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Using Accounting Information in Risk Analysis

1. Introduction

This study focuses on using accounting information in risk analysis. We look at capital risk from the perspective of the owners and managersas well as from an investor's point of view. We also examine the implications of variable profitability ratios of a firm for risk assessment in the capital market. We consider the risk as both as a variance and as a semi-variance. The profitability of a company can be measured using three main profitability ratios: return on assets (*ROA*), return on equity (*ROE*) and return on sales (*ROS*).

This paper is an extension of the research previously presented by Rutkowska-Ziarko (2015)[3], which concluded that the total risk, defined as the variability and semi-variability of the stock prices, is affected by the changeability of profit earned by a company. In that study 15 food companies listed on the Warsaw Stock Exchange were analysed and it was found that there was a noticeable correlation between the semi-variability of company profitability ratios and the downside risk of investment in such companies. It was also observed that higher profitability ratios had an impact on the higher long-term average rate of return on the capital market.

The aim of this paper is to answer two questions. Firstly, does the profitability of a company, as indicated by various accounting profitability ratios, translate into higher returns for investors in the capital market?

Secondly, does the level of risk on the capital market relate to the volatility of company profitability ratios?

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[3] A. Rutkowska-Ziarko, *Influence of profitability ratio and company size on profitability and investment risk in the capital market*, "Folia Oeconomica Stetinesia" 2015, 15(23), pp. 151–161.

2. Downside Risk

In this paper we measure volatility using two different approaches, (i) the symmetric and (ii) the asymmetric one. In the symmetric approach we use classical measures of risk such as variance and standard deviation.

In the asymmetric approach we consider a semi-variance and semi-deviation, which are the measures of downside risk. The discussion why investors are more interested in downside risk can be found in many publications[4].

Markowitz proposed a semi-variance, which is the mean of deviations below a certain specified level, as a downside equivalent of a variance[5]. A semi-variance is one of many possible alternatives that can be used to compute the total risk of an investment. In this paper we determine the semi-variance for the rate of return on the capital market ($dS(R)_i^2$) using the risk-free rate (R_{ft}) as the target point:

$$dS(R)_i^2 = \frac{1}{T-1}\sum_{t=1}^{T} lpm_{it}^2, \tag{1}$$

where:

$$lpm_{it} = \begin{cases} 0 & for\ R_i \geq R_{ft} \\ R_{it} - R_{ft} & for\ R_{it} < R_{ft} \end{cases},$$

where:
R_{it} – the rate of return on the capital market for i-*th* company.

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[4] J. Estrada, *Systematic risk in emerging markets: The D–CAPM*, "Emerging Markets Review"2002, vol.3, pp. 365–379; T. Post, P. Van Vliet, *Downside risk and asset pricing*, "Journal of Banking and Finance" 2006, vol. 30(3), pp. 823–849; U. Galagedera, R. Brooks, *Is co-skewness a better measure of risk in the downside than downside beta? Evidence in emerging market data*, "Journal of Multinational Financial Management" 2007, vol. 17, pp. 214–230; D. Pla-Santamaria, M. Bravo, *Portfolio optimization based on downside risk: a mean-semivariance efficient frontier from dow jones blue chips*, "Annals of Operations Research" 2013, vol. 20(1), pp. 189–201; A. Rutkowska-Ziarko, *Fundamental portfolio construction based on semi-variance*, "Olsztyn Economic Journal" 2013, vol. 8(2), pp. 151–162; L. Markowski, *Conditional volatility exposures in asset pricing in the downside and classical framework*, "Research in Economics and Business: Central and Eastern Europe" 2015 7(1), pp. 5–22; F. Klebaner, Z. Landsman, U. Makov, J. Jing Yao, *Optimal portfolios with downside risk*, "Quantitative Finance" 2017, vol. 17(3), pp. 315–325.

[5] H. Markowitz, *Portfolio selection: efficient diversification of investments*, John Wiley and Sons, New York 1959.

We apply the concept of semi-variance as well, to determine the semi-volatility of profitability ratios of a company. The main problem with applying the concept of downside risk to accounting variables is the target level of a given ratio. To calculate the semi-variance for the stock rate of return the risk-free rate is used, however, there is nothing similar for accounting ratios. One solution is to use the average level of a financial ratio in each sector as the target point[6].

Let us try to define the semi-variance for the return on assets (ROA). The semi-variance for the profitability ratio could also be defined in a similar way:

$$dS_i^2(ROA) = \frac{1}{T-1}\sum_{t=1}^{T} lpm_{it}^2(ROA), \tag{2}$$

where:

$$lpm_{it}(ROA) = \begin{cases} 0 & for\ ROA_{it} \geq \overline{ROA}_M \\ ROA_{it} - \overline{ROA}_M & for\ ROA_{it} < \overline{ROA}_M \end{cases}.$$

where:

$\overline{ROA}_M$ – average level of *ROA* for all the analysed companies in the sector or in the market,

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

$$ROA_{Mt} = \sum_{i=1}^{k} w_i * ROA_{it},$$

$$w_i = \frac{MV_i}{\sum_{i=1}^{k} MV_i},$$

MV_i – market value of company *i-th*.

The semi-variance for *ROA* represents how changes in the profitability of the whole sector or market affect the profitability of a given company in a weak position. A weak position is defined as a period when the average profitability ratio for a company is lower than the average level in the sector (market).

The calculation of the target point is important as it identifies the level at which a company's profitability is acceptable; below this point the profitability of the company is regarded as insufficient. This approach is similar to the previous

[6] A. Rutkowska-Ziarko, C. Pyke, *The development of downside accounting beta as a measure of risk*, "Economics and Business Review" 2017, vol. 4, in press.

research on the Polish food company sector[7], however, one difference is we use the average value, scaled (weighted) by market capitalization, whereas in the previous study we used equally the weighted average. The second difference is that this study calculates one target point for the whole analysed period, while in the previous paper we calculated the reference point separately for each period.

3. Data and Empirical Results

The data for 24 construction companies listed on the Warsaw Stock Exchange was collected and analysed during the period 1 January 2012 – 30 June 2017. In addition, quarterly financial statements during the period between Quarter 4 2011 and Quarter 1 2017 were also analysed for the 24 construction companies.

The quarterly financial reports used by investors always refer to a company's performance in the previous quarter. Therefore, in this study a quarter back shift is applied to the financial data so that it matches with the market share prices. The mean, standard deviation and semi-deviation was calculated for *ROA*, *ROE* and *ROS*, for every company. Distribution parameters were also calculated for quarterly rates of return of each stock exchange company: the mean rate of return, standard deviation of the rate of return and semi-deviation of the rate of return. This provided cross sectional data for different stocks. We used this data for calculating Pearson's correlation coefficient for the parameters of the distribution of rates of return, the parameters of distribution of different profitability ratios. These are shown in Tables 1–3. Note that in all the tables the following symbols were used:

$\bar{R}$ – mean rate of return;
$S(R)$ – deviation of the rate of return;
$\underline{dS(f)}$ – semi-deviation of the rate of return;
$\overline{ROE}$, $\overline{ROA}$, $\overline{ROS}$ – mean *ROE*, *ROA*, *ROS*;
$S(ROE)$, $S(ROA)$, $S(ROS)$ – deviation of *ROE*, *ROA*, *ROS*;
$dS(ROE)$, $dS(ROA)$, $dS(ROS)$ – semi-deviation of *ROE*, *ROA*, *ROS*.

We can see that in the long term the rate of return for stock owners relates to profitability on equity (see: Table 1). It was also found that downside risk on the capital market is statistically significantly correlated with the semi-variability

[7] A. Rutkowska-Ziarko, *Influence of profitability ratio…*

of the return on equity. There is a positive correlation between $S(R)$ and $S(ROE)$, but this correlation is weak.

Table 1. Correlation between the rate of return distribution parameters and *ROE* distribution parameters

	$\bar{R}$	$S(R)$	$dS(f)$	$\overline{ROE}$	$S(ROE)$	$dS(ROE)$
$\bar{R}$	1					
$S(R)$	–0.2593	1				
$dS(f)$	–0.4725	0.9234	1			
$\overline{ROE}$	0.6323	–0.2863	–0.4025	1		
$S(ROE)$	0.2758	0.0533	0.0905	0.2793	1	
$dS(ROE)$	–0.4945	0.3391	0.4901	–0.8599	0.1865	1

Source: the authors' calculations.

In all the presented tables, the critical value of Pearson's coefficient is 0.4044 at the significance level of 0.05 and 0.3438 at the significance level of 0.1.

Table 2. Correlation between rate of return distribution parameters and *ROA* distribution parameters

	$\bar{R}$	$S(R)$	$dS(f)$	$\overline{ROA}$	$S(ROA)$	$dS(ROA)$
$\bar{R}$	1					
$S(R)$	–0.2593	1				
$dS(f)$	–0.4725	0.9234	1			
$\overline{ROA}$	0.3580	–0.3718	–0.5053	1		
$S(ROA)$	–0.1289	0.0962	0.1211	–0.2227	1	
$dS(ROA)$	–0.2921	0.3129	0.4169	–0.8653	0.6686	1

Source: the authors' calculations.

The correlation coefficients between rate of return distribution parameters and *ROA* distribution parameters are presented in table 2. There is a positive and statistical significant correlation (at the significance level of 0.1) between the mean *ROA* of the companies under consideration and the average rates of return on the investment in their shares. There is also a positive correlation between the variability of return on assets and stock exchange investment risk, but statistically insignificant and very low (0.096). For the downside risk approach, a stronger and statistically significant correlation occurred. One can

see that there are negative correlations between the mean rate of return and risk measured by the standard deviation and semi-deviation. A similar situation is observed for the mean *ROA* and variability and semi-variability of *ROA*.

There is a low-level correlation between the mean *ROS* of the companies in the study and the mean rates of return achieved from investments in their shares. Also, there is a positive correlation between the variability and semi-variability of return on sales and the risk of stock exchange investments, the correlation being statistically significant and stronger for the downside risk.

Table 3. Correlation between rate of return distribution parameters and *ROS* distribution parameters

	$\bar{R}$	$S(R)$	$dS(f)$	$\overline{ROS}$	$S(ROS)$	$dS(ROS)$
$\bar{R}$	1					
$S(R)$	–0.2593	1				
$dS(f)$	–0.4725	0.9234	1			
$\overline{ROS}$	0.2490	–0.3535	–0.4958	1		
$S(ROS)$	–0.1014	0.0824	0.0841	0.1042	1	
$dS(ROS)$	–0.2283	0.3130	0.4121	–0.6923	0.6244	1

Source: the author's calculations.

4. Conclusion

We found that in the Polish construction company sector, the profitability of a company translates into higher profits for investors on the capital markets. It has been verified that the risk on the capital market is related to the volatility of profitability ratios for a company. This study supports the assertion that downside risk is more important for stock market investors than the variance approach.

This research supports the previous research on the food sector companies listed on the Warsaw Stock Exchange, which found that there is a positive correlation between profitability ratios and the rates of return on investment in their shares. Both for the Polish food company sector and for the construction sector, there is a noticeable correlation between the semi-variability of profitability ratios and the downside risk of investment in shares of such companies.

In our future research, we will extend the analysis of the total risk to the systematic risk measures.

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Wykorzystanie informacji księgowych w analizie ryzyka

Streszczenie

W niniejszym artykule oceniamy, czy w analizie ryzyka można wykorzystać informacje z zakresu rachunkowości finansowej. Naszym celem jest udzielenie odpowiedzi na dwa pytania: (i) Czy rentowność firmy, jak wskazują różne wskaźniki rentowności księgowej, przekłada się na wyższe zwroty dla inwestorów na rynku kapitałowym? (ii) Czy poziom ryzyka na rynku kapitałowym jest związany ze zmiennością wskaźników rentowności przedsiębiorstw? Kwartalne sprawozdania finansowe 24 spółek budowlanych notowanych na Giełdzie Papierów Wartościowych w Warszawie zostały

zebrane i przeanalizowane pod kątem wyników na rynku kapitałowym. W analizie wykorzystywane są trzy kluczowe wskaźniki rentowności: zwrot z aktywów (ROA), zwrot z kapitału (ROE) i zwrot ze sprzedaży (ROS). Stwierdziliśmy, że zyskowność przedsiębiorstwa przekłada się bezpośrednio na wyższe zyski inwestorów na rynkach kapitałowych. Weryfikujemy również, czy ryzyko na rynku kapitałowym jest związane ze zmiennością wskaźników rentowności dla firmy.

Słowa kluczowe: wskaźniki rentowności, ROA, ROE, ROS, ryzyko dolne, sektor przedsiębiorstw budowlanych.