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Application of fundamental multiples in capital asset pricing.  
An empirical verification on the Polish market (1998-2004)

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# Application of fundamental multiples in capital asset pricing. An empirical verification on the Polish market (1998-2004)

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## **Abstract**

The aim of the paper is the empirical verification of fundamental multiples as capital asset pricing tools for the companies listed on Warsaw Stock Exchange. Three multiples are examined: earnings to price, operating cash flow to price and book value to equity. In the first step, the fundamental multiples are examined in terms of their ability to explain expected returns. In the second step, the company's capitalization as a size proxy is added to the set of explanatory variables. The methodology is based on Fama and French [2], with necessary adjustments. The research is carried on monthly data for 1998-2004 for companies listed on Warsaw Stock Exchange. The results do not support the proposition that fundamental multiples adequately explain expected returns. It seems that relations between firms' returns and their multiples which are well documented for Western equity markets do not hold for companies listed on Polish stock exchange.

Keywords: asset pricing, financial multiples, multiple valuation, CAPM, APT, fundamental valuation

JEL code: G12

## 1. Introduction

Increased interest in application of fundamental multiples in predicting expected returns, which is observed in the last decade, is to some extent the result of growing evidence questioning the legitimacy of popular CAPM (see e.g. [3]), the main assumption for which is the existence of efficient market<sup>1</sup>.

The aim of this study is to verify whether there is a significant association between expected returns on capital assets and their fundamental multiples as it has been proven by a number of studies on other markets [2,4,5,6]. The four variables tested by Fama and French [2] (further referred to as FF) will be also verified for the companies listed on Warsaw Stock Exchange (WSE). These are:

- Earnings per share / share price (*EP*),
- Operating cash flow per share / share price (*CF*),
- Book value / Market value (*BVMV*),
- Market capitalisation (*CAP*).

Though the last variable is not a multiple, it seems to be essential in formulating expectations about returns. It is commonly accepted as the proxy for size effect (see Banz [1]).

Despite many controversies and problems with proper use of multiples they have become a well-accepted tool in valuation analysis. Most commonly the multiples find application in formulating the investment strategies since they presumably allow to identify the over- and undervalued shares. The multiples are also frequently employed for the valuation of IPOs.

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<sup>1</sup> Unfortunately, most of efficient market assumptions are not satisfied on Polish stock exchange (Warsaw Stock Exchange: WSE). The factors limiting the effectiveness of WSE are: lack of short sales, large impact of single investors on prices as well as the information asymmetry.

## 2. The data

Due to relatively short history of capital market in Poland, its limited importance and small number of listed companies in its first years, this research was conducted for the period of 1998-2004. The study includes all companies quoted on the Warsaw Stock Exchange. Similarly to FF, all financial companies were excluded from the sample (due to because of their specific features as well as the incomparable level of financial leverage). Sample size changes over time and fluctuate from 113 to 147 companies for a year depending on availability of data and number of IPOs. If published, consolidated financial statements were used for calculating the independent variables. Otherwise unconsolidated statements were the second choice of data source.

The dependent variable is the monthly return  $R_{it}$ , calculated as:

$$R_{i,t} = \ln\left(\frac{\text{Share price}_{i,t}}{\text{Share price}_{i,t-1}}\right)$$

According to FF, there are four independent variables considered. First is the defined as the **ratio of net earnings to market price (EP)**. It is the most popular multiple on the capital market expressing price as multiplicity of net results, the price which investors are ready to pay for company's shares. A positive relation between expected return on a share and EP value is expected. *EP* is defined as follows:

$$EP_{i,t} = \frac{EPS_{i,t}}{\text{Share price}_{i,t}}$$

where *EPS* denotes earnings per share.

Second independent variable to be considered is the **ratio of cash generated from operating activities to the share price (CF)**. In theory this multiple should be much more significant for investors than the previous one, as it points out a real ability of the company to generate cash. Similarly, a positive relation between multiple and return is expected.

$$CF_{i,t} = \frac{\text{Operating cash flow per share}_{i,t}}{\text{Share price}_{i,t}}$$

Next, the dummy variables were added to models with *EP* and *CF* multiples. These variables are denoted as *DEP* and *DCF*, respectively. The dummy variables are expected to control for negative values of multiples *EP* and *CF* and are calculated according to the following formula:

$$DEP_{i,t} = \begin{cases} EP_{i,t} & \text{for } EP_{i,t} \leq 0 \\ 0 & \text{for } EP_{i,t} > 0 \end{cases}$$

$$CEP_{i,t} = \begin{cases} CF_{i,t} & \text{for } CF_{i,t} \leq 0 \\ 0 & \text{for } CF_{i,t} > 0 \end{cases}$$

The third variable is defined as **book value of equity to its market price** (*BVMV*). Higher levels of this multiple may suggest that investors do not consider a company as an attractive investment with regards to its assets efficiency. The multiple itself can be viewed as proxy for risk of a firm, hence higher returns should be expected from a company with high value of this multiple. Since only positive values of *BVMV* are used to construct observations, the variable is generated in logarithmic form:

$$BVMV_{i,t} = \ln\left(\frac{\text{book value of equity}_{i,t}}{\text{market value of equity}_{i,t}}\right)$$

Following FF methodology, the values of *EP*, *CF* and *BVMV* are calculated as the ratios of end-year value of particular fundamental variable per share (numerator of the formula) to the last price quoted in a respective year (denominator).

The last variable considered as fundamental explanatory variable for expected returns is the **capitalisation of the company** (*CAP*). This is in fact second proxy for a firm's risk. It is expected that high-capitalisation companies should be much safer and more stable, hence

investors would require lower returns than from small companies which are often in a growth phase of business (and therefore are more risky). The variable is defined as follows:

$$CAP_{i,t+6} = \ln(\text{firm capitalisation}_{i,t+6})$$

and is calculated in June next year, as compared to the other three fundamental variables.

The source of financial statements data for Polish listed companies was the financial service „Securities.com”. All share prices were downloaded from internet newspaper „Parkiet”.

### 3. Methodology

In order to verify the cross-sectional relations between expected returns on capital assets (explained variable) and the factors-multiples defined in previous section as explanatory variables the technique based on FF was applied. Each of four factor variables ( $k=1,\dots,4$ ) was used in a simple regression model which has been OLS estimated for each of sixty months available in the sample.

For a given month the sample includes all companies for which all data are available across the month. The basic model is as follows:

$$R_i = \gamma_0 + \gamma_1 FACTOR_{k,i} + e_i$$

where  $R_i$  denotes the endogenous variable which is the monthly return on stock  $i$ , and  $FACTOR_i$  represents (for the  $i$ -th firm) one of the four fundamental variables described above.

Following the FF, six-months interval between December (for which values of the first three factors are calculated) and July of next year (when the returns  $R_i$  are calculated) is applied. A half-year delay should assure that investors are fully familiar with company's financial results for the previous year. Hence, the returns for the period of July 1999 to June 2000 are regressed against the fundamental multiples for 1998. Consequently, fundamental variables of the year

2000 are used for modelling returns for July 2000 to June 2001. For the variable CAP the situation is different. Its value is calculated for the first time in June 1999 and is used as the independent variable for July 1999 – June 2000.

For each factor, the above procedure was repeated for five consecutive years

The half-year interval between fiscal year-end and the date of first observed returns might be questionable. Though there are some companies publishing their consolidated annual reports even in September following year, most investors have strongly formulated expectations already in March, after the publication of the fourth quarter results. Therefore, the study was repeated with the first returns date set for March 1999 when using fundamentals from the year 1998, remaining other parts of methodology unchanged.

As a result, sixty parameters  $\gamma_1$  for each explanatory variable were estimated and verified with respect to their significance in the regression models. According to FF approach, in consequence the estimates should be averaged for each factor variable.

In the next step, a model including all four factor variables has been attempted:

$$R_i = \gamma_0 + \sum_{k=1}^4 \gamma_{1,k} FACTOR_{i,k} + e_i$$

The OLS was applied for all estimation purposes.

#### 4. Results

Following the methodology described in previous section, 240 cross-sectional models were estimated. These were 60 monthly models for each of the four explanatory variables. They constitute what we call the **primary project**.

In the **secondary project** the same number of models have been estimated. The secondary project assumes that the returns are calculated as of March (instead of July – assuming faster information access i.e. supposedly more precise expectation).

In case of heteroskedasticity of error terms (F test at significance level of 0,1), the OLS standard error of estimation was replaced with the White’s error. Table 1 presents the number of models for which heteroskedasticity was detected.

Table 1: Number of estimated regressions with heteroskedasticity of error terms

Factor variables and the models: primary (June-July) and secondary projects (March-February)	<i>EP</i>		<i>CF</i>		<i>BVMV</i>		<i>CAP</i>	
	July-June	March-February	July-June	March-February	July-June	March-February	July-June	March-February
Number of models	16	17	11	11	10	14	17	20

Source: own estimation

\*

For **net earnings multiple** (*EP*) which was the first analysed factor both median and the average of  $\gamma_1$  are positive, which is in line with expectation. However, in 21 cases for the periods July–June and 19 cases for March–February the values of  $\gamma_1$  are negative and only every sixth model is statistically significant. The parameter  $\gamma_2$  for the dummy variable was found to be significant only in nine estimated models and (as expected) on average it was negative. Summary of findings is displayed in Table 2.

Table 3 presents the results for the **cash flow multiple** (*CF*). It can be seen that only in five cases for primary project and seven cases in secondary one, the factor *CF* was found to be statistically significant. In contrary to the previous results, the parameter  $\gamma_2$  for *DCF* variable is on average positive, however, it can not be regarded as statistically significant.

Table 2: Models with *EP*. Summary of OLS estimation results for the regression models

$$R_{i,t} = \gamma_{0,t} + \gamma_{1,t}EP_{i,t} + \gamma_{2,t}DEP_{i,t} + \varepsilon_{i,t}$$

<i>EP</i>	Returns for July–June (primary project)						Returns for March–February (secondary project)					
	$\gamma_0$	p < 0,05	$\gamma_1$	p < 0,05	$\gamma_2$	p < 0,05	$\gamma_0$	p < 0,05	$\gamma_1$	p < 0,05	$\gamma_2$	p < 0,05
Number of negative coefficients	34	25	21	0	41	7	32	22	19	0	40	7
Number of positive coefficients	26	18	39	10	19	2	28	17	41	9	20	2
Average coefficient value	-0,002		0,044		-0,037		-0,001		0,042		-0,036	
Median coefficient value	-0,011		0,027		-0,033		-0,004		0,027		-0,032	

Source: own estimation

Table 3: Models with *CF*. Summary of OLS estimation results for the regression models

$$R_{i,t} = \gamma_{0,t} + \gamma_{1,t}CF_{i,t} + \gamma_{2,t}DCF_{i,t} + \varepsilon_{i,t}$$

<i>CF</i>	Returns for July–June (primary project)						Returns for March–February (secondary project)					
	$\gamma_0$	p < 0,05	$\gamma_1$	p < 0,05	$\gamma_2$	p < 0,05	$\gamma_0$	p < 0,05	$\gamma_1$	p < 0,05	$\gamma_2$	p < 0,05
Number of negative coefficients	34	23	25	3	24	4	32	21	25	2	23	4
Number of positive coefficients	26	18	35	2	36	5	28	19	35	5	37	5
Average coefficient value	0,001		0,003		0,010		0,001		0,006		0,012	
Median coefficient value	-0,009		0,005		0,010		-0,004		0,005		0,011	

Source: own estimation

The results for the third multiple, i.e. **multiple of book to market value**, are presented in Table 4. Alike in previous models, the parameter  $\gamma_1$  was mostly insignificant. Its average value was similar in primary and secondary project, however significant difference was observed in median. Positive relation between expected return and BVMV multiple is in line with expectation. Summary is presented in table number four.

Table 4: Models with *BVMV*. Summary of OLS estimation results for the regression models

$$R_{i,t} = \gamma_{0,t} + \gamma_{1,t}BVMV_{i,t} + \varepsilon_{i,t}$$

<i>BVMV</i>	Returns for July–June (primary project)				Returns for March–February (secondary project)			
	$\gamma_0$	p < 0,05	$\gamma_1$	p < 0,05	$\gamma_0$	p < 0,05	$\gamma_1$	p < 0,05
Number of negative coefficients	33	8	23	6	32	14	21	6
Number of positive coefficients	27	11	37	13	28	15	39	12
Average coefficient value	0,000		0,0086		0,000		0,0095	
Median coefficient value	-0,014		0,0068		-0,008		0,0108	

Source: own estimation

Table 5 shows the results for the last of the fundamental variables considered in this study, i.e. the *CAP* variable. The results indicate that **size effect** measured by the value of company's capitalisation is negatively correlated with expected return. Such relation seems to be coherent with assumptions. Smaller companies may be perceived as more risky. Therefore the higher returns should be expected from smaller firms as compared to the larger, more stable firms (which usually pay out the dividend to shareholders). Other explanation for lower returns on companies with larger *CAP* value may be higher liquidity of their stocks. However, like for other three variables, the parameter  $\gamma_1$  was mostly found to be statistically insignificant.

Table 5: Models with *CAP*. Summary of OLS estimation results for the regression models

$$R_{i,t} = \gamma_{0,t} + \gamma_{1,t}CAP_{i,t} + \varepsilon_{i,t}$$

<i>CAP</i>	Returns for July–June (primary project)				Returns for March–February (secondary project)			
	$\gamma_0$	p < 0,05	$\gamma_1$	p < 0,05	$\gamma_0$	p < 0,05	$\gamma_1$	p < 0,05
Number of negative coefficients	30	12	36	11	34	15	31	11
Number of positive coefficients	30	15	24	12	26	15	29	14
Average coefficient value	0,006		-0,0005		-0,011		0,0012	
Median coefficient value	0,003		-0,0029		-0,037		-0,0006	

Source: own estimation

Summing up, none of tested variables was firmly found to be statistically significant in models explaining the returns on Warsaw Stock Exchange. Therefore, there is no use in attempting the next step of FF approach, i.e. the averaging of coefficients. Though in most cases the direction of the relation between factors and the expected returns was in line with expectation, its statistical significance remained uncertain. Low values of determination coefficients (Table 6), although common for such cross-section exercises, also indicate the inadequacy of attempted models.

Table 6: Summary of determination coefficient values for all estimated models in primary and secondary project

Number of estimated models with:	<i>EP</i>		<i>CF</i>		<i>BVMV</i>		<i>CAP</i>	
	July-June	March-February	July-June	March-February	July-June	March-February	July-June	March-February
$R^2 < 0,01$	16	23	21	15	31	29	25	27
$0,01 < R^2 < 0,05$	29	28	30	32	18	18	23	17
$0,05 < R^2 < 0,1$	9	6	6	8	9	11	7	11
$R^2 > 0,1$	6	3	3	5	2	2	5	5

Source: own estimation

Including all variables in one model does not change overall conclusion.

## 5. Summary

The results indicate that there is no definite and statistically significant correlation between tested fundamental variables and the expected returns on equities on Warsaw Stock Exchange for the period of 1998-2004. This conclusion is consistent with findings of Tarczyński and Łuniewska [10]. The following reasons may serve as the explanation of the results:

1. The most important reason is a possibility of efficient absorption of information on fundamental values in share prices. Investors' expectations about the annual financial results are becoming more and more accurate over the year (thanks to quarterly reports). Therefore the significant change in share price could be observed only around the dates of financial statements publication. On the other hand, good results shown by the companies in a given year might enhance the investors' expectations for the following years, and that may cause systematic increase of share prices.
2. All models assume linear relationship between examined factors and the expected returns. This might be the simplification, although the type of possible nonlinearity is not indicated by the theory.
3. The estimated coefficients could have different values in various sectors. Therefore, inclusion of companies from all sectors in one sample may lead to the weakening of statistical significance of models' coefficients (e.g.  $PE=15$  seems to be low for IT company, however, it is high for a chemical firm).
4. Application of  $BVMV$  multiple to the entire market might be inappropriate (unlike the two first factors, this one is not the earnings multiple).  $BVMV$  is usually applied for valuation (comparison) of capital extensive companies. It seems that in this case not only financial companies should be eliminated from the sample but IT sector as well.
5. Low values of earnings multiples  $EP$  and  $CF$  do not necessarily mean that the stocks are underpriced. Such values may reflect the risk of future cash generation, its distribution to the shareholders or ability to reinvest earnings at the required cost of capital.
6. There might be a problem in appropriate measuring of multiples. E.g. the high net result published by the company might be the effect of single extraordinary event. This may cause  $EP$  multiple to attain abnormally high value.

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