RISK ATTRIBUTION – A MODEL FOR ESTABLISHING THE IMPACT OF GLOBAL RISK FACTORS[1]

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Abstract: The global recession that started in the twenty-first century forced investors to invent or re-discover a paradigm for risk treatment. The solution lies in the risk attribution of historical stock return of listed companies in relation to global macroeconomic factors, its decomposition and research in terms of risk exposure and risk premia. The consistency of this approach enables investors to act as risk managers and macro analysts of equity markets and to predict potential sources of risk for companies, the stock exchange, the economy, and the globalizing world.

Key words: global risk factors; factor risk premium; factors rank.
JEL: C32, C58, G32

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The **aim** of this paper is to identify global risk factors that affect the yield of companies quoted on newly emerging European equity markets. Hence, the **subject** of the treatise is defining a model that could be employed to achieve this, which is the risk attribution model. The **object** of this research paper is to specify an investment universe comprising all companies quoted on newly emerging European equity markets and to examine their daily returns.

The **thesis** advanced by the author is that there are specific global risk factors whose impact upon return volatility investors should take into account

[1] The paper is based on the research 'Shte se prevarne li aktivniat portfeilen menidzhmant v panatseya za postkrizisnia kapitalov svyat'[In English: Could Active Portfolio Management become a panacea for the post-crisis Financial World?], which was awarded the second prize in the Fourth Academic Contest 'PhD Ivanka Petkova' for research papers in the sphere of international finance held by the Economic Policy Institute in 2015 and has not so far been published in a peer-reviewed scientific journal.

when designing a more adequate model to predict stock returns. In order to support that thesis, the paper accomplishes a number of **objectives**, such as designing an investment universe comprising all companies that are subject to this research, drawing up a list of any potentially influencing factors, testing those factors in terms of the investment universe by applying the model of risk attribution, identifying the complex rank of all factors by taking into consideration their aggregate value, explanatory power, and interfactor correlation, ranking those factors; quantifying the impact of all identified factors by applying the model of stock return decomposition, analyzing them and then arriving at conclusions based on the findings of this research. The paper assumes that those findings (and the theoretical conclusions based on them, in particular) are applicable to practice. In fact, this is only possible when the set of methods employed are précised to meet the demand of business practice.

1. References Overview

According to Zahariev (2015)[2], the activity of a successful investor is based on the analysis of assets that is a necessary pre-condition for any investment process. Prodanov (2013)[3] points out that this is a process of investing capital and obtaining sufficient yield to cover the sum invested and expected stock returns. To these, Patev (2015)[4] adds the requirement that the disadvantages of the process be removed so that it could be transformed into a financial decision. Some of these disadvantages refer to the simultaneous existence of an investment risk and uncertainty as to the form in which it will materialize – Brusarksi, Zahariev, and Manliev (2015)[5] and the international dimensions of the impact of global economy – Radkov and Zahariev (2015)[6].

Several authors suggest solutions for overcoming these disadvantages. Simeonov (2015)[7], for example, recommends that a specific strategy be employed which should combine selected assets, investment motive, and rational expectations about the future; Radkov and Zahariev (2015) recommend taking into account global impact when constructing an investment portfolio; Patev

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[2] **Zahariev.** Andrey i dr. Finansov analiz. Svishtov, AI Tsenov, 2015.

[3] **Prodanov.** Stoyan i dr. Investitsii. 6. izd., Svishtov, AI Tsenov, 2013.

[4] **Patev**, Plamen. Upravlenie na portfeila. 3. izd. V. Tarnovo, ABAGAR, 2015.

[5] **Brusarski,** R., Zahariev, A., Manliev, G. Finansova teoriya. V. Tarnovo, Faber, 2015.

[6] **Radkov,** R., Zahariev, A. Mezhdunarodni finansi. V. Tarnovo, ABAGAR, 2015, 276 s.

[7] **Simeonov,** Stefan. Finansovi derivati. Ruse, AVANGARD PRINT, 2015. 190 s.

(2014)[8] suggests that successful portfolio management requires combining specific assets.

The theoretical foundations of modern portfolio theory equip us with definitions of those concepts. Markowitz (1952)[9] defines the investment process as a process of constructing a portfolio with an optimum risk-reward ratio that takes into consideration investors' risk profiles, as well as the two risk sources – systematic and unsystematic. Four scientists, Tobin (1958)[10], Sharpe (1964)[11], Lintner (1965)[12][13] and Mossin (1966)[14], formulated independently the Capital Asset Pricing Model (CAPM), according to which the price of an asset is proportionate to its systematic and market risk.

Ross (1976)[15] developed further the single-factor model in the Arbitrage Pricing Theory (APT), which introduced the impact of multiple factors. The theory identified a relationship between assets return and various macroeconomic factors, such as inflation (consumer price index), sudden changes in the interest rate curve, etc. With his criticism to the Capital asset pricing model, Roll (1977)[16], supported the multi-factor models and proved that the market alone cannot provide a description of real economy.

Other authors developed further the research works of Ross (1976) and Roll (1977) and examined a variety of factors such as: the size of companies - Banz (1981)[17] and Reinganum (1983)[18]; global macroeconomic factors -

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[8] **Patev**, Plamen. Mezhdunaroden finansov menidzhmant. - Svishtov, AI Tsenov, 2014. 203 s.

[9] **Markowitz**, Harry. Portfolio Selection / H. Markowitz // *The Journal of Finance*. – 1952, N 7 (1) p. 77-91.

[10] **Tobin**, James. Liquidity Preference as Behavior towards Risk / James Tobin // *The Review of Economic Studies* – 1958, N 67 p. 65-86.

[11] **Sharpe**, William F. Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk / William F. Sharpe // *The Journal of Finance*. – 1964, N 19 (3) p. 425-442.

[12] **Lintner**, John V. The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets / John V. Lintner // *The Review of Economics and Statistics* – 1965, N4 (7) p. 13-37.

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[15] **Ross**, Stephen A. The Arbitrage Theory of Capital Asset Pricing / Stephen A. Ross // *The Journal of Economic Study* – 1976, N34 (4), p. 341-360.

[16] **Roll**, Richard. A critique of the Asset Pricing Theory's Tests Part I; On Past and Potential Testability of the Theory / Richard Roll // *The Journal of Financial Economics* – 1977, N4 (2), p. 129-176.

[17] **Banz**, Rolf W. The Relationship between Return and Market Value of Common Stock / Rolf W. Banz // *The Journal of Financial Economics* – 1981, N9 (3), p. 3-18.

[18] **Reinganum**, Marc R. The Anomalous Stock Market Behavior of Small Firms in January / Marc R. Reinganum // *The Journal of Financial Economics* – 1983, N12 (6), p. 89-104.

Solnik (1983)[19]; the three factors – market, size, and ratio between the market value and the book value of companies - Fama and French (1993)[20]; the type of industry which companies belong to – Asness, Porter, and Stevens (2000)[21]; the class of the assets and the style and strategy of assets investment – Bender, Briand, Nielsen, and Stefek (2010)[22].

Other scientists followed an alternative path and quantified the impact of factors by formulating factor exposure, factor premium, and an independent residual component of returns. Litterman (1996)[23] did the same by employing his model of risk decomposition. Oxelheim (2003)[24] designed a model for determining macroeconomic uncertainty (MUST), which made it possible to eliminate return volatility resulting from the impact of macroeconomic factors. Montagu (2013)[25] limited risk decomposition to the Global Risk Attribution Model (GRAM) which quantifies the impact of factors not through their exposure but through the factor premium.

2. Database Researched

One of the objectives set in this research paper is to define an investment universe comprising the stocks of all companies quoted on newly emerging equity markets. We believe that financial companies should be excluded from that entity since they are governed by a special legal framework that renders them subject to a different type of analysis, i.e. bank analysis. We have also excluded companies that would make difficult or impossible statistical calculations due to the fragmentary, incomplete or unstable nature of their time series.

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[19] **Solnik**, Bruno. The Relation between Stock Prices and Inflationary Expectations: The International Evidence / Bruno Solnik // *The Journal of Finance* – 1983, N38 (1), p. 35-48.

[20] **Fama**, Eugene et al. Common risk factors in the returns on stocks and bonds / Eugene Fama, Kenneth French // *The Journal of Financial Economics* – 1993, N33, p. 3-56.

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[22] **Bender**, Jennifer et al. Portfolio of Risk Premia: A new Approach to Diversification / Jeniffer Bender, Remy Briand, Frank Nielsen, Dan Stefek. // *The Journal of Portfolio Management* – 2010, N36 (2), p. 17-25.

[23] **Litterman**, Robert. Hot Spots and Hedges / Robert Litterman // *The Journal of Portfolio Management* – 1966, Special Issue (12), p. 52-75.

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[25] **Montagu**, Chris. Citi Global Risk Attribute Model (GRAM) Version 2.0 / Chris Montagu // *Quantitative Analysis (Citi) North America* – 2013.

The subject of this research is the return of these companies, calculated on a daily basis by applying a natural logarithm between their closing price on day t-1 and their closing price on day t. This research covers the period from January 2004 to December 2014, so returns have been calculated for that time span, too. This, in turn, specifies the maximum possible length of the time series to 2,870 observations, which is the number of workdays during the period that is subject to research.

The second objective is to identify a sample of factors that may potentially influence the investment universe. Those factors may be grouped as follows:

Measurable macro factors – these are global macroeconomic factors and indexes whose influence has been repeatedly quoted, tested, and proved in various scientific works. The group includes the following factors: annual Libor (further indicated as 1Y Libor); monthly Libor (1M Libor); annual to monthly Libor spread (1Y-1M Libor); annual Euribor (1Y Euribor); monthly Euribor (1M Euribor); annual to monthly Euribor spread (1Y-1M Euribor); four- week treasury bill return (4W T-bill); fifty-two –week treasury bill return (52W T-bill); the spread between both returns (52W-4W T-bill); crude oil price return Brent in Europe (Oil); returns on the indexes MSCI US REIT, S&P 500, NASDAQ, FTSE 100, DJIA and S&P VIX, as well as differences in USD/GBP, USD/JPY, USD/CHF and USD/CN exchange rates.

Calculated macro factors – those are the averaged values of national macroeconomic factors and indicators. The selection of economies whose national macroeconomic factors and indicators will be averaged is based on two requirements – the highest GDP and total sum of GDP exceeding 60 % of global GDP. This renders the national economies of those countries a driving force of global economy therefore their national macroeconomic factors and indexes are representative of global economy. During the period researched in this paper, those were the USA, China, Japan, Germany, France, the UK, Brazil, Italy, Russia, and Indonesia.

The weights used to weigh the national macroeconomic factors and indexes are current[26] GDPs transformed into international dollars. In order to avoid a situation in which a single economy would receive a high relative share due to its extremely high GDP, those weights are examined for extreme values larger than three standard deviations from the average weight. All ex-

[26] There is a common misconception how to weigh values which change over time. Thus if weights are calculated based on values which are static over time, their weights will remain static as well. If, however, dynamic values are used to calculate weights, it would be logical for them to result in dynamic weights. This is all important when the values used to weigh time series are derived from other time series. Therefore a better approach would be to use dynamic weights which, similar to weighted values, change over time as well.

treme values are adjusted by applying Winsorization[27] to reduce their values to three standard deviations from the average one. Since the sum of the weights should equal 100%, the difference between the primary and the Winsorized weight of all extreme values is distributed proportionately among the rest of the weights.

Factors whose values are averaged include: ten-year government bonds return (10YGBR); change in the gross domestic product (ΔGDP); detrended change in gross domestic product (ΔGDP DTR); unemployment rate (UNEMP); export change (ΔEXP); import change (ΔIMP); balance of trade change (ΔTrB); consumer price index (CPI) and consumer price index year-over-year (CPI YoY), i.e. nine factors in total.

Global market factors – these are specific market relationships whose impact on return has been proved more than once.[28] The factors which we have included in this research are the Growth/Value spread (GVSpr) whose calculation is based on the indexes S&P Global BMI Growth and S&P Global BMI Value; and the Large/Small spread (LSSpr) which is measured by using the STOXX Global 3000 Large and Small indexes.

- **Global industry factors** – these represent the global premia which companies in different industries obtain in terms of the global equity market. Those factors are measured by calculating indexes constructed under the following principle:
- Calculate the average daily return of all[29] companies in the global investment universe;
- Calculate the average daily return of all companies in the global investment universe which belong to each of the nine[30] industries;
- Calculate the spreads between average daily return in the nine industries and the average daily return of all companies in the global investment universe.

The local market factor represents the main market index return on the stock exchange in the country for which that factor has been identified.

In order to test empirically different factors, the latter should be comparable both in terms of the unit that will be used to measure them and in

[27] From the English 'Winsorization', the process of statistical transformation of extreme values for the purpose of reducing possible spurious outliners, named after Charles P. Winsor.

[28] **Banz** (1981), Reinganum (1983), Fama & French (1993), Asness, Porter & Stevens (2000), etc.

[29] Depending on companies which open or close their public status or trading on a stock exchange, the structure of each average return changes every months, yet does not pose a problem, as averaging reduces the influence of a single company to a marginal one.

[30] After the GICS classification, excluding financial industry companies.

terms of the basis on which they will be quantified. Measurement units may be made comparable by reducing the values of factors to their first differences while at the same time applying a natural logarithm between the values of factors on day t-1 and their values on day t. For measurable macro factors, global market factors, industrial and local market factors this is irrelevant, since they are measured daily on a constant base.

The situation is different with calculated macro-factors, though. Due to their nature, many of them are not measured continuously, but on a monthly, quarterly, or annual basis. In order to be comparable they need to be interpolated until their approximate daily values are calculated. This would lead to the gross assumption that interpolated daily values are representative for a factor that is measured on a non-continuous basis. From the perspective of mathematics, an interpolated daily value may be approximated by dividing the monthly value by the number of days in a month. From the perspective of econometrics, this would be wrong since approximated daily values do not follow the trend of monthly values.

It is possible to employ a polynomial equation of higher degree, yet this approach has a major disadvantage – approximate values are calculated by applying the method of the least squares, which minimizes the total deviation of the squares of approximated values from values themselves. It would be more appropriate to use the so-called spline interpolation which limits MLS to fixing the trend to certain points which in this case are their monthly values. The trend thus established follows monthly observations accurately, which renders their aggregate deviation equal to zero. By combining mathematical division of monthly values and spline interpolation, daily observations may strictly follow the trend of monthly observations, while their sums for a month would match strictly the monthly observation. As a result, the daily values of calculated macro-factors are interpolated, which ensures comparability of company returns and the other groups of factors.

3. Set of Methods Employed

Now that we have defined the investment universe and identified potentially influencing factors, this paper will specify a model that will be employed to accomplish another objective, that is, to test different factors through risk attribution. In order to do so, we need to apply a single-factor regression of the return on a given stock in terms of a specific factor. It is not the regression coefficients that we will be pursuing as a result of this regression, but the determination coefficient and the statistical significance index, the p-value of the regression beta coefficient. The regression is repeated for each pair of assets and factors.

We calculate the average weighted determination coefficient for each factor which measures the total explanatory power of the factor with the formula:

(1) $$\overline{R_F^2} = \frac{\sum_{i=1}^{N}(w_{i,F} * R_{i,F}^2)}{N} = \frac{\sum_{i=1}^{N}\left(\frac{1}{\sqrt[k]{L_{max} - L_i + 1}} * R_{i,F}^2\right)}{N},$$

where:

$\overline{R_F^2}$. is the weighted average determination coefficient of factor F;

$R_{i,F}^2$ is the coefficient of the determination return of company i over factor F;

N is the number of assets included in the investment universe;

L_i is the number of observations in the return time series of company i;

L_{max} is the maximum possible number of observations in the return time series of company i;

$w_{i,k}$ is the weight[31] of the coefficient of return determination for company i in terms of global macro-factor F;

k is a coefficient[32] employed to adjust the weight of the determination coefficient over the length of the times series.

We then measure the proportion of significant p-values of beta coefficients in the investment universe for each factor by employing the formula:

(2) $$P_F = \frac{pv_{\beta_{i,F}}}{N},$$

where:

P_F is the number of significant p-values of beta coefficients in the investment universe in terms of factor F;

$pv_{\beta_{i,F}}$ is the p-value of asset i in terms of factor F;

N is the number of assets in the investment universe.

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[31] The necessity to weigh the individual determination coefficients of the return for each company arises from the fact that we have included in the investment universe assets with incomplete return time series. When a time series becomes shorter, the value of the determination coefficient increases, which could, if there is a large enough number of assets with shorter time series, result in the deviation of the average determination coefficient to a higher value.

[32] The higher the value, the smaller the weight adjustment for shorter time series. The latter is determined based on the normality of the distribution of the lengths of time series in the investment universe. If it is distorted, then the number of companies with shortened time series is higher, which would increase their share in the average coefficient.

This proportion indicates the overall statistical significance of each factor in the investment universe.

Finally, we need to calculate the average 'module' correlation for each factor by employing the formula:

(3) $$\overline{|C_F|} = \left[\sum_{f=1}^{F-1} |C_{F,f}|\right] - 1\,,$$

where:

$\overline{|C_F|}$ is the average 'module' correlation of researched factor F;

$C_{F,f}$ is the correlation between researched factor F and a specific factor f.

Based on the average determination coefficient, the percentage of significant p-values of beta coefficients, and the average 'module' correlation, a rank of total factor significance can be calculated for each factor F with the formula:

(4) $$Rank_{F,N} = \sqrt[3]{Rank_{\overline{R^2_{i,F}}} * Rank_{P_F} * Rank_{(\overline{|C_F|})}},$$

where:

M is the number of factors researched;

$Rank_{F,N}$ is the rank of total factor significance of factor F in investment universe *B*, the rank combining its average statistical significance and explanatory power. All other symbols have the same meaning as in the equations considered earlier in the paper.

Ranks make it possible to range factors according to their significance to the investment universe, their explanatory power about assets return, as well as the extent to which those assets do not correlate with one another. The next step in the set of methods we have employed is to quantify the impact of different factors. This may be achieved with the model of return decomposition whose primary objective is to divide the return for a particular period into its components: return resulting from the impact of factor A; return resulting from the impact of factor B, etc. As a result, investors will have return components whose number is n+1, provided that they measure the impact of *n* significant factors. The last return which does not relate to any of the factors is in fact the fundamental return materialized by the asset when it is not influenced by any factor at all. It also corresponds to the additional or active return specified in investment literature.

Return decomposition is based on a standard multi-factor time regression dependence which aims to explain return by employing a range of influencing factors that may be grouped into:

A) significant global macro factors which may be measurable or calculated; B) selected global market factors (two in this research); C) a selected global industry factor according to the industry to which a company belongs that indicates the way in which the return of a particular company is affected by the global performance of that industry; D) a local market factor which indicates the fundamental dependence of a company return on the return of that index on the market on which the company is quoted. The model is based on the equation:

$$R_{i,t} = \alpha_i + \sum_j \beta_i * F_{Macr,t} + \sum_k \beta_i * F_{Mkt,t} + \beta_i * F_{Ind,t} + \beta_i * F_{Cntr,t} + \varepsilon_{i,t} \, , \quad \textbf{(5)}$$

where:

$R_{i,t}$ is the total realised return on asset i for period t;

α_i is the alpha regression coefficient;

F_t represents the values of significant global macro-factors, global market factors, global industrial factors, and the national market factor for period t;

β_i is the sensitivity of return to individual factors;

$\beta_i * F_t$ are the risk premia of individual factors on return for period t;

$\varepsilon_{i,t}$ represents regression residuals, i.e. the residual return on asset i for period t, which is unaccounted for and therefore does not depend on those factors;

Based on the equation above we could formulate the following: risk premia for each factor make it possible to quantify return sensitivity. The last element in the equation, $\varepsilon_{i,t}$, indicates the residual component of return which was earlier specified as equivalent to active return.

4. Empirical Research

In the empirical part of this research, the risk distribution model is employed to determine the factors affecting the investment universe and to measure their influence. At the same time, obtained results are studied and interpreted in terms of the investment universe so as to arrive at specific conclusions about equity markets in Europe as a whole.

Table 1 summarises thirty most significant factors in the investment universe. As a matter of fact, they answer the question that was put forward earlier in this paper (in Set of Methods), namely, which factors have the strongest impact on the investment universe. The significance of all reviewed factors exceeds 80 percent; therefore, the risk attribution employed may be defined as successful. Nevertheless, it does not enable us to quantify the impact of each factor upon the investment universe in a manner that would be different from the percentage of significance of the factor in terms of that universe.

Table 1. **Rank of factor significance to companies**

Factor	Rank (%)	Factor	Rank (%)
1Y Libor	97.20%	S&P VIX	93.85%
1M Libor	96.69%	USD/GBP	94.39%
1Y-1M Libor	93.21%	USD/JPY	94.05%
1Y Euribor	97.38%	USD/CNY	92.96%
1M Euribor	96.94%	USD/CHF	89.62%
1Y-1M Euribor	93.47%	10YGBR	99.49%
4Week T-Bill	91.60%	ΔGDP	94.16%
52 Week - T-Bill	91.64%	ΔGDP (NoTrend)	99.68%
52W-4W T-Bill	95.23%	Unemp	95.49%
Oil Price	83.50%	Exports Diff.	96.28%
MSCI US REIT	95.91%	Imports Diff.	82.95%
S&P 500	97.53%	TrBal Diff. (Exp-Imp)	82.21%
NASDAQ	97.15%	CPI	93.61%
FTSE 100	96.46%	CPI YoY	99.95%
DJIA	97.81%	CPI Δ	88.29%

Sources: FRED®, Quandl, S&P Capital IQ™ and calculations of the author

At this stage, investors have at their disposal all information risk attribution may provide, i.e., which factors have the most significant impact upon the researched investment universe. Should they stop their considerations here, they will still be able to coordinate their portfolio calibration activities in terms of influencing factors to avoid risk exposure or exploit it in order to make further profit. Whatever their decision, investors will still lack information as to how strong the impact of all these factors is. In order to answer that question, investors will need to decompose assets return.

Table 2 presents averaged risk exposure of different companies to different factors. They have been grouped based on the aggregate researched investment universe, the industries to which the companies in that universe belong or their position on the Bulgarian equity market.

The data presented in this table enables us to arrive at certain conclusions as to the risks faced by European companies, equity markets and economies. As for the impact of the consumer price index factor, it affects adversely the returns of companies and that relatedness follows strict economic logic.

Industries like healthcare and telecommunication services, however, respond in a different manner, i.e. their return increases with an increase in consumer price index (their exposures being 7.96 and 10.88 respectively). This results from the inelastic demand and supply of pharmaceutical products when prices rise due to inflation.

Table 2. **Average risk exposure to factors**

Average regression coefficients (by industry)	Consumer Price Index	Growth/Value spread	Industrial premium	Large/Small spread	S&P 500	Unemployment	USD / CNY	Change in GDP	Annual Euribor	Euribor spread	DAX	Export difference	Oil price
Total	-2.5	-0.9	-1.1	-1.6	1	-2.5	-0.5	5	-1.4	3.8	0.1	-0.3	0.6
Consumer staples	-5.1	-0.7	-1.9	-1.4	0.9	-4.4	-1.1	4.6	-1.9	7.2	0.1	-0.4	0.7
Consumer discretionary	-0.6	-1.1	-3.6	-1.5	0.9	-2.7	0.3	4.9	-1.1	6	0.2	-0.3	0.8
Energy sector	-3.6	0	3	-1.6	1	-0.7	-1.2	5.3	-1.6	3.4	0.1	-0.1	0.9
Healthcare	8	-0.8	2.8	-1.5	1.3	0.5	1.2	4.7	0.4	-0.6	0	-0.7	0.4
Industrials	-3.1	-1.2	-2.6	-1.9	1.1	-2.2	-0.3	5.4	-1.6	1.7	0.1	-0.1	0.7
IT	-4.8	-1.1	2.1	-2	1.4	-1.7	-2	2.8	-2	5.1	0.1	0.2	0.1
Materials	-6.6	-0.8	0.9	-1.9	1.1	-2.5	-0.4	5.7	-2	3.5	0.1	0	0.3
Telecommunication Services	10.9	-0.7	1.4	-1.1	0.5	3.1	-1.1	10.3	2.4	-4.9	0.1	-1.4	0.4
Utilities	-5.9	-1	-0.2	-1.4	0.3	-2.3	-1	5.3	-1.3	2.2	0	-0.2	0.2

Sources: FRED®, Quandl, S&P Capital IQ™ and calculations of the author

In the case of telecommunication services, inflation leads to a different paradox - nominal prices of goods decrease as those are goods not produced in Europe or produced at much lower costs. Companies belonging to both industries are a classic example of potential speculative investment that takes advantage of exposure to the consumer price index, i.e. by investing in such companies, investors may ensure profit in result of general public impoverishment.

Another fundamental dependence is the extremely low exposure of consumer discretionary (-4.40) to unemployment. This supports empirically the thesis that reduced job opportunities lead to lower consumption of non-essential goods. The situation is similar in all other industries except for the change in the USD/CNY currency rate. Although ostensibly strange, this has its logical explanation: European companies respond negatively to each positive change in the currency rate since a higher currency rate in fact means cheaper US dollars and more expensive yuans. This in turn results in higher prices of goods and commodities that companies purchase from China.

Fig. 1 presents the S&P 500 index whose influence on European companies' return is rather volatile as a result of three major events in European economic history, namely, the economic crisis, the debt crisis, and the European political crisis of 2014. Fig. 2 presents the USD/CNY currency rate, whose risk premia has the tendency to rise even if interrupted in three different years with zero return.

Fig. 3 illustrates a situation when the opportunity to make a profit is not materialised and the only option is to remove the unemployment factor exposure by using different strategies - short sales, hedging, or insurance. Fig. 4 presents objectively the impact of the 2008 crisis, when there was global economic panic and many investors, including institutional ones, acted hastily to avoid losses, which resulted in negative premia.

Fig. 5 illustrates the influence of the European interbank interest rate whose positive risk premium remains positive even with shrinking volumes. This is due to the drop of bank interest rates everywhere. Fig. 6 is explicitly dynamic as it is produced as a result of global export changes. A possible explanation for the explicit dynamic nature of the figure is the cyclic character of production, the length of each production cycle being two years in global terms.

Fig. 7 presents the impact of a specific factor – that of oil price. This factor followed an alarming trend since the premium was negative not only in the years of the crisis but after the year 2013 as well, i.e. the impact of the factor is bound to grow further.

Taking into the account the risk premia and the risk exposures established by these factors, we need to consider their aggregate influence upon stocks return. This may indicate where the greatest risk lies when identifying groups of industries, factors, etc. In order to do this, the individual annual values of risk premia are averaged to calculate an average risk premium. The average values thus calculated may be employed to predict the risk premium that could be expected from each factor, industry, or the investment universe that is subject to research.

Figures 8 and 9 present average risk factor premia in terms of industries and factors affecting them. It is not the values of risk premia that matter but the accumulation those values produce when combined with the risk premia of other factors. For example, the larger the scope of factor impact upon an industry (illustrated in Fig. 9), or the aggregate risk-premium of influencing factors upon various industries (illustrated in Fig. 8), the greater the risk exposure of the industry and the factor, respectively.

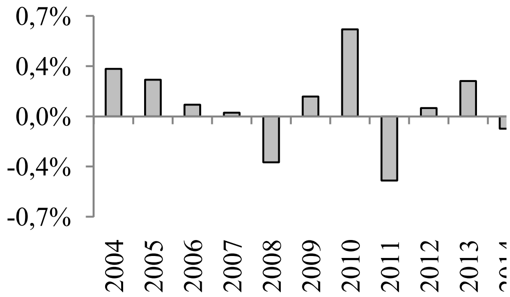


Figure 1. **S&P 500**

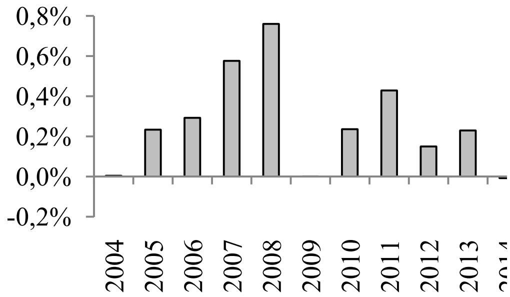


Figure 2. **USD/CNY**

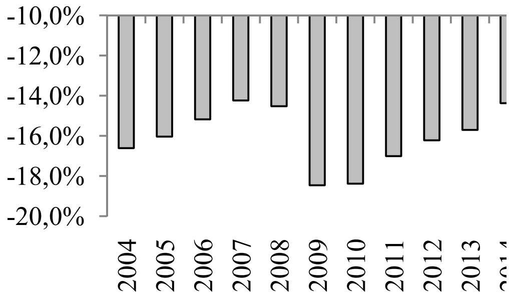


Figure 3. **Unemployment**

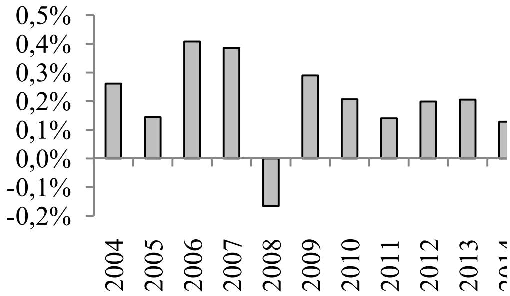


Figure 4. **Change in GDP**

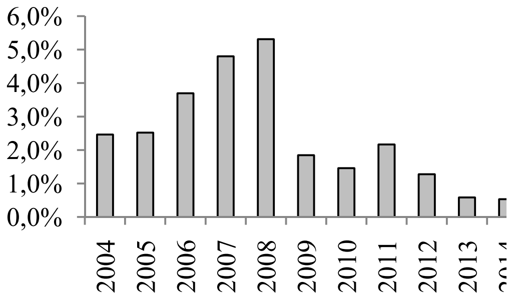


Figure 5. **Annual Euribor**

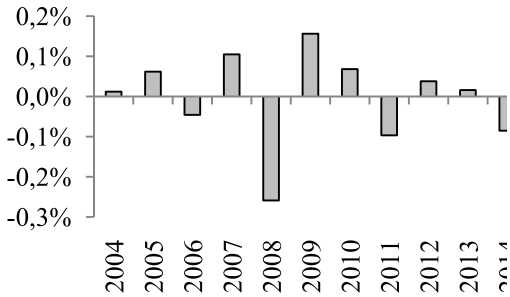


Figure 6. **Export difference**

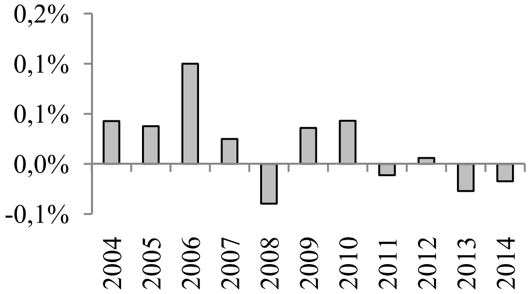
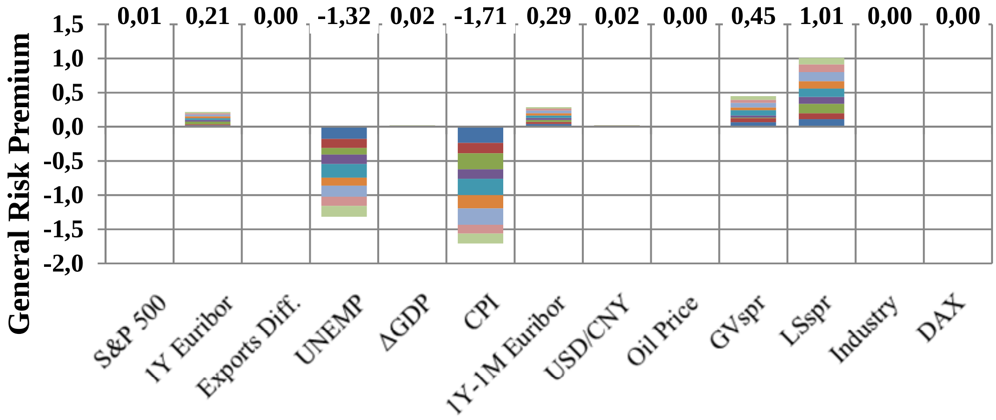


Figure 7. **Oil Price**

When presented in a similar manner, this information equips investors with awareness about factors that may pose a higher, lower or no risk at all.

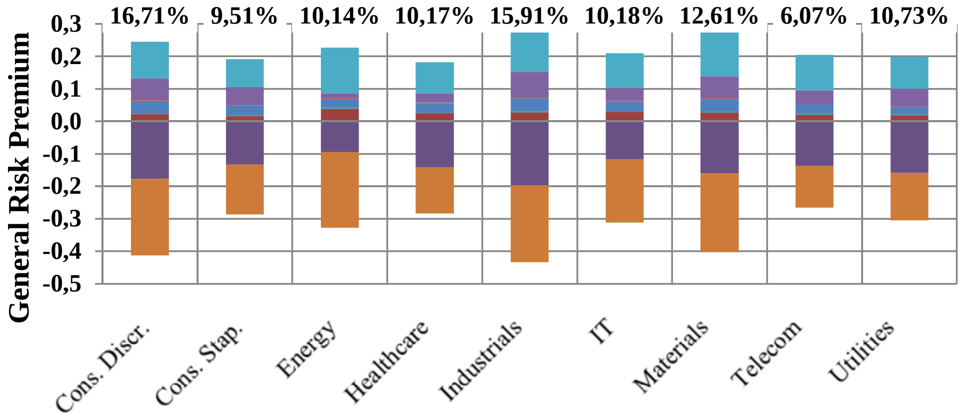
Figure 8. **General risk profile of industries by sector**



As evident from Fig. 8, the riskiest factors are those of unemployment and consumer price index. And vice versa, the most favourable risk factors are the size and the type of the company, i.e. Growth and Value. Hence, investors may choose to avoid exposure to unemployment and inflation and to increase their potential earnings by making exposures to factors such as the size and the type of the company. This is precisely the policy adopted by many investors in their willingness to speculate an exposure versus a specific risk factor. Such an exposure is frequently accompanied by exposures to much riskier factors, as is the case here.

The same information is presented in Fig. 9, though from the perspective of the riskiest industries in terms of various factors exposure. In this case, these are the Consumer Discretionary industry, the Industrials, and the extractive industry (materials). Conversely, the least risky sectors prove to be those of healthcare, telecommunication services, and utilities.

Figure 9. **General risk impact of factors upon industries**



Conclusion

The empirical methods we have employed to support the thesis made in the introduction of this paper, enable us to draw some general conclusions as to the investment universe we have researched, one of them being that certain global risks do exist which influence return volatility. At this stage, the greatest risks faced by European economies and equity markets prove to be those identified as far back as the appearance of economic science, namely, unemployment and inflation. Furthermore, healthcare, and especially pharmaceutics, the telecommunication services sector, the energy sector and the utilities sector prove to be risky industries, too.

The guidelines for further research of the issues raised in this paper relate to employing this set of methods and expanding it to a range which will be large enough to specify the features of particular markets (for example, Bulgaria), groups of markets (e.g. newly emerging east-European markets), specific periods (for example, before, during, and after the crisis), etc.

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