Company size, book-to-market and momentum effects, and other deviations from the CAPM - evidence from the Warsaw stock exchange

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Capital Asset Pricing Model is one of the most popular models applied to explain the risk premium for capital employment. The model has been tested for developed capital markets with conclusions that emphasized many of its imperfections. Some of these imperfections are connected with company characteristics, such as a company's size, book-to-market value etc. The aim of the research is to test whether the anomalies of the CAPM that have been pointed out so far are also true for Poland. I concentrate on companies listed on the Warsaw Stock Exchange during 2007-2010. The event study is applied to identify these anomalies. The research results reveal that the expected returns approximated by the CAPM are contaminated during the evaluation process. This is in line with the conclusions of a previous research paper discussing developed countries.

JEL Classifications: G12, G14

Keywords: CAPM anomalies, event studies, size effect, book-to-market effect, momentum effect

Introduction

The Capital Asset Pricing Model, one of the most popular models applied to explain the level of risk premium for capital employment, has considerable significance for all of the capital market participants. The model allows us to estimate the expected rate of return above the risk-free rate in relation to the market-risk premium (an excess rate of return on the market portfolio, which consists of all the assets listed in a given capital market, above the risk-free rate).

CAPM tests conducted in developed capital markets point to the model's numerous anomalies (imperfections). Some of them are often associated with a company's characteristic features (e.g. company size, book-to-market, debt level, or historical rate of return) which distort the relationship between the expected rate of return and risk. The method most frequently used to identify these anomalies assumes building decile portfolios. Such portfolios are made up of companies ordered according to a given characteristic (e.g. company size) in order to analyse these portfolios' rates of return. An alternative way of identifying deviations from the pricing model is the event study method employed in this paper.

The purpose of the present research was to determine whether, in the Polish capital market, a company's certain features can distort a pricing based on the CAPM, as is the case in developed markets. The paper's starting point is an event study procedure adopted to analyse 1998-2012 data from the Warsaw Stock Exchange. Using the CAPM to determine the expected rates of return helped to establish whether - in the case of groups of companies with extremely different levels of a given characteristic - we can observe abnormal returns which differ from each other (in a situation where no differences should

be observed). The research described here is part of the debate whether certain fundamental company characteristics cause deviations in the CAPM, and if so, what is the character of these deviations.

Previous research

An event study is an increasingly popular analytical method used in finance. It was developed by E. Fama, L. Fisher, M. Jensen and R. Roll (1969), whose article "The Adjustment Of Stock Prices To New Information" first established its principles and applications. Interest in the method has been growing ever since. In the five leading journals of finance, the number of articles based on the method exceeded half a thousand a long time ago, with over 400 of them published in The Journal of Finance and The Journal of Financial Economics alone (Kothari and Warner, 2008).

An event study investigates the reaction of market prices to certain events such as splits, announcing dividend payment, forecasting financial results, and holding primary or secondary share issues. To do so, abnormal returns on these companies' securities are estimated. A company's rates of return observed in a given period are compared with actually unobserved rates of return estimated by a given model. Those are the rates which the company would achieve if the event did not occur (normal, theoretical, expected rate of return). A price reaction is usually measured in the short and the long term, and the reference model most frequently used is the market model or the CAPM. The method enables us to determine the impact of a given type of event on the share prices of companies under study (see Campbell, Lo and MacKinlay 1996).

The event studies conducted by S. J. Brown and J. B. Warner (1980; 1985) showed that employing the market model should lead to correct conclusions about the influence of certain events on the market value. This was indicated by average above-normal rates of return which were not significantly different from zero for randomly selected dates and companies.

A similar method of employing an event study for a random event-date selection and a random company selection was suggested by K. R. Ahern (2009). In his research, however, Ahern made one step further: he randomly selected companies not from among the whole population but from among groups of companies with certain fundamental characteristics such as the book-to-market value, the company size and prior returns. In particular groups there occurred anomalies - unexpected abnormal returns for companies with a different level of a given characteristic. This requires utmost caution when interpreting the results of an event study when abnormal returns are observed for a group of companies with certain level of characteristic features.

Sample and method description

The information sources used in the present study were the Serwis GPWInfoStrefa database together with a database of WSE securities operations, and Notoria Serwis database of financial statements. The first two databases provided information on the closing prices of companies and the WIG index in 1997-2012, as well as information on various kinds of operations that have an impact on these companies' quotations. The third base was used to obtain financial information from annual financial statements for the years 1998-2012. The research covered all 580 companies listed on the Warsaw Stock Exchange in 1997-2012 (including newly-listed companies and those withdrawn from the stock market in that period).

First of all, the companies' quotations were adjusted for dividends, splits, preemptive rights etc. Subsequently, on the basis of quotations thus corrected, particular time series of one-session rates of return were estimated to form a basis for further stages of the research.

To detect potential CAPM anomalies related to companies' certain characteristic features, the event study method was employed. Studies conducted worldwide have demonstrated that in some cases, when an event study is conducted on a sample of companies with some common characteristics not necessarily representative of the values observed on the entire stock market, we can see abnormal returns, even if the event dates were selected randomly (on those days we should not observe any rates of return different from the benchmark rates set by a given pricing model). These anomalies may lead us to confirm the wrong hypothesis about the positive or negative impact of a given type of events on the company value; at the same time, they are proof of the imperfection of the pricing model (e.g. the CAPM) used in an event study.

The present study divided the sample into subgroups identified according to companies' characteristic features. For a given day of the event, all the features were determined on the basis of the one-quarter period preceding the day of the event. The companies' distinguishing characteristics were:

1. average prior returns (PR)

2. average volume of share trading (V)

3. average value of the volume of share trading (VV)

4. average trading volume in relation to all the shares issued (V/N)

5. average capitalisation (MV)

6. total assets (A)

7. total sales (S)

8. ratio of equity to total assets (E/A)

9. ratio of liabilities and provisions for liabilities to total assets (L/A)

10. ratio of long-term liabilities and provisions for liabilities to total assets (LTL/A)

11. ratio of short-term liabilities to total assets (STL/A)

12. ratio of fixed assets to total assets (FA/A)

13. ratio of current assets to total assets (CA/A)

14. ratio of intangible and legal assets to total assets (IA/A)

15. ratio of cash to total assets (C/A)

16. ratio of net working capital (current assets - current liabilities) to total assets (NWC/A)

17. ratio of net profit to total assets (net return on assets, ROA)

18. ratio of net profit to total sales (net return on sales, ROS)

19. ratio of net profit to equity (return on equity, ROE)

20. ratio of earnings before interest and taxes to total assets (operating return on assets, EBIT/A)

21. ratio of earnings before interest and taxes to total sales (operating return on sales, EBIT/S)

22. ratio of earnings before interest and taxes to equity (operating return on equity, EBIT/E)

23. ratio of earnings before interest, taxes, depreciation and amortisation to total assets (EBITDA/A)

24. ratio of earnings before interest, taxes, depreciation and amortisation to total sales (EBITDA/S)
25. ratio of earnings before interest, taxes, depreciation and amortisation to equity (EBITDA/E)
26. value of equity per share (E/N)
27. net earnings per share (EPS)
28. book-to-market ratio (BV/MV)
29. ratio of total cash flow to total assets (CF/A)
30. ratio of operating cash flow to total assets (OCF/A)
31. ratio of investment cash flow to total assets (ICF/A)
32. ratio of total cash flow to total sales (CF/S)
33. ratio of operating cash flow to total sales (OCF/S)
34. ratio of investment cash flow to total sales (ICF/S)
35. ratio of total cash flow to equity (CF/E)
36. ratio of operating cash flow to equity (OCF/E)
37. ratio of investment cash flow to equity (ICF/E)
38. percentage increase in total assets (ΔA)
39. percentage increase in total sales (ΔS)
40. percentage increase in net profit (ΔEAT).

Each trading day, the sample companies were assigned to particular deciles, according to the value of the selected characteristics in the previous quarter. Particular research subgroups were formed by companies situated in the bottom decile (companies with the lowest level of a given characteristic) and the top decile (companies with the highest level of a given characteristic), thus establishing 80 research subgroups.

Next, average abnormal returns on securities were established for all the companies with the identified characteristics. The abnormal returns were estimated as the difference between the rate of return taking into account the effect of the event (observed rate of return) and the normal rate of return (benchmark rate), which would be expected on condition that the event does not occur - determined by the CAPM. Abnormal returns $AR_{i,t}$ for the i-th company on day t are determined by means of the following equation:

$$AR_{i,t} = R_{i,t} - \left(R_t^F + \beta_i \left(R^M - R^F \right) \right), \qquad (1)$$

Where, $R_{i,t}$ - rate of return for the i-th company on day t, R_t^F - one-session risk-free rate determined on day t on the basis of the average yield on 52-week treasury bills from the last auction before day t, β_i - company's market risk coefficient estimated in a 252-session window of estimation using the method of least squares, $\left(R^M - R^F \right)$ - expected market premium per one session.

The procedure of determining abnormal rates of return was repeated for each of the 40 characteristics for all the companies from the extreme deciles for each of the successive 3,650 sessions in 1998-2012. Unlike in Ahern, where event dates were randomly selected, in the present study the event dates were successive session days in the whole period examined.

The next step was to calculate average abnormal returns ($\overline{AR_t}$) in extreme deciles according to a given characteristic, according to the following formula:

$$\overline{AR_t} = \frac{1}{N_S} \sum_{i=1}^{N_S} AR_{i,t} \,, \qquad (2)$$

Where, N_S - number of "events" - cases (the number of companies found in the extreme deciles at particular sessions in the whole period under study; the average numerical size of particular deciles: about 85,000 cases).

In addition to average values, medians of abnormal returns were established for the analysed deciles of particular characteristics.

The study tested zero hypothesis H_0, assuming that the average levels of abnormal returns established for the bottom and the top decile of a given characteristic do not differ from each other $\left(\overline{AR_t^{DD}} = \overline{AR_t^{GD}}\right)$, with alternative hypothesis H_1, according to which the average levels of abnormal returns established for extreme deciles of a given characteristic are different $\left(\overline{AR_t^{DD}} \neq \overline{AR_t^{GD}}\right)$. To examine the significance of the results, a *t*-student test was used for averages and a Mann-Whitney test for medians.

The research made it possible to estimate a total of about seven million partial excess rates of return divided into 80 groups corresponding to the two extreme deciles of 40 characteristic features. If the CAPM was a correct pricing model, applicable to all companies regardless of their possession of certain characteristic features, we should not observe average abnormal rates of return differing from each other in particular extreme deciles of a given characteristic.

Research results

Table 1 shows the average abnormal returns calculated with the use of the CAPM in particular extreme deciles of the 40 characteristics. Analogous values for medians of abnormal returns are presented in Table 2. The second column presents the size of deciles for particular characteristics examined. The third and the fourth columns demonstrate the level of abnormal returns for companies from the bottom and the top decile of a given characteristic. The fifth column shows the difference between them (top decile - bottom decile). The extreme level of significance (p-value) for particular results is presented in the sixth column. All the values given are per one session. To better illustrate the economic significance of particular anomalies, the seventh column shows the difference per year.

TABLE 1. ABNORMAL RETURNS IN THE EXTREME DECILES OF PARTICULAR CHARACTERISTICS - AVERAGE VALUES

Characteristic	N	Decile		Difference (%)		*p*-value	Difference per year (%)
		bottom (%)	top (%)				
PR	95,190	-0.043	0.111	0.154	***	0.000	38.90
V	95,181	0.015	0.033	0.018		0.449	4.53
VV	95,181	0.055	-0.033	-0.088	***	0.000	-22.28
V/N.	95,181	-0.013	-0.009	0.004		0.853	1.05
MV	95,181	0.119	-0.014	-0.133	***	0.000	-33.46
A	93,219	0.110	-0.016	-0.125	***	0.000	-31.62
S	93,246	0.041	-0.006	-0.048	**	0.039	-12.02
E/A	93,212	-0.016	0.034	0.050	**	0.033	12.56
L/A	84,843	0.056	-0.006	-0.062	**	0.016	-15.74
LTL/A	93,212	-0.016	0.034	0.050	**	0.033	12.56

TABLE 1. ABNORMAL RETURNS IN THE EXTREME DECILES OF PARTICULAR CHARACTERISTICS - AVERAGE VALUES

Characteristic	N	Decile		Difference (%)		p-value	Difference per year (%)
		bottom (%)	top (%)				
STL/A	83,276	0.055	-0.036	-0.091	***	0.000	-22.97
FA/A	83,276	-0.001	-0.018	-0.017		0.406	-4.37
CA/A	83,276	-0.018	0.002	0.020		0.344	5.05
IA/A	90,094	0.001	-0.015	-0.016		0.438	-3.94
C/A	52,321	-0.007	0.040	0.047		0.109	11.78
NWC/A	83,276	-0.054	0.065	0.119	***	0.000	29.87
ROA	93,203	-0.064	0.125	0.189	***	0.000	47.57
ROS	62,153	-0.091	0.013	0.104	***	0.001	26.19
ROE	91,983	-0.083	0.119	0.202	***	0.000	50.81
EBIT/A	91,665	-0.068	0.127	0.195	***	0.000	49.08
EBIT/S	61,340	-0.092	0.009	0.101	***	0.001	25.33
EBIT/E	90,445	-0.073	0.115	0.188	***	0.000	47.34
EBITDA/A	89,442	-0.073	0.125	0.198	***	0.000	49.93
EBITDA/S	70,370	-0.053	0.020	0.073	**	0.011	18.37
EBITDA/E	88,283	-0.075	0.105	0.180	***	0.000	45.43
E/N	93,212	0.053	0.000	-0.052	**	0.044	-13.20
EPS	93,260	-0.137	0.071	0.208	***	0.000	52.53
BV/MV	91,992	-0.008	0.033	0.041	*	0.095	10.36
CF/A	92,787	0.026	0.018	-0.008		0.683	-2.09
OCF/A	92,481	0.021	0.034	0.012		0.571	3.07
ICF/A	88,900	0.027	-0.006	-0.033	*	0.098	-8.37
CF/S	64,300	-0.032	-0.015	0.018		0.477	4.44
OCF/S	64,274	-0.020	-0.025	-0.005		0.849	-1.27
ICF/S	61,693	-0.052	-0.043	0.009		0.710	2.32
CF/E	91,581	0.027	0.013	-0.014		0.497	-3.56
OCF/E	91,261	0.014	0.012	-0.002		0.918	-0.57
ICF/E	87,765	-0.001	-0.006	-0.005		0.815	-1.17
ΔA	92,725	-0.053	0.044	0.097	***	0.000	24.43
ΔS	66,497	-0.129	-0.036	0.093	***	0.000	23.43
ΔEAT	90,439	-0.017	0.036	0.053	***	0.007	13.30

Source: Author's own
Note: statistical significance at the 1% (***), 5% (**) and 10% (*) confidence levels.

The average values of extraordinary rates of return established for companies with different levels of given characteristics (Table 1) differ from their medians (Table 2). On the one hand, it suggests the occurrence of outliers. On the other, it makes it difficult to draw definitive conclusions.

TABLE 2. ABNORMAL RETURNS IN THE EXTREME DECILES OF PARTICULAR CHARACTERISTICS - MEDIANS

Characteristic	N	Decile		Difference (%)		p-value	Difference per year (%)
		bottom (%)	top (%)				
PR	95,190	-0.046	-0.042	0.004	***	0.000	0.92
V	95,181	-0.027	-0.059	-0.032	***	0.000	-8.15
VV	95,181	-0.028	-0.060	-0.033	***	0.000	-8.29
V/N.	95,181	-0.028	-0.062	-0.034	***	0.000	-8.65
MV	95,181	-0.041	-0.044	-0.003	***	0.000	-0.76
A	93,219	-0.040	-0.041	0.000	***	0.000	-0.10
S	93,246	-0.044	-0.045	0.000	***	0.000	-0.10

TABLE 2. ABNORMAL RETURNS IN THE EXTREME DECILES OF PARTICULAR CHARACTERISTICS - MEDIANS

Characteristic	N	Decile		Difference (%)		p-value	Difference per year (%)
		bottom (%)	top (%)				
E/A	93,212	-0.040	-0.037	0.003	***	0.000	0.78
L/A	84,843	-0.037	-0.042	-0.006	***	0.000	-1.50
LTL/A	93,212	-0.040	-0.037	0.003	***	0.000	0.78
STL/A	83,276	-0.041	-0.043	-0.002	***	0.000	-0.50
FA/A	83,276	-0.040	-0.042	-0.002		0.498	-0.43
CA/A	83,276	-0.042	-0.040	0.002		0.403	0.51
IA/A	90,094	-0.042	-0.043	-0.001		0.659	-0.22
C/A	52,321	-0.039	-0.044	-0.004		0.918	-1.09
NWC/A	83,276	-0.044	-0.040	0.004	***	0.000	0.96
ROA	93,203	-0.049	-0.036	0.013	***	0.000	3.17
ROS	62,153	-0.057	-0.050	0.007	***	0.000	1.68
ROE	91,983	-0.048	-0.037	0.010	***	0.000	2.63
EBIT/A	91,665	-0.047	-0.035	0.013	***	0.000	3.15
EBIT/S	61,340	-0.056	-0.051	0.005	***	0.000	1.24
EBIT/E	90,445	-0.047	-0.038	0.008	***	0.000	2.13
EBITDA/A	89,442	-0.048	-0.034	0.014	***	0.000	3.43
EBITDA/S	70,370	-0.053	-0.047	0.006	***	0.000	1.50
EBITDA/E	88,283	-0.048	-0.039	0.008	***	0.000	2.13
E/N	93,212	-0.045	-0.034	0.011	***	0.000	2.72
EPS	93,260	-0.046	-0.035	0.011	***	0.000	2.67
BV/MV	91,992	-0.038	-0.043	-0.006	***	0.000	-1.44
CF/A	92,787	-0.041	-0.040	0.001	***	0.001	0.28
OCF/A	92,481	-0.043	-0.038	0.005	***	0.000	1.37
ICF/A	88,900	-0.040	-0.044	-0.004	***	0.000	-0.93
CF/S	64,300	-0.054	-0.048	0.006	**	0.033	1.49
OCF/S	64,274	-0.051	-0.047	0.004	***	0.000	0.91
ICF/S	61,693	-0.049	-0.050	-0.001		0.837	-0.14
CF/E	91,581	-0.041	-0.041	0.001	**	0.041	0.15
OCF/E	91,261	-0.042	-0.039	0.003	***	0.000	0.82
ICF/E	87,765	-0.041	-0.044	-0.003	**	0.048	-0.71
ΔA	92,725	-0.046	-0.042	0.004	***	0.000	1.10
ΔS	66,497	-0.052	-0.048	0.005	***	0.000	1.19
ΔEAT	90,439	-0.044	-0.040	0.004	***	0.000	0.90

Source: Author's own
Note: statistical significance at the 1% (***), 5% (**) and 10% (*) confidence levels.

As the tables above demonstrate, not all research results of abnormal returns related to companies' characteristic features lend themselves to definitive interpretation. Therefore, the following discussion will concern only those characteristics for whose averages and medians significant and same-sign differences were observed between companies with extreme levels of the characteristics investigated.

The results for the prior returns (PR), confirm the momentum effect and favour companies with bigger historical increases. Characteristics (V), (VV) and (V/N) have in common the volume and value of share trading. However, only results related to the value of trading are significant at the levels of both the average and the median. However, an explanation of this result (a discount for companies with the greatest value of trading - contrary to what might be expected) is that in the Polish capital market the highest level of share trading is experienced by large companies, which experience a discount because of the size. It is indicated by results linked to size-related characteristics, namely (MV), (A) and (S).

Business and Economic Horizons

The next characteristics - from (E/A) to (NVC/A) - are related to asset structure, capital structure and net working capital. Unfortunately, the results are significant only for the latter two. A premium can be observed in the case of companies pursuing a conservative policy of working capital management - a premium for companies with high levels of characteristics (NWC/A), (E/A) and (LTL/A) - whereas a discount is related to a high level of current liabilities.

Return is represented by characteristics (ROA) to (EBITDA/E) and (EPS), whereas a company's rate of growth is reflected by characteristics (ΔA) to (ΔEAT). In all these cases, we can observe a premium for the most profitable companies as well as for those with the highest rate of growth.

Conclusion

The results of the event study research in the Polish capital market confirm the imperfections of the CAPM observed in developed markets. The anomalies are related to certain characteristic features of the companies. A low or a high level of these characteristics differently distorts the approximations of the pricing model used in an event study.

The greatest deviations of CAPM pricing can be observed in the case of companies with extreme levels of characteristics such as prior returns (PR), company size (MV, A, S), working capital management strategy (E/A, L/A, LTL/A, STL/A, NWC/A), and profitability and rate of growth (ROA, ROS, ROE, EBIT/A, EBIT/S, EBIT/E, EBITDA/A, EBITDA/S, EBITDA/E, EPS, ΔA, ΔS, ΔEAT). The momentum effect, the size effect, and several other less well-known effects appear to exist also in the Polish capital market. However, they do not allow for a definitive confirmation of the book-to-value or illiquidity-discount effect.

The results obtained suggest the need to seek new and to further improve existing pricing models in order to estimate risk premium with greater precision. A real challenge is to develop a pricing model which will make it possible to take into account all (or at least most of) the risk factors influencing the rates of return, and which at the same time will be resistant to pricing anomalies caused by a company's fundamental characteristics.

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