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Market and Accounting Risk Factors of Asset Pricing in the Classical and Downside Approaches

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Abstract

Theoretical background: The variability of the company's profitability is the result of the accompanying risk. To compare the profitability of many companies, relative profitability measures, which include profitability ratios, are more convenient. This article analyses market and accounting risk factors of CAPM. Risk was considered in variance and downside framework. Market betas, accounting betas were used in an extended version of the asset pricing model. Additionally, the influence of profitability ratios, such as ROA and ROE on the average rate of return on the capital market are considered.

Purpose of the article: The main purpose of this study is to test the standard and extended CAPM relations between systematic risk measures and mean returns for single companies quoted on the Polish capital market and equally-weighted portfolios in two approaches: variance and downside risk.
Research methods: The research based on individual securities and portfolios, compares the one-factor risk-return relationships with two-factor ones estimated using mean returns in cross-sectional regressions. The regressors were expressed in absolute terms and classical and downside beta coefficients. The sample includes companies differing in terms of size and across different industries.
Main findings: Portfolios with higher classical or downside market betas generate higher mean returns. The negative risk premium for accounting betas for variance and downside risk was identified. It is not in accordance with our earlier study of the Polish construction sector, where a positive and significant risk premium for downside accounting betas was found. The highest explanatory power of rates on returns on the Polish capital market were found for average ROA and ROE. This confirms the results of the previous studies on the Polish capital market for food and construction sectors.

Introduction

The main and obvious goal of the company is to generate profit. The company's ability to generate profit translates in the long run into an increase in its market value and, as a result, an increase in the company's share prices. The variability of the company's profitability is the result of the accompanying risk. The company's profitability can be expressed in absolute terms such as, e.g. net profit or operating profit. To compare the profitability of many companies, relative profitability measures, which include profitability ratios, are more convenient.

Risk management is a process that involves activities aimed at planned and targeted analysis and control of the occurring risk in business operations as well as control of the effects of these activities (Włodarczyk, 2018). In this article, capital market risk and the operational risks associated with the fluctuations of accounting profitability ratios in companies were examined. The authors consider two main profitability ratios, ROA and ROE, and focus on accounting information in risk analysis and the impact of profitability ratios such as ROA and ROE and accounting betas on the average rate of return.

In this paper, the sensitivity of a given company to changes in profitability on the domestic market is considered. Accounting beta and downside accounting beta were used to test this sensitivity. The study used the extended version of the CAPM model. Risk factors affecting the average yields on the WSE were investigated. First, it was assumed that more profitable companies should achieve higher average returns on the capital market. In addition, investors should be compensated for the risk associated with fluctuations in this profitability, i.e. there should be a premium for the risks associated with accounting beta. The models also include classic beta coefficients determined according to the Sharpe model and their lower counterparts (Estrada, 2007).

The main objective of this study is to test the standard and extended CAPM relations between systematic risk measures and mean returns for single companies quoted on the Polish capital market and equally-weighted portfolios in two approaches: variance and downside risk.

Literature review

One of the concepts of specification and verification of asset pricing models is an approach in which relationships between the systematic risk and the expected return depend on companies' conditions. Amorim, Lima and Murcia (2012) conducted research into the relationship between accounting information and systematic risk in the Brazilian financial market. They concluded that accounting variables are valuable support to market beta in risk analysis. Sarmiento-Sabogal and Sadeghi (2015) found similarities between accounting betas and market betas for US-listed firms, but they also discovered that accounting betas overestimate the market risk. Cambell, Polok and Vuolteenaho (2010) emphasised the role of accounting information in risk analysis and the calculation of cost of capital. They focus on the correlation of stock cash flow and profitability and provide an example of the application of accounting risk measures using the Morningstar stock rating system.

The role of accounting profitability in multi-factor models is still developing. Fama and French (2018) proposed six-factor models with cash profitability and operating profitability used to construct profitability factors. The idea of a risk-return relationship is strictly connected to CAPM postulates, but this model is often criticized as an insufficient theory to describe asset pricing. Many studies in developed markets demonstrate that downside measures outperform classical CAPM measures in explaining stock returns (Post, Van Vliet, 2006; Ang, Chen, & Xing, 2006; Tsai, Chen, & Yang, 2014). In emerging markets, Estrada (2002, 2007) demonstrated that downside measures were better priced and the downside CAPM model explained the risk-return relationship better than the traditional model. Zaremba and Czapkiewicz (2017) tested explanatory power of four popular factor pricing models in emerging European markets. They analysed about 100 anomalies documented in the financial literature. Out of wide range of variables they used, there were also profitability factors such as ROA and ROE. Considering these ratios, they found positive differences between means that significantly differ from zero under the equally-weighted and capitalization-weighted portfolios. Ali (2019) examined whether downside risk is significant in asset pricing on the Chinese stock market. This research showed a positive risk premium for downside variability in the medium and long term.

Research methods. Downside risk and accounting betas

Downside measures require the use of semi-variance of returns and co-semi-variance between asset *i* and market portfolio or, more generally, lower partial moments (LPM). Bawa and Lindenberg (1977) developed the mean-lower partial moment model, which was as one of the first in the downside risk literature. The expected return of any asset or portfolio is then given (Mamoghli & Daboussi, 2010):

$$E(R_i) = R_f + \beta_i^{mlpm_n(\tau)}\left(E(R_M) - R_f\right) \quad (i = 1, \dots, N) \tag{1}$$

where $\beta_i^{mlpm_n(\tau)}$ is the measure of systematic risk with the target rate τ. In a special case when the threshold rate τ equals risk-free rate and for $n = 2$, the systematic risk (downside beta of Bawa and Lindenberg formula) can be written as follows:

$$\beta_i^{BL} = \frac{E\{(R_i - R_f)\cdot\min[(R_M - R_f),0]\}}{E\{\min\,[(R_M - R_f),0]^2\}} \tag{2}$$

The idea of LPM was developed as the *n*-th order generalised LPM by Harlow and Rao (1989). The downside beta of the Harlow and Rao formula is given by:

$$\beta_i^{HR} = \frac{E\{(R_i - \mu_i)\cdot\min[(R_M - \mu_M),0]\}}{E\{\min\,[(R_M - \mu_M),0]^2\}} \tag{3}$$

where μ_i , μ_M are the average returns of security *i* and market portfolio.

In the current study, formulas described in (2) and (3) were employed to calculate the downside betas to study the risk-return relationships.

The downside accounting betas are calculated in a similar way to the market betas. The risk-free rate was replaced by the long-term average of the profitability ratio in the sector or market (Rutkowska-Ziarko & Pyke, 2017). Additionally, the authors of this study need to build the market index for a given ratio. The basic solution is using the mean of a given ratio (Hill & Stone, 1980). For example, using the Bawa and Lindenberg formula adopted for downside accounting beta for *return on assets* $\beta_i^{BL}(ROA)$, R_f was replaced in formula (2) by γ.

$$\beta_i^{BL}(ROA) = \frac{E\{(ROA_i - \gamma)\cdot\min[(ROA_M - \gamma),0]\}}{E\{\min\,[(ROA_M - \gamma),0]^2\}} \tag{4}$$

where ROA_i and ROA_M are *return on assets* for company *i* and for market portfolio, γ is a target point. *Return on assets* for market portfolio was calculated as follows:

$$ROA_M = \sum_{i=1}^{N} ROA_i * \frac{MV_i}{\sum_{i=1}^{N} MV_i} \tag{5}$$

where MV_i is the market value of company *i*.

As the target point (γ), the average long-term return of assets for market portfolio was taken:

$$\gamma = \overline{ROA}_M = \frac{1}{T}\sum_{t=1}^{T} ROA_{Mt} \tag{6}$$

where ROA_{Mt} is *return on assets* for market portfolio in time *t*.

The downside beta of Harlow and Rao was used to calculate the downside accounting beta $\beta_i^{HR}(ROA)$:

$$\beta_i^{HR}(ROA) = \frac{E\{(ROA_i - \overline{ROA}_i)\cdot \min[(ROA_M - \overline{ROA}_M),0]\}}{E\{\min[(ROA_M - \overline{ROA}_M),0]^2\}} \tag{7}$$

where

$$\overline{ROA}_i = \frac{1}{T}\sum_{t=1}^{T} ROA_{it} \tag{8}$$

and ROA_{it} is *return on assets* for company *i* in time *t*. The downside accounting betas for *return on equity* will be calculated in the same way.

Results and discussion

The study sample employs stocks quoted on the Polish stock market and consists of stocks listed in the WIG20, mWIG40 and sWIG80 indices. The sample period for quarterly returns starts from January 2010 to December 2017. In this period, 62 stocks were marked by a time series, 10 from the WIG20, 21 from the mWIG40 and 31 from the sWIG80 indices. The sample includes a set of stocks mixed in terms of size and across different industries.

In this study, equally-weighted portfolios were also analysed. Each portfolio consisted of five stocks and was formed in a rolling procedure. In that procedure, 58 portfolios for the whole sample (all securities) and 27 portfolios for subsamples (large-medium securities and small securities) were formed by ascending sorted securities on the relevant risk measure.

The market-wide WIG index is used as the market portfolio approximation and the proxy for the risk-free rate was the Warsaw Interbank Offer Rate (WIBOR 3M) for a three-month investment. All data were obtained from the EMIS database. The study of relations between risk measures and expected rates of return was carried out in a two-step procedure. In the first stage, based on all observations of the sample, the risk measures and ratios were estimated using single linear regressions and formulas from section 2.

In the second stage, a single cross-sectional analysis was incorporated, where mean returns on assets or portfolios were regressed on the beta coefficient and other non-standard independent variables as the potential risk measure estimated in the first stage of the procedure. The general form of one-factor CAPM can be written according to the equation:

$$\overline{R}_i = \lambda_0 + \lambda_1 \widehat{RM}_i + \eta_i; \quad (i = 1, \ldots, N) \tag{9}$$

where:

$\overline{R}_i$ means rates of return for the *i*-th security or portfolio,

$\widehat{RM}_i$ is the estimate of risk measures for the *i*-th security or portfolio in the form of β_i, $\beta_i^{HR}, \beta_i^{BL}$, $\overline{ROA}_i, \overline{ROE}_i, \beta_i(ROA)$, $\beta_i(ROE), \beta_i^{HR}(ROA), \beta_i^{HR}(ROE), \beta_i^{BL}(ROA)$, $\beta_i^{BL}(ROE)$,

λ_0, λ_1 are structural parameters,
η_i is random variable term of i-th security or portfolio.

From the relationships (9), some testable implications can be formulated. The risk premium denoted by parameter of λ_1 associated with all risk measures should assume significant and positive values. Finally, the constant term λ_0 of the relation (9) should significantly differ from zero and correspond to the actual risk-free rate.

As shown in Table 1, downside market betas β^{HR} have a slightly stronger explanatory power than classical beta. β^{BL} is significant, but there is a negative risk premium. The negative risk premium also occurred for all types of accounting betas. In previous research for a similar period for construction sectors, a positive risk premiums for all accounting betas in variance and downside framework were received (Rutkowska-Ziarko, Markowski, & Pyke, 2019).

Table 1. One-factor cross-sectional regressions of risk factors on mean returns for all stock companies

	Individual securities			Equally-weighted portfolios		
Risk factor	λ_0	λ_1	R^2	λ_0	λ_1	R^2
β	0.0163 (2.208)**	0.0145 (1.979)*	0.061	0.0119 (3.123)***	0.0194 (4.922)***	0.302
β^{HR}	0.0164 (2.235)**	0.0144 (1.978)*	0.061	0.0085 (2.079)**	0.0225 (5.312)***	0.335
β^{BL}	0.0394 (6.225)***	-0.0132 (-1.971)*	0.060	0.0367 (9.961)***	-0.0107 (-2.622)**	0.109
$\overline{ROA}$	0.0086 (1.461)	1.4358 (4.196)***	0.227	0.0093 (3.058)***	1.4010 (7.473)***	0.499
$\overline{ROE}$	0.0099 (1.949)*	0.6974 (4.783)***	0.276	0.0077 (2.772)***	0.7906 (8.992)***	0.591
$\beta(ROA)$	0.0313 (8.522)***	-0.0077 (-2.215)**	0.061	0.0328 (13.580)***	-0.0147 (-4.638)***	0.277
$\beta(ROE)$	0.0313 (8.397)***	-0.0078 (-1.994)*	0.062	0.0320 (17.051)***	-0.0133 (-5.417)***	0.344
$\beta^{HR}(ROA)$	0.0306 (8.249)***	-0.0059 (-1.656)	0.044	0.0310 (15.741)***	-0.0109 (-4.059)***	0.227
$\beta^{HR}(ROE)$	0.0305 (8.093)***	-0.0055 (-1.350)	0.029	0.0307 (16.611)***	-0.0098 (-3.754)***	0.201
$\beta^{BL}(ROA)$	0.0325 (9.554)***	-0.0096 (-3.891)***	0.201	0.0334 (19.460)***	-0.0137 (-8.852)***	0.583
$\beta^{BL}(ROE)$	0.0322 (9.603)***	-0.0099 (-4.015)***	0.212	0.0327 (15.321)***	-0.0123 (-6.313)***	0.416

Note: *, **, ***, indicate significance at the 10%, 5% and 1% level, respectively. Regression t-statistics are in parentheses.

Source: Authors' own study.

The highest risk premium occurred for ROA (1.4%) and ROE (0.79%). R-square is the highest for mean ROE, it equals 23% for individual securities and 59% for the portfolio. In prior studies, a positive correlation between the profitability ratios and the quarterly average rates of return was observed for Polish food and construction companies (Rutkowska-Ziarko, 2015; Rutkowska-Ziarko & Pyke, 2018). Konchitichi, Luo, Ma, and Wu (2016) found a negative risk premium for ROA and positive risk premium for $\beta(ROA)$. Stancu and Stancu (2014) used ROA and ROE as the independent variables in a model describing returns on the Bucharest Stock Exchange. The regression coefficients were positive, but not statistically significant.

Table 2. One-factor cross-sectional regressions of risk factors on mean returns for large and medium stock companies

	Individual securities			Equally-weighted portfolios		
Risk factor	λ_0	λ_1	R^2	λ_0	λ_1	R^2
β	0.0109 (1.104)	0.0246 (2.454)**	0.172	-0.0003 (-0.078)	0.0373 (8.844)***	0.758
β^{HR}	0.0104 (0.991)	0.0239 (2.330)**	0.158	0.0021 (0.422)	0.0324 (6.156)***	0.602
β^{BL}	0.0382 (3.769)***	-0.0077 (-0.692)	0.016	0.0547 (7.687)***	-0.0375 (-4.291)***	0.424
$\overline{ROA}$	0.0087 (1.074)	1.4692 (3.427)***	0.288	0.0124 (2.383)**	1.2873 (4.266)***	0.421
$\overline{ROE}$	0.0133 (1.890)*	0.6085 (3.402)***	0.285	0.0123 (3.207)***	0.6983 (6.217)***	0.607
$\beta(ROA)$	0.0353 (6.810)***	-0.0077 (-1.872)*	0.108	0.0354 (10.621)***	-0.0158 (-3.791)***	0.365
$\beta(ROE)$	0.0360 (6.897)***	-0.0092 (-2.020)*	0.123	0.0357 (12.41)***	-0.0157 (-4.531)***	0.451
$\beta^{HR}(ROA)$	0.0352 (6.746)***	-0.0072 (-1.776)*	0.098	0.0340 (11.511)***	-0.0128 (-3.434)***	0.320
$\beta^{HR}(ROE)$	0.0355 (6.717)***	-0.0081 (-1.746)*	0.096	0.0339 (14.871)***	-0.0118 (-4.177)***	0.411
$\beta^{BL}(ROA)$	0.0358 (8.031)***	-0.0100 (-3.541)	0.302	0.0353 (12.920)***	-0.0142 (-6.055)***	0.595
$\beta^{BL}(ROE)$	0.0352 (7.815)***	-0.0089 (-3.340)***	0.278	0.0360 (13.910)***	-0.0129 (-6.122)***	0.600

Note: *, **, ***, indicate significance at the 10%, 5% and 1% level, respectively. Regression *t*-statistics are in parentheses.

Source: Authors' own study.

The research sample was divided into two sub-samples. The first sub-sample included large and medium stock companies from the WIG20 and mWIG40 market indexes, while the second sub-sample included small stock companies from the sWIG80. The regression parameters for individual companies and portfolios in one-factor models were then re-estimated (Tables 2 and 3).

All signs of regression parameters were the same as for the whole sample. The authors hypothesised that for larger firms the explanatory power of independent variables would be higher compared to smaller firms. This assumption was confirmed empirically. For almost all risk factors, the R-squared values were higher for large and medium companies compared to small firms, with one exception for $\overline{ROA}$. For larger firms and equally-weighted portfolios, all risk factors were significant at the 1% level. For small firms, one risk factor ($\beta^{HR}(ROE)$) was statistically insignificant.

Table 3. One-factor cross-sectional regressions of risk factors on mean returns for small stock companies

	Individual securities			Equally-weighted portfolios		
Risk factor	λ_0	λ_1	R^2	λ_0	λ_1	R^2
β	0.0208 (1.908)*	0.0059 (0.548)	0.010	0.0137 (2.350)**	0.0128 (2.145)**	0.155
β^{HR}	0.0210 (2.042)*	0.0059 (0.569)	0.011	0.0086 (1.774)*	0.0176 (3.415)***	0.318
β^{BL}	0.0389 (4.711)***	-0.0165 (-1.959)*	0.117	0.0355 (7.567)***	-0.0148 (-2.909)***	0.253
$\overline{ROA}$	0.0089 (0.999)	1.3525 (2.288)**	0.153	0.0036 (0.851)	1.8816 (6.283)***	0.613
$\overline{ROE}$	0.0052 (0.670)	0.8625 (3.255)***	0.267	0.0081 (2.151)**	0.7536 (5.449)***	0.543
$\beta(ROA)$	0.0276 (5.237)***	-0.0091 (-1.411)	0.064	0.0311 (13.921)***	-0.0287 (-6.720)***	0.643
$\beta(ROE)$	0.0270 (5.041)***	-0.0068 (-0.909)	0.028	0.0292 (15.351)***	-0.0244 (-5.793)***	0.573
$\beta^{HR}(ROA)$	0.0265 (4.961)***	-0.0045 (-0.623)	0.013	0.0269 (12.061)***	-0.0106 (-2.302)**	0.175
$\beta^{HR}(ROE)$	0.0261 (4.848)***	-0.0009 (-0.106)	0.001	0.0269 (11.151)***	-0.0077 (-1.468)	0.079
$\beta^{BL}(ROA)$	0.0291 (5.533)***	-0.0091 (-1.931)*	0.114	0.0339 (13.400)***	-0.0176 (-5.521)***	0.549
$\beta^{BL}(ROE)$	0.0299 (5.860)***	-0.0131 (-2.440)	0.170	0.0345 (11.110)***	-0.0225 (-5.284)***	0.528

Note: *, **, ***, indicate significance at the 10%, 5% and 1% level, respectively. Regression *t*-statistics are in parentheses.

Source: Authors' own study.

Long-term average ROA and ROE have the highest explanatory power of return rates on the Polish capital market. *R*-squared values were higher for the sample of large and medium stock companies compared to smaller companies. One can see that using equally-weighted portfolio, the influence of risk factor on average rate of return is more visible. In every regression, determination coefficients are higher for portfolios compared to individual companies.

Conclusions

The results indicate that downside beta is not a worse measure of risk in explaining variations of returns (and for small companies, even better) which is confirmed by portfolio investments based on these companies. Investors are rewarded by a positive statistically significant premium for the acceptance of traditional beta and downside beta. This means that stocks or portfolios with higher classical or downside betas generate higher mean returns. This conclusion is consistent with many recent studies and gives strong evidence for using CAPM with lower partial moments in addition to CAPM. The findings indicate that the risk premium coefficients for downside beta with the risk-free rate as a threshold are negative and mostly important.

For all accounting betas a negative risk premium occurs. In many cases, it is statistically significant. Accounting betas measure the sensitivity of a firm's accounting profitability for the changes in the whole market. This means that for the Polish capital market, more sensitive companies (in the context of higher accounting betas) have a lower rate of return. This is contrary to prior research on the Polish construction sector, where a positive significant risk premium for downside accounting betas was identified (Rutkowska-Ziarko, Markowski, & Pyke, 2019). The authors suppose that the reason for the negative risk premium in accounting beta can be from using companies from different industries together in one research sample.

The average profitability ratios are significant risk factors in every estimated cross-sectional regression, for individual securities and equally-weighted portfolios. Regardless of using ROE and ROA in one-factor models or using them in two-factor models together with any market beta, they always have a significant and positive impact on the average rate of return. This means that profitability ratios are very important for investors and they can be considered separately, or as an additional risk factor to market betas. This confirms the earlier studies of the Polish food and construction sector capital markets mentioned in the article.

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