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THE EFFECT OF EXOGENOUS VARIABLES ON P/E DETERMINANTS. THE CASE OF BALKAN CAPITAL MARKETS

The many applications of P/E ratio has increased the importance of studying the determinants of the multiplier. This paper is focused on examining the effect of exogenous factors (macroeconomic variables) on the connection between P/E and its determinants. Our results show that there are significant implications if the effect of these variables is removed. Even more, there is an evidence that exogenous factors are artificially increasing the connection between P/E and the determinants.

Keywords: P/E ratio, fundamental analysis, relative valuation, macroeconomic factors.
Tabl. 8, fig. 5, lit. 22

Problem setting. In recent years, the comparative assessment has been used more widely in the investment practice because of its advantages against the traditional assessment by discounting the expected cash flows. The main advantages are associated with a smaller number of assumptions, an easy technical application and the synergy of market and fundamental information. All this allows a selection of shares to be made, without the need for subjective expectations about the future of companies. The most popular market multiplier of the comparative assessment tools is the indicator "price-earnings". It is used in many directions of the investment management – style investing, stock selection, relative valuation, etc. However, in the financial theory, there is unclearness about the range of factors that influence it. The standard grouping of factors includes the return on equity (ROE) and net margin. The problem is that typically it is not taken into account the effect of exogenous factors on both the ROE and margin and the effect of exogenous factors on the market multiplier. The aim of the paper is to investigate the stability of the connection between P/E and its determinants after eliminating the influence of exogenous factors. Thus, it is possible to trace the real influence of these determinants, which allows the investor to calculate the multiplier more accurately. The object of the empirical analysis are the Balkan capital markets. The obtained results give reasons to say that exogenous factors artificially strengthen the connection between determinants and P/E, which may confuse the investor.

The rest of the article is as follows: the first part studies the theoretical issues of the determinants of P/E; the second part develops the methodology for clearing the influence of exogenous factors from the ROE and margin; the third part describes the use of database and in the fourth part, an empirical test is carried out. The article ends with conclusions and recommendations.

Theoretical aspects of the market multiplier "Price-Earnings"

In P/E the market value per share is divided by the net profit (earning) per share for a given period. The multiplier is widely applied in the investment process where it is used as a technique for selection of undervalued or overvalued assets. Historically shares with low P/E provides a higher yield, as this dependence is the basis of stylistic investment. In terms of a separate company, the question, whether the current ratio P/E is undervalued or overvalued, is not solved. The methodology for determing the fundamental value of P/E and other market multipliers is a controversial topic. Market multipliers compare the market price of a company with a component of the financial statements, which is specific for different companies. According to Damodaran (2002) the process of comparative assessment passes through three stages:

Finding "similar comparable companies";

Finding standardised indicators for comparing the market value;

Controlling the differences between the compared companies.

The methodology of comparative assessment is intuitive and there is no significant disputes on it. But the technology for passing through the three stages is an object for some disputes. First, it must be determined the sample of companies comparable to the assets. The first option is defended by the thesis in Boatman and Baskin (1981), according to which the signs of formation of the companies in the "peer group" must be the expected levels of companies' growth. Alford (1991) first offered a general principal of using the industry as a peer group. Series of articles argue that in constructing a peer group except the principle of belonging to the industry, fundamental factors must be taken into account. The main idea for the creation of a peer group is the studied asset to be compared with others, which have a similar business model, in order the used market multipliers to be comparable.

The other major problem facing the comparative assessment is controlling the differences among the different companies in the peer group. The process of controlling aims to eliminate any influence of external factors on the results of the comparison. The first option for such analysis is when deducing the total value of market multiplier for the peer group to use moving average or harmonic average. Another option is the approach of Easton (2004), who offers modifying the multipliers used or in other words the use of deflators. The result of this study is also PEG ratio, which actually is based on P/E ratio, gives the price of expected growth. The third option, which is the most recognised of science and practise, is the use of statistical methods and techniques. It is about using of the multifactorial spatial regression between the ratios of companies and their determinants. But this decision raises another problem – what are the determinants of market multipliers? The first who connect the P/E ratio with the fundamental factors are Edwards and Bell (1961) and Beaver and Morse (1978), Peasnell (1982) does the same. A summary of the proposed determinants makes Damodaran (2002), who deduces the following determinants of the P/E ratio:

The coefficient of retention of profits;

Minimal required rate of return;

The expected growth of profits.

On a base of these determinants and seeking the fundamental value of P/E, Leibowitz (2002) develops the model of franchise value, where the main drivers of value are the return on equity (ROE) and net margin. In his model, the value of the company is divided into intangible and franchise. The intangible value is a function of company's profits and the discount percent. On the other hand, the franchise value can be defined as an addition over the intangible value and depends on two factors – a growth factor and franchise factor:

$$FV = \frac{ROE-k}{k*ROE} * \frac{g}{k-g}, \quad (1)$$

where:

ROE – return on equity; k – discount percent; g – expected growth.

Given the theory of Modigliani and Miller is accurate or the companies' value does not depend on their dividend policy, we can assume that the "retention of profits" ratio is equal to 1. Thus, the growth (g) will be a function of the profitability. The best way for measuring the company's profitability is the net margin:

$$Net\ margin = \frac{Net\ Income}{Total\ Sales}. \quad (2)$$

Eventually, the study of Leibowitz and Kogelman can be systematized as follows: the two factors that most should affect the value of P/E multiplier are the return on equity (ROE) and net margin. Subsequently these results are reproduced in a number of other studies and now these two factors are considered as key determinants of the multiplier.

The global financial and economic collapse of 2008-2010 redrew the key processes that drive the capital markets. The occurrence of concepts as Smart Beta and similar ones show the increased influence of macroeconomic factors on companies. In other words, the value of the companies is already a function of exogenous factors rather than internal drivers such as

profitability and stability. The reason for this phenomenon is the increase in the correlation among the markets in the time of crisis. Empirical evidence for this effect shows the studies of Yang, Tapon and Sun (2006), Longin and Solnik (2001) and Ball and Tourus (2000).

Thus, we should ask a question – what happens to the determinants of the P/E multiplier and how their effect is influenced by the intensifying exogenous factors? The issue is of great research significance because if the effect of determinants is compromised in any way, it can lead to wrong investment decisions by investors. The studied effect is the following: if the macroeconomic factors influence strongly enough on ROE and profit margin as well as on the observed P/E, it can be created a false impression that the two determinants influence on P/E, but in fact exogenous factors are the real driver. Therefore, the aim of this study is to develop a methodology for testing the process.

The research on the effect of exogenous variables on the determinants of P/E.

To be able to follow the process described above, it is necessary first to clear the determinants of the impact of exogenous processes before we can observe how they affect the multiplier. For this purpose, it is necessary: firstly – to determine which are the most important exogenous factors; secondly – to measure them in a spatial context and thirdly, to clear their influence on spatial determinants.

The determination of significant exogenous factors begins with the construction of a wide pool of macroeconomic variables. Subsequently, these variables are tested by means of temporal regression for any impact on the companies' profitability of the following type:

$$r_{it} = \alpha_i + \beta_i * MF_i \qquad (3)$$

where:

α_i – constant; β_i – exposure of the company i to the exogenous factor; MF_t – the value of the exogenous factor during the period t.

Then based on statistical significance of this pool, the five factors which have the widest impact on the companies of a particular market (a group of markets) are selected. The problem of measuring the impact of exogenous factors in the spatial aspect comes from the fact that most macroeconomic variables are measured for a certain period and have unique values to various companies. On the other hand, the determinants of P/E should be explored in spatial aspect because based on them, the companies are identified, and undervalued and overvalued companies are selected. The best way to present the influence of macroeconomic variables on the companies to a specific point on the timeline is through the companies' exposure to a given factor. This exposure is actually the coefficient β of the equation (3) which is strictly individual for each company at a given moment and measures the size of the influence of this exogenous factor on the profitability of the company's shares.

Once we have established the most significant factors and measured their individual influence on each company (through exposure), we should eliminate this influence on the connection between P/E and the two determinants. This is done through an additional spatial regression of ROE compared to exposures during the given period. This regression represents a multifactorial equation of the type:

$$ROE_i = \alpha + \sum_{1..5}^{k} \varphi_k * \beta_{ik} + \epsilon_i \qquad (4)$$

where:

ROE_i – return on equity of the company i; α – constant; φ_k – regression parameter of factor k; β_{ik} – exposure of company i to the exogenous factor k; ϵ_i – error of the regression model.

Actually, the ϵ_i component of the equation (4) represents that part of ROE specific to any company that is not a result of the influence of exogenous factors. In other words, the vector of ϵ_i is the ROE determinant, cleared from external factors. Thus the methodology used to clear the influence in its original form as a result is:

$$ROE' = \alpha + \epsilon_i. \qquad (5)$$

But since the technique is applied in the conditions of a spatial model, the parameter α is the same for all companies and really would not change the clean data on ROE. Therefore, we equate ROE directly to the vector of errors from the equation (4) and that is the modified determinant of ROE, which will be tested in another spatial regression. The use of ϵ_i as data for another regression has some advantages since ϵ_i has the following characteristics:

1: $\sum \epsilon_i = 0$

2: $cov_{MF_i,\epsilon_i} = 0$

3: $cov_{\epsilon_j,\epsilon_i} = 0$

Using the method of ordinary least squares (OLS), we should get exactly those features of ϵ_i. The feature 2 proves that the vector planned to use as an input really is cleared of any correlation with exposures of companies to exogenous factors. Additionally, features 1 and 2 guarantee partly that the modified variable has a normal distribution, which is a requirement for the correct application of any model. Logically, we use the same procedure for the other analysed determinant of P/E – net margin by the following equations:

$$Net\ Margin_i = \alpha + \sum_{1..5}^{k} \varphi_k * \beta_{ik} + u_i \quad (6)$$

where:

ROE_i – return on equity of the company i;

α – constant;

φ_k – regression parameter of factor k;

β_{ik} – exposure of company i to the exogenous factor k;

u_i – error of the regression model.

Following the same logic, net margin cleaned from external influence is the u_i vector. The equations (4) and (6) are multifactorial regressions and the input data must implement certain statistical requirements. The main problem with such kind of models is the multicollinearity or the requirement that input independent variables are not correlated is violated. In real economic life is too difficult to find a set of variables, which have no correlation with each other. In this case, the correlation between the vectors with exposures β_k is a very serious problem. On the one hand, expectedly companies have similar exposures to various exogenous factors because the factors themselves are correlated with each other. In addition, one of the consequences of the multicollinearity is that σ_{ϵ_i} is not calculated correctly, which is a serious problem for the procedure we offer, since it means that the distribution of ϵ_i is not real and will lead to incorrect results. Therefore, it is necessary to use the technique for clearing the correlation between the independent variables in the regression model. In this study, we use the Principal Component Analysis (PCA). Practically, the Principal Component Analysis is a statistical procedure that based on orthogonal transformations of vectors modifies correlated variables into uncorrelated vectors called principal components. For the purposes of the study, we will use the basic and most simple technology of PCA presented in Jolliffe (2002). The idea of PCA is rather intuitive and consists in fitting the data in the ellipsoid whose axes constitute the principal components. The procedure consists in "spin" of axes so that the principal components are ranked by the size of their variations and there is no correlation.

The orthogonal linear transformation actually moves the data to a new coordinate system. The calculations start by subtracting the average μ from each variable so that the vector can start from the origin of coordinate system, thus getting nxk matrix X. The original variables, now with an average of 0, are located in the columns of this matrix. The essence of the procedure consists in calculating the к-numbers of vectors W(k), which are called eigenvectors. The vectors W(k) actually are used for weighting to get the final principal components t(k):

$$t_k = W_k * X_k \quad (7)$$

The calculation of W_k is a combination of heuristic and optimization model because first the final result t_k should be sorted in descending variation or in other words t_1 must have the highest variation then t_2 and so on. In order to get this result, the main thing is to calculate eigenvectors, thus the first eigenvector W_1 must meet the following optimization equation:

$$W_1 = \arg max \ \{\| X * W \|^2\} = \arg\max\{W^T * X^T * X * w\} \quad (8)$$

whereby $\| W \| = 1$

The above equation can still be recorded as follows:

$$W_1 = \arg\max\left\{\frac{W^T * X^T * X * w}{W^T * W}\right\} \quad (9)$$

Multiplying W_1 by X_1 we get the result for the first principal t_1 component. Once, we have done the procedure for the first component, we pass to the heuristic part of the application of PCA and calculate the next k-1 components. In order to get each subsequent k-component we must deduce X_{k+1} from X_1:

$$\widehat{X_k} = X - \sum_{s=1}^{k-1} X * W_s * W_S^T \quad (10)$$

Based on this result, we should calculate the other W_k vectors, by working with matrices:

$$W_K = \arg\max\left\{\| \widehat{X_k} * W \|^2\right\} = \arg\max\left\{(W^T * \widehat{X_k}^T * \widehat{X_k} * W\right\} \quad (11)$$

Having already a complete matrix of eigenvectors W_k we can find a final set of principle components:

$$\mathrm{T} = \mathrm{W} * \mathrm{X} \quad (12)$$

where:

W – nxk matrix of calculated eigenvectors; X – nxk matrix with input variables, modified to have an average 0; T – nxk matrix with k-number of principals.

The idea to use the PCA is that the principal components T_k have absolutely no correlation to each other while the initial macroeconomic variables have a high correlation to each other, which will rather damage the results of multifactor regression for clearing the determinants from the exogenous influence. Although the logic of PCA is rather intuitive, calculations are quite heavy. Also from the statistical point of view, PCA has two major problems:

The technology is highly sensitive to scaling of data;

The orthogonal transformation always leads to data loss and it is important to find the optimal technology, which combines successfully clearing of the correlation without losing a significant part of the data.

The application of PCA is necessary evil in order to meet the requirements of the multifactorial regression model. For this purpose, mathematical peculiarities of PCA remain in the background and we apply the described methodology through econometric software R and in particular the function princomp. The most important is the final result – the principal components have been uncorrelated and to respond in a sufficiently good way to the distribution of input exogenous factors.

Once we have successfully applied the multifactorial model for clearing the exogenous influence on the determinants of P/E, we should see if there is a significant change in the influence of determinants. For this purpose, we carry out the well-known spatial regressions between P/E and values of the two determinants, through actually observed values (ROE and Net margin) and clean from exogenous influence values (ROE' and Net margin') or:

$$P/E_i = \alpha + \gamma_1 * ROE_i + \gamma_2 * NM_i + \epsilon_i \quad (13)$$

$$P/E_i = \alpha + \gamma_3 * ROE_i' + \gamma_4 * NM_i' + \epsilon_i \quad (14)$$

However, before applying the spatial regressions there are some peculiarities, which should be taken into account. In order the calculated parameters γ_1, γ_2, γ_3, γ_4 and the stochastic error ϵ_i to be objective, it is necessary the variables to meet certain requirements:

Variables involved in the regression must be stationary around their average;

There should lack autocorrelation in variables;

It is necessary the sample used to come from the normal distribution or in other words, we have a requirement for normality.

However, the equations (13) and (14) are spatial and it is not a matter of temporal series because of this the first two requirements are inapplicable. As for the requirement for the normality of data, we use the test of "Shapiro-Wilks test for normality":

$$W = \frac{\left(\sum_{i=1}^{n} a_i * x_i\right)^2}{\sum_{i=1}^{n}(x-\mu_x^s)^2} \quad (15)$$

where:

W – test statistics; x_i – observations from the sample; μ_x^s – arithmetic average of a specific sample; a_i – constant.

The constant a_i is calculated as follows:

$$\boldsymbol{a} = \frac{m^T * V^{-1}}{(m^T * V^{-1} * V^{-1} * m)^{1/2}} \quad (16)$$

where:

a – vector of constants; m – vectors with expected values of order statistics of random variables with identical and independent distribution, which are generated by the sample; V – covariance matrix of vectors m.

The test statistic W has normal distribution and can be interpreted as follows: using a 95% confidence interval if the p-value is less than 0.05, then the null hypothesis cannot be dismissed and the sample comes from the normal distribution. The test of Shapiro-Wilks is chosen because according to Razali and Wah (2011) the test has more "statistical power" of importance compared to similar tests for normality of Anderson-Darling and Kolmogorov-Smirnov. This procedure will guarantee the validity of data involved in spatial regressions. It is important to note that in equation (14) independent variables are actually residues of multifactorial regression and as such, they initially meet the necessary requirements for normality, therefore they must be tested. The main hypothesis is that there are serious differences in behaviour of coefficients γ_1 and γ_3, as well as between γ_2 and γ_4, which will be caused by the influence of exogenous factors on determinants.

Data on the connection between P/E and its determinants of the Balkan capital markets.

In order to test empirically the exogenous influence on the determinants of P/E we will apply the developed methodology to a group of emerging markets. We choose this type of markets because due to the availability of market imperfections it should be a serious problem with the influence of exogenous factors. The selected group of countries that will be the object of research includes the Balkan capital markets and in particular – Slovenia, Slovakia, Romania, Bulgaria and Croatia. The period of study includes years after the global financial and economic crisis 2012-2015 because if we include the earlier period, the existence of the crisis will have an uncontrolled influence on the results. This means that we have four independent spatial regressions about the impact of ROE and Net margin on P/E respectively for each year of the period. Temporal regressions used to determine which are the significant exogenous factors are based on weekly observations about profitability in a current year. To make a sample, the companies must meet some requirements: 1) to have some fundamental indicators which allow calculation of P/E for the period; 2) available market prices for the period; 3) observations in which P/E is a negative value are eliminated. We impose these restrictions to get a model that is as close as possible to the reality and the applied econometric models are not distorted by unrealistic values.

Next, we should construct the used exogenous factors. After we pre-specified the frequency of temporal regressions on a weekly basis, at some extent we limit the type of used factors to macroeconomic variables that are monitored on a weekly basis. Although this is a quite large limitation, there is a logical connection, when it comes to capital markets as they are strongly dynamised and macroeconomic factors measured of great frequency hardly have

a strong influence. Table 1 shows the methodology used to construct the factors and rationale their application.

Table 1

Financial and macroeconomic factors

№	Tested exogenous factors	Source/Constructing	Justification
1.	Weighted CDS spread	The difference between the levels of CDS of five-year government bonds of each country and a certain developed market (Germany). Weighted by GDP for the year.	It measures the risk attitudes of investors.
2.	Weighted HICP	Weighted levels of inflation by GDP of the studied countries.	It measures the inflations in studied markets.
3.	Weighted GV Bonds Yield	Yield on 10-year government bonds of studied countries weighted by their GDP.	It measures state solvency.
4.	Oil price	Brent crude oil price index	Oil as a key economic barometer.
5.	Gold	-	Gold is a reserve resource and measures "escaping" from the capital markets.
6.	Natural Gas, Gasoline	-	They represent major energy resources.
7.	1Y Euribor, 1M Euribor, Overnight Libor	-	They represent the movement of leading base interest rates.
8.	EUR/USD, EUR/RUB, EUR/JPY, EUR/CNY, EUR/IDR	Forex Spot rate	The connection of the base currency in Europe with currencies of other leading economies.
9.	MSCI World	-	It measures the performance of the global capital market.

All required figures are supplied by the global economic database S&P Capital IQ. Additionally for some time series used to construct exogenous factors, Eurostat is applied. After the application of restricted criteria for participation in the sample, we get the following number of companies per year (spatial regressions): 2012 – 75 companies, 2013 – 90 companies, 2014 – 90 companies, 2015 – 63 companies. Although the sample seems small, it should not be forgotten that the stock exchanges are relatively small and the resulting number of companies is sufficient to get reliable statistical conclusions.

An empirical testing of the exogenous factors' influence on the determinants of P/E

Using the obtained data, it should be tested the process of influence of exogenous factors on the connection between P/E and its two determinants. It is necessary to repeat our hypothesis that if we remove the influence of exogenous factors, it will be observed different behaviour of the connection among ROE, Net margin and P/E of the companies.

First, the application of temporal regression must determine which macroeconomic variables are significant for the companies of the leading Balkan stock exchange markets. Table (2) shows the statistics on the number of regressions (in years) where p-value indicator is lower than 0.05 limit and in other words, the factor has a significant influence on the company concerned.

Table 2

Tests for significance of exogenous factors

Year	2012		2013		2014		2015	
1	2	3	4	5	6	7	8	9
Factor	N	% of all companies	N	% of all companies	N	% of all companies	N	% of all companies
Weighted CDS Spread	72	96.00%	88	97.78%	68	75.56%	19	30.16%
Weighted HICP	8	10.67%	21	23.33%	34	37.78%	15	23.81%
Weighted GV Bond Yield	68	90.67%	55	61.11%	45	50.00%	16	25.40%

Continued Table 2

1	2	3	4	5	6	7	8	9
Oil	16	21.33%	11	12.22%	37	41.11%	12	19.05%
Gold	27	36.00%	19	21.11%	33	36.67%	17	26.98%
Natural Gas	18	24.00%	20	22.22%	17	18.89%	8	12.70%
Gasoline	14	18.67%	19	21.11%	49	54.44%	15	23.81%
1Y Euribor	14	18.67%	51	56.67%	51	56.67%	16	25.40%
1M Euribor	8	10.67%	49	54.44%	51	56.67%	23	36.51%
Overnight Libor	23	30.67%	68	75.56%	44	48.89%	19	30.16%
EUR/USD	13	17.33%	53	58.89%	71	78.89%	23	36.51%
EUR/RUB	16	21.33%	10	11.11%	47	52.22%	13	20.63%
EUR/JPY	52	69.33%	84	93.33%	61	67.78%	29	46.03%
EUR/CNY	18	24.00%	71	78.89%	65	72.22%	23	36.51%
EUR/IDR	19	25.33%	51	56.67%	50	55.56%	14	22.22%
MSCI World	56	74.67%	85	94.44%	72	80.00%	13	20.63%

Based on table (1) we choose six most influencing factors for each year. Although there are some imperfections, this method allows us to get a good general idea about the influence of exogenous factors. From temporal regressions we actually take also β coefficients or so-called exposures which show the spatial influence of macroeconomic variables on the company.

Next step is actually applying of the multifactorial model of equations (4) and (6) to study the impact of these exposures on the two determinants, but before that it is necessary to deal with multicollinearity. For instance, in 2015 the correlation matrix for exposures appears in the following way (table 3).

Table 3

The correlation matrix of exogenous factors in 2015

	Weighted CDS Spread	Gasoline	1M Euribor	EUR/USD	EUR/JPY	MSCI World
Weighted CDS Spread	1.0000					
Gasoline	-0.1084	1.0000				
1M Euribor	0.0030	0.3158	1.0000			
EUR/USD	-0.1899	0.0275	-0.2869	1.0000		
EUR/JPY	-0.2967	-0.0927	-0.0986	0.7975	1.0000	
MSCI World	-0.2985	0.1273	0.2598	-0.4860	-0.5073	1.0000

Obviously, the existence of such high correlation coefficients is a major problem for the implementation of any multifactorial regression model and as we mentioned above the errors ϵ_i will not be calculated correctly. Although in some cases this problem may remain insignificant, in this case ϵ_i is the result that is sought and we cannot assume to have doubts about incorrect calculations. The other correlation matrices for 2012-2014 are shown in table 4.

Table 4

Correlation matrices for 2012-2014

	Weighted CDS Spread	Weighted GV Bond Yield	Gold	EUR/RUB	EUR/JPY	MSCI World
1	2	3	4	5	6	7
Weighted CDS Spread	1.0000					
Weighted GV Bond Yield	0.7056	1.0000				
Gold	0.5762	0.4542	1.0000			
EUR/RUB	0.0890	0.3335	0.4451	1.0000		
EUR/JPY	0.8792	0.5865	0.5390	0.2739	1.0000	
MSCI World	-0.9005	-0.6841	-.6556	-0.3628	-0.8754	1.0000
Weighted CDS Spread	1.0000					
Weighted GV Bond Yield	0.7099	1.0000				

Continued Table. 4

1	2	3	4	5	6	7
Gold	-0.1514	0.0346	1.0000			
EUR/USD	0.1189	0.3373	0.4933	1.0000		
EUR/JPY	0.4011	0.6449	0.4288	0.8460	1.0000	
MSCI World	-0.7263	-0.4579	-.0865	-0.4428	-0.6071	1.0000
Weighted CDS Spread	1.0000					
Weighted GV Bond Yield	0.6242	1.0000				
Gasoline	-0.0975	-0.3082	1.0000			
EUR/USD	0.3949	0.2669	0.1342	1.0000		
EUR/CNY	0.3488	0.3037	0.1176	0.9798	1.0000	
MSCI World	-0.6463	-0.3556	-0.0070	-0.7851	-0.7382	1.0000

Therefore, we apply the above described base version of Principal Components Analysis. By means of the R-software we make orthogonal transformation of vectors. Subsequently, the obtained principal components are ranked by degree of variance. For 2015 they are as follows (figure 1):

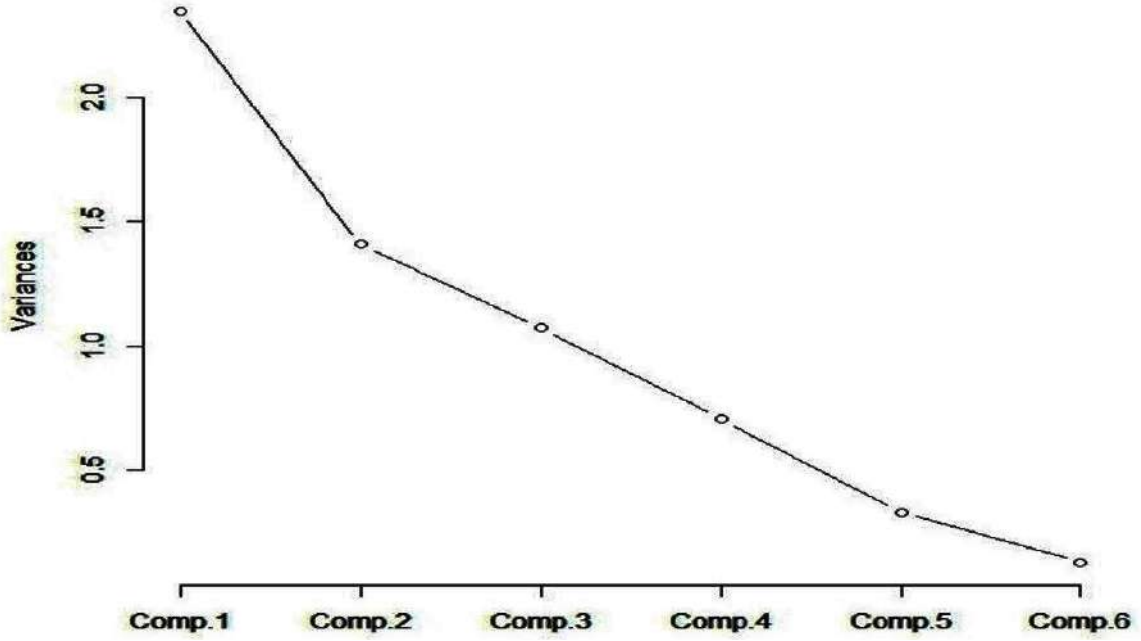

Fig. 1. Ranking of principal components on variances for 2015

Exactly these will be the components, which we will use as independent variables in the multifactorial regression because they are products of the corresponding significant exogenous factors. These principal components have two important properties: the first is that they are orthogonal to each other and the second is that they are not correlated. The result of orthogonal transformation for the other years is in fig. 2,3. As an evidence for the lack of correlation we again construct the correlation matrix for 2015 (table 5).

Table 5

Correlation matrix of principal components for 2015.

	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6
Comp1	1.0000					
Comp2	0.0000	1.0000				
Comp3	0.0000	0.0000	1.0000			
Comp4	0.0000	0.0000	0.0000	1.0000		
Comp5	0.0000	0.0000	0.0000	0.0000	1.0000	
Comp6	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000

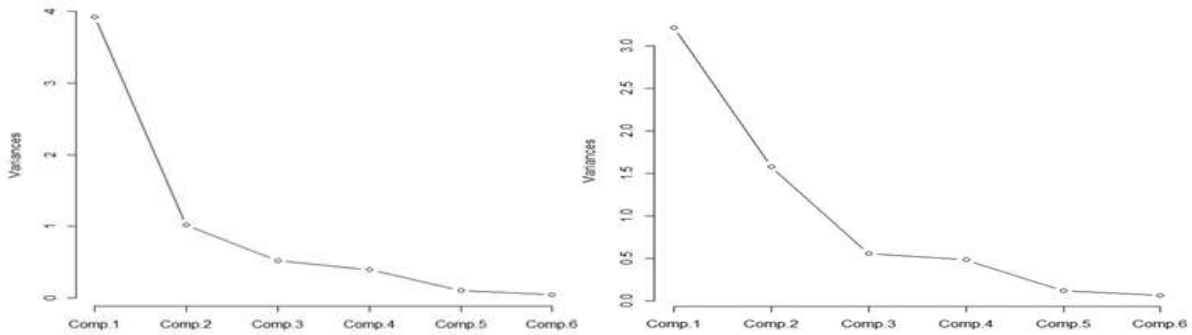

Fig. 2. Ranking of principal components on variances for 2012 (left) and 2013-14

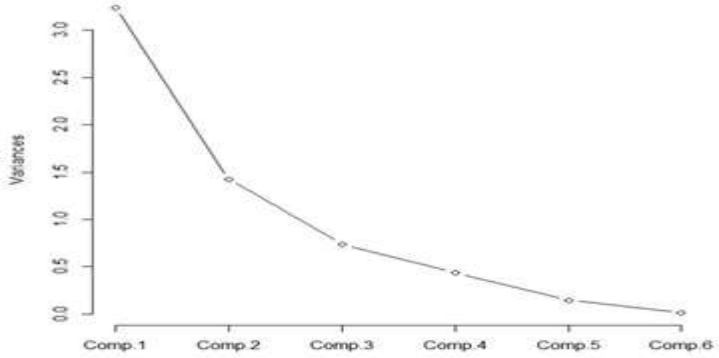

Fig. 3. Ranking of principal components on variances for 2015

Obviously, the technology successfully clears the correlation, reducing it to zero. Of course, as we mentioned before, this is the price of losing certain amount of information, but for the purpose of this study, it is not necessary to enter into the depths of mathematics. As we mentioned the use of PCA model does not give satisfactory results. The correlation matrices of principal components for previous years of the study are shown in table 6.

Table 6

Correlation matrices of principal components 2012-2014

2012	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6
Comp1	1.00					
Comp2	(0.00)	1.00				
Comp3	0.00	(0.00)	1.00			
Comp4	(0.00)	0.00	(0.00)	1.00		
Comp5	(0.00)	0.00	0.00	(0.00)	1.00	
Comp6	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	1.00
2013	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6
Comp1	1.00					
Comp2	0.00	1.00				
Comp3	0.00	0.00	1.00			
Comp4	(0.00)	(0.00)	0.00	1.00		
Comp5	(0.00)	0.00	0.00	0.00	1.00	
Comp6	0.00	0.00	(0.00)	0.00	(0.00)	1.00
2014	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6
Comp1	1.00					
Comp2	0.00	1.00				
Comp3	(0.00)	0.00	1.00			
Comp4	(0.00)	(0.00)	0.00	1.00		
Comp5	(0.00)	0.00	0.00	(0.00)	1.00	
Comp6	0.00	0.00	(0.00)	0.00	0.00	1.00

Once we have successfully prepared the data to meet the requirements of the multifactorial regression we should apply the described multifactorial model for clearing the

influence of exogenous factors on the determinants of P/E. Subsequently, the application of spatial regressions for the effect on P/E is implemented. For modelling P/E, we must do some transformations in order to adapt the data to meet the necessary requirements for the regression analysis. Therefore, for each year, the companies are descending ranked and this rank is normalised to an average zero and standard deviation one. However, we apply the test of Shapiro-Wilks for the normality of data.

Table 7

Results of the test of Shapiro-Wilks for normality

	W	p-value
P/E 2015	0.96	0.03
P/E 2014	0.96	0.01
P/E 2013	0.97	0.02
P/E 2012	0.95	0.00
Net margin 2015	0.83	0.00
Net margin 2014	0.10	0.00
Net margin 2013	0.09	0.00
Net margin 2012	0.72	0.00
ROE 2015	0.89	0.00
ROE 2014	0.43	0.00
ROE 2013	0.93	0.00
ROE 2012	0.93	0.00

Table (7) shows that in any case the hypothesis for normality of data is confirmed at 95% confidence interval. This means that all tested variables can be used in the spatial regression analysis. On the other hand, it validates the regressions done which aims to clear the exogenous influence and on the other hand, it allows to do testing for the effect of this influence on the connection between P/E and its determinants. The effect will be analysed after comparing the results of spatial regressions between P/E and the observed ROE and Net margin (called Normal regressions) and between P/E and their cleared forms (called Augmented regressions).

Table 8

Results of spatial regressions between P/E and determinants

Year	Determinants	Normal regression		Augmented regression	
		t-stat	Residuals variance	t-stat	Residuals variance
2012	ROE	6.26	0.766	5.65	0.7854
	Net Margin	1.21		1.21	
2013	ROE	8.03	0.7536	6.49	0.8086
	Net Margin	-3.98		-2.52	
2014	ROE	1.98	0.9727	1.48	0.9934
	Net Margin	-2.17		-0.07	
2015	ROE	2.98	0.9441	2.57	0.9632
	Net Margin	0.13		-0.03	

The results follow an interesting connection (table 8). In each spatial regression, we can observe deterioration of results after the removed influence of exogenous factors. This is evident primarily by the increase in residuals variance and systematically reducing of t-stat.

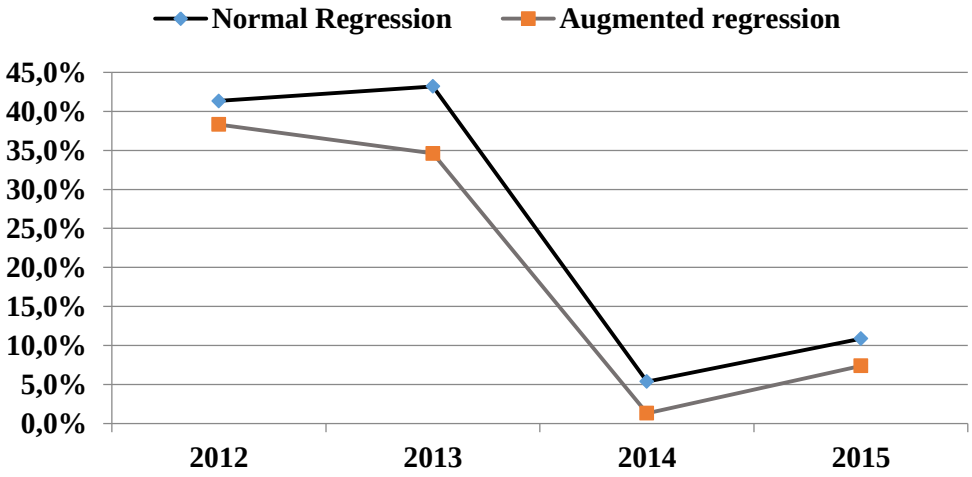

Fig. 4. R2 of the individual spatial regressions during the period 2012-2015

Although p-value gives more interpretable results for the statistical significance, we use t-stat because it most visibly combines the magnitude of coefficient β and its risk (standard error). Another important result is that the net margin stops to be significant determinant of P/E after 2013. The reduction of statistical properties of determinants after removing the external noise is visible on the graph (figure 4) of the coefficient of determination. Although in one or another reason it can be observed a general decline in the coefficient of determination, we can see clearly the decline of the coefficient at augmented regressions. This decline demonstrates that when we remove the influence of exogenous factors, we get very different results. In addition, it turns out that this influence "pumps" the connection between P/E and determinants because influencing on both it creates an artificial connection. Going into more details on the variation of P/E, we can examine the change of the variation percent of the two determinants by using the method of Pratt (figure 5).

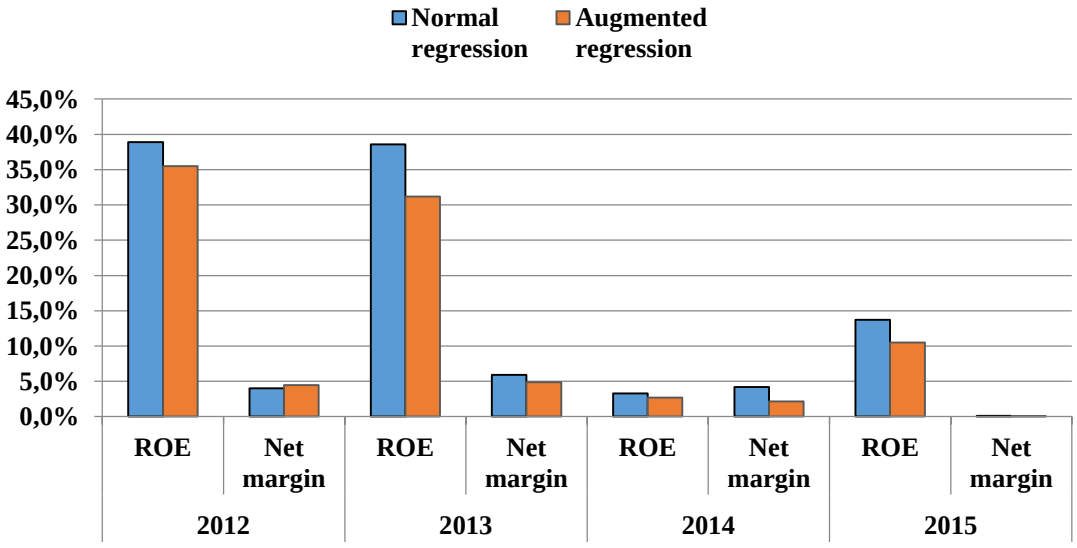

Fig. 5. The Percent of explained variation in P/E of determinants in the individual spatial regressions during the period 2012-2015

It can be clearly noted that in all cases ROE explains lower percent of the P/E variation after the removing exogenous influence. As for the Net margin, the results are mixed. This means that ROE is strongly correlated and is influenced by exogenous factors since the Net margin tolerates higher level of independence. In this case, we have chosen the method of Pratt because it uses the basic model for dividing which factor what percentage explains from the variance of the dependent variable. After applying the empirical data, we can confirm the hypothesis that exogenous factors influenced strongly on the connection between P/E and its determinants. In this case, we see particularly high artificial strengthening the connection between P/E and the market multiplier. The same process is also observed in Net margin but in a lower extent. The valuable of the empirical part is that investors must be careful when they use ROE and Net margin in calculating of the fundamental P/E multiplier of the company because there is a great possibility to be misled if they do not take into account the external macroeconomic environment.

Conclusions.In theoretical aspect, the focus of the study is on the determinants of P/E coefficient as a key indicator for assessing the companies by investors, incl. Hedge funds and especially in establishing the cases of undervalued and overvalued companies. In a narrow sense, the fundamental financial analysis examines the P/E coefficient of the positions of endogenous factors, where the influence of the financial management is particularly strong on the denominator of the coefficient. In a broad sense, the financial analysis allows to examine and establish the influence of the intensifying exogenous factors on the P/E coefficient and especially on its nominator. Macroeconomic developments and indicators of the country where the respective capital market operates are reflected on the nominator of the P/E coefficient. Therefore, measuring the strength of the influence of exogenous factors on the P/E coefficient requires justification of the target methodology for testing the factor influence. Taken in complex, the nominator and denominator of the P/E coefficient are factor modeled by ROE for the nominator and Net margin for the denominator.

Empirically, the study is focused on the capital markets of Slovenia, Slovakia, Romania, Bulgaria and Croatia that are European Union members respectively: the first and second countries are from the wave of enlargement in 2004, the third and fourth ones are members from 2007 and the last one is a member from 2013. The study is for the period 2012-2015 and includes 318 unique corporate observations with audited reported data under the international accounting standards. The studied companies in the sample vary from the highest number of 90 in 2013 and 2014 and the lowest number of 63 companies in 2015.

The results of the developed methodology and subsequent empirical analysis allow confirming that in the current dimensions of financial markets the growing influence of exogenous (macroeconomic) factors change the dependence between the fundamental variables. After clearing the effect of exogenous variables on the determinants (ROE and Net margin), their influence on P/E actually weakens. The reason for this can be determined the high correlation of exogenous factors with the two determinants and with the P/E coefficient. The comparison between the two main tested indicators clearly shows that for the five stock exchanges ROE is qualified as highly correlated and susceptible to the influence of exogenous factors. The Net margin has a higher level of independence. The main recommendation for investors operating on the studied markets as well as globally is not to neglect the influence of exogenous factors on the applied financial models for measuring, modeling and forecasting of the market capitalization of companies trade on the stock exchange.

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