STOCK SELECTION ON THE WARSAW STOCK EXCHANGE – FINANCIAL RATIOS OR PROFITABILITY RATIOS. ANALYSIS BETWEEN 2001 AND 2011

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Abstract

The process of a portfolio optimisation is preceded by a stock selection. The article is concentrated on using the synthetic measure of development in the stock selection. The synthetic measure of development proposed by Zdzisław Hellwig is one of the methods of linear arrangement. It enables the classification of companies in relation to the set variables, that are financial ratios and their relative growth rates. The purpose of the article is to choose which set variables (financial ratios or profitability ratios – their nominal values as well as their relative growth rates) should be used in order to point out the best quantile portfolio. Companies are divided into five quantile portfolios due to their position in the ranking that is constructed on the base of the synthetic measure of development. The author uses data of companies listed on the Warsaw Stock Exchange between 2001 and 2011. The rankings and portfolios are built separately for each year. As a result, it can be stated that the second portfolio of the ranking constructed on the base of financial ratios is better than portfolios constructed on the base of profitability ratios.

Key words: financial ratios, stock selection, synthetic measure of development

JEL Code: C38, G11, G32

Introduction

The stock selection is an important part of a portfolio construction. There are many methods that allow to choose stocks and one of them is the method based on the synthetic measure of development. The synthetic measure of development (SMD) was proposed by Hellwig (Hellwig, 1968). It is used in a lot of areas when the object is described by many variables (Balcerzak, 2009). Tarczyński is the first one who proposed using the SMD in order to construct securities portfolio on account of their financial strength (Tarczyński, 1994). He introduced the notion of the TMAI that is Taxonomic Measure Attractiveness of Investment. Tarczyński and Łuniewska examined in details the possibility of using the TMAI (Tarczyński

& Łuniewska, 2003). They use the chosen financial ratios as the set variables. Węgrzyn proposed to use financial ratios that describe each of four areas of a company activity as a set variables for the synthetic measure of development (Węgrzyn, 2008). These four areas of companies' activity are measured by profitability ratios, turnover ratios (asset utilisation and efficiency ratios), liquidity ratios, leverage ratios (capital structure and solvency ratios) (Jerzemowska, 2006).

The accounting-based market anomalies like other anomalies are against the market efficiency hypothesis. However, Fama points out that the long-term return anomalies tend to disappear with changes in technique (Fama, 1998). After all, it does not change that there are a lot of researches that try to find new anomalies or study already known. One of them was discovered by Hirshleifer et al., this anomaly is related to net operating assets (NOA) and it can be used in order to predict future returns (Hirshleifer, Hou, Teoh & Zhang, 2004). However, Rubinstein discusses many discovered anomalies and notices it is not enough to reject the efficient market hypothesis (Rubinstein, 2001).

The purpose of the article is to point out the better set of variables (between two sets that are compared) that can be used in order to construct profitable quantile portfolio on the base of the synthetic measure of development. In the first set there are nominal values of financial ratios that are describing each of four areas of a company activity and their relative growth rates. Whereas, in the second set there are nominal values of profitability ratios and their relative growth rates. The SMD is computed on the base of each set of variables separately. Then, companies are linear arranged by the value of the SMD. As the result, companies are selected to one of five quantile portfolios by the position in the ranking. The structure of quantile portfolios is not optimised. Performances of quantile portfolios are compared with the performance of well-diversified proportional portfolio that contains all analysed companies. The study is performed in the period between 2001 and 2011 for companies listed on the Warsaw Stock Exchange in Poland.

The purpose of the article is not to construct optimal portfolios that lie on the efficient frontier. Such portfolios can be constructed on the base of Markowitz portfolio theory (Markowitz, 1952). During the construction of Markowitz's optimal portfolio, many constraints can be taken into account. There are many methods that can be used in order to include the constraint, one of them are genetic algorithms (Soleimani, Golmakani & Salimi, 2009). Moreover, Sroczyńska-Baron points out the possibility of using the game theory in order to construct the optimal portfolio (Sroczyńska-Baron, 2009). The game theory can be also used in case to optimise the process of purchasing and selling stocks (Sroczyńska-Baron,

2008). The optimised process of purchasing and selling stocks can improve the performance of portfolio.

1 Synthetic measure of development

The synthetic measure of development is one of the methods of linear arrangement. It enables the classification of companies in relation to the set variables (Hellwig, 1968). In case of companies' analysing, the value of the SMD points out the financial strength of companies (Tarczyński & Łuniewska, 2003). The SMD for a given company is computed as follows (Tarczyński & Łuniewska, 2003):

$$TMAI_i = 1 - \frac{d_i}{d_0}, \tag{1}$$

Where,

d_i – Euclidean distance between the company and the model object given by the formula:

$$d_i = \sqrt{\sum_{j=1}^{m} \frac{1}{m} \cdot \left(z_{ij} - z_{0j}\right)^2}, \tag{2}$$

z_{ij} – value of the j^{th} variable for i^{th} company (after standardisation)

z_{0j} – value of the j^{th} variable for the model object:

$$z_{0j} = \max_{j=1}^{m}\left(z_{ij}\right), \tag{3}$$

d_0 – the norm that guarantees the value of TMAI between 0 and 1:

$$d_0 = \max\left(d_{0j}\right). \tag{4}$$

As it can be noticed from the equation (2), it is assumed that each financial ratio has the same weight in the synthetic measure of development.

Variables (financial ratios) are divided into stimulants and destimulants. Stimulants are those financial ratios for which an increase is assessed positively. Whereas destimulants are those financial ratios for which an increase is assessed negatively. Then variables (both stimulants and destimulants) are standardised.

2 Relative growth rate

Among the analysed financial ratios there are such financial ratios, that can be positive or negative. Therefore, in order to compute the relative growth rate, the following formula is used (Węgrzyn, 2008):

$$\delta = \frac{\Delta W_{t_1}}{\left|W_{t_0}\right|} = \begin{cases} \dfrac{W_{t_1} - \left|W_{t_0}\right|}{\left|W_{t_0}\right|} & \text{when} \quad W_{t_1} < 0 \quad \text{and} \quad W_{t_0} < 0 \\ \dfrac{W_{t_1} - \left|W_{t_0}\right|}{\left|W_{t_0}\right|} & \text{in} \quad \text{other} \quad \text{cases} \end{cases}, \tag{5}$$

Where:

W_{t1} – value of the financial ratio in the current year,

W_{t0} – value of the financial ratio in the previous year (the base year).

Values that are produced by the formula (5) cannot be explicitly interpreted. They can be interpreted only when the financial ratio for two consecutive years is positive. Moreover, when financial ratio for the base year (W_{t0}) is equal to zero then a relative growth rate cannot be computed. The proposed method of computing relative growth rate can be used when among the analysed data, financial ratios can be found that are negative (eg. loss) or positive (eg. profit) and:

- increase and decrease of losses (negative values) is negatively assessed,
- decrease of profits (positive values) is negatively assessed,
- increase of profits (positive values) is positively assessed,
- profits instead of losses are positively assessed[1].

3 Financial ratios

In the study, the following financial ratios and their relative growth rate are used[2]:

A. Profitability ratios:

- ROE* – return on equity (Jerzemowska, 2006),
- ROA* – return on assets (Jerzemowska, 2006),
- ROS* – return on sales (Jerzemowska, 2006),

[1] It is positively assessed when there are profits (positive values) for the current year (W_{t1}) and there are losses (negative values) for the base year (W_{t0}).

[2] In case of financial ratios marked with an asterisk (*) the nominal values as well as their relative growth rates are considered. In case of financial ratios do not makred with an asterisk only relative growth rate is considered.

- Mzbs* – gross profit on sales (Jerzemowska, 2006),
- Mzop* – operating profit on sales,
- Mzb* – gross profit margin (Helfert, 2003),
- operating income,
- net income,
- net sales,

B. Liquidity ratios:

- Wpb* – current ratio (Jerzemowska, 2006 and Helfert, 2003),
- Wps* – quick ratio (Jerzemowska, 2006 and Helfert, 2003),
- Wpp* – acid test (Jerzemowska, 2006),
- RGS* – operating cash flows on sales,
- RGZ* – net profit on operating cash flows,
- cash flow from operating activities,

C. Asset turnover ratios (activity ratios or efficiency ratios):

- RA* – asset turnover in days (Helfert, 2003),
- RNal* – receivables conversion period (in days) (Jerzemowska, 2006),
- RZap* – inventory conversion period (in days) (Jerzemowska, 2006),
- Cop* – operating cycle (in days) ,
- RZob* – payables conversion period (in days) (Jerzemowska, 2006),
- CKG* – Cash Conversion Cycle (Jerzemowska, 2006),
- RMO* – current assets turnover in days (Jerzemowska, 2006),

D. Financial leverage ratios (debt ratios):

- Szo* – debt ratio,
- WPM* – equity to fixed assets,
- WOZ* – sum of depreciation and financial costs to net profit (Jerzemowska, 2006),
- WPZ* – current liabilities to sum of annual interest expense and depreciation,

4 Data and Assumptions

In the study, the nonfinancial companies that are listed on the WSE between 04.2001 and 04.2012 are included. They are included, in the end of March for a given year, in one of the following indexes: WIG20, mWIG40[3] or sWIG80[4]. From among such companies the following are excluded:

[3] If there was not an index mWIG40 then an index midWIG is used.

- banks, insurances companies and lease companies,
- companies included in the following sectors: finance or finance–other,
- companies for which there is no full financial statements for two preceding years[5],
- companies that in the balance sheet (that is used in order to compute financial ratios or their relative growth) have negative value of the shareholders equity,
- companies that in the income statement (that is used in order to compute financial ratios or their relative growth) have value of revenues from sales equal to zero.

As the result in the consecutive years there are between 95 and 118 companies qualified for the study. The number of companies qualified for the study in a given year is shown in the Tab. 1.

Tab. 1: The number of companies qualified for the study in the consecutive years

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Number of companies	96	95	97	102	108	105	106	113	117	118	116

Source: Own study.

For each company qualified for the study in a given year the financial ratios and their relative growth rates described in the section 3 are computed. In order to compute the financial ratios the financial statements for a previous year are used. While, in order to compute the relative growth rate of financial ratios two financial statements for consecutive years that precede the investment year are used.

The values of financial ratios and their relative growth rates are used to the construction of the SMD. Two synthetic measures of development are computed, the first one (called TMAI) is computed on the base of all financial ratios and their relative growth rates presented in the section 3. The second one (called TMAI_R) is computed on the base of profitability ratios and their relative growth rates that are presented in the section 3 A.

Each SMD is used in order to conduct a linear arrangement of the companies separately for each year. In case of the first one the ranking is called TMAI. While in case of the second one it is called TMAI_R. The position of the company in each ranking separately allows to assign it into one of five quantile portfolios in the following way:
- into the first portfolio, 20% of companies with the highest position are put,

[4] If there was not an index sWIG800 then an index WIRR is used.
[5] In the study are used financial statements from the following data bases prepared by the Notoria Serwis: 1(39)/2003, 3(45)/2004, version 18.30 may 2010, version 20.50 march 2012.

- into the second portfolio, the next 20% of companies with the highest position are put that are not included in the first portfolio,
- into the third portfolio, the next 20% of companies with the highest position are put that are not included in the first or second portfolio,
- into the fourth portfolio, the next 20% of companies with the highest position are put that are not included in the first or second or third portfolio,
- into the fifth portfolio, the remaining companies are put.

As the result five equipotent portfolios for each ranking are constructed. Each portfolio is bought during the last session in the first week of April a given year and sold during the last session in the first week of April next year. In each company 10,000 PLN is invested, quantity of stocks is rounded down to integer and it is constant during the investment period.

In the study the financial companies like banks, insurance companies and lease companies are not included. As the result, index WIG or any other index cannot be a benchmark. The benchmark portfolio (BP) is constructed like other portfolios. In the BP all companies qualified for a study in the given year are included. In each company 10,000 PLN is invested, quantity of stocks is rounded down to integer. The quantity of stocks is constant during the investment period.

Assessment of each portfolio is done by:
- average geometric rate of return for an eleven-years-period of investment (R_G),
- cumulated rate of return (R_{cum}),
- investment rate of return,
- a Sharpe ratio (Sharpe, 1966).

5 Results

There are investment rates of return for each constructed portfolio between 2001 and 2011 in the Table 2. In case of the TMAI ranking, the comparison of returns achieved by each portfolio with the return for the BP points out that the Portfolio 2 and the Portfolio 4 the most frequently give the rate of return that is higher than the rate of return for the BP (that situation occurs 8 times during 11 years). Whereas, in case of the TMAI_R ranking that situation is for the Portfolio 3 (also 8 times during 11 years).

In the Table 3, there are cumulated rates of return and geometric average rates of return. In case of the TMAI ranking the Portfolio 2 gives the highest R_G, that is 6.6 pp[6] higher

[6] pp – percentage points

than the R_G for the BP. As the result, the R_{cum} for the Portfolio 2 is more than 2 times higher than it is for the BP. While, in case of the TMAI_R ranking, the Portfolio 1 gives the highest R_G, that is 2.6 pp higher than the R_G for the BP. The comparison of the R_G for that two portfolios points out that the R_G for the Portfolio 2 in the TMAI ranking is higher than it is for the Portfolio 1 in the TMAI_R ranking by 4 pp.

Tab. 2: Investment rate of return for constructed portfolios.

Year		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Benchmark portfolio (BP)		-12.7%	-5.6%	187.2%	15.7%	143.0%	82.5%	-28.2%	-54.7%	60.7%	6.7%	-23.4%
TMAI	Portfolio 1	-53.2%	-45.6%	**188.2%**	11.7%	**372.4%**	79.5%	-28.9%	-62.9%	48.9%	**29.3%**	-40.5%
	Portfolio 2	-18.4%	-17.1%	**250.7%**	**35.0%**	**149.6%**	**121.6%**	**-16.0%**	**-53.1%**	**73.5%**	**8.2%**	-27.1%
	Portfolio 3	-13.4%	**23.2%**	177.3%	-0.9%	98.9%	71.7%	-30.3%	**-49.4%**	**63.0%**	1.6%	**-12.1%**
	Portfolio 4	**7.2%**	**16.6%**	**201.1%**	**16.2%**	66.1%	**105.1%**	-31.6%	**-54.5%**	**71.4%**	-5.6%	**-18.3%**
	Portfolio 5	**13.1%**	**-5.3%**	121.4%	**16.4%**	38.4%	34.4%	-33.7%	**-53.7%**	46.8%	1.1%	**-19.2%**
TMAI_R	Portfolio 1	-33.4%	-40.1%	**250.6%**	**18.5%**	**395.8%**	**117.3%**	**-15.0%**	-61.8%	43.0%	**30.1%**	-38.4%
	Portfolio 2	-16.2%	-19.9%	**189.2%**	15.6%	61.8%	**127.4%**	**-25.6%**	**-53.4%**	**92.5%**	5.7%	-24.7%
	Portfolio 3	**-11.4%**	**2.5%**	**224.4%**	**30.4%**	71.9%	53.6%	**-21.9%**	**-46.9%**	**69.7%**	3.4%	**-17.5%**
	Portfolio 4	**-0.9%**	**10.4%**	148.6%	0.2%	71.4%	73.7%	-43.6%	**-51.1%**	49.4%	-1.2%	**-20.3%**
	Portfolio 5	**-2.0%**	**19.0%**	128.1%	14.6%	121.3%	40.3%	-34.5%	-60.4%	49.8%	-3.3%	**-16.6%**

Bold font is used for values that are higher than they are for the benchmark portfolio.
Source: own study.

Tab. 3: Cumulated rate of return and geometric average rate of return.

	Benchmark portfolio (BP)	TMAI					TMAI_R				
		Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5
Cumulated rate of return	419%	110%	**856%**	414%	**512%**	89%	**565%**	338%	**508%**	163%	197%
Geometric average rate of return	16.2%	7.0%	**22.8%**	16.1%	**17.9%**	5.9%	**18.8%**	14.4%	**17.8%**	9.2%	10.4%

Bold font is used for values that are higher than they are for the benchmark portfolio.
Source: own study.

There are the Sharpe ratios for constructed portfolios in the Table 4. It can be noticed that the Sharpe ratio for the BP has positive value 6 out of 11 times. The Portfolio 2 in the TMAI ranking has higher value of the Sharpe ratio than it is for the BP in case of 7 years. While the positive values of the Sharpe ratio are studied, then the Portfolio 2 in case of 3 years has higher positive value of the Sharpe ratio than it is for the BP (the opposite situation is 3 times). The Portfolio 1 in the TMAI_R ranking has higher value of the Sharpe ratio than it is for the BP in case of 3 years. While the positive values of the Sharpe ratio are studied then

the Portfolio 1 only once has higher positive value of the Sharpe ratio than it is for the BP (the opposite situation is 5 times). The comparison of the positive values of the Sharpe ratio points out that the Portfolio 2 in the TMAI ranking has higher positive value of he Sharpe ratio than it is for the Portfolio 1 in the TMAI_R ranking in case of 5 years (the opposite situation is only once).

Tab. 4: The Sharpe ratio for constructed portfolios.

Year		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Benchmark portfolio (BP)		-2.14	-1.49	4.54	0.55	3.53	2.33	-1.40	-2.85	2.48	0.17	-1.47
TMAI	Portfolio 1	-4.50	-4.23	3.33	0.20	2.84	1.67	**-1.21**	**-2.80**	1.32	**1.07**	-2.05
	Portfolio 2	**-1.95**	**-1.42**	3.60	**1.03**	**3.61**	2.32	**-0.72**	**-2.77**	2.46	**0.22**	-1.78
	Portfolio 3	**-2.05**	**0.75**	4.09	-0.46	3.03	2.17	-1.55	**-2.42**	**2.52**	-0.19	**-0.81**
	Portfolio 4	**-0.61**	**0.50**	4.53	0.52	3.07	**2.48**	-1.63	-3.12	**2.84**	-0.86	**-1.18**
	Portfolio 5	**-0.19**	**-1.19**	3.05	**0.56**	1.63	1.14	-1.73	**-2.45**	2.23	-0.30	**-1.14**
TMAI_R	Portfolio 1	-2.85	-2.95	3.53	0.45	2.79	2.17	**-0.71**	**-2.64**	1.12	**1.05**	-2.22
	Portfolio 2	**-1.98**	-1.62	3.58	0.43	1.71	**2.66**	**-1.34**	**-2.63**	**2.88**	0.09	-1.47
	Portfolio 3	**-1.99**	**-0.56**	4.53	**0.88**	3.07	1.49	**-1.14**	**-2.61**	**2.73**	-0.06	**-1.15**
	Portfolio 4	**-1.08**	**0.03**	3.74	-0.37	2.85	2.24	-2.04	**-2.70**	**2.65**	-0.42	**-1.27**
	Portfolio 5	**-1.23**	**0.75**	3.51	0.50	3.44	1.22	-1.54	**-2.78**	2.20	-0.78	**-0.91**

Bold font is used for values that are higher than they are for the benchmark portfolio.
Source: own study.

Conclusion

The article is an attempt to point out the set of financial ratios that should be used to choose stocks to the portfolio. Two sets of financial ratios are studied: all financial ratios as well as their relative growth rates (they are used in the construction of TMAI ranking) and profitability ratios as well as their relative growth rates (they are used in the construction of TMAI_R ranking). As a result, it can be stated that the Portfolio 2 in the TMAI ranking is better one in terms of the average geometric rate of return and the Sharpe ratio than any other portfolio in the TMAI_R ranking.

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