of cash flows. His considerations assume that the variability of cash flows is dependent on the operating leverage. The exchange of fixed costs with variable costs lowers the operating leverage and therefore reduces the variability of cash flows. Such a reduction in the operating leverage may add value if markets are imperfect. This enhancement in value through a reduction in fixed costs is the result of a lower probability of financial distress, caused by less volatile cash flows. Instead of measuring the operating leverage, Petersen (1994) considers only the variability of cash flows in his empirical investigations. He concludes that the choice of pension plan is dependent on the variability of a firm's cash flow (Petersen, 1994). The underlying assumption of a cause-effect relation between the operating leverage and the cash flow variability is interesting. This assumption is the catalyst for chapter 6 which thoroughly investigates the relation between the cost structure and earnings volatility.

Lord (1995) continues the work of Dran (1991). He deepens the investigation of the relation between the cost structure and the breakeven point and takes the impact on the operating leverage into account. His derivation starts with the traditional definition of operating leverage as the ratio of contribution margin and operating income. Lord (1995) shows different partial derivatives, with respect to quantity sold, variable costs, price and level of fixed cost, of the formula. With the help of these formulas, he explains the factors influencing the operating leverage, namely rising quantity sold and increasing prices lead to a reduction in the operating leverage, while rising variable or fixed costs cause an increase in the operating leverage. But, Lord (1995) does not exclude the possibility that a firm increases its fixed costs, reduces its unit variable costs and at the same time reduces its degree of operating leverage through a reduction in the breakeven point. It depends on the level of substitution of variable and fixed costs. Furthermore, he shows potential flaws in the elasticity measure by producing negative values or unrealistically large values for small changes in sales. He agrees with O'Brien and Vanderheiden (1987) that a realistic proxy for the operating leverage should be larger than 1 (Lord, 1995).

Darrat and Mukherjee (1995) compare the findings of Mandelker and Rhee (1984) and Huffman (1989). They investigate the relation between the financial and operating leverage as well as the influence of these two variables on the systematic risk of a company. On one side, Mandelker and Rhee (1984) claim that the operating and financial leverage are independent of each other and their impact on the systematic risk is multiplicative. This independence holds across industries. On the other side, Huffman (1989) argues that there is a relation between the two leverages since a company's capacity decision takes both types of leverage into account. The relation of the two leverages should vary according to the growth potential of the industry. Darrat and Mukherjee (1995) utilize the coefficient of regression of changes in operating income with changes in sales as a proxy for the operating leverage. They draw the conclusion that the operating leverage influences the systematic risk of a company. However, this influence and the type of relation vary significantly among industries. These findings indicate that a proper research design must take industry aspects into account.

Lord (1998) further develops the findings of his previously mentioned paper (Lord, 1995). His study is important for empiricists considering the operating leverage. Lord (1998) explains why commonly utilized proxies for the operating leverage have significant flaws and appraises the approaches of Mandelker and Rhee (1984) and O'Brien and Vanderheiden (1987). He uses a sample with randomly generated variables which consists of information about the price per unit, amount of units sold, as well as variable and fixed costs. In his tests he allows the price and unit output to vary. He differs between low and high volatilities of these two variables, and conducts rolling regressions for estimating the operating leverage according to Mandelker and Rhee (1984). In a scenario with low volatile unit output and high volatile prices, the Mandelker and Rhee (1984) approach produces operating leverages with illogical values; many coefficients are smaller than 0 – even though the output is larger than the breakeven point. Further, the variation of coefficients is large. This effect is even larger if a company produces far beyond the breakeven point. Additionally, volatile prices and volatile output also produce unreasonable operating leverages. In respect of the approach developed by O'Brien and Vanderheiden (1987), Lord (1998) finds similar results. The variation in coefficients is even larger applying the two-step approach. Lord (1998) results confirm the findings of Dugan and Shriver (1992). The findings of Lord (1995) and Lord (1998) question the utilization of point-to-point and time-series estimates as a proxy for the operating leverage[8]. The appraisal of these

[8]The flaws of the different proxies are discussed in detail in section 3.3.

approaches is based on data from non-public sources and it is not possible to repeat these investigations with actual, publicly available company data. Further, it is difficult to estimate the number of illogical values. These findings show the need for certain corrections in the proxies produced by various methods.

Similar to Kelly and Sussman (1966), McDaniel (1984) and Dran (1991), Howard (2000) investigates the relation between fixed and variable costs and the impact on the breakeven point and degree of operating leverage. According to Howard (2000), this topic is of great interest because the relation between these two cost types influences the breakeven point and operating leverage. Further, changes in the cost relation have an impact on the variability of earnings (Howard, 2000). Comparing the variability of earnings with the operating leverage shows that an increase in fixed costs does not always lead to an increase in the variability of earnings. His considerations are similar to those of Kelly and Sussman (1966). The introduction of the variability of earnings enhances the meaning of operating leverage, as evidenced by Petersen (1994), who bases his investigations on the relation between operating leverage and earnings variability.

Ho, Xu, and Yap (2004) conduct an investigation about the R&D intensity of a firm and the systematic risk. They refer to the papers of Rubinstein (1973) and Mandelker and Rhee (1984) and decompose the systematic risk into three parts: intrinsic business risk, operating leverage and financial leverage. They measure the operating leverage according to the approach developed by Mandelker and Rhee (1984). The coefficients resulting from the regressions are multiplied by the ratio of the averages of sales and operating income. Chung (1989) adapts the operating leverage in a similar way. They also consider the operating risk, measured as the product of business risk and operating leverage. Ho et al. (2004) assume that R&D intensity and operating leverage are positively related because often R&D expenditures lead to an increase in fixed costs. The results show that the operating leverage does not significantly vary between portfolios sorted by different R&D intensity (Ho et al., 2004). This is the first study using one single cost category in respect of operating leverage considerations. So, different expenses show different degrees of flexibility. Because R&D expenses are important for future income streams, such costs can hardly be reduced when sales decrease.

In a recently published study, the operating leverage is used as a factor to explain the BM ratio anomaly. Gourio (2004) develops a theoretical model in which he places the operating leverage at center of his deliberations. Because costs do not vary proportionally with sales, lowly productive firms benefit more during booms than productive companies. By the same token, however, less productive firms suffer more during recessions compared to productive companies. He thus uses his model to explain why companies with high BM ratios tend to outperform companies with low BM ratios. According to Gourio (2004), low BM ratio companies are more productive compared to high BM ratio companies. Therefore, BM ratio and expected return are positively related through the level of productivity. In his model, he defines operating leverage as the inverse capital share. For his empirical investigations he uses the ratio of operating costs to sales or the operating margin as proxies for the capital share. He concludes that high BM ratio companies are more sensitive to aggregate shocks because they have higher operating leverages, i.e. lower operating margins, and are less productive. During booms, the relative value of less productive firms increases because they benefit disproportionally from increasing demands, i.e. positive operating leverage effect. He finds evidence in his data that the operating income of high BM ratio companies increases 6% and the operating income of low BM ratio companies only 1.5% if GDP increases 1% (Gourio, 2004). However, during recessions, operating income shrinks more compared to revenues. The lower margin companies therefore exhibit higher systematic risks and have higher average returns. While Gourio (2004) is able to draw relations between operating leverage and returns under consideration of the BM ratio, his proxy for operating leverage lacks a link to traditional operating leverage considerations.

Hodgin and Kiymaz (2005) compare operating leverage explanations in various managerial textbooks. They start with the basic formula to calculate the operating leverage, namely contribution margin divided by operating profit. Referring to Dran (1991), they argue that it is insufficient to reduce drivers of operating leverage to fixed costs. In particular, they consider the distance to the breakeven point as central to a comprehensive discussion of the operating leverage. However, according to Hodgin and Kiymaz (2005) it is important to draw a line between what is mathematically correct and what is meaningful from a manager's perspective. They argue that a thorough discussion about the operating leverage differentiates between considered management decisions, external factors as well as engineering-based limits. Hodgin and Kiymaz (2005) explain that the variables of the operating leverage formula can each be assigned to one of these three categories: ". . . management-determined choices – operating fixed costs and output levels; market determined parameters – price in a competitive market as time passes; and economic and engineering relationships – unit variable costs, given operating fixed cost increases due to new capital integration" (p. 27). Because fixed costs are the only variable which the management can directly influence, management should pay close attention to this factor (Hodgin & Kiymaz, 2005). This differentiation between operating leverage drivers and the classification to the three categories is also interesting for empirical investigations as it supports focusing on the cost structure of a company.

Brimble and Hodgson (2007) conduct an empirical investigation to evaluate the explanatory power of accounting variables for differences in the systematic risk. They follow the breakdown of systematic risk applied by Penman (2004). According to Penman (2004), the operating leverage together with the expense risk drive the riskiness of the profit margin. Brimble and Hodgson (2007) compute five different proxies for the systematic risk and equate the operating leverage with the profit margin risk according to Penman (2004). This proxy is only indirectly linked to theoretical operating leverage considerations. However, the operating leverage and the earnings variance are the only two proxies of operating risk that are significant in regressions explaining the different measures of systematic risk (Brimble & Hodgson, 2007). Contrary to Lev (1974), Rubinstein (1973), Mandelker and Rhee (1984) or Chung (1989), Brimble and Hodgson (2007) base their choice of proxies on the model of Penman (2004). Like most other studies, Brimble and Hodgson (2007) confirm the importance of characteristics of the cost structure.

Gulen, Xing, and Zhang (2008) analyze the performance differences of value and growth companies. Value companies are less flexible in adjusting their business operations during periods of adverse economic developments. They therefore develop an inflexibility index to assess these adjustment challenges. This index consists of three sources of inflexibility: costly reversibility, operating leverage and debt. For each source they define variables which measure the degree of flexibility. Costly reversibility means that it is more expensive to reduce costs than increase expenses. Value firms face higher reversibility costs because their assets-in-place are less productive and therefore they have to disinvest more often. The variable sales of property, plant and equipment serves as a proxy for measuring the level of disinvestment. Operating leverage is measured as the three-year average of the ratio of percentage change in operating income to percentage change in sales. Time-series averages show that high BM ratio portfolios have a higher proportion of fixed assets, disinvest more often, and exhibit higher degrees of financial and operating leverage (Gulen et al., 2008). Because of higher operating leverage, value companies are more vulnerable to economic downturns. The inflexibility index and the degree of operating leverage increase continuously from growth to value firms. Regression analyses prove that the degrees of financial and operating leverage are particularly significant in explaining monthly stock returns. Furthermore, like Fama and French (1992), they measure monthly returns for ten deciles sorted according to the inflexibility index. Because of the significant outperformance of the low flexibility portfolio, they conclude that inflexible companies exhibit higher costs of equity.

Like Gulen et al. (2008), Garcia-Feijoo and Jorgensen (2010) try to explain the BM ratio anomaly. They investigate the relation of operating leverage to systematic risk, monthly returns and BM ratio on a firm and on a portfolio level basis. They differentiate between two methods of calculating the operating leverage: the time-series regression approach according to O'Brien and Vanderheiden (1987) and the point-to-point approach according to Ferri and Jones (1979). They conduct a time-series regression on a 5-year moving time window to calculate operating and financial leverage. Instead of dropping companies generating negative operating income, they apply a transformation to compute the logarithms of negative earnings. Descriptive statistics for portfolios sorted by size and BM ratio show a positive relation between operating leverage and BM ratio. The positive relation between size and operating leverage is less convincing but still visible. Comparing the extreme size and BM ratio portfolios shows significant differences in operating leverage (Garcia-Feijoo & Jorgensen, 2010). The operating leverage is significant in explaining monthly stock returns but shows a low coefficient in regressions on a firm level. The BM ratio, on the other hand, is highly significant in explaining the degree of operating leverage on a firm level. Garcia-Feijoo and Jorgensen (2010) conclude that their results support a risk explanation of the BM ratio anomaly.

Similar to Gulen et al. (2008) and Garcia-Feijoo and Jorgensen (2010), Novy-Marx (2011) tries to explain the BM ratio anomaly. His model assumes a difference between the riskiness of assets-in-place and growth assets. Because assets-in-place create costs they are more risky. Growth assets do not (yet) have an impact on the balance sheet or income statement. According to Novy-Marx (2011), this assumption is at the center of the operating leverage hypothesis. Based on the assumption that high operating leverage companies are less flexible and exhibit lower margins, such companies are more exposed to demand shocks. Therefore, the BM ratio anomaly is associated with low productivity, due to the high proportion of assets-in-place, and therefore high dependence on economic conditions. He defines operating leverage as the ratio of COGS plus SGA to total assets (Novy-Marx, 2011). This definition of the operating leverage is new. Different regressions confirm the operating leverage as a significant variable in explaining monthly returns. The significance persists even when including BM ratio and size. But contrary to the findings of Garcia-Feijoo and Jorgensen (2010), portfolios employing a quintile sort on the basis of the operating leverage do not exhibit a clear relation to the BM ratio. The return differences between high and low operating leverage portfolios are significant.

Contrary to the previously mentioned papers, Kahl et al. (2011) introduce a new method to approximate the operating leverage of a company that focuses on the cost structure. Instead of measuring the elasticity of operating income regarding changes in sales, they put the proportion of fixed to variable costs at the center of their approach. They circumvent the problem of negative earnings. They calculate expected sales and expected operating costs based on the trend of the past two years. The percentage difference between actual and expected sales and actual and expected operating costs is utilized in regressions. Using operating costs and sales as the dependent and independent variables, respectively, the resulting coefficient is the proxy for the properties of a company's cost structure. Kahl et al. (2011) explain: "Cost structure captures the sensitivity of operating cost growth to sales growth after accounting for growth trends" (p. 13). A low cost structure indicates high fixed costs. In addition to point estimates, they apply distributional rankings in regressions to mitigate the uncontrollable impact of noise inherent in the cost structure factor. The main purpose of their paper is to investigate the relation between the operating leverage and corporate financial policy measures such as the leverage ratio or cash ratio. They find evidence that high operating leverage companies exercise more conservative financial policies and hold more cash reserves than companies with a lower operating leverage. However, high operating leverage companies have lower leverage ratios only when the company is financially constrained. Therefore, they confirm the tradeoff hypothesis but only under consideration of the access to capital markets (Kahl et al., 2011).

The literature review includes twenty-nine papers. The before-mentioned papers are summarized in table 85 on page 190. Thirteen papers explain risk aspects of the operating leverage, nine the features of the operating leverage and only five discuss relations between this company feature and other company-specific characteristics. The characteristics of the operating leverage are discussed during the total considered time period. The insights of these rather theoretical papers find their way into empirical investigations. Because there is now direct approach to measure the operating leverage, proxies are necessary. The approximation of the operating leverage is a crucial aspect and some academics appraise the various approximation methods. Even though the approximation of the operating leverage according to equation (10) on page 40 is simple and related to theoretical discussions, only in four studies such proxies are used. In eleven empirical investigations the proxies applied base on time-series estimates. Thirteen papers use point estimates. Section 3.3 discusses in detail the advantages and disadvantages of the three approaches. Most of the studies focus on the elasticity aspect of the operating leverage, only eight pay attention to the costs-side of the operating leverage. Some papers consider multiple approximation methods, topic areas or focuses.

Regarding these three aspects, this dissertation refers to two papers: Lev (1974) and Garcia-Feijoo and Jorgensen (2010), both use proxies measured with time-series estimates to analyze risk aspects. Section 2.4 explains how the dissertation uses research gaps to contribute to discussions about the riskiness of a company. Regarding the research gap, the approximation technique plays a critical role.

2.3. Finance Literature

The preceding section 2.2 mentions various papers, for instance Lev (1974), Gahlon and Gentry (1982), Mandelker and Rhee (1984) and Chung (1989), which test the significance of the operating leverage as a factor explaining CAPM's beta. CAPM stems from Sharpe (1964) and Lintner (1965) and builds on the work of Markowitz (1952). Markowitz (1952) explains that risk-averse investors are solely concerned about the mean and variance of their portfolio returns. Investors chose portfolios which minimize variances in respect of the expected return, or maximize the expected return according to a given variance of return. On this basis, Sharpe (1964) and Lintner (1965) developed the CAPM, which claims a linear relation between risk and expected return. This relationship is testable.

All portfolios can be plotted in a chart, where the vertical axis shows the expected portfolio return and the horizontal axis indicates the portfolio's standard deviation. Sharpe (1964) makes two important assumptions. First, all investors are able to borrow on equal terms. Second, they agree on the prospects of investments. With these assumptions, it is possible to identify mean-variance-efficient portfolios. All combinations of assets that are mean-variance efficient lie on the minimum variance frontier (Fama & French, 2004). Sharpe (1964) differentiates between the price of time and the price of risk. The price of risk, that is the expected return of an additional unit of risk, is shown by the shape of the efficient frontier. There is a clear tradeoff between risk and expected return. An investor pursuing high returns has to accept significant volatility in the portfolio's return. The price of time is shown by the risk-free interest rate. It lies on the vertical line at zero risk, i.e. zero variance or stable returns. The intersection indicates the level of the interest rate. Fama and French (2004) explain that the introduction of the risk-free rate turns the minimum variance frontier into a straight line. This line starts at the zero variance portfolio and defines the tangency portfolio where it meets the efficient frontier. All efficient portfolios consisting of investments in risky assets and borrowing or lending at the risk-free rate lie on this line. Such portfolio considerations have an impact on the expected return of single assets. Sharpe (1964) explains that some part of total risk of a security can be diversified. Therefore, the total risk of a security cannot fully explain its price. "Obviously the part of an asset's risk which is due to its correlation with the return on a combination cannot be diversified away when the asset is added to the combination. . . . this type of risk . . . should be directly related to expected return (Sharpe, 1964, p. 440)". CAPM's beta is the relevant factor capturing this correlation between the returns of a single asset and the portfolio.

Academics have long debated which accounting factors influence beta. In their empirical investigations Beaver, Kettler, and Scholes (1970) test the relation between total and systematic risk of a firm and seven accounting measures, for instance the earnings variability, earnings covariability or accounting beta. They conclude: "The evidence is consistent with the contention that the accounting risk measures are impounded in the market risk measures" (Beaver et al., 1970, p. 670). Furthermore, accounting risk measures are useful in predicting future market risk measures. Rosenberg and McKibben (1973) use also accounting measures to predict systematic and specific risks in common stocks. The empirical investigations show that accounting factors are significant predictors of systematic risk. Bowman (1979) investigates the theoretical linkage between some accounting characteristics and the market risk. He confirms a theoretical association between the financial leverage and accounting beta and the systematic risk of a firm. Ryan (1997) gives a comprehensive overview over investigations about the relation between accounting factors and equity risk. Earnings variability most strongly relates to systematic risk (Ryan, 1997). Other accounting factors related to risk are operating business risk, operating and financial leverage. Regarding portfolio theory, Ryan (1997) believes that accounting factors should relate closer with total risk than systematic risk because of the possibility to diversify among securities. Some academics, such as Lev and Kunitzky (1974), reach more conclusive empirical findings when controlling for different industries, which indicates that the association between accounting factors and risk is stronger for companies with homogeneous accounting characteristics.

The empirical findings of Bowman (1979) deviate from theoretical considerations. His assessment of the relation between earnings variability and market risk is not congruent with the theoretical considerations of Beaver et al. (1970). However, there are several arguments that speak in favor of a positive relation between systematic risk and accounting factors. Lev and Kunitzky (1974) explain that investors perceive companies with stable earnings to be less risky. Similarly, Hepworth (1953) and Gordon (1964) argue that investors feel more comfortable with investments generating constant earnings. Beidleman (1973) adds that this argument holds even for financial analysts. Graham, Harvey, and Rajgopal (2005) extend this to management and explain why executives prefer smooth earnings. One reason is that managers believe in a close relation between earnings variability and earnings predictability. So, managers believe that analysts prefer smooth earnings because the prediction of future earnings is easier (Graham et al., 2005). Dichev and Tang (2009) find evidence for a negative relation between earnings variability and predictability. This may lead to less information about companies with volatile earnings and therefore lower trading activities. Minton and Schrand (1999) further explain that volatile earnings make it difficult to fund corporate investments. Companies with volatile earnings often need external funding, and their earnings volatility makes such funding more expensive.

Fama and French (2004) summarize the results of various tests assessing the implications of CAPM. They differentiate between testing the relation between beta and risk premium, testing the power of beta to predict returns and more recent investigations where other factors compete with beta in explaining stock returns. Basu (1977) finds that low PE ratio portfolios earn higher absolute and risk-adjusted returns compared to high PE ratio portfolios, and concludes that this outperformance is the result of market inefficiencies. Banz (1981) finds evidence that small companies reveal higher returns compared to large companies, yet this performance difference is not explained by the CAPM. Another factor differentiating between high and low returns is the financial leverage. Bhandari (1988) finds a positive association between financial leverage and expected return. This relation holds even controlling for other factors such as market beta. Fama and French (2004) argue that scaling market measures with accounting measures is useful to extract information about expected returns. The investigations in Fama and French (1992) support this interpretation of the superiority of such ratios compared to market beta. Fama and French (1993) argue that stock prices are not one-dimensional as claimed by the CAPM. It is more realistic that many factors influence stock prices. The findings of Fama and French (1992) are further developed in Fama and French (1993) and lead to a three-factor asset pricing model. This model consists of three mimicking portfolios: MARKET, SMB and HML. These factors act as proxies for risk aspects common to variation in returns. According to Fama and French (2004), empirical results of the three-factor model are superior to CAPM. Fama and French (1995) also prove a relation between the factors explaining stock returns and accounting earnings. They show that portfolio earnings are explained by the annual earnings differences of the SMB and the differences of HML portfolios. Earnings behave similarly to stock returns. These findings support a link between stock returns and accounting returns: “If the size and BE/ME [BM ratio] risk factors in returns (unexpected changes in stock prices) are the result of rational pricing, they must be driven by common factors in shocks to expected earnings that are related to size and BE/ME [BM ratio]" (Fama & French, 1995, p. 132).

2.4. Research Gap

Section 1.2 explains the basic idea of this dissertation. A comprehensive study of the characteristics of a company's cost structure and its impact on accounting and stock returns is of relevance to capital market participants who analyze accounting fundamentals for decision making. The following research gaps explain that the before-mentioned research questions fit to an existing research stream, while at the same time are innovative and add value to the discussion about the riskiness of companies. Filling these research gaps is not just of relevance from an academic point of view, but also for its potential to reveal cross-disciplinary implications. By traversing from the core of a company's activities, the production process, to the bottom line of the income statement and then to the capital market perspective, this dissertation strives to build a bridge between management accounting and corporate finance.

Putting the characteristics of the cost structure at the center of investigations allows a bridge to be built between accounting returns and stock returns. The considerations of Petersen (1994) assume a relation between the operating leverage and earnings volatility. Howard (2000) continues such deliberations. The findings of Beaver et al. (1970) and Ryan (1997) show that considering the earnings variability is of relevance for investors, too. Their investigations confirm a relation between earnings variability and systematic risk. Kahl et al. (2011) find evidence for an association between characteristics of the cost structure and earnings variability. However, the proxy developed by Kahl et al. (2011) measures the difference between the actual and expected operating costs as well as the actual and expected sales. But, of more interest is the direct relation between the cost structure and the volatility of earnings.[9] So, there is no empirical investigation based on a broad set of data that assesses explicitly the impact of the cost structure on earnings volatility. Because accounting relations clearly demonstrate the importance of cost structure properties, this research gap has a solid theoretical foundation.

Early papers describe the relation between the operating leverage and a company's systematic risk. The theoretical foundations for this association can be traced back to Rubinstein (1973), Lev (1974), Mandelker and Rhee (1984) and Chung (1989). Most investigations assess the joint impact of operating and financial leverage on the systematic risk. There is no assessment of the distinct impact of the cost structure on systematic risk. Further, because the operating leverage is different from financial leverage, the appropriate risk parameter is unlevered beta. None of the previously mentioned papers considers the unlevered beta. Such investigations enable a differentiation between operating and

[9] The discussion in section 3.2 explains the relation between the operating leverage, changes in sales and changes in operating income. This interrelation is described in formula (21) on page 52, which enables an assessment of the accounting relation based on theoretical considerations.

financial risk as well as an assessment of the kinds of risks that investors are compensated for.

Further, the works of Gulen et al. (2008), Garcia-Feijoo and Jorgensen (2010) and Novy-Marx (2011) show that operating leverage considerations also offer insights for explaining the BM ratio anomaly. Some academics argue that companies with large proportions of fixed assets lose value during recessions, because their assets have less worth (Novy-Marx, 2011). Their loss in value is larger compared to companies with more growth opportunities and therefore low BM ratios. Others claim that companies with high exposure to fixed costs are more risky. They face severe challenges when revenues decline (Gulen et al., 2008). The approach of this dissertation differentiates itself from existing literature through a strict focus on the cost structure. It excludes, for example, costs such as depreciation. According to Kahl et al. (2011), depreciation are likely to be manipulated by the management, thus only operating costs are taken into account. Most of these costs are cash-relevant and related to the production process. Additional to BM ratio, also size is considered. Because size is related to returns, this aspect is relevant for shareholders, too. The hypothesis that with rising degree of cost structure rigidity the riskiness of a company increases, stands behind the focus on cost structure properties. The properties of cost structures may relate to size and BM ratio because there could be similarities in accounting return properties. So, the assumed similarities in accounting returns may link the cost structure with BM ratio and size. This aspect is taken into account in the fourth empirical investigation.

As shown in the literature review, there are many different proxies available for empirical investigations[10]. However, because the operating leverage refers to a company's cost function, which is dynamic and undergoes changes, static approximations are insufficient. Today, data availability as well as statistical methods allow the operating leverage to be estimated for many consecutive points in time, provided a sufficiently comprehensive data set is available. Dynamic proxies are an important improvement compared to the research designs described in early papers. For instance, Mandelker and Rhee (1984) cannot confirm stationarity of their operating leverage approximation. At the same time, there is a tradeoff between the number of observations and the quality of the proxy in empirical investigations. For instance, large time windows, e.g. 10 years, for moving averages lead to sound estimations, but reduce the sample to companies with a large data history. Conversely, short intervals threaten the quality of the approximations but improve the sample size. Five-year moving average time windows seem a reasonable compromise. This adjustment in the research design with usage of panel data better match the dynamics that companies operate in.

[10] Section 3.3 provides an overview of different computation methods. The approximations are explained in detail. Reasonable proxies are a crucial requirement for satisfying results in empirical tests. The variables considered have to approximate appropriately the cost structure characteristics to draw conclusions about its impact on various corporate characteristics.

To date, the development of new proxies neglects the potential to directly approximate properties of the cost structure. The literature review makes clear that the amount of fixed costs may not be the single factor influencing the operating leverage, e.g. Kelly and Sussman (1966), McDaniel (1984) or Dran (1991). It is more likely the relation of fixed to variable costs through the breakeven point that determines the operating leverage. This insight motivates researchers to switch the focus from the cost aspect to the elasticity aspect of the operating leverage or, in the words of Kelly and Sussman (1966), from the absolute to the relative viewpoint. However, this focus seems to neglect the fact that the breakeven point itself is defined by the amount of fixed costs. This is surprising because Lev (1974) already based his proxy on the elasticity of operating costs regarding sales volume. This dissertation aims to exploit this gap. Therefore, in this dissertation, proxies focus on the cost structure itself and not the elasticity aspect. This approach has many advantages. Focusing on the elasticity aspect of the operating leverage leads to a selection bias towards profitable companies. Focusing on the cost structure itself circumvents this problem. Furthermore, according to Hodgin and Kiymaz (2005) fixed costs are under control of the management, and these may play an important role regarding the relation between operating leverage and a company's inherent risk. Further, the application of rolling regressions allows an approximation of the properties of the cost structure at different points in time. Therefore, the construction of panel data with such proxies is possible. The proxies measure the degree of rigidity of the cost structure. This feature is put into relation to risk parameters. Regarding the level of riskiness, sources of risk evolving from existing assets – a company's production process – are considered. This limitation refers to Gahlon and Gentry (1982) who apply the same focus on existing assets. To conclude, the approximation is new in respect of the considered variables and the measurement, but the broader context of this dissertation is similar to many of the described papers in section 2.2.

3. Theoretical Considerations

The operating leverage characterizes a company's cost structure and influences the impact of changes in sales on the operating income. Its measurement and accurate interpretation demand a basic understanding of management accounting and aspects of reporting. The estimation of the operating leverage is based on the differentiation between variable and fixed costs, which is essential in management accounting. Because the empirical investigations of this study apply a broad sample of listed companies, the estimation procedures are dependent on how expenses are structured and reported in annual reports. In this respect, this chapter commences with a brief comparison of absorption and direct costing; in particular their differing approaches to the valuation of inventory. Afterwards, the characteristics of the operating leverage are discussed in detail to provide the necessary context for the appropriate approximation of the cost structure and for the research designs of the empirical investigations. At the end of the chapter, the perspective of the capital market is introduced. The explanations indicate that a high share of fixed costs is a primary cause of a high operating leverage, which increases the coefficient of earnings variability and thereby increases the riskiness from a shareholder perspective.

3.1. Absorption vs. Direct Costing

In the 1950s, a controversial discussion among accountants about absorption and direct costing commenced that continues to this day. This discussion is not limited to the internal usage of either approach but takes the requirements of various stakeholders for financial information into account, too. Brummet (1955) explains that the term direct costing is misleading. Most accountants believe that direct costing is about assigning costs to the products with which they are either directly or indirectly associated. According to Brummet (1955), direct costing does not refer to product costs but rather to the differentiation between fixed and variable costs in respect of the relevant time period. Fixed costs which do not vary with production levels are period costs and recorded in the income statement as expenses against sales during the period they are incurred. Variable costs, on the other hand, do change with production levels and may be capitalized to inventory valuation. Table 2 compares the two approaches. It is an abstraction of the example in Sopariwala (2007).

Absorption Costing	Direct Costing
Sales	Sales
- Variable COGS	- Variable COGS
- Fixed COGS	- Variable SGA
Gross Profit	Contribution Margin
- Variable SGA	- Fixed COGS
- Fixed SGA	- Fixed SGA
Operating Income	Operating Income

Table 2: Absorption vs. direct costing
Table 2 shows two simplified income statements structured according to absorption and direct costing. Absorption costing matches different expenses to either COGS or SGA; COGS tend to be variable costs, SGA fixed. Direct costing mainly differentiates between fixed and variable costs. Variable costs fluctuate with production levels.

Absorption costing differentiates between cost types. COGS are directly associated with the production of a company's output, for instance material costs. Sales minus COGS gives a company's gross profit. SGA are not directly related to the production process but are relevant for maintaining the company's facilities. After subtracting SGA from gross profit, the operating income results. Both cost categories contain shares of fixed and variable costs. In direct costing, however, the differentiation between fixed and variable costs is decisive: Expenses related to production levels are considered variable costs, if not, they are fixed. Under this approach, sales minus variable costs gives the contribution margin; the contribution margin minus fixed costs gives the operating income.

Schulte (1975) argues that neither absorption nor direct costing is about segregating expenses. The aim of both accounting approaches is to calculate net income and thus to value the stock of inventory and work in progress. While the calculation of net income and valuation of inventory are interrelated, they are treated differently under the two approaches. Under absorption costing, fixed manufacturing costs are included in the inventory valuation. Under direct costing, only variable costs are considered in the valuation of inventory. Table 2 highlights this point with the positioning of fixed COGS after the contribution margin in direct costing, and before gross profit in absorption costing. Schulte (1975) concludes: "Under a good costing system, the effective portion of fixed manufacturing costs should be charged to product" (p. 12). Schulte (1975) counters many arguments of direct costing advocates in a convincing manner, and defends absorption costing with two strong arguments.

The first argument refers to the definition of assets according to FASB Statement of Financial Accounting Concepts No. 6, paragraph 25 (FASB, 1985): "Assets are probable future economic benefits obtained or controlled by a particular entity as a result of past transaction or event" (p. 16). Paragraph 26 further explains that future economic benefit means, assets may contribute to future net cash inflows. According to Schulte (1975), fixed manufacturing costs have the potential to contribute to the generation of future revenues. Therefore, these costs qualify for capitalization to inventory levels. The second argument refers to an important accounting principle, namely the matching principle. Paragraph 146 of the same standard states (FASB, 1985): “The revenue and expense(s) are directly related to each other and require recognition at the same time. In present practice, for example, a sale of product or merchandise involves both revenue (sales revenue) for receipt of cash or receivables and expense (cost of goods sold) for sacrifice of the product or merchandise sold to customers” (p. 47). Schulte (1975) argues that without capitalizing fixed manufacturing costs, the matching principle is in jeopardy. Therefore, absorption costing better fits the requirements of external users of reporting information.

The debate about absorption and direct costing is yet to be resolved, as discussed at length in Sopariwala (2007). Foster and Baxendale (2008) highlight one of the consequences of absorption costing: The ability to capitalize parts of fixed manufacturing costs greatly facilitates earnings management. Producing beyond demand increases inventory levels and reduces COGS, which in turn increases operating income. Thus, if parts of fixed costs may be capitalized, management has an additional lever to manage earnings.

Since the beginning of the debate about absorption and direct costing, the way corporations are organized and manage their production processes have changed substantially. Foster and Baxendale (2008) explain that two contrasting tendencies have emerged. In 1984 many companies, especially manufacturing firms, introduced just-in-time production. This method of managing the product cycle aims to reduce inventory levels to the lowest level possible. The production process starts after receiving the order. Thus, when inventory levels decrease, the possibility to manage earnings through the attachment of fixed manufacturing costs to inventory levels diminishes. The opposite tendency has emerged in capital-intensive production facilities. According to Foster and Baxendale (2008), capital-intensive production increases the level of fixed manufacturing costs. Because such expenses can be attached to inventory valuations, this augments the levers for earnings management.

Foster and Baxendale (2008) report time-series averages of variables which allow an estimation of these two tendencies. Table 3 shows time-series averages of inventory levels in percentage of sales and depreciation in percentage of COGS. Contrary to Foster and Baxendale (2008), who limit their investigations to manufacturing companies, table 3 shows time-series averages for a large sample sorted by industry groups[11].

[11]Section 4.3 explains the sample's properties and the origin of data used in the empirical investigations.

	Inventory in % of Sales				Depreciation in % of COGS			
	74-11	74-84	84-00	00-11	74-11	74-84	84-00	00-11
Business Equipment	13.95%	21.22%	15.07%	9.31%	11.88%	6.87%	10.80%	15.36%
Chemicals	16.09%	16.56%	15.05%	17.10%	6.47%	5.30%	7.25%	7.00%
Consumer Durable	16.95%	20.13%	15.11%	14.49%	4.18%	3.34%	4.56%	5.04%
Consumer Non Durable	14.14%	16.19%	13.24%	12.72%	5.83%	3.87%	7.16%	6.49%
Energy	6.40%	9.25%	5.68%	4.58%	40.35%	37.58%	41.94%	40.82%
Healthcare	15.43%	21.06%	16.32%	11.90%	10.30%	5.34%	11.22%	11.78%
Manufacturing	17.90%	19.00%	16.82%	17.74%	5.05%	4.29%	5.56%	5.56%
Other	9.11%	13.58%	9.75%	5.72%	12.09%	7.05%	14.12%	13.36%
Shops	12.76%	15.02%	12.35%	11.73%	3.29%	2.48%	3.47%	3.62%
Telecom	3.14%	4.86%	4.39%	1.30%	28.93%	17.09%	27.14%	36.55%
Utilities	5.69%	12.80%	2.80%	3.11%	15.62%	20.25%	13.93%	13.71%
Total	13.65%	17.03%	13.48%	10.76%	10.63%	7.38%	11.19%	12.90%

Table 3: Inventory levels and capital-intensiveness of production
Table 3 shows time-series averages of inventory in percent of sales and depreciation in percent of COGS for different industries. Fama-French 12-industry classification is used (French, 2012). The time-series averages cover four time periods to illustrate developments in the variables.

Table 3 reveals large differences among industries in respect of the two variables. The level of inventory is largest for companies in manufacturing, consumer durable and chemical industries. These findings seem rational. For instance, manufacturing companies work with different input factors which they store to avoid bottlenecks in the production process; work in progress leads to further increases in inventory levels. Nevertheless, the average inventory level over all industries has decreased from past to more current time periods. This finding supports the argument of Foster and Baxendale (2008). Most industries reveal a continuous decrease in the variable from past to more current time periods.

Table 3 shows that the production processes of the various industries became more capital-intensive. This means that companies build large production facilities and depreciate these investments over a long time period. The energy sector is capital-intensive whereas shops reveal very low time-series averages. Again, the findings in table 3 support the results of Foster and Baxendale (2008): The time-series average for the whole sample increases from past to more current time periods.

In summary, there are two contrasting developments – one tends to increase and the other to decrease inventory levels. But, the reduction of the proportion of inventory in percentage of sales, true for most industries, mitigates the issue of capitalizing fixed manufacturing costs, because the capitalization impact is already captured by the ratio of inventory and sales.

Table 2 shows that both COGS and SGA consist of fixed and variable costs. However, the reporting of these two variables under absorption costing poses challenges to accountants when estimating the operating leverage. While this does not mean that companies under absorption costing are not able to distinguish between fixed and variable costs, they do not report the proportion of one to the other. This lack of information is true for reporting COGS and SGA, and also for valuing the inventory level. Therefore, approximations of the operating leverage are necessary.

3.2. Characteristics of the Operating Leverage

3.2.1. Definition

According to Hodgin and Kiymaz (2005), six out of nine managerial textbooks equate the operating leverage with the amount of fixed costs. Citations such as “The relationship between fixed costs and variable costs determines the degree of operating leverage, a measure of the sensitivity of profits to changes in sales” (Forgang & Einolf, 2006, p. 145), or “This difference [referring to variable costs being dependent on units sold whereas fixed costs are independent on the amount of products sold] between variable and fixed costs allows us to define the operating leverage” (Ross, Westerfield, & Jaffe, 2005, p. 327) and “It can be shown that operating leverage increases as fixed costs rise and as variable costs fall” (Ross et al., 2005, p. 327), support the findings of Hodgin and Kiymaz (2005). But, the following citation from O’Brien and Vanderheiden (1987) emphasizes another aspect: “OL generally refers to the single-period magnification of the uncertainty of operating income relative to the uncertainty of sales” (p. 45). Most of these citations have in common that they mention the relation between variable and fixed costs, or only the amount of fixed costs, as the factor determining the operating leverage. According to the last citation, however, operating leverage is also an indicator measuring how operating income changes due to variations in sales. According to O’Brien and Vanderheiden (1987), such variations in sales and operating income are uncertain and difficult to anticipate.

Thus, the operating leverage has two interrelated applications: On one side, it relates to the cost structure of a company. On the other side, it measures the elasticity of operating income regarding changes in sales. Depending on the focus, its calculation formula and characteristics change. This chapter explains the relation between these two aspects. Starting from the textbook equation, formal derivations make clear that the cost structure and the elasticity aspect are interrelated. Generally, operating leverage refers to computations based on variables capturing the cost structure of a company at a specific point in time. Formulas measuring the elasticity of operating income use observations from at least two points in time and therefore measure the degree of operating leverage. Operating leverage corresponds to the absolute viewpoint where degree of operating leverage to the relative viewpoint according to Kelly and Sussman (1966).

3.2.2. Textbook Formula

In order to explain the characteristics and ambiguity of the operating leverage the introduction of formulas is necessary. Predominately, it is calculated using the following formula, see for example Kelly and Sussman (1966):

$$\text{(1)} \qquad \text{Operating leverage} = \frac{Q \times (p - v)}{Q \times (p - v) - FC}$$

Formula (1) is called textbook formula. Q refers to the quantity of units sold, p is the price per unit, v the variable costs per unit, and FC the amount of fixed costs. All variables are measured at a specific point in time. Therefore, the formula does not measure changes or elasticities. This approach is sometimes called the point estimate of operating leverage (for instance Lord, 1995). It consists of four parameters that influence the operating leverage: quantity of products sold, price of the product, variable and fixed costs. Formula (1) shows that reducing the factors influencing the operating leverage to the amount of fixed costs is false.

The two types of costs – variable and fixed costs – refer only to operating costs and do not consider financial costs or taxes. For example, in a manufacturing company raw materials are considered variable costs. For each additional unit produced, more raw material is necessary. On the other hand, personnel expenditures for accounting or marketing staff are fixed, as they do not vary with the number of units produced. Moreover, fixed costs are independent of cost drivers, while variable costs are not. The differentiation between variable and fixed costs is thus important for defining the operating leverage.

Drawing the line between variable and fixed costs is dependent on the relevant time period. "In the long run, firms enjoy greater production flexibility. All factors of production are variable." (Forgang & Einolf, 2006, p. 146). But for both shareholders and management, the very-long run is not the relevant time period. Forgang and Einolf (2006) explain that the long run is a transition period, during which companies adjust their production process to new economic realities. For the purpose of the dissertation, in the relevant time period the relation between cost drivers and variable costs and changes in fixed costs differ to a large degree. Variable costs and cost drivers change proportionally whereas fixed costs behave erratically[12].

In formula (1) the numerator is also called contribution margin. This margin provides a cushion to cover fixed costs. The denominator is also called operating income. Therefore, formula (1), the textbook formula, is the ratio of the contribution margin to operating income.

[12] In chapters 5 to 9 various empirical investigations are conducted. The characteristics of the cost structure are put into context using accounting numbers and market information from capital markets. The assessments assume either a simultaneous influence of the cost structure on other factors of interest, especially accounting factors, or a time gap of 16 months between the cost structure proxy of year t and the returns of year t+1. Thus, this dissertation defines the relevant time period in dependence on reporting practices of listed companies. Further, it is differentiated between proxies based on observations from multiple points in time and proxies that refer to one specific point in time. This differentiation takes the market's ability to absorb new information into account.

3.2.3. Relation to Breakeven Point

To explain the drivers of the operating leverage and its relation to the breakeven point, the parameter fixed costs in formula (1) is replaced according to the definition of the breakeven point.

(2a) $$Q_{BEP} = \frac{FC}{p - v}$$

(2b) $$FC = Q_{BEP} \times (p - v)$$

Q_{BEP} is the quantity of products a company must sell to cover all operating costs. It is the breakeven quantity. Replacing FC in formula (1) with the previous computation of FC according to formula (2b) and in accordance with the explanations of Kelly and Sussman (1966) gives:

(3) $$\begin{aligned} \text{Operating leverage} &= \frac{Q \times (p - v)}{Q \times (p - v) - Q_{BEP} \times (p - v)} \\ &= \frac{Q \times (p - v)}{(Q - Q_{BEP}) \times (p - v)} \\ &= \frac{Q}{Q - Q_{BEP}} \end{aligned}$$

Formula (3) explains that the operating leverage is a function of the quantity of products sold and the breakeven point. This finding is confirmed by McDaniel (1984). The distance between the actual quantity sold and the breakeven quantity determines a company's operating leverage. A large distance between the actual production level and the breakeven point increases the denominator and thus reduces the operating leverage. The contribution margin is omitted in formula (3). The removal of the contribution margin may explain why some academics emphasize the relevance of fixed costs regarding the definition of the operating leverage. But, formula (2a) explains that the breakeven point is a function of fixed costs and the difference between price and variable costs, which is equal to the contribution margin.

Further to the findings of Kelly and Sussman (1966), the formula (3) shows that companies producing at the breakeven point, i.e. Q equals Q_{BEP}, have an indefinable operating leverage because the denominator is 0. Additionally, companies with sales volumes that are insufficient to breakeven have a negative operating leverage. Applying the approach of McDaniel (1984), the relations between operating leverage, breakeven point and units sold are explained with a simplified example.

The sample is based on two companies (Company A and Company B) with different cost structures. These two one-product companies are active in the same industry and produce with linear cost functions[13]. The shape of the cost function of a company is determined by its underlying production function. The production function describes the process of transforming input factors into a product. Adding input prices to the production function leads to the cost function (Samuelson & Marks, 2010). A linear cost function means that production costs consist of fixed costs that are independent of the units produced, and variable costs that change proportionally to the number of units produced. Fixed costs arise even when no output is produced. The example assumes that variable costs increase/decrease proportionally to units produced. Therefore, only the variable costs drive the total and marginal costs. The total production costs per unit decrease constantly towards the level of marginal costs because with rising output the fixed costs lose weight in average costs. According to Brickley, Smith, and Zimmerman (2004), average total costs and marginal costs are normally u-shaped and intersect when total costs turn convex. In the example, the assumption is that total costs rise constantly with variable costs and that both companies have constant marginal costs per unit. This is necessary in order to explain the characteristics of the operating leverage. Formula (1) shows that the price of units sold is a parameter influencing the operating leverage. The example assumes competitive markets and therefore equal prices for both companies.

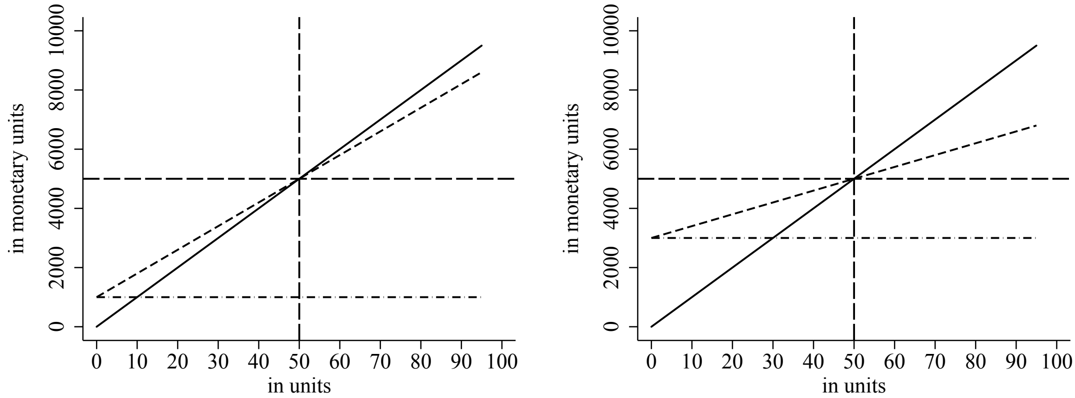
Company A and Company B reveal completely different cost structures. Company A has fixed costs of 1000, variable costs per unit of 80 and sells its products at a price of 100. In contrast, Company B shows fixed costs of 3000, variable costs per unit of 40 and a selling price of 100. The example differentiates between three underlying situations for each company. Table 4 summarizes the cost structures under the different situations.

	Company A			Company B		
Situation	1	2	3	1	2	3
Price per unit	100	100	100	100	100	100
V per unit	80	76	70	40	20	50
FC	1000	1200	1200	3000	4000	4000
BEP	50	50	40	50	50	80

Table 4: Cost structures of the two companies
Table 4 describes the cost structures of Company A and Company B. The cost structures differ according to the three situations 1, 2 and 3. The cost structure of Company A improves constantly from situation 1 to 3. Conversely, the cost structure of Company B significantly worsens from situation 2 to 3. Prices are stable because of competitive markets. In situations 1 and 2 the companies have equal breakeven points.

The graphs in figure 2 display the cost structures of the two companies, plotting sales, fixed costs and total costs in monetary units.

[13] The purpose of the example is to explain the characteristics of the operating leverage. Of interest are the interrelations between the operating leverage, variable and fixed costs as well as the breakeven point. This example simplifies the reality. Thus, Company A and B produce and sell only one product, exhibit linear cost functions and their cost functions do not change over time. These assumptions are common to breakeven analysis, too.

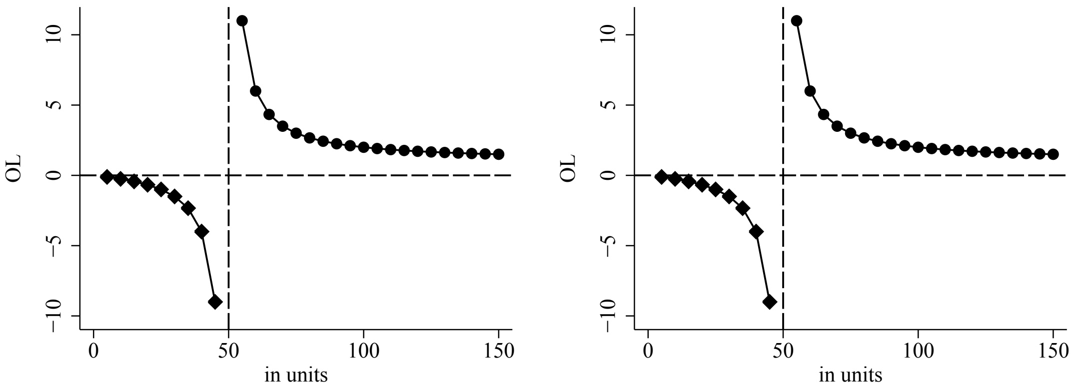


(a) Cost structure of Company A **(b)** Cost structure of Company B

Figure 2: Cost structures of Companies A and B
The graphs show the fixed costs (horizontal, dot-dash line), total costs (dashed line) and sales (solid line) of Company A and B in situation 1. The vertical long dashed lines indicate the breakeven points. The horizontal long dashed lines show the sales volumes at breakeven points.

Compared to Company B, Company A has much lower fixed costs. The opposite is true regarding the variable costs. Company A has only 20 per unit remaining to cover fixed costs, whereas Company B operates with a comfortable margin of 60 per unit. Although the two companies have completely different cost structures, they exhibit a significant commonality with regard to the operating leverage: Interestingly, both companies have exactly the same breakeven point. The vertical long dashed lines in the graphs in figure 2 show that in order to avoid losses, both companies have to sell at least 50 units. Inserting the parameters for Company A and Company B in formula (2a) confirms equal breakeven points of 50 units; Company A: $\frac{1000}{100-80}$ and Company B: $\frac{3000}{100-40}$.

Because of these differences in cost structure, one would expect different operating leverages. Company B operates with much higher fixed costs. So, it seems reasonable to expect a higher exposure of Company B to the operating leverage. However, formula (3) shows that the operating leverage is a function of the quantity sold and the breakeven point. Because both companies sell equal amounts of products and have the same breakeven points, they also reveal equal operating leverages. Further, the formula (3) explains that if the amount of units sold is less than the breakeven point, the operating leverage becomes negative. Therefore, to describe the dependence of the operating leverage on units sold, the graphs in figure 3 differ between negative and positive operating leverage. Formula (3) is used to compute the two leverages. The vertical lines again indicate the breakeven points of 50 units.



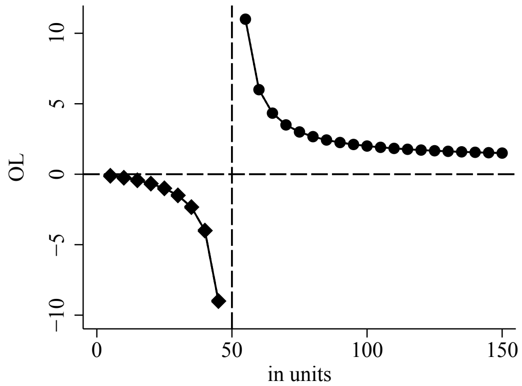
(a) OL of Company A in situation 1 **(b)** OL of Company B in situation 1

Figure 3: OL of companies A and B
The graphs show the shapes and levels of the operating leverages in dependence on the quantity of products sold for Company A and B in situation 1. The vertical long dashed lines indicate the breakeven points.

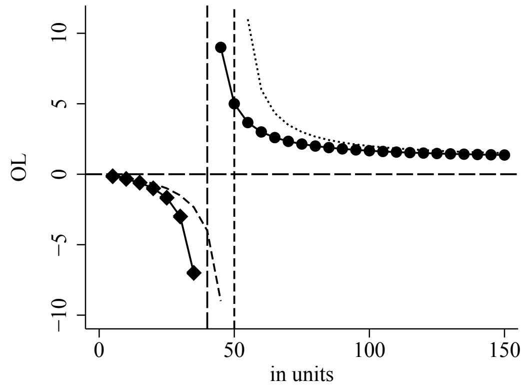
The two graphs in figure 3 show that the operating leverages of both companies have equal shapes and levels. Thus, irrespective of the proportion of fixed to variable costs, companies have equal operating leverages if their breakeven points are the same. Kelly and Sussman (1966) as well as McDaniel (1984) explain this insight. The operating leverage is not only a function of fixed costs. The operating leverage varies with fixed costs through the breakeven point (McDaniel, 1984). Further, approaching the breakeven point, the operating leverage steers towards positive or negative infinity, depending on the direction it originated from. With increasing distance to the breakeven point, the operating leverage decreases.

A company's cost function is not static. Rather it changes continuously due to market dynamics. Lord (1995) describes the effects of changes in variables influencing the operating leverage. His descriptions follow mathematical derivatives of formula (1) with respect to the four variables. When sales and prices increase, the operating leverage decreases. The opposite is true for rising fixed and variable costs. However, according to Lord (1995) the rate of substitution of fixed and variable costs determines whether the operating leverage increases with changes in the proportion of fixed to variable costs. Three outcomes are possible: The operating leverage may increase, decrease or remain constant. This means that an increase in fixed costs does not automatically cause an increase in the operating leverage. The impact of changes in the proportion of variable to fixed costs on the operating leverage is shown below with reference to the example.

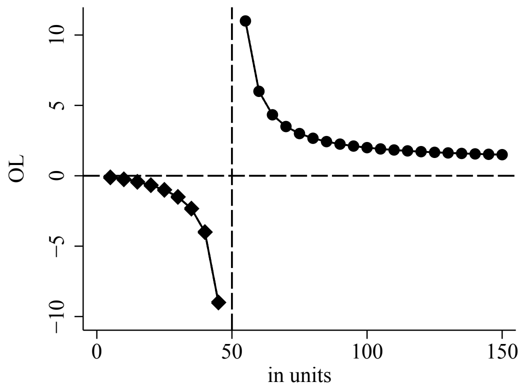
In situation 2, Company A adapts its cost function with an increase in fixed costs and a decrease in variable costs. For example, assume that the company invests in fixed assets and thereby reduces its variable costs, for instance through a higher degree of automation in the production process. The fixed costs of Company A increase 20%, the variable costs decrease only 5%. In situation 2, the fixed costs of Company B increase 1/3 and the variable costs halve to 20. In situation 3, Company A is able to reduce its variable costs and substantially improve productivity. The opposite is true for Company B. Its variable costs increase to 50. The graphs in figure 4 reveal the impact of these changes in the cost structures on the operating leverage.



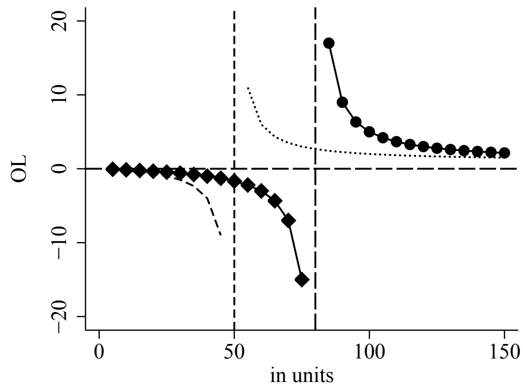
(a) OL of Company A in situation 2



(b) OL of Company A in situation 3



(c) OL of Company B in situation 2



(d) OL of Company B in situation 3

Figure 4: OL of companies A and B in situations 2 and 3
The graphs show the developments of the operating leverages in dependence on the quantity of products sold for Company A and Company B in situations 2 and 3. The vertical dashed lines indicate the breakeven points. The shorter dashed lines in graphs 4b and 4d indicate the conditions of the original situation 2.

The graphs in figure 4 reveal that the operating leverage remains constant for both companies in situation 2. According to formula (2a) the operating leverage is a function of the breakeven point. Because the breakeven points for both companies do not change, their operating leverages stay the same. In situation 3, the operating leverages change according to changes in the breakeven points. The reduction in the breakeven point for Company A shifts the operating leverage to the left. The operating leverage of Company B shifts to the right, because of an increase in the breakeven point to 80 units. A decrease (increase) in the breakeven point shifts the operating leverage to the left (right). So, a shift to the left (right) means that compared to the previous situation, the operating leverage is smaller (larger) at each number of units produced. Consequently, a reduction (an increase) in the breakeven point diminishes (augments) the riskiness of a company.

Even though these two changes are based on a fictitious example, the possibility of a constant, increasing or decreasing operating leverage arising due to changes in cost structure is realistic. The substitution of fixed and variable costs is explained in reference to the breakeven point formula (2a). At the breakeven point total revenues cover all costs.

$$Q_{BEP} \times (p - v) - FC = 0 \tag{4}$$

Under the assumption of competitive markets, companies have no pricing power. If two cost structures have the same breakeven point, the following condition is true:

$$Q_{BEP} \times v_1 + FC_1 = Q_{BEP} \times v_2 + FC_2 \tag{5}$$

Solving formula (5) for the breakeven point gives:

$$Q_{\mathrm{BEP}} \times (v_1 - v_2) = FC_2 - FC_1 \tag{6a}$$

$$Q_{\mathrm{BEP}} = \frac{FC_2 - FC_1}{v_1 - v_2} \tag{6b}$$

An increase in fixed costs has to correspond with a decrease in variable costs in order to keep the breakeven point constant. For instance, applying formula (6b) to Company A under situation 2 gives an increase in fixed costs of 200 and a corresponding reduction in variable costs of 4. Therefore, the breakeven point remains at 50 units.

The example shows that when analyzing the operating leverage of two companies, considering the breakeven point is very helpful. The company with the lower breakeven point also exhibits a lower operating leverage. However, the relation between variable and fixed costs may differ. Further, Lord (1998) explains that companies producing below breakeven point reveal a negative operating leverage. Conversely, if the company produces beyond the breakeven point, the operating leverage is larger than 1.

3.2.4. Controllable Factors

Hodgin and Kiymaz (2005) argue that changes in one parameter of formula (1) affect the remaining parameters, too. They suggest differentiating between management decisions, changes due to market forces and engineering-based limits. According to Hodgin and Kiymaz (2005), managers can only control or influence the output and the level of fixed costs. In competitive markets, the price of products is determined by the market participants and is therefore beyond the influence of managers. The impact of changes in fixed costs on total production costs is dependent on the engineering relationship between fixed and variable costs. Before deciding to adjust the amount of fixed costs, managers need to consider how variable costs change (Hodgin & Kiymaz, 2005).

Hodgin and Kiymaz (2005) explain these insights with rewriting formula (1) in monetary units.

$$\text{Operating leverage} = \frac{Q \times (p - v)}{Q \times (p - v) - FC} = \frac{TR - TV}{TR - TV - FC} \tag{7}$$

TR is total return, TV is total variable costs and FC stands for total fixed costs. Next, Hodgin and Kiymaz (2005) define a simplified income statement, which they solve for the contribution margin:

$$TR - TV - FC = Profit \tag{8a}$$

$$TR - TV = Profit + FC \tag{8b}$$

Substitution the contribution margin with the new definition according to formula (8b) into formula (7) gives:

$$\text{Operating leverage} = \frac{Profit + FC}{Profit + FC - FC} = \frac{Profit + FC}{Profit} = 1 + \frac{FC}{Profit} \tag{9}$$

Profit in formulas (8a), (8b), and (9) equals operating income and excludes the financial results and special items. This definition of operating leverage shows that if managers want to control this parameter, they have to focus on the amount of fixed costs. The amount of fixed costs is the numerator in formula (9). The second factor under manager control is the level of output. This parameter is indirectly captured by the denominator in formula (9).

Formula (9) explains that without fixed costs, there is no operating leverage because the second term of the formula is 0. Therefore, companies producing without fixed costs have an operating leverage of 1. This means that such firms are not able to magnify operating income by increasing the sales volume. O'Brien and Vanderheiden (1987) mention that an appropriate proxy for the operating leverage is larger than 1 if the company produces beyond breakeven point. This is one of the few conditions to test the appropriateness of a proxy focusing on the elasticity aspect of the operating leverage. To keep the operating leverage at the same level, an increase in fixed costs may not outweigh the increase in operating income. Operating profit may increase because variable costs decrease. This relation is dependent on the engineering relationship between fixed and variable costs.

3.2.5. Elasticity Aspect

In empirical investigations the operating leverage is not calculated according to point estimates[14]. This is because companies do not produce their income statements according to direct costing, but absorption costing, which does not report the relation of variable to fixed costs, see section 3.1. However, the following equation is often used as an approximation of operating leverage, for instance in Ferri and Jones (1979), Gahlon and Gentry (1982) or McDaniel (1984)).

$$\text{Degree of operating leverage} = \frac{\Delta Profit}{\Delta TR} \tag{10}$$

Both variables in formula (10) are in percentage change. Formula (10) demonstrates why the degree of operating leverage is an elasticity measure; namely, it measures the variations in operating income according to changes in sales. This type of computation is called a point-to-point estimate (Lord, 1995). Following the approach of Hodgin and Kiymaz (2005), the relation between formula (10) and formula (1) can be explained as follows. The first step is to rewrite formula (10).

$$\text{Degree of operating leverage} = \frac{\frac{\Delta Q \times p - \Delta Q \times v - \Delta FC}{Q \times p - Q \times v - FC}}{\frac{\Delta Q \times p}{Q \times p}} \tag{11}$$

Formula (11) replaces the parameters of formula (10) with a simplified income statement like formula (8a). Because fixed costs do not vary with changes in output, the change in fixed costs is 0 and ceases to apply. Rearranging the formula again gives:

$$\begin{aligned} \text{Operating leverage} &= \frac{\frac{\Delta Q \times (p-v)}{Q \times (p-v) - FC}}{\frac{\Delta Q \times p}{Q \times p}} \\ &= \frac{\Delta Q \times (p-v) \times Q \times p}{(Q \times (p-v) - FC) \times \Delta Q \times p} \\ &= \frac{Q \times (p-v)}{Q \times (p-v) - FC} \end{aligned} \tag{12}$$

The result of these rearrangements is formula (1). Therefore, this derivation by Hodgin and Kiymaz (2005) explains the relation between formula (1) and formula (10) and is relevant because it proves that the proxy used in empirical investigations directly relates to the textbook definition of operating leverage. The main difference between the operating leverage (formula (1)) and the degree of operating leverage (formula (10)) is a time gap of 1. Thus, the degree of operating leverage equals the operating leverage of the previous year.

[14] Formulas (1), (7), and (9) are called point estimates because their input variables refer to one specific point in time or time period.

However, Lord (1995) mentions some weaknesses of formula (10). Because formula (10) follows a point-to-point estimate, its results may differ from calculations according to formula (1). The problem is that not all variables from formula (1) are known. This makes it difficult to differentiate between changes in prices and units produced in formula (10). Further, Lord (1995) shows that with increasing distance to the breakeven point, small changes in output may result in an operating leverage of less than 1. These flaws of point-to-point estimates have to be considered when using such approaches in empirical investigations. The following section 3.3 therefore discusses and compares different approximation methods.

The measurement distortions have one common root: The price of the product and number of units sold are unknown. Beyond this aspect, which has to be accepted in empirical investigations, this section explains the link between the cost and elasticity aspect of the operating leverage. The prove of a theoretical connection between these two aspects is relevant because it provides a reason for the focus on the cost-side in the development of the own approximation. The argument of Hodgin and Kiymaz (2005) is relevant in this context too. Further, the influence of the breakeven point has to be considered in testing the relation between the cost structure rigidity and operating leverage proxies. The convex shape of the operating leverage, see the graphs in figure 3 on page 36, indicates that high operating leverage means also higher likelihood of negative operating income. With rising distance to breakeven point, the operating leverage decreases and losses its impact on changes in operating income. This is important form a risk perspective; the first and second research questions refer to these considerations.

3.3. Proxies of Operating Leverage

To gather a comprehensive collection of different proxies of the operating leverage, the analysis of accounting and finance journals is necessary. Due to the nature of such literature, the contexts discussed differ. While some papers focus on characteristics of the operating leverage, others emphasize aspects of risk by explaining, for example, the relation between the operating leverage and the systematic risk. A few papers compare the financial and operating leverage and explain the interrelations. The table 85 on page 190 summarizes the discussed research papers, the considered contexts, and the focus of the approximations. Because various research fields are considered, the collection includes a considerable number of proxies. Further, the variety of contexts covered means that the proxies have to fulfill various theoretical and/or practical requirements. Thus, the operating leverage is presented from different perspectives and therefore, no single theory dominates the proxies considered.

The proxies are assigned to groups, which are discussed in separate subsections. The groups differ according to the computation method. Comparing formula (1) and formula (10), for example, illustrates that either the input variables refer to one point in time or the variables measure changes of certain parameters. In the latter, the proxy consists of input variables from at least two different points in time. Further, in some papers the proxies are calculated using time-series regressions. In time-series regressions the parameters utilized are measured at many points in time. Thus, there are three groups: point estimates, point-to-point estimates and time-series estimates. Grouping the proxies according to the computation approach, while convenient, neglects one crucial aspect of the operating leverage: Although the operating leverage is a sensitivity measure, few papers try to approximate the relation of fixed to variable costs. Therefore, in addition to the focus on the sensitivity aspect, sometimes the approximation of the cost structure is the actual goal. In the following discussions, the context and the purpose of the papers are described when necessary.

3.3.1. Point Estimates

Point estimates use variables based on only one point in time. Therefore, they have the advantage that they can be measured on a quarterly or yearly basis and tracking changes in the proxies is simple. The textbook formula, see formula (1) on page 32, to measure the operating leverage is a point estimate. Kelly and Sussman (1966), Gahlon (1981), Prezas (1987), Dran (1991), Lord (1995), Lord (1998), Howard (2000), and Hodgin and Kiymaz (2005) all use this formula. Most of these papers investigate the characteristics of the operating leverage, especially its drivers, for example in Kelly and Sussman (1966), Dran (1991), and Howard (2000). Notably, however, none of these papers includes an empirical investigation. The reason is that to compute the operating leverage according to the textbook formula, the relation of fixed to variable costs or the breakeven point must be known. Because companies do not report this information, researchers need proxies. Further, the formula considers the elasticity as well as the cost structure aspect of the operating leverage[15].

Rubinstein (1973) approximates the operating leverage using the contribution margin. This proxy is the result of his explanation of the operating risk, and is not utilized in other research papers. Compared to the textbook formula, using the contribution margin alone as a proxy seems insufficient since it neglects the fixed costs. A further example of a point estimate of the operating leverage is the ratio of fixed assets to total assets, which is mentioned by Ferri and Jones (1979), O'Brien and Vanderheiden (1987) and Dugan and Shriver (1989). Although Ferri and Jones (1979) describe this proxy as flawed, they use it as a comparative rule. O'Brien and Vanderheiden (1987) explain that the proxy assumes that a high ratio of fixed assets causes fixed costs. First, accounting rules stipulate steady depreciation of fixed assets at a fixed rate. Second, long-term contracts with suppliers cause fixed costs, too. However, O'Brien and Vanderheiden (1987) claim that the inverse

[15] See section 3.2.5 and formula (12) and page 40 for the derivation.

of the asset turnover ratio – total assets to expected sales – is a better proxy for measuring the capital-intensiveness of a production process. In regard to depreciation, O'Brien and Vanderheiden (1987) further suggest two other proxies: the ratio of depreciation to total assets and the ratio of depreciation to sales. According to O'Brien and Vanderheiden (1987), depreciation may relate to the operating leverage because it captures the capital-intensiveness of a company, i.e. measure the lifetime of the fixed assets. However, these depreciation proxies are not utilized in empirical investigations. Depreciation is not cash-sensitive. For this reason, it is questionable if such a variable is relevant under risk considerations.

Other researchers focus on cost categories in relation to sales, too. Gourio (2004) uses the ratio of operating costs to sales as a proxy for the operating leverage. Novy-Marx (2011) uses production costs as the numerator and total assets as the denominator. Brimble and Hodgson (2007), in contrast, work with the ratio of EBIT to sales, i.e. profit margin. They refer to Penman (2004) who splits the systematic risk of a company into various components. One of these, the operating risk, is mainly driven by the profit margin risk, which is comprised of the the operating leverage and expense risk. Ferri and Jones (1979) as well as Garcia-Feijoo and Jorgensen (2010), on the other hand, compute the five-year average of the ratio of fixed assets to total assets in order to smooth the effect of large deviations from average ratios.

This overview shows that a broad variety of proxies are possible and these vary according to the input variables. Because some proxies use cost factors and others income variables, the focus of the proxies varies, too. All the proxies are, however, subject to criticism. Using depreciation as input variable, for example, has to be questioned. First, depreciation is manipulable. Second, depreciation is not cash-sensitive. This aspect is important from a risk perspective. A further area of concern is whether using the margin as a proxy for the operating leverage really measures what it is supposed to measure. Margin is a profitability measure. Thus, such a proxy measures the profitability and not the sensitivity of earnings. For their part, Ferri and Jones (1979) and Garcia-Feijoo and Jorgensen (2010) show that for some proxies it is useful to compute moving averages to reduce the impact of one single observation. Interestingly, the approximation of the operating leverage according to formula (24) on page 78 is not applied in the considered research papers, despite it being both practicable and easily measurable[16].

3.3.2. Point-to-Point Estimates

The second group of proxies is called point-to-point estimates. The input factors of a point-to-point estimate refer to two points in time, and often reflect changes in accounting variables within a certain time period. In many papers, the ratio of change in operating

[16]Subsection 4.5.2 explains the assumptions of COGS being variable and SGA fixed. Formula (24) on page 78 bases on this assumption.

income and sales is utilized as a proxy for the operating leverage, for example Ferri and Jones (1979), Gahlon and Gentry (1982), Mandelker and Rhee (1984), McDaniel (1984), Chung (1989), Lord (1995), Howard (2000). Subsection 3.2.5 explains the theoretical link between this proxy and the textbook formula. The existence of a theoretical link supports the choice of this proxy – a point-to-point estimate that consists of easily observable variables – for use in empirical investigations. Moreover, because the input variables are available on a quarterly or yearly basis, this proxy enables changes in the elasticity of earnings to be tracked. For these reasons, it is often used in empirical investigations. However, Lord (1995) explains that point-to-point estimates are flawed compared to point estimates. This is because variables such as the price or the quantity of products sold influence the operating leverage, but are neither known to the public nor stable over time. Therefore, point-to-point estimates according to formula (10) may produce operating leverages that differ from the textbook computation. Further, even when a company is producing beyond the breakeven point, very small changes in units produced could lead to an operating leverage smaller than 1. This implies that variable costs are larger than the price per unit sold. Lord (1995) states: "Notice that very small changes in unit output create relatively large changes in EBIT as they are leveraged in the numerator, since they are multiplied by the operating margin" (p. 325). This effect is even stronger for companies operating near the breakeven point[17]. In empirical investigations using listed companies, many variables that Lord (1995) uses for his calculations are not available. Further, these variables are not stable. For empirical investigations, only the operating income and sales are available. Moreover, it is conceivable that cases can arise where the direction of changes in operating income and sales are incongruent with the logic of the operating leverage. Consider, for example, that sales increase while the operating income decreases. This results in a negative operating leverage, although the company is producing beyond the breakeven point. In the opposite case, sales decrease while operating income increases, the operating leverage is also negative. But again, the company is producing beyond the breakeven point. These two situations may arise for reasons beyond operating leverage considerations; for instance changes in accounting practices. To alleviate the discussed flaws, building moving averages of changes in operating income and sales is a practical solution, see for instance Gulen et al. (2008). This proxy has a clear focus on the elasticity of operating income regarding changes in sales.

Only Lev and Thiagarajan (1993) use other point-to-point estimates. They compute the difference between changes in the gross margin and changes in sales. They argue that a disproportionate difference in these is a negative sign because the gross margin should vary in line with changes in sales. They assume that COGS reflect variable costs (Lev & Thiagarajan, 1993). Regarding fixed costs, they compare annual changes in SGA with

[17] In subsection 3.2.3, the relation between the operating leverage and the breakeven point is described. The sensitivity of changes in the operating leverage is highest near the breakeven point.

changes in sales. They assume SGA represent fixed costs (Lev & Thiagarajan, 1993).

To conclude, the elasticity proxy is very often used in empirical investigations. Utilizing moving averages of the changes is a practical way to mitigate some of the discussed flaws. Only Lev and Thiagarajan (1993) create a proxy that focuses on the cost structure.

3.3.3. Time-series Estimates

The third group of proxies is called time-series estimates. The primary computation method is regression analysis. Regressions require several observations of the input variables at different points in time. The first researcher to apply this approach was Lev (1974). Using the following regression, he approximates the flexibility of a cost structure.

$$TC_{j,t} = a_j + \beta_j Q_{j,t} + \epsilon_{j,t} \tag{13}$$

TC is total operating costs. Q is the quantity of products sold. Thus, formula (13) regresses operating costs on the quantity of units sold. Lev (1974) conducts this regression using panel data. This allows an approximation of the cost structure properties for each firm. The regression coefficient β_j indicates the sensitivity of variable costs in respect of Q. Because the quantity of products sold is not available, Lev (1974) utilizes a company's revenue as right-hand-side variable. Lev (1974) states: "Such an estimation procedure implicitly assumes that no substantial changes in the production process (i.e. the fixed-variable cost mix) have taken place during the period over which the regression was run" (p. 634). To test the stationarity of the cost structure approximation, Lev (1974) runs the regressions for different time intervals. He cannot confirm stationarity. Another flaw of this approach is that Lev (1974) uses absolute values instead of logarithms of the absolute values. Petersen (2009) explains the advantages of using logarithms in regressions.

A similar approach is applied by Mandelker and Rhee (1984). This approach has been examined many times. Instead of testing the relation between sales and total operating costs, Mandelker and Rhee (1984) utilize the operating income as dependent variable.

$$lnEBIT_{j,t} = a_j + \beta lnSales_{j,t} + \epsilon_{j,t} \tag{14}$$

$lnEBIT$ is the logarithm of EBIT and $lnSales$ the logarithm of sales. Formula (14) regresses EBIT on sales. Thus, it measures the sensitivity of EBIT in respect of sales. The regression coefficient β is the proxy for the degree of operating leverage. Mandelker and Rhee (1984) test for the assumption of stationarity of this elasticity proxy, and cannot confirm stationarity across the ten-year time periods considered. They apply a portfolio grouping approach when testing the relation between the operating leverage and systematic risk. The approach of Mandelker and Rhee (1984) is used by Dugan and Shriver (1989), Dugan and Shriver (1992), Huffman (1989), Lord (1998), and Ho et al. (2004). Darrat and Mukherjee (1995), in contrast, utilize changes in operating income and sales as input variables instead of absolute values or the logarithms of the absolute values.

The procedure of Mandelker and Rhee (1984) to approximate the operating leverage is further developed by O'Brien and Vanderheiden (1987). O'Brien and Vanderheiden (1987) claim that the technique of Mandelker and Rhee (1984) does not consider the trend of the two variables with the result that the coefficients cluster around 1. To control for the common trend, O'Brien and Vanderheiden (1987) suggest the following two step approach.

$$lnEBIT_{j,t} = \beta_1 lnEBIT_{j,0} + \beta_2 \Delta EBIT_{j,t} + \epsilon_{j,t}^{EBIT} \tag{15}$$

$$lnSales_{j,t} = \beta_1 lnSales_{j,0} + \beta_2 \Delta Sales_{j,t} + \epsilon_{j,t}^{Sales} \tag{16}$$

$LnEBIT$ is again the logarithm of EBIT, $lnSales$ the logarithm of sales. $lnEBIT_{j,0}$ is the first EBIT available for a company. $lnSales_{j,0}$ is the first observation of sales available for a company. These two variables do not vary. $\Delta EBIT$ measures changes in EBIT, $\Delta Sales$ changes in sales. So, both regressions measure variations in EBIT and variations in sales on both the trend of each variable and the first observations available. The residuals, $\epsilon_{j,t}^{EBIT}$ and $\epsilon_{j,t}^{Sales}$, measure the part of the variations in the dependent variables not explained by the right-hand-side variables. These unexplained variations capture effects beyond the common growth trend of the left- and right-hand-side variables. These two resulting variables are utilized in the following final regression:

$$\epsilon_{j,t}^{EBIT} = \beta \epsilon_{j,t}^{Sales} + \epsilon_{j,t} \tag{17}$$

Formula (17) regresses the residuals of formula (15) on residuals of formula (16). The coefficient of the regression β : ". . . measures the average sensitivity of (i) the percentage deviation of operating earnings from its trend, relative to (ii) the percentage deviation of sales from its trend" (O'Brien & Vanderheiden, 1987, p. 47). Dugan and Shriver (1992), Lord (1998) and Garcia-Feijoo and Jorgensen (2010) also apply this technique.

Lord (1998) critically appraises the approach used by Mandelker and Rhee (1984) and O'Brien and Vanderheiden (1987). Similar to Lord (1995), Lord (1998) tests the sensitivity of the two approaches regarding changes in prices and output volume. He applies the criterion that according to formula (9) the operating leverage is larger than 1 if a company produces beyond the breakeven point. His results show that under the Mandelker and Rhee (1984) technique, the coefficients exhibit values below 1 when small changes in units sold and large price changes occur. This effect is amplified when the company is producing at a large distance to breakeven point. The same analysis of the O'Brien and Vanderheiden (1987) approach exhibits equal results with more volatile coefficients. Lord (1998) uses moving time periods to conduct the regressions. Similarly, the regressions of Garcia-Feijoo and Jorgensen (2010) use moving time periods of 5 years. They report a mean operating leverage of around 4 with a standard deviation of 7. The mean operating leverage of the lowest 5% of coefficients is 0.11; less than 1, but above 0.

Another proxy based on time-series estimates is the coefficient of variation. Dugan and Shriver (1989) measure the coefficient of variation of EBIT, while Petersen (1994) uses the variation of cash flows as a proxy for the operating leverage. The coefficient of variation is the ratio of the standard deviation to the mean and is therefore based on observations from several points in time. This explains why this approach also belongs to the group of time-series estimates. However, the volatility of earnings or cash flows is not a direct proxy of the operating leverage. These reflect the impact of the operating leverage on earnings and cash flows[18].

The last approach in this group is developed by Kahl et al. (2011). Like Lev (1974), and contrary to all other researchers within this group, they shift their focus from the elasticity aspect to the cost aspect of the operating leverage. Their goal is to measure ex-ante expectations of a company's cost structure. Based on the geometric growth rates of operating costs as well as sales, they compute the expected values of the two parameters for the next year. They use the differences between the expected and actual values in percent of the last year of observations as variables in the time-series regression. A high coefficient indicates high variable costs and low fixed costs. Because this proxy is still prone to illogical values (for example, a negative coefficient does not make sense) Kahl et al. (2011) use distributional rankings in addition to actual values for their further investigations.

The ambiguity of the operating leverage can be recognized in the broad variety of proxies, computation methods and input factors. Some proxies consider only a few features of the operating leverage, others are closely related to the textbook formula and have a solid theoretical basis. In summary, in empirical investigations times series estimates are often utilized. In particular, the approaches developed by Mandelker and Rhee (1984) and O'Brien and Vanderheiden (1987) are frequently applied in empirical investigations. However, the reflections of Lord (1998) are important and must be considered to correctly interpret the operating leverage. Lev (1974) as well as Kahl et al. (2011) show that time-series regressions provide the possibility to estimate characteristics of a cost structure. However, only moving time windows allow changes in the proxies to be tracked. The own proxies developed are inspired by Lev (1974) as well as Kahl et al. (2011). To capture the ambiguity of the operating leverage three proxies are used in the empirical investigations. They vary according to their focus and the underlying assumptions.

[18] Chapter 6 analyzes the relation between the characteristics of a company's cost structure and the volatility of earnings. The close relation shows that the cost structure has an influence on the volatility of earnings.

3.4. Perspective of the Capital Market

The way capital market participants think about risk is influenced by the portfolio theory of Markowitz (1952). Based on Markowitz's mean-variance approach, Sharpe (1964) and Lintner (1965) established the CAPM. This model explains the expected return of a company, which is a linear function of beta. Thus, if the operating leverage influences the riskiness of a company, there should be a relation to beta. Such a relation can be based on theoretical considerations or empirical investigations that verify the connection; subsection 3.4.1 thus explains the interrelations between the cost structure and beta. At the same time, the operating leverage also impacts on other accounting characteristics. In this regard, some academics explain that the volatility of earnings is related to the systematic risk of a company; this topic is discussed in subsection 3.4.2.

3.4.1. CAPM Decomposition

According to Spremann (2004), the CAPM serves as model to derive the expected return of a single company from the return of the market portfolio. In this regard, the volatility of the market return and the return of the company must be considered. These aspects go back to the mean-variance approach of Markowitz (1952), in which volatility and return are closely related. From a portfolio optimization perspective, shareholders cannot expect to be compensated for bearing company specific risks. Such risks can – and will – be diversified by rational and risk-averse investors. The company-specific portion of risk is also called unsystematic risk. Thus, shareholders earn return for bearing risks that cannot be eliminated by diversification. The total risk of a company is its standard deviation of return.

CAPM explains the expected return in respect of the systematic risk of the company. There is a linear relation between the expected return and this systematic risk. This linear relationship is testable and makes the CAPM intuitively comprehensible. According to Fama and French (2004), formula (18) expresses the CAPM.

$$E(R_j) = r_{risk-free} + [E(R_M) - r_{risk-free}]\beta_{j,M} \tag{18}$$

$E(R_j)$ is the expected return of security j, $r_{risk-free}$ is the risk-free rate. $E(R_M) - r_{risk-free}$ measures the performance difference between the market portfolio and the risk-free rate; namely, the risk premium. Formula (18) shows that the expected return of security j is the risk-free rate plus the risk premium times the security's beta. $\beta_{j,M}$ is the covariance of security j and the market portfolio. According to Fama and French (2004), formula (19) explains how beta is calculated.

$$\beta_{j,M} = \frac{cov(r_j, r_M)}{\sigma^2(r_M)} \tag{19}$$

Beta is the relative systematic risk of security j. The return of shareholders is dependent on the correlation of security j and the market portfolio. The additional risk of adding security j to the market portfolio is a function of its covariance with the market portfolio. If security j is highly correlated with the market portfolio, the systematic risk is large and beta is above 1. This dependence on the market portfolio cannot be diversified. A security with beta of 1 earns exactly the market return. Zero beta means that the expected return equals the risk-free rate.

Of interest for this dissertation is also the unlevered beta. Because the operating leverage excludes financial considerations, the unlevered beta is the better comparative rule than beta. The unlevered beta is calculated according to the following equation and without considering taxes. It follows the description of Damodaran (2005).

$$\beta_{ul} = \frac{\beta}{1 + \text{Financial Leverage}} \tag{20}$$

The linear relationship between the systematic risk and expected return expressed in formula (18) is often applied in empirical investigations. However, Roll (1977) notes that testing the CAPM requires complete knowledge of the market portfolio. If empirical assessments confirm the linear relation, this could be the result of an inadequate proxy for the market portfolio. Conversely, if empirical tests reject the CAPM, this could be the result of choosing the wrong proxy for the market portfolio, too. Therefore, because the real market portfolio – consisting of all relevant securities – is unknown, testing the CAPM is hardly possible.

The use and validity of the CAPM are often discussed in research papers. The empirical findings vary to a large degree. For example, Low and Nayak (2009) apply different proxies of the market portfolio to the regressions of Fama and MacBeth (1973) to test the critique of Roll (1977). They conclude that it is unlikely that the choice of market portfolio influences the t-stats of Fama and MacBeth (1973) regressions. The number of stocks in the sample is more important regarding the regression outputs. As a result, the rejection of the CAPM does not even need the caveat of the influence of the choice of market portfolio on the results. Iqbal and Brooks (2007) test the CAPM for stocks listed on the Karachi Stock Exchange. In cross-sectional regressions on a firm-level to explain stock returns, betas computed using weekly data produced more positive coefficients than betas computed using other frequencies. Iqbal and Brooks (2007) interpret this as an indication of the market having matured enough to reward investors for bearing systematic risk. Another research paper confirming CAPM is conducted by Gunnlaugsson (2006). The sample consists of stocks listed on the Icelandic stock market. The sample is small, consisting of only 27 companies with data available for a time period of five years. Similar results are found by Gökgöz (2007) for his sample of companies listed on the Istanbul Stock Exchange. So, even though there is significant evidence against the validity of CAPM, academics still actively test this model. In a comprehensive literature review, Houda and Bouri (2010) conclude that the validity of CAPM remains questionable. Chen and James (2002) argue in a similar vein; namely, because there is no other equally well accepted model to estimate expected returns, CAPM is still frequently tested in different contexts. For instance, Dolde, Giaccotto, Dev, and O'Brien (2011) test the difference between a local and global CAPM for stocks with high and low foreign exchange exposure. Even though they find a difference between the two models, the economic impact of this is low (Dolde et al., 2011). Fama and French (2004) explain several flaws found in empirical investigations. They explain that the relation between beta and expected return is too flat. Further, there are other factors superior to beta in explaining stock returns. However, because the model has sound theoretical foundations, defining the drivers of beta is also possible.

Decompositions of CAPM explain the relation between the operating leverage and the systematic risk of a company. Thus, the relation between the operating leverage and a company's risk is based on a well know and accepted risk model. Lev (1974), Gahlon and Gentry (1982), Mandelker and Rhee (1984) and Chung (1989) explain the decompositions of CAPM.

In a first step, Lev (1974) replaces the stock returns with the ratio of earnings and market value of the company. The equivalence of these two return measures is shown in Miller and Modigliani (1961). Their explanations describe the link between the valuation of a company, using per share data, and valuation based on a company's cash flows. The rate of return on a stock is equal to the after-tax earnings plus the change in market value divided by a company's market value. The calculation of earnings follows formula (8a) minus interest payments multiplied by (1 - tax rate). It is the cash flow to be earned by shareholders. After this replacement, Lev (1974) divides formula (19) into three covariance parts: covariance between sales and the market return, covariance between the variable costs and the market return, and covariance between change in market value and market return. The covariance of fixed costs with the market return is zero, because fixed costs do not vary. Lev (1974) argues that the first and the third terms are equal for companies from the same industry. So, a company's riskiness is dependent on the covariance between its variable costs and market return. Lev (1974) states: "Summarizing, the preceding analysis suggests that both the overall risk (volatility) and the systematic risk of common stocks will be positively associated with the degree of operating leverage, or negatively associated with the firm's level of variable costs" (p. 632). Large covariance of variable costs with market reduces the riskiness from a capital market perspective.

According to Gahlon and Gentry (1982), the replacement of stock returns with accounting returns in formula (19) enables a link to be established between a company's cost structure and its systematic risk. Contrary to Lev (1974), Gahlon and Gentry (1982) explain that the CAPM is about expected returns. This means that the replacement of the expected stock return has to be carried out with an equivalent expected accounting return. O'Brien and Vanderheiden (1987) further emphasize this point. Gahlon and Gentry (1982) develop a formula consisting of factors influencing beta: degree of operating and financial leverage, revenue variability and the correlation between a firm's cash flow to changes in the overall economy. These four factors define the risk of a company and therefore its expected return. The operating leverage is: ". . . the percentage change in expected before-tax operating cash flow that will be associated with a one-percent change in expected revenue . . ." (Gahlon & Gentry, 1982, p. 17). So, the computation follows formula (10). Financial leverage measures the riskiness of external debt funding, which is not considered by Lev (1974). The revenue variability scaled by the expected revenues captures the fluctuations of the demand for a company's products. Highly volatile revenues indicate fluctuations in demand. And the fourth factor captures the dependence of the company's revenues on the development of the economy.

Mandelker and Rhee (1984) investigate the joint impact of the financial and operating leverage on the systematic risk of a company. They refer to the findings of Gahlon and Gentry (1982) and proceed in a similar way. They also substitute the return term with the ratio of earnings and the market value of equity. Their derivations result in a model in which beta consists of the product of the degree of financial leverage, degree of operating leverage and the intrinsic business risk. The intrinsic business risk is the risk of a completely unlevered company (Mandelker & Rhee, 1984). This factor is similar to the covariance of cash flows and the overall economic development according to Gahlon and Gentry (1982). Mseddi and Abid (2010) explain that an important contribution of Mandelker and Rhee (1984) is the introduction of leverages computed with accounting flow figures rather than stock market figures.

Chung (1989) starts from the definition of beta. His final model of beta is similar to the one developed by Mandelker and Rhee (1984). Beta is a function of the beginning values of net income and equity, the operating and financial leverage and the demand beta (Chung, 1989). The demand beta is similar to the intrinsic business risk defined by Mandelker and Rhee (1984). It measures the covariance of a firm's sales with the overall economic development.

More recently, Mseddi and Abid (2010) developed their own model to explain the fundamental risk of a firm. Unlike Mandelker and Rhee (1984) and Chung (1989), Mseddi and Abid (2010) solve the equation to express the relation with excess returns. They explain that a company's excess return is a function of the operating and financial leverage, the risk premium over market return and a company's intrinsic business risk.

According to Gahlon and Gentry (1982), the replacement of stock returns with accounting returns allows to utilize accounting figures to explain drivers of systematic risk. This aspect is key for building this link. Comparing the before-discussed models illustrates that the systematic risk of a company is a function consisting of at least two different accounting measures and a term capturing the dependence of a firm's revenues on the general development of the economy. The discussions in this section provide an appropriate research approach where the cost structure is integral part of[19].

3.4.2. Earnings Variability

Solving formula (10) on page 40 for change in operating income results in formula (21). This formula shows how the operating leverage amplifies changes in operating income and that without fluctuations in sales, the operating leverage cannot materialize.

$$\Delta Profit = \Delta Sales \times DOL \tag{21}$$

Change in profits, which is the operating income without consideration of financial results, and change in sales are expressed in percentage terms. The degree of operating leverage, calculated according to formula (10), and volatility in sales are the parameters influencing changes in operating income. Companies with a highly volatile demand structure and a high operating leverage have to deal with significant volatility in operating income. Conversely, companies with stable demand and a low operating leverage exhibit steady income streams. “In general, the higher the operating leverage, the higher the earnings volatility with respect to demand fluctuations” (Lev, 1974, p. 630). Lev (1974) describes a direct relation between the operating leverage and the volatility of earnings. Formula (21) is the formal derivation of the considerations of Lev (1974). This accounting relation raises discussion on whether volatile earnings make a company more risky than one with constant earnings.

Various researchers argue in favor of a relation between earnings variability and risk. Beaver et al. (1970) argue that accounting risk measures combine the individual risk component of a company and the systematic risk of a firm. Earnings variability is one of several possible fundamental risk measures. Beaver et al. (1970) define the standard deviation of the earnings to price ratio as earnings variability. This factor has a high correlation with CAPM’s beta. They conclude that accounting risk is implied in the market risk (Beaver et al., 1970). But, the proxy of earnings volatility includes the stock price. It is not a pure accounting characteristic because information generated by markets is considered, too. Rosenberg and McKibben (1973) reveal similar findings. Conducting regressions for different time periods with beta and the volatility of stock returns as dependent variables prove significant and positive coefficients for the variable earnings volatility. This means that unstable earnings increase beta and volatility in stock returns. According to Lev and Kunitzky (1974), a low level of uncertainty in respect of a company’s operations should

[19] Chapter 7 assesses a model consisting of business risk, financial leverage, and an approximation of the cost structure characteristics to explain total and systematic risk. There are two proxies for business risk: correlation coefficient of sales growth with sales growth of company’s industry peer group and the volatility of changes in sales. This relation is the major topic of the third research question. The accounting measures are the operating and financial leverage. Financial leverage is either the ratio of total debt to equity or the proportion of equity to total assets.

be honored by investors with a lower level of perceived risk. Like Rosenberg and McKibben (1973), Lev and Kunitzky (1974) differ between the overall riskiness of a firm and the firm's systematic risk. Lev and Kunitzky (1974) confirm that smoothing indicators are strongly related to market risk parameters. These findings indirectly prove the relation between risk and volatility of earnings. Because companies actively smooth earnings and because such activities are related to market risk, earnings volatility and market risk are related, too[20]. Lev and Kunitzky (1974) are not the first researchers to claim that companies smooth their earnings. Hepworth (1953) already addressed the topic of income smoothing twenty years earlier. In addition to tax issues, Hepworth (1953) states that equity and debt holders feel more comfortable with a management that is able to report stable earnings developments. Gordon (1964) argues in a similar way. The satisfaction of shareholders with their investment is a function of the average rate of growth and the stability of income. Therefore, management will apply accounting standards which allow stable and smooth income reporting (Gordon, 1964). Again, Beidleman (1973) corroborates this argument: ". . . earnings variability is interpreted as an important measure of the overall riskiness of the firm and has a direct effect on investors' capitalization rates and thus an adverse effect on the value of a firm's share" (p. 654). So, a high dispersion of future cash flows results in a lower present value of these cash flows. In addition to shareholders, management also prefers smooth earnings. Graham et al. (2005) deliver evidence of this with a comprehensive survey interviewing 401 CFOs. The primary reason why executives prefer smooth earnings is that outsiders perceive constant earnings to be less risky than volatile earnings (Graham et al., 2005). Because analysts are interested in normalized earnings, they prefer smoothed earnings. According to Graham et al. (2005) management intentionally smooths earnings to make predicting future cash flows easier for analysts. Beidleman (1973) further argues that the confidence of analysts increases when companies smooth their earnings and so prediction of future earnings becomes easier. This may be beneficial for shareholders, because the market value of a company approaches the intrinsic value. Beidleman (1973) concludes that smoothing could widen the market for shares of companies with stable earnings, and therefore reduce the cost of capital. The argument of more efficient forecasts for smoothed earnings is mentioned by Barnea, Ronen, and Sadan (1976), too. The findings of Minton and Schrand (1999) explain why there is a positive relation between risk and the volatility of earnings or cash flows. They find that firms with highly volatile earnings have significantly lower level of investments. If such companies use external funding to cover their investment needs, they pay higher

[20] Lev and Kunitzky (1974) mention an important limitation to their considerations: "Ideally, the association between smoothing and risk measures should have been examined within the framework of a well-specified risk model. Without such a model, results as those reported above should be regarded as tentative" (p. 270). The second empirical investigations have in so far a solid theoretical foundation that they test the application of formula (21) based on a sample of listed companies. The third empirical part refers to models described in section 3.4 and therefore has also a well-established theoretical foundation.

prices. Thus, Minton and Schrand (1999) argue that volatile cash flows increase the need for external funding, which becomes more expensive. Their empirical investigations confirm these interrelations (Minton & Schrand, 1999). Barnes (2001) analyzes the relation between a firm's valuation and the volatility of earnings. He finds a significant positive relation between the BM ratio and the volatility of earnings. Barnes (2001) concludes that earnings volatility has an adverse economic impact.

Some academics doubt that a relationship exists between the volatility of earnings and the riskiness of a company. Bowman (1979) explains the relation between the systematic risk and various accounting factors, such as financial leverage, accounting beta and earnings variability. According to Bowman (1979), there is no direct relationship between earnings variability and market risk, even though empirical research would suggest one, for instance Beaver et al. (1970). His considerations are based on formula (19). This formula explains that it is the covariability of a company's return with the return of market portfolio that defines the riskiness, not the variability of earnings per se. Under the assumption that market volatility is fixed, Bowman (1979) is able to relate the factors theoretically. Bowman (1979) concludes that there is no direct relationship, and that the relation found in empirical investigations may be the result of measurement errors in the variables. Damodaran (2004) also casts doubt on the apparent relation between earnings volatility and market risk. From a portfolio optimization point of view, earnings volatility belongs to the idiosyncratic risk of a company and therefore, shareholders will not be compensated for taking such risks. Additionally, it is not the volatility of earnings that is a threat for shareholders, but the risk of a permanent decline in earnings (Damodaran, 2004).

This definition of risk is particularly interesting from an operating leverage perspective, because the decline in earnings resulting from lower sales volume is influenced by the cost structure. Regarding this downside risk of earnings, the level of fixed costs is relevant because it defines the breakeven point[21]. The other argument of Damodaran (2004), referring to portfolio theory is also pertinent. Even though from a portfolio optimization point of view shareholders will not be compensated for taking the risk of high exposure towards the operating leverage, high leverage could cause volatile stock returns. This impact is of interest for shareholders, too.

According to the before-mentioned considerations there are different ways to link earnings variability and market risk. First, investors prefer stable income streams. This is true for management, too. Stable earnings often mean stable remuneration. Because predicting future earnings is easier when earnings are stable, analysts also benefit from constant income streams. Second, companies with volatile earnings postpone investments. Lower levels of investment may have an adverse effect on a company's value. Third, companies with volatile earnings have to bear higher cost of capital.

[21] See formula (2a) on page 33 for further information.

To conclude, this dissertation assumes a relation between cost structure rigidity and earnings variability. Testing this relation is part of the second empirical investigation, see section 6 and refers to the second research question. Beyond this accounting relation, described at the beginning of this subsection 3.4.2, this dissertation investigates the relation between cost structure rigidity and risk parameters from a capital market perspective. This aspect is part of the third research question and analyzed in empirical part three to four. Section 3.4 lays the theoretical foundations. The underlying assumption is that volatile earnings make a company more risky from a shareholder perspective, and that this volatility in earnings is influenced by the rigidity of cost structure. This third research question refers to Beaver et al. (1970), Graham et al. (2005) and others.

3.5. Insights for Empirical Investigations

Chapter 3 describes the operating leverage from various perspectives. This section 3.5 summarizes those insights which are relevant for the empirical investigations, starting with chapter 4. It builds a bridge between theoretical aspects and empirical investigations through summarizing the relevant implications and considering the research questions and research gap described in previous chapters. These implications refer to the development of the own estimation of cost structure characteristics, the impact of the cost structure on accounting returns and finally the link between the cost structure and risk aspects from the capital market's perspective.

The research gap described in section 2.4 refers to the focus of the operating leverage. Because the operating leverage measures the elasticity of earnings which is influenced by the cost structure, two focuses exist. The focus of the own approximations is the cost side of a company and not the elasticity aspect. Subsection 3.2 explains the relation between these two aspects with the derivation of formulas, see formula (12) on page 40. This derivation gives the rational explanation why a focus on the cost structure of a company directly relates to its operating leverage. Another strong argument for this relation is the influence of fixed costs on the breakeven point, which is the primary driver of the operating leverage. These insights provide theoretical arguments why digging deeper into the research gap is related to the operating leverage. Those arguments answer the first research question – *Is there a relationship between the degree of cost structure rigidity and commonly accepted operating leverage figures?* – from a theoretical point of view. The first empirical part of chapter 5 applies these considerations in practical investigations based on a broad sample of listed companies.

Additional to the before-described explanations, subsection 3.3 shows the advantages and disadvantages of various operating leverage proxies. Unknown parameters, like price per unit and number of products sold, is an unavoidable fact true for all approximations. But, those proxies with a focus on the elasticity aspect of the operating leverage have the disadvantage of influencing the sample. Because only companies generating operating profit can be part of the sample, the sample gets a bias towards profitable companies. Because leverage levers outcomes in both directions, such a reduction in the sample is inappropriate. This bias can be avoided with the focus on the cost-side.

Another lesson learned relevant for the coming investigations, is the impact of the cost structure characteristics on a company's accounting returns. The cost structure stands between the top and bottom line of the income statement. It is therefore comprehensible that the correlation between sales and costs has an impact on the volatility of earnings. This relation is expressed in formula (21) on page 52 and bases on considerations about the operating leverage. The operating leverage materializes when sales fluctuate. This condition is true in reality for most companies. The relation is object of the second research question – *Is there a relationship between the degree of cost structure rigidity and the volatility of earnings and profitability figures?* – which is investigated in the second empirical part, chapter 6. A company's value is dependent on the cash flow it generates. Therefore, it is relevant to consider how the cost structure influences the properties of cash flows. This research topic is preparatory work for the third research question, which focuses on risk aspects. If the own proxy is significant in explaining a company's accounting return volatility, it may qualify as factor explaining risk parameters from the capital markets.

The explanations in section 3.4 apply this accounting relation to risk considerations in capital markets. Modern finance differences between total and systematic risk, both types of risk are part of the investigations in chapters 7 to 9. Total risk is measured with stock return volatility. On the other side, the systematic risk is expressed in formula (18) on page 48 with beta as the crucial factor. The third research question – *Is there a relationship between the degree of cost structure rigidity and risk factors from a capital market perspective?* – is about the connection between the cost structure characteristics and such risk aspects. Theoretical and practical evidence in favor of such a relation exists and is described in section 3.4. The exchange of stock returns with accounting returns in formula (19) on page 48 links costs with beta. Because the cost structure approximation excludes financial aspects, the empirical investigations in chapter 7 consider also the unlevered beta. The relation between cost structure characteristics and total risk refers to the second research question which is tested in empirical part II. If cost structure rigidity causes volatilities in earnings, this factor could also be the primary driver for volatilities in stock returns.

Modern finance assumes a positive relation between risk and return. So, the question emerges if companies with rigid cost structures outperform companies with more flexible cost structures. This aspect is the second part of the third research question – *Do portfolios consisting of companies with rigid cost structures reveal the potential for excess returns?* – and investigated in chapter 9. The empirical investigations consider the three-factor model of Fama and French (1992). Their model consists of BM ratio, size and market portfolio. The proper answer of the question of a possible outperformance demands an application of such a model. At the end, it is possible to decide if the rigidity of a cost structure is related to risk parameters and if shareholders can benefit with investing in such companies. Chapter 8 analyzes the relations between cost structure rigidity and BM ratio and size and gives therefore first indications for the last empirical part in chapter 9.

The considerations in section 3.2 are also relevant to explain the limitations inherent in the research topic. With reference to the example described in section 3.2 the limitations become comprehensible. Company A and B of the fictitious example produce one product. The number of products produced, the selling price of the product and the input factors, i.e. the variable and fixed costs, are known for each company. Moreover, the number of products produced is the only cost driver. For empirical investigations based on a sample of listed companies, only aggregate sales and costs figures are known. So, it is not possible to differentiate between changes in prices or units sold in regard of changes in sales and operating costs. For practical reasons all empirical investigations base on aggregated sales, COGS and SGA figures. This aggregate sales and costs figures are used to approximate the rigidity of the cost structure for the total company.

4. Research Hypotheses, Study Design and Data

The general goal of the empirical investigations, see chapters 5 to 9, is to provide a comprehensive understanding of the cost structure and its impact on the operating leverage, on accounting return characteristics and on stock returns. The sample consists of companies listed on NYSE, Amex or Nasdaq. First, the relation between properties of the cost structure and well-known approximations of the operating leverage is assessed in chapter 5. Second, the link between cost structure proxies and earnings volatility is investigated in chapter 6. Third, chapters 7, 8 and 9 address aspects of risk and return. The relation of the cost structure to the BM ratio and level of market capitalization are part of these risk considerations. The empirical investigations utilize research methods that are commonly accepted in finance research, such as those developed in Fama and French (1992), Fama and French (1993), and Fama and French (1995). Each chapter of the empirical investigations includes a thorough description of the null hypotheses and the factors used to test the same. These explanations refer to the five subsections of section 4.1 of this chapter 4, which explain the research hypotheses.

In order to provide a solid foundation for the empirical investigations, chapter 4 gives an overview of the research hypotheses, research methodologies, the sample characteristics, and the proxies developed to estimate the properties of a firm's cost structure.

4.1. Research Hypotheses

Section 3.5 explains how theoretical considerations influence the research questions and the assessment of the same. This section 4.1 formulates the research hypotheses for each empirical part. It is a further development with more detailed considerations of the explanations in the before-mentioned section 3.5. Chapters 5 to 9 express the null hypotheses which enable statistical investigations of the research hypotheses explained in the following subsections 4.1.1 to 4.1.5. Additional, the considered variables are introduced in these chapters. Empirical part I refers to the first research question, empirical part II to the second research question, and because of the relevance of the third research question it is separated into empirical part III, IV and V.

4.1.1. Research Hypothesis of Empirical Part I

The first empirical part analyses the first research question. The cost structure is theoretically related to the operating leverage and the breakeven point. This is discernible with formulas (9) on page 39 and formula (2a) on page 33. Further, the graphs in figure 4 on page 37 explain that with increasing distance to the breakeven point, the operating leverage decreases. Fixed costs lose importance because more products are sold. This development is accompanied by an increase in flexibility. The following hypothesis is tested:

The cost structure rigidity has an impact on the operating leverage of a company.

This hypothesis is relevant for several reasons. First, it assesses the validity of the cost structure proxies. The accounting relation in formula (12) on page 40 describes the link between the cost structure and operating leverage. The empirical investigations may confirm this relation based on publicly available data for listed companies. Confirmation of the hypothesis would justify the further use of these proxies in empirical investigations. Second, there is an ongoing discussion about the drivers of the operating leverage. These empirical investigations may provide evidence for the usefulness of the cost structure proxies as drivers. Section 2.2 shows that there is no other investigation that tests these interrelations. Third, this investigation assesses this relation not theoretically, but empirically, with a sample of listed companies and publicly available data. Thus, this analysis also investigates the use of publicly available data for management accounting purposes.

4.1.2. Research Hypotheses of Empirical Part II

The second research hypotheses test the effect of positive and negative changes in revenues on the operating income through the cost structure properties and aim at answering the second research question. This empirical part basis on formula (21) on page 52. It shows that without variations in sales, the operating leverage has no impact on operating income. In practice, product demand permanently varies for most companies due to the market forces arising from ongoing competition for new customers. So, changes in sales are real and with these, the cost structure gains in importance. Additionally, Penman (2004) derives a theoretical relation between the cost structure, margin and profitability. These considerations combined underpin the definition of the following two hypotheses. The first hypothesis states:

The cost structure rigidity has an impact on the volatility in earnings.

Based on this expected volatility in earnings, the second hypothesis claims:

The cost structure rigidity has an impact on the volatility in profitability figures.

The reasons for testing the joint impact of cost structure characteristics and changes in sales on earnings volatility are manifold. Kahl et al. (2011) mention that there is scant literature about the volatility in cash flows or other income variables. Yet, the topic is relevant for management, shareholders and analysts alike. So, if the empirical investigations may confirm the impact of the cost structure on operating income, empirical evidence would support theoretical considerations for a solid explanation of operating income volatility.

Section 2.3 discusses different aspects of earnings volatility. Earnings and cash flows are key variables in defining the value of a company. Analysts pay close attention to earnings, as they are required to forecast this figure. So, they are not only interested in the earnings per se, but also its volatility. Earnings are also central for management, as the provision of accurate earnings guidance helps reduce market uncertainty. For shareholders, the ROE is especially important. It signals how much a company earns on the invested capital; stable profitability figures are considered a seal of quality. To conclude, companies with smooth and stable earnings are less risky, compared to companies with highly volatile earnings. Therefore, getting to know the drivers of operating income volatility is important.

4.1.3. Research Hypotheses of Empirical Part III

If the capital market critically reviews the characteristics of a company's cost structure and its impact on the volatility in earnings, the expectation of an influence on the volatility in stock returns emerges. This aspect belongs to the first part of the third research question.

The explanations in subsection 3.2.3 show that highly leveraged companies produce near breakeven point, i.e. near a loss situation. This poses a severe threat to shareholders. Such companies may destroy capital, abandon dividend payments, and are likely to dilute capital shares through capital increases. Furthermore, losses are also a threat to ratings because key figures such as interest coverage deteriorate. These developments jeopardize not just current ratings but also rating outlooks. Overall, such characteristics of companies with rigid cost structures make these risky, i.e. their return volatilities – or total risk – are expected to be substantial.

However, the discussion in subsection 3.4.2 makes clear that there is no direct theoretical link between the volatility of accounting returns and the systematic risk of companies. Rather, it is the covariance between the earnings and the state of the economy which influences the riskiness of a company. Bowman (1979) explains that only under the restrictive assumption of constant volatility of market portfolio, a theoretical relation between earnings variability and systematic risk can be established. There are other reasons, discussed in subsection 3.4.2 why a relation between the volatility of accounting returns and the systematic risk of companies may exist. According to Beidleman (1973) and Graham et al. (2005), both, management and analysts favor stable earnings, too, because forecasts are easier for companies with smooth earnings. This increases the attractiveness of companies with smooth earnings, which has an adverse impact on the cost of capital for companies with fixed cost structures. The considerations from subsection 3.4.1 show that beside the before-mentioned considerations about a potential relation between earnings volatility and systematic risk, there are theoretically sound models, such as those of Mandelker and Rhee (1984) or Chung (1989), which show that the operating leverage is a factor influencing beta, i.e. systematic risk.

With the findings of chapter 5, operating leverage is replaced with cost structure proxies. This switch from relative to absolute viewpoint according to Kelly and Sussman (1966) results in a better logic to the before-mentioned models. Because business risk is likely to be related to earnings elasticity, the replacement leads to a better differentiation between business risk and riskiness evolved through cost structure properties. If exclusively non-finance related risk aspects of a company should be tested, then unlevered beta is the appropriate comparative rule to use. The following empirical investigations take such models into account. To sum up, the following hypothesis will be tested:

The rigidity of cost structure has an impact on the riskiness of a company from capital market perspective. Therefore, there is an association between the degree of rigidity and the volatility of stock returns, betas and unlevered betas of companies.

The results of the empirical investigations are important for shareholders and analysts. If the hypothesis is confirmed, they know that beyond its impact on accounting returns, the cost structure is also relevant for risk considerations in respect of the capital market perspective. The results are pertinent for management: If the estimation of the properties of the cost structure is significant, then management has a variable to express their business risk. The possibility to express this risk aspect is an advantage for managements in their interaction with analysts.

4.1.4. Research Hypotheses of Empirical Part IV

Fama and French (1992) argue: “If assets are priced rationally, our results suggest that stock risks are multidimensional” (p. 428). Their analyses conclude that the positive and linear relation between beta and return holds only during a restricted time period. The application of various fundamental factors in their investigations leads to the conclusion that size and BM ratio are superior to beta in capturing the riskiness of a company. BM ratio is positively related to future stock returns, and size is negatively related.

The selection of size and BM ratio is based on previous findings of other researchers[22]. According to Fama and French (1992), BM ratio estimates the distress probability of a company. For example, companies with poor accounting performance show high ratios. Another explanation refers to expectations of market participants. A high ratio indicates low expectations, a low ratio signals high expectations. These expectations base on past accounting performance which missed prior targets. Companies with high ratios bear the burden of a high cost of capital. Therefore, they have higher expected stock returns.

The interpretation of the second factor, market capitalization or size, is ambiguous. Banz (1981) was the first to discover the negative relation between market capitalization and stock return. He concludes: “We do not even know whether the factor is size itself or whether size is just a proxy for one or more true but unknown factors correlated with size” (Banz, 1981, p. 16). Size could be a proxy for the BM ratio or EP ratio. However, the findings of Fama and French (1992) contradict this interpretation. Another interpretation refers to the abundance of available information (Banz, 1981). Because it is likely that the amount of available information is lower for small companies, investors hesitate to hold

[22] Their investigations also include the ratio of earnings to size and a company’s financial leverage. But, BM ratio and size absorb the information content of these factors (Fama & French, 1992).

their shares of small companies and are only willing to do so if compensated accordingly. According to Chan and Chen (1991), small capitalized firms have characteristics similar to so-called marginal firms: “They have lost market value because of poor performance, they are inefficient producers, and they are likely to have high financial leverage and cash flow problems. They are marginal in the sense that their prices tend to be more sensitive to change in the economy, and they are less likely to survive adverse economic conditions” (p. 1468). So, this explanation of the size effect claims that the source of risk of small companies is their dependence on the general state of the economy and poor accounting performance. The definition of marginal firms underscores poor accounting performance and cash flow problems, like the interpretation of the reasons for high BM ratio.

Chapter 2 shows that some recently published research papers use the operating leverage in the context of the findings of Fama and French (1992). They discuss attempts to explain the positive relation between BM ratio and stock returns. Gourio (2004) assumes that the level of productivity is a factor influencing returns. Poor accounting returns are a feature of companies with high BM ratio and such companies have also a high operating leverage. His proxies for the operating leverage, the ratio of operating costs to sales or the operating margin, are therefore a direct measure of the productivity of a company. Gulen et al. (2008) argue that companies with high BM ratios are less flexible in adjusting to economic downturns. Novy-Marx (2011) argues in a similar vein. According to Novy-Marx (2011), companies with high BM ratios are exposed to industry shocks. Because such companies have balance sheets with substantial fixed assets, they face severe challenges to overcome demand shocks. Garcia-Feijoo and Jorgensen (2010) also follow a risk-based explanation of the BM ratio anomaly. The relation between operating leverage and size is not explicitly targeted by these researchers. Only Garcia-Feijoo and Jorgensen (2010) show operating leverage proxies for double-sorted size and BM ratio portfolios.

Previous considerations in subsection 4.1.2 show that companies with high fixed costs may have volatile earnings and profitability. They are more likely to generate negative operating income and incur financial distress because they operate near breakeven point. These fundamental characteristics of fixed cost structure companies and the interpretation of the BM ratio underpin the following hypothesis:

There is an association between cost structure rigidity and BM ratios.

Hodgin and Kiymaz (2005) argue that managers control the amount of fixed costs. In a competitive environment, the price of products, input and output, are given and outside the sphere of managerial influence. But, if the size of a company is associated with market power, size and operating leverage may be negatively related. As their market power increases, large companies are able to influence prices in their favor. Thus, as the number of controllable variables in formula (1) on page 32 increases, the operating leverage is likely to be lower. The interpretation of the size effect, e.g. poor accounting performance and cash flow problems, combined with the assumption that market capitalization is positively related to market power, underpin the following hypothesis:

There is an association between cost structure rigidity and market capitalization.

These two hypotheses are relevant for several reasons. First, this chapter further develops the discussion about the riskiness of a company. This chapter introduces new risk factors beyond CAPM. BM ratio and size are two factors superior to beta in estimating expected returns (Fama & French, 1993). So, if the cost structure rigidity influences a company's riskiness, an association between BM ratio and size is expected. This assessment is relevant for analysts and investors, because both consider these two risk parameters when making investment recommendations and decisions. In addition, the true drivers behind the outperformance of high BM ratio and small companies are still unknown. Fama and French (2004) explain that behavioralists argue that this outperformance is caused by investors' under- and overreactions to past performance. Markets correct these exaggerations, which explains the higher returns for high BM ratio companies. On the other hand, outperformance of high BM ratio and low capitalization firms could also be the result of unrecognized aspects of risk. An association with the cost structure would add evidence to this risk explanation.

4.1.5. Research Hypotheses of Empirical Part V

Shareholders seek to earn total returns at a reasonable risk level. Previous considerations show that companies with rigid cost structures may have larger volatilities in earnings and higher total and systematic risk. It is therefore reasonable to expect such companies to yield higher returns compared to less risky, more flexible companies. Consequently, the first hypothesis of this chapter is:

There is an association between cost structure rigidity and portfolio returns as well as risk features of such returns.

From an investor perspective, it is of interest whether investing in rigid cost structure companies pays off or not. But, it is not sufficient to compare returns and risk figures for different portfolios. A proper model is needed to analyze this aspect. Therefore, the three-factor model of Fama and French (1993) is used to test if such companies earn excess returns beyond the model's risk factors. This investigation to find out about a potential outperformance follows Gulen et al. (2008). The main aspect is the constant, which is an output parameter generated by regressions. The regressions include SMB, HML and MARKET as right-hand-side variables. These factors consider the expectations of market participants. The cost structure characteristic is much more limited to one single feature of a company and it neglects the perspective of market participants. Further, the cost structure belongs to the business risk of a company, and is thus distinct from financial risk or growth risk. Because the BM ratio combines accounting figures and market capitalization, it should absorb the influence of the cost structure on the value of a company. From this point of view, it is unlikely that there will be a positive alpha with investing in companies with rigid cost structures. So, the following hypothesis combines these considerations.

The returns of portfolios constructed upon cost structure proxy can be explained by the three-factor model of Fama and French (1993). No significant alpha remains.

In addition to the application of the three-factor model, it is necessary to assess which factors drive future stock returns. The approach developed in Fama and MacBeth (1973) is used for this last analysis. Finance literature describes many factors with explanatory power. In particular, accounting multiples that take earnings variables into account may serve as a basis for incorporating cost types in such models. Formula (22) explains how COGS and SGA can be integrated as right-hand-side variables in regressions.

$$\frac{EBITDA}{EV} = \frac{Sales}{EV} - \frac{COGS}{EV} - \frac{SGA}{EV} \tag{22}$$

Formula (22) explains the constituents of the ratio of EBITDA to enterprise value. Basically, formula (22) is a simplified income statement. Sales minus the two cost types results in EBITDA. Because the main focus lies on the two cost categories, the ratio of EBITDA to enterprise value is replaced by the three right-hand-side variables of formula (22). This allows cost factors to be incorporated in the regression model to analyze drivers of future stock returns.

There is a large body of literature that confirms a positive impact of the BM ratio on stock returns. Further, size and financial leverage are negatively and positively related to returns, respectively. Like the BM ratio, the EBITDA/EV ratio positively influences returns. Therefore, if the EBITDA/EV ratio has a positive impact on future returns, the two cost factors are negatively related. These explanations are intuitively appealing. A large proportion of costs to the value of a company signals low productivity, so such an investment can hardly be successful. On the other hand, the two cost categories COGS and SGA impact very differently on a company's future business potential. Section 4.3 explains the constituents of the two cost categories and their differences. COGS comprises expenses to produce goods which are sold during a financial year. These are not expected to influence a company's value positively. Conversely, SGA comprises expenses to maintain the production facilities. Further, a proportion of SGA aims to increase the potential for future success. Expenses for R&D or advertising have a different impact on future potential than expenses for raw materials, i.e. COGS. Therefore, the relation of cost categories to future stock returns is vague. However, the third hypothesis favors common sense.

There is no association between SGA and COGS and future stock returns. The variables BM ratio, size, financial leverage and past return explain future returns.

The analyses of this chapter are relevant for investors. First, investors need to know how the cost structure influences stock return properties. Second, the results can be used to assess whether an exposure to rigid cost structure companies may pay off. Third, the chapter provides information about the influence of cost categories on future stock returns.

4.2. Research Methodologies

To test the hypotheses, various methodologies are applied. In order to gain an overview of the association between the variables employed, descriptive statistics for portfolios constructed using different factors are calculated. In this regard, deciles are used for portfolios constructed using only one criterion, while quintiles are used for portfolios that apply two criteria. Furthermore, regression analyses investigate if the relations expressed in the descriptive statistics are significant, and indicate the explanatory power of the independent variables. Finally, mimicking portfolios are utilized to investigate the relation between the characteristics of the cost structure and the factors used in Fama and French (1993).

4.2.1. Portfolio Building and Descriptive Statistics

In a first step, descriptive statistics for portfolios, sorted according to the cost structure proxies and other variables, show how the variables under consideration vary among different portfolios. The criteria for portfolio building and time-series averages calculated for each portfolio refer to the research hypotheses. This approach allows to get a first impression about the assumed relations between the considered variables expressed in the hypotheses. To build the portfolios, three different approaches are applied.

First, building portfolios based on BM ratio and size follows the approach of Fama and French (1992). Fama and French (1992) use annual breakpoints of the variables, based on a sample of companies listed on the NYSE. The definition of the breakpoints follows the distribution of the estimates of the variables. As a result, each portfolio consists of different numbers of portfolios depending on the variation of the estimates. These breakpoints are available on the homepage of Professor French (French, 2012). However, such breakpoints are available only for BM ratio and size.

In the second approach, instead of assigning equal numbers of companies to portfolios, the distribution of the variables estimates is decisive for assigning the companies to the appropriate portfolio. For example, those companies with the lowest 10% of cost structure estimates for one year belong to the first decile, those with estimates between the bottom 10% and 20% belong to the second decile, and so on, until each company for each year is placed into one of the ten deciles. This approach has the advantage that those companies with similar estimates are grouped together. This clustering is much more effective than simply splitting the sample into strongly balanced portfolios. The disadvantage is that the number of companies in each group varies. The number of companies is dependent on the distribution of the variables estimates. As a result, this approach is only feasible if the variation of the variable is more or less equally distributed. If the majority of the observations are at one end of the distribution, the portfolios become too imbalanced. For these variables, equally distributed portfolios are built according to the rankings of the annual variable. This is the third approach. Table 84 on page 187 summarizes the number of observations of deciles built according to the cost structure proxies.

Quintile rankings are used when applying two criteria to build portfolios. Fama and French (1992) introduce this approach to compare the explanatory power of two variables. In their influential paper "The Cross-Section of Expected Stock Returns", Fama and French (1992) test CAPM's beta for various portfolios constructed according to company size. The assumption is that if beta really explains the expected return of stocks, this must hold even when controlling for the level of market capitalization. To test the effectiveness of beta, they sort their sample into ten portfolios sorted by company size. Afterwards, they build ten subportfolios for each portfolio according to the beta of each firm. Fama and French (1992) show that within the company size deciles, beta does not capture differences in returns. But, within beta deciles, small companies yield higher returns than large companies. This analysis indicates that the size of a company is superior to beta in explaining differences in returns.

This technique is also of interest in the context of the operating leverage. Novy-Marx (2011), Gulen et al. (2008) or Garcia-Feijoo and Jorgensen (2010) apply this double-sorting approach to test if the operating leverage is related to BM ratio and size. Chapter 8 applies their approach. The research hypothesis of empirical part IV assumes a positive relation between cost structure rigidity and BM ratio, and a negative relation with size. To separate the influence of BM ratio and size, the double-sorting approach is applied. In chapters 5 and 6 the double-sorting approach proves very useful, too. The first empirical part tests if the approximation of the cost structure rigidity relates to common proxies for operating leverage. To consider the distance to breakeven point, a company's margin is used as second criterion for portfolio building. The double-sorting approach allows to test the influence of the cost structure, while holing the influence of the margin constant. Formula (21) on page 52, this accounting relation is expressed in the research hypothesis of chapter 6, shows that not only the operating leverage, but also changes in sales have an impact on changes in the operating income. So, assigning each firm to a cost structure portfolio and a sales growth portfolio allows an assessment of which factor has more power in explaining variations in operating income. Again, the breakpoints of the variable under consideration for stocks listed on the NYSE form the basis for building BM ratio and company size portfolios. Because companies listed on the NYSE tend to be large compared to other stock exchanges, for instance AMEX or Nasdaq, such breakpoints reduce the otherwise dominating impact of small companies. For other variables, there are no breakpoints available. Therefore, either the total distribution of the variable applied or portfolios comprising an equal number of companies based on the variable rankings are built.

Because the sample is small compared to that of Fama and French (1992), quintiles are built for double sorting[23]. Some variables, for instance the margin, are only useful for companies generating positive operating income. This fact reduces the sample size for certain assessments.

For each year, companies are assigned to a quintile according to the variables estimates. So, for each year each company has two numbers; one for the proxy of the cost structure and another for instance for the margin. This results in 25 portfolios sorted by the annual rankings of the two variables. This procedure is repeated for various variables under consideration.

The descriptive statistics show the time-series averages of the variables under consideration. If the means across the portfolios continuously increase or decrease as expected under the predefined hypothesis, then the applied sorting criterion seems to explain variations in the variable. Even if no continuous development is evident, significant differences between the extreme portfolios may lead to a confirmation of the hypothesis. The tables show the differences in the variables of the first and tenth deciles and t-stats of t-tests assessing if these are significantly different from 0. A t-stat above 1.96 indicates that the difference between the two extreme means is significantly different from 0 at the 5% significance level. Given a t-stat above 1.96, the interpretation that the two portfolios have different accounting characteristics is justified. Together, these statistics provide an initial assessment of the relations under consideration. Further analyses, especially regressions, provide more specific information.

4.2.2. Regression Analyses

In addition to descriptive statistics, different types of regressions are conducted. The first of these uses indicator variables. The indicator variable fixcostr is 1 for companies with rigid cost structures according to the different proxies, and 0 for all other companies. The indicator variable flexcostr is 1 for companies with flexible cost structures according to the different proxies, and 0 for all other companies. The construction of the indicator variables is based on the portfolio constructions described in subsection 4.2.1. Only the first and the fifth quintiles are used; i.e., the indicator variables consider only the two extreme portfolios. Therefore, the regression output shows if the two extreme portfolios have significantly different dependent variables compared to the middle three quintile portfolios. The reason for working with indicator variables is the exclusion of measurement errors.

[23]Sections 4.3 and 4.4 provide further information about the sample. Table 79 on page 182 shows how the initial sample is adjusted. The limitations that a company has to be listed at NYSE, Amex or Nasdaq and that only companies with fiscal year ending in December are considered, have a huge impact on the sample size.

The second type of regressions use point estimates of cost structure approximations in place of the two indicator variables. These regressions show if the independent variables explain variations in the regressands. The approximation of the cost structure is the factor of most interest. The differentiation between regressions with indicator variables and point estimates applies the approach of Kahl et al. (2011).

Besides the use of indicator variables, a second way to mitigate the errors-in-variables bias is to conduct the regressions for portfolios instead of single companies. For instance, Mandelker and Rhee (1984), Chung (1989) and Garcia-Feijoo and Jorgensen (2010) conduct regressions for portfolios to assess the significance of their variables. In this context, the factor determining the portfolio construction is decisive. Chung (1989) explains that portfolios should be built according to an appropriate proxy, which can be observed independently and is not prone to measurement errors. So, the calculation of this variable and its input factors should be different from the explanatory variables. At the same time, however, the variables should correlate and express the same characteristic of a company.

The broad variety of explanatory variables makes it difficult to define the appropriate proxy. There are several reasons for this. Since most of the explanatory variables are outputs of regressions, the proxy should be computed differently. Further, because the main focus is fixed costs, this aspect should also be considered. Moreover, none of the explanatory variables captures the capital market perspective, yet because prices absorb expectations of market participants, it would be interesting to consider this market information, too. These considerations combined underlie the decision to sort the portfolios in the sample according to the ratio of SGA to market capitalization. First, all firms are sorted according to this ratio for each year under consideration. Then, 25 portfolios are built according to the rankings. For each year, the portfolios consist of a similar number of firms depending on the total number of companies per year. Garcia-Feijoo and Jorgensen (2010) build 50 portfolios. This number is arbitrarily selected and is a compromise between generating variables with less measurement errors and not losing too much information through the formation of means. Table 9 on page 81 summarizes the correlations among the explanatory variables and the proxy used for portfolio building. To compare the results with Costr(SGA), the correlations with the ratio of opcosts to size are also presented. Opcosts is the sum of SGA and COGS. Comparing the results of these two ratios shows that Costr(SGA) is superior. Especially the higher correlation with Costr(5ya) speaks in favor of Costr(SGA).

The regressions are run cross-sectionally with indicator variables and point estimates for panel data. The following formula explains the general form of the regression.

$$y_{j,t} = a_{j,t} + \beta_1 var1_{j,t} + \beta_2 var2_{j,t} + \beta_3 var3_{j,t} + \ldots + \gamma Z_{j,t} + \epsilon_{j,t} \qquad (23)$$

The dependent variable $y_{j,t}$ varies according to the hypotheses. In the first empirical investigation, proxies for the operating leverage serve as left-hand-side variable. In the second empirical investigation, changes in operating income is the factor to explain. Volatility in returns, beta and unlevered beta are the dependent variables in the third empirical investigation. Future returns are the left-hand-side variable in the last empirical investigation.

The three variable parameters $var1$ to $var3$ refer to the factors that should explain the dependent variable. The number of right-hand-side variables considered varies between the investigations. One of these variables is a proxy of the cost structure. The format of this variable is either the previously-described indicator variable or the point estimates. The variable $Z_{j,t}$ summarizes two dummy variables; one reflecting the time aspect and the other the industry affiliation.

Most regressions are run cross-sectionally for either companies (j) or portfolios (i). The term t varies according to the number of observations available per company. The time dummy absorbs correlations of variables among different companies at the same point in time. For instance, during the financial turmoil in 2008, nearly all stock prices tumbled. Such situations cause correlations among stock prices of companies, which influences the properties of residuals and the significance of coefficients. The time dummy absorbs this effect. Similarly, the industry dummy captures correlations of variables of companies within the same industry. The relevance considering industries is confirmed by the research results of Darrat and Mukherjee (1995). Kahl et al. (2011) incorporate the same dummy variables. Petersen (2009) discusses different approaches to control for such factors influencing the residuals of regressions. Petersen (2009) suggests controlling for time and industry effects while clustering residuals for companies, because such residuals tend to correlate for firms at different points in time (heteroskedasticity). Petersen (2009) explains that it is necessary to cluster the more frequent factor. Because there are more companies than years, the residuals are clustered for companies.

4.2.3. Mimicking Portfolios

The regressions explained in the previous section test if the cost structure proxy is significant in explaining variations in dependent variables. Such investigations are conducted to test the first two research questions. However, the third research question is about a potential outperformance of portfolios consisting of companies with rigid cost structures. To analyze this aspect, another research approach is utilized, which is described as follows.

Fama and French (1993) develop another popular research approach utilizing time-series regressions. Time-series regressions are often applied in finance research. This approach uses stock returns of different mimicking portfolios as right-hand-side variables and returns of portfolios sorted upon the factor of interest as left-hand side variables. Chan, Karceski, and Lakonishok (1998) explain that mimicking portfolios serve various purposes. In particular, mimicking portfolios can be used to explain which factors drive asset returns, to test the sensitivity of factors to the macroeconomic environment, and to evaluate asset managers. In the context of the third research question, the first aspect is considered. The decisive aspect of this approach is the portfolio building procedure.

Fama and French (1993) build mimicking portfolios according to the size and BM ratio of companies[24]. They assume that variables related to returns, for instance size and BM ratio, must also be useful to capture aspects of risk in returns. Such mimicking portfolios are built on the yearly observations of the variables. Fama and French (1993) separate the sample into a small (S) and big portfolio (B) according to the yearly market capitalization. Similarly, the sample is divided into three BM ratio groups based on the breakpoints of the first 30% (L), the middle 40% (M) and the top 30% (H). Each company belongs to a size and BM ratio group in each year. Based on this information, Fama and French (1993) build six portfolios: SL, SM, SH, BL, BM and BH. For instance, the BL portfolio consists of the biggest companies with low BM ratios. They calculate monthly size-weighted returns for each portfolio starting in July of year t to June of year t+1. Based on these returns, the performance of the mimicking portfolios is calculated. SMB is the performance difference between the average returns of the three small portfolios and the three large portfolios. HML considers only the two extreme portfolios and measures the difference between the average returns of the two high BM ratio portfolios and the two low BM ratio portfolios. Because SMB measures the return differences of portfolios with similar BM ratios, the time series should be free of influence from the BM ratio. Similarly, HML captures performance differences based on different BM ratio exposures while keeping the influence of size to a minimum. Fama and French (1993) use size-weighted returns of the six portfolios to reduce the variance in returns. The third mimicking portfolio, MARKET, captures the difference between the monthly size-weighted returns of the total sample and the risk-free rate. Unlike Fama and French (1993), the performance calculation in this dissertation starts at end of April, because nowadays, companies report more promptly.

Chapter 9 tests the Fama-French three-factor model, developed in Fama and French (1993), for portfolios, double-sorted according to size and cost structure proxy. The regressions show if the returns of these portfolios can be explained by the three mimicking portfolios. This makes it possible to assess if returns of portfolios comprising companies with rigid cost structures and different average sizes, have characteristics similar to those of high BM ratio companies or small companies. And, the regression outputs show if beyond the explanatory power of the mimicking portfolios exists the potential for outperformance. This would be the case if there is a significant positive constant. This approach makes it possible to answer the second part of the third research question.

Based on the mimicking portfolio approach, chapter 8 applies the procedure of Fama and French (1995). Instead of stock returns, accounting returns are used in the portfolio building procedure. These regressions show if accounting returns of portfolios consisting

[24] Fama and French (1993) also consider term-structure risk factors in returns, but these are not relevant to this dissertation.

of companies with rigid cost structures can be explained by accounting returns of high BM ratio portfolios and small market capitalization portfolios. This investigation belongs to the first part of the third research question, which asks about the relation between cost structure rigidity and risk parameters. The significance and size of the coefficients of the regressions show the explanatory power of such mimicking portfolios. If the coefficients of portfolios consisting of companies with rigid cost structures are positive and significant, accounting returns of such companies show common features with accounting returns of mimicking portfolios. Such findings would support the assumption of a relation between the cost structure rigidity and BM ratio and size.

4.3. Source of Data

The sample consists of companies from the Compustat North America database. Using the Wharton Research Data Services online tool, the necessary information from the balance sheets and income statements of active and inactive companies for the fiscal years from 1969 to 2011 was downloaded. The following sample adjustments were then undertaken with the aim of producing a sample of companies with reliable accounting information.

Only companies reporting in USD are considered. Companies with a 4-digit SIC between 6000 and 6999 (financial companies) are dropped, because the accounting characteristics of financial institutions are hardly comparable with other non-financial companies. Notably, Kahl et al. (2011), Garcia-Feijoo and Jorgensen (2010) or Novy-Marx (2011) also exclude financial companies. Only companies listed on NYSE, Amex or Nasdaq are included in the sample. The assumption that the quality of accounting information is best for companies listed on the main exchanges explains this adjustment. Because of the focus on companies with operating activities, the limitation that sales, COGS and SGA are larger than 0 is applied. Further, only companies that differentiate between COGS and SGA are considered. To check this aspect, companies must report according to Income Statement Model Number 1. Companies with negative or missing equity (CEQ) are dropped. CSHO and stock price information have to be available, too.

All accounting information must be provided on a yearly basis. Moreover, SGA, COGS and sales have to be available for five successive years, otherwise the company is dropped. This is necessary to compute the factors based upon five-year moving time windows. The sample consists of companies with information on a yearly basis for the fiscal years 1974 to 2009, but the relevant time period starts from 1984. According to Foster and Baxendale (2008), companies introduced just-in-time production in 1984. Because this decreased inventory levels, the manipulation of earnings through the valuation of inventory levels also decreased. With the reduction in inventory levels it is assumed that the assignment of costs to COGS or SGA corresponds to the actual behavior of such costs. Thus, observations prior 1984 are not considered in the empirical investigations.

The number of available observations varies per company and year. One reason for the loss of a large number of observations is that to conduct proper regressions, no time gaps within the observations for one company are allowed. Another reason is that only companies with a fiscal year ending in December are taken into account. Furthermore, dependent and independent variables are analyzed and adjusted for outliers. Table 79 on page 182 gives a summary of the sample adjustments.

Year	Number of companies	Year	Number of companies
1974	*645*	1992	581
1975	*653*	1993	584
1976	*670*	1994	598
1977	*666*	1995	605
1978	*648*	1996	621
1979	*660*	1997	646
1980	*667*	1998	660
1981	*648*	1999	684
1982	*623*	2000	738
1983	*591*	2001	806
1984	565	2002	792
1985	511	2003	858
1986	476	2004	864
1987	479	2005	861
1988	491	2006	880
1989	499	2007	895
1990	536	2008	925
1991	567	2009	868

Table 5: Number of companies per year
Table 5 summarizes the number of companies per year. In total, the sample consists of 2717 companies, 17590 observations, and a time period of 26 years. On average, information is available for 677 companies per year.

The research topic is the cost structure of a firm, and Compustat provides information for different types of costs that are relevant in this regard. For the approximation of variable and fixed costs, the total of operating costs – the sum of SGA and COGS – is the key variable. Compustat describes these two cost types as follow:

"COGS: This item represents all costs directly allocated by the company to production, such as material, labor and overhead. (Standard & Poor's, n.d.)" COGS comprise direct labor expenses, expenses to pay suppliers, and maintenance and repair costs. Lease expenses also belong to this cost category, even though it is difficult to differentiate between financial and operating expenses in this regard. No adjustments are made in this respect. However, the definition shows that these costs refer to a company's production process. The association between the cost types of COGS and the production process is decisive for the assumption that COGS reflect variable costs.

"SGA: This item represents all commercial expenses of operation (i.e., expenses not directly related to product production) incurred in the regular course of business pertaining to the securing of operating income. (Standard & Poor's, n.d.)" More specifically, according to Compustat, SGA comprise the following cost categories: research and development expense, staff expense, pension expense, rental expense and advertising expense. These expenses are not directly related to the production process.

The differentiation between variable and fixed costs demands the definition of a cost driver. In management accounting, defining a cost driver is possible when internal data about the production process is available; for instance expenses for raw materials or the number of orders. Often, the number of output units is the cost driver. Because the number of units produced is not available, sales serve as the cost driver. COGS relate directly to the production of a company. Therefore, the assumption that these costs are variable seems reasonable. Conversely, SGA comprise expenses which serve to maintain the general business operations. They are not directly related to the output produced but are also distinct from financial or tax expenses. Thus, the assumption that SGA are fixed business expenses also seems reasonable[25].

Information about stock prices, risk-free rate and a broad stock market index are sourced from Compustat, once again using Wharton Research Data Services to obtain the necessary information. Stock prices are available on a monthly basis. Compustat provides the closing price at month end and the monthly total return for each company. Total return represents the monthly price changes with reinvested dividends or cash equivalent distributions taken into account. A proxy for the risk-free rate and a broad index are used to estimate beta. The yields of 30-day T-bill and the value-weighted returns (dividends reinvested) of the S&P 500 serve as the two proxies.

4.4. Descriptive Statistics of Data Sample

As described earlier, some restrictions and adaptations of the sample are necessary. Therefore, it is important to give an overview of the sample properties. Time-series averages of different accounting factors are calculated and summarized in table 6.

	Mean	sd	P25	Median	P75
Size	4508	17900	116	515	2126
Sales	3321	13200	148	521	1984
Margin	11.59%	8.36%	5.82%	9.69%	15.28%
ROE	16.01%	15.40%	8.36%	13.69%	19.92%
ROA	7.83%	5.84%	3.78%	6.69%	10.41%
RONOA	29.64%	791.72%	14.25%	19.83%	27.72%
Leverage	0.92	10.70	0.11	0.43	0.85

Table 6: Descriptive statistics for total sample
Table 6 summarizes properties of variables to describe the sample. Table 82 on page 186 provides further information about the definition of the variables. Contrary to some empirical investigations, the variables in table 6 are not truncated.

Size and sales show similar properties. There are a few very large companies, which

[25]Subsection 4.5.2 discusses this assumption with table 8 on page 77, which provides further information about how SGA and COGS differ regarding their dependence on changes in sales.

skews the distribution. The average Margin is about 12%. ROE of 16% is quite large; ROA is lower in comparison because the earnings are divided by total assets. The average RONOA of nearly 30% is also quite large. Its standard deviation shows that there are some firms with a high share in cash on the balance sheet; these cash positions reduce the denominator. The results for some variables, truncated at the 1% and 99% percentile, exhibit different properties. This is especially true for variables with a very large standard deviation. To reduce the impact of a few extreme observations, truncated variables are used in some empirical investigations.

	Number	Size	Sales	Margin	ROE	ROA	RONOA	Leverage
Business Equipment	3263	3372	1605	11.31%	14.64%	8.64%	71.20%	0.37
Chemicals	823	3016	2920	10.52%	16.00%	6.94%	21.40%	0.88
Consumer Durable	615	1465	2249	9.52%	15.39%	7.80%	24.09%	0.64
Consumer Non Durable	1510	4869	3227	12.65%	19.50%	9.16%	26.77%	1.01
Energy	1203	14100	15600	14.68%	15.55%	6.53%	22.55%	1.75
Healthcare	1690	11800	3371	16.40%	19.36%	10.36%	29.47%	0.55
Manufacturing	3579	2575	2695	9.89%	15.11%	7.47%	14.36%	0.68
Other	2517	1906	1598	11.89%	15.08%	6.60%	20.66%	1.30
Shops	1775	1434	2217	6.72%	15.68%	7.06%	20.17%	0.89
Telecom	505	7751	4467	17.54%	16.56%	6.47%	8.93%	3.52
Utilities	110	1620	1344	18.53%	10.71%	3.79%	13.76%	1.28
Total	17590	4508	3321	11.59%	16.01%	7.83%	29.64%	0.92

Table 7: Descriptive statistics for industries
Table 7 summarizes properties of variables to describe the sample industries. The Fama-French 12-industry classification is used (French, 2012). Table 82 on page 186 provides further information about the definition of the variables. Contrary to some empirical investigations, the variables in table 7 are not truncated.

Table 7 summarizes time-series averages for different industries. The second column shows the number of observations per industry. While none of the industries dominates the sample there are only few telecom or utilities companies. Moreover, size and sales show that the energy sector is large. Finally, the Margin and profitability measures vary among industries, with healthcare and consumer non-durables seeming the most profitable. Industry differences are captured through the integration of an industry dummy in regressions, or with creating variables in relative comparison with industry averages.

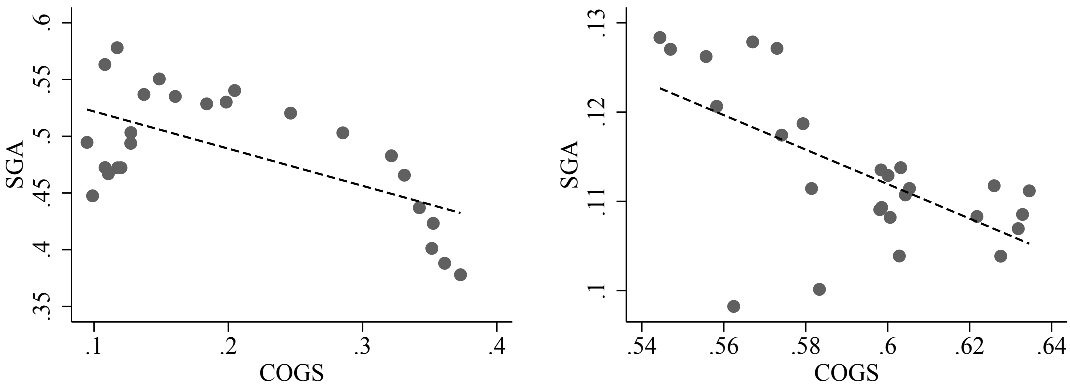
4.5. Construction of Cost Structure Proxies

The two viewpoints – absolute and relative – on the operating leverage according to Kelly and Sussman (1966) are useful, to differentiate the own proxies from those described in section 3.3. The idea is to approximate the degree of cost structure rigidity. This focus complies to the absolute viewpoint. Most researches estimate the elasticity of earnings, i.e. the relative viewpoint. The problem is that a sober calculation of this elasticity demands positive operating income. But, neglecting companies generating operating losses leads to a severe reduction in the sample. Further, generating losses means that not enough products are sold and too much costs exist. From a risk perspective, the relevance of the cost structure rigidity in this regard is interesting. Even though the cost structure is not the sole driver of the operating leverage, it is a key characteristic of a company. The relevance of this corporate characteristic is shown by formula (2a) on page 33; the level of fixed costs is decisive for the breakeven point. Moreover, the breakeven point according to formula (3) is a factor influencing the operating leverage. Further, subsection 3.2.5 explains the link between the textbook formula (1) and the elasticity formula (10) with the derivation according to formula (12) on page 40. Additional to the proxies of cost structure rigidity, the textbook formula is replicated – with two assumptions regarding COGS and SGA. In both approaches – cost structure rigidity and textbook formula – the level of fixed costs is crucial. In order to consider this relevance of fixed costs, the last proxy focuses solely on fixed costs and bases on the same assumption like the calculation of the textbook formula. This proxy measures the ratio of SGA to market capitalization. So, it takes the perspective of market participants into account, too. The following subsections describe the features of operating costs, approximation methods and necessary adaptations.

4.5.1. Features of SGA and COGS

As discussed in section 3.3, very few researchers try to directly approximate the cost structure. Using formula (13), Lev (1974) estimates the sensitivity of the relation between total operating costs and sales. Kahl et al. (2011) also address the cost structure but focus on the deviations from expected cost figures.

As already mentioned before, only costs related to a company's operations are of interest here. Section 4.3 describes COGS and SGA as the two components comprising operating costs. There is a tradeoff between SGA and COGS. Either a company operates with large proportion of fixed costs, because it decides to do much on its own. Or the management outsources certain tasks, which increases its share in variable costs but keeps the level of fixed costs to a minimum. Figures 5a and 5b illustrate the tradeoff between SGA and COGS.



(a) Example Pfizer **(b)** Example McDonald's

Figure 5: Tradeoff between SGA and COGS
The graphs 5a and 5b show the tradeoff between SGA and COGS for Pfizer and McDonald's. The cost structure of Pfizer is more rigid than that of McDonald's because of the higher proportion of SGA. COGS and SGA are both shown in relation to sales. The dotted lines represent the regression lines.

The differing cost structures of McDonald's and Pfizer serve as examples to illustrate the tradeoff between SGA and COGS. Pfizer is a research-intensive company. Expenses for R&D are part of SGA because such companies often have a budget for research activities. For instance, R&D comprised nearly 50% of SGA in 2009. The ratio of SGA to sales is therefore large[26]. In contrast, the ratio of COGS to sales is low, because the actual production of drugs is not expensive. Conversely, McDonald's operates with low fixed costs. It reveals a large ratio of COGS to sales and a correspondingly low ratio of SGA to sales. COGS contain expenses for food, payrolls and other operating expenses. They comprise the majority of operating costs. Advertising expenses are low because McDonald's operates using a franchise system. These two companies show that there is a clear tradeoff between SGA and COGS. The total sample reveals a significantly negative Spearman correlation coefficient of 0.77 between these two variables.

The description of COGS and SGA in section 4.3 indicates that the assumption of COGS being variable and SGA being fixed costs is comprehensible. However, the allocation of costs to COGS or SGA is under influence of the management. There is the possibility that two companies differently assign similar expenses either to COGS or SGA. Further, chapter 3 explains that the differentiation between fixed and variable costs has also to do with the relevant time period. Again, the relevant time period may vary between companies. These factors make clear that the assignment of costs to COGS or SGA is to some degree uncertain. But, in general SGA have the feature of an investment in intangibles. For instance, marketing expenses or R&D expenses provide value for future business activities. Whereas COGS have a clear cost driver. And this cost driver relates

[26]The allocation of expenses for R&D to fixed or variable costs is discussed in more detail in Ho et al. (2004). Ho et al. (2004) conclude, that such expenses are fixed and therefore impact on the operating leverage. This conclusion supports the assumption of SGA being fixed, because expenses for R&D belong to SGA.

to the output produced and limits the purpose of COGS to the production process. This aspect allows to compare how the two cost types relate to a company's output and with that, to better understand the before-described uncertainties. Following the assumption of Lev (1974) that sales approximate a company's production output, the following table 8 summarizes regression outputs with changes in COGS and SGA being the dependent variables and changes in sales the independent variable.

	ΔSGA	$\Delta COGS$
$\Delta Sales$	0.66***	0.96***
	(64.60)	(131.56)
Constant	0.06***	-0.01
	(5.46)	(-0.99)
R^2	0.41	0.78
Adjusted R^2	0.41	0.78
F	156.99	714.95
Observations	17590	17590

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 8: COGS and SGA regressed on changes in sales
Table 8 summarizes regression outputs to estimate the elasticities of SGA and COGS. The first regression regresses changes in SGA on changes in sales. In the second regression, changes in COGS are used as dependent variable. Industry and time dummies are considered and residuals are clustered for companies.

Table 8 shows that the two cost types behave differently. The coefficient of the first regression is lower compared to the second regression. A 1% increase in changes in sales leads to increase in SGA of only 0.7% compared to an increase of nearly 1% for COGS. This much higher elasticity of COGS is a strong indicaction for the before-mentioned assumption of COGS being more dependent on changes in sales. Further, changes in sales explain only 40% of changes in SGA, compared to nearly 80% for changes in COGS. Again, this is an important finding regarding the critical assumption because it indicates that there are other drivers for SGA than the sales volume. Together, these two findings support the assumption of COGS being variable and SGA being fixed costs. There are other research papers conducting empirical investigations based on the same assumption; see for instance Lev and Thiagarajan (1993) or Echevarria (1997).

4.5.2. Development of Cost Structure Proxies

All proxies developed exclude expenses for depreciation and amortization. The main reason is that only actual expenses occurring during a fiscal year should be considered. According to Kahl et al. (2011) the management is able to influence depreciation and amortization. For instance, the management is free to delay investments. The resulting level of depreciation and the relevant time period are also manipulable and therefore, may not be congruent with real maintenance needs. Amortization is dependent on past investments and impairment tests. So, both types of expenses are the result of past decisions and do not represent current expenses. Further, depreciation and amortization are not cash-sensitive and therefore, only partly relevant from a risk perspective. Another reason for the exclusion of depreciation is its dilution impact on operating costs perspective. Depreciation is a result of investments in fixed assets. When considering these expenses, the share in fixed assets may have a large influence on the operating leverage proxies. For instance, service companies with low levels of fixed assets, may have a low operating leverage even though their cost structure is very rigid because they have many employees. On the other side, investments in tangible assets may cause expenses, which are part of COGS or SGA. Such expenses are of interest, not the resulting depreciation over a defined time period. For instance, expenses resulting from a contract with a supplier which delivers raw material to the production site, belong to COGS and are therefore considered. Or the expenses for the new controlling officer which oversees the new production site, belongs to SGA and are considered, too. Such expenses which occur during a fiscal year are of interest and taken into account. These considerations which lead to the exclusion of depreciation and amortization expenses comply with the definition of fixed costs according to Brummet (1955). Fixed costs are period costs, and they are recorded against sales during the period they are incurred. Depreciation and amortization expenses do not comply with this definition of fixed costs.

Under the assumptions that COGS reflect variable and SGA fixed costs, the following formula is a reasonable starting point to approximate the properties of a company's cost structure.

$$Costr = \frac{Sales - COGS}{Sales - COGS - SGA} \tag{24}$$

Formula (24) is the testable version of formula (1) on page 32. The numerator estimates the contribution margin and the denominator is equal to the operating profit. Costr(1y) uses actual figures for one year. Costr(5ya) is based on five-year moving averages of gross profit and operating income; moving time windows smooth the effect of outliers. Additionally, only companies with positive gross profits and operating income are taken into account. With moving time windows, a one-year negative operating profit loses its influence. Formula (24) is a snapshot of the cost structure. It does not consider variations or changes in the relation between the variables.

Compared to formula (24), there are other approaches to capturing the dynamics of the production process. For instance, Lev (1974) approximates the cost structure with a regression analysis of operating costs and sales. This approach is further developed in two ways. First, instead of absolute values of sales and operating costs, the logarithms of the two factors or their yearly changes are used as input variables in regressions.

$$var_{j,t}^{opcost} = a_{j,t} + Costr_{j,t} \times var_{j,t}^{Sales} + \epsilon_{j,t} \tag{25}$$

$Var_{j,t}^{opcost}$ is either the logarithm of total operating costs or the yearly change in total operating costs. The same alternatives for $var_{j,t}^{Sales}$ are utilized as right-hand-side variables. The abbreviation of the approximation based on the absolute values is Costr(absolute), the other proxy is called Costr(change) because changes in operating costs and change in sales are utilized. This utilization of changes in the considered variables refers to Kahl et al. (2011).

The regressions are conducted for each company separately on a five-year moving time window. The coefficients $Costr_{j,t}$ are therefore available on a yearly basis after the first year of the five-year time window. This aspect is indicated by the term t in $Costr_{j,t}$. The term j refers to firms. This approach allows changes in the cost structure to be tracked and is therefore superior to the method of Lev (1974). Garcia-Feijoo and Jorgensen (2010) also run regressions using a five-year moving time window and Gulen et al. (2008) use three-year moving time windows. This is an advantage when assessing the relation between a company's cost structure and risk metrics. Lev (1974) also mentions that the characteristics of the cost structure vary over time. To address this time aspect, Lev (1974) runs regressions for different time periods.

Costr(absolute) is a further development of the approach defined by Lev (1974). According to Granger and Newbold (1974), regressions with absolute values lead often to spurious outputs. Granger and Newbold (1974) argue that regressions based on absolute values of the variables result in very large R^2 values, which undermines the quality of the regressions. They suggest working more often with logarithms or changes of the variables. Table 83 on page 187 shows the results of three types of regressions. Conducting cross-sectional regression with the logarithms of the absolute values of total operating costs and sales, gives an R^2 of 99% compared to an R^2 of 81% for the regression based on changes of the two variables.

The factors of interest for the approximations are the coefficients of the regressions. In table 83 on page 187, the format of the variables varies between the regressions. The first regression uses actual numbers. A one unit increase in sales leads to a change of operating costs according to the coefficient. In the second regression, the coefficient measures the elasticity of operating costs regarding changes in sales. A change of 100% in the logarithm of sales, leads to a change in the logarithms of operating costs of 1 times the coefficient. The coefficients of the third regression in table 83 indicate how much total operating costs change with a unit increase in the sales variable.

From table 83 on page 187 only the second and third regressions are of interest here. The second regression provides coefficients which are named Costr(absolute). The coefficients resulting from the third regression are the input factors for the variable Costr(change). In both regressions, low coefficients indicate a cost structure that is not much influenced by changes in sales. Large coefficients mean the opposite: Changes in sales have a large impact on changes in operating costs. Regarding the differentiation between variable and fixed costs, the logical interpretation is that low coefficients should relate to large levels of fixed costs and vice versa.

Regressions are sensitive to the input variables and the time periods. Both regressions base on a five-year moving time window. This time period seems short, but longer time periods would cause a drastic reduction in the number of firms. Further, measuring changes in variables is prone to generating outliers. Even though the rationale behind the regressions is comprehensible, it is not clear if there is a direct relation to other cost structure proxies.

For this reason, it makes sense to develop another proxy independent of regression problems. Subsection 3.2.4 explains that managers can control the amount of fixed costs. Therefore, it is useful to consider this aspect in the approximation of the cost structure, too. As already explained, formula (24) assumes SGA are fixed. Based on empirical findings and the discussions of section 2.3, it is evident that price multiples, i.e., the ratio of accounting information to market capitalization, are relevant in estimating expected returns. For instance, section 2.3 discusses the significance of the BM ratio. Further, according to Fama (1970) stock markets are efficient. This means that prices absorb all relevant information[27]. So, if prices reflect how the information available affects current prices, then they also consider the influence of the cost structure on earnings and prices. Therefore, the ratio of SGA and market capitalization is an interesting multiple that combines the information content in prices with an accounting characteristic. This proxy is also used in portfolio building. Novy-Marx (2011) utilized the ratio of total operating costs and total assets as proxy for the operating leverage. This proxy and the ratio of SGA and size are similar in respect of their close relation to the productivity of a company. Large ratios may signal low productivity. This aspect of productivity differences among companies in relation to operating leverage considerations is also considered in Brimble and Hodgson (2007), who use the profit margin as proxy for the operating leverage.

Table 9 summarizes the correlations between the proxies. Even though all variables approximate the characteristics of the cost structure, not all proxies are related. There is a strong correlation between Costr(SGA) and Costr(5ya). This means that both proxies are mainly influenced by SGA because SGA are considered in both approximations. The influence of using moving time windows is expressed by the quite low correlation between Costr(1y) and Costr(5ya). The two variables to estimate the cost structure rigidity are correlated. Overall, the diversity of proxies is necessary to capture different aspects of the cost structure.

[27]Fama (1970) mentions three conditions for efficient capital markets: Trading and the process of information gathering do not incur costs, and all market participants agree on the implications of the available information on prices.

	Costr(SGA)	Costr(opcosts)	Costr(1y)	Costr(5ya)	Costr(absolute)	Costr(change)
Costr(SGA)	1.00					
Costr(opcosts)	0.62	1.00				
Costr(1y)	0.08	0.04	1.00			
Costr(5ya)	0.31	0.11	0.15	1.00		
Costr(absolute)	0.08	0.07	0.00	-0.04	1.00	
Costr(change)	0.05	0.07	-0.01	-0.07	0.36	1.00

Table 9: Correlations between cost structure proxies
Table 9 summarizes cross-correlations between cost structure proxies and the proxy used for portfolio building. Further information about SGA and COGS is available in section 4.3. Section 4.5 describes the measurement of cost structure proxies. Subsection 4.2.1 describes the usage of portfolio building in regression analysis.

4.5.3. Adjustments

The proxies utilized in the empirical investigations should be meaningful from a management accounting perspective. Based on the explained assumptions, this is true for the proxy created according to formula (24).

Formula (25) could produce flawed results for different reasons. Of interest here are the coefficients, as they characterize a company's cost structure. So, adjustments are justified if they lead to an increase in meaningfulness of the coefficients. One problem is that the values of the coefficients can either be positive or negative. Positive values indicate that total costs move in the same direction as changes in sales. Positive and significant coefficients indicate a positive association between the variables. Large coefficients mean that changes in sales go hand-in-hand with large increases in operating costs. This implies that companies with large coefficients have cost structures dominated by variable costs. Small coefficients indicate that operating costs vary less with changes in sales, implying that such companies have more rigid cost structures.

A point of discussion is if negative coefficients are realistic in this context. A negative coefficient means than a unit increase in sales goes hand-in-hand with a decrease in operating costs. Negative values only make sense if the company is able to make significant changes in its cost structure. For example, they may indicate a substantial substitution of fixed costs for variable costs with a decrease in total costs at the same time. Even though such drastic adjustments are possible, they should be rare in practice.

This interpretation shows that especially very large or small (negative) values of either proxy cause interpretation problems. To ensure that the proxies fulfill the condition of being meaningful from a management accounting perspective, observations of variables below the 1% or above the 99% percentile are dropped. The findings of Lord (1995) and Lord (1998) speak in favour for these adjustments.

Table 10 summarizes the descriptive characteristics of the proxies. The cost structure proxies reveal different variations. For example, the two cost structure proxies applying formula (24) show very large variations. The mean is larger than the median, indicating that the distribution is skewed to the left. There are only few large observations. The majority of estimates are on the left side of the distribution. This unequal distribution causes problems when working with portfolios sorted by the distribution of values. Because most observations of the values are smaller than the median, building portfolios according to the distribution of the variable leads to large portfolios at the bottom and very small portfolios at the top of the distribution. Table (84) on page 187 shows the number of observations for each decile of the different cost structure proxies. The construction of portfolios according to the variables Costr(1y) and Costr(SGA) does not base on the distribution of each variable. Instead, portfolios with equal number of observations are built. Costr(absolute) and Costr(change) have very similar ranges. The proxy for the operating leverage in Mandelker and Rhee (1984) shows similar properties. With a mean of 3.96 and a median of 1.69, this distribution is also skewed.

	Mean	sd	P25	Median	P75
Costr(1y)	4.15	30.16	1.79	2.50	3.58
Costr(5ya)	3.21	2.51	1.82	2.53	3.66
Costr(absolute)	0.95	0.17	0.89	0.98	1.04
Costr(change)	0.90	0.25	0.79	0.94	1.03
Costr(SGA)	0.36	0.64	0.10	0.21	0.41

Table 10: Properties of cost structure proxies
Table 10 summarizes properties of the cost structure proxies. Section 4.5 describes the measurement of cost structure proxies. None of the variables are truncated.

To conclude, three approximations of the cost structure characteristics are utilized in the following empirical investigations. Costr(absolute) and Costr(change) are the coefficients of regressions with operating costs and sales as input variables. These proxies do not assume that SGA are fixed, and COGS variable costs, but use total operating costs as dependent variable. But, like in the construction of Costr(1y) and Costr(5ya), depreciation and amortization are excluded. Costr(SGA) is the ratio of SGA to market capitalization. It is the only proxy considering market prices. It also assumes that SGA are fixed costs. The sample is adjusted with dropping all companies with Costr(absolute) and Costr(change) below or above the 1% and 99% percentile. Further, the sample is restricted to companies listed on the three main US exchanges. The research hypotheses explained in section 4.1 – these refer to the three research questions described in chapter 1 – are analyzed with the research methodologies discussed in section 4.2. It starts with comparing the before-mentioned approximations of the cost structure rigidity with common approximations of the operating leverage.

5. Empirical Part I: Cost Structure and Operating Leverage

This chapter analyzes the influence of the cost structure approximation on the operating leverage. In a first step the null hypothesis is explained. This refers to the research hypothesis described in subsection 4.1.1. The null hypothesis is formulated denying the relationship expressed in the research hypothesis. The statistical tests produce outputs to reject or not the null hypothesis. If the null hypothesis is rejected, the alternative hypothesis is accepted. The results described in subsections 5.2 and 5.3 are interpreted and put into context in subsection 5.4.

5.1. Null and Alternative Hypothesis

The null and alternative hypotheses can be summarized as follows.

- H_0*: There is no relationship between proxies for the cost structure rigidity and operating leverage proxies.*
- H_a*: There is a relationship between proxies for the cost structure rigidity and operating leverage proxies.*

Section 3.3 sorts different proxies according to their computation method into three categories; namely, point estimates, point-to-point estimates and time-series estimates. First, the most frequently tested approximation of the operating leverage with an elasticity focus is considered in the following investigations. The five-year average of the proxy calculated according to formula (10) on page 40 serves as the dependent variable. This approximation belongs to the category of point-to-point estimates. From the category of time-series estimates, the approaches developed by Mandelker and Rhee (1984) and O'Brien and Vanderheiden (1987) are considered, too. The regressions according to equations (14) on page 45 and (17) on page 46 also use five-year moving time windows.

Section 3.2 explains the factors that influence the operating leverage. Even though it appears self-evident to many academics that the level of fixed costs is the primary factor of influence, the properties of the operating leverage are more ambiguous than generally considered. The fictitious example in section 3.2 shows that the operating leverage is large for companies producing near the breakeven point. As the distance to the breakeven point increases, the operating leverage decreases. So, the proper investigation of the relationship demands the consideration of the distance to breakeven point additional to the cost structure proxy. Formula (2a) on page 33 shows that the breakeven point is the ratio of fixed costs to the contribution margin per unit. Total operating costs are therefore an essential part of the breakeven point analysis. The selected approximation of the distance to the breakeven point is the Margin. It considers total operating costs, too. A high Margin indicates a large distance to the breakeven point. This factor is dependent on industry specifics. Table 7 on page 74 indicates that some industries operate at higher Margins than others. Therefore, each company is assigned to a quintile portfolio based on a comparison of its five-year average EBITDA Margin to the industrial average. EBITDA is chosen because the focus is on operating costs. The 12-industry classification of French (2012) is applied. Companies with low Margins within their industry are assigned to the first quintile. The fifth quintile consists of high Margin companies.

To match the time periods used to calculate the Margin and the proxies of the cost structure, only those proxies with a moving time window of five years are considered. This enables the concurrent impact of the Margin and proxies on the operating leverage to be tested. The dependent variables – proxies of the operating leverage – are also based on a five-year moving time window to ensure there is no time gap between the dependent and independent variables. The expected relation is either positive or negative depending on the kind of proxy. At the least, significant differences between the extreme decile portfolios should be evident to reject the null hypothesis. The regression results obtained using indicator variables show if the extreme portfolios have operating leverages that are distinct from the middle quintile portfolios. The regressions using point estimates of the proxy for single companies and portfolios show if the proxy is a significant explanatory variable of the operating leverage. Table 11 summarizes the expected interaction if the null hypothesis is rejected.

	DOL(ela)	DOL(MR)	DOL(OV)
Costr(5ya)	positive	positive	positive
Costr(absolute)	negative	negative	negative
Costr(change)	negative	negative	negative
Margin	negative	negative	negative

Table 11: Expected interactions between factors of Empirical Part I
Table 11 summarizes the expected interactions between the factors taken into account in chapter 5. The dependent factors are mentioned in column headings.

5.2. Results

Section 5.2 starts with descriptive statistics for cost structure portfolios. Regression analyses provide further information about the significance of the explanatory variables.

	A: Costr(5ya)			B: Costr(absolute)			C: Costr(change)		
	DOL(ela)	DOL(MR)	DOL(OV)	DOL(ela)	DOL(MR)	DOL(OV)	DOL(ela)	DOL(MR)	DOL(OV)
1	1.27	1.30	0.99	3.25	4.16	1.09	1.35	1.31	0.76
2	1.53	1.33	0.91	3.35	4.04	1.22	1.57	1.61	0.88
3	1.39	1.45	0.87	3.24	3.69	1.05	1.42	1.76	1.10
4	2.76	1.64	1.25	3.39	3.10	1.07	1.70	1.79	0.96
5	0.50	1.55	0.49	2.69	2.50	1.08	1.54	1.72	1.03
6	1.47	2.61	-0.14	1.56	1.54	1.02	1.23	1.54	0.99
7	3.23	na	na	0.50	0.64	0.88	1.32	1.09	0.95
8	0.51	na	na	-0.46	-0.17	0.80	1.27	0.86	0.91
9	0.03	na	na	-0.96	-0.67	0.84	1.22	0.86	0.98
10	0.49	-1.56	0.40	-0.50	-0.79	0.85	2.11	0.82	0.75
Total	1.35	1.31	0.97	1.35	1.31	0.97	1.35	1.31	0.97
10-1	-0.78	-2.86	-0.59	-3.76	-4.95	-0.25	0.76	-0.49	-0.01
t-stat	0.45	3.26	0.93	3.54	24.48	1.75	1.12	2.26	0.07

Table 12: DOL proxies across cost structure deciles
Table 12 summarizes time-series averages of DOL proxies across different cost structure deciles. Section 4.5 explains the calculation of cost structure proxies. Each year, all companies are assigned to deciles according to their Costr proxy. Companies in the first decile reveal a flexible cost structure according to Costr(5ya) and a fixed cost structure according to Costr(absolute) and Costr(change). The opposite is true for the top decile. Table 84 displays the number of observations in each decile. Section 3.3 explains the calculation of the operating leverage proxies. A high DOL figure means high elasticity of earnings. Row 10-1 shows the difference between the mean values of the top and bottom deciles. T-stat is based on a t-test to test the significance of the difference between the top and bottom.

Table 12 shows that portfolios sorted by Costr(absolute) reveal patterns for all operating leverage proxies that confirm the expectation. The operating leverage proxies decline continuously from the first to the tenth decile. This means that companies with fixed cost structures, i.e., those in the bottom decile, are more exposed to the operating leverage. The elasticity of earnings is much higher for companies that operate with rigid cost structures. The differences between the tenth and the first decile are different from 0 at the 5% significance level for DOL(ela) and DOL(MR) and at the 10% level for DOL(OV). The variation in DOL(OV) is much lower compared to DOL(MR).

The results for other cost structure proxies are less conclusive. For portfolios sorted by Costr(5ya), DOL(MR) reveals a significant t-stat. For portfolios, sorted by Costr(change), DOL(MR) is also significant and meets the expectation. DOL(ela) seems to be sensitive to outliers. For instance, in panel A decile six and seven reveal very high DOL(ela) compared to deciles eight to ten. The tendency toward outliers of DOL(ela) is true in panel C, too. The top decile shows a DOL(ela) of 2.11 compared to 1.22 for the ninth decile. When excluding the tenth decile, panel C shows a pattern that is consistent with the expectation. With rising Costr(change), DOL(ela) decreases. Because the results displayed in table 12 for Costr(absolute) are convincing, this cost structure proxy is also used for the double-sorting approach.

Costr(absolute)	Margin					
	A: DOL(ela)					
	1	2	3	4	5	All
1	5.11	0.40	5.86	3.72	2.04	3.31
2	7.75	4.42	3.56	2.31	1.81	3.34
3	2.51	2.12	1.67	1.67	1.29	1.85
4	-0.16	0.14	0.36	0.48	0.72	0.31
5	-2.51	-1.98	-0.81	-0.16	0.04	-0.82
All	1.65	1.41	1.34	1.27	1.13	
	B: DOL(MR)					
1	na	5.28	5.57	4.52	3.31	4.09
2	5.56	4.81	4.08	3.27	2.34	3.27
3	2.15	1.98	1.79	1.64	1.39	1.76
4	0.27	0.42	0.44	0.56	0.69	0.50
5	-1.86	-1.27	-0.95	-0.87	-0.13	-0.70
All	1.35	1.40	1.36	1.27	1.21	
	C: DOL(OV)					
1	na	1.01	1.23	1.20	1.13	1.16
2	0.83	1.04	0.95	1.09	1.12	1.07
3	0.91	1.07	1.01	1.01	1.13	1.03
4	0.78	0.81	0.82	0.89	0.98	0.87
5	0.34	0.78	0.75	0.78	1.02	0.85
All	0.85	0.96	0.93	0.97	1.07	

Table 13: DOL proxies across double-sorted cost structure and Margin portfolios
Table 13 summarizes time-series averages of DOL proxies for portfolios double-sorted by Costr(absolute) and Margin. Section 4.5 explains the calculation of Costr(absolute); Margin is the ratio of EBITDA to sales. Portfolios are formed on a yearly basis according to the Costr(absolute) and Margin relative to the industry peer group. These rankings are combined to produce 25 portfolios. From the bottom to top Costr(absolute) quintile, the cost structure becomes more flexible. The number of observations per portfolio varies between 52 and 1889. Margin increases from the bottom to top quintile. For each portfolio, the time-series average of DOL proxies is calculated. Section 3.3 explains the calculation of the DOL proxies. A high DOL figure means high elasticity of earnings.

The relative Margin approximates a company's distance to the breakeven point. As this distance increases, the operating leverage is expected to decline. The rows denoted all in table 13 show if this association holds in practice. DOL(ela) and DOL(MR) exhibit patterns that comply with the expectation. The operating leverage proxies decrease from the first to fifth Margin quintile. As the Margin increases relative to other companies from the same industry, the operating leverage decreases. Only DOL(OV) does not vary among the Margin quintiles.

The double-sorting approach allows the impact of cost structure and Margin on the operating leverage to be tested for different Costr quintiles. For the non-negative DOL(ela), the association holds. There is a decrease in DOL(ela) from the first to the fifth Margin quintiles for the first three Costr(absolute) quintiles. The negative DOL(ela) of Costr quintile three and four do not fit the pattern. A similar pattern is true for DOL(MR). Quintiles one to three show an association with the Margin that is in line with prior belief. The operating leverage proxy steadily decreases. In panel C, the variation in DOL(OV) is small between the Margin quintiles. Within Margin quintiles, the cost structure proxy still differentiates between high and low earnings sensitivities. This is true in panel A, B and C.

The results of the descriptive statistics show that there is an association between cost structure characteristics and the operating leverage. Further, the influence of the Margin is also in line with expectations, at least for some operating leverage proxies. To gain further insight into the relation between the cost structure and the operating leverage, various regressions are conducted.

	DOL(ela)	DOL(MR)	DOL(OV)
$\text{Fixcostr}_{Costr(absolute)}$	1.97***	2.76***	0.11
	(3.05)	(16.80)	(0.95)
$\text{Flexcostr}_{Costr(absolute)}$	-2.11***	-2.05***	-0.15***
	(-7.89)	(-30.91)	(-2.88)
Margin	-1.09**	-0.62***	0.73***
	(-2.48)	(-4.25)	(4.40)
Constant	1.97***	1.85***	0.69***
	(4.43)	(14.21)	(5.38)
R^2	0.01	0.14	0.01
Adjusted R^2	0.01	0.13	0.01
F	5.01	36.78	1.74
Observations	16519	13245	13245

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 14: Costr(absolute) indicator variables and DOL proxies
Table 14 summarizes the results of regressions according to formula (23) on page 68. The dependent variables are various DOL proxies; section 3.3 explains the calculation of these. Fixcostr and flexcostr are indicator variables based on Costr(absolute). Fixcostr is 1 for companies with Costr(absolute) in the lowest quintile, indicating rigid cost structures, and 0 for all others. Flexcostr is 1 for companies with Costr(absolute) in the fifth quintile, indicating flexible cost structures, and 0 for all others. Margin is the five-year average of the ratio between EBITDA and sales. Industry and time dummies are applied and residuals are clustered for companies.

Table 14 shows that the regressions for DOL(ela) and DOL(MR) show results that are in line with prior belief. Fixcostr is significant with positive coefficients. This means that companies in the bottom quintile according to Costr(absolute) have significantly different DOL(ela) and DOL(MR) from the middle quintiles. Flexcostr is significant with negative coefficients in all three regressions. So, companies in the fifth quintiles according to Costr(absolute) show lower operating leverage proxies than companies belonging to the middle quintiles. The Margin regressor is significant and negative in the first two regressions. This is consistent with the expectation because as the Margin increases, the operating leverage decreases.

	DOL(ela)	DOL(MR	DOL(OV)
$Fixcostr_{Costr(change)}$	0.23	0.22**	-0.21**
	(0.84)	(2.27)	(-2.18)
$Flexcostr_{Costr(change)}$	0.18	-0.44***	-0.10*
	(0.95)	(-5.65)	(-1.65)
Margin	-1.16***	-0.54***	0.78***
	(-2.60)	(-3.61)	(4.64)
Constant	1.79***	1.78***	0.68***
	(3.73)	(11.88)	(5.28)
R^2	0.01	0.02	0.01
Adjusted R^2	0.00	0.02	0.01
F	2.86	5.28	1.66
Observations	16519	13245	13245

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 15: Costr(change) indicator variables and DOL proxies
Table 15 summarizes the results of regressions according to formula (23) on page 68. The dependent variables are various DOL proxies; Section 3.3 explains the calculation of these. Fixcostr and flexcostr are indicator variables based on Costr(change). Fixcostr is 1 for companies with Costr(change) in the lowest quintile, indicating rigid cost structures, and 0 for all others. Flexcostr is 1 for companies with Costr(change) in the fifth quintile, indicating flexible cost structures, and 0 for all others. Margin is the five-year average of the ratio between EBITDA and sales. Industry and time dummies are applied and residuals are clustered for companies.

Compared to the results summarized in table 14, the regression outputs in table 15 are less convincing. Fixcostr loses its significance for DOL(ela). The coefficient is negative for DOL(OV), which is contrary to the prior belief. Flexcostr is significant with negative coefficients for DOL(MR) and DOL(OV). These findings are in line with the time-series averages summarized in table 12. Margin is again significant and negative for DOL(ela) and DOL(MR). To conclusively test the relation between the cost structure and the operating leverage, the indicator variables are replaced with point estimates of cost structure proxies.

	DOL(ela)	DOL(MR)	DOL(OV)
Costr(absolute)	-6.74***	-6.86***	-0.53***
	(-15.64)	(-46.49)	(-5.19)
Margin	-1.99***	-1.64***	0.64***
	(-4.48)	(-9.42)	(3.86)
Constant	8.68***	8.52***	1.20***
	(14.76)	(46.00)	(7.26)
R^2	0.04	0.56	0.02
Adjusted R^2	0.04	0.56	0.02
F	10.22	64.38	2.25
Observations	16519	13245	13245

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 16: Costr(absolute) and DOL proxies
Table 16 summarizes the results of regressions according to formula (23) on page 68. The dependent variables are various DOL proxies; section 3.3 explains the calculation of these. Independent variable is the point estimate of Costr(absolute); its calculation is explained in section 4.5. Margin is the five-year average of the ratio between EBITDA and sales. Industry and time dummies are applied and residuals are clustered for companies.

Table 16 summarizes the regression outputs with Costr(absolute). The negative and significant coefficients of Costr(absolute) are in line with expectations; namely, the more flexible the cost structure, the lower the operating leverage. This is exactly what the results in table 16 confirm. The coefficients of Margin are negative and significant only for regressions with DOL(ela) and DOL(MR). So, an increasing Margin is associated with a lower operating leverage for these proxies. This is strong evidence for the offsetting effect of the Margin on the operating leverage.

	DOL(5ya)	DOL(MR)	DOL(OV)
Costr(change)	-0.25	-1.24***	-0.05
	(-1.27)	(-15.45)	(-0.79)
Margin	-1.20***	-1.18***	0.70***
	(-2.64)	(-7.60)	(4.16)
Constant	2.07***	3.03***	0.73***
	(3.90)	(18.06)	(5.10)
R^2	0.01	0.06	0.01
Adjusted R^2	0.00	0.06	0.01
F	2.92	10.85	1.54
Observations	16519	13245	13245

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 17: Costr(change) and DOL proxies
Table 17 summarizes the results of regressions according to formula (23) on page 68. The dependent variables are various DOL proxies. Section 3.3 explains the calculation of DOL proxies. Independent variable is the point estimate of Costr(change). Section 4.5 explains the calculation of Costr(change). Margin is the five-year average of the ratio between EBITDA and sales. Industry and time dummies are considered and residuals are clustered for companies.

A comparison of the findings summarized in table 16 with those in table 17 shows that Costr(change) is significant with the appropriate sign only in the second regression.

Margin fulfills the expectation in the first two regressions. The third regression reveals low F-stats, indicating that, in total, the model does not explain variations in DOL(OV).

5.3. Robustness

In robustness tests, the regressions with point estimates are conducted for portfolios instead of companies. The relevant variables are averaged according to the portfolios built upon Costr(SGA). No time and industry dummies are included. The residuals are clustered at the portfolio level. This controls for dependencies of residuals within a portfolio at different points in time.

	DOL(5ya)	DOL(MR)	DOL(OV)
Costr(absolute)	-5.53***	-5.40***	-0.78***
	(-4.25)	(-11.59)	(-2.87)
Margin	1.37	-0.65**	0.53***
	(1.16)	(-2.78)	(3.01)
Constant	6.40***	6.55***	1.63***
	(4.70)	(14.21)	(5.90)
R^2	0.06	0.38	0.07
Adjusted R^2	0.06	0.38	0.07
F	18.08	68.45	16.28
Observations	650	650	650

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 18: Costr(absolute) and DOL proxies of portfolios
Table 18 summarizes the results of regressions according to formula (23) on a portfolio basis. The dependent variables are various DOL proxies; section 3.3 explains the calculation of these. Independent variable is the point estimate of Costr(absolute); its calculation is explained in section 4.5. Margin is the five-year average of the ratio between EBITDA and sales. Portfolios are constructed using the ratio of SGA to market capitalization explained in subsection 4.2.2.

Table 18 shows that Costr(absolute) is significant with a negative coefficient, confirming that this cost structure proxy explains variations in operating leverage proxies. The negative sign is in line with expectations: The more flexible a cost structure, the lower the operating leverage. A comparison of the results in table 18 with those of regressions at the firm level, see table 16 on page 89, confirms the explanatory power of Costr(absolute), while Margin becomes insignificant in the first regression.

The results in table 19 show that Costr(change) is less convincing in explaining variations in operating leverage proxies than Costr(absolute). The coefficient is negative and significant only for DOL(MR). Contrary to the expectation, the Margin is positive. This is not congruent with the findings in table 17. A comparison of the results of regressions using companies, see table 17 on page 89, with those for portfolios, shows that Costr(change) only remains significant for DOL(MR), but the Margin turns positive.

	DOL(5ya)	DOL(MR)	DOL(OV)
Costr(change)	-0.06	-1.27***	0.04
	(-0.09)	(-5.15)	(0.25)
Margin	3.50***	0.89***	0.86***
	(3.69)	(3.35)	(5.46)
Constant	0.84	2.30***	0.79***
	(1.40)	(9.26)	(4.86)
R^2	0.03	0.11	0.06
Adjusted R^2	0.03	0.10	0.05
F	7.54	31.79	15.47
Observations	650	650	650

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 19: Costr(change) and DOL proxies of portfolios
Table 19 summarizes the results of regressions according to formula (23) on a portfolio basis. The dependent variables are various DOL proxies; section 3.3 explains the calculation of these. Independent variable is the point estimate of Costr(change); its calculation is explained in section 4.5. Margin is the five-year average of the ratio between EBITDA and sales. Portfolios are constructed using the ratio of SGA to market capitalization explained in subsection 4.2.2.

5.4. Interpretation

Chapter 5 discusses the relation between the cost structure proxies and well known proxies for the operating leverage. These tests are necessary because it is unclear how variations in operating costs impact on operating leverage proxies. The results of the descriptive statistics are convincing. There is a clear pattern linking the cost structure and the operating leverage. This is true for Costr(absolute) and Costr(change). The operating leverage proxies decrease from the first to the tenth deciles. The results for Costr(5ya) do not reveal a clear pattern. Applying Costr(absolute) and the relative Margin as criteria for the construction of portfolios shows that both factors differentiate between high and low DOL(ela) and DOL(MR) portfolios. The regressions using indicator variables confirm the findings of the descriptive statistics. In regressions with point estimates at the firm level, the Costr(absolute) variable seems to have most explanatory power. The robustness tests confirm these findings. This variable is superior to the Margin in explaining variations in operating leverage proxies. One reason for the reduction in significance of Margin in robustness tests could be that robustness tests do not consider industry differences. Table 7 on page 74 reveals large differences in this profitability measure among industries.

The results make clear that there is a strong relation between the elasticity of operating costs and the elasticity of earnings. Companies with rigid cost structures reveal larger elasticities of earnings, while companies with cost structures dominated by variable costs reveal lower elasticities. The fit of the regressions varies largely among the different tests. According to the R^2, Costr(absolute) and the Margin explain up to 56% of DOL(MR), but only 2% of DOL(OV). In general, R^2 are marginally larger for regressions at the portfolio level.

Taken as a whole, the results of the empirical investigations lead to the following conclusion:

- *H_0: Rejected.*
- *H_a: Accepted.*

Because there are no other assessments of the drivers of the operating leverage, it is not possible to compare the results. It is also important to bear in mind the limitations outlined in the research design. Some regressions do not show convincing outputs, especially for DOL(OV). This could either be the result of a poor approximation of the cost structure or an inappropriate approximation of the operating leverage. Because it is not possible to define the exact operating leverage, see for instance Dugan and Shriver (1992) for further explanations, it is impossible to decide which approximation flaw is responsible for these results. However, the robustness tests mitigate the impact of measurement errors and confirm the explanatory power of Costr(absolute).

6. Empirical Part II: Earnings Analyses

The first empirical part focuses on the cost structure and its relation to the operating leverage. The results confirm a relation between cost structure proxies and well known operating leverage proxies, and thus justify the use of cost structure proxies in the further investigations.

The investigations in chapter 6 analyze accounting characteristics. Because the cost structure stands between a company's top (sales) and bottom line (operating income), it is relevant to test how its properties influence operating income. From an accounting perspective, it is comprehensible that the cost structure characteristics influence the earnings volatility. If empirical investigations may confirm such interactions, shareholders get to know a factor to estimate earnings sensitivities. Both, shareholders and analysts do not like volatile earnings because volatility makes a company more risky. To differentiate between earnings and profitability, two null hypotheses are part of the investigations.

6.1. Null and Alternative Hypotheses

The first null hypothesis considers earnings.

- $1 - H_0$: *A rigid cost structure is not associated with high volatility in earnings.*
- $1 - H_a$: *A rigid cost structure is associated with high volatility in earnings.*

The second null hypothesis takes profitability figures into account.

- $2 - H_0$: *A rigid cost structure is not associated with high volatility in profitability figures.*

- $2 - H_a$: *A rigid cost structure is associated with high volatility in profitability figures.*

While fundamental analysis offers many different ways to assess the profitability of firms, only standard measurements are tested here; namely, ROA, RONOA and ROE. ROE and ROA are calculated using the net income before extraordinary items. So, compared to the EBIT, the net income considers financial results and tax expenses, too. Because the cost structure is a business characteristic of a firm, a closer relation to the RONOA is expected. To test the first null hypothesis, earnings are estimated using EBITDA and the Margin. The standard deviation of EBITDA is based on the annual changes in EBITDA. This factor is prone to outliers. The reason why the Margin is considered is that measuring the standard deviation of a ratio produces less extreme values.

The standard deviations of these five factors are calculated according to formula (26). Again, five-year moving time windows are used to calculate the standard deviations. x refers to the five measures of earnings and profitability described above.

$$\text{Standard deviation of x} = \sqrt{\frac{\sum (x - \overline{x})^2}{(n-1)}} \tag{26}$$

According to formula (21) on page 52, the multiplication of changes in revenues with the operating leverage causes changes in the operating income. Without changes in sales, the operating leverage can not materialize. Therefore, changes in sales must be considered. Like the considerations about the breakeven point in section 5.1, sales growth is used as factor to build portfolios in the following investigations. Again, the relative five-year average sales growth compared to the industry peer group determines the assignment of each company to growth quintiles. Companies in the first quintile reveal the lowest sales growth within their industry, while companies in the fifth quintile belong to the 20% of companies with the highest sales growth within their industry. The point estimates of changes in sales serve as input variables for different types of regressions. This variable is truncated at the 1% and 99% percentile because of outliers.

Like the considerations in chapter 5, only cost structure proxies with a five-year moving time window are considered. This is necessary in order to match the time periods between the dependent and independent variables. Detailed information about the proxies are given in section 4.5. Table 20 summarizes the expected interactions between the considered factors if the null hypotheses are rejected.

	Volatility of earnings		Volatility of profitability		
	EBITDA(sd)	Margin(sd)	ROE(sd)	ROA(sd)	RONOA(sd)
Costr(5ya)	positive	positive	positive	positive	positive
Costr(absolute)	negative	negative	negative	negative	negative
Costr(change)	negative	negative	negative	negative	negative
Sales(change)	positive	positive	positive	positive	positive

Table 20: Expected interactions between factors of Empirical Part II
Table 20 summarizes the expected interactions between the factors taken into account in chapter 6. The dependent factors are specified in the column headings.

6.2. Results

The second empirical part investigates the relation between a company's cost structure and characteristics of accounting returns. At the center of the investigations is the volatility of such accounting returns, whereby the assessment differentiates between volatility of earnings and volatility of profitability.

	A: Costr(5ya)		B: Costr(absolute)		C: Costr(change)	
	EBITDA(sd)	Margin(sd)	EBITDA(sd)	Margin(sd)	EBITDA(sd)	Margin(sd)
1	61.12%	3.09%	177.77%	8.60%	196.62%	6.97%
2	95.02%	3.12%	168.01%	8.25%	202.17%	6.46%
3	179.54%	4.25%	182.22%	7.28%	172.13%	7.04%
4	223.92%	5.01%	149.84%	6.19%	162.67%	6.14%
5	303.41%	5.23%	122.41%	4.33%	128.89%	4.71%
6	321.18%	6.26%	76.80%	2.24%	87.43%	3.00%
7	301.31%	6.21%	54.78%	2.31%	50.33%	2.03%
8	286.54%	5.51%	64.49%	4.18%	49.55%	2.97%
9	355.02%	5.83%	78.79%	5.32%	64.32%	3.89%
10	339.04%	7.10%	73.17%	5.80%	71.70%	4.97%
Total	85.29%	3.28%	85.29%	3.28%	85.29%	3.28%
10-1	277.92%	4.00%	-104.60%	-2.80%	-124.92%	-2.01%
t-stat	15.33	10.13	5.37	6.51	6.14	4.32

Table 21: Earnings volatility for cost structure deciles
Table 21 summarizes time-series averages of earnings volatility measures across different Costr portfolios. Chapter 4.5 explains the calculation of Costr proxies. Every year, all companies are assigned to deciles according to their Costr proxy. Companies in the first decile reveal a flexible cost structure according to Costr(5ya) and a fixed cost structure according to Costr(absolute) and Costr(change). The opposite is true for the tenth deciles. Table 84 displays the number of observations in each decile. Table 82 describes the calculation of earnings volatility. EBITDA(sd) and Margin(sd) are the standard deviation of each variable, based on a five-year moving time window. These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers. Row 10-1 shows the differences between the mean values of the top and bottom deciles. T-stat is based on a t-test to test the significance of the differences of the bottom and top decile.

Table 21 summarizes the volatility of EBITDA and the Margin across deciles, sorted by the three cost structure proxies. The results show a clear pattern and establish a strong association between the cost structure and the volatility of earnings. These results meet the expectation. Deciles sorted by Costr(5ya) show the most stable pattern. Both volatility measures continuously increase from the bottom to the top decile. The pattern is similar but less stable for deciles sorted by Costr(absolute) and Costr(change). For both proxies, the bottom deciles indicate high volatility in earnings. This is in line with the expectation. The variables decline in value until decile eight. Both volatility factors increase slightly for the last two deciles. However, the differences between the extreme deciles are still significant. All t-stats show that the differences between the extreme deciles are significantly different from zero.

	A: Costr(5ya)			B: Costr(absolute)			C: Costr(change)		
	ROE(sd)	ROA(sd)	RONOA(sd)	ROE(sd)	ROA(sd)	RONOA(sd)	ROE(sd)	ROA(sd)	RONOA(sd)
1	8.61%	3.78%	7.50%	15.50%	7.84%	17.06%	13.71%	6.83%	21.14%
2	10.23%	4.71%	10.18%	15.66%	7.35%	18.01%	13.79%	6.39%	18.80%
3	13.51%	6.36%	15.19%	14.96%	7.33%	18.63%	13.11%	6.57%	16.31%
4	15.70%	7.61%	17.96%	13.58%	6.47%	15.80%	12.49%	6.40%	15.98%
5	17.22%	7.78%	21.05%	11.31%	5.22%	10.46%	10.99%	5.37%	11.72%
6	17.47%	8.66%	22.51%	8.40%	3.66%	7.60%	9.52%	4.33%	8.43%
7	20.71%	8.60%	25.18%	8.13%	3.54%	7.25%	8.26%	3.38%	6.65%
8	16.19%	7.87%	19.48%	10.40%	4.75%	9.08%	9.29%	3.82%	7.63%
9	19.91%	9.21%	22.34%	11.26%	5.07%	9.77%	9.85%	4.50%	8.69%
10	17.29%	9.11%	20.59%	13.71%	6.21%	12.80%	10.96%	4.72%	12.34%
Total	9.64%	4.32%	9.11%	9.64%	4.32%	9.11%	9.64%	4.32%	9.11%
10-1	8.68%	5.34%	13.08%	-1.80%	-1.63%	-4.26%	-2.75%	-2.11%	-8.80%
t-stat	7.19	11.62	7.14	1.40	3.04	1.82	2.14	4.13	2.78

Table 22: Profitability volatility measures for cost structure deciles
Table 22 summarizes time-series averages of earnings volatility measures across different Costr portfolios. Chapter 4.5 explains the calculation of Costr proxies. For each year, all companies are assigned to deciles according to their Costr proxy. Companies in the first decile reveal a flexible cost structure according to Costr(5ya) and a fixed cost structure according to Costr(absolute) and Costr(change). The opposite is true for the tenth deciles. Table 84 displays the number of observations in each decile. Table 82 describes the calculation of profitability volatility measures. ROE(sd), ROA(sd), and RONOA(sd) are the standard deviation of each variable, based on a five-year moving time window. These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers. Row 10-1 shows the difference between the mean values of the top and bottom deciles. T-stat is based on a t-test to test the significance of the differences of the bottom and top decile.

Table 21 reveals a clear association between the cost structure and the volatility of earnings. Because of this association, it is likely that there is a similar relation between the cost structure and the volatility of profitability. Table 22 displays information about these relations. Again, portfolios sorted by Costr(5ya) show a stable pattern. With rising Costr(5ya), the volatility increases. This finding is in line with expectations. Companies with fixed cost structures generate unstable returns compared to companies with flexible cost structures. T-stats for all three volatility measures are significantly different from 0. For some variables, the top decile has a volatility two to three times larger than that of the bottom decile. Table 22 reveals only few t-stats below the threshold of 1.96. The differences in ROE(sd) and RONOA(sd) between the top and bottom deciles for Costr(absolute) are not significantly different from 0. Contrary to prior belief, the ROE(sd) increases after the seventh decile. The same is true for the other two variables. This behavior of volatility is less pronounced for portfolios sorted by Costr(change).

Costr(absolute)	Sales(change)					
	A: EBITDA(sd)					
	1	2	3	4	5	All
1	138.40%	105.00%	218.74%	181.16%	381.19%	172.03%
2	107.62%	130.37%	139.63%	208.17%	307.33%	160.45%
3	75.69%	62.90%	61.35%	87.66%	158.48%	89.19%
4	58.67%	38.43%	39.40%	52.61%	92.19%	56.73%
5	53.40%	46.79%	66.45%	111.58%	193.77%	76.94%
All	76.41%	61.67%	62.26%	82.97%	145.61%	
	B: Margin(sd))					
1	7.23%	7.52%	10.81%	10.67%	12.48%	8.39%
2	4.90%	5.35%	6.86%	8.99%	10.76%	6.53%
3	2.41%	2.12%	2.42%	2.97%	4.12%	2.81%
4	2.35%	2.14%	2.29%	2.82%	3.70%	2.69%
5	4.45%	4.27%	5.39%	7.31%	9.47%	5.47%
All	3.03%	2.68%	2.95%	3.46%	4.35%	

Table 23: Earnings volatility measures across double-sorted portfolios
Table 23 summarizes time-series averages of earnings volatility measures for portfolios double-sorted by Costr(absolute) and Sales(change). Chapter 4.5 explains the calculation of Costr(absolute). Sales(change) is measured annually. Portfolios are formed on a yearly basis according to the Costr(absolute) and Sales(change) relative to the industry peer group. These rankings are combined to produce 25 portfolios. From the bottom to top Costr(absolute) quintile, the cost structure becomes more flexible. Sales(change) increase from the bottom to top quintile. The number of observations per portfolio varies between 44 and 1844. For each portfolio, the time-series average of earnings volatility measures is calculated. Table 82 describes the calculation of earnings volatility variables. EBITDA(sd) and Margin(sd) are the standard deviation of each variable, based on a five-year moving time window. These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers.

The impact of the cost structure on earnings only materializes when sales vary. Formula (21) explains this relation between changes in sales, operating leverage and changes in earnings. To better analyze the joint effect of sales and the characteristics of the cost structure, portfolios are double-sorted based on the two characteristics. Table 23 summarizes the results for Costr(absolute).

The row denoted All in table 23 shows that the top quintiles, which consist of companies with the largest changes in sales relative to the industry peer group, have higher earnings volatility than the bottom quintiles. This difference for EBITDA(sd) is quite large. The volatility of the top quintile is nearly twice the volatility of the bottom quintile. The difference for Margin(sd) is 50%. When controlling for the influence of Costr(absolute) on volatility, the differences between sales quintiles emerge. As variation in sales rises, the volatility of the variables increases. This is true for EBITDA(sd) and Margin(sd). This means that earnings volatility for companies with similar cost structure characteristics depends on the differences in Sales(change). According to the results in table 23, the association between Sales(change) and volatility seems stronger for companies with rigid cost structures.

Costr(absolute)	Sales(change)					
	A: ROE(sd)					
	1	2	3	4	5	All
1	14.41%	13.05%	18.18%	17.18%	21.17%	15.59%
2	12.35%	12.49%	13.79%	15.48%	19.09%	14.03%
3	10.49%	7.79%	7.71%	8.94%	11.13%	9.19%
4	10.07%	7.31%	7.15%	8.13%	10.32%	8.59%
5	12.31%	9.16%	11.55%	13.70%	17.48%	12.06%
All	10.87%	8.29%	8.29%	9.24%	11.54%	
	B: ROA(sd)					
1	7.28%	6.63%	8.54%	7.72%	9.79%	7.56%
2	5.78%	5.86%	6.97%	7.64%	9.31%	6.74%
3	4.33%	3.38%	3.50%	4.09%	5.15%	4.08%
4	3.89%	3.06%	3.23%	3.87%	4.77%	3.78%
5	4.86%	4.06%	5.32%	6.90%	8.82%	5.45%
All	4.54%	3.63%	3.81%	4.33%	5.35%	
	C: RONOA(sd)					
1	16.12%	14.05%	18.42%	21.62%	28.43%	17.62%
2	11.17%	12.52%	16.20%	19.91%	33.55%	16.72%
3	6.83%	6.09%	7.26%	8.92%	12.69%	8.38%
4	5.69%	5.94%	6.59%	8.07%	11.30%	7.62%
5	8.05%	7.76%	9.32%	15.54%	22.18%	10.77%
All	7.53%	6.97%	7.95%	9.57%	13.77%	

Table 24: Profitability volatility measures across double-sorted portfolios
Table 24 summarizes time-series averages of earnings volatility measures for portfolios double-sorted by Costr(absolute) and Sales(change). Chapter 4.5 explains the calculation of Costr(absolute). Sales(change) are measured annually. Portfolios are formed on a yearly basis according to the Costr(absolute) and Sales(change) relative to the industry peer group. These rankings are combined to produce 25 portfolios. From the bottom to top Costr(absolute) quintile, the cost structure becomes more flexible. Sales(change) increase from the bottom to top quintile. The number of observations per portfolio varies between 44 and 1844. For each portfolio, the time-series average of earnings volatility measures is calculated. Table 82 describes the calculation of profitability volatility measures. ROE(sd), ROA(sd), and RONOA(sd) are the standard deviation of each variable, based on a five-year moving time window. These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers.

Table 24 summarizes time-series averages of profitability measures for portfolios double-sorted according to the properties of the cost structure and Sales(change). The rows denoted All in table 24 show that there are large differences between extreme quintiles solely for RONOA(sd). The top sales quintile shows a volatility nearly double that of the bottom quintile. ROA(sd) is approximately 20% higher and ROE(sd) only 6% higher. Similar to the findings in table 23, the differences become more transparent when controlling for Costr(absolute). For each profitability measure, the top quintile shows a larger volatility compared to the bottom quintile. The difference varies between 2.5% and 200%. For ROE(sd), this differentiation power of Sales(change) is stronger for the extreme Costr(absolute) quintiles. For ROA(sd) and RONOA(sd), this is not the case. These results lead to the conclusion that Sales(change) is a factor influencing the volatility of profitability. When controlling for changes in sales, the difference in volatilities between the bottom and top Costr(absolute) quintiles leads the conclusion that the properties of the cost structure influence earnings volatility, too. However, contrary to the expectation, the top quintiles reveal volatilities slightly higher than those of the prior quintile.

	EBITDA(sd)	Margin(sd)
$Fixcostr_{Costr(absolute)}$	0.92***	0.05***
	(7.49)	(19.50)
$Flexcostr_{Costr(absolute)}$	0.02	0.02***
	(0.37)	(16.37)
Sales(change)	1.88***	0.05***
	(11.11)	(15.53)
Constant	0.26**	0.02***
	(2.36)	(3.72)
R^2	0.07	0.25
Adjusted R^2	0.07	0.25
F	9.32	41.81
Observations	16884	16892

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 25: Costr(absolute) indicator variables and earnings volatility
Table 25 summarizes the results of regressions according to formula (23) on page 68. The dependent variables are EBITDA(sd) and Margin(sd). Table 82 describes the calculation of earnings volatility variables. These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers. Fixcostr and flexcostr are indicator variables based on Costr(absolute). Fixcostr is 1 for companies with Costr(absolute) in the lowest quintile, indicating rigid cost structures, and 0 for all others. Flexcostr is 1 for companies with Costr(absolute) in the fifth quintile, indicating flexible cost structures, and 0 for all others. Sales(change) is the five-year average of annual changes in sales. Industry and time dummies are applied and residuals are clustered for companies.

The regression results summarized in table 25 display additional information about the patterns evident in table 23. Companies with fixed cost structures according to Costr(absolute) show higher volatility in earnings compared to the middle portfolios. The significance of the fixcostr variable is confirmed by its positive coefficient. Conversely, flexcostr is insignificant in the first regression and significant with a positive coefficient in the second regression. These results do not match the expectations. The positive coefficients in particular contradict prior beliefs because they indicate that the top quintile exhibits a higher Margin(sd) than the middle quintiles. Table 23 already indicates that the top quintile portfolio has rather higher than lower volatility in earnings. The variable Sales(change) is significant with a positive coefficient.

	EBITDA(sd)	Margin(sd)
$Fixcostr_{Costr(change)}$	0.89***	0.03***
	(6.08)	(10.44)
$Flexcostr_{Costr(change)}$	-0.22***	0.01***
	(-3.51)	(4.61)
Sales(change)	1.79***	0.04***
	(10.68)	(13.10)
Constant	0.28**	0.02***
	(2.41)	(4.01)
R^2	0.07	0.19
Adjusted R^2	0.07	0.19
F	8.38	26.23
Observations	16884	16892

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 26: Costr(change) indicator variables and earnings volatility
Table 26 summarizes the results of regressions according to formula (23) on page 68. The dependent variables are EBITDA(sd) and Margin(sd). Table 82 describes the calculation of earnings volatility variables. These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers. Fixcostr and flexcostr are indicator variables based on Costr(change). Fixcostr is 1 for companies with Costr(change) in the lowest quintile, indicating rigid cost structures, and 0 for all others. Flexcostr is 1 for companies with Costr(change) in the fifth quintile, indicating flexible cost structures, and 0 for all others. Sales(change) is the five-year average of annual changes in sales. Industry and time dummies are applied and residuals are clustered for companies.

The outputs in the table 26 are based on regressions with Costr(change) indicator variables. The results are comparable with those in table 25. The fixcostr indicator variable is positive and significant for both regressions. Contrary to the regressions with Costr(absolute), even flexcostr meets the expectations for EBITDA(sd). Again, the regressor Sales(change) is statistically significant with positive coefficients.

	ROE(sd)	ROA(sd)	RONOA(sd)
$Fixcostr_{Costr(absolute)}$	0.05***	0.03***	0.09***
	(7.34)	(10.25)	(6.75)
$Flexcostr_{Costr(absolute)}$	0.03***	0.01***	0.02***
	(4.82)	(6.36)	(3.10)
Sales(change)	0.05***	0.03***	0.17***
	(5.61)	(9.37)	(10.32)
Constant	0.08***	0.02***	-0.03***
	(8.98)	(8.20)	(-4.13)
R^2	0.06	0.14	0.11
Adjusted R^2	0.06	0.14	0.11
F	11.82	21.63	11.57
Observations	16920	16917	16867

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 27: Costr(absolute) indicator variables and profitability volatility
Table 27 summarizes the results of regressions according to formula (23) on page 68. The dependent variables are ROE(sd), ROA(sd), and RONOA(sd). Table 82 describes the calculation of profitability volatility variables. These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers. Fixcostr and flexcostr are indicator variables based on Costr(absolute). Fixcostr is 1 for companies with Costr(absolute) in the lowest quintile, indicating rigid cost structures, and 0 for all others. Flexcostr is 1 for companies with Costr(absolute) in the fifth quintile, indicating flexible cost structures, and 0 for all others. Sales(change) is the five-year average of annual changes in sales. Industry and time dummies are applied and residuals are clustered for companies.

Table 22 already indicates that there is an association – but no clear linear relation – between the volatility of profitability figures and the deciles sorted upon different cost structure proxies. It seems that those portfolios consisting of companies with flexible cost structures, show also high volatility in profitability. The regression results summarized in table 27 confirm these findings from descriptive statistics. Fixcostr is significant with positive coefficients in all three regressions. This means that those companies with rigid cost structures reveal larger volatilities compared to the middle quintiles. The same results are true for flexcostr. However, fixcostr reveals larger coefficients and therefore, the differences to the middle quintiles are larger. Sales(change) meets prior belief in every regression.

	ROE(sd)	ROA(sd)	RONOA(sd)
$Fixcostr_{Costr(change)}$	0.03***	0.02***	0.09***
	(3.68)	(5.51)	(5.63)
$Flexcostr_{Costr(change)}$	-0.00	0.00	0.00
	(-0.09)	(0.07)	(0.14)
Sales(change)	0.04***	0.03***	0.16***
	(4.90)	(8.41)	(9.90)
Constant	0.08***	0.03***	-0.03***
	(9.15)	(8.48)	(-3.71)
R^2	0.06	0.12	0.11
Adjusted R^2	0.06	0.12	0.11
F	10.66	18.93	11.12
Observations	16920	16917	16867

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 28: Costr(change) indicator variables and profitability volatility
Table 28 summarizes the results of regressions according to formula (23) on page 68. The dependent variables are ROE(sd), ROA(sd), and RONOA(sd). Table 82 describes the calculation of profitability volatility variables. These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers. Fixcostr and flexcostr are indicator variables based on Costr(change). Fixcostr is 1 for companies with Costr(change) in the lowest quintile, indicating rigid cost structures, and 0 for all others. Flexcostr is 1 for companies with Costr(change) in the fifth quintile, indicating flexible cost structures, and 0 for all others. Sales(change) is the five-year average of annual changes in sales. Industry and time dummies are applied and residuals are clustered for companies.

There is evidence for a relation between cost structure and volatility of profitability in table 28. Fixcostr is significant with positive coefficients in all three regressions. This is in line with expectations. Flexcostr is not significant, indicating no clear differences between the top and middle quintile portfolios. Sales(change) meets the expectation in all three regressions.

The regressions with indicator variables show that especially companies with rigid cost structures have high volatilities in earnings and profitability figures. Less clear is the relation for companies with flexible cost structures. To better understand these interrelations, the regressions are rearranged with point estimates of the cost structure proxies.

	EBITDA(sd)	Margin(sd)
Costr(absolute)	-1.73***	-0.05***
	(-14.78)	(-16.71)
Sales(change)	1.91***	0.04***
	(11.60)	(14.88)
Constant	1.93***	0.07***
	(11.60)	(12.50)
R^2	0.09	0.24
Adjusted R^2	0.09	0.24
F	13.19	29.03
Observations	16884	16892

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 29: Costr(absolute) and earnings volatility
Table 29 summarizes the results of regressions according to formula (23) on page 68. The dependent variables are EBITDA(sd) and Margin(sd). Table 82 describes the calculation of earnings volatility variables. These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers. Chapter 4.5 explains the calculation of Costr(absolute). Sales(change) is the five-year average of annual changes in sales. Industry and time dummies are applied and residuals are clustered for companies.

Table 29 shows that Costr(absolute) meets the expectation. The negative and significant coefficients indicate that as Costr(absolute) increases – indicating increasing flexibility of the cost structure – the volatility in earnings decreases. Sales(change) is significant with positive coefficients.[28]

	EBITDA(sd)	Margin(sd)
Costr(change)	-1.31***	-0.04***
	(-14.18)	(-20.29)
Sales(change)	1.74***	0.04***
	(10.73)	(13.64)
Constant	1.45***	0.06***
	(10.32)	(9.97)
R^2	0.10	0.27
Adjusted R^2	0.10	0.27
F	12.10	36.12
Observations	16884	16892

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 30: Costr(change) and earnings volatility
Table 30 summarizes the results of regressions according to formula (23) on page 68. The dependent variables are EBITDA(sd) and Margin(sd). Table 82 describes the calculation of earnings volatility variables. These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers. Chapter 4.5 explains the calculation of Costr(change). Sales(change) is the five-year average of annual changes in sales. Industry and time dummies are applied and residuals are clustered for companies.

[28] The significance of Sales(change) is confirmed in regressions replacing the cost structure proxies with the operating leverage proxies. DOL(MR) is also significant with positive signs, what is congruent with expectations, for EBITDA(sd) and Margin(sd), whereas DOL(ela) is significant only in explaining EBITDA(sd). DOL(OV) does not have any explanatory power. The number of observations is lower because these proxies exclude companies generating losses. Negative earnings amplify variations of the left-hand-side variables what may explain the results for the operating leverage proxies.

Replacing Costr(absolute) with Costr(change) confirms the expected relation between the cost structure and earnings volatility. Table 30 shows that all variables meet the expectations. Costr(change) is significant and negative for both regressions. With rising changes in sales, the volatility of earnings increases.

	ROE(sd)	ROA(sd)	RONOA(sd)
Costr(absolute)	-0.06***	-0.04***	-0.11***
	(-8.80)	(-12.05)	(-8.86)
Sales(change)	0.05***	0.03***	0.17***
	(5.40)	(9.25)	(10.34)
Constant	0.14***	0.06***	0.09***
	(13.56)	(15.18)	(6.11)
R^2	0.07	0.14	0.11
Adjusted R^2	0.06	0.14	0.11
F	12.96	22.79	11.83
Observations	16920	16917	16867

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 31: Costr(absolute) and profitability volatility
Table 31 summarizes the results of regressions according to formula (23) on page 68. The dependent variables are ROE(sd), ROA(sd), and RONOA(sd). Table 82 describes the calculation of profitability volatility variables. These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers. Chapter 4.5 explains the calculation of Costr(absolute). Sales(change) is the five-year average of annual changes in sales. Industry and time dummies are applied and residuals are clustered for companies.

Table 31 summarizes the regression results using volatility of profitability as the dependent variable. Costr(absolute) is significant with a negative sign in all three regressions. This confirms that the characteristics of the cost structure influences the volatility of profitability figures. The negative coefficients indicate that as the degree of flexibility increases, the volatility decreases. This is in line with expectations. Sales(change) also fulfills the expectations.[29]

[29] In regressions with operating leverage proxies as right-hand-side variables, Sales(change) keeps its significance and confirms its relevance. DOL(ela) and DOL(MR) reveal some explanatory power with coefficients close to 0, whereas DOL(OV) is insignificant in all three regressions. The exclusion of companies generating losses could mitigate the explanatory power of these proxies.

	ROE(sd)	ROA(sd)	RONOA(sd)
Costr(change)	-0.04***	-0.03***	-0.09***
	(-7.74)	(-13.65)	(-9.47)
Sales(change)	0.04***	0.03***	0.16***
	(4.73)	(8.33)	(9.82)
Constant	0.12***	0.05***	0.06***
	(11.76)	(14.60)	(5.36)
R^2	0.07	0.15	0.12
Adjusted R^2	0.06	0.15	0.12
F	12.56	24.98	11.52
Observations	16920	16917	16867

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 32: Costr(change) and profitability volatility
Table 32 summarizes the results of regressions according to formula (23) on page 68. The dependent variables are ROE(sd), ROA(sd), and RONOA(sd). Table 82 describes the calculation of profitability volatility variables. These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers. Chapter 4.5 explains the calculation of Costr(change). Sales(change) is the five-year average of annual changes in sales. Industry and time dummies are applied and residuals are clustered for companies.

Table 32 summarizes the regression outputs with Costr(change) and Sales(change) as right-hand-side variables. The results for the variable Costr(change) are like those for the proxy Costr(absolute). Costr(change) is significant with a negative coefficient in all regressions. The variable Sales(change) is significant with a positive coefficient.

6.3. Robustness

The regressions testing for robustness are conducted on a portfolio and not a firm level. The time and industry dummy variables are excluded. 25 portfolios are built annually based on Costr(SGA). The dependent and independent variables are averaged across portfolios.

	EBITDA(sd)	Margin(sd)
Costr(absolute)	-5.69	-0.11***
	(-1.49)	(-3.86)
Sales(change)	4.07*	0.05***
	(1.97)	(3.03)
Constant	6.81*	0.13***
	(1.82)	(4.87)
R^2	0.01	0.31
Adjusted R^2	0.01	0.30
F	3.37	9.15
Observations	622	626

t statistics in parentheses
* $p<0.1$, ** $p<0.05$, *** $p<0.01$

Table 33: Costr(absolute) and earnings volatility of portfolios
Table 33 summarizes the results of regressions according to equation (23) on a portfolio basis. The dependent variables are EBITDA(sd) and Margin(sd). Table 82 describes the calculation of earnings volatility variables. Independent variable is the point estimate of Costr(absolute); its calculation is explained in section 4.5. Sales(change) is the five-year average of annual changes in sales. Portfolios are constructed using the ratio of SGA to market capitalization explained in subsection4.2.2.

Table 33 shows that the sales variable seems to have more explanatory power compared to Costr(absolute). Costr(absolute) is significant in explaining variations in Margin(sd), whereas this proxy is not significant for EBITDA(sd). Sales(change) is significant in both regressions.

	EBITDA(sd)	Margin(sd)
Costr(change)	-3.12	-0.10***
	(-0.89)	(-5.40)
Sales(change)	4.12*	0.05***
	(1.88)	(3.11)
Constant	4.17	0.12***
	(1.26)	(6.90)
R^2	0.01	0.37
Adjusted R^2	0.01	0.37
F	3.63	16.65
Observations	622	626

t statistics in parentheses
* $p<0.1$, ** $p<0.05$, *** $p<0.01$

Table 34: Costr(change) and earnings volatility of portfolios
Table 34 summarizes the results of regressions according to equation (23) on a portfolio basis. The dependent variables are EBITDA(sd) and Margin(sd). Table 82 describes the calculation of earnings volatility variables. Independent variable is the point estimate of Costr(change); its calculation is explained in section 4.5. Sales(change) is the five-year average of annual changes in sales. Portfolios are constructed using the ratio of SGA to market capitalization explained in subsection4.2.2.

The results in table 34 are similar to the results in table 33. Costr(change) is significant in the second regression, too. Sales(change) is positive and significant in both regressions.

	ROE(sd)	ROA(sd)	RONOA(sd)
Costr(absolute)	0.11*	0.01	-0.17
	(1.90)	(0.77)	(-1.01)
Sales(change)	0.08***	0.03**	0.53**
	(2.82)	(2.54)	(2.37)
Constant	-0.02	0.03**	0.24
	(-0.38)	(2.12)	(1.31)
R^2	0.05	0.03	0.04
Adjusted R^2	0.04	0.03	0.04
F	6.94	3.32	9.45
Observations	623	623	623

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 35: Costr(absolute) and profitability volatility of portfolios
Table 35 summarizes the results of regressions according to equation (23) on a portfolio basis. The dependent variables are ROE(sd), ROA(sd), and RONOA(sd). Table 82 describes the calculation of profitability volatility variables. Independent variable is the point estimate of Costr(absolute); its calculation is explained in section 4.5. Sales(change) is the five-year average of annual changes in sales. Portfolios are constructed using the ratio of SGA to market capitalization explained in subsection4.2.2.

Table 35 shows the results for regressions using profitability figures as dependent variables. Costr(absolute) has no explanatory power. But, Sales(change) is significant in all regressions.

	ROE(sd)	ROA(sd)	RONOA(sd)
Costr(change)	-0.03	-0.04***	-0.46***
	(-0.69)	(-3.56)	(-2.87)
Sales(change)	0.06**	0.02**	0.48**
	(2.54)	(2.34)	(2.33)
Constant	0.12***	0.08***	0.50***
	(2.87)	(7.33)	(3.06)
R^2	0.03	0.06	0.05
Adjusted R^2	0.03	0.06	0.05
F	4.34	12.20	12.87
Observations	623	623	623

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 36: Costr(change) and profitability volatility of portfolios
Table 36 summarizes the results of regressions according to equation (23) on a portfolio basis. The dependent variables are ROE(sd), ROA(sd), and RONOA(sd). Table 82 describes the calculation of profitability volatility variables. Independent variable is the point estimate of Costr(change); its calculation is explained in section 4.5. Sales(change) is the five-year average of annual changes in sales. Portfolios are constructed using the ratio of SGA to market capitalization explained in subsection4.2.2.

According to the results in table 36, the proxy Costr(change) seems to be superior to Costr(absolute) in explaining variations in profitability figures. Costr(change) is significant with the correct sign for ROA(sd) and RONOA(sd). Again, Sales(change) remains significant.

Taken as a whole, the results for regressions at the portfolio level are to some degree less convincing than the results at the firm level. In particular, Costr(absolute) losses its explanatory power. The results for Costr(change) are more robust. Sales(change) remains significant in most regressions.

6.4. Interpretation

Chapter 6 investigates the accounting relation expressed in formula (21) on page 52 using different cost structure proxies. Various variables are used to estimate the volatility of earnings and profitability figures.

The descriptive statistics reveal a strong association between the degree of rigidity and the volatility of earnings. For example, t-stats of the differences between the extreme deciles for all volatility measures and across the three cost structure proxies are significant. But, there are slight tendencies for rising volatilities after decile seven. This indicates a nonlinear relation, evident for portfolios sorted by Costr(absolute) and Costr(change). In double sorting using changes in sales, it is evident that variations in a company's top line figure differentiates between high and low earnings volatility when controlling for the cost structure. Regressions using indicator variables show that especially the fixcostr variable fulfills the expectations. Thus, those companies with particularly rigid cost structures show high volatilities. The regressions using point estimates make clear that Costr(absolute) and Costr(change) have a significant influence on the volatility of earnings.

The results for volatility in profitability figures are similar, with the major difference being that the volatility of profitability and the cost structure do not show a linear relation. Those companies with very flexible cost structures reveal quite significant volatility in profitability figures. Further, Sales(change) has an unambiguous impact on the volatility. With rising changes in sales, the volatility of profitability increases. Regressions using point estimates show that the proxies for the cost structure are significant influence factors. The robustness tests indicate that Costr(change) is more robust than Costr(absolute) in explaining volatilities.

In conclusion, the assessments of the relations confirm formula (21) on page 52. Companies with rigid cost structures and variations in product demand are confronted with severe earnings and profitability volatilities. This is an important finding for management, shareholders and analysts alike. These interpretations lead to the following conclusions for the first null hypothesis

- $1 - H_0$: *Rejected.*
- $1 - H_a$: *Accepted.*

and for the second null hypothesis.

- $2 - H_0$: *Rejected.*
- $2 - H_a$: *Accepted.*

Another aspect influencing these portfolio volatilities is the proportion of companies generating operating losses. Because the calculation of the standard deviation considers all observations, negative operating income enhances the volatility of accounting returns because it increases the variations in the variables.

	A: Costr(absolute)			B: Costr(change)		
	Observations	Losses	in %	Observations	Losses	in %
1	170	47	27.65%	142	26	18.31%
2	249	57	22.89%	265	43	16.23%
3	487	83	17.04%	505	92	18.22%
4	1011	141	13.95%	1059	161	15.20%
5	2433	213	8.75%	2140	276	12.90%
6	6503	305	4.69%	5300	448	8.45%
7	4906	306	6.24%	6197	270	4.36%
8	1235	153	12.39%	1395	61	4.37%
9	398	64	16.08%	407	25	6.14%
10	198	45	22.73%	180	12	6.67%
Total	17590	1414	8.04%	17590	1414	8.04%

Table 37: Numbers of observations with losses across Costr-deciles
Table 37 summarizes the number of observations and those with negative operating income across Costr deciles. EBIT is considered as factor for operating income. Chapter 4.5 explains the calculation of Costr proxies. For each year, all companies are assigned to deciles according to their Costr proxy. Companies in the first decile reveal a fixed cost structure. The opposite is true for the tenth deciles. Table 84 displays the number of observations in each decile.

Table 37 shows that companies with fixed cost structures are more likely to generate negative operating income. This is true for both cost structure proxies. Costr(change) shows a linear relation to the share of negative income. Conversely, the top deciles according to Costr(absolute) have a higher ratio of losses compared to the middle portfolios. This aspect partly explains the nonlinear relation between the degree of rigidity and the volatility of profitability figures that is true for Costr(absolute) portfolios. Similar to the empirical investigations in chapter 5, there are also no other research results with which to compare the findings of chapter 6.2.

7. Empirical Part III: Total and Systematic Risk

The findings of chapter 6 support the accounting relation expressed in formula (21), namely, there is an association between the cost structure and the volatility of accounting returns. These findings combined with the discussions in subsection 3.4.2 lay the foundations for this third empirical part, which takes risk considerations based on capital market information into account. The introduction of the capital market perspective extends the research context beyond management accounting.

7.1. Null and Alternative Hypotheses

In modern finance one differentiates between total and systematic risk. Total risk is the starting point of the investigations in this empirical part. Subsection 3.4.1 explains the decomposition of CAPM into its company-specific drivers. When excluding the financial aspect as a driver, the unlevered beta is the correct comparative rule. The following hypotheses consider these three risk parameters.

The first hypothesis focuses on total risk.

- $1-H_0$: *A rigid cost structure is not associated with volatility in stock returns.*
- $1-H_a$: *A rigid cost structure is associated with volatility in stock returns.*

Hypotheses two and three switch focus to systematic risk.

- $2-H_0$: *A rigid cost structure is not associated with beta.*
- $2-H_a$: *A rigid cost structure is associated with beta.*
- $3-H_0$: *A rigid cost structure is not associated with unlevered beta.*
- $3-H_a$: *A rigid cost structure is associated with unlevered beta.*

The standard deviation of the stock returns is calculated for each company individually based on annual monthly returns. Then, beta is calculated for each company individually by regressing monthly returns on the returns of a broad stock market index. The following formula (27), which is based on formula (18) on page 48, expresses the regression to approximate beta.

$$r_{j,t} - r_{risk-free} = a_{j,t} + \beta_{j,t}(r_{M,t} - r_{risk-free}) + \epsilon_{j,t} \quad (27)$$

The returns of the dependent variable and the market portfolio are defined as excess returns. This regression is conducted using 12-month moving time windows. The risk-free rate is the yield of the 30-day T-bill. The proxy of the market portfolio is the value-weighted return with dividends reinvested of the S&P 500. The factor of interest is the coefficient of the regression, namely beta.

Beta is the ratio of the covariance of a company's returns with the index returns and the variance of the index return. It measures how much returns vary compared to the index. The regression results provide monthly betas for each firm based on the covariances of the returns of the previous 12 months. To be able to compare these monthly figures with the annual fundamentals, the December betas are used. This allows beta and the fundamentals of the firms to be tested for the same time period. The unlevered beta is calculated according to the formula (20) on page 49. It follows the approach of Damodaran

(2005). Because the cost structure and operating leverage are distinct from a company's financial leverage, it makes sense to consider the unlevered beta, too[30].

The decomposition of beta into influence factors provides the foundation for the selection of the appropriate parameters. As discussed in subsection 3.4.1, Lev (1974), Gahlon and Gentry (1982), Mandelker and Rhee (1984) and Chung (1989) all aim to determine these factors based on models derived from formulas (18) and (19). A common feature across all their models is that beta is not just a function of accounting characteristics but also business risk.

Business risk captures the dependence of a company's revenues on the state of the economy. This dependence is measured using the correlation coefficient between a company's revenues and total revenues of its industry peers (Sales(cor)). This relation is measured using a five-year moving time window. A large dependence implies higher risk for shareholders. The alternative figure is the variation in sales (Sales(sd)). Large fluctuations in sales are the results of permanently shifting demand dynamics. Again, higher volatility implies higher risk. The standard deviation of sales is measured according to formula (26). A five-year moving time period is used.

The two accounting factors applied are the financial and operating leverage. The financial leverage is the ratio of total debt to common equity. The expectation is that as leverage increases, the riskiness increases, too. The alternative is the equity ratio. A negative association between this variable and riskiness is expected. The financial leverage is excluded when explaining variations in the unlevered beta. Instead of the operating leverage, the cost structure proxies are used. This empirical part is a further development of the examinations in chapter 6. Thus, the same cost structure proxies are used. No regressions with indicator variables are conducted, but regressions at the portfolio level for robustness tests. Table 38 summarizes the interactions between the considered variables if the null hypotheses are rejected.

	Return(sd)	Beta	Beta(ul)
Costr(5ya)	positive	positive	positive
Costr(absolute)	negative	negative	negative
Costr(change)	negative	negative	negative
Leverage	positive	positive	positive
Equity ratio	negative	negative	negative
Sales(cor)	positive	positive	positive
Sales(sd)	positive	positive	positive

Table 38: Expected interactions between factors of Empirical Part III
Table 38 summarizes the expected interactions between the factors taken into account in chapter 7. The dependent factors are specified in the column headings.

[30]For further discussion about the difference between levered and unlevered beta see, for example, Fernandez (2003). Fernandez (2003) calls formula (20) on page 49 the practitioners method. This term refers to the formula's simplification of the complex relation between the two types of beta.

7.2. Results

To gain a first impression of the relation between the risk figures and the cost structure, time-series averages of these figures are calculated for different cost structure portfolios.

	A: Costr(5ya)			B: Costr(absolute)			C: Costr(change)		
	Return(sd)	Beta	Beta(ul)	Return(sd)	Beta	Beta(ul)	Return(sd)	Beta	Beta(ul)
1	10.87%	1.06	0.72	13.28%	1.02	0.81	13.05%	1.22	0.89
2	12.49%	1.11	0.80	12.99%	1.25	0.89	13.03%	1.03	0.77
3	14.12%	1.06	0.81	13.17%	1.16	0.89	13.52%	1.19	0.90
4	15.14%	1.18	0.89	12.68%	1.21	0.90	12.86%	1.18	0.89
5	15.97%	1.22	0.97	12.15%	1.16	0.84	12.25%	1.16	0.84
6	16.02%	1.25	1.13	11.45%	1.07	0.75	11.81%	1.11	0.79
7	17.73%	1.16	0.86	11.17%	1.02	0.69	11.04%	1.03	0.69
8	15.41%	1.46	1.19	11.54%	1.07	0.71	10.77%	0.97	0.65
9	15.86%	1.36	1.05	11.47%	1.04	0.68	11.21%	0.96	0.67
10	16.94%	1.21	0.99	12.37%	1.06	0.64	11.99%	1.06	0.72
Total	11.64%	1.08	0.75	11.64%	1.08	0.75	11.64%	1.08	0.75
10-1	6.07%	0.14	0.27	-0.91%	0.04	-0.17	-1.06%	-0.16	-0.17
t-stat	8.40	1.03	2.68	1.32	0.27	1.74	1.64	1.22	1.75

Table 39: Total and systematic risk for cost structure deciles
Table 39 summarizes time-series averages of standard deviation of stock returns, beta and unlevered beta across different Costr-deciles. Chapter 4.5 explains the calculation of Costr proxies. For each year, all companies are assigned to a decile according to their Costr proxy. Companies in the first decile reveal a flexible cost structure according to Costr(5ya) and a fixed cost structure according to Costr(absolute) and Costr(change). The opposite is true for the tenth deciles. Table 82 describes the calculation of Return(sd), beta and beta(ul) according to formulas (26), (27) and (20). These variables are truncated at the 1% and 99% percentile to mitigate the impact of outliers. Row 10-1 shows the difference between the mean values of the top and bottom deciles. T-stat is based on a t-test to test the significance of the differences of the first and tenth deciles.

The time-series averages summarized in table 39 show mixed results. The t-stat of the differences between the extreme portfolios for Return(sd) are significantly different from 0 in panel A. Return(sd) develops in line with expectations up to the seventh decile for Costr(5ya), after which the trend changes. This pattern is true for all three cost structure proxies. Regarding beta, none of the three t-stats is significant. Deciles sorted by Costr(change) show the largest difference in beta between the extreme portfolios followed by Costr(5ya). In panel B, the bottom decile reveals a very low average beta of 1.02. Compared to the values of the next three deciles, this low beta does not fit the pattern. The patterns regarding beta(ul) are clearer. Costr(5ya) and Costr(absolute) differentiate between high and low beta(ul). In general, none of the three cost structure proxies clusters all three risk metrics in line with expectations. Regarding beta and beta(ul), the pattern indicates a nonlinear relation, whereby betas cluster within the bottom and top half of the deciles. Further, beta(ul) is smaller compared to the levered betas because of the financial leverage adjustment. The differences between the first and tenth deciles are larger for beta(ul) compared to the differences for beta. This indicates lower leverage ratios for companies with fixed cost structures. Table 40 summarizes two leverage factors to gain further information about this interrelation.

	A: Costr(5ya)		B: Costr(absolute)		C: Costr(change)	
	Leverage	Equity ratio	Leverage	Equity ratio	Leverage	Equity ratio
1	0.72	50.24%	0.83	56.48%	0.75	54.63%
2	0.63	52.52%	0.64	57.37%	0.70	55.22%
3	0.65	52.97%	0.65	56.42%	0.58	57.97%
4	0.60	55.21%	0.62	56.03%	0.61	57.58%
5	0.52	53.78%	0.61	53.31%	0.63	55.53%
6	0.44	58.22%	0.65	50.97%	0.65	51.85%
7	0.50	55.66%	0.73	49.17%	0.73	47.41%
8	0.69	53.62%	0.83	48.79%	0.76	49.78%
9	0.61	50.79%	0.87	49.16%	0.73	51.85%
10	0.74	57.64%	0.86	47.52%	0.87	50.61%
Total	0.69	51.13%	0.69	51.13%	0.69	51.13%
10-1	0.03	7.40%	0.03	-8.96%	0.12	-4.02%
t-stat	0.22	2.92	0.24	4.17	1.11	1.71

Table 40: Financial leverage indicators across cost structure deciles
Table 40 summarizes time-series averages of the financial leverage and equity ratio across different Costr deciles. Chapter 4.5 explains the calculation of Costr proxies. For each year, all companies are assigned to a decile according to their Costr proxy. Companies in the first decile reveal a flexible cost structure according to Costr(5ya) and a fixed cost structure according to Costr(absolute) and Costr(change). The opposite is true for the tenth deciles. Leverage ratio is total debt, excluding other liabilities and deferred taxes, divided by equity. The equity ratio measures the proportion of equity to total assets. Row 10-1 shows the difference between the mean values of the top and bottom deciles. T-stat is based on a t-test to test the significance of the differences of the first and tenth deciles.

The relation between the financial and operating leverage is assumed to be negative, see for instance Ferri and Jones (1979) and Huffman (1989). Table 40 shows time-series averages of two financial leverage figures. The results of panels A and B tend to confirm this tradeoff hypothesis. However, the first two deciles in panels B and C do not match the broader picture. Even though there is only one significant t-stat, it seems that companies with rigid cost structures tend to have lower exposure to the financial leverage. This conclusion is congruent with the findings of Kahl et al. (2011)[31]. Therefore, the differences in leverage ratios explain the large differences in beta(ul) between the extreme deciles according to Costr(absolute) and Costr(change).

The descriptive statistics reveal a mixed picture regarding the association between the characteristics of the cost structure and risk aspects from a capital market perspective. To gain a better understanding of the relations, different regressions are conducted.

[31] The consideration of access to capital markets changes the picture to some degree. Kahl et al. (2011) conclude that the negative relation between the operating and financial leverage holds especially for companies with limited access to capital markets.

	Return(sd)		Beta		Beta(ul)	
	1	2	3	4	5	6
Costr(5ya)	0.03***	0.03***	0.01	0.00	0.02*	0.02
	(16.26)	(15.33)	(0.60)	(0.30)	(1.65)	(1.56)
Leverage	0.01***		0.03*			
	(5.73)		(1.77)			
Sales(cor)	0.00		0.01		0.01	
	(0.78)		(1.00)		(0.86)	
Equity ratio		-0.02**		-0.09*		
		(-2.37)		(-1.77)		
Sales(sd)		0.05***		0.12***		0.06***
		(4.14)		(4.96)		(2.69)
Constant	0.02***	0.05***	0.51***	0.54***	0.25***	0.32***
	(2.97)	(9.50)	(10.61)	(11.05)	(4.90)	(9.51)
R^2	0.21	0.22	0.08	0.08	0.09	0.09
Adjusted R^2	0.21	0.22	0.07	0.08	0.09	0.09
F	102.04	103.48	35.28	36.10	38.69	38.94
Observations	17577	17590	17002	17015	17212	17225

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 41: Total and systematic risk and Costr(5ya)
Table 41 summarizes the results of the regressions according to formula (23). Chapter 4.5 explains the calculation of Costr proxies. The dependent variables are the standard deviation of returns, beta and unlevered beta. The standard deviation of return is measured for each firm based on the twelve monthly returns of a year. Beta is measured on a firm basis with a moving 12-month time window. Unlevered beta is computed according to formula (20). Sales(cor) is the five-year moving average correlation coefficient of a company's sales growth with the corresponding industry's sales growth. Leverage is total debt to equity. Equity ratio is the ratio of equity to total assets. Sales(sd) measures the standard deviation of changes in sales with a moving five-year time window. All explanatory variables are in log scale. Industry and time dummies are applied and residuals are clustered for companies.

Table 41 summarizes the results of regressing the three risk parameters on Costr(5ya). Costr(5ya) is significant in explaining variations in Return(sd). In the fifth regression Costr(5ya) is significant at the 10% level, which confirms a relationship with beta(ul). The coefficients are positive, which is in line with the expectation, as is the positive and significant coefficient for financial leverage in regressions one and three. The second proxy for a company's exposure to financial leverage, the equity ratio, is also significant. The coefficients are negative, indicating that a rise in the share of equity leads to a reduction in the riskiness. Sales(sd) is superior to Sales(cor) because of its significant and positive coefficients. Comparing the R^2 of the regressions shows that the model explains a broader variation in total risk than in systematic risk.[32]

[32] Replacing Costr(5ya) with operating leverage proxies reveals comparable results. DOL(MR) is also significant in regressions 1, 2, 5 and 6, but insignificant in explaining beta. DOL(ela) is significant in explaing total risks, whereas DOL(OV) is insignificant in all regressions. Because these proxies exclude companies generating losses, the number of observations is lower. This aspect may influence the regression outputs.

	Return(sd)		Beta		Beta(ul)	
	1	2	3	4	5	6
Costr(absolute)	-0.05***	-0.04***	-0.15**	-0.14**	-0.23***	-0.22***
	(-6.56)	(-5.34)	(-2.38)	(-2.14)	(-4.12)	(-3.94)
Leverage	0.01***		0.03*			
	(5.42)		(1.91)			
Sales(cor)	0.00		0.01		0.00	
	(0.26)		(0.97)		(0.80)	
Equity ratio		-0.02***		-0.10**		
		(-2.69)		(-1.97)		
Sales(sd)		0.05***		0.11***		0.05**
		(4.04)		(4.75)		(2.44)
Constant	0.09***	0.12***	0.62***	0.65***	0.43***	0.49***
	(9.36)	(16.54)	(10.02)	(9.77)	(7.13)	(10.55)
R^2	0.18	0.20	0.08	0.08	0.09	0.09
Adjusted R^2	0.18	0.20	0.08	0.08	0.09	0.09
F	92.90	93.52	35.56	36.36	39.41	39.62
Observations	17577	17590	17002	17015	17212	17225

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 42: Total and systematic risk and Costr(absolute)
Table 42 summarizes the results of the regressions according to formula (23). Chapter 4.5 explains the calculation of Costr proxies. The dependent variables are the standard deviation of returns, beta and unlevered beta. The standard deviation of return is measured for each firm based on the twelve monthly returns of a year. Beta is measured on a firm basis with a moving 12-month time window. Unlevered beta is computed according to formula (20). Sales(cor) is the five-year moving average correlation coefficient of a company's sales growth with the corresponding industry's sales growth. Leverage is total debt to equity. Equity ratio is the ratio of equity to total assets. Sales(sd) measures the standard deviation of changes in sales with a moving five-year time window. All explanatory variables are in log scale. Industry and time dummies are applied and residuals are clustered for companies.

Table 42 shows better results compared to table 41. The cost structure proxy is significant with the correct sign in all six regressions. The negative sign shows that as the value of Costr(absolute) rises, the cost structure becomes more flexible, which indicates a reduction in the riskiness of a company. Therefore, the negative sign fulfills the expectation. Leverage is significant in explaining variations in total risk and systematic risk. The same is true for the equity ratio. Again, Sales(cor) is not significant. Variations in sales, the second proxy for the business risk, is significant with the correct sign in all regressions. The reported R^2 is similar to those shown in table 41.

	Return(sd)		Beta		Beta(ul)	
	1	2	3	4	5	6
Costr(change)	-0.04***	-0.03***	-0.10**	-0.08**	-0.15***	-0.14***
	(-9.52)	(-8.05)	(-2.44)	(-2.10)	(-4.53)	(-4.28)
Leverage	0.01***		0.03*			
	(5.54)		(1.91)			
Sales(cor)	0.00		0.01		0.01	
	(0.61)		(1.06)		(0.97)	
Equity ratio		-0.02***		-0.10**		
		(-3.00)		(-2.01)		
Sales(sd)		0.05***		0.11***		0.05**
		(3.93)		(4.67)		(2.27)
Constant	0.08***	0.11***	0.58***	0.61***	0.37***	0.44***
	(9.67)	(19.09)	(11.46)	(11.31)	(6.79)	(12.52)
R^2	0.18	0.20	0.08	0.08	0.09	0.09
Adjusted R^2	0.18	0.20	0.08	0.08	0.09	0.09
F	95.39	95.16	35.50	36.25	39.45	39.59
Observations	17577	17590	17002	17015	17212	17225

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 43: Total and systematic risk and Costr(change)
Table 41 summarizes the results of the regressions according to formula (23). Chapter 4.5 explains the calculation of Costr proxies. The dependent variables are the standard deviation of returns, beta and unlevered beta. The standard deviation of return is measured for each firm based on the twelve monthly returns of a year. Beta is measured on a firm basis with a moving 12-month time window. Unlevered beta is computed according to formula (20). Sales(cor) is the five-year moving average correlation coefficient of a company's sales growth with the corresponding industry's sales growth. Leverage is total debt to equity. Equity ratio is the ratio of equity to total assets. Sales(sd) measures the standard deviation of changes in sales with a moving five-year time window. All explanatory variables are in log scale. Industry and time dummies are applied and residuals are clustered for companies.

Replacing Costr(absolute) with Costr(change) confirms the satisfying results summarized in table 42. Table 43 reports a significant and negative Costr(change). This is true in all regressions. Therefore, also Costr(change) is associated with the riskiness of company. The results for the other variables are similar to the previously-mentioned results.

7.3. Robustness

In robustness tests, the regressions are conducted at the portfolio level. Portfolios are sorted by Costr(SGA). For each year, 25 portfolios are built according to the rankings of the ratio of SGA to size. All variables, dependent and independent, are averaged within the portfolios. After averaging the variables, the logarithms of these variables are built. This approach reduces measurement errors.

	Return(sd)		Beta		Beta(ul)	
	1	2	3	4	5	6
Costr(5ya)	0.02***	0.03***	-0.00	0.11***	-0.09***	-0.09***
	(3.84)	(6.20)	(-0.02)	(4.18)	(-3.26)	(-3.10)
Leverage	0.03***		-0.03			
	(3.07)		(-1.04)			
Sales(cor)	-0.01		-0.02		0.04	
	(-1.14)		(-0.25)		(0.67)	
Equity ratio		-0.04		1.34***		
		(-0.86)		(6.49)		
Sales(sd)		0.01*		0.06***		0.03
		(1.95)		(3.98)		(1.24)
Constant	0.07***	0.08***	0.72***	-0.02	0.66***	0.65***
	(10.83)	(3.65)	(33.79)	(-0.20)	(18.96)	(16.69)
R^2	0.10	0.08	0.00	0.05	0.02	0.02
Adjusted R^2	0.10	0.07	-0.00	0.05	0.02	0.02
F	28.61	18.75	0.98	21.56	7.72	10.27
Observations	650	650	649	649	650	650

t statistics in parentheses
* $p<0.1$, ** $p<0.05$, *** $p<0.01$

Table 44: Total and systematic risk and Costr(5ya) of portfolios
Table 44 summarizes the results of the regressions according to formula (23) on a portfolio basis. Chapter 4.5 explains the calculation of Costr proxies. The dependent variables are the standard deviation of returns, beta and unlevered beta. The standard deviation of return is measured for each firm based on the twelve monthly returns of a year. Beta is measured on a firm basis with a moving 12-month time window. Unlevered beta is computed according to formula (20). Sales(cor) is the five-year moving average correlation coefficient of a company's sales growth with the corresponding industry's sales growth. Leverage is total debt to equity. Equity ratio is the ratio of equity to total assets. Sales(sd) measures the standard deviation of changes in sales with a moving five-year time window. All explanatory variables are in log scale. Portfolios are constructed using the ratio of SGA to market capitalization explained in subsection4.2.2.

Table 44 shows mixed results. In regressions 1, 2 and 4, Costr(5ya) exhibits the expected significance and positive coefficients. The other results for this variable do not meet the expectation. Leverage is significant in the first regression, whereas the equity ratio reveals significance in regression 4. Sales(sd) is still superior to Sales(cor). Compared to the results in table 41, Costr(5ya) has a positive impact especially on the total risk of a firm.

	Return(sd)		Beta		Beta(ul)	
	1	2	3	4	5	6
Costr(absolute)	0.13*	0.15**	-0.74*	-0.03	-1.29***	-1.28***
	(2.04)	(2.11)	(-1.95)	(-0.06)	(-3.37)	(-3.39)
Leverage	0.03***		-0.02			
	(3.43)		(-0.71)			
Sales(cor)	-0.01		-0.04		0.02	
	(-1.15)		(-0.62)		(0.33)	
Equity ratio		-0.14**		0.84***		
		(-2.49)		(3.44)		
Sales(sd)		0.01		0.05***		0.03
		(1.51)		(3.31)		(1.42)
Constant	0.00	0.07	1.21***	0.36	1.40***	1.39***
	(0.09)	(1.09)	(4.87)	(1.02)	(5.54)	(5.52)
R^2	0.08	0.05	0.01	0.04	0.02	0.03
Adjusted R^2	0.08	0.04	0.00	0.03	0.02	0.02
F	13.27	8.62	3.61	11.69	7.64	11.18
Observations	650	650	649	649	650	650

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 45: Total and systematic risk and Costr(absolute) of portfolios
Table 45 summarizes the results of the regressions according to formula (23) on a portfolio basis. Chapter 4.5 explains the calculation of Costr proxies. The dependent variables are the standard deviation of returns, beta and unlevered beta. The standard deviation of return is measured for each firm based on the twelve monthly returns of a year. Beta is measured on a firm basis with a moving 12-month time window. Unlevered beta is computed according to formula (20). Sales(cor) is the five-year moving average correlation coefficient of a company's sales growth with the corresponding industry's sales growth. Leverage is total debt to equity. Equity ratio is the ratio of equity to total assets. Sales(sd) measures the standard deviation of changes in sales with a moving five-year time window. All explanatory variables are in log scale. Portfolios are constructed using the ratio of SGA to market capitalization explained in subsection 4.2.2.

The results in table 45 are less convincing than those in table 42. For regressions at the firm level, Costr(absolute) is significant with negative coefficients in all regressions. Regarding table 45, Costr(absolute) loses its significance in regression 4. In the first two regressions, the coefficients turn positive. The results for beta(ul) match the expectation.

	Return(sd)		Beta		Beta(ul)	
	1	2	3	4	5	6
Costr(change)	-0.05	-0.07**	-0.37	0.07	-0.70**	-0.68**
	(-1.46)	(-2.12)	(-1.23)	(0.22)	(-2.35)	(-2.21)
Leverage	0.04***		-0.03			
	(3.85)		(-0.90)			
Sales(cor)	-0.02		-0.02		0.05	
	(-1.60)		(-0.34)		(0.99)	
Equity ratio		-0.19***		0.86***		
		(-4.25)		(3.89)		
Sales(sd)		0.01		0.05***		0.03
		(1.23)		(3.23)		(1.19)
Constant	0.12***	0.23***	0.95***	0.29	0.98***	0.96***
	(5.66)	(7.78)	(5.16)	(1.10)	(5.21)	(4.91)
R^2	0.08	0.04	0.01	0.04	0.02	0.02
Adjusted R^2	0.07	0.04	0.00	0.03	0.01	0.01
F	6.82	8.33	2.67	10.52	4.59	5.62
Observations	650	650	649	649	650	650

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 46: Total and systematic risk and Costr(change) of portfolios
Table 45 summarizes the results of the regressions according to formula (23) on a portfolio basis. Chapter 4.5 explains the calculation of Costr proxies. The dependent variables are the standard deviation of returns, beta and unlevered beta. The standard deviation of return is measured for each firm based on the twelve monthly returns of a year. Beta is measured on a firm basis with a moving 12-month time window. Unlevered beta is computed according to formula (20). Sales(cor) is the five-year moving average correlation coefficient of a company's sales growth with the corresponding industry's sales growth. Leverage is total debt to equity. Equity ratio is the ratio of equity to total assets. Sales(sd) measures the standard deviation of changes in sales with a moving 5-year time window. All explanatory variables are in log scale. Portfolios are constructed using the ratio of SGA to market capitalization explained in subsection 4.2.2.

Table 46 shows that Costr(change) is significant with expected coefficients for beta(ul), but insignificant for beta and only partly significant for total risk. Compared to table 43, in which Costr(change) is significant in all regressions, these results are less convincing.

7.4. Interpretation

The descriptive statistics show a mixed picture. The relation between Return(sd) and cost structure proxies is more or less linear. For Costr(absolute) and Costr(change), the linear relation hold only until decile 7. For beta, the results cluster within the bottom and top half of deciles. The association between leverage adjusted betas and the cost structure meets the expectation. Companies with rigid cost structures tend to have higher beta(ul). That there is a more convincing relation with beta(ul) than beta is in line with prior expectations. Because financial leverage and operating leverage are negatively related, they offset each other to some degree. With the exclusion of the financial leverage, the cost structure can exercise its full effect on beta(ul).

Cost structure proxies have statistically significant predictive capability in explaining the three risk parameters along other variables. For regressions at the firm level, most proxies reveal the correct sign. Sales(sd) is superior to Sales(cor). In general, R^2 is around 20% for total risk and near 10% for systematic risk. This indicates that the models partially explain the variations in the risk parameters. But, the riskiness of companies from the perspective of capital markets is driven by other factors, too.

Comparing the results with the findings of Mandelker and Rhee (1984) shows that the R^2 is similar; Mandelker and Rhee (1984) reveal an R^2 of 10% for regressions at the firm level. Financial leverage is statistically significant in Mandelker and Rhee (1984), too. In Chung (1989), the regression for individual firms results in an R^2 of 22%. The variable operating leverage is significant, but not the financial leverage. However, Chung (1989) restricts its sample to 355 companies with SIC between 2000 and 4900. This restriction of the sample may be one reason for the different results. It is intuitively comprehensible that manufacturing companies are riskier because of their high exposure to operating leverage. One major difference between the approaches of Mandelker and Rhee (1984) and Chung (1989) and the current research design is that the regressions here are performed using panel data. For each company there are several observations from different points in time. Because all variables are computed with rolling time windows, this research design allows for fluctuations of the dependent and independent variables during the time period. This is not the case for the approaches of Mandelker and Rhee (1984) and Chung (1989).

Comparing the results of the cross-sectional regressions for portfolios with the corresponding regression in Chung (1989) makes clear that the results of this chapter are promising. In the results of Chung (1989), the regression for the portfolios sorted according to the proxy used for portfolio building, shows insignificant variables. Both the financial leverage and the operating leverage are insignificant. The same is true for the Sales(cor). When the portfolios are sorted based on the operating leverage, the operating leverage and the Sales(cor) turn significant. Mandelker and Rhee (1984) apply also the portfolio approach. The regression for portfolios sorted on the proxy for portfolio building shows significant and positively related variables. Even though Mandelker and Rhee (1984) do not consider the Sales(cor), the regression reveals an R^2 of 43%. However, if portfolio sorting takes place with operating leverage, the R^2 reduces to 17% and the financial leverage turns insignificant. Therefore, the results of all mentioned assessments are dependent on the portfolio construction to some degree.

To conclude, the cost structure proxies show explanatory power, albeit more strongly for the total risk than the systematic risk of firms. Nevertheless, the findings allow the following conclusions to be drawn:

- $1 - H_0$: *Rejected.*
- $1 - H_a$: *Accepted.*
- $2 - H_0$: *Rejected.*
- $2 - H_a$: *Accepted.*

- $3 - H_0$: *Rejected.*
- $3 - H_a$: *Accepted.*

8. Empirical Part IV: BM Ratio and Size

The third research question consists of three parts. The risk aspects of this research question are subject of the third and fourth empirical parts. The third empirical part analyzes the interactions between the cost structure and risk parameters with reference to the CAPM. This empirical investigation focuses on risk parameters BM ratio and market capitalization. These factors are important because they are also used to test if investing in companies with rigid cost structures is beneficial.

8.1. Null and Alternative Hypotheses

The first hypothesis considers the BM ratio.

- $1 - H_0$: *A rigid cost structure is not associated with BM ratio.*
- $1 - H_a$: *A rigid cost structure is associated with BM ratio.*

Hypotheses two takes the market capitalization into account.

- $2 - H_0$: *A rigid cost structure is not associated with market capitalization.*
- $2 - H_a$: *A rigid cost structure is associated with market capitalization.*

Because the relations between the cost structure of a company and the market capitalization and BM ratio are at the center of the investigations, these variables are considered in this chapter. Sorting the sample based on these variables gives a notion of how these variables are related. Building portfolios upon one factor and finding a relation with another factor does not automatically mean that building portfolios upon the second factor will result in clusters of the first factor[33]. Additionally, the double-sorting approach allows the relations to be compared while holding a factor constant. Table 47 summarizes the expectations if the null hypotheses are rejected.

[33] For instance, sorting according to the BM ratio shows a relation to cost structure characteristics. But, sorting according to cost structure proxies does not cluster the BM ratio to the same degree. So, the BM ratio is influenced by factors beyond the cost structure while the BM ratio absorbs information contained in cost structure proxies.

	BM ratio	Size
Costr(1y)	positive	negative
Costr(5ya)	positive	negative
Costr(absolute)	negative	positive
Costr(change)	negative	positive
Costr(SGA)	positive	negative

Table 47: Expected interactions between factors of Empirical Part IV
Table 47 summarizes the expected interactions between the factors taken into account in chapter 8. The dependent factors are specified in the column headings.

In addition to the proxies already introduced in the previous empirical parts, two more cost structure approximations are considered in the following assessments. Unlike Costr(5ya), Costr(absolute) and Costr(change), Costr(1y) and Costr(SGA) are not computed with five-year moving time windows. Both proxies are based on input factors from one point in time. Thus, these proxies allow the relations to be tested in a more direct way and without time lags. Costr(SGA) and Costr(1y) accommodate the market's ability to quickly absorb information. With Costr(1y), there is a comparative rule to Costr(SGA). These two proxies are also used in chapter 9.

The hypotheses explained in section 4.1.4 refer to similarities in accounting performance between high BM ratio companies and those with rigid cost structures. Companies with high BM ratios are likely to incur financial distress. Because of the highly volatile earnings of rigid cost structure companies, these firms are also likely to generate losses. So, the second method applied tests if earnings of rigid cost structure companies can be explained by comparing the earnings of high BM ratio companies and those of small firms. This technique follows the approach described by Fama and French (1995). In a first step, mimicking portfolios are built. Subsection 4.2.3 explains the construction of these portfolios. Afterwards, the annual earnings of companies within the same portfolio are summed up and profitability factors are calculated. These earnings of SMB, HML and MARKET serve as right-hand-variables in regression analyses. Under a similar method, profitability factors of portfolios sorted by size and cost structure proxies are calculated. These earnings serve as left-hand-side variables. It is not expected that the mimicking portfolios explain the accounting returns of all portfolios. Portfolios consisting of the smallest companies with rigid cost structures are of most interest. For these portfolios, positive and significant coefficients of SMB and HML are expected. MARKET is expected to be significant in all regressions. This method tests if there is an association between cost structure rigidity and BM ratio and size – not directly with comparing time-series averages of the features of companies like descriptive analyses – but with focusing on the behavior of earnings of portfolios with high exposure towards the relevant factors.

8.2. Results

In a first step, descriptive statistics show how the cost structure proxies vary between portfolios built according to BM ratio and size. Because the cost structure characterizes only one distinct property of companies, this sorting procedure makes more sense than sorting according to cost structure proxies.

	BM ratio	Size	Costr(SGA)	Costr(1y)	Costr(5ya)	Costr(absolute)	Costr(change)
1	0.18	12496	0.16	3.04	3.20	0.93	0.90
2	0.31	5898	0.18	2.96	3.05	0.94	0.89
3	0.40	5316	0.23	3.65	3.02	0.95	0.89
4	0.50	3857	0.27	3.77	3.08	0.97	0.90
5	0.60	3692	0.30	3.69	3.09	0.96	0.90
6	0.69	2490	0.35	3.63	3.14	0.96	0.90
7	0.78	2607	0.37	4.03	3.28	0.96	0.89
8	0.94	1656	0.43	4.17	3.27	0.97	0.89
9	1.18	1475	0.59	6.26	3.50	0.96	0.90
10	2.01	609	1.00	8.53	3.78	0.97	0.89
Total	0.68	4514	0.36	4.15	3.21	0.95	0.90
10-1	1.83	-11887	0.84	5.49	0.58	0.04	-0.01
t-stat	63.43	15.45	27.82	2.70	6.08	6.68	0.74

Table 48: Cost structure proxies across BM ratio deciles
Table 48 summarizes time-series averages of cost structure approximations across BM ratio deciles. Portfolios are formed on a yearly basis. The breakpoints for building the BM ratio portfolios follow the explanations of Fama and French (1992). Year-end prices are used to calculate the market capitalization. For each year the sample is divided into ten portfolios based on the BM ratio. Section 4.5 explains the calculation of cost structure proxies. High Costr(1y), Costr(5ya) and Costr(SGA) and low Costr(absolute) and Costr(change) indicate fixed cost structures. Row 10-1 shows the difference between the mean values of the top and bottom deciles. T-stat is based on a t-test to test the significance of the differences of the first and tenth deciles.

Table 48 gives a first impression of the relation between the cost structure and the BM ratio. The first column shows how the BM ratio varies among the deciles. The time-series average of the BM ratio for value companies (tenth decile) is more than 1.5 times the BM ratio of the ninth portfolio. The differences across the middle portfolios are small. The size of the portfolios steadily decreases from the first to tenth decile. The difference between the extreme portfolios is significant. Thus, value companies are smaller than growth companies. There is a linear (negative) relation between size and BM ratio. Costr(1y) and Costr(SGA) exhibit a relation to BM ratio that fits the expectation. As the BM ratio rises, both proxies increase, too. The t-stat confirms the significant difference between the extreme deciles. Costr(5ya) varies in line with prior beliefs to some degree. Value companies show larger Costr(5ya) compared to growth companies. The results for Costr(absolute) do not meet the expectations. Costr(change) shows only marginal variations.

	BM ratio	Size	Costr(SGA)	Costr(1y)	Costr(5ya)	Costr(absolute)	Costr(change)
1	1.09	64	0.71	7.96	4.67	0.95	0.88
2	0.76	220	0.40	4.37	3.65	0.96	0.89
3	0.68	381	0.33	4.01	3.16	0.96	0.89
4	0.61	604	0.28	3.12	2.93	0.96	0.89
5	0.57	913	0.23	2.86	2.70	0.96	0.88
6	0.54	1333	0.21	2.49	2.44	0.95	0.89
7	0.51	2025	0.19	2.48	2.39	0.95	0.91
8	0.47	3335	0.18	2.35	2.31	0.96	0.91
9	0.47	6678	0.19	2.44	2.35	0.96	0.92
10	0.41	37009	0.15	2.19	2.21	0.95	0.94
Total	0.70	4499	0.36	4.15	3.21	0.95	0.90
10-1	-0.68	36945	-0.56	-5.77	-2.46	0.00	0.07
t-stat	18.01	49.22	19.52	3.69	26.15	0.64	9.06

Table 49: Cost structure proxies across size deciles
Table 49 summarizes time-series averages of cost structure approximations across size deciles. Portfolios are formed on a yearly basis. The breakpoints for building the size portfolios follow the explanations of Fama and French (1992). Year-end prices are used to calculate the market capitalization. For each year the sample is divided into ten portfolios based on size. Section 4.5 explains the calculation of cost structure proxies. High Costr(1y), Costr(5ya) and Costr(SGA) and low Costr(absolute) and Costr(change) indicate fixed cost structures. Row 10-1 shows the difference between the mean values of the top and bottom deciles. T-stat is based on a t-test to test the significance of the differences of the first and tenth deciles.

Table 49 shows time-series averages of cost structure proxies across size deciles. The top decile is nearly five times larger than the ninth decile. There is a clear negative relation between size and BM ratio. Small companies reveal higher BM ratios compared to large companies. Costr(SGA), Costr(1y), Costr(5ya), and Costr(change) reveal large and significant differences between the extreme portfolios. Further, they reveal a pattern that is in line with prior beliefs. Small companies tend to have more rigid cost structures than large companies. The continuous development of the proxies indicates a linear relation. Contrary to table 48, Costr(change) shows convincing patterns in table 49.

Comparing the results of tables 49 and 48 shows that some cost structure proxies have an association with BM ratio, and most proxies with size. To better understand the interrelations between these, time-series averages of cost structure proxies for portfolios double-sorted according to the BM ratio and size are calculated. This approach follows Garcia-Feijoo and Jorgensen (2010). They also compare different cost structure approximations in cross tables using BM ratio and size as sorting criteria.

Size	BM ratio						Size	BM ratio					
A: Costr(SGA)							B: Costr(1y)						
	1	2	3	4	5	All		1	2	3	4	5	All
1	0.30	0.36	0.44	0.51	0.98	0.60	1	4.72	5.97	5.23	5.39	9.79	6.65
2	0.18	0.25	0.31	0.38	0.53	0.31	2	3.24	3.94	3.51	3.73	3.47	3.60
3	0.16	0.21	0.25	0.27	0.36	0.22	3	2.66	2.91	2.60	2.53	2.39	2.68
4	0.13	0.17	0.23	0.24	0.37	0.19	4	2.57	2.28	2.39	2.36	2.19	2.41
5	0.13	0.18	0.21	0.21	0.32	0.17	5	2.42	2.26	2.23	2.11	1.92	2.30
All	0.17	0.25	0.32	0.40	0.80		All	3.00	3.71	3.66	4.10	7.41	
C: Costr(absolute)							D: Costr(change)						
1	0.91	0.94	0.95	0.96	0.97	0.95	1	0.83	0.88	0.89	0.88	0.89	0.88
2	0.93	0.95	0.97	0.98	0.98	0.96	2	0.86	0.89	0.90	0.91	0.90	0.89
3	0.93	0.97	0.98	0.97	0.97	0.96	3	0.87	0.89	0.90	0.88	0.85	0.88
4	0.96	0.97	0.96	0.93	0.91	0.96	4	0.92	0.93	0.89	0.88	0.87	0.91
5	0.94	0.96	0.97	0.98	0.96	0.95	5	0.94	0.92	0.92	0.90	0.95	0.93
All	0.94	0.96	0.96	0.96	0.96		All	0.89	0.90	0.90	0.89	0.89	
E: Costr(5ya)													
1	4.90	4.32	4.18	4.13	4.27	4.31							
2	3.56	3.08	2.92	2.87	2.70	3.06							
3	2.83	2.64	2.48	2.33	2.12	2.58							
4	2.53	2.28	2.24	2.17	2.17	2.35							
5	2.46	2.21	2.13	1.88	1.86	2.27							
All	3.12	3.05	3.11	3.28	3.65								

Table 50: Cost structure proxies across size and BM ratio portfolios
Table 50 summarizes time-series averages of cost structure proxies for portfolios double-sorted upon size and BM ratio. Portfolios are formed on a yearly basis. The breakpoints for building size and BM ratio portfolios follow the explanations of Fama and French (1992). Prices to calculate the market capitalization refer to the end of December values of year t. For each year the sample is divided into five portfolios based on company size. Afterwards, the sample is split into five portfolios according to the BM ratios. These rankings produce 25 portfolios. The number of observations per portfolio varies between 124 and 1897. Section 4.5 explains the calculation of cost structure proxies.

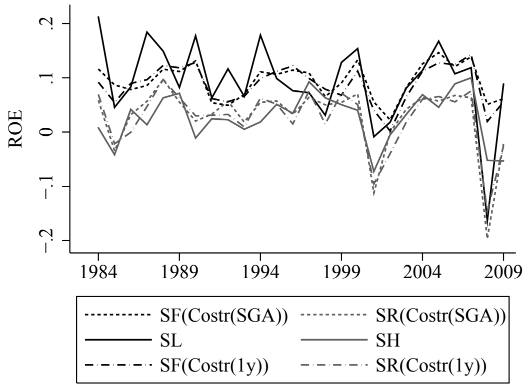
Table 50 displays that, in general, size seems to differentiate better between different cost structure properties than BM ratio. Controlling for BM ratio, size still differentiates between companies with fixed or variable cost structures. All panels reveal this structure. Within BM ratio quintiles, small companies have rigid cost structures compared to large firms. When controlling for size, BM ratio seems less capable of differentiating between rigid and flexible cost structures. According to panel B, Costr(1y) does not meet the expectation when controlling for size. The convincing pattern shown in the row denoted All is the result of some extreme observations for the smallest quintile with the most rigid cost structures. Although the All row in panel E for Costr(5ya) shows a pattern that is consistent with the expectation, the development of the proxies within size quintiles does not meet expectations. The most convincing results are shown by Costr(SGA). This proxy reveals the expected pattern when controlling for size and BM ratio. In total, the association between size and cost structure is stronger compared to BM ratio and cost structure.

	A: Costr(SGA)		B: Costr(1y)		C: Costr(5ya)		D: Costr(absolute)		E: Costr(change)	
	BM ratio	Size	BM ratio	Size	BM ratio	Size	BM ratio	Size	BM ratio	Size
1	0.44	9044	0.72	7171	0.66	6’044	0.78	2236	0.55	1801
2	0.49	10099	0.66	8261	0.74	1’734	0.73	2908	0.60	2816
3	0.51	7619	0.63	5472	0.78	607	0.88	3110	0.63	3676
4	0.53	5897	0.61	5840	0.88	213	0.68	3972	0.66	2930
5	0.54	5134	0.60	6405	0.85	338	0.65	5306	0.71	3117
6	0.62	3379	0.61	5926	0.68	443	0.65	4999	0.72	3998
7	0.68	1687	0.63	3667	1.17	134	0.74	4272	0.71	5051
8	0.76	1171	0.66	1868	1.03	187	0.75	3404	0.64	8100
9	0.94	629	0.80	1124	1.02	164	0.78	3223	0.60	5033
10	1.47	373	0.91	492	0.76	215	1.02	4038	0.65	4607
Total	0.70	4508	0.68	4626	0.70	4’508	0.70	4508	0.70	4508
10-1	1.03	-8671	0.18	-6679	0.10	-5830	0.25	1802	0.10	2806
t-stat	19.81	11.32	7.53	9.52	1.02	2.11	1.19	1.73	1.94	1.82

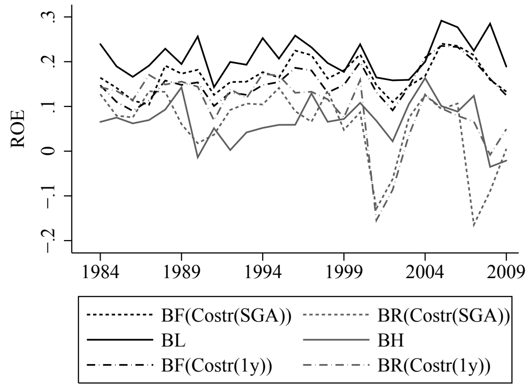
Table 51: BM ratio and size across cost structure deciles
Table 51 summarizes time-series averages of size and BM ratio across cost structure deciles. Portfolios are formed on a yearly basis. Prices to calculate the market capitalization refer to the end of December values of each year. For each year the sample is divided into ten portfolios based on cost structure proxies. Section 4.5 explains the calculation of cost structure proxies. Row 10-1 shows the difference between the mean values of the top and bottom deciles. T-stat is based on a t-test to test the significance of the differences of the first and tenth deciles.

Like Novy-Marx (2011) and Garcia-Feijoo and Jorgensen (2010), table 51 summarizes time-series averages for cost structure deciles instead of sorting the sample by size or BM ratio. Regarding size, the results for all proxies reveal a uniform pattern. Companies with fixed cost structures are smaller compared to companies with more flexible cost structures. This relation is convincing for Costr(SGA), Costr(1y), and Costr(5ya). The bottom deciles, which consist of companies with variable cost structures, have average sizes of 9044, 7171, and 6044. The top decile shows very low average market capitalizations of only 373, 492, and 215. The differences for Costr(absolute) and Costr(change) are less clear, but still statistically significant at the 10% significance level. Regarding BM ratio, the results are less convincing. Costr(1y) has a significant t-stat but the pattern among the deciles is not stable. The most extreme cost structure portfolio reveals a high BM ratio. The variations among deciles for the other proxies are unclear, too. Only Costr(SGA) shows continuously increasing BM ratios from the bottom to top deciles. In total, compared to the results shown in table 48, it seems that there are factors beyond the cost structure that influence the BM ratio of companies.

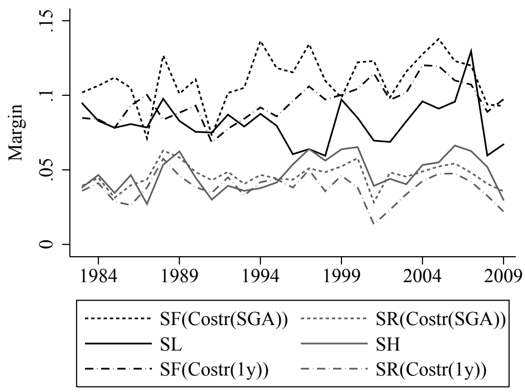
Even though companies with different cost structures do not show a stringent relation to the BM ratio, there is still the possibility that companies with rigid cost structures and value companies have common features from an accounting perspective. Fama and French (1995) investigate earnings consistency of size and BM ratio portfolios. They provide evidence that high BM ratio companies have lower earnings compared to low BM ratio companies. Chapter 6 shows that the cost structure has an influence on accounting earnings and profitability measures. These considerations are based on formula (21) on page 52 and indicate a direct relation between the characteristics of the cost structure and a company’s earnings. Therefore, it makes sense to test if accounting earnings of companies with rigid cost structure and those with a high BM ratio and small capitalization behave similarly.



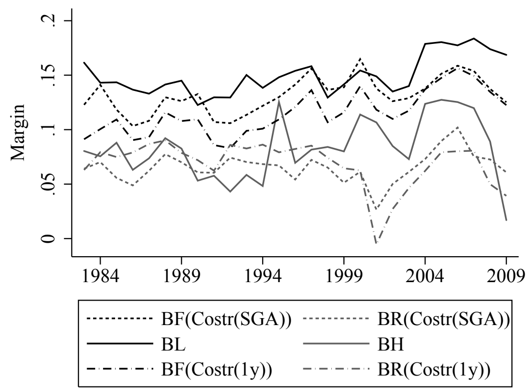
(a) Small portfolios: Time trend of ROE



(b) Big portfolios: Time trend of ROE



(c) Small portfolios: Time trend of Margin



(d) Big portfolios: Time trend of Margin

Figure 6: Time trends of ROE and Margin for double-sorted portfolios
Graphs 6a to 6d show the time trends of ROE and Margin for various portfolios. The sum of income and equity and the sum of EBIT and sales for the considered portfolios are use to calculate ROE and Margin. SF consists of small companies with flexible cost structures according to Costr(1y) and Costr(SGA). SR are small companies with rigid cost structures. SL stands for small companies with a low BM ratio and SH for small companies with a high BM ratio. The letter B indicates portfolios consisting of large companies. Subsection 4.2.3 explains the portfolio construction procedure.

The time-series plots in figure 6 show the stability of ROE and Margin for different BM ratio, cost structure and size portfolios. Graphs 6a and 6b demonstrate that high BM ratio companies have a lower ROE. This is true for small and big companies. The shapes of the curves for the four portfolios SL, SH, BL and BH, are similar with a quite stable difference in ROE of around 10 percent. So, low BM ratio companies – both small and large – generate higher returns. In graph 6a, the difference in ROE between SF(Costr(1y)) and SR(Costr(1y)) is stable, too. The curves show similar variations over time with large decreases for SR(Costr(1y)) during recessions. Consequently, companies with flexible cost structures generate consistently higher ROE. The ROE difference for SF(Costr(SGA)) and SR(Costr(SGA)) are in line with expectation but rather small. SF(Costr(SGA)) generates sustainable higher returns compared to SR(Costr(SGA)). According to graph 6b the differences are less visible for big companies. The ROE for large Costr(1y) portfolios behave similarly compared to the small portfolios after 1995. Before 1995, there are years when BR(Costr(1y)) generates higher returns compared to BF(Costr(1y)). BR(Costr(SGA)) shows more or less constantly lower ROE compared to BF(Costr(SGA)).

Graphs 6c and 6d display the time trend of the Margin. The differences in Margin are larger between the two extreme cost structure portfolios compared to the BM ratio portfolios. This seems to be true for small and large portfolios.

Figure 6 shows that like the differences between high and low BM ratio companies, rigid and flexible cost structure companies reveal different stability in earnings, too. Companies with rigid cost structures generate lower earnings compared to flexible cost structure companies. The patterns between rigid cost structure portfolios and high BM ratio portfolios are comparable. The following regressions provide further insights into these relationships. The right-hand-side variables are the differences in fundamentals of the Fama and French (1993) portfolios. The left-hand-side variables are the annual earnings of cost structure portfolios.

	BF	BM	BR	SF	SM	SR
MKT(ROE)	1.07***	0.98***	1.17*	0.95***	0.78***	1.22***
	(7.09)	(4.69)	(1.95)	(6.40)	(6.28)	(8.49)
SMB(ROE)	-0.23**	0.14	-0.06	0.08	0.39***	1.36***
	(-2.29)	(1.03)	(-0.14)	(0.85)	(4.71)	(14.28)
HML(ROE)	-0.09	0.05	-0.03	-0.03	0.13**	0.34***
	(-1.38)	(0.58)	(-0.11)	(-0.53)	(2.49)	(5.72)
Constant	-0.00	0.00	-0.00	-0.00	-0.00	-0.00
	(-0.01)	(0.12)	(-0.20)	(-0.21)	(-0.65)	(-0.21)
R^2	0.74	0.58	0.18	0.73	0.80	0.95
Adjusted R^2	0.71	0.52	0.06	0.69	0.77	0.94
F	20.17	9.69	1.49	18.93	27.82	121.63
Observations	25	25	25	25	25	25

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 52: Regressions with changes in ROE for Costr(SGA) portfolios
Table 52 summarizes the results of regressions according to the approach explained in Fama and French (1995). Section 4.2.3 explains the construction of six size and BM ratio portfolios. This process is also used to build six size and cost structure portfolios. Earnings, EBIT, sale, equity, and total assets for companies within a portfolio are added. For each portfolio, the annual ROE, ROA, and Margin are calculated. Afterwards, the annual changes in these variables are measured to give the left-hand-side variables. The right-hand-side variables are the differences of these changes between small and big portfolios (SMB), and high and low BM ratio portfolios (HML). MARKET represents the annual changes in the variables for the total sample.

Table 52 shows the regression results for portfolios constructed according to the ratio of SGA and market capitalization. MKT(ROE) is significant in all regressions. SMB(ROE) is significant with a negative sign for the first regression with ROE of BF(Costr(SGA)) as the dependent variable. This negative relation fulfills the expectation because the portfolio BF(Costr(SGA)) consists of large companies with flexible cost structures. SMB(ROE) is also significant with a positive sign for SM(Costr(SGA)) and SR(Costr(SGA)). This explanatory power of SMB(ROE) shows that small companies with rigid cost structures have changes in ROE which can be explained by accounting returns of small companies. HML is only relevant for SM(Costr(SGA)) and SR(Costr(SGA)). This means that the accounting returns of high BM ratio companies explain changes in fundamentals of small companies with fixed cost structures. To sum up, the results support a relationship between the BM ratio and size and the cost structure. SMB(ROE) and HML(ROE) explain accounting returns of portfolios consisting of small companies with rigid cost structures. The larger coefficients for SMB compared to HML shows that SMB has a larger economic impact. So, small companies with large degrees of cost structure rigidity show accounting returns with risk characteristics, similar to small and high BM ratio companies.

	BF	BM	BR	SF	SM	SR
MKT(ROE)	1.05***	0.62***	1.96***	0.91***	0.73***	1.18***
	(9.26)	(3.51)	(5.44)	(5.59)	(7.08)	(6.66)
SMB(ROE)	-0.24***	0.11	0.23	0.30**	0.69***	1.04***
	(-3.22)	(0.95)	(0.97)	(2.83)	(10.08)	(8.94)
HML(ROE)	-0.06	0.01	0.07	0.06	0.16***	0.28***
	(-1.24)	(0.19)	(0.46)	(0.84)	(3.75)	(3.87)
Constant	0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.08)	(-0.04)	(-0.11)	(-0.03)	(-0.59)	(-0.33)
R^2	0.82	0.46	0.65	0.72	0.91	0.89
Adjusted R^2	0.80	0.38	0.60	0.68	0.89	0.87
F	32.83	5.91	12.83	18.18	68.28	55.73
Observations	25	25	25	25	25	25

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 53: Regressions with changes in ROE for Costr(1y) portfolios
Table 53 summarizes the results of regressions according to the approach explained in Fama and French (1995). Section 4.2.3 explains the construction of six size and BM ratio portfolios. This process is also used to build six size and cost structure portfolios are. Earnings, EBIT, sale, equity, and total assets for companies within a portfolio are added. For each portfolio, the annual ROE, ROA, and Margin are calculated. Afterwards, the annual changes inthese variables are measured to give the left-hand-side variables. The right-hand-side variables are the differences in these changes between small and big portfolios (SMB), and high and low BM ratio portfolios (HML). MARKET represents the annual changes in the variables for the total sample.

Table 53 summarizes the results of regressions with MKT(ROE), SMB(ROE) and HML(ROE) as explanatory variables and accounting returns of six cost structure portfolios sorted by Costr(1y) as dependent variables. The results are similar to those reported in table 52. Again, MKT(ROE) is significant in all regressions. SMB(ROE) shows explanatory power for the small portfolios. HML is significant for the same portfolios. From these findings one may conclude that accounting returns for certain cost structure portfolios have similarities with accounting returns of small and high BM ratio portfolios. So, even though BM ratio is not directly related to the cost structure, see for example table 51, the results of tables 52 and 53 show a clear association between the accounting earnings of SMB and HML and cost structure portfolios.

8.3. Robustness

Instead of building portfolios upon another cost structure proxy, tables 54 and 55 show the results for ROA instead of ROE. Costr(1y) and Costr(SGA) are the only two proxies based on annual input variables for which moving time windows are not applied. The results displayed in tables 54 and 55 are comparable with those in tables 52 and 53. Thus, the same relations exist for ROA. These results support the findings in subsection 8.2.

	BF	BM	BR	SF	SM	SR
MKT(ROA)	1.13***	0.91***	0.88*	1.08***	0.85***	1.07***
	(7.38)	(4.76)	(1.76)	(5.51)	(6.03)	(7.76)
SMB(ROA)	-0.28**	0.19	-0.18	0.11	0.41***	1.16***
	(-2.64)	(1.39)	(-0.52)	(0.77)	(4.12)	(12.04)
HML(ROA)	-0.09	0.05	-0.12	-0.05	0.13**	0.26***
	(-1.41)	(0.65)	(-0.57)	(-0.60)	(2.27)	(4.66)
Constant	-0.00	0.00	-0.00	-0.00	-0.00	-0.00
	(-0.03)	(0.12)	(-0.20)	(-0.03)	(-0.69)	(-0.40)
R^2	0.75	0.62	0.17	0.68	0.79	0.93
Adjusted R^2	0.72	0.56	0.05	0.64	0.76	0.92
F	21.54	11.23	1.39	14.94	25.79	98.36
Observations	25	25	25	25	25	25

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 54: Regressions with changes in ROA for Costr(SGA) portfolios
Table 54 summarizes the results of regressions according to the approach explained in Fama and French (1995). Section 4.2.3 explains the construction of six size and BM ratio portfolios. The same process is used to build six size and cost structure portfolios. Earnings, EBIT, sale, equity, and total assets for companies within a portfolio are added. For each portfolio, the annual ROE, ROA, and Margin are calculated. Afterwards, the annual changes in these variables are measured to give the left-hand-side variables. The right-hand-side variables are the differences in these changes between small and big portfolios (SMB), and high and low BM ratio portfolios (HML). MARKET represents the annual changes in the variables for the total sample.

	BF	BM	BR	SF	SM	SR
MKT(ROA)	1.07***	0.64***	1.86***	0.77***	0.78***	1.31***
	(10.11)	(4.01)	(5.01)	(4.89)	(7.17)	(6.97)
SMB(ROA)	-0.27***	0.13	0.27	0.28**	0.69***	1.11***
	(-3.69)	(1.12)	(1.02)	(2.49)	(9.00)	(8.35)
HML(ROA)	-0.06	0.03	0.04	0.04	0.16***	0.28***
	(-1.28)	(0.39)	(0.26)	(0.57)	(3.55)	(3.59)
Constant	0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.36)	(-0.31)	(-0.12)	(-0.06)	(-0.75)	(-0.44)
R^2	0.85	0.53	0.63	0.68	0.90	0.89
Adjusted R^2	0.82	0.47	0.58	0.64	0.89	0.88
F	38.64	8.00	11.85	15.04	64.71	57.67
Observations	25	25	25	25	25	25

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 55: Regressions with changes in ROA for Costr(1y) portfolios
Table 55 summarizes the results of regressions according to the approach explained in Fama and French (1995). Section 4.2.3 explains the construction of six size and BM ratio portfolios. The same process is used to build six size and cost structure portfolios. Earnings, EBIT, sale, equity, and total assets for companies within a portfolio are added. For each portfolio, the annual ROE, ROA, and Margin are calculated. Afterwards, the annual changes in these variables are measured to give the left-hand-side variables. The right-hand-side variables are the differences in these changes between small and big portfolios (SMB), and high and low BM ratio portfolios (HML). MARKET represents the annual changes in the variables for the total sample.

8.4. Interpretation

The two hypotheses in section 8.2 question the relation between the degree of rigidity and BM ratio and the relation between the degree of rigidity and size. A comparison of the properties of portfolios built based on BM ratio and market capitalization gives a first impression of these relations. Costr(SGA), Costr(1y) and Costr(5ya) behave similarly: With rising BM ratios, the proxies increase, too. But, the relations with Costr(absolute) and Costr(change) are unclear. There is no linear relation between BM ratio and these proxies. Without doubt, small companies have more rigid cost structures than larger ones. This is true for all proxies except Costr(absolute). In double-sorting using BM ratio and size, size shows more differentiating power than BM ratio. Within BM ratio quintiles, size still differentiates between flexible and fixed cost structures. On the other hand, controlling for size weakens the positive association between BM ratio and cost structure proxies. The only exception is Costr(SGA); this proxy behaves in accordance with expectations when controlling for BM ratio or size.

The superior relation of the degree of cost structure rigidity and size to the degree of rigidity and BM ratio may have its source in business factors. On one hand, the BM ratio absorbs information based on expectations of market participants. So, the ratio is not only influenced by characteristics of the production process of a company, but also other aspects of risk such as the financial leverage or growth risk. On the other hand, the size of a company may be related to the production process. First, small companies could be less experienced in organizing their production process. Less experienced could mean that the production process is not yet optimized, what has an effect on the degree of cost structure rigidity. Second, market power is associated with size. Thus, larger companies have an influence on market prices. These factors explain the close relation between the cost structure and size.

Gulen et al. (2008) report the operating leverage, measured according to formula (10) on page 40, across BM ratio deciles. They show a steady increase in operating leverage from growth to value companies. The factor size is not considered. Like the results displayed in table 50 on page 124, Garcia-Feijoo and Jorgensen (2010) also show the operating leverage, calculated according to formula (17) on page 46, for double-sorted portfolios. But, unlike the results in table 50 on page 124, Garcia-Feijoo and Jorgensen (2010) report a closer relation between the operating leverage and BM ratio than between the operating leverage and size. Novy-Marx (2011) reports the BM ratio and size for operating leverage quintiles, whereby the BM ratio is negatively related to the operating leverage, and – like the findings reported in section 8.2 – the operating leverage is negatively related to size. Further, the quintile consisting of companies with the highest operating leverage reveals the lowest ROA (Novy-Marx, 2011). This low ROA for the most operationally leveraged companies is in line with the low profitability reported in figure 6 on page 126 for rigid cost structure portfolios.

The time-series plots in figure 6 show that companies with rigid cost structures underperform those with more variable cost structures. This is true for different profitability measures and holds across two cost structure proxies. This underperformance is similar to the lower accounting returns generated by companies with high BM ratios compared to those with low BM ratios. The results are more convincing for small portfolios than for large ones. The results of different regressions, summarized in tables 52 to 55, confirm this similarity in accounting returns between high BM ratio companies and companies with rigid cost structures. So, even though there is no direct relation between BM ratio and cost structure proxies, both value companies and rigid cost structure companies underperform in accounting returns. And, accounting returns of small companies and companies with high BM ratios explain returns of small companies with rigid cost structures. Because none of the above-mentioned papers conducts such regressions, no comparison is possible. However, the results lead to the following conclusion:

- $1 - H_0$: *Rejected.*
- $1 - H_a$: *Accepted.*

The rejection of the first null hypothesis is valid under consideration of the similarities between accounting returns of high BM ratio companies and such with rigid cost structures. Such a restriction is not necessary for the assessment of the second null hypothesis.

- $2 - H_0$: *Rejected.*

- $2 - H_a$: *Accepted.*

9. Empirical Part V: Portfolio Return Properties

The fifth empirical part focuses on the behavior of returns of portfolios sorted upon size and cost structure rigidity. This chapter 9 addresses shareholders because at the center of interest is the question if investing in companies with rigid cost structures is beneficial. Because modern finance assumes a relation between risk and return – the second to the fourth empirical investigations confirm a relation between cost structure rigidity and the level of riskiness – this chapter switches to the return aspect.

9.1. Null and Alternative Hypotheses

In a first step, the relation between the cost structure and stock returns is at the center of investigations.

- $1 - H_0$: *Portfolios with rigid cost structure companies do not reveal higher stock returns and larger exposure towards risk parameters.*
- $1 - H_a$: *Portfolios with rigid cost structure companies reveal higher stock returns and larger exposure towards risk parameters.*

Second, not the absolute return but the relative potential outperformance is tested.

- $2 - H_0$: *Portfolios with rigid cost structure companies generate outperformance.*
- $2 - H_a$: *Portfolios with rigid cost structure companies do not generate outperformance.*

Third, it is tested if the two relevant cost categories explain future returns.

- $3 - H_0$: *BM ratio, size, leverage and past return do not suppress the explanatory power of SGA and COGS in explaining future stock returns.*
- $3 - H_a$: *BM ratio, size, leverage and past return suppress the explanatory power of SGA and COGS in explaining future stock returns.*

Contrary to chapter 7, this chapter investigates the returns of portfolios and not single companies. The cost structure proxy of year t is decisive for the portfolio construction. The return calculation starts in the following year in April and considers the following 12 monthly returns. So, the returns are based on a one-year holding period. Descriptive statistics show the returns, standard deviation and beta for the portfolios. The two risk factors are measured for equally- and size-weighted returns. The calculation of the standard deviation applies formula (26) on page 93 and beta is calculated according to formula (27) on page 109. Both variables are calculated for portfolio returns for the total time period. Because chapter 8 provides evidence that there is a relation between cost structure, size and BM ratio, the returns are calculated for double-sorted portfolios, too. Portfolios are built based on size and cost structure proxies. The first factor is size and not the BM ratio because chapter 8 indicates that size absorbs certain explanatory power of the cost structure, see for instance table 50 on page 124.

In this chapter, the three-factor model of Fama and French (1993) is applied to test the second null hypothesis. The regressions are similar to those explained in chapter 8.2. Instead of accounting returns, portfolio returns serve as input variables. Because monthly stock returns are available, these tests produce more statistically reliable information to assess if the three factors MARKET, SMB and HML explain returns of cost structure portfolios. Of particular importance are the constants (a_i) of the regressions. They indicate if the three-factor model fully explains the portfolio returns or whether it is possible to generate excess returns from investing in companies with rigid cost structures. The regressions follow the approach of Fama and French (1993). Formula (28) explains the approach.

$$r_{i,t} = a_i + \beta_{i,M} MARKET_t + \beta_{i,s} SMB_t + \beta_{i,h} HML_t + \epsilon_{i,t} \tag{28}$$

The left-hand-side variable ($r_{i,t}$) is the performance difference of the portfolio return and the risk-free rate. Subsection 4.2.3 explains the construction of SMB and HML. MARKET is the size-weighted return of all stocks in the sample minus the risk-free rate. The expectation expressed in the research hypothesis is that the model explains portfolio returns. No significant positive constant (a_i) remains.

The second type of regression to test the third null hypothesis follows Fama and MacBeth (1973) and is expressed in formula (29). The left-hand-side variable is the return of an individual company for year t+1. All right-hand-side variables refer to the time period t, i.e. they are lagged to the dependent variable. The model tests which factors are significant in explaining a company's stock return.

$$\begin{aligned} r_{j,t+1} = a_j + \beta_1 \frac{Sale}{EV}_{j,t} + \beta_2 \frac{COGS}{EV}_{j,t} + \beta_3 \frac{SGA}{EV}_{j,t} + \beta_4 BMratio_{j,t} \\ + \beta_5 size_{j,t} + \beta_6 Leverage_{j,t} + \beta_7 return_{j,t-1} + \gamma Z_{j,t} + \epsilon_{j,t} \end{aligned} \tag{29}$$

Formula (22) on page 64 explains the integration of the first three parameters in formula (29). These are surrogates for the EBITDA/EV ratio. With these replacements, the model is able to assess if costs have an impact on returns. Greenblatt (2010) uses the ratio of EBITDA to enterprise value as a factor explaining future stock returns. This factor is different from the BM ratio, because the numerator is a flow variable and the denominator considers liabilities of a company, too. $BMratio$ is equity divided by market capitalization. *Size* is the market capitalization. *Leverage* measures the exposure of a company to the financial leverage. Alternatively, the *equityratio* replaces leverage. Like Novy-Marx (2011), the previous return of a company $Return_{t-1}$ is considered, too. The model incorporates dummy variables to capture time and industry effects.

9.2. Results

In a first step, returns of different portfolios are compared. The returns as well as the variations in the risk parameters are of interest.

BM ratio								
	A: equally-weighted				B: size-weighted			
	Mean	Return(sd)	Beta	t-stat	Mean	Return(sd)	Beta	t-stat
1	1.12%	5.42%	1.08	3.75	0.96%	4.93%	0.97	3.51
2	1.12%	5.54%	1.07	3.65	1.07%	4.98%	1.02	3.89
3	1.22%	5.47%	1.04	4.03	1.10%	4.91%	0.93	4.05
4	1.35%	5.42%	1.03	4.49	1.31%	5.40%	1.01	4.40
5	1.41%	5.50%	1.00	4.65	1.19%	5.21%	0.94	4.14
6	1.44%	5.61%	1.03	4.65	1.48%	6.02%	1.07	4.45
7	1.55%	5.41%	0.94	5.19	1.19%	5.58%	0.99	3.86
8	1.52%	5.73%	0.97	4.80	1.48%	6.17%	1.03	4.34
9	2.04%	5.95%	0.95	6.21	1.52%	6.49%	0.98	4.24
10	2.48%	7.12%	0.97	6.32	2.02%	7.89%	1.05	4.63
10-1	1.36%				1.06%			
t-stat	4.54				2.70			

Table 56: Properties of portfolio returns for BM ratio deciles
Table 56 displays averages of portfolio returns, standard deviation of returns, beta and t-stats across BM ratio deciles. Portfolios are built yearly according to the relevant factor. Portfolio building uses the breakpoints of the variable published on the homepage of French (2012). All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly returns are measured, either equally- or size-weighted. Standard deviation is calculated according to formula (26) and beta according to formula (27). T-stat indicates if the return is statistically significantly different from 0 (column) or if the return differences between the extreme deciles are significantly different from 0 (row).

Table 56 confirms the BM ratio anomaly. The size- and equally-weighted returns increase from the bottom to top BM ratio deciles. The differences between the two extreme portfolios are statistically significantly different from 0. Another similarity between size- and equally-weighted returns is the large volatility of the tenth decile. In respect of beta, no pattern is evident.

	Size							
	A: equally-weighted				B: size-weighted			
	Mean	Return(sd)	Beta	t-stat	Mean	Return(sd)	Beta	t-stat
1	2.22%	6.04%	0.89	6.66	1.80%	5.91%	0.93	5.52
2	1.47%	6.02%	1.02	4.41	1.44%	6.03%	1.03	4.33
3	1.27%	5.92%	1.04	3.90	1.27%	5.92%	1.04	3.90
4	1.25%	5.94%	1.05	3.82	1.26%	5.94%	1.05	3.83
5	1.15%	6.33%	1.14	3.28	1.16%	6.33%	1.14	3.31
6	1.39%	5.72%	1.05	4.39	1.38%	5.70%	1.05	4.37
7	1.16%	5.73%	1.10	3.66	1.17%	5.75%	1.09	3.69
8	1.25%	5.69%	1.14	3.97	1.24%	5.67%	1.13	3.97
9	1.15%	5.34%	1.08	3.90	1.14%	5.24%	1.06	3.93
10	1.13%	4.86%	1.03	4.21	1.09%	4.53%	0.94	4.34
10-1	-1.09%				-0.71%			
t-stat	4.18				2.74			

Table 57: Properties of portfolio returns for size deciles
Table 57 displays averages of portfolio returns, standard deviation of returns, beta and t-stats across size deciles. Portfolios are built yearly according to the relevant factor. Portfolio building uses the breakpoints of the variable published on the homepage of French (2012). All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly returns are measured, either equally- or size-weighted. Standard deviation is calculated according to formula (26) and beta according to formula (27). T-stat indicates if the return is statistically significantly different from 0 (column) or if the return differences between the extreme deciles are significantly different from 0 (row).

Table 57 shows that small companies reveal higher returns compared to large companies. This is true in panel A and B. Regarding the risk parameters, there is a tendency toward larger standard deviations for small companies. The tenth decile, consisting of the largest companies, shows low volatility in returns. Beta does not indicate a higher level of risks for small companies.

In summary, tables 56 and 57 display the outperformance of high BM ratio companies and small firms. These findings are important because they confirm the value- and size anomaly. The remainder of this chapter focuses on portfolios constructed upon cost structure proxies. Section 9.1 explains that because a rigid cost structure amplifies accounting returns and stock return volatilities, it is expected that returns of portfolios consisting of companies with such cost structures will show large volatilities, too.

Costr(5ya)								
	A: equally-weighted				B: size-weighted			
	Mean	Return(sd)	Beta	t-stat	Mean	Return(sd)	Beta	t-stat
1	1.39%	5.21%	1.01	4.83	1.08%	4.50%	0.95	4.35
2	1.61%	5.82%	1.06	5.01	1.24%	5.83%	1.16	3.85
3	1.83%	6.84%	1.07	4.84	1.17%	8.46%	1.24	2.51
4	1.94%	8.47%	1.03	4.14	0.99%	9.59%	1.21	1.87
5	2.08%	10.82%	1.03	3.48	1.76%	12.00%	1.14	2.65
6	1.63%	12.35%	1.31	2.30	0.83%	15.13%	1.56	0.96
7	3.80%	15.98%	1.54	3.90	3.14%	16.38%	1.64	3.14
8	2.26%	16.95%	0.98	2.23	2.22%	18.05%	1.02	2.06
9	2.22%	15.74%	1.27	2.24	2.04%	16.05%	1.32	2.02
10	2.88%	16.91%	1.25	3.09	2.58%	18.15%	1.34	2.57
10-1	1.50%				1.50%			
t-stat	1.73				1.58			

Table 58: Properties of portfolio returns for Costr(5ya) deciles
Table 58 displays averages of portfolio returns, standard deviation of returns, beta and t-stats across Costr(5ya) deciles. Portfolios are built yearly according to the cost structure proxy. Section 4.5 explains the calculation of the proxy. Portfolio building follows the distribution of the values of the proxy. All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly returns are measured, either equally- or size-weighted. Standard deviation is calculated according to formula (26) and beta according to formula (27). T-stat indicates if the return is statistically significantly different from 0 (column) or if the return differences between the extreme deciles are significantly different from 0 (row).

Table 58 summarizes returns of portfolios sorted by Costr(5ya). The pattern of the size-weighted returns in particular meets the expectation. Companies with rigid cost structures have higher returns compared to companies with flexible cost structures. Further, the standard deviation of returns expresses a strong relation to the degree of rigidity. The standard deviation of the top decile is three times the volatility of the bottom decile. The cost structure proxy is measured with a moving time window of five years. But, the annual volatility still relates to it. These volatilities are much larger compared to those summarized in tables 56 and 57. However, the number of companies in deciles varies substantially for Costr(5ya). According to table 84 on page 187, there are many observations in the bottom deciles and only few in the top deciles. Consequently, the moderating effect of diversification on volatility is much lower for the top deciles. The second risk parameter, beta, does not show a steady increase from the bottom to top decile. But, it seems that the top five deciles reveal larger betas compared to the bottom five deciles. Betas of rigid cost structure portfolios are larger compared to value portfolios or small portfolios. The insignificant t-stats of the return differences is a result of the large standard deviations.

	Costr(absolute)							
	A: equally-weighted				B: size-weighted			
	Mean	Return(sd)	Beta	t-stat	Mean	Return(sd)	Beta	t-stat
1	1.64%	10.25%	1.06	2.89	0.81%	9.85%	1.10	1.49
2	1.39%	7.48%	1.03	3.34	0.92%	7.97%	1.06	2.07
3	1.33%	6.70%	0.98	3.60	1.17%	6.42%	0.94	3.29
4	1.45%	6.18%	1.10	4.25	0.97%	6.04%	1.14	2.90
5	1.46%	5.73%	1.07	4.60	1.13%	5.19%	1.02	3.96
6	1.47%	5.37%	1.02	4.97	1.07%	4.69%	0.98	4.12
7	1.52%	5.45%	1.02	5.06	1.18%	5.03%	0.99	4.25
8	1.42%	5.51%	0.99	4.68	1.11%	5.54%	1.02	3.64
9	1.57%	6.34%	0.94	4.50	1.32%	6.16%	0.91	3.87
10	2.01%	7.93%	1.00	4.59	0.82%	6.56%	0.89	2.26
10-1	0.38%				0.01%			
t-stat	0.65				0.02			

Table 59: Properties of portfolio returns for Costr(absolute) deciles
Table 59 displays averages of portfolio returns, standard deviation of returns, beta and t-stats across Costr(absolute) deciles. Portfolios are built yearly according to the cost structure proxy. Section 4.5 explains the calculation of the proxy. Portfolio building follows the distribution of the values of the proxy. All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly returns are measured, either equally- or size-weighted. Standard deviation is calculated according to formula (26) and beta according to formula (27). T-stat indicates if the return is statistically significantly different from 0 (column) or if the return differences between the extreme deciles are significantly different from 0 (row).

Table 59 shows a mixed picture. The first decile consists of companies with rigid cost structures. But, this portfolio shows lower returns compared to the top decile in panel A and B. On the contrary, the standard deviation of the bottom decile is quite large. Even though there is no continuous decrease in volatility from the bottom to the top decile, it seems that high volatility clusters at the bottom and top two or three deciles. Volatilities and betas are lower than those in table 58.

	Costr(change)							
	A: equally-weighted				B: size-weighted			
	Mean	Return(sd)	Beta	t-stat	Mean	Return(sd)	Beta	t-stat
1	2.13%	8.43%	1.14	4.58	1.87%	9.27%	1.21	3.66
2	1.10%	7.12%	1.09	2.81	0.99%	8.90%	1.23	2.02
3	1.60%	6.81%	1.07	4.25	1.57%	7.81%	1.12	3.65
4	1.49%	6.37%	1.11	4.24	1.05%	6.53%	1.13	2.91
5	1.61%	5.89%	1.07	4.94	1.21%	6.34%	1.14	3.45
6	1.54%	5.51%	1.03	5.06	1.20%	5.10%	1.03	4.27
7	1.47%	5.28%	1.00	5.06	1.01%	4.49%	0.92	4.09
8	1.29%	4.89%	0.91	4.78	1.17%	4.67%	0.83	4.53
9	1.84%	5.87%	0.95	5.66	1.41%	6.67%	1.00	3.82
10	1.45%	7.71%	0.91	3.40	0.90%	10.94%	1.19	1.48
10-1	-0.68%				-0.98%			
t-stat	1.40				1.51			

Table 60: Properties of portfolio returns for Costr(change) deciles
Table 60 displays averages of portfolio returns, standard deviation of returns, beta and t-stats across Costr(absolute) deciles. Portfolios are built yearly according to the cost structure proxy. Section 4.5 explains the calculation of the proxy. Portfolio building follows the distribution of the values of the proxy. All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly returns are measured, either equally- or size-weighted. Standard deviation is calculated according to formula (26) and beta according to formula (27). T-stat indicates if the return is statistically significantly different from 0 (column) or if the return differences between the extreme deciles are significantly different from 0 (row).

According to table 60, the proxy Costr(change) seems more strongly related to returns than Costr(absolute). The first decile shows large returns. The development from the bottom to the top decile is not stable. The same is true for the standard deviation. The volatility pattern implies that volatility is large at both extremes.

Tables 58 to 60 show portfolio return properties for portfolios sorted by cost structure proxies calculated with moving time windows. Because the market is quick to absorb new information and because the newest income statement information relevant to these proxies has only a marginal impact on the proxy, more direct proxies are needed for portfolio construction. Subsection 4.2.1 explains the definition of the proxy used for portfolio building. This factor and the one-year clone of Costr(5ya) are additionally used to build portfolios. Unlike the other proxies, portfolios built upon these new proxies consist of equal numbers of firms.

	Costr(SGA)							
	A: equally-weighted				B: size-weighted			
	Mean	Return(sd)	Beta	t-stat	Mean	Return(sd)	Beta	t-stat
1	1.06%	5.88%	1.06	3.26	0.82%	5.74%	1.09	2.58
2	1.07%	5.29%	1.04	3.65	1.05%	4.87%	0.91	3.92
3	1.15%	5.19%	1.02	4.02	1.01%	4.77%	0.91	3.83
4	1.17%	5.33%	1.04	3.99	1.19%	4.80%	0.96	4.48
5	1.36%	5.64%	1.06	4.36	1.37%	5.23%	1.02	4.75
6	1.42%	5.48%	1.04	4.68	1.33%	5.27%	1.00	4.56
7	1.53%	5.56%	1.00	4.98	1.55%	6.04%	1.12	4.66
8	1.54%	5.70%	1.01	4.88	1.54%	5.59%	1.03	4.99
9	1.87%	5.97%	0.97	5.68	1.70%	5.95%	0.94	5.16
10	2.77%	7.24%	1.02	6.93	1.69%	7.33%	1.08	4.19
10-1	1.72%				0.88%			
t-stat	5.61				2.45			

Table 61: Properties of portfolio returns for Costr(SGA) deciles
Table 61 displays averages of portfolio returns, standard deviation of returns, beta and t-stats across Costr(SGA) deciles. Portfolios are built yearly according to the cost structure proxy. Section 4.5 explains the calculation of the proxy. Portfolio building follows the distribution of the values of the proxy. All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly returns are measured, either equally- or size-weighted. Standard deviation is calculated according to formula (26) and beta according to formula (27). T-stat indicates if the return is statistically significantly different from 0 (column) or if the return differences between the extreme deciles are significantly different from 0 (row).

Table 61 shows a clear pattern for returns. As the ratios rise, returns increase. So, companies with large levels of SGA reveal higher returns. The top decile exhibits higher volatility than the other deciles. There are no large differences in volatilities in the remaining portfolios. Regarding beta, no clear pattern is evident. The results are similar for size- and equally-weighted returns.

Costr(1y)								
	A: equally-weighted				B: size-weighted			
	Mean	Return(sd)	Beta	t-stat	Mean	Return(sd)	Beta	t-stat
1	1.40%	5.93%	0.96	4.28	1.18%	5.53%	0.89	3.86
2	1.46%	5.29%	0.99	5.01	1.26%	5.20%	0.97	4.40
3	1.26%	5.48%	1.04	4.15	0.99%	5.75%	1.12	3.13
4	1.42%	5.28%	1.00	4.88	0.92%	4.92%	0.97	3.38
5	1.30%	5.29%	1.00	4.44	1.06%	4.97%	0.93	3.87
6	1.38%	5.63%	1.02	4.43	1.04%	4.70%	0.86	4.02
7	1.48%	5.44%	0.99	4.93	1.37%	5.57%	1.05	4.45
8	1.57%	6.01%	1.08	4.74	1.22%	6.49%	1.20	3.39
9	1.79%	6.31%	1.04	5.13	1.35%	8.05%	1.33	3.03
10	2.02%	7.56%	1.06	4.85	1.34%	9.44%	1.37	2.57
10-1	0.62%				0.16%			
t-stat	1.82				0.35			

Table 62: Properties of portfolio returns for Costr(1y) deciles
Table 62 displays averages of portfolio returns, standard deviation of returns, beta and t-stats across Costr(1y) deciles. Portfolios are built yearly according to the cost structure proxy. Section 4.5 explains the calculation of the proxy. Portfolio building follows the distribution of the values of the proxy. All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly returns are measured, either equally- or size-weighted. Standard deviation is calculated according to formula (26) and beta according to formula (27). T-stat indicates if the return is statistically significantly different from 0 (column) or if the return differences between the extreme deciles are significantly different from 0 (row).

The results in table 62 are comparable with those in table 61. The top decile portfolio reveals a high return with high volatility. In panel B, the top four deciles have rather high returns compared to the remaining portfolios. The differences in returns and volatilities for the rest of the portfolios are small. Beta seems related to the proxy solely in panel B.

Tables 58 to 62 show that the relations between cost structure characteristics and both returns and volatilities vary among the proxies used for portfolio construction. Costr(5ya) and those proxies with a small time lag seem more strongly related than Costr(absolute) and Costr(change). To better distinguish between the impact of size and cost structure characteristics on returns, the returns of portfolios double-sorted according to these factors are compared.

Size	Costr(SGA)														
	A: equally-weighted														
	Return					Return(sd)					Beta				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	1.54%	1.21%	1.46%	1.70%	2.57%	6.22%	5.91%	5.88%	5.82%	6.74%	0.88	0.92	1.09	1.10	1.10
2	0.88%	1.11%	1.45%	1.34%	1.62%	5.97%	6.26%	6.37%	6.20%	6.70%	0.89	1.05	1.11	1.12	1.00
3	1.15%	1.12%	1.36%	1.26%	1.81%	6.27%	6.14%	6.16%	6.29%	7.56%	0.95	1.10	1.09	1.13	1.01
4	1.01%	1.25%	1.27%	1.43%	1.35%	5.87%	5.79%	6.22%	6.32%	8.11%	0.90	1.08	1.07	1.16	1.04
5	0.92%	1.16%	1.27%	1.41%	1.56%	5.53%	4.86%	5.06%	5.99%	7.33%	0.97	1.08	1.09	1.10	0.89
	B: size-weighted														
1	1.44%	1.24%	1.32%	1.54%	1.93%	6.46%	6.11%	6.15%	5.92%	6.79%	0.96	0.92	1.08	1.10	0.97
2	0.92%	1.09%	1.46%	1.32%	1.63%	6.01%	6.31%	6.35%	6.23%	6.71%	0.96	1.05	1.10	1.13	0.91
3	1.18%	1.12%	1.39%	1.25%	1.90%	6.24%	6.14%	6.03%	6.28%	7.47%	0.99	1.10	1.07	1.16	0.99
4	1.02%	1.30%	1.27%	1.42%	1.45%	5.87%	5.79%	6.32%	6.34%	7.98%	0.94	1.08	1.07	1.16	1.03
5	0.96%	1.07%	1.35%	1.49%	1.50%	4.99%	4.60%	5.19%	6.31%	7.60%	1.07	1.08	1.07	1.06	0.88

Table 63: Properties of returns for double-sorted size and Costr(SGA) portfolios
Table 63 displays averages of portfolio returns, standard deviation of returns and betas. Portfolios are built yearly according to size and the cost structure proxy. Section 4.5 explains the calculation of the proxy. Portfolio building follows the number of observations per year for the cost structure proxies and the breakpoints of size. The annual number of observations per portfolio varies between 1 and 137 for Costr(SGA) with an average portfolio size of 27. 0 return is assumed if no observations are available. All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly returns are measured, either equally- or size-weighted. Standard deviation is calculated according to formula (26) and beta according to formula (27).

Size	Costr(1y)														
	A: equally-weighted														
	Return					Return(sd)					Beta				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	2.03%	1.86%	1.71%	1.69%	2.20%	6.24%	5.73%	6.69%	6.03%	6.70%	0.81	0.86	0.91	0.96	0.96
2	1.20%	1.22%	1.28%	1.45%	1.15%	5.79%	6.22%	5.98%	6.36%	7.23%	0.92	1.03	1.04	1.08	1.15
3	1.40%	1.23%	1.12%	1.25%	1.25%	6.28%	5.82%	6.07%	6.75%	7.95%	1.02	1.04	1.08	1.12	1.26
4	1.27%	1.06%	1.32%	1.27%	0.56%	5.95%	5.88%	5.89%	6.13%	10.83%	1.09	1.12	1.10	1.11	1.43
5	1.16%	1.10%	1.04%	1.38%	1.56%	5.38%	5.24%	4.79%	5.46%	9.27%	1.00	1.09	0.98	1.03	1.41
	B: size-weighted														
1	1.86%	1.58%	1.33%	1.33%	1.73%	6.38%	5.65%	6.32%	6.31%	6.58%	0.89	0.88	1.01	1.01	1.02
2	1.24%	1.24%	1.24%	1.45%	1.09%	5.83%	6.13%	6.06%	6.35%	7.34%	0.92	1.02	1.05	1.07	1.17
3	1.41%	1.24%	1.13%	1.37%	1.32%	6.22%	5.81%	6.04%	6.66%	7.93%	1.01	1.04	1.08	1.12	1.25
4	1.28%	1.08%	1.33%	1.25%	0.59%	5.92%	5.94%	5.94%	6.12%	11.39%	1.08	1.13	1.11	1.11	1.44
5	1.24%	0.90%	1.05%	1.27%	1.51%	5.08%	4.96%	4.65%	5.86%	9.24%	0.91	1.01	0.86	1.11	1.41

Table 64: Properties of returns for double-sorted size and Costr(1y) portfolios
Table 64 displays averages of portfolio returns, standard deviation of returns and betas. Portfolios are built yearly according to size and the cost structure proxy. Section 4.5 explains the calculation of the proxy. Portfolio building follows the number of observations per year for the cost structure proxies and the breakpoints of size. The annual number of observations per portfolio varies between 1 and 123 for Costr(1y) with an average of 26. 0 return is assumed if no observations are available. All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly returns are measured, either equally- or size-weighted. Standard deviation is calculated according to formula (26) and beta according to formula (27).

Table 63 provides information about the characteristics of portfolio returns, while controlling either for size or the influence of the cost structure. Size differentiates between low and high returns when controlling for cost structure. Within cost structure quintiles, returns decrease from the bottom to the top quintiles. This is true for panel A and B. The relation between size and the risk parameters is unclear. Neither standard deviation nor beta show a consistent pattern. When controlling for size, returns increase from the first to the fifth cost structure quintile. This pattern is stable for equal- and size-weighted returns. Standard deviation of returns increases within size quintiles. The variation in betas is less clear.

The results reported in table 64 are less convincing than those in table 63. The returns do not vary much among Costr(1y) quintiles. It seems that controlling for size absorbs most of the differences in returns. So, returns differ among size quintiles when controlling for Costr(1y). This is true for size- and equally-weighted returns. The standard deviation of returns increases with rising Costr(1y). This behavior of volatility remains stable when controlling for size. The top Costr(1y) quintiles in particular reveal high standard deviations. The beta patterns among the portfolios are similar to the volatility structure. As Costr(1y) rises, beta increases, too. When controlling for the cost structure, standard deviation and beta do not exhibit a homogeneous pattern.

To conclude, the relation between returns and the cost structure varies for different approximation methods. Of those proxies calculated with a moving time window, Costr(5ya) shows the most convincing results. Of the two proxies based on annual input variables, Costr(SGA) reveals a closer relation to returns than Costr(1y). This is true when controlling for the impact of size on returns. Regarding the risk parameters, a more coherent picture is evident. Portfolios consisting of companies with rigid cost structures tend to be more volatile. As a next step, the three-factor model of Fama and French (1993) is applied for double-sorted portfolio returns.

Size and Costr(SGA)										
	MARKET					MARKET(t)				
	1	2	3	4	5	1	2	3	4	5
1	0.84	0.84	0.89	0.85	0.90	16.28	19.86	24.98	23.35	20.07
2	0.87	0.99	1.04	1.02	1.02	19.70	26.22	29.85	31.77	29.15
3	1.05	1.06	1.04	1.01	1.03	25.78	29.76	30.62	27.84	19.04
4	1.09	1.09	1.10	1.14	1.08	30.03	34.69	28.22	29.83	14.34
5	1.10	1.00	1.01	1.04	0.86	35.05	44.33	37.63	22.74	11.33
	SMB					SMB(t)				
1	0.67	0.82	0.88	0.87	1.06	9.19	13.82	17.47	17.07	16.79
2	0.70	0.87	0.87	0.85	1.01	11.20	16.26	17.76	18.56	20.52
3	0.64	0.66	0.77	0.84	0.98	11.19	13.15	16.02	16.39	12.77
4	0.32	0.42	0.48	0.45	0.49	6.21	9.34	8.74	8.36	4.58
5	0.01	0.08	0.13	0.12	0.36	0.12	2.39	3.45	1.92	3.23
	HML					HML(t)				
1	0.37	0.26	0.18	0.36	0.45	5.19	4.37	3.57	7.17	7.20
2	0.30	0.17	0.27	0.31	0.55	4.92	3.24	5.68	6.84	11.37
3	0.29	0.17	0.27	0.33	0.65	5.13	3.43	5.69	6.58	8.64
4	0.23	0.12	0.27	0.37	0.62	4.66	2.78	4.91	6.98	6.03
5	0.06	0.13	0.10	0.25	0.51	1.29	4.27	2.56	3.97	4.85
	Constant					Constant(t)				
1	0.00	0.00	0.00	0.01	0.01	2.06	1.20	3.03	3.97	7.10
2	-0.00	0.00	0.00	0.00	0.00	-0.78	0.49	2.10	1.44	2.35
3	0.00	0.00	0.00	0.00	0.00	0.09	0.24	1.60	0.79	2.02
4	-0.00	0.00	0.00	0.00	0.00	-0.80	1.19	0.58	1.12	0.02
5	-0.00	0.00	0.00	0.00	0.00	-1.00	1.18	2.06	1.40	1.22
	R^2									
1	0.56	0.68	0.76	0.75	0.72					
2	0.65	0.77	0.81	0.83	0.83					
3	0.73	0.78	0.81	0.79	0.67					
4	0.76	0.81	0.75	0.77	0.47					
5	0.79	0.86	0.82	0.63	0.37					

Table 65: Regressions of returns of Costr(SGA) portfolios on mimicking portfolios
Table 65 summarizes the results of regressions conducted according to formula (28). Portfolios are built yearly according to size and the cost structure proxy. Section 4.5 explains the calculation of the proxy. Portfolio building follows the distribution of the values of the cost structure proxy and the breakpoints of size. The annual number of observations per portfolio varies between 1 and 137 for Costr(SGA) with an average portfolio size of 27. 0 return is assumed if no observations are available. All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly size-weighted returns are measured. Dependent variables are the excess returns of the portfolios. The construction of mimicking portfolios is explained in subsection 4.2.3. The left half of table 65 summarizes the coefficients and the right half t-statistics of the explanatory variables.

Table 65 shows that the three independent variables explain the portfolio returns to a large degree. Most of the coefficients are significant. The factor loadings on MARKET are stable and significant. The large coefficients indicate an economically meaningful impact on the returns. The coefficients and the t-statistics for SMB are larger for the bottom size-quintiles than the top size quintiles. This makes sense because the bottom quintiles consist of small companies. Within size quintiles, the coefficients steadily increase as Costr(SGA) rises. Thus, the returns of portfolios consisting of companies with rigid cost structures are driven largely by SMB. A similar pattern is true for HML. Again, the coefficients and t-statistics increase within size quintiles in the direction of companies with larger Costr(SGA). Thus, in addition to their significant SMB coefficients, portfolios with rigid cost structure companies show returns that are explainable by HML. Constants are around 0 and indicate that the three factors explain the variations in returns.

Size and Costr(1y)										
	MARKET					MARKET(t)				
	1	2	3	4	5	1	2	3	4	5
1	0.78	0.80	0.84	0.89	0.89	15.60	21.57	16.23	24.31	18.83
2	0.89	0.97	0.99	1.01	1.08	22.56	28.16	31.02	30.91	22.11
3	1.00	1.00	1.02	1.05	1.19	23.23	31.52	32.00	24.76	19.67
4	1.08	1.09	1.07	1.08	1.37	28.79	33.80	29.93	26.65	13.02
5	1.02	1.08	0.97	1.02	1.36	30.97	49.33	41.79	28.85	14.96
	SMB					SMB(t)				
1	0.72	0.86	0.99	0.90	1.02	10.22	16.41	13.54	17.36	15.29
2	0.63	0.91	0.80	0.97	0.99	11.31	18.72	17.65	20.97	14.34
3	0.56	0.68	0.80	0.94	0.90	9.23	15.20	17.82	15.66	10.48
4	0.29	0.44	0.47	0.42	0.74	5.49	9.58	9.26	7.38	5.01
5	-0.07	0.17	0.07	0.15	0.49	-1.51	5.58	2.23	3.04	3.79
	HML					HML(t)				
1	0.64	0.36	0.25	0.32	0.32	9.20	6.96	3.51	6.31	4.90
2	0.47	0.31	0.29	0.23	0.23	8.50	6.51	6.46	4.98	3.41
3	0.56	0.29	0.19	0.02	0.01	9.45	6.59	4.18	0.33	0.17
4	0.42	0.28	0.08	0.12	0.46	8.00	6.15	1.53	2.17	3.10
5	0.42	0.06	-0.07	-0.08	-0.04	9.09	2.07	-2.17	-1.56	-0.34
	Constant					Constant(t)				
1	0.01	0.01	0.01	0.01	0.01	3.87	4.95	3.07	3.79	5.32
2	0.00	0.00	0.00	0.00	0.00	0.40	0.79	1.28	2.56	0.17
3	0.00	0.00	0.00	0.00	0.00	0.76	0.88	0.46	1.40	0.65
4	0.00	-0.00	0.00	0.00	-0.01	0.24	-0.72	1.76	1.05	-1.60
5	-0.00	0.00	0.00	0.00	0.00	-0.29	0.51	1.22	2.79	1.07
	R^2									
1	0.59	0.73	0.61	0.76	0.68					
2	0.70	0.80	0.82	0.83	0.71					
3	0.70	0.81	0.82	0.75	0.63					
4	0.75	0.81	0.77	0.72	0.44					
5	0.76	0.89	0.85	0.73	0.47					

Table 66: Regressions of returns of Costr(1y) portfolios on mimicking portfolios
Table 66 summarizes the results of regressions conducted according to formula (28). Portfolios are built yearly according to size and the cost structure proxy. Section 4.5 explains the calculation of the proxy. Portfolio building follows the distribution of the values of the cost structure proxy and the breakpoints of size. The annual number of observations per portfolio varies between 1 and 123 for Costr(1y) with an average of 26. 0 return is assumed if no observations are available. All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly size-weighted returns are measured. Dependent variables are the excess returns of the portfolios. The construction of mimicking portfolios is explained in subsection 4.2.3. The left half of table 66 summarizes the coefficients and the right half t-statistics of the explanatory variables.

Like the results reported in table 65, MARKET is also statistically significant in table 66. The SMB factor shows comparable properties. There is also a tendency for coefficients to increase within size quintiles in the direction of companies with higher Costr(1y). So, these portfolio returns are similar to the returns of small companies. As the level of market capitalization increases, the factor loses some of its impact on the returns. Unlike the findings in table 65, HML does not increase with rising rigidity in cost structures. The coefficients indicate the opposite. Like the results of table 65, constants are around 0 with insignificant t-statistics.

In summary, regressions conducted according to the approach of Fama and French (1993) explain variations in portfolio returns to a large degree. These portfolios do not earn excess returns. The results confirm the significance of SMB and HML. The association with SMB is more stable across different cost structure proxies. The results for HML are more in line with expectations for portfolios sorted by Costr(SGA).

The following investigations focus on factors explaining stock returns for single companies. Chapter 9.1 explains the model tested. Formula (22) on page 64 explains the replacement of the EBITDA/EV ratio with enterprise-multiples with numerators sales, COGS and SGA. This replacement makes it possible to test the explanatory power of the two operating cost categories.

	Dependent variable: $Return_{t+1}$									
	1	2	3	4	5	6	7	8	9	10
EBITDA/EV	0.63***									
	(7.41)									
SALE/EV		0.26***	0.21**	0.23***	0.31***	0.31***		0.26***	0.26***	
		(2.88)	(2.51)	(2.69)	(3.46)	(3.48)		(3.11)	(3.13)	
SGA/EV		-0.05	-0.03	-0.08	-0.13	-0.13	0.18***	-0.11	-0.11	0.16***
		(-0.50)	(-0.35)	(-0.78)	(-1.30)	(-1.33)	(5.35)	(-1.12)	(-1.17)	(5.02)
COGS/EV		-0.24**	-0.21**	-0.23***	-0.32***	-0.32***	-0.00	-0.27***	-0.27***	-0.01
		(-2.57)	(-2.48)	(-2.67)	(-3.47)	(-3.49)	(-0.64)	(-3.14)	(-3.16)	(-0.83)
BM ratio			0.10***	0.08***	0.08***	0.08***	0.09***	0.09***	0.09***	0.09***
			(6.51)	(5.36)	(5.21)	(5.04)	(5.52)	(5.70)	(5.51)	(5.87)
lnsize				-0.01***	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***
				(-4.06)	(-3.41)	(-3.46)	(-3.17)	(-3.70)	(-3.78)	(-3.54)
Leverage					0.02**	0.02**	0.01*			
					(2.26)	(2.27)	(1.87)			
$Return_{t-1}$						-0.01	-0.01		-0.01	-0.01
						(-1.13)	(-1.08)		(-1.55)	(-1.57)
Equity ratio								-0.09***	-0.10***	-0.09***
								(-3.48)	(-3.49)	(-3.34)
Constant	-0.11***	-0.10**	-0.02	0.19***	0.16**	0.17**	0.20***	0.19***	0.20***	0.06
	(-2.80)	(-2.54)	(-0.73)	(3.09)	(2.35)	(2.43)	(2.87)	(2.96)	(3.05)	(0.87)
R^2	0.15	0.17	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Adjusted R^2	0.15	0.16	0.17	0.17	0.18	0.18	0.18	0.18	0.18	0.18
F	93.17	89.05	87.92	86.02	77.86	76.01	77.72	84.10	82.19	83.77
Observations	17238	16953	16692	16692	14870	14870	14898	16365	16365	16395

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 67: Regressions of returns of companies on enterprise multiples
Table 67 summarizes the results of regressions conducted according to formula (29). Dependent variables are returns of firms in year t+1. The 12 monthly return calculation starts at end of April in t+1. The following factors serve as right-hand-side variables: BM ratio is the relation of equity to market capitalization, lnsize is the logarithm of market capitalization, leverage is the ratio of total liabilities to equity, $Return_{t-1}$ is the past return of the company, equity ratio is the relation of equity to total assets. The replacement of EBITDA/EV is explained in formula (22). Except for size, $Return_{t-1}$ and the dependent variable, all other variables are truncated at 1% and 99% percentile to mitigate the impact of outliers. Industry and time dummies are applied and residuals are clustered for companies.

Table 67 shows that the EBITDA/EV ratio is statistically significant with positive coefficients. This is a precondition for the exchange of this variable according to formula (22). The second regression shows the results after the replacement. The Sales/EV ratio is positive and significant. Of the two cost factors, only COGS/EV ratio is significant with negative coefficients. Therefore, a high ratio has a negative impact on future returns. Both the Sales/EV ratio and COGS/EV ratio remain significant in all regressions. The BM ratio is also significant with a positive impact on future returns. This finding is congruent with the expectation and the results in table 56. The negative coefficient of size is also expected. Compared to the equity ratio, the leverage ratio exhibits only weak significance. The negative coefficient of the equity ratio is in line with expectations; higher equity ratio indicates lower risk levels. The past return is not significant. In regressions 7 and 10, the replacement of EBITDA/EV is incomplete. However, this adjustment allows the influence of the cost categories to be compared. Interestingly, SGA/EV ratio turns significant with a positive coefficient, while the COGS/EV ratio becomes insignificant. So, in direct comparison with COGS, a large proportion of SGA to enterprise value seems to positively influence future stock returns. This result is remarkable since these two regressions contain additional factors, which have proven their explanatory power many times. This relation between SGA and future returns is also evident in table 61 on page 139.

9.3. Robustness

This section repeats the regressions according to formula (29) on page 133. The models tested in table 67 contain enterprise multiples. Formula (22) explains the replacement of the EBITDA/EV ratio with enterprise multiples using cost types in the nominator. To compare the results of regressions summarized in table 67, the explanatory power of point estimates of cost structure proxies are tested in this robustness section.

	Dependent variable: $Return_{t+1}$						
	1	2	3	4	5	6	7
Costr(5ya)	0.01***	0.01**	0.00	0.00	0.00	0.00	0.00
	(4.46)	(2.35)	(0.38)	(0.33)	(0.33)	(0.17)	(0.19)
BM ratio		0.15***	0.11***	0.12***	0.11***	0.12***	0.11***
		(10.52)	(7.75)	(7.57)	(7.26)	(7.85)	(7.50)
lnsize			-0.02***	-0.02***	-0.02***	-0.02***	-0.02***
			(-6.41)	(-5.59)	(-5.64)	(-5.94)	(-6.01)
Leverage				0.01	0.01		
				(1.55)	(1.58)		
$Return_{t-1}$					-0.01*		-0.01**
					(-1.88)		(-2.50)
Equity ratio						-0.12***	-0.12***
						(-3.99)	(-4.01)
Constant	-0.02	-0.03	0.35***	0.14**	0.15**	0.22***	0.23***
	(-0.65)	(-0.94)	(5.42)	(2.04)	(2.14)	(2.98)	(3.10)
R^2	0.15	0.17	0.17	0.17	0.17	0.17	0.17
Adjusted R^2	0.15	0.17	0.17	0.17	0.17	0.17	0.17
F	90.15	91.15	88.57	78.82	76.83	86.15	84.07
Observations	17590	17252	17252	15288	15288	16872	16872

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 68: Regressions of returns of companies on Costr(5ya)
Table 68 summarizes the results of regressions conducted according to formula (29). Dependent variables are returns of firms in year t+1. The 12 monthly return calculations start at end of April in t+1. The following factors serve as right-hand-side variables: BM ratio is the relation of equity to market capitalization, lnsize is the logarithm of market capitalization, leverage is the ratio of total liabilities to equity, $Return_{t-1}$ is the past return of the company, equity ratio is the relation of equity to total assets. The calculation of the cost structure proxy is explained in section 4.5. Except for Costr(5ya), size, $Return_{t-1}$ and the dependent variable, all other variables are truncated at 1% and 99% percentile to mitigate the impact of outliers. Industry and time dummies are applied and residuals are clustered for companies.

Table 68 shows the results using Costr(5ya) as the independent variable. The impact on future returns is limited. The factor is significant only in the first two regressions. With the integration of BM ratio and size, Costr(5ya) loses its significance. The results for the other variables are similar to the results reported in table 67.[34]

[34] The three operating leverage proxies, DOL(ela), DOL(MR) and DOL(OV), are insignificant in explaining future returns.

	Dependent variable: $Return_{t+1}$						
	1	2	3	4	5	6	7
Costr(change)	-0.03	-0.02	-0.01	-0.03*	-0.03*	-0.03	-0.03
	(-1.54)	(-1.37)	(-0.66)	(-1.73)	(-1.72)	(-1.54)	(-1.53)
BM ratio		0.15***	0.11***	0.12***	0.11***	0.12***	0.11***
		(10.87)	(7.75)	(7.58)	(7.26)	(7.86)	(7.51)
lnsize			-0.02***	-0.02***	-0.02***	-0.02***	-0.02***
			(-6.80)	(-5.90)	(-5.94)	(-6.26)	(-6.32)
Leverage				0.01	0.01		
				(1.61)	(1.64)		
$Return_{t-1}$					-0.01*		-0.01**
					(-1.88)		(-2.51)
Equity ratio						-0.12***	-0.12***
						(-4.15)	(-4.18)
Constant	0.03	0.00	0.37***	0.17***	0.18***	0.24***	0.25***
	(0.90)	(0.11)	(5.91)	(2.63)	(2.72)	(3.47)	(3.59)
R^2	0.15	0.17	0.17	0.17	0.17	0.17	0.17
Adjusted R^2	0.15	0.17	0.17	0.17	0.17	0.17	0.17
F	90.52	91.27	88.56	78.83	76.83	86.16	84.09
Observations	17590	17252	17252	15288	15288	16872	16872

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 69: Regressions of returns of companies on Costr(change)
Table 69 summarizes the results of regressions conducted according to formula (29). Dependent variables are returns of firms in year t+1. The 12 monthly return calculations start at end of April in t+1. The following factors serve as right-hand-side variables: BM ratio is the relation of equity to market capitalization, lnsize is the logarithm of market capitalization, leverage is the ratio of total liabilities to equity, $Return_{t-1}$ is the past return of the company, equity ratio is the relation of equity to total assets. The calculation of the cost structure proxy is explained in section 4.5. Except for Costr(change), size, $Return_{t-1}$ and the dependent variable, all other variables are truncated at 1% and 99% percentile to mitigate the impact of outliers. Industry and time dummies are applied and residuals are clustered for companies.

Table 69 reports the results for regressions using Costr(change) as the explanatory variable. The results are not convincing. Although the coefficients are negative, which is in line with the expectation, they are significant only in regressions 4 and 5. This significance is surprising since in regressions 1 to 3, Costr(change) is insignificant. Interactions between Costr(change) and the leverage ratio could explain this change in significance.

	Dependent variable: $Return_{t+1}$						
	1	2	3	4	5	6	7
Costr(1y)	0.01***	0.00*	0.00	0.00	0.00	0.00	0.00
	(4.15)	(1.89)	(0.42)	(0.40)	(0.35)	(0.55)	(0.48)
BM ratio		0.14***	0.11***	0.11***	0.11***	0.11***	0.11***
		(9.73)	(7.33)	(7.04)	(6.86)	(7.16)	(6.93)
lnsize			-0.02***	-0.02***	-0.02***	-0.02***	-0.02***
			(-5.84)	(-5.11)	(-5.15)	(-5.35)	(-5.43)
Leverage				0.01*	0.01*		
				(1.73)	(1.75)		
$Return_{t-1}$					-0.01		-0.01*
					(-1.34)		(-1.95)
Equity ratio						-0.11***	-0.11***
						(-3.73)	(-3.76)
Constant	-0.01	0.03	0.40***	0.28***	0.29***	0.42***	0.43***
	(-0.27)	(1.01)	(5.63)	(4.18)	(4.25)	(5.15)	(5.25)
R^2	0.15	0.17	0.17	0.17	0.17	0.17	0.17
Adjusted R^2	0.15	0.17	0.17	0.17	0.17	0.17	0.17
F	85.28	86.54	84.41	75.46	73.66	82.18	80.27
Observations	16739	16429	16429	14616	14616	16097	16097

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 70: Regressions of returns of companies on Costr(1y)
Table 70 summarizes the results of regressions conducted according to formula (29). Dependent variables are returns of firms in year t+1. The 12 monthly return calculations start at end of April in t+1. The following factors serve as right-hand-side variables: BM ratio is the relation of equity to market capitalization, lnsize is the logarithm of market capitalization, leverage is the ratio of total liabilities to equity, $Return_{t-1}$ is the past return of the company, equity ratio is the relation of equity to total assets. The calculation of the cost structure proxy is explained in section 4.5. Except for size, $Return_{t-1}$ and the dependent variable, all other variables are truncated at 1% and 99% percentile to mitigate the impact of outliers. Industry and time dummies are applied and residuals are clustered for companies.

The results in table 70 are similar to those reported in table 68. The cost structure variable is only significant in the first two regressions. The integration of the BM ratio and size suppresses the explanatory power of Costr(1y). The other results are the same as reported in table 68.

	Dependent variable: $Return_{t+1}$						
	1	2	3	4	5	6	7
Costr(SGA)	0.19***	0.13***	0.12***	0.11***	0.11***	0.10***	0.10***
	(5.17)	(5.45)	(4.97)	(4.60)	(4.57)	(4.09)	(4.06)
BM ratio		0.09***	0.07***	0.07***	0.07***	0.08***	0.08***
		(5.33)	(4.12)	(4.34)	(4.19)	(4.89)	(4.68)
lnsize			-0.01***	-0.01***	-0.01***	-0.01***	-0.01***
			(-4.64)	(-4.14)	(-4.17)	(-4.29)	(-4.36)
Leverage				-0.00	-0.00		
				(-0.18)	(-0.15)		
$Return_{t-1}$					-0.01		-0.01**
					(-1.30)		(-1.99)
Equity ratio						-0.05*	-0.05*
						(-1.81)	(-1.85)
Constant	-0.06*	0.00	0.25***	0.07	0.08	0.10	0.11
	(-1.88)	(0.08)	(4.11)	(1.14)	(1.23)	(1.50)	(1.63)
R^2	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Adjusted R^2	0.18	0.17	0.17	0.17	0.17	0.17	0.17
F	92.18	93.00	90.46	81.52	79.47	88.32	86.18
Observations	17590	17252	17252	15288	15288	16872	16872

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 71: Regressions of returns of companies on Costr(SGA)
Table 71 summarizes the results of regressions conducted according to formula (29). Dependent variables are returns of firms in year t+1. The 12 monthly return calculations start at end of April in t+1. The following factors serve as right-hand-side variables: BM ratio is the relation of equity to market capitalization, lnsize is the logarithm of market capitalization, leverage is the ratio of total liabilities to equity, $Return_{t-1}$ is the past return of the company, equity ratio is the relation of equity to total assets. The calculation of the cost structure proxy is explained in section 4.5. Except for size, $Return_{t-1}$ and the dependent variable, all other variables are truncated at 1% and 99% percentile to mitigate the impact of outliers. Industry and time dummies are applied and residuals are clustered for companies.

Costr(SGA) is the proxy for the cost structure rigidity with the strongest explanatory power for future returns. The variable is significant and positive in every regression. BM ratio and size do not suppress the explanatory power of Costr(SGA). These results are not comparable with the results described in tables 68 to 70.

9.4. Interpretation

At the beginning of section 9.2 it is shown that small companies outperform larger ones, and high BM ratio companies reveal higher returns than small BM ratio companies. The results for the BM ratio deciles in Fama and French (1992) show lower returns whereas betas are larger for all portfolios. These lower returns are true for size portfolios in Fama and French (1992), too. The returns of BM ratio, table 56 on page 134, and size portfolios, table 57 on page 135, do not reveal a relation to risk parameters.

The investigations yield mixed results for the returns of cost structure portfolios. Portfolios sorted by Costr(5ya), Costr(change), Costr(SGA), and Costr(1y), see tables 58 to 62, reveal return patterns that are more or less congruent with the research hypothesis. For these portfolios, there is a tendency for returns to increase as the rigidity of the cost structures increase. Costr(SGA) measures the ratio of SGA and market capitalization. This factor is similar to the operating leverage proxy of Gourio (2004). The close relation to returns of Costr(SGA) could be the result of measuring not only the cost structure rigidity, but to some degree also the productivity. Garcia-Feijoo and Jorgensen (2010) report equally and size-weighted returns for deciles sorted by the operating leverage. Their results provide evidence that high operating leverage companies generate higher returns. Garcia-Feijoo and Jorgensen (2010) do not report a continuous development of returns. The differences between the extreme deciles are between 0.37% and 0.53%. These return differences are similar to those for portfolios constructed upon Costr(1y) (return difference between 0.16% to 0.62%), but lower compared to Costr(SGA) (return difference between 0.88% to 1.72%) or Costr(change) portfolios (return difference between 0.68% to 0.98%). Novy-Marx (2011) reveals return differences between high and low operating leverage quintiles of about 0.44% to 0.51%. Gulen et al. (2008) construct portfolios upon their inflexibility index. The operating leverage is part of this index. The return differences between the most flexible and the most inflexible deciles is between 0.72% and 1.03%. Thus, these comparisons show that the results in section 9.2 are comparable with those of other investigations. Tables 63 and 64 show returns of double-sorted portfolios. The return patterns reveal a stronger association between size and return than between cost structure and return.

In respect of the volatilities of portfolio returns, no comparison with other research papers is possible. But, the results make clear that portfolios consisting of rigid cost structure companies are more volatile than portfolios with more flexible companies. This relation between the rigidity of cost structure and volatility is stable when controlling for size, see tables 63 and 64. These results fit the findings of section 6.2. Table 24 on page 97 shows that ROE(sd) increases with rising rigidity of cost structure even when controlling for changes in sale. Costr(absolute) and Costr(change) show that volatilities in returns are high at both extremes. Again, this finding is congruent with the findings for profitability measures displayed in table 22 on page 95. Therefore, these results support the interpretation that market participants recognize the influence of the cost structure on accounting returns.

- $1-H_0$: *Rejected.*
- $1-H_a$: *Approved.*

The three-factor model of Fama and French (1993) explains the returns of portfolios built upon size and cost structure proxies. The significant coefficients of SMB and HML are positive. For Costr(SGA) portfolios, see table 65 on page 144, the coefficients of SMB and HML increase with rising rigidity. The increase in coefficients of SMB is true for Costr(1y), see table 66 on page 146, too. The constants are zero and insignificant. Novy-Marx (2011) reports regression results of the three-factor model for operating leverage quintiles. The constants are insignificant, too. As the operating leverage increases, the exposure to SMB is amplified. The relation to HML is unclear. Gulen et al. (2008) conduct regressions according to the three-factor model for portfolios built according to the flexibility index. The constants are significant and positive for the top two most inflexible deciles. Because Gulen et al. (2008) consider various sources of corporate riskiness in their flexibility index, the comparison with the cost structure is valid only to some degree.

- $2 - H_0$: *Rejected.*
- $2 - H_a$: *Approved.*

The last assessments conduct regressions similar to those in Fama and MacBeth (1973). The results show that cost structure proxies have weak explanatory power for future returns. Only an incomplete replacement of the EBITDA/EV ratio, i.e. excluding Sales/EV ratio, results in a significant SGA/EV ratio while the COGS/EV ratio turns insignificant. Regressions with correct replacements show that the COGS/EV ratio is significant with negative coefficients. So, large proportions of COGS to enterprise value have a negative impact on future returns. The other cost structure proxies lose their significance when BM ratio and size are considered. These results are comparable to those in Gulen et al. (2008). Their operating leverage approximation turns insignificant when the BM ratio is included. Conversely, Novy-Marx (2011) reports a significant operating leverage even when size and BM ratio are included. Novy-Marx (2011) uses the ratio of total operating costs to total assets as a proxy for the operating leverage. The findings are comparable with those of Novy-Marx (2011) because SGA/EV ratio is positive and significant if Sales/EV ratio is excluded. This regression setup is comparable with the regression of Novy-Marx (2011) on which the before-mentioned significance of operating leverage refers to. Also the regressions conducted with Costr(SGA) as explanatory variable provide results similar to those in Novy-Marx (2011). Costr(SGA) is the ratio of SGA and size. Its constituents are similar to the variable constructed by Novy-Marx (2011). However, even though Costr(SGA) is significant in regressions explaining future returns, the majority of the assessments lead to the following conclusion.

- $3 - H_0$: *Rejected.*
- $3 - H_a$: *Approved.*

10. Transfer of Findings to Financial Matters

The empirical investigations improve the understanding of the features of the cost structure, its impact on accounting returns and also stock returns. This chapter 10 transfers the findings to financial matters. Chapter 1 mentions three addresses of this dissertation: managements, analysts and shareholders. The following applications are designed for these stakeholders.

The first section 10.1 describes the starting point, which comprises a short description of the main results of the empirical investigations. It summarizes the findings which are useful for the knowledge transfer to financial matters. Afterwards, sections 10.2 and 10.3 present the applications. The developed approach to define risk clusters, see section 10.2, is designed for managements, analysts and shareholders, whereas the integration of the findings into the context of value investing, see section 10.3, targets shareholders or investors.

10.1. Starting Point

The following table 72 gives an overview over the various tested null hypotheses and their results.

Research Question	Empirical Part	Results	Note
1	I	H_0: Rejected	Costr related to OL proxies
2	II	$1-H_0$: Rejected	Costr related to earnings volatility
2	II	$2-H_0$: Rejected	Costr related to profitability volatility
3	III	$1-H_0$: Rejected	Costr related to Return(sd)
3	III	$2-H_0$: Rejected	Costr related to Beta
3	III	$3-H_0$: Rejected	Costr related to Beta(ul)
3	IV	$1-H_0$: Rejected	Costr related to BM ratio
3	IV	$2-H_0$: Rejected	Costr related to size
3	V	$1-H_0$: Rejected	Costr related to return and risk figures
3	V	$2-H_0$: Rejected	Costr unrelated to excess return
3	V	$3-H_0$: Rejected	SGA and COGS unrelated to $return_{t+1}$

Table 72: Summary of results from empirical investigations
Table 72 summarizes the results from empirical investigations. The first column refers to one of the three research questions. The second column displays which of the five empirical parts treats the corresponding hypotheses. The third column indicates if the null hypothesis is rejected or not. The last column provides a short interpretation of the results. The rejection of the first null hypothesis of the fourth empirical part is justified under consideration of the discovered similarities of accounting returns of high BM ratio companies and such with rigid cost structures.

The first two empirical investigations, which answer research question number one and two, analyze the cost structure from an accounting perspective. The cost structure stands between sales and operating income, and therefore it influences the operating leverage and the volatility in earnings. This influence on the bottom line of the income statement and the evidence provided by empirical tests are relevant for managements, analysts and shareholders. In section 10.2 this insight is used to develop an approach to define risk clusters which can be used as peer group. Strategic considerations are deduced based on such risk clusters.

The third to the fifth empirical investigations consider the features of stock returns of companies and portfolios. Most of the cost structure proxies developed prove significant in explaining total and systematic risk. But, in regressions with future returns as left-hand-side variable, cost structure proxies have only weak explanatory power. BM ratio and size suppress the explanatory power of cost structure proxies. With the three-factor model of Fama and French (1993) the potential for excess return is tested. The results are unambiguous: There is no excess return possible with investing in companies with rigid cost structures. But, additional statistical analyses reveal a connection between cost structure rigidity and size and BM ratio. A relation to BM ratio exists indirectly through similarities in accounting returns between high BM ratio companies and rigid cost structure companies. This similarity in accounting returns is the key information for further developing the investment strategy of active value investors, i.e. investors who buy companies with high BM ratios. Controlling this business weakness may alter the return and risk relation. This application is explained in section 10.3 and targets shareholders.

10.2. How to Define Risk Clusters

Managements, analysts and shareholders lay emphasis on estimation of the level of riskiness. This section 10.2 develops an approach to facilitate the assignment of companies to risk categories. The influence of the cost structure on accounting returns is used to better differentiate between risky and less risky companies, i.e. companies with high and low earnings and profitability volatilities.

Subsection 10.2.1 explains the use of risk clusters for the before-mentioned stakeholders. The definition of risk clusters is part of subsection 10.2.2. Afterwards, subsection 10.2.3 applies the developed procedure. Finally, subsection 10.2.4 explains standard strategies for companies in different risk clusters.

10.2.1. Theoretical Considerations

Different sources of risk exist and the before-mentioned stakeholders are interested in tools to sort companies according to risk exposures. For these three stakeholders, earnings volatility is a severe threat.

For managements, return volatilities are an important information because such volatilities make it difficult to give adequate earnings guidance. Furthermore, their remuneration is often dependent on earnings and therefore they have an own interest in understanding how certain business activities influence the bottom line.

On the other side, analysts are responsible for earnings predictions. Their predictions support market participants to form expectations. Again, understanding the drivers of such volatilities is helpful to develop precise earnings forecasts.

In order to decide what companies fit to an investor's risk appetite, the earnings volatility should be considered. There is a relation between the volatility of earnings and the volatility of stock returns, but also systematic risk. Therefore, shareholders do well to take this accounting information into account.

So, these stakeholders have common interest in identifying earnings volatility. Chapter 6 shows that sales volatility and the cost structure are the drivers of earnings volatility. These two factors serve as parameters to define risk clusters. In other words, the underlying belief of the following approach is that in the process of selecting companies to compare to, the cost structure should be considered.

The uses of such risk clusters for the three stakeholders are manifold. First, risk clusters facilitate the appropriate definition of peer groups. If the peer group consists of companies with comparable risk levels, the before-mentioned stakeholders may expect similar returns of companies within a specific cluster. Furthermore, peer groups serve for relative performance assessments. This aspect is especially important for analysts and managements. The relation between risk exposure and performance is an important information because it enables them to conclude from one factor to the other. Analysts may benefit from relative performance analysis to make more precise earnings forecasts. For managements, the same proceeding is useful for earnings guidance. Another purpose of risk clusters refers to a company's strategy. The knowledge about risk exposure enables managements and analysts to explain or question, respectively, strategic developments. Such derivations are possible because some combinations of risk exposures are more favorable than others.

10.2.2. Development of Risk Clusters

The approach uses three aspects to define risk clusters: industry classification, volatility in sales and the degree of cost structure rigidity. Each factor impounds a different source of risk. This is the main reason why these factors are relevant for the development of risk clusters. The following explanations describe these risk sources.

The empirical investigations take industry differences into account; either through dummy variables in regressions or through developing the considered variable relatively compared to industry averages. These two approaches consider similarities in accounting characteristics among companies within the same industry. Relations between factors can be measured more precisely with controlling otherwise dominant industry aspects. The developed approach follows this methodological consideration. Furthermore, in the asset management industry it is common practice to limit the scope of selecting companies for relative performance analysis within an industry classification. The reason is that business cycles and demand dynamics exert similar influence on companies within an industry. It is a more qualitative than quantitative process to define industry classifications. Therefore, the application of the developed procedure to define peer groups uses the Fama-French industry classification as first criterion.

The industry itself gives analysts a hint regarding the dependence on economic cycles. However, there are companies with high and such with low volatilities in sales within industries. The consideration of such volatilities is the attempt to quantitatively measure the dependence on the economy of a company. This factor is taken as proxy for business risk because in empirical investigations it produces more robust results compared to the correlation of sales growth with the industry peer group. So, the volatility in sales is the second aspect considered to define risk clusters.

Now, the approach goes one step further and splits the two groups – within an industry classification – into four clusters. The factor for further segregation is the degree of cost structure rigidity. The exposure to economic cycles, i.e. the volatilities in sales, materializes through the operating leverage. This means that the dependence on economic cycles should be applied first, before considering the cost structure. But the cost structure rigidity is also relevant because it has an impact on the features of earnings. The process refers to formula (21) on page 52 and allows to capture two significant factors influencing the bottom line of companies.

To sum up, the process consists of three steps:

1. The first step is to define the industry classification of interest. In the following application, see subsection 10.2.3, of the procedure described in figure 7, industry classification from Fama-French is used.

2. The second step is to separate companies with high Sales(sd) from those with low Sales(sd). The median of Sales(sd) of the total sample is used.

3. The third step is to segregate the two groups from step 2 into four clusters according to differences in the cost structure rigidity. Again, the median of the considered cost structure proxy is used as threshold. For the application of the procedure Costr(absolute) is used.

Figure 7 describes the process which explicitly includes the cost structure rigidity within industry analysis.

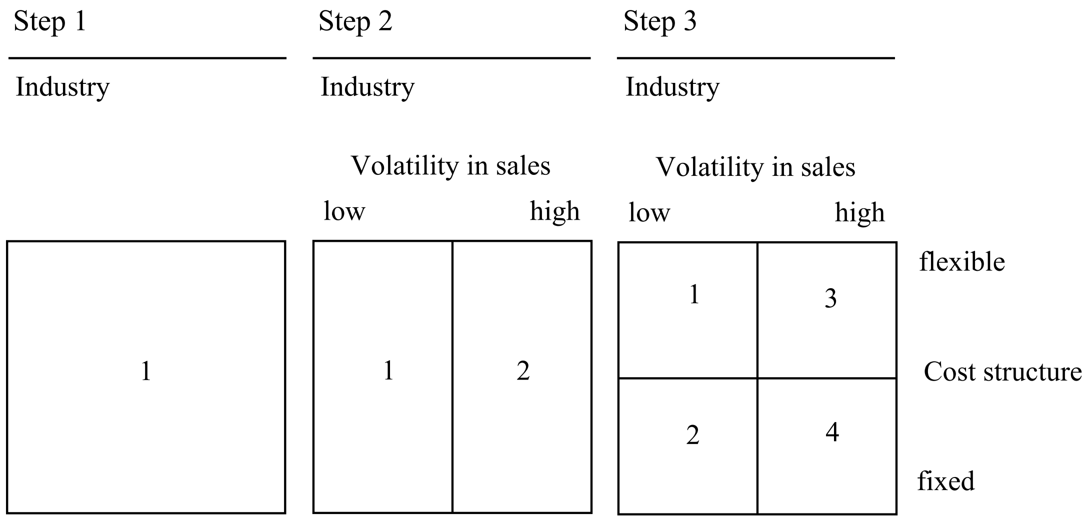


Figure 7: Integration of cost structure rigidity within industry analysis
The idea to consider the cost structure stems from formula (21) on page 52; changes in sales and cost structure rigidity are the drivers of volatilities in earnings. Further, these two factors are also significant in explaining total and systematic risks of companies. The first step is to define the relevant industry. Second, it is differentiated between high and low dependence on economic developments. Third, the cost structure is used to build four risk clusters. These risk clusters serve as peer group.

After these three steps, a risk map with four clusters results, each representing a unique mix of risk sources.

- Cluster 1: low dependence on business cycle, flexible cost structure.
- Cluster 2: low dependence on business cycle, fixed cost structure.
- Cluster 3: high dependence on business cycle, flexible cost structure.
- Cluster 4: high dependence on business cycle, fixed cost structure.

Cluster 1 consists of companies with low exposure to the development of the economy. The cost structure is flexible and therefore, these companies reveal low levels of riskiness. The opposite is true for companies belonging to cluster 4. These companies are dependent on business cycles and their cost structure is rigid. The combination of these two factors make these companies risky. Cluster 2 and 3 are expected to show similar levels of riskiness. Companies within cluster 2 may afford rigid cost structures, because they are only modestly dependent on the economy. Cluster 3 companies compensate the high dependence with a flexible cost structure.

The procedure to define these clusters has to be executed for each industry individually. The following subsection 10.2.3 applies the before-described procedure for two industries. The practical application of this procedure is necessary to deduce standard strategies in dependence on the four risk clusters.

10.2.3. Application of the Procedure

The before-mentioned approach is simple to put into practice. The following explanations use the same sample of companies like the empirical investigations. As already explained, the industry classification of Fama-French is maintained. Figure 7 explains how managements, analysts and shareholders may precede to cluster companies with similar levels of riskiness. The following table 73 summarizes the number of companies in each category after the corresponding segregation, i.e. step 1 to 3.

	Step 1	Step 2		Step 3			
Risk Cluster	1	1	2	1	2	3	4
Business Equipment	3263	1243	2020	623	620	876	1144
Chemicals	823	578	245	281	297	145	100
Consumer Durables	615	375	240	207	168	127	113
Consumer Non Durables	1510	992	518	494	498	306	212
Energy	1203	291	912	148	143	375	537
Healthcare	1690	953	737	457	496	341	396
Manufacturing	3579	1823	1756	876	947	814	942
Other	2517	1112	1405	599	513	709	696
Shops	1775	1105	670	694	411	432	238
Telecom	505	254	251	98	156	133	118
Utilities	110	69	41	34	35	26	15
Total	17590	8795	8795	4511	4284	4284	4511

Table 73: Segregation of companies within industries
Table 73 shows the number of companies in the eleven industries across different risk clusters. The column with heading Step 1 summarizes the total number of companies for each industry. Step 2 divides the companies within an industry into two groups according to Sales(sd). Step 3 results in four clusters through a further segregation of the companies within an industry according to the cost structure rigidity. The procedure refers to figure 7.

The information provided in table 73 refers to the total sample time period[35]. The sample consists of 17590 observations. Three industries, namely business equipment, manufacturing and others, comprise more than 50% of the available observations. Step 2 means to separate those companies with high Sales(sd) from the others. The threshold is the median of the total sample's Sale(sd). This step reveals that some industries are more dependent on business cycles than others. This insight is in line with approaches explained by financial companies. For instance, Morningstar Research (2011) divides industries into three super sectors: cyclicals, defensive and sensitive. Companies in these super sectors differ according to their exposure to economic cycles. Business equipment is regarded as sensitive to changes in the business cycle. Table 73 supports this expectation: Above 60% of the companies within this industry belong to group 2 after the second step. The third step is to further split the two groups according to a company's degree of cost structure rigidiy. The median of Costr(absolute) is used. The results are two more groups, consist-

[35] If analysts use this procedure, they put companies into risk clusters. This task bases on evaluation of company information available in financial reporting. Therefore, this assignment of individual companies is dependent on a specific point in time and varies with changes in accounting features.

ing of more or less similar numbers of companies. The resulting four clusters comprise companies with similar dependence on business cycles and similar degree of cost strucutre rigidity.

The use of this approach gets concrete when the before-mentioned procedure is applied for a specific industry. Because the clustering of the level of riskiness is the paramount goal, time-series averages of risk indicators are shown. In order to compare industry differences, the procedure is applied for two industries. The first industry chosen is business equipment. The ratio of companies with sales volatilities above and below the median of the sample is about 60:40 for the total time period. Therefore, business equipment is a cyclical industry. The opposite is true for the second industry. Consumer non durables is a defensive industry because companies from this industry benefit from stable demand dynamics. This is visible with the before-mentioned ratio which is about 40:60.

Table 74 summarizes accounting characteristics, total and systematic risk parameters of companies in the business equipment industry. Companies within this industry show large accounting return volatilities. To compensate the uncertainties stemming from such accounting properties, the leverage ratio is low. As a result of the volatilities in earnings total and systematic risks are quite significant. Splitting the companies within this industry according to Sales(sd) shows that all considered features move in the expected direction. For instance, earnings volatilities are above the average for the high Sales(sd) group, and below the average for the low Sales(sd) group. The explanatory power of the cost structure characteristics is visible after step 3. The fixed cost structure clusters have larger earnings volatilities, lower leverage ratios but higher total and systematic risks compared to the two flexible cost structure clusters.

	Step 1	Step 2		Step 3			
	1	1	2	1	2	3	4
Margin(sd)	4.8%	3.0%	5.9%	2.5%	3.4%	5.0%	6.7%
ROE(sd)	12.3%	8.3%	14.8%	7.9%	8.7%	13.4%	15.8%
Leverage	0.37	0.39	0.37	0.43	0.35	0.44	0.31
Return(sd)	14.0%	11.8%	15.4%	11.8%	11.9%	15.4%	15.3%
Beta	1.36	1.19	1.47	1.15	1.23	1.42	1.51

Table 74: Risk clusters within the business equipment industry
Table 74 is the application of the approach described in figure 7. All companies within the industry business equipment are separated into two groups; those with above and such with below the total sample average of Sales(sd). Afterwards, these two groups are further separated into two portfolios; those with above and such with below the total sample average of Costr(absolute). The numbers shown are time-series averages of the variables. Table 82 explains the calculation of the variables.

Table 75 shows the time-series averages of the same variables of companies from the consumer non durables industry. Compared to the numbers in table 74, this industry reveals lower risk levels according to earnings volatilities but also to total and systematic risks. Again, the differentiation between low and high Sales(sd) companies changes the numbers in line with the expectation. The explanatory power of the cost structure is true for this defensive industry, too. Again, the group of companies with rigid cost structures have larger earnings volatilities, lower leverage ratios but higher total and systematic risks compared to the groups consisting of companies with flexible cost structures.

	Step 1	Step 2		Step 3			
	1	1	2	1	2	3	4
Margin(sd)	2.3%	1.8%	3.3%	1.6%	2.0%	2.7%	4.2%
ROE(sd)	7.8%	6.7%	10.0%	6.7%	6.7%	9.3%	11.1%
Leverage	1.01	1.05	0.95	1.34	0.76	1.20	0.58
Return(sd)	10.0%	8.9%	12.1%	8.7%	9.1%	11.7%	12.9%
Beta	0.90	0.84	1.01	0.78	0.90	0.98	1.06

Table 75: Risk clusters within the consumer non durables industry
Table 75 is the application of the approach described in figure 7. All companies within the industry consumer non durables are separated into two groups; those with above and such with below the total sample average of Sales(sd). Afterwards, these two groups are further separated into two portfolios; those with above and such with below the total sample average of Costr(absolute). The numbers shown are time-series averages of the variables. Table 82 explains the calculation of the variables.

These two industry examples show the benefit of the approach described in figure 7: The differentiation between the sensitivity to changes in the business cycle and cost structure rigidity lead to a clustering of the level of riskiness. From the perspective of an analyst or the management, the same procedure can be utilized in order to assign the object of interest, i.e. a specific company, to one of the four clusters. The following figure shows exemplary the assignment of companies from the industry business equipment to these clusters.

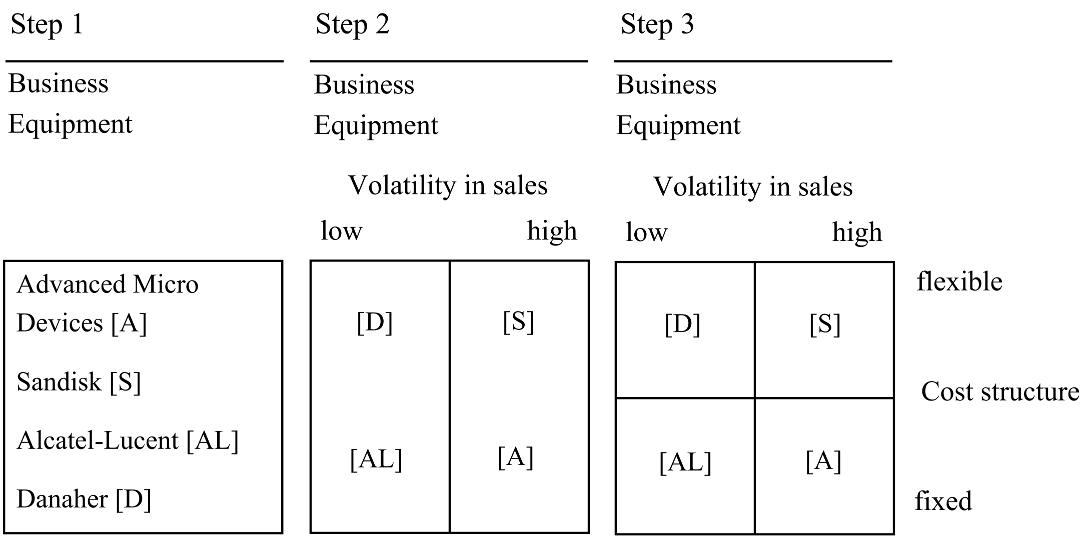


Figure 8: Assignment of business equipment companies to risk clusters
In figure 8 four companies are assigned to the four clusters based on the procedure described in figure 7. The assignment uses accounting information available in 2006.

Based on the statistical information of each company at the end of year 2005, the clustering described in figure 8 results. In this example, each company fits to a different cluster. At first sight, the companies seem to be very similar. They operate in the same industrial environment. However, their dependence on business cycles varies. Furthermore, they operate with distinct cost structures. The following figure repeats such an assignment of four companies from the consumer non durables industry.

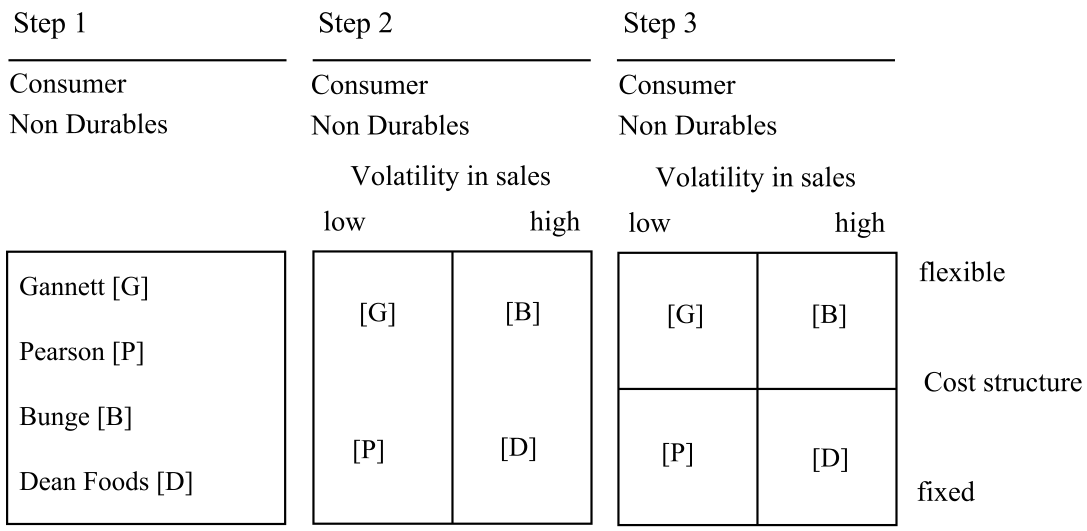


Figure 9: Assignment of consumer non durables companies to risk clusters
In figure 9 four companies are assigned to the four clusters based on the procedure described in figure 7. The assignment uses accounting information available in 2006.

Figure 9 consists of two media companies, Gannett and Pearson, and two food companies, Bunge and Dean Foods. They belong to the same industry. Again, the dependence on the economy and the degree of cost structure rigidity varies. Each company belongs to a different cluster according to figure 9. Therefore, these companies may not be useful for relative performance analyses.

There are manifold benefits of this procedure. First, the four risk clusters make it simple to define a company's risk exposures. There are two dimensions which represent risk aspects. Second, the risk cluster is the accurate peer group, because these companies have comparable exposures to these sources of risk. Based on the comparable level of riskiness, these companies should achieve similar returns. Third, the risk clusters facilitate to deduce strategies to improve the exposure to risk sources. This tool enables analysts or managements to appraise or explain, respectively, strategic initiatives. This third benefit is explained in detail in the following subsection 10.2.4.

10.2.4. Deduction of Standard Strategies

After the assignment of each company to the clusters described in the previous subsection 10.2.3, the user gets a better understanding of the source of riskiness. It can be the dependence on the development of the economy, the degree of cost structure rigidity or even both. The statistical data to build the clusters as well as the information utilized to assign companies to the clusters, refer to past accounting performance. The responsibility of the analysts and the managements is to give reason to handle the corresponding sources of riskiness[36]. For managements, the reference to these risk clusters facilitates the justification for certain strategic moves. On the other side, analysts can use this framework to challenge a management's vision for the company. Based on the clusters they are able to forecast to some degree a comprehensible strategy. These aspects vary according to the four clusters[37].

- Cluster 1 – "The Stable": low dependence on business cycle, flexible cost structure. Companies within this cluster show low levels of riskiness. The low dependence on the economy is an indicator for stable revenue streams. The flexible cost structure means that there is only a modest operating leverage impact on earnings. The business itself and how the company manages this business are not sources of riskiness. Because of this situation such companies may try to get some leverage on earnings with increasing the debt levels. Therefore, analysts should pay close attention to the financial side of the balance sheet. Another strategy to leverage on earnings is to make the cost structure more fixed costs orientated. To conclude, this cluster may have below average ROE, but above average leverage ratios.

- Cluster 2 – "The Efficient": low dependence on business cycle, fixed cost structure. Contrary to cluster 1, companies within this cluster have rigid cost structures. This means that the low changes in sales impact more on the bottom line compared to cluster 1. The rigid cost structure is a source of risk, and therefore analysts may expect higher ROE compared to cluster 1. Only below average leverage ratios may compensate this increased level of riskiness. This means that analysts should pay attention to both the cost structure and the leverage ratio. A sudden loss of revenues has an adverse impact on the bottom line. In general, companies within this cluster reveal an interesting mix of risks. Especially, because the cost structure is under influence of the management and therefore can be adjusted if the demand situation changes.

- Cluster 3 – "The Ineffective": high dependence on business cycle, flexible cost structure. Because sales vary heavily with changes in business cycle, companies within this cluster are risky. Because operating costs vary with sales, companies face difficulties to increase the ROE. The ROE is expected to be below the average of cluster 2 companies. Analysts may expect large fluctuations in earnings, but low ROE. This combination seems to be only limited attractive for investors. Therefore, the strategic focus should be a diversification of revenue streams.

[36] The way managements handle the risk exposure is also relevant for shareholders. In this regard, shareholders are the addresses of explanations in reference to risk management.

[37] These considerations aim at anticipating strategic moves of companies from different risk clusters. Table 86 on page 191 shows time-series averages of ROE, ROA, Margin and the equity ratio for each risk cluster across the eleven industries. Even though these figures refer to past achievements, they provide some statistical information to appraise the deduced standard strategies for each risk cluster.

- Cluster 4 – “The Hazardous”: high dependence on business cycle, fixed cost structure. Companies within this cluster are very risky. Their revenue streams are dependent on economic developments. Additionally, the rigid cost structure amplifies these variations in sales. These companies should reduce their total risk level with only modest indebtedness. Similar to the situation in cluster 3, a diversification of income streams would reduce the risk level, but the company could still amplify their earnings with their rigid cost structure. Analysts are well advised to closely monitor revenue streams, business operations and the leverage ratio. Because of these diverse sources of risk, above average ROE is expected.

These explanations based on the four clusters reveal that actually, only two clusters have an appealing mix of risk sources. “The Stable” and “The Efficient” risk clusters are attractive for investors because they are in good position to achieve high returns with modest risk exposures. Figure 10 makes clear, that the management and analysts should expect the following efforts from cluster 3 and 4 companies.

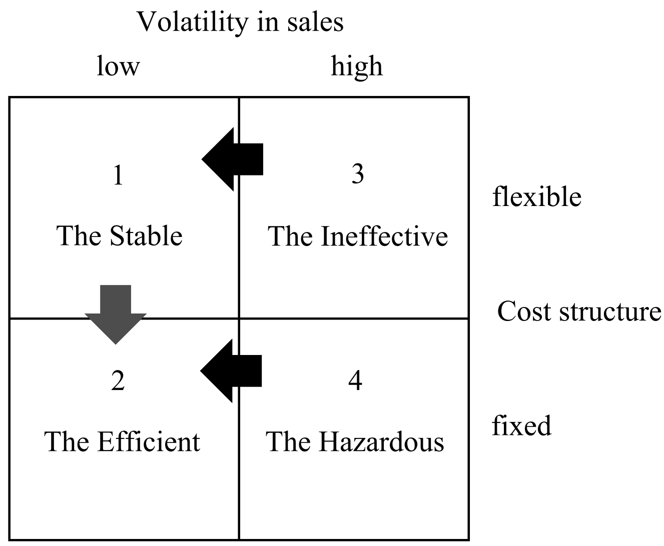


Figure 10: Standard strategies explained in reference to risk clusters
Figure 10 explains standard strategies for companies in the clusters 3 and 4. The gray arrow from cluster 1 to cluster 2 indicates also a practical strategic direction, but because of the increase in riskiness, such a move needs the acceptance of shareholders. The standard strategies assume that companies strive for improving the ROE.

Because cluster 3 companies face difficulties to materialize changes in sales to improve the bottom line, these companies may invest in a diversification of revenue streams. Because of the high level of riskiness, companies within cluster 4 should also try to reduce their sales volatilities. With lower volatility in sales, such companies benefit still from rigid cost structures. Cluster 1 companies earn stable returns with lowly volatile sales. With a more rigid cost structure, these companies may increase their ROE. The arrow is only gray and not black, because such a strategic change increases the level of riskiness and therefore, the management has to expect reactions from their shareholders. Such a move may not be accepted. To conclude, figure 10 provides analysts and managements with a map and compass, so they know where the target company stands and where the company should go to. Basically, with “The Stable” and “The Efficient” there are only two attractive risk clusters where the other companies should aim at. The general motivation beyond this strategies is either an increase in expected ROE or the reduction of the level of riskiness without a loss in potential ROE. The following statement summarizes the considerations based on the procedure explained in figure 7.

The approach designed in section 10.2 consists of three factors: industry classification, Sales(sd) and the degree of cost structure rigidity. The procedure to develop risk clusters consists of three steps. First, one industry is chosen. Then, the companies are divided into groups according to their volatility in sales. The third step further segregates the two groups in respect of the cost structure rigidity. The result of these three steps are four risk clusters within an industry. Then, a specific company is assigned at a specific point in time to one of the four clusters, i.e. its peer group. Now, analysts, managements and shareholders know that in dependence on the cluster the company belongs to, there are only few standard strategic directions to go. With such a map and compass, analysts may challenge the management, or the management may be able to convince the analysts of their business initiatives. Shareholders benefit from this framework with a deeper understanding of a company’s risk exposure.

The following section 10.3 further explains how cost structure characteristics can be used for improving investment decisions. The main focus is value investing.

10.3. How to Improve Value Investing

Strict value investors buy companies with high BM ratios. The following explanations design an approach to alter the risk and return relation of value investing. The idea stems from the empirical finding of similarities in accounting performance of high BM ratio companies and companies with rigid cost structures. Because the cost structure is a risk factor, controlling this company feature has an influence on the portfolio return properties.

The next subsection 10.3.1 discusses theoretical considerations. Afterwards, in subsection 10.3.2 the development of the approach is explained. Subsection 10.3.3 shows statistical characteristics of returns of the altered value investing strategy.

10.3.1. Theoretical Considerations

Even though cost structure rigidity qualifies as risk characteristic, it does not show the potential for investors to earn excess returns. This insight stems from the fifth empirical investigation. Some cost structure proxies have a relation to return and risk; i.e. portfolios consisting of companies with rigid cost structures yield higher returns, show larger return volatilities and betas. But, there is no significant alpha visible in regression outputs of the Fama-French three-factor model. Further, BM ratio and size suppress the explanatory power of cost structure proxies for future returns. The reason for this limited use is the scope of the cost structure: The risk evolving from production process is only one of several sources of riskiness for which shareholders may get compensated for. For instance, the proxies developed do not consider financial risk or growth risk. Because BM ratio absorbs the expectations of market participants, its scope is much wider and therefore raises the chance to earn excess returns.

The results in empirical part IV make clear that rigid cost structure companies and companies with high BM ratios show similarities in accounting returns. Both types of companies tend to be less productive compared to their counterparts. Chapter 8 shows that rigid cost structure companies show similar productivity developments over time. One reason for this underperformance in accounting returns may be the cost structure. With the increased volatility in earnings, the likelihood of losses or poor earnings is also elevated. The driver behind this volatility is the rigid cost structure, which amplifies changes in sales. This finding indicates that the outperformance of high BM ratio companies is at least to some degree result of the increased level of riskiness evolving from rigid cost structures.

The control of this weakness may positively alter the risk and return relation, because one threat for shareholders is reduced. So, this similarity in accounting returns and the knowledge about the driver causing the volatility, are used to further develop value investing. Even though the connection between BM ratio and cost structure is not obvious, it is expected that returns decrease – and return volatilities too – when controlling for this accounting weakness. The approach to control this risk aspect is explained in the following subsection 10.3.2.

10.3.2. Development of the Approach

Chapter 6 assesses the impact of the cost structure on earnings. The results make clear that the cost structure is a significant factor influencing the volatility of earnings.

From an investor's perspective, earnings are highly relevant. The cost structure puts the return on earnings at risk, because it elevates the volatility in earnings. Not only the absolute earnings, but especially the return on earnings is of interest for shareholders. The earnings and the equity are easily observable. Such company factors are known and reported in a company's financial statement.

In order to alter the value investing strategy, the ROE(sd) seems to be the accurate factor to control; this variable is influenced by the cost structure rigidity and relevant for investors. The approach assumes that a company's fundamentals have an impact on returns. Because the profitability varies among industries, the ROE(sd) within industries is considered and serves as criterion to assign a company to the different volatility groups. This separation allows testing the impact of the cost structure on return properties or in other words, the impact of controlling a company's ROE(sd).

Because only two factors are considered – namely the BM ratio and ROE(sd) – the approach is easily put into practice. Only four steps are necessary:

1. Sort the companies in the sample according to the BM ratio and rank them; 1 means high BM ratio.
2. Sort the companies in the sample according to the relative ROE(sd) and rank them; 1 means low ROE(sd).
3. Select those high BM ratio companies with low ROE(sd); those companies with low combined rankings.
4. Repeat step 1 to 3 each year.

The following subsection 10.3.3 provides return and risk properties of various portfolios developed according the before-mentioned steps. In order to comprehensively analyze the impact of controlling the ROE(sd), two portfolio construction methods are utilized which both relate to the third step.

According to the first method, those ten companies with the lowest or highest combined rankings within the top BM ratio quintile are used to construct two portfolios. These portfolios consist of companies with either very high ROE(sd) or very stable ROE, but similar BM ratios. The second method splits the universe into three value groups; 20% with low and 20% with high BM ratios and the remaining 60% of the sample. The sample is also divided into three ROE(sd) groups; 1/3 with high and 1/3 with low ROE(sd), and the remaining 1/3 with middle ROE(sd). The result of the combination of these groups are nine portfolios. The annual number of observations availabe in these portfolios varies between 8 and 404.

The first portfolio construction method allows to compare volatilities because the number of companies in the two portfolios is 10. The second method provides a more stable picture of the return properties with controlling the influence of ROE(sd) because the average number of companies across the nine portfolios is 75. The following subsection 10.3.3 starts with the second method.

10.3.3. Statistics of the Approach

The following table 76 summarizes some accounting characteristics for portfolios consisting of high BM ratio companies. These value portfolios are further segregated into portfolios with high and low ROE(sd) companies.

ROE(sd)	BM ratio					
	ROE(sd)			Equity ratio		
	Low	Mid	High	Low	Mid	High
All	12.56%	9.57%	11.29%	52.37%	51.37%	48.13%
Low	2.71%	2.74%	2.92%	59.38%	55.32%	54.01%
Mid	7.11%	6.92%	6.96%	54.33%	52.83%	49.83%
High	26.68%	11.64%	20.49%	44.00%	50.19%	42.88%
High-Low	23.97%	8.90%	17.57%	-15.38%	-5.13%	-11.13%
t-stat	37.83	26.3	29.89	21.50	10.13	12.11
	Size			Losses		
All	9’044	3’486	1’029	4.01%	7.25%	17.10%
Low	11’280	6’989	1’334	0.33%	0.85%	4.76%
Mid	10’187	3’908	1’112	2.03%	4.26%	12.51%
High	5’920	2’610	763	9.23%	9.28%	29.02%
High-Low	-5’360	-4’379	-571			
t-stat	6.19	9.66	2.09			

Table 76: Accounting characteristics for double-sorted BM ratio and ROE(sd) portfolios
Table 76 displays time-series averages of ROE(sd), equity ratio, size, and the share of companies generating negative EBIT within these portfolios. Portfolios are built yearly according to BM ratio and ROE(sd). Companies are assigned to three value groups; 20% with low and 20% with high BM ratios and the remaining 60% of the sample. The sample is further divided into three ROE(sd) groups; 1/3 with high and low ROE(sd) and the remaining 1/3 with middle ROE(sd). The assignment to ROE(sd) groups takes place within industries. The annual number of observations per portfolio varies between 8 and 404 with an average of 75. All input factors to calculate the variables used for portfolio construction refer to year-end values. Table 82 describes the calculation of these variables.

Table 76 shows that assigning companies to different ROE(sd) groups leads to a separation between low and high risk companies. Obviously, the ROE(sd) varies strongly among the subgroups. Even though high BM ratio companies show an average of 11.3% of ROE(sd), the low and middle ROE(sd) subportfolios reveal much lower volatilities. Companies with low ROE(sd) have higher equity ratios compared to their counterparts. Although value companies tend to be financially leveraged, those value companies with stable ROE(sd) reveal on average more solid balance sheets. This finding is surprising because companies with stable earnings could afford higher leverage ratios. They are also larger in respect of market capitalization. These differences are statistically significant. The percentage of companies generating losses is much lower for the low ROE(sd) portfolio. Only about 5% of the companies within this group reveal negative EBIT. Within the value portfolio, this share is three times larger. In total, the four features show that low ROE(sd) value companies are less risky compared to high ROE(sd) value companies. The following table 77 displays the return properties of these portfolios.

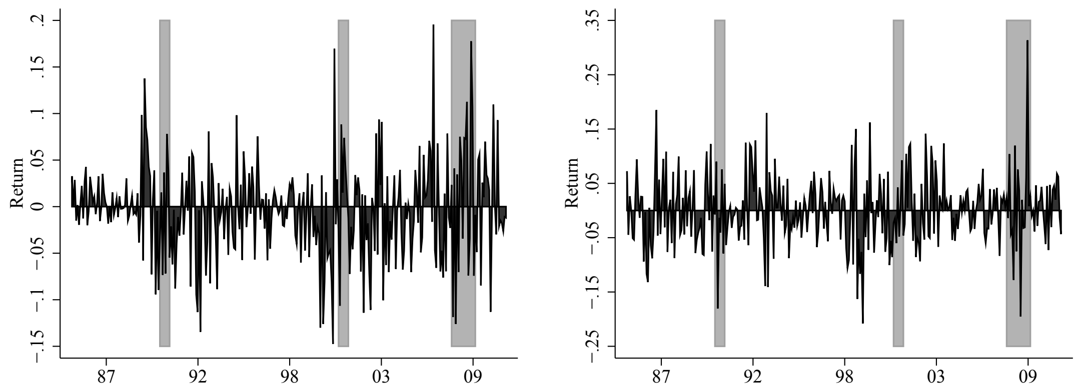
ROE(sd)	BM Ratio								
	A: equally-weighted								
	Return			Return(sd)			Beta		
	Low	Mid	High	Low	Mid	High	Low	Mid	High
All	1.16%	1.41%	2.27%	5.38%	5.37%	6.32%	1.07	1.00	0.96
Low	1.12%	1.24%	1.65%	5.01%	4.97%	6.25%	1.01	0.95	0.89
Mid	1.14%	1.37%	1.87%	5.53%	5.66%	6.40%	1.07	1.03	0.94
High	1.20%	1.46%	2.96%	6.00%	5.53%	7.70%	1.11	1.01	1.05
High-Low	0.08%	0.21%	1.31%						
t-stat	0.53	1.85	4.19						

ROE(sd)	BM Ratio								
	B: size-weighted								
All	1.03%	1.22%	1.67%	4.81%	4.78%	6.33%	0.98	0.94	1.01
Low	0.96%	1.22%	1.35%	4.92%	4.76%	6.95%	0.97	0.85	0.99
Mid	1.17%	1.37%	1.63%	5.12%	5.63%	7.23%	0.95	0.98	1.03
High	1.02%	1.21%	1.98%	5.31%	5.35%	8.06%	1.02	1.04	1.13
High-Low	0.06%	-0.01%	0.63%						
t-stat	0.34	0.07	1.56						

Table 77: Properties of returns for double-sorted BM ratio and ROE(sd) portfolios
Table 77 displays averages of portfolio returns, standard deviation of returns and betas. Portfolios are built yearly according to BM ratio and ROE(sd). Companies are assigned to three value groups; 20% with low and 20% with high BM ratios and the remaining 60% of the sample. The sample is further divided into three ROE(sd) groups; 1/3 with high and low ROE(sd) and the remaining 1/3 with middle ROE(sd). The assignment to ROE(sd) groups takes place within industries. The annual number of observations per portfolio varies between 8 and 404 with an average of 75. All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly returns are measured, either equally- or size-weighted. Standard deviation is calculated according to formula (26) and beta according to formula (27).

Table 77 repeats the outperformance of value companies compared to companies with low BM ratios shown in section 9.2. This return difference is visible in panel A and B. The average return of value companies is 2.27%. Controlling for the ROE(sd) reduces the average return to 1.65%. Value companies with high ROE(sd) show an average return of 2.96%. The difference in returns of 1.31% between these two portfolios is significantly different from 0. But, this outperformance of the riskier value portfolio is not significantly different from 0 in panel B. The standard deviation of the low volatile value portfolio is lower compared to the value portfolio in panel A and especially compared to its riskier counterpart in panel A and B. The same is true for beta. These two risk parameters clearly demonstrate that controlling for volatility in ROE(sd) reduces to risk level of returns. These results are similar when controlling for ROA(sd) or Margin(sd) instead of ROE(sd).

The lower returns of the low ROE(sd) portfolio go hand in hand with lower riskiness; table 76 demonstrates the lower risk level from an accounting perspective and table 77 shows that portfolio returns are less volatile. Companies with stable profitability figures reveal stronger balance sheets, i.e. higher equity ratios. Therefore, it is expected that such companies perform better during recessions. The following graphs from figure 11 reveal how the low and high ROE(sd) value portfolios perform compared to a value only portfolio.

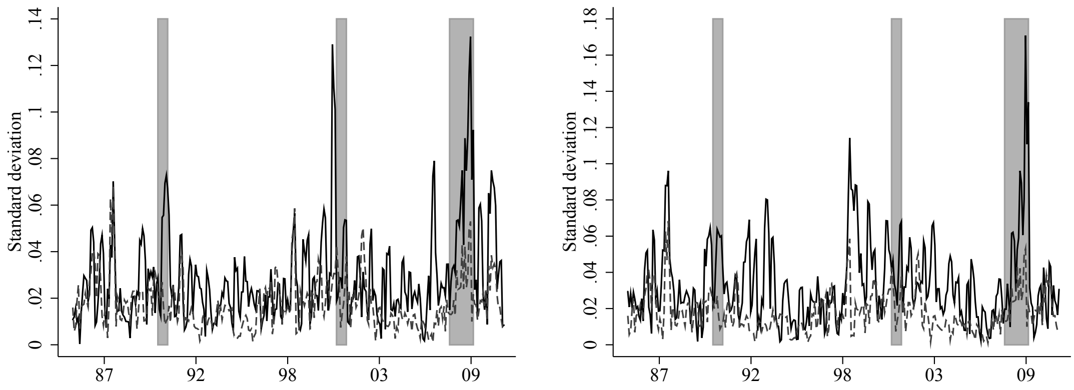


(a) Returns of low ROE(sd) value stocks **(b)** Returns of high ROE(sd) value stocks

Figure 11: Comparing returns of value strategies
Graphs 11a and 11b display the return differences between the portfolio of high BM ratio companies with low ROE(sd) and the value portfolio, and high BM ratio companies with high ROE(sd) and the value portfolio. Portfolio construction and return calculation are explained in the notes of table 76 and subsection 10.3.2. The returns used are size-weighted. Instead of using all companies within these value and ROE(sd) groups, only those ten companies with the lowest and highest ROE(sd) within the top BM ratio quintile in a year are considered for portfolio construction. The gray areas signal time periods of business cycle contraction according to NBER.

The graphs in figure 11 show that the low ROE(sd) value companies perform better during time periods with contraction in the business cycle compared to the high ROE(sd) companies. During the first recession, the first portfolio loses about 6%, whereas the other portfolio loses nearly 10% relatively to the general value strategy. The second recession hits only the portfolio consisting of high ROE(sd) companies; it loses 4% whereas the qualitatively stronger portfolio gains 9%. In the most recent recession, both portfolios earn an outperformance of about 23%. These cumulative relative returns during recessions show that an active value investor is able to limit his losses if considering past volatilities in earnings. However, the results make clear that the performance of the strategies varies heavily during the considered time periods. It seems that recessions are not homogenous in the sense, that the causes, the durations and the reactions of institutions like the central bank are hardly comparable across recessions. The interventions from political decision-makers and central banks may have huge impact on the stock market, for instance through the introduction of stimulus programs or the reduction of interest rates. Therefore, it is not surpising that the performances vary during these three time periods.

As described before, the cumulative returns of the low ROE(sd) portfolio are more attractive compared to the high ROE(sd) portfolio, because this strategy shows some protective potential regarding the downside, and at the same time provides the potential to benefit from rising stock markets caused by interferences, what was the case during the latest recession. Beside the return also the volatility has to be considered. The average return of the qualitative stronger portfolio is 1.3% compared to 1.8% of the second portfolio. This difference is not statistically significant (t-stat of t-test of 1). The standard deviation is 7.7%, whereas the portfolio consisting of the high ROE(sd) value companies shows an average volatility above 9%. The difference in the three-month rolling return volatilities is statistically significant (t-stat of t-test of 2.34). The volatility difference is a strong indication of the lower risk level. The maximum drawdown is about 20% for the low ROE(sd) and above 30% for the high ROE(sd) portfolio. This higher maximum drawdown is compensated by the upside potential; nearly 55% for the high and 36% for the low ROE(sd) portfolio.



(a) Return(sd) of low ROE(sd) value stocks **(b)** Return(sd) of high ROE(sd) value stocks

Figure 12: Comparing standard deviations of value strategies
Graphs 12a and 12b display the average three-month rolling standard deviation of the returns of the portfolio of high BM ratio companies with low ROE(sd) and high BM ratio companies with high ROE(sd). The gray dashed line is the standard deviation of the size-weighted S&P 500 index return. Portfolio construction and return calculation are explained in the notes of table 76 and subsection 10.3.2. The returns to calculate the standard deviations are size-weighted. Instead of using all companies within these value and ROE(sd) groups, only those ten companies with the lowest and highest ROE(sd) within the top BM ratio quintile in a year are considered for portfolio construction. The standard deviation is calculated according to formula (26) with a moving three-month time window. The gray areas signal time periods of business cycle contraction according to NBER.

The graphs in figure 12 show that both strategies have higher standard deviations compared to the volatility of a broad index. Because the portfolios consist of ten companies, this difference in volatilities is not surprising. During recessions, both strategies reveal increasing volatilities. It seems that the volatility of the portfolio consisting of high ROE(sd) companies increases more compared to the development in figure 12a. Comparing the two graphs results in the conclusion, that especially during periods of business cycle expansions the qualitative more solid portfolio shows lower standard deviation. For instance, between the first and second recession the low ROE(sd) portfolio exhibits stable volatilities, compared to a more erratic volatility of the high ROE(sd) portfolio. The following table 78 summarizes the returns and standard deviations during time periods of business cycle expansion for different portfolios.

Portfolio	Large exposure		Low exposure		t-stat	
	Return	Return(sd)	Return	Return(sd)	Return	Return(sd)
ROE(sd) Value portfolio	2.02%	3.14%	1.42%	2.61%	1.20	3.54
BM ratio	1.94%	2.26%	1.17%	1.74%	2.51	6.16
Size	1.70%	1.90%	1.26%	1.68%	1.81	3.24
Costr(5ya)	2.09%	5.51%	1.28%	1.68%	1.06	17.89
Costr(absolute)	1.18%	2.44%	1.19%	2.11%	0.04	3.32
Costr(change)	1.29%	2.84%	1.22%	2.89%	0.13	0.34
Costr(1y)	1.56%	2.64%	1.44%	1.89%	0.34	6.42
Costr(SGA)	1.78%	2.00%	1.17%	1.88%	2.36	1.82

Table 78: Comparison of portfolio returns during business cycle expansion
Table 78 displays time-series averages of portfolio returns and standard deviations for different portfolios. The left side of the table with column heading large exposure, summarizes the parameters for portfolios with large exposure towards ROE(sd), BM ratio, size or cost structure rigidity. The middle column with column heading low exposure shows the time-series averages for portfolios with low exposure towards ROE(sd), BM ratio, size and cost structure rigidity. The column t-stat summarizes t-stats of t-tests to test the significance of the differences in return and standard deviation of the high and low exposure portfolios. The construction of the value portfolios is described in the notes of table 76 and subsection 10.3.2. The other portfolios consist of the top and bottom quintile companies in respect of the factor used for portfolio construction. All input factors to calculate the variables used for portfolio construction refer to year-end values. The return calculation starts at end of April in t+1. 12 monthly returns, size-weighted, are measured. Standard deviation is calculated according to formula (26) with a three-month moving time window. NBER data is used to determine time periods of business cycle expansion. The S&P 500 index gains 1.2% with a standard deviation of 1.7% during the considered time period.

Table 78 confirms the lower standard deviation of the low ROE(sd) value portfolio during time periods of business cycle expansion. The difference is statistically significantly different from 0. The value portfolio consisting of high ROE(sd) shows larger returns compared to the counterpart. This is true for other portfolios, too. Those portfolios with large exposure towards the factor used for portfolio construction reveal higher returns. Also the portfolios built with cost structure proxies support this insight. Companies with rigid cost structure benefit from growing economies because the cost structure magnifies changes in sales. But, only the difference of the Costr(SGA) portfolio is statistically significant. Most of these portfolios have standard deviations larger compared to their counterparts. The significance of the standard deviation differences is more convincing compared to the return differences. Three of the five cost structure proxies show significant differences.

To conclude, the dependence on the economy and how this positive sales changes impact on the bottom line, determine a portfolio's return and standard deviation. These return properties support the conclusion that investors looking for more stable returns should consider the past earnings volatility of companies. Considering the ROE(sd) is beneficial to reduce volatilities. These considerations lead to the following recommendation.

Active – but risk-averse – value investors should consider past volatilities in ROE in order to reduce the return volatility of the portfolio, but also the maximum drawdown of the returns. The considered criterion for the selection of value companies leads to a reduction in potential returns compared to a value-only strategy. But, it protects investors *at the same time during periods of business cycle contraction. During times with business cycle expansion the portfolio generates stable returns. An active investor – with more risk-appetite – may increase its portfolio return with selecting companies with volatile ROE. Such investors have to be able to stand high return volatility and severe losses. When the economy grows, this strategy generates strong returns. The passive value investor is well-served by investing in a broad sample of companies with high BM ratios.*

11. Conclusion

Chapter 11 draws the conclusions of the empirical findings and considers these within the theoretical context discussed in chapter 3. Aspects worthy of further research are discussed, too.

11.1. Summary of Findings

The explanations in section 1.2 include three research questions that are addressed through a comprehensive investigation of the properties of cost structure in relation to earnings, risk and return. In essence, the study's goal is to assess the relation between the rigidity of a company's cost structure and the company's riskiness. In particular, it strives to answer the key question of does the degree of cost structure rigidity have a magnifying influence on the level of riskiness of a company? Or, are companies with flexible cost structures less risky because their operating costs vary with sales volume? The study therefore uses various risk figures as dependent variables while cost structure characteristics comprise the independent variables. Both the definition of dependent and independent variables as well as the approximation of the cost structure properties are based on theoretical considerations about the operating leverage. As such, the operating leverage serves as the basis for building reliable research designs, i.e. choosing the right parameters for assessments of specific interrelations, and at the same time lays the foundations for the creation of appropriate proxies.

Defining the proxies starts in chapter 3 which explains the properties of the operating leverage and identifies its main drivers; namely, the proportion of fixed to variable costs and the distance to the breakeven point. Because the breakeven point itself is influenced by the level of fixed costs and the contribution margin, this dissertation approximates the degree of rigidity of a company's cost structure. These interrelations, which figure 3 on page 36 and figure 4 on page 37 of the fictitious example illustrate, are assessed in the first empirical investigation. Section 5.2 confirms a relation between the cost structure proxies and operating leverage figures and therefore affirmatively answers the first research question. However, the quality of the fit varies among the proxies. Further, the ratio of EBITDA to sales is useful as a proxy for the distance to the breakeven point. These results can be influenced by various factors. For instance, the proxy for the distance to the breakeven point could be flawed, or there may be errors in the measurement of the operating leverage or the cost structure characteristics. But, using the approximation of the cost structure explained in section 4.5, the problem of considering companies producing below their breakeven point can be circumvented. Furthermore, the robustness tests provide convincing results and support the conclusion that cost structure rigidity and breakeven distance are the main drivers of the operating leverage.

After the definition of the cost structure proxies and the assessment of their relation to operating leverage definitions, the focus of the investigations shifts to aspects of risk. Chapter 3 explains the connection between the operating leverage and changes in operating income. Solving formula (10) on page 40 for changes in operating income explains the drivers of these fluctuations. Section 6.2 provides results for assessments of these interrelations. The operating leverage in formula (10) is replaced by cost structure proxies. The hypothesis states that a rigid cost structure amplifies changes in earnings. The findings of the descriptive statistics and regression analyses confirm this hypothesis: A rise in the degree of rigidity and large changes in sales cause high volatility of earnings and profitability measures. Consequently, the results confirm the relation expressed in formula (10) and affirmatively answer the second research question. Further, they also support the explanations expressed in figures 3 and 4. Companies producing near the breakeven point have a higher operating leverage. Table 37 on page 108 provides evidence that rigid cost structure companies are more likely to generate negative operating income. So, these companies operate at production levels near the breakeven point and are more likely to incur losses than companies producing far beyond the breakeven point. These losses amplify the volatility of earnings and profitability measures. Consequently, these analyses show that the properties of the top and bottom line of the income statement are related through the cost structure.

The assessments of chapters 7 to 9 move beyond formula-determined accounting interrelations to integrate the perspective of the capital market. Section 3.4 outlines the relevant theoretical considerations. At the center of interest is the relation between the operating leverage and the riskiness of companies. There are two ways of linking these aspects. The first link refers to the findings of empirical part II, namely, volatile earnings pose shareholders with difficulties, because their return on invested capital is placed at risk. The second explanation goes back to Lev (1974) and others, who derive the link by replacing stock returns with accounting returns in the calculation of CAPM's beta. The assessments differ between total risk, i.e. the volatility of stock returns, and systematic risk. The models include financial leverage and business risk, which is approximated by sales volatility and the correlation of a company's sales growth with its industry peer group. The findings support the notion that cost structure rigidity has a reinforcing impact on stock return volatility. Different regressions show that cost structure proxies better explain variations in unlevered beta than variations in beta. Because the cost structure characterizes the production process of a company without considering financial aspects, these findings are in line with prior beliefs. So, the first part of the third research question can be answered affirmatively.

Recently published papers apply the operating leverage to finance topics beyond CAPM. Gulen et al. (2008) create an inflexibility index that includes the operating leverage to show that inflexible companies earn higher returns. Garcia-Feijoo and Jorgensen (2010) investigate the characteristics of double-sorted BM ratio and size portfolios. They find a positive relation between BM ratio and the operating leverage. Novy-Marx (2011) assumes that companies with operating leverage exposure face severe problems with demand shocks. The characteristics of high BM ratio companies and small companies explained in Fama and French (1992) show similarities with the findings of chapter 6 in regard to accounting return characteristics. Financial distress risk and poor accounting performance characterize such companies. Because rigid cost structure companies have larger return volatilities and are more likely to generate losses, it is not far-fetched to assume that cost structure characteristics are related to the BM ratio and to size. The results show that the relation to size is superior to the relation to the BM ratio. Companies with rigid cost structures are generally smaller. In double-ranking, size remains the differentiating factor between high and low rigidity while controlling for the BM ratio. Figure 6 on page 126 indicates similarities between rigid cost structure companies, high BM ratio companies and small companies in respect of accounting returns. These similarities are confirmed with the results of regressions of accounting returns on returns of mimicking portfolios. One reason for these relations is the possibility of large companies to control parameters of formula (1) on page 32. Further, large companies tend to be mature with a longer history of business activities and are therefore more experienced in optimizing production. To conclude, the second part of third research question can only be answered affirmatively in part; the relation to size is more convincing than the relation to BM ratio.

Because chapters 6, 7, and 8 show that rigid cost structure companies are riskier than more flexible companies from various perspectives, shareholders investing in rigid cost structure companies should correspondingly obtain higher returns. The last empirical investigations thus consider the return properties of portfolios constructed upon cost structure proxies. The results show that rigid cost structure portfolios do tend to outperform, but their higher returns are dependent on the kind of proxy used for portfolio construction. Proxies constructed with input variables based on one year and not rolling windows show a more convincing relation with return properties. The relation to return volatilities is clear: As rigidity rises, return volatilities increase. This relation is stable for double-sorted portfolios. The variations in returns are fully explained by the three-factor model of Fama and French (1993). The returns of double-ranked portfolios show high loadings on SMB and HML for portfolios consisting of small companies with rigid cost structures. So, even though such companies are more risky, it is not possible to earn excess returns, because BM ratio and size absorb the effect of the cost structure. This interpretation is confirmed in regressions similar to those explained in Fama and MacBeth (1973), because cost structure proxies lose significance when including BM ratio and size. The replacement of the EBITDA/EV ratio with Sales-, SGA-, and COGS-multiples shows that the COGS/EV ratio is significant with negative coefficients whereas the SGA/EV ratio is insignificant. When excluding the Sales/EV ratio, the SGA/EV ratio turns significant with positive coefficients. So, it seems that different cost categories have different influences on future returns. These results affirmatively answer the second part of the third research question only to a limited extent: Depending on the proxies utilized to build portfolios, rigid cost structure portfolios outperform more flexible ones, but no excess return is possible.

Overall, the results suggest that the characteristics of the cost structure influence the properties of accounting earnings and stock returns. However, the interrelations observed depend on the kind of proxy used. All proxies exclude depreciation and amortization. Hence, they focus exclusively on operating costs, neglect noisy depreciation expenses and do not consider financial aspects. Some of the proxies assume that COGS are variable, and SGA are fixed costs. In reality, companies have some leeway to decide which expenses are COGS or SGA. Because of these restrictions, the scope of these proxies seems limited. Especially in comparison with the explanatory power of the BM ratio and size – which both consider the expectations of market participants – the cost structure appears limited solely to risk aspects emerging from business activities, i.e. existing assets. And yet, the explanatory power of the cost structure in various contexts shows the opposite is true: It exhibits an influence on the bottom line and also influences portfolio return properties.

This explanatory power is used to develop two applications with practical use. The first application is a three-step approach to facilitate the definition of an appropriate peer group within industries. First, an industry has to be selected. The second step is to differentiate between high and low Sales(sd) companies. The third step is to further split the two groups into subcategories according to the cost structure rigidity. These two variables are significant in regressions to explain total and systematic risk. Additionally, these two factors are the main drivers of accounting return volatilities. The result of this three-step approach are four risk clusters consisting of companies with similar level of riskiness and accounting characteristics. Such an approach is useful for managements, analysts and shareholders in order to consider different risk exposures or to assess the performance of a company in respect of its peer group.

The second application addresses investors or shareholders. It aims at further developing value investing, i.e. investing in companies with high BM ratios. Two findings are incorporated: First, the cost structure rigidity is an important factor for earnings and profitability figures. Companies with rigid cost structure have volatile earnings and profitability features. Second, accounting returns of rigid cost structure companies behave similarly to accounting returns of high BM ratio companies. Regressing accounting returns of rigid cost structure companies on accounting returns of high BM ratio companies results in significant coefficients. These two findings are transferred to adjust return properties of active value investing strategies. More risk-averse value investors may lower the riskiness of their investments if they consider the ROE(sd) in selecting value companies. Selecting only companies with low ROE(sd) reduces the volatility but also the return. Investors with a higher risk-appetite can increase their return with buying value companies with large ROE(sd). Such an approach increases the return, but also the standard deviation.

11.2. Implications for Academics

Beside the applications described in chapter 10, the topic itself, i.e. the operating leverage as a factor of company risk, and the approaches in the assessments are of importance for finance academics, too. The literature in section 2.2 explains the ambiguity of the operating leverage in regard to its approximations and drivers. For this reason, the first two empirical investigations strive to provide information that enhances understanding of the operating leverage.

The first empirical part assesses the interactions between the cost structure and the distance to the breakeven point. Both of these factors are supposed to influence the operating leverage according to Kelly and Sussman (1966), McDaniel (1984) or Dran (1991). But, they did not try to test these drivers in empirical investigations based on publicly available data. One of the difficulties is the approximation of these drivers with the available information. The distance to breakeven point is approximated by the relative Margin. The investigations make clear that proxies for cost structure rigidity and the relative Margin of a company are the two significant variables in explaining operating leverage proxies. Therefore, these results support the considerations of Kelly and Sussman (1966) and others with providing a simple and straight-forward solution for transferring these considerations to empirical investigations based on publicly available company information.

In a similar vein formula (21) on page 52 is tested in the second empirical investigations. Again, this formula explains drivers of changes in accounting factors – this time in respect of changes in operating income. The formula defines two drivers: the cost structure and changes in sales. The second empirical investigation confirms the influence of the cost structure rigidity and changes in sales on accounting return volatilities. So, also this investigation provides support for testing accounting relations with public company information. In conclusion, this dissertation is an example of how cross-disciplinary applications could evolve and motivate other collaborations. It is also an example of how rough approximations of variables may serve for clarifying interrelations.

11.3. Research Outlook

A possibility for future research would be the application of internal, company-specific data about the production process. This improvement in data quality could lead to more precise estimates of the proportion of fixed to variable costs, making more input variables of formula (1) on page 32 known. Because the levels of fixed and variable costs are delicate company information, it would be difficult to motivate companies to provide this information. Another approach would be to let companies classify themselves as either fixed-cost orientated or flexible-cost orientated companies. This information would suffice to build portfolios of companies with different cost structure characteristics.

Moreover, there may be other valid approaches to approximating the characteristics of the cost structure, such as assigning cost categories to variable or fixed costs based on a qualitative appraisal. For example, personnel expenses and R&D expenses tend to be fixed whereas expenses for raw material tend to be variable costs. This approach could also consider depreciation or financial expenses to produce an approximation of the cost structure that is not limited to operating costs. Integrating financial expenses could improve the explanatory power of this new proxy in respect of variations in beta. Similar to the approach of O'Brien and Vanderheiden (1987) described by formula (17) on page 46, formula (25) on page 78 could be adjusted by the trend of the two variables, too. Improving the proxies should raise the quality of the outputs of the investigations.

The replacement of the EBITDA/EV ratio with Sales-, SGA-, and COGS-multiples in regressions similar to those explained in Fama and MacBeth (1973) indicates that cost categories have a different influence on future returns. This aspect could be the subject of further research, too. The description of SGA and COGS in section 4.3 shows that these costs are indeed different in their implications for the ongoing success of a company. Such assessments could change the perception of costs in corporate finance. Instead of focusing on the earnings a company generates, the efficient allocation of expenses deserves more attention.

A. Appendix

A.1. Sample and Factor Description

Adjustment	Number of Observations
Total observations downloaded for time period 1969 to 2012	304293
Drop companies not reporting according to ismod = 3	59125
Drop companies with SIC code between 6000-6999	28664
Drop companies with exchg other than 11, 12 or 14	89158
Drop companies with negative or missing CEQ	7740
Drop companies with other missing data	60816
Drop companies with fiscal year ending other than December	25964
Drop companies with outliers	8758
Drop fiscal year before 1984	6478
Final sample	17590

Table 79: Adjustments of sample
Table 79 summarizes adjustments to the sample and the corresponding loss in observations. The restriction to consider only companies listed on NYSE, AMEX or Nasdaq has the strongest influence on the sample size. Variables from Group 1 in table 82 and factor changes in sales are adjusted for outliers. Observations of these variables smaller than the 1% percentile and larger than the 99% percentile are dropped. The remaining sample is adjusted for the resulting gaps in observations.

Item description	Mnemonic	Number	Keyset
Cash and Short-Term Investments	CHE	1	1
Assets – Total	AT	6	1
Long-Term Debt – Total	DLTT	9	1
Preferred Stock/Liquidating Value	PSTKL	10	1
Sales/Turnover (Net)	SALE	12	1
Depreciation and Amortization	DP	14	1
Interest Expense	XINT	15	1
Income Taxes – Total	TXT	16	1
Income before extraordinary items	IB	18	1
Common Shares Outstanding	CSHO	25	1
Investment and Advances/Other	IVAO	32	1
Debt in Current Liabilities – Total	DLC	34	1
Deferred Taxes and Investment Tax Credit	TXDITC	35	1
Minority Interest (Balance Sheet)	MIB	38	1
Cost of Goods Sold	COGS	41	1
Preferred Stock/Redemption Value	PSTKRV	56	1
Common/Ordinary Equity – Total	CEQ	60	1
Amortization of Intangibles	AM	65	1
CAPEX	CAPX	128	1
Preferred/Preference Stock (Capital) – Total	PSTK	130	1
Selling, General and Administrative Expenses	XSGA	189	1
Liabilities – Total	LT	181	1
Stockholders' Equity – Total	SEQ	216	1
Treasury Stock – Preferrred	TSTKP	227	1
Preferred Dividends in Arrears	DVPA	242	1
Price Close – Fiscal Year End	PRCC_F	31	24
Price/Close/Monthly	PRCCM	51	3
Monthly total return	TRT1M	na	na
Fiscal Year End	fyrc	na	na
Income Statement Model Number	ismod	na	na
Stock exchange code	exchg	na	na

Table 80: Summary of data from Compustat
Table 80 summarizes all data utilized in the various investigations. All variables are from Compustat and downloaded from Wharton Research Data Services. All accounting factors are on a yearly basis. Stock prices are on a monthly basis.

Item description	Abbreviation	Calculation
Gross Profit	GP	12 - 41
Earnings before interest, depreciation/amortization and taxes	EBITDA	12 - 41 - 189
Earnings before interest and taxes	EBIT	EBITDA - 14
Earnings before taxes	EBT	EBIT - 15
Earnings before interest and depreciation/amortization	EBIDA	EBITDA - 16
Operating costs	opcosts	41 + 189
Equity	equity	216 + 35 - 56/10/130 or 60 + 130 or 6 - 181
Book equity	book equity	60 + 227 - 242
Financial liability	FL	34 + 9 + 130 + 242 + 38 - 227
Net operating assets	NOA	book equity + FL - 1 - 32
Market capitalization	size	31×25

Table 81: Summary of own input factors
Table 81 summarizes all variables utilized for the definition of the factors in the empirical investigation. The calculation of equity follows the description of French (2012). The calculation of book equity, FL and NOA follows Penman (2004). The numbers in the third column refer to the column heading Number in table 80.

Abbreviation	Calculation	Limitations/Remarks
	Group 1: Approximation of cost structure properties	
Costr(1y)	$\frac{GP}{EBITDA}$	Positive GP and EBITDA
Costr(5ya)	$\frac{GP}{EBITDA}$	Positive five-year average of GP and EBITDA
Costr(absolute)	$lnopcosts_{j,t} = a_{j,t} + Costr(absolute)_{j,t} \times lnSales_{j,t} + \epsilon_{j,t}$	SGA, COGS and sales available for at least five consecutive years
Costr(change)	$\Delta opcosts_{j,t} = a_{j,t} + Costr(change)_{j,t} \times \Delta Sales_{j,t} + \epsilon_{j,t}$	Change in SGA, COGS and sales available for at least five consecutive years
Costr(SGA)	$\frac{SGA}{Size}$	SGA and size available
	Group 2: Approximation of operating leverage	
DOL(ela)	$\frac{\Delta EBIT}{\Delta Sale}$	Positive five-year average of EBIT
DOL(MR)	$lnEBIT_{j,t} = a_{j,t} + DOL(MR)_{j,t} \times lnSales_{j,t} + \epsilon_{j,t}$	Positive EBIT for five consecutive years
DOL(OV)	$lnEBIT_{j,t} = lnEBIT_{j,0} + \Delta EBIT_{j,t} + \epsilon^{EBIT}_{j,t}, \quad lnSales_{j,t} = lnSales_{j,0} + \Delta Sales_{j,t} + \epsilon^{Sales}_{j,t}, \; \epsilon^{EBIT}_{j,t} = DOL(OV)_{j,t} \times \epsilon^{Sales}_{j,t} + \epsilon_{j,t}$	Positive EBIT for five consecutive years
	Group 3: Measuring company profitability	
ROE	$\frac{IB}{0.5 \times (CEQ_{t-1} + CEQ_t)}$	Positive IB
ROA	$\frac{IB}{0.5 \times (AT_{t-1} + AT_t)}$	Positive IB
RONOA	$\frac{EBIDA}{0.5 \times (NOA_{t-1} + NOA_t)}$	Positive EBIDA
Margin	$\frac{EBITDA}{Sales}$	Positive EBITDA
	Group 4: Measuring accounting risk	
Equity ratio	$\frac{CEQ}{AT}$	CEQ and AT available
ROE(sd)	Standard deviation of ROE	IB and CEQ available for at least five consecutive years
ROA(sd)	Standard deviation of ROA	IB and AT available for at least five consecutive years
RONOA(sd)	Standard deviation of RONOA	EBIDA and NOA available for at least five consecutive years
Margin(sd)	Standard deviation of Margin	EBITDA and sales available for at least five consecutive years

Abbreviation	Calculation	Limitations/Remarks
Leverage	$\frac{(DLTT+DLC)}{CEQ}$	DLTT, DLC and CEQ available
Sales(sd)	Standard deviation in changes in sales	Changes in sales available for at least five consecutive years
Sale(cor)	Coefficient of correlations between $\Delta Sales_{j,t}$ and $\Delta Sales_{industry,t}$	Fama-French 12-industry classification utilized
	Group 5: Measuring risk from the capital market perspective	
Beta	$r_{j,t} - r_{risk-free} = a_{j,t} + \beta_{j,t}(r_{M,t} - r_{risk-free}) + \epsilon_{j,t}$	Beta is calculated with a 12-month rolling time window
Beta(ul)	$beta_{ul} = \frac{\beta}{1+leverage}$	Leverage available
Return(sd)	Standard deviation of total return	Annual standard deviation of monthly returns used in assessments
BM ratio	$\frac{equity}{size}$	Positive equity
Size	$PRCC\_F \times CSHO$	Price and shares outstanding available

Table 82: Measurement of variables
Table 82 summarizes all variables used in empirical investigations. Costr variables from Group 1 approximate the degree of cost structure rigidity. The variables from Group 2 estimate the operating leverage of a company. Further information about the approximation approaches is available in section 3.3. Group 3 compromises well-known measures of a company's profitability. The definitions of operating income and NOA are described in table 81. Group 4 consists of variables estimating a company's accounting risk. Group 5 consists of risk proxies from a capital market perspective. The variables from Group 1 serve as independent variables, whereas variables from Group 2 to 5 serve as dependent variables in the various empirical investigations.

	Opcosts	lnOpcosts	$\Delta Opcosts$
Sales	0.84***		
	(87.83)		
LnSales		1.00***	
		(524.52)	
$\Delta Sales$			0.89***
			(117.68)
Constant	-535.29***	-0.27***	0.02***
	(-3.82)	(-6.23)	(3.25)
R^2	0.99	0.99	0.81
Adjusted R^2	0.99	0.99	0.81
F	626.76	10334.38	759.16
Observations	17590	17590	17590

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table 83: Approaches to approximate the cost structure properties
Table 83 summarizes regression outputs for three approaches to estimating the properties of the cost structure. The first regression regresses operating costs on sales and follows Lev (1974). In the second regression, the logarithms of the two variables are used. Changes in these two variables serve as input variables in the third regression. The coefficients of regressions two and three serve as input variables for the empirical investigations. Industry and time dummies are considered and residuals are clustered for companies.

	Costr(1y)	Costr(5ya)	Costr(absolute)	Costr(change)	Costr(SGA)	BM ratio	Size
1	1722	11866	170	142	1771	2141	4133
2	1705	3905	249	265	1758	2349	2247
3	1713	951	487	505	1761	2219	1760
4	1701	349	1011	1059	1757	2027	1483
5	1707	187	2433	2140	1754	1762	1411
6	1712	122	6503	5300	1762	1531	1242
7	1706	60	4906	6197	1761	1416	1186
8	1708	47	1235	1395	1757	1313	1247
9	1710	44	398	407	1762	1363	1294
10	1697	59	198	180	1747	1444	1585

Table 84: Number of observations of cost structure deciles
Table 84 shows the number of observations for deciles built according to the cost structure proxies. Table 82 describes the calculation of the proxies. The definition of the deciles follows the distribution of the variable or portfolios with equal numbers of observations are built. See subsection 4.2.1 for further information about portfolio construction.

A.2. Summary of Literature

Source	Group	Focus	Topic Area	Main Findings
Kelly & Sussman, 1966	pe	both	feature	Explanation of difference between absolute and relative viewpoint; in addition to fixed costs, the breakeven point also influences the operating leverage.
Rubinstein, 1973	pe	costs	risk	Operating leverage, in addition to demand fluctuations and operating efficiency, is part of operational risk that drives stock returns.
Lev, 1974	tse	costs	risk	Proxy for rigidity of cost structure explains standard deviation of returns and systematic risk; proxy is static.
Ferri & Jones, 1979	pe, ptpe	elasticity	relation	Negative, but rather erratic than linear, relation between operating and financial leverage; ratio of fixed assets to total assets is more linear than the elasticity proxy.
Gahlon, 1981	pe	both	risk	Operating leverage is theoretically linked to CAPM's beta when using expected and not actual sales.
Gahlon & Gentry, 1982	pe	both	risk	Systematic risk and business risk are related; operating leverage in addition to financial leverage, variation in sales, and dependence of sales on economy influence this business risk.
Mandelker & Rhee, 1984	tse	elasticity	risk	Operating leverage determines systematic risk together with financial leverage; the two leverages are negatively related; proxy is static but assessments using different time intervals reject stationarity of operating leverage.
McDaniel, 1984	ptpe	elasticity	feature	Relation of variable to fixed costs and the distance to breakeven point determine the operating leverage.
O'Brien & Vanderheiden, 1987	tse	elasticity	risk	Introduces two-step approach to estimating operating leverage; operating leverage and cost of capital are theoretically linked only when considering expected sales.
Prezas, 1987	pe	both	relation	Rejects the tradeoff hypothesis between financial and operating leverage.
Chung, 1989	ptpe	elasticity	risk	Operating leverage is a significant factor in regressions explaining systematic risk; financial and operating leverage have a nonlinear, multiplicative effect on the level of riskiness.
Dugan & Shriver, 1989	tse	both	feature	Appraisal of different operating leverage proxies; approach of Mandelker and Rhee (1984) fits to the definition of operating leverage; admission that true operating leverage is not measurable.

Source	Group	Focus	Topic Area	Main Findings
Huffman, 1989	tse	elasticity	risk, relation	Rejects a positive relation between operating leverage and systematic risk and a negative relation between operating and financial leverage; questions calculation of operating leverage according to Mandelker and Rhee (1984).
Dran, 1991	pe	both	feature	Distance to breakeven point is a major factor influencing the operating leverage; an increase in fixed costs does not necessarily increase the riskiness if distance to breakeven point does not alter.
Dugan & Shriver, 1992	tse	elasticity	feature	Approach of O'Brien and Vanderheiden (1987) is superior to approach of Mandelker and Rhee (1984) because coefficients tend to be larger than 1.
Lev & Thiagarajan, 1993	ptpe	costs	risk	Differences between changes in sales and changes in gross margin have a negative impact on excess returns; differences between changes in sales and changes in SGA indicate management's ability to control costs.
Petersen, 1994	tse	elasticity	relation	Operating leverage influences the volatility of earnings and with that the choice of pension scheme of a company.
Lord, 1995	pe	both	feature	An increase in level of fixed costs alongside a reduction in variable costs could result in a constant breakeven point and operating leverage.
Darrat & Mukherjee, 1995	tse	elasticity	risk, relation	Relation between operating leverage and systematic risk varies across industries.
Lord, 1998	pe	both	feature	Because the price of products and units sold are unknown to the public, proxies of the operating leverage based on publicly available information (for instance approach of Mandelker and Rhee (1984) or O'Brien and Vanderheiden (1987)) are flawed.
Howard, 2000	pe	both	feature	Riskiness of a company, earnings variability and operating leverage are interrelated.
Ho et al., 2004	tse	elasticity	relation	The relation between operating leverage and R&D intensity is low.
Gourio, 2004	pe	costs	risk	Relation between BM ratio and operating leverage through the productivity of firms; high BM ratio companies and companies with high operating leverage tend to be lowly productive and more exposed to aggregate demand shocks; outperformance of high BM ratio companies explained by risk.

Source	Group	Focus	Topic Area	Main Findings
Hodgin & Kiymaz, 2005	pe	both	feature	Discussions about operating leverage differentiated by management decisions, external factors influencing operating leverage, and engineered-based limits; level of fixed costs are under control of management.
Brimble & Hodgson, 2007	pe	costs	risk	Operating leverage and earnings variability are significant factors in explaining systematic risk.
Gulen et al., 2008	ptpe	elasticity	risk	Operating leverage is part of inflexibility index which is related to portfolio returns; inflexible companies exhibit higher costs of equity.
Garcia-Feijoo & Jorgensen, 2010	tse	costs	risk	Identification of a positive relation between operating leverage and BM ratio, and a low relation with size; results support risk explanation of BM ratio anomaly.
Novy-Marx, 2011	pe	costs	risk	Higher cost of capital for companies with high exposure to operating leverage due to higher share of assets-in-place with low productivity.
Kahl et al., 2011	tse	costs	relation	Companies with high operating leverage exhibit a more conservative financial policy; when access to capital markets is constrained, high operating leverage companies have lower financial leverage.

Table 85: Summary of literature
Table 85 summarizes the literature discussed in section 2.2. The column Group differentiates between three measurement approaches to approximating the operating leverage: pe stands for point estimate, ptpe for point-to-point estimate, and tse for time-series estimate. See section 3.3 for further information. The column Focus differentiates between the focuses of operating leverage approximations: elasticity focus, costs focus or both. The column Topic Area distinguishes between risk considerations (risk), discussions about the properties of the operating leverage (feature), and interrelations with other accounting characteristics (relation).

A.3. Risk Clusters

	ROE				ROA			
	1	2	3	4	1	2	3	4
Business Equipment	13.4%	16.5%	13.1%	15.2%	7.1%	9.3%	7.6%	9.8%
Chemicals	13.7%	17.9%	14.7%	18.7%	6.2%	8.2%	5.4%	7.2%
Consumer Durables	13.0%	17.4%	14.1%	18.2%	7.0%	9.3%	6.0%	8.9%
Consumer Non Durables	19.2%	23.0%	14.2%	18.6%	7.9%	11.3%	6.8%	10.3%
Energy	12.0%	18.9%	14.6%	16.3%	5.1%	7.4%	5.5%	7.4%
Healthcare	17.6%	23.5%	16.0%	18.4%	9.4%	12.4%	7.6%	10.8%
Manufacturing	14.1%	16.4%	13.2%	16.3%	7.0%	8.3%	6.2%	8.1%
Other	14.6%	18.3%	13.5%	14.4%	6.7%	8.3%	5.2%	6.5%
Shops	13.8%	16.4%	17.5%	17.3%	7.1%	8.7%	5.2%	7.1%
Telecom	13.8%	17.6%	19.7%	13.9%	6.5%	6.8%	6.3%	6.1%
Utilities	9.4%	11.7%	9.8%	12.9%	3.1%	4.2%	3.9%	4.4%
Total	14.8%	18.5%	14.4%	16.1%	7.2%	9.2%	6.2%	8.5%

	Margin				Equity ratio			
	1	2	3	4	1	2	3	4
Business Equipment	9.1%	12.0%	9.8%	13.4%	55.0%	59.1%	60.1%	65.7%
Chemicals	9.6%	11.6%	9.1%	12.1%	44.8%	46.5%	39.4%	42.2%
Consumer Durables	9.1%	11.5%	7.5%	9.6%	52.1%	54.0%	46.1%	52.4%
Consumer Non Durables	11.7%	15.1%	9.8%	13.1%	48.2%	51.9%	47.0%	54.7%
Energy	7.8%	12.3%	12.2%	19.3%	40.8%	43.8%	42.1%	47.5%
Healthcare	15.3%	18.1%	13.1%	18.2%	55.1%	57.0%	54.0%	62.3%
Manufacturing	9.3%	10.9%	8.4%	10.8%	50.4%	51.1%	45.4%	52.7%
Other	10.8%	12.9%	9.9%	14.0%	46.5%	48.4%	41.9%	47.9%
Shops	6.3%	8.2%	5.9%	6.8%	50.0%	52.8%	43.3%	48.4%
Telecom	19.7%	17.1%	15.7%	18.4%	46.0%	42.2%	36.5%	45.1%
Utilities	16.8%	25.6%	12.2%	15.4%	33.6%	35.0%	33.9%	28.7%
Total	10.1%	12.8%	9.7%	13.7%	49.9%	52.0%	47.6%	54.8%

Table 86: Time-series averages of accounting figures for risk clusters
Table 86 summarizes time-series averages of ROE, ROA, Margin and equity ratio. The time-series averages are calculated for the companies in a risk cluster according to figure 7 on page 160. Each industry is treated separately. Table 82 explains the calculation of the accounting variables.

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