

Contents

1	Introduction	1
1.1	Motivation and Problem Statement	1
1.2	Outline of Thesis	7
2	Theoretical Background	11
2.1	Modern Portfolio Theory	11
2.1.1	Mean Variance Framework	11
2.1.2	Separation Theorem	21
2.1.3	Utility Theoretic Foundation	24
2.1.4	Weaknesses of the Classical Portfolio Theory .	34
2.2	Asset Pricing Theory	36
2.2.1	Capital Asset Pricing Model - CAPM	36
2.2.2	Empirical Evidence - Critique and Anomalies .	41
2.2.3	Factor Models	44
2.2.4	Methodology for Empirical Testing	47
2.3	Summary	51
3	Alternative Approaches in Portfolio Management	53
3.1	Risk Measures and Risk Contributions	53
3.1.1	What Is Risk?	53
3.1.2	Risk Measures	55
3.1.3	Risk Contributions	63
3.2	Portfolio Models	74
3.2.1	Equally Weighted Portfolio ($1/n$)	74
3.2.2	Minimum Risk Portfolios	75
3.2.3	Equally Risk Contribution Portfolios	77
3.3	Utility Theoretic Foundations	80
3.3.1	Expected Utility Theory	80

3.3.2	Other Approaches	85
3.3.3	Summary	105
4	Literature Review	107
4.1	Minimum Risk Portfolios	107
4.1.1	MV/Low Risk Anomaly	107
4.1.2	Minimum-CVaR Portfolio	119
4.1.3	Maximum Drawdown and Drawdown Measures	123
4.1.4	Minimum-CDaR Portfolio	126
4.2	Risk Budgeting Portfolios	128
4.2.1	Volatility Risk Budgets	128
4.2.2	CVaR Risk Budgets	137
4.2.3	Summary of the Risk Budgeting Studies	140
5	Robustness	147
5.1	Definition of Robustness	147
5.2	Approaches to Robust Portfolios: A Short Review . .	149
5.3	Review of the Robustness of the Markowitz Approach	152
5.4	Robustness of the Volatility Risk Budgeting Portfolio .	155
5.5	Summary	158
6	Empirical Studies	159
6.1	Organization of Studies	159
6.2	Performance Study	161
6.2.1	Methodology	162
6.2.2	European Fund	173
6.2.3	Global Portfolio	192
6.2.4	German Market	215
6.2.5	Summary of the Performance Studies	240
6.3	Exploring Risk-Based Pricing Anomalies	241
6.3.1	Methodology	242
6.3.2	Global Portfolio	246
6.3.3	Germany 1973	250
6.3.4	Rolling Regressions	257
6.3.5	US Industry Indices	262

6.3.6	US MSCI	264
6.3.7	German Industry Indices	266
6.3.8	German MSCI	270
6.3.9	Four-Factor Model	274
6.3.10	Summary of the Factor Regressions	275
6.4	Robustness Study	276
6.4.1	Methodology	277
6.4.2	Simulation Study	280
6.4.3	Empirical Study	304
6.4.4	Results of the Robustness Study	318
7	Extensions of Empirical Studies	321
7.1	Fat Tailed Distributions	321
7.2	Binary Stability Portfolio	335
7.3	Hierarchical Clustering	348
7.3.1	Global Portfolio	352
7.3.2	German Market	355
7.3.3	Different Clustering Algorithm	359
7.3.4	Summary	361
8	Conclusion	363
A	Appendix	371
A.1	Germany1973 Dataset	371
A.2	Regressions	372
A.2.1	Global Dataset	372
A.2.2	Germany 1973 Dataset	377
A.2.3	US Industry Dataset	383
A.2.4	US MSCI Dataset	384
A.2.5	German Industry Dataset	385
A.2.6	German MSCI Dataset	387
A.3	Robustness Study	388
	Bibliography	391