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THE FUNDAMENTAL ATTITUDE TO BUILDING A STOCK PORTFOLIO

The paper introduces a new method of building a fundamental stock portfolio. The author puts forward a statement that this new approach to portfolio theory makes it possible to obtain long-term portfolios outperforming those delivered by the classic portfolio analysis.

1. INTRODUCTION

The theory of portfolio, recognized as one of the greatest achievements of present finance, is described in detail (Markowitz 1959; Sharpe 1970, 1978; Dobbins et al. 1994; Trucker et al. 1994; Elton et al. 1995; Haugen 1996). The foundations of the theory of portfolio were laid by Markowitz (Markowitz 1952, 1959). Since 1952, when Markowitz published his theory of portfolio, many simpler methods have also originated. The most appreciated of them was Sharpe's model (Sharpe 1970, 1978).

The methods proposed within the classical theory of portfolio are connected by one thing: they are always created on the basis of the rate of return and the investment risk. In the article there is considered a proposal of construction of a long-term stock portfolio. The basis of construction of such a portfolio is Taxonomic Measure of Investment's Attractiveness (*TMAI*), while the rate of return and the risk are only the restrictive conditions. The assumptions of this approach were first proposed by Tarczyński in 1995.

Unlike the classic portfolio techniques, I propose to build a stock portfolio on the basis of the maximization of *TMAI*. The rate of return and the risk, the basic components of the objective in the classical portfolio analysis, are in the proposed attitude only restrictive conditions. It is a completely new look at the problems of construction the stock portfolio.

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In the paper there is shown a basic outline of the construction of a fundamental stock portfolio and its practical exemplification for the companies listed on the Warsaw Stock Exchange.

2. CONSTRUCTING THE *TMAI*

The basic element of construction of the fundamental stock portfolio is creation of *TMAI*, the synthetic measure stating the fundamental strength of the company.

The proposal of building *TMAI* is dedicated to investors, who want to make right decisions, but are limited by time and cannot apply a multitude of ratios used in the ratio analysis. This is also a trial of a recapitulation of the whole ratio analysis that is significant for those, who cope with the ratio analysis.

The method proposed below should be listed in a group of methods between portfolio analysis and fundamental analysis with the advantage of the latter. It uses the Multidimensional Comparative Analysis (Polish abbreviation *WAP*) as a tool to show the most attractive, from the point of capitalization and the safest from the point of risk, companies listed on a stock exchange (Tarczyński 1994, 1997).

WAP is a division of statistics, where in recent years we can observe a very dynamic development. Generally, *WAP* deals with the methods and techniques of comparing the multivariate aspects according to the fixed criterion. In the schemes of *WAP* there is analysed, among other things, the problem of hierarchization of objects and their sets taken in multidimensional spaces of features from the point of characteristics that you cannot measure directly. Such a characteristic is also the degree of stock attractiveness for companies listed on the Warsaw Stock Exchange. For the investor it is a question: *in what to invest so as to earn as much as possible at the least risk?*

In the real world for solving these kind of problems portfolio methods are used first of all. Unfortunately, many of them cannot be used at the Warsaw Stock Exchange yet.

The main problem is a short period of existence of the Warsaw Stock Exchange (only 8 years), small number of listed companies (not much more than 200), shallow market (an average turnover of stocks at one session is at the level of 1%). Moreover, this market is at the stage of formation (there are appearing the new financial tools, that have been existing on well-developed markets for a very long time), what is a reason of instability of the Polish capital market. All these factors cause the techniques requiring large amount of data and the market stability are not applicable in conditions of the Warsaw Stock Exchange yet. The methods of portfolio analysis surely belong to such a kind of techniques.

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The use of *WAP* lets us take into consideration some elements of portfolio methods and enter elements that are not used by these methods. The basis for analysis is a two-dimensional matrix of observations:

$$X = [x_{ij}] \quad (i = 1, ..., n;\ j = 1, ..., m), \tag{1}$$

where n, m – number of objects and number of variables, respectively.

The matrix X refers to a particular moment (on the Warsaw Stock Exchange it is a quotation). In October 1998 on the Warsaw Stock Exchange there were listed 174 companies.

In theory and practice there are many ratios and their systems, which are significant when estimating a company condition and perspectives of its development. The necessity of the maximum selection of information forces us to choose the key ratios. These ratios show the most important events for the investor when making decisions. In connection with this, I have proposed a set of variables in five groups of ratios describing the company financial standing. These are:

– liquidity ratios,
– debt ratios,
– activity ratios,
– profitability ratios,
– market-based ratios.

From these groups the following ratios were analysed: **liquidity** – current liquidity ratio, quick liquidity ratio; **debt** – level of debt ratio, debt to equity ratio; **activity** – inventory turnover ratio, accounts receivables ratio, liabilities turnover ratio; **profitability** – net profitability ratio, return on equity (ROE), return on total assets (ROA); **market-based** – earnings per share (EPS), price to earnings ratio (P/E), price to book value ratio (P/BV), company's dynamics of profit ratio, market risk beta ratio (beta from Single Index Model), rate of return, risk of rate of return.

When selecting such measures, I was guided by their significance in estimation of the company financial standing. All the indicated measures are known in the world's financial literature (Tarczyński 1997), so there is no need to present their economic interpretation. In order to attain clarity, the paper shows only the method of calculating them:

$$\text{current liquidity ratio} = \frac{\text{financial assets}}{\text{current liabilities}},$$

where: financial assets = accounts receivables + inventory + cash + securities;

$$\text{quick liquidity ratio} = \frac{\text{financial assets - inventory}}{\text{current liabilities}};$$

$$\text{level of debt ratio} = \frac{\text{current liabilities}}{\text{total assets}};$$

$$\text{debt to equity ratio} = \frac{\text{current liabilities}}{\text{equity}};$$

$$\text{inventory turnover ratio} = \frac{\text{inventory} \cdot 360}{\text{income}};$$

$$\text{accounts receivables ratio} = \frac{\text{receivables} \cdot 360}{\text{income}};$$

$$\text{liabilities ratio} = \frac{\text{liabilities} \cdot 360}{\text{income}};$$

$$\text{net profitability ratio} = \frac{\text{net profit}}{\text{income}};$$

$$\text{ROE} = \frac{\text{net profit}}{\text{income}};$$

$$\text{ROA} = \frac{\text{net profit}}{\text{total assets}};$$

$$\text{EPS} = \frac{\text{net profit}}{\text{number of shares}};$$

$$\text{P/E} = \frac{\text{current price per share}}{\text{net profit per share}};$$

$$\text{P/BV} = \frac{\text{current price per share}}{\text{book value per share}};$$

$$\text{company's dynamics of profit ratio} = \frac{\text{net profit in year } t}{\text{net profit in year } (t\text{-}1)};$$

$$\text{rate of return} = \frac{\text{price of share in period } t}{\text{price of share in period } (t\text{-}1)} - 1.$$

$$\text{risk of rate of return} = \sqrt{\frac{\sum_{i=1}^{n}(R_i - \overline{R})^2}{n-1}},$$

where: R_i – weekly rate of return for the *i-th* company; $\overline{R}$ – average weekly rate of return for all companies taken into consideration when compiling the portfolio; n – number of analysed periods.

Having so specified the set of variables characterising companies attractiveness, we can go into the next stage of estimating the synthetic measures of investment's attractiveness for companies listed on the Warsaw Stock Exchange.

In practice the set of chosen variables may be defined on the base of investors' preferences and their attitude towards risk.

In practice it is often difficult to use variables defined as above. Sometimes it comes from a specific activity (for example banks) and the organizational form (for example holdings). Otherwhiles some variables are impossible to estimate due to the results of company's activity. For example, the loss obtained in the analysed period does not allow us to calculate: net profitability ratio, P/E, company's dynamics of profit ratio. In 1993 an example of such a company was Tonsil S.A. It shows the shortcomings of the proposed method, but does not make it impossible to use. The *TMAI* is built on the basis of the following equations:

$$TMAI_i = 1 - \frac{q_i}{\|Q\|} \quad (i = 1, \ldots, n), \tag{2}$$

where $\|Q\|$ is a norm of the synthetic variable. For the firms listed on the stock exchange it is a sum of mean and doubled standard deviation of the synthetic variable:

$$\|Q\| = \bar{q} + a \cdot S_q. \tag{3}$$

where: a – a positive number, which is calculated in this way that *TMAI* lies in the interval (0; 1); S_q – standard deviation of q_i.

We know that $0 \leq TMAI \leq 1$ and $q_i > 0$, then we can calculate the border value of a:

$$a \geq \frac{q_{i\max} - \bar{q}}{S_q},$$

where $q_{i\max}$ – the maximum value of q_i.

Based on this relation we should accept the value of a as an integral part of this relation. In practice it is enough if we accept the value of a at the level of 2. The q_i values have been calculated according to:

$$q_i = \left[\sum_{j=1}^{m} w_j \cdot (x'_{ij} - x'_{0j})^2 \right]^{1/2} \quad (i = 1, \ldots, n), \tag{4}$$

where: $x_{ij}^{'}$ – standardized values of the j-th diagnostic variable for the i-th object

$$x_{ij}^{'} = \frac{x_{ij} - \overline{x}_j}{s_j} \quad (j = 1, \ldots, n), \tag{5}$$

$\overline{x}_j, s_j$ – mean and standard deviation of the j-th variable, respectively; $x_{0j}^{'}$ – coordinates of the upper pole of the set calculated from the equation

$$x_{0j}^{'} = \max_i \left\{ x_{ij}^{'} \right\}. \tag{6}$$

In the case of the same number of variables in the proposed groups, we can fix all the weights w_j at the level of 1. Unfortunately, these numbers are different, so we should accept at least such a system of weights, that would provide the same part in the measure for every of exposed groups. This means, that in the variant using all variables from five groups (group I–2 variables, II–2, III–3, IV–3, V–7) and assuming the same influence of each group, we will receive the following system of weights for variables from each group:

- group I–1/10,
- group II–1/10,
- group III–1/15,
- group IV–1/15,
- group V–1/35.

That system of weights has been used for calculating the *TMAI* values presented in the further part of this article.

Another possibility is to choose from each group one representative and take the unit system of weights. Choosing a representative can be achieved, for example, on the basis of the maximum variability ratio calculated as a quotient of standard deviation of the variable and its mean. Another method is a diversification of influence for every group and application of a weight system based, for example, on the correlation between the diagnostic variables and the remaining ones, or on the basis of level of variability of diagnostic features in the relation to the sum of all levels of variability for used variables.

The equations (2)÷(6) implicate that realizations of the synthetic variable q_i were fixed using w_j weights, standardization at 0–1 and Euclidean distance in relation to the upper pole of the set.

In practice, there are two main groups of variables: stimulants and destimulants. The stimulants are these variables, whose higher values mean higher level of development of the analysed event, and the destimulants have this property, that their smaller value indicates higher level of development of the analysed event.

Variables, that in the proposed set were the destimulants, were turned into the stimulants. If we want to do it, we can either use the formulas $x_{ij} = 1/x_{ij}^{'}$ or $x_{ij} = c_j - x_{ij}^{'}$, where the x_{ij} are the values of destimulant converted into the stimulants and the $x_{ij}^{'}$ are the original values of the destimulant, c_j is constant, that in order to avoid negative values may be calculated from: $c_j \geq \max_i \{x_{ij}\}$.

The proposed procedure might be used for making investment decisions. The *TMAI* can be the base for calculating a weight system for the companies in an analysis of the kind of a portfolio. It is also the important information about a situation at the market in each branch represented by the companies on the Warsaw Stock Exchange that may help to make strategic decisions by the firms operating in the branch or planning a new entry into the branch.

3. MODEL OF TAXONOMIC MEASURE OF INVESTMENTS' ATTRACTIVENESS – *TMAI*

Examining the classic idea of the stock portfolio pragmatically we can claim that they are the techniques of analyses and making long-term investments. Mostly, it comes from the little flexibility of the stock portfolio. Constructing the portfolio is pointless, if the process of its creation can sometimes take even several weeks, and the portfolio can change, for example, after a month. Even if, on the basis of estimation of the current market situation, we ascertain the necessity for a reconstruction of the portfolio, the practical performance of this process, due to the limited liquidity of the stock exchange (on the Warsaw Stock Exchange, in one quotation, 1% of shares of every company are in turnover) is impossible in short-term period. So it seems obvious, that the stock portfolio should be constructed for a long-term period. From the analysis of the stock exchange we can ascertain that the criterion of the rate of return and the risk, calculated on the basis of the variance of the rate of return, are not the best measures because of their instability. It is particularly apparent in the developing markets (as, for example, the Polish market), with a little liquidity, where the classic portfolios do not allow to achieve above average profits.

It is an impulse to look for the new solutions, allowing us to construct the stock portfolio naturally applying the long-term essentials of the investment decision. It seems that combination of methods of the fundamental analysis and the idea of construction of the stock portfolio may be useful. It is impossible to do it in the direct way because the fundamental

analysis is too broad and we cannot formalize it for the needs of construction of the stock portfolio without considerable simplifications.

The fundamental analysis, as a typical technique of analyses for the needs of long-term investments, seems to be a good basis for construction of the stock portfolio. At this stage we must solve the problem of reduction of the multi- factorial results of the fundamental analysis to the form, which we can apply to build the stock portfolio.

The new idea of construction of the stock portfolio is a proposal to build a fundamental stock portfolio that will be the long-term portfolio including the important virtues of the fundamental analysis, that is including the real strength of the companies and excluding the weak ones, from the economic point of view, which we call the speculative companies. The portfolio built on these bases will be stable and safe. It seems that for the long-term investors the virtues of this attitude are obvious. The main objective of optimization is a sum of values of the synthetic measures describing the fundamental strength of *TMAI* for the companies that enter into the composition of the portfolio weighted by means of participation of the share in the portfolio. The value of this criterion is maximized. Such a construction of the objective is to ensure the stability and safety of the portfolio in the long-term period. Stages of construction of the fundamental stock portfolio are shown in Figure 1.

The proposed attitude allows us to perform the objective estimation of the financial standing for the companies listed on the Warsaw Stock Exchange and to construct the stock portfolio including the companies' fundamental strength and the long-term character of the investment. On the basis of such a portfolio, there are also possible further researches, that can, for example, aim at the elaboration of the universal and stable criteria for the synthetic measure and the restrictive conditions, which will not be sensitive to the stage of the capital market development.

The calculation of *TMAI* for chosen companies was made on the basis of the following set of features: current liquidity ratio, quick liquidity ratio, level of debt ratio, debt to equity ratio, inventory turnover ratio, accounts receivables ratio, liabilities turnover ratio, net profitability ratio, return on equity (ROE), return on total assets (ROA), earnings per share (EPS), price to earnings ratio (P/E), price to book value ratio (P/BV), company's dynamics of profit ratio, market risk beta ratio, rate of return, risk of rate of return.

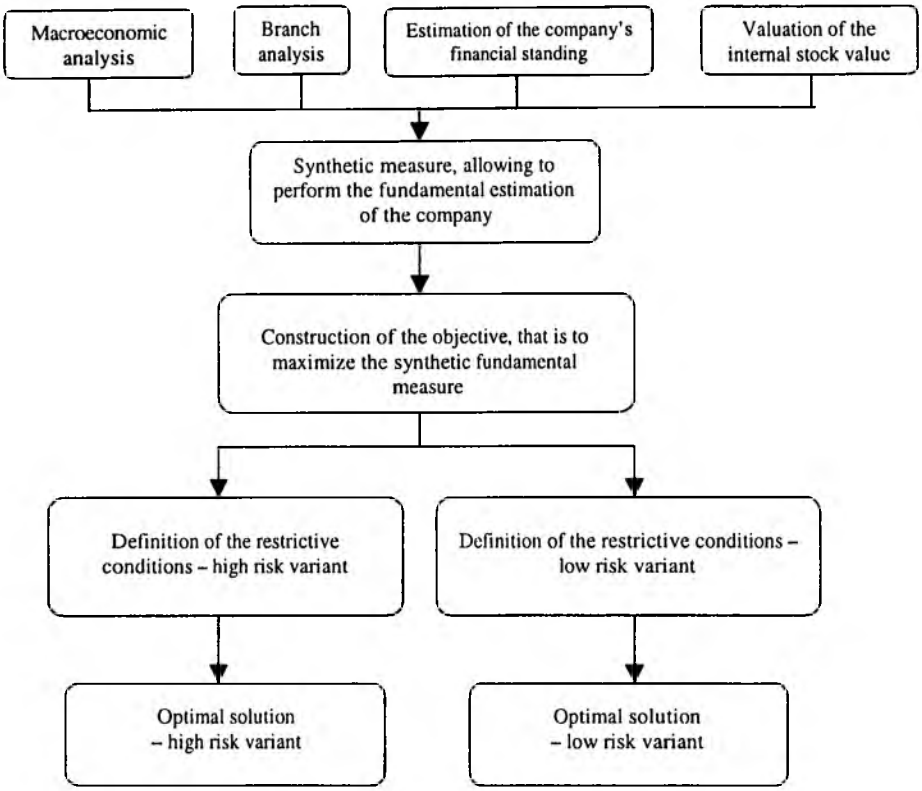

Fig. 1. Stages of construction of the fundamental stock portfolio
Source: own elaboration.

As we see in the set of features shown above, these are variables coming from a capital market and financial variables, used to perform an analysis of company's financial standing. Calculations of *TMAI* were performed on the basis of data for the year 1995. This particular year was chosen for the analysis because it was pretty stable, considering the rate of return and the risk with the downward tendency of the rate of return (it was the first year after the greatest decline in the whole history of the Warsaw Stock Exchange). In such case the classic portfolio analysis does not give the best results. The fundamental portfolio is free from this limitation because the most significant criterion of the estimation of the portfolio is the maximum value of the *TMAI* function that defines the fundamental strength of the portfolio. Such portfolio should, in a long-term horizon, allow us to achieve above average profits. The fundamental portfolio, as well as the fundamental analysis, allows us to invest in shares of a single company and this investment brings high profits, but in a long-term period.

Financial ratios come from the elaboration *Wyniki finansowe spółek giełdowych* (March 1996). The results of calculations are given in Table 1. Because several financial measures were used as a basis for the estimation of the companies, I did not include financial institutions to provide the comparability of data.

Table 1
Taxonomic measure of investment attractiveness for selected companies listed on the Warsaw Stock Exchange

Number	Stocks	*TMAI*	Number	Stocks	*TMAI*
1	Agros	0.163	30	Rafako	0.059
2	Animex	0.180	31	Relpol	0.147
3	Budimex	0.183	32	Remak	0.115
4	Bytom	0.013	33	Rolimpex	0.128
5	Compland	0.247	34	Sokołów	0.118
6	Dębica	0.174	35	Stalexp	0.173
7	Elbudowa	0.129	36	Stomil	0.143
8	Elektrim	0.115	37	Swarzędz	0.031
9	Exbud	0.065	38	Tonsil	0.004
10	Górażdże	0.164	39	Universal	0.019
11	Irena	0.186	40	Vistula	0.101
12	Jelfa	0.073	41	Wedel	0.079
13	Kable BFK	0.077	42	Wólczanka	0.084
14	Kable	0.093	43	Zasada	0.042
15	Kęty	0.145	44	Żywiec	0.095
16	Krosno	0.065	45	Betonstal	0.168
17	Mostexp	0.172	46	Domplast	0.109
18	MostGda	0.052	47	Drosed	0.123
19	MostWar	0.084	48	Echo	0.226
20	MostalZab	0.122	49	Efekt	0.090
21	Novita	0.031	50	Elektroex	0.130
22	Okocim	0.099	51	FarmFood	0.104
23	Oława	0.174	52	Indykpol	0.052
24	Optimus	0.107	53	Jutrzenka	0.116
25	Pekpol	0.046	54	KPBP Bick	0.084
26	PolfaK	0.077	55	Krakchemia	0.084
27	PolifarbCn	0.095	56	LDASA	0.059
28	PolifarbWr	0.128	57	PPWK	0.121
29	Próchnik	0.015	58	Prochem	0.164

Source: own calculations.

When we have a synthetic measure that lets us perform a fundamental analysis for a given company, there can be defined a following criterion that makes construction of the stock portfolio possible, the best considering a weighted average of the synthetic measure of development. Formally, that portfolio may be written by means of the following formula (Tarczyński 1995):

$$f = \sum_{i=1}^{k} TMAI_i \cdot x_i \rightarrow \max, \tag{7}$$

where: f – value of the objective; $TMAI_i$ – taxonomic measure of investment's attractiveness for *i-th* company; x_i – fraction of the *i-th* company in the portfolio; k – number of companies being a basis to construction of the portfolio (in this example $k = 58$).

The objective can be satisfied (obtaining an optimal stock portfolio considering the taxonomic measure of investment's attractiveness) when the restrictive conditions are defined. These are following:

$$\sum_{i=1}^{k} R_i \cdot x_i \geq R, \tag{8}$$

$$\sum_{i=1}^{k} S_i \cdot x_i \leq S, \tag{9}$$

$$\sum_{i=1}^{k} \beta_i \cdot x_i \geq \beta, \tag{10}$$

$$\sum_{i=1}^{k} Zh_i \cdot x_i \geq Zh, \tag{11}$$

$$\sum_{i=1}^{k} x_i = 1, \tag{12}$$

$$x_1, x_2, \ldots, x_k \geq 0, \tag{13}$$

where: R_i – weekly rate of return for the *i-th* company; R – average weekly rate of return for all companies taken into consideration when compiling the portfolio; S –average weekly risk of investments for all companies taken into consideration when constructing the portfolio; S_i – weekly risk of investment for *i-th* company calculated as the standard deviation for of R_i; β_i – weekly coefficient beta for the *i-th* company; β – average weekly beta coefficient for all companies taken into consideration when constructing the portfolio; Zh_i –relation of hypothetical profit to net profit for *i-th* company (hypothetical profit is a forecast of net profit); Zh – average relation of hypothetical profit to net profit for all companies taken into

consideration when constructing the portfolio; k – number of companies taken into consideration when constructing the portfolio.

Average values accepted as limits in restrictive conditions may be fixed in other, more or less rigorous ways. For example, a limit for beta coefficient and relation of hypothetical profit to net profit may be equal 1. Proposed model needs several additional restrictions and an explanation of the appearance of some restrictive conditions.

First, there is a restriction of potential stocks that we can put into the portfolio. Practically, the number of all listed companies can be reduced only to these, for which, in the examined period of analysis, the rate of return is above 0. We can also accept as a restrictive criterion both a branch or comparability of financial ratios (for example banks and other companies). Of course, in an extreme case all the restrictions can be omitted and all stocks can be accepted for the analysis. But if there are several hundreds or thousands of companies listed on the stock exchange, this behaviour will be neither rational nor efficient.

Second, there is a definition of the period coming under the analysis. Accepted in the model weekly base for all factors except for relation of hypothetical profit to net profit (a result of the fact that the companies have to publish the net profit every month) does not have to occur in all cases. These periods can be longer or shorter, mostly influenced by the character of investment (long–term, or short–term) and availability of statistical data.

Third, at the very beginning, there is a necessity of definition of the level of risk acceptance by the investor. The model allows two situations: not accepting the high risk or accepting the high risk, which may cause the change of the inequality sign in restrictive conditions (9) of the model.

The restrictive conditions (10)÷(13), are clear and do not need any explanations.

The proposed way of constructing the stock portfolio will be shown in the example of companies selected from the Warsaw Stock Exchange, for which values of *TMAI* are given in Table 1. In the objective (7) that is to be maximized, values of *TMAI* come from table 1 and x_i are the unknown fraction of certain stocks in the portfolio. Due to the large number of companies, restrictive conditions with their limits are included in Table 2. Limits put in Table 2 for the rate of return and risk were fixed at the level of arithmetic mean and for the beta coefficient and relation of hypothetical profit to net profit at the level of 1.

A model defined by formulas (7)÷(13) is a classic problem of linear programming, that can be easily solved using for example algorithm *SIMPLEX*. This method of solving problems of linear programming is available in most statistical packages. Calculations are rather simple and do not demand a large expenditure of work and time.

For data included in Tables 1 and 2, calculations can be performed in every spreadsheet. In the optimal solution the following companies were found: Budimex (27%), Compland (55%) and Dębica (18%). This solution may be written as follows:

$$f = 0{,}27 \cdot TMAI_3 + 0{,}55 \cdot TMAI_5 + 0{,}18 \cdot TMAI_6 \approx 0{,}217,$$
$$0{,}012 \cdot x_3 - 0{,}003 \cdot x_5 + 0{,}057 \cdot x_6 \geq 0{,}011,$$
$$0{,}078 \cdot x_3 + 0{,}058 \cdot x_5 + 0{,}087 \cdot x_6 \leq 0{,}073,$$
$$1{,}364 \cdot x_3 + 0{,}753 \cdot x_5 + 1{,}206 \cdot x_6 \geq 1{,}0,$$
$$1{,}826 \cdot x_3 + 2{,}045 \cdot x_5 + 0{,}906 \cdot x_6 \geq 1{,}0,$$

Taking shares of companies from the objective to the restrictive conditions, we have:

$$0{,}012 \cdot 0{,}27 - 0{,}003 \cdot 0{,}55 + 0{,}057 \cdot 0{,}18 = 0{,}012,$$
$$0{,}078 \cdot 0{,}27 + 0{,}058 \cdot 0{,}55 + 0{,}087 \cdot 0{,}18 = 0{,}069,$$
$$1{,}364 \cdot 0{,}27 + 0{,}753 \cdot 0{,}55 + 1{,}206 \cdot 0{,}18 = 1{,}0,$$
$$1{,}826 \cdot 0{,}27 + 2{,}045 \cdot 0{,}55 + 0{,}906 \cdot 0{,}18 = 1{,}78.$$

The achieved portfolio ought to be included to the family of the safe ones (limits and directions of inequalities in the restrictive conditions prove this).

For that portfolio the rate of return and risk can be calculated by means of formulas:

$$R_p = \sum_{i=1}^{n} x_i \cdot R_i,$$
$$S_p^2 = \sum_{i=1}^{n} x_i^2 \cdot S_i^2 + 2 \cdot \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} x_i \cdot x_j \cdot S_i \cdot S_j \cdot r_{ij},$$

where: R_p – rate of return for portfolio; x_i – fraction of the *i-th* company in the portfolio; S_p^2 – risk of portfolio; S_i, S_j – standard deviation of rate return for the *i-th* and *j-th* stocks, respectively; r_{ij} – correlation coefficient between the *i-th* and *j-th* stocks, respectively; n – number of shares in the portfolio.

In the portfolio, which is optimal from the point of view of the *TMAI* criterion, its rate of return equals:

$$R_p = 0{,}27 \cdot 0{,}012 + 0{,}55 \cdot (-0{,}003) + 0{,}17 \cdot 0{,}057 \approx 0{,}011,$$

whereas the risk equals:

$$S_p^2 = 0{,}27 \cdot 0{,}078 + 0{,}55 \cdot 0{,}058 + 0{,}18 \cdot 0{,}087 + 2 \cdot (0{,}27 \cdot 0{,}55 \cdot 0{,}078 \cdot 0{,}058 \cdot 0{,}15 +$$
$$0{,}27 \cdot 0{,}17 \cdot 0{,}078 \cdot 0{,}087 \cdot 0{,}45 + 0{,}55 \cdot 0{,}18 \cdot 0{,}058 \cdot 0{,}087 \cdot 0{,}12) \approx 0{,}069,$$
$$S_p \approx \pm 0{,}263.$$

The portfolio constructed in this way is a fundamental portfolio, typical for the long-term investor. In this example the risk is high. We should remember, however, that the moment when the portfolio was constructed was in the period of decline on the Warsaw Stock Exchange.

Table 2
Restrictive conditions with limits according to formulas 8÷11

Stocks	Beta (β_i)	Rate of return (R_i)	Risk (S_i)	Hypothetical profit (Zh_i)	Stocks	Beta (β_i)	Rate of return (R_i)	Risk (S_i)	Hypothetical profit (Zh_i)
Animex	1.323	0.014	0.075	2.848	Relpol	0.817	0.012	0.089	1.158
Budimex	1.364	0.012	0.078	1.826	Remak	1.345	0.042	0.051	0.901
Bytom	0.750	0.010	0.043	0.369	Rolimpex	1.369	0.011	0.075	1.745
Compland	0.753	-0.003	0.058	2.045	Sokołów	1.128	0.027	0.086	0.449
Dębica	1.206	0.057	0.087	0.906	Stalexp	1.503	0.004	0.071	0.993
Elbudowa	0.922	0.019	0.070	1.329	Stomil	1.099	0.013	0.081	0.987
Elektrim	1.050	0.025	0.071	0.756	Swarzędz	1.090	0.024	0.066	0.087
Exbud	1.050	-0.006	0.078	0.564	Tonsil	1.335	-0.007	0.068	0.152
Górażdże	0.825	0.013	0.080	1.272	Universal	1.390	0.002	0.077	0.399
Irena	1.198	0.024	0.056	0.751	Vistula	0.973	-0.003	0.069	0.854
Jelfa	0.912	0.004	0.064	0.587	Wedel	0.584	0.011	0.074	0.491
Kable BFK	1.346	0.006	0.060	0.566	Wólczanka	0.994	-0.004	0.061	0.754
Kable	1.130	0.025	0.087	0.757	Zasada	-0.204	0.000	0.063	0.546
Kęty	0.378	0.007	0.073	1.014	Żywiec	0.706	0.024	0.098	0.680
Krosno	1.187	0.003	0.079	0.526	Betonstal	0.490	0.008	0.095	7.282
Mostexp	0.868	0.017	0.079	0.958	Domplast	1.072	0.007	0.073	1.017
MostGda	0.917	0.003	0.062	0.540	Drosed	1.022	0.022	0.109	1.255
MostWar	1.121	0.033	0.073	0.538	Echo	0.576	0.012	0.056	1.059
MostalZab	1.570	0.010	0.071	1.141	Efekt	1.363	-0.004	0.044	1.012
Novita	1.021	0.016	0.086	0.241	Elektroex	0.940	0.008	0.094	0.070
Okocim	1.041	0.003	0.074	0.960	FarmFood	0.458	0.011	0.095	1.296
Otawa	1.062	0.009	0.075	1.230	Indykpol	0.987	0.020	0.054	0.474
Optimus	0.986	0.013	0.050	1.087	Jutrzenka	0.440	0.004	0.077	1.938
Pekpol	0.367	0.014	0.079	0.446	KPBP Bick	0.867	0.009	0.074	0.540
PolfaK	0.686	0.015	0.065	1.073	Krakchemia	1.705	0.027	0.094	0.042
PolifarbCn	1.016	0.017	0.065	0.550	LDASA	1.274	0.004	0.089	0.835
PolifarbWr	1.362	0.007	0.066	1.105	PPWK	0.457	-0.007	0.056	1.881
Próchnik	0.894	0.002	0.139	0.280	Prochem	1.067	0.024	0.054	0.398
Rafako	1.379	-0.009	0.063	0.692	LIMITS	1.000	0.011	0.073	1.000

Source: own calculations.

4. CONCLUSIONS

The proposal of the construction of a fundamental stock portfolio is a completely new outlook at portfolios. In practice portfolios based on the categories of the rate of return and the risk are very detailed, not flexible and only short or medium-term.

In stable markets, a fundamental approach where the rate of return and the risk are used as constraints, gives a possibility to build a stable stock portfolio, where the rate of return and the risk are consistent with the possibilities of the market. It comes from the fact that constraints for proposed *TMAI* model are calculated on the basis of a trend of limits for data coming from the nearest past.

It seems that the fundamental stock portfolio may be an interesting alternative to the classic stock portfolio. When we build the stock portfolio on the basis of a classic attitude, we use the rate of return and the risk. This means that the good portfolio (allowing us to achieve above average profits) can be constructed only under conditions of systematic increases of the stock prices. In a long horizon, this does not have to be the truth. In the proposed attitude, even during economic recession, we can build a good portfolio that in a long period allows us to achieve high advantages. It is a natural transfer of the idea of the fundamental analysis to the portfolio analysis. We can be sure that the fundamental portfolio will allow us to achieve the rate of return at a given level of risk not worse than the average rate of return at a given level of risk for the market, if we use these characteristics as restrictive conditions for the portfolio.

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