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Financial markets

9. The application of a multidimensional comparative analysis for the short selling of stocks

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Abstract

In this article the application of the taxonomic measure of investment attractiveness (TMAI) has been presented. It is the element of multidimensional comparative analysis. An empirical study based on the data from the Warsaw Stock Exchange has been conducted. The time scope embraces years 2009–2014 in which different types of market trends occurred. There was a bullish, bearish as well as the horizontal trend. Calculations have been carried out of almost 80 public shares from sWIG80. TMAI value has been computed for each stock on the grounds of financial analysis. It is the synthetic measure which has been estimated on the basis of a dozen financial ratios e.g. asset

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management, liquidity, profitability, debt management as well as market value ratios. Both have been counted in the research and downloaded from stock market services. All of the ratios have been classified as nominants, stimulants or destimulants. Furthermore, the standardization of variables has been carried out. In the article the "not weighted" type of TMAI has been utilized which means that variables are of the same importance in terms of their final impact on the TMAI's value. Shares with the lowest values of TMAI have been selected to short-sell portfolio according to the assumption that such stocks are potentially the worst investment assets. The aim of the research is to verify the usefulness of the TMAI method for creating short-sell portfolios. The hypothesis states that the portfolio built on the grounds of stocks with the relatively low TMAI value got comparatively lower rates of return than other portfolios and the market benchmark. The verification of the hypothesis has been done in terms of the rate of return achieved. Such an approach enables an investor to sort financial assets from the best to the worst investments. It occurs that in a period given, the performance of companies with relatively low TMAI was much worse than other firms. The rates of return of such shares were especially low 3 years after they had been purchased.

Introduction

Along with the development of the Warsaw Stock Exchange, more and more companies have been listed there. In such conditions, the choice of appropriate stocks becomes even harder. It derives from the lack of explicit rules of stock selection for one's portfolio. Furthermore, the utilization of risk measurement techniques and the rate of return can lead to wrong conclusions. This situation urged investors to seek the effective methods which would help them to make long-term accurate decisions. In this regard, many people believe that a fundamental analysis can be useful to make a good choice. However, without any rigorous criteria, it would be misleading too. So even this method should comply to some procedures. Consequently, the statistical methods became increasingly popular. To most helpful belong: multidimensional comparative analysis and taxonomic methods (Tarczyński and Łuniewska, 2004, p. 60–90). Taxonomy concerns the issues of object classification on the basis of their features. It includes a lot of techniques and it helps in distinguishing homogenous groups of elements. It also can be utilized to order the set of objects and determine a certain measure of synthetic assessment (Proniewski and Tarasiuk, 2012, p. 165).

The article presents an original approach to the Taxonomic Measure of Investment Attractiveness (TMAI) as it focuses on its usefulness for negative selection. It means that unlike studies of the majority of authors who are keen on TMAI issues and use this indicator to build portfolios by buying stocks, the article checks the efficiency of TMAI in terms of indicating companies with relatively worse growth prospects. Then, such investment objectives may be convenient assets for short selling. There is also an assumption taken that all the companies which are studied can be an object of short selling (it is only a premise because actually only some stocks are available for such trade actions). Such an approach constitutes an original research approach. Initially, the TMAI measure was introduced and propagated by the works of W. Tarczyński and taken up by many other authors. Notwithstanding this, the utilization of TMAI has been mainly focused on the selection of companies for long-side portfolios – it has been used to indicate stocks with potentially extraordinary growth prospects. This article presents a different (opposite) approach as TMAI is calculated with the aim to point out shares which would presumably bring extraordinarily weak rates of return. As a result, they might be profitable components of short-selling portfolios.

The aim of the article is to verify the usefulness of the TMAI method for creating short-sell portfolios. The hypothesis states that the portfolio built on the grounds of stocks with a relatively low TMAI value got comparatively lower rates of return than other portfolios and the market benchmark. The verification of the hypothesis has been done in terms of the rate of return achieved.

The empirical part of the article has been based on the comparative analysis, financial analysis and the analysis of Pearson's correlation. Mean and median rates of return of stocks have been computed. Then, these variables have been compared with each other and benchmark values.

9.1. The characteristics of multidimensional comparative analysis

The concept of multidimensional comparative analysis (MCA) is related to the group of statistical methods which aim at the simultaneous analysis of more than 2 variables describing an object or occurrence. These methods are used to examine factors which characterize analysed objects but are not directly measurable. MCA consists of orderly and a homogeneous group of objects (features) which serve to choose an object in terms of a specific criterion. Objects and variables (characteristics) belong to the basic terms of multidimensional comparative analysis. When it comes

to stock market analysis, financial ratios calculated for separate companies can serve as variables. Companies listed on the exchange constitute objects. Variables can be both quantitative and qualitative (Tarczyński and Łuniewska, 2006).

The essence of MCA or taxonomic methods is very compound on account of a large number of variables as well as the diversity of methods that can be potentially utilized. Due to the complexity of this matter, the manner of conducting this analysis can be different every time, however, some activities remain stable regardless of the characteristics of an issue methods (Tarczyński and Łuniewska, 2004, p. 60–90).

According to another definition, MCA constitutes a formally consistent set of statistical methods which serve to select information purposely about elements of some groups. First and foremost, it is aimed at detecting the regularity of mutual relations between those elements (Jarocka, 2012; Gorzelak, 1981).

Variables used in a research can have various characters and may be even incomparable. Practically, they can be divided into three groups (Tarczyński and Łuniewska, 2006):

- nominants,
- stimulants,
- destimulants.

Variables having a positive impact on the analysed criterion are called stimulants. The higher is its value, the better it is. Destimulants along with their growing value influence negatively a situation. Features with optimal values in a given range are nominants. Values higher or lower than a stated figure are believed to be undesirable (Tarczyński and Łuniewska, 2006).

The procedure of MCA includes the choice of variables describing the analysed objects. For instance, companies quoted on stock exchanges can constitute objects. Then, the ratios taken to a research should be normalized and ought to build together an aggregate and synthetic measure. The normalization of measures is very vital due to the fact that variables must be mutually comparable and fully standardized. Finishing the previous stage allows for the construction of an aggregate measure which provides a multidimensional description of every object. An object which will be given the highest marks in terms of most analysed features will be granted the highest synthetic grade. It is usually standardised in the range between 0 and 1, where 1 is the best value (Proniewski, 2012, p. 165).

Ratio analysis as the part of financial analysis (fundamental analysis in general) requires taking data from financial statements of companies. As shown in the previous subsection, there are 5 main groups of financial indicators: profitability, liquidity, debt management, asset management

and market value. Despite their precise definition, usually it is desirable to comment on their value in the light of the whole financial statement, current situation of a firm on the market and the accountancy policy taken by a company. There can be distinguished two main groups of ratio analysis: one-dimensional and multi-dimensional. In one-dimensional analysis only single ratios are taken into account and they are the objects of conclusion. In multi-dimensional analysis many indicators are used. Mutual connections between them are analysed (Gruszczyński, 2002, p. 131–134).

Multi-dimensional analysis is possible to be conducted after selecting the number of ratios and determining the relation between them. This selection should be done on the grounds of many financial statements. The sample ought to be numerous to be representative. In this type of an analysis practically all available methods of multi-dimensional statistics and econometrics can be used. In the literature, often used is the method of discrimination analysis (Gruszczyński, 2002, p. 134–135).

Multidimensional comparative analysis (MCA) is a scientific discipline dealing with methods and techniques used to compare objects (e.g., enterprises, clients, products) described by means of many qualities (Chałaj, 2002, p. 94). Thus, MCA examines complex phenomena, i.e. ones which cannot be measured in a direct way, and which depend on at least two different variables, observations on which are known. A complex phenomena is, for instance, a competitive position of an enterprise which may be described by means of a group of chosen statistical qualities (Wasilewska and Jasiakiewicz, 2000, p. 276; Turczak and Zwiech, 2009).

In order to assess the taxonomic measure of investment attractiveness (TMAI), Tarczyński uses a set of such features as a relation of hypothetical profit to net profit, dynamics of net profit, rate of return on shares, beta coefficient, current liquidity ratio, fast liquidity ratio, profitability, debt ratio, receivables rotation, stock rotation, rotation of payables, fixed assets efficiency and rate of return on equity capital. This made it possible to create a portfolio of securities based on criterion resulting from synthetic measure (Nermend, 2009). If market data for a certain company is not available to calculate market risk index (beta coefficient), risk of the investment can be described by various financial ratios that are commonly used to evaluate the financial condition of the company – profitability ratios, liquidity ratios, solvency ratios or turnover ratios (Cwynar, 2010).

The procedure of taxonomic measure of development can be split into several stages (Tarczyński and Łuniewska, 2006). The first step is to classify companies by their synthetic development measures. The classification criterion is the measure of economic and financial condition in the fields of: liquidity, profitability, indebtedness and management

efficiency. The base should comprise several dozen of companies. For this base, a fundamental portfolio should be constructed which takes into consideration the financial and economic condition of companies, as well as the long-term character of an investment. The synthetic development measure TMAI can be estimated with the following formulae (Tarczyński and Gazińska, 2012):

$$\mathrm{TMAI}_i = 1 - d_i / d_0 \tag{9.1}$$

where:
TMAI_i – synthetic development measure for the i-th object,
$i = 1, 2, \ldots, n$,
d_i – distance between the i-th object and the model object defined with the formula:

$$d_i = \sqrt{\sum_{j=1}^{m} \left(z_{ij} - z_{0j}\right)^2} \tag{9.2}$$

where:
$i = 1, 2, \ldots, n$,
d_o – norm which assures that TMAI_i values belong to the interval from 0 to 1:

$$\boldsymbol{d_0 = \overline{d} + a \times S_d} \tag{9.3}$$

where:
= standard deviation of d_i.

According to the previous relations, the marginal value for $\boldsymbol{a}$ constant may be found:

$$\boldsymbol{a \geq \frac{d_{i\max} - \overline{q}}{S_d}} \tag{9.4}$$

where:
$d_{i\max}$ = the maximum d_i value.

Then, the fundamental portfolio takes the form:

$$\mathbf{TMAI} = \sum_{i=1}^{n} x_i \times \mathbf{TMAI_i} \rightarrow \mathbf{min},$$
$$\sum_{i=1}^{n} x_i = 1\,, \tag{9.5}$$
$$x_i \geq 0$$

where:
TMAI = synthetic development measure.

TMAI is the synthetic measure which enables investors to assess objectively companies quoted on stock exchanges in the field of fundamental analysis. It may be used to examine the fundamental power of a given company, therefore, the attractiveness of investments, which means the economic and financial situation of the company. Instead of analysing many ratios separately, it is only one indicator which should be evaluated and interpreted. The main advantage of such an approach is its simplicity. Normally, conducting fundamental analysis of a company is a long and sophisticated process. This, quite reliable indicator may be, at least partially, taken as a substitute (Tarczyński, 1994, 1997, 2002; Mastalerz-Kodzis and Pospiech, 2011).

9.2. Data and research method

In this subsection the scope of the research is discussed (especially time, spatial and concerning the essential facts). Time time scope of the article can be generally outlined as 2009–2014 so shares quotations from this period have been taken into consideration. Financial indicators have been calculated at the end of 2010 and, in this case, only the data from this year has been used. Additionally, stock exchange quotations from 2009 and 2010 have been used in order to calculate the expected rates of return. There is an assumption that the potential investor started his investments on January, 2011 when s/he bought shares. Another presumption is that s/he sells securities after 1, 2 or 3 years of an investment so on January, 2012, 2013 or 2014. So yields of final portfolios have been calculated on the basis of 1, 2 or 3 – year stock quotations. The beginning of an investment has been chosen to be in January so as to start with the beginning of the year.

There are several other reasons why such a time frame has been selected. First, more than 20 years has passed since the Warsaw Stock Exchange was established. This period abounded in bullish and bearish trends so the author wanted to check the method of creating portfolios in diverse market

circumstances. Second, the data has been taken from the period of time relatively close to the actual moment of carrying out a research. This criterion has been met by the selection of time frame (5 years) between the end of 2009 and the beginning of 2014. Third, during the period mentioned, the WSE was by far more experienced market than in 1990s. Fourth, the years: 2011, 2012, 2013 and 2014 seem to be just ideal to verify performance of portfolios due to the alternately occurrence of bullish, horizontal and bearish market trends. Wobbling market situation staggered the confidence and trust of investors. In that period, the value of the index lost more than 10000 points and it was below 40000 points. It dropped by nearly 30 percent. Nevertheless, 2012 was by far the better year for the stock market. Until August 2012 there were neither bulls nor bears who had the market under control – it was the period of horizontal movements – there was no distinct trend – WIG changes fluctuated from local dips and tops and their range amounted to circa 16 percent (from top to bottom). One half of the year 2012 was horizontal and in the second half the value of WIG was going up – in the second quarter the upward trend started which lasted to 2013. From the second half of 2012 to the end of the research period at the end of March 2013 an upward trend occurred when WIG rose by 15 percent. Such a period has been chosen because of its specific market conditions. Owing to the above facts, the selection of years 2009–2014 is legitimate – the research could be conducted in a relatively variable economic surrounding – there occurred every possible market trend – upward, downward and horizontal which proves that the conclusions of the research may be drown for every market circumstances. Consequently, it is possible to measure the influence of index options on the efficiency of portfolios in the various market conditions.

To do so, and to have objective results, a large number of companies is required. On the whole, almost 80 companies have been chosen from stock market indices quoted on the Warsaw Stock Exchange. All of them are listed in table 9.2. Generally, 426 companies were listed on the WSE in 2011 so the research embraces circa 18 percent of the total number of firms. To companies selected belong those which are the members of the sWIG80 – index of 80 companies with the lower level of capitalization. Companies from this index have been selected because it was the assumption to conduct the research on the basis of medium-sized companies. Furthermore, in comparison with firms which are not members of any index mentioned above, they are by far more liquid in the market (turnover of their stocks is satisfactory) and their capitalisation is several times higher. Moreover, larger companies from WIG20 and mWIG40 are most often selected for research so selecting enterprises from sWIG80 may constitute an additional contribution to the studies over TMAI effectiveness.

However, some companies did not meet one basic criteria set in the research to be incessantly quoted on the stock market between 2011 and 2014 and, as a consequence, they had to be expelled from the examined group of firms.

The study has been carried out with the use of the data from Polish capital market and it can be especially interesting for Polish readers due to the fact that only companies quoted on the Warsaw Stock Exchange have been taken into consideration. Conducting the research has been possible on the grounds of the satisfactory liquidity of quoted stocks which, above all, plays a crucial role for institutional investors.

When it comes to the most essential source of data, quotations of stocks from gpwinfostrefa.pl and stooq.pl have been utilized. Financial information about companies has been downloaded from internet portals such as bankier.pl, money.pl and the official site of the Warsaw Stock Exchange. Another source of data constitutes financial statements of companies, especially yearly consolidated reports from webpages of every company. Some indicators of fundamental analysis have been calculated on the basis of the author's own study and others have been taken from the stock database *Notoria Serwis*. To calculate these indicators the data from 2010 has been obtained.

The research consists of 5 main stages. The study has been divided into stages in order to make it transparent and to provide the clear distinction between selection, calculation, creation of portfolios and conclusions. Moreover, it indicates the extensiveness and complexity of the research as well as the difficult nature of investment issues. Realizing each stage one by one has been necessary to build portfolios of companies quoted on the Warsaw Stock Exchange. It begins with the choice of time frame which financial data have been gathered from. The next is the selection of companies which are the objects of the research. Then, rates of return of stocks for each company have been calculated. The next steps concern activities related to the estimation of the taxonomic measure of investment attractiveness (TMAI).

At the beginning of the research (**stage 1**) it was necessary to select the time frame of the research. It was divided into two parts:

- period 1 (January, 2009 to December, 2010) from which financial data was gathered. It served to calculate financial ratios,
- period 2 (January, 2011 to January, 2014) served to collect data of stock quotations with the aim to check investment results of portfolios.

The time frame is very vital owing to the fact that the results of the research would vary significantly in different market conditions – normally the rate of return of stocks is by far higher in the upward trend than in a downward trend. As a consequence, the time range from January, 2011

to January, 2014 (3 years of testing) is good enough to verify the accuracy and reliability of an investment system. Auxiliary calculations such as financial indicators, have been prepared on the data from 2009 to December, 2010, taken both from financial reports and the *Notoria* database as well as some other sources.

Another thing is related to the choice of companies that have been building their final portfolios. All firms selected to the research were the representatives of the sWIG80 index. Nevertheless, some companies, have been excluded due to their withdrawal from the stock market during the period examined. Consequently, the number of stocks taken to the research does not precisely amount to 80.

Stage 2 is devoted to financial analysis. It consists of a selection of financial indicators and their calculation for each company. The author based the research mainly on the ratios taken from the stock information database *Notoria Serwis*. Some of them were also obtained from web portals: http://bankier.pl and http://money.pl. In the case of the part of the ratios presented the author conducted his own calculations. The *Notoria* database consists, inter alia, of consolidated financial reports of companies and financial ratios. Table 9.1 presents indicators utilized in the research as well as groups they belong to and formulas to estimate them. On the whole, there have been 23 indicators calculated for each enterprise. For the total number of 23 indicators there are: 4 liquidity ratios, 7 activity ratios, 4 debt management ratios, 6 profitability ratios and 2 market value ratios.

Stage 3 concerns the calculation of rates of return of companies for the data from 2011–2014. The historical data of stock quotations has been utilized from 4 years (2011–2014). Moreover, by such a manner returns on the WIG, WIG20 and sWIG80 index have been counted so as to provide comparison between the performance of portfolios created and market benchmarks. Importantly, while calculating rates of return of shares, corporate actions have been taken into consideration. It means that such events as dividends and splits influence stock prices so prices have been each single time recounted so as to assure that corporate actions did not have a direct and immediate impact on the rate of return calculated.

9.3. The application of the taxonomic measure of investment attractiveness

This subsection is devoted to the description of the application of the taxonomic measure of investment attractiveness (TMAI). However, this part of the article focuses chiefly on the practical side of this application,

not the theoretical one. It is connected to **stages 4–5**. The manner of the TMAI calculation has also been presented.

From the wide range of financial indicators that would possibly match this research, 23 have been selected. They have been listed in table 9.1. Nevertheless, obtaining values of these ratios is not sufficient to process further computation of TMAI. Some of these ratios are positive for the assessment of the company when they rise. For other ratios, the lower is their value, the better it is for the company. There is also other group of ratios which should amount to the value from the specific range believed to be the most favourable. As it is visible, the interpretation of ratios is not clearly explicit so with the aim of conducting TMAI, ratios, treated as variables, ought to be transformed into converted indicators that may be homogeneously interpreted. Variables which are positive for companies when their value rise are called stimulants. On the contrary to this, variables that are assessed positively when their values decline, are called destimulants. Some indicators have desired values in the certain range – these are nominants. Crucially, destimulants and nominants should be transformed into stimulants so as to lead to the situation that higher values of every ratio signify better financial condition of companies. To convert destimulants into stimulant the following formulae can be used (Tarczyński and Łuniewska, 2006, p. 12):

$$Z_{ij(s)} = 1 - Z_{ij(d)} \quad \text{or} \quad Z_{ij(s)} = \frac{1}{Z_{ij(d)}} \tag{9.6}$$

where:
$Z_{ij(s)}$ – the value of destimulant converted into stimulant,
$Z_{ij(d)}$ – the original value of destimulant.

To convert nominants into stimulant the followi ng formulae can be used (Tarczyński and Łuniewska, 2006, p. 12):

$$Z_{ij} = \frac{\min(\text{nom}_j; Z_{ijN})}{\max(\text{nom}_j; Z_{ijN})}, \quad Z_{ij} = -|Z_{ijN} - \text{nom}_j|. \tag{9.7}$$

where:
Z_{ij} – the value of nominant converted into stimulant,
nom_j – nominal value of j variable.

Table 9.1 presents the division of ratios utilized in the research into stimulants, destimulants and nominants.

Stage 5 is comprised of the final calculation of TMAI. TMAI is the synthetic indicator which includes several or more indicators in itself. It can serve as a relative measure to compare stocks and to draw a conclusion which one offers brighter investment prospects and potentially a higher rate of return. It is important to stress that there are 2 types of that indicator:

- TMAI with weights,
- TMAI without weights.

The financial ratios shown in table 9.1 have an influence on the TMAI value. In the approach to count this indicator 'without weights' each variable (financial ratio) has the same impact on the final value of TMAI. This method is based on the assumption that, in fact, variables do not differentiate results to a large extent – their significance is comparable (Tarczyński and Łuniewska, 2006, p. 44–45). The method of TMAI calculation 'without weights' has been used in this article.

Type of indicator	Indicator	Group of ratio	Formula	Preferred value range (for nominants only)
Stimulants	Gross profit on sales margin	Profitability ratio	Gross profit on sales / Sales	
	Gross profit margin	Profitability ratio	Gross profit / Sales	
	Operating profit margin	Profitability ratio	Operating profit / Sales	
	Return on Sales (RoS)	Profitability ratio	Net income / Sales	
	Return on Assets (RoA)	Profitability ratio	Net income / Total assets	
	Return on Equity (RoE)	Profitability ratio	(Net income / Shareholders' equity) * 100%	
	Net working capital	Liquidity	Current assets – current liabilities	
	Asset Coverage Ratio	Liquidity	(Total assets – intangible assets – current liabilities – debt obligations) / total debt outstanding	
	Times-interest-earned (TIE)	Debt management	EBIT / Interest charges	

Type of indicator	Indicator	Group of ratio	Formula	Preferred value range (for nominants only)
Nominants	Current ratio	Liquidity	Current assets / Current liabilities	1.5 – 2.0
	Quick ratio	Liquidity	(Current assets – Inventory) / (Current liabilities)	1.0 – 1.2
	Super quick ratio	Liquidity	(Current assets – inventory – prepaid expense – net accounts receivable) / current liabilities	1.0 – 1.2
	Days Sales Outstanding (DSO)	Activity ratio	Receivables / Average sales per day	7.0 – 17.0
	Debt ratio	Debt management	Total debt / Total assets	0.57 – 0.67
Destimulants	Inventory turnover ratio	Activity ratio	Sales / Inventories	
	Operating cycle	Activity ratio	Days inventory outstanding + days sales outstanding – days payable outstanding	
	Liability turnover ratio	Activity ratio	(Current liabilities / costs of revenues) * 360	
	Cash conversion cycle	Activity ratio	Inventory conversion period + receivables conversion period – payables conversion period	
	Current assets turnover ratio	Activity ratio	Sales / current assets	
	Assets turnover ratio	Activity ratio	Sales / assets	
	Debt / EBITDA ratio	Debt management	Total liabilities / EBITDA	
	Price / Earnings (P/E)	Market value	Market price of one share / Earnings per one share	
	Market / Book value ratio (M/BV)	Market value	Market price per share / Book value per share	

Table 9.1. Types of ratios applied in the research

Source: own study based on Gabrusewicz, 2002; Brigham and Houston, 2005, p. 78–89; Dębski, 2011; Gajdka and Walińska, 2000; and websites: Smallbusiness, Advanced AR funding; Investowords and Investopedia.

9.4. Key empirical findings

Table 9.2 presents the value of TMAI for each company as well as their rates of return. There is an assumption that shares were bought at the beginning of 2011 (at the first session at the opening price). This date is the reference point for the rate of return computation. The profitability has been calculated for each stock at three different dates: after 1, 2 and 3 years so at 2nd January 2012, 2nd January 2013 and 2nd January 2014.

Enterprise	Rate of return after 1 year (%)	Rate of return after 2 years (%)	Rate of re turn after 3 years (%)	Tmai
AB SA	–23.07	–2.09	27.24	0.367
ABC DATA	–41.07	–43.57	23.51	0.347
AGROTON	–46.55	–71.26	–94.40	0.372
ALCHEMIA	–42.50	–37.50	–33.75	0.314
ALMA	–29.31	–43.03	–24.03	0.335
AMICA	–22.98	31.55	186.66	0.336
APATOR	–5.58	80.70	111.28	0.348
ARCTIC	–42.05	–51.97	–77.30	0.331
ARMATURA	–56.11	–59.74	–44.88	0.309
ASSECO BUSINESS SOLUTIONS	–23.07	–2.09	26.30	0.376
ASSECO CENTRAL EUROPE (ASSECOSLO)	–27.81	–7.53	5.84	0.353
ATM	–46.40	39.89	70.96	0.316
AUTOMOTIVE COMPONENTS	–48.30	–31.21	104.88	0.339
AZOTY TARNÓW	–7.43	83.09	117.33	0.350
BARLINEK	–71.39	–75.94	–66.31	0.298
BBI DEVELOPMENT	–41.30	–17.39	–13.04	0.398
BOMI	–72.24	–97.79	–99.88	0.308
CALATRAVA (IB SYSTEM)	–5.26	0.00	–94.74	0.313
CC ENERGY (KAREN)	–68.35	–74.68	–86.08	0.287
CENTRUM NOWOCZESNYCH TECHNOLOGII S.A.	–24.25	–12.41	–45.52	0.338

Enterprise	Rate of return after 1 year (%)	Rate of return after 2 years (%)	Rate of re turn after 3 years (%)	Tmai
CHEMOSERVIS-DWORY	–54.35	–58.70	–60.87	0.310
CIECH	–18.07	4.54	46.24	0.288
CITY INTERACTIVE	17.85	–5.16	–55.98	0.381
COGNOR (CENTROSTAL)	35.42	–9.17	–49.17	0.278
COMARCH	–33.80	–10.38	20.38	0.336
COMP	–3.01	–10.68	–1.50	0.333
CORMAY	172.23	107.46	39.06	0.315
DEBICA	–12.50	5.42	88.93	0.340
DOM DEVELOPMENT	–29.60	–14.08	39.94	0.381
EFH	–62.61	–84.35	–93.48	0.323
ERBUD	–75.06	–76.44	–42.41	0.336
FAMUR	33.71	121.91	146.63	0.324
FARMACOL	–43.00	–18.53	69.43	0.363
GANT	–61.35	–76.63	–96.41	0.443
GRAJEWO	–46.13	24.06	168.87	0.336
HAWE	–21.50	–5.00	–15.25	0.350
IDM	–56.71	–92.95	–96.98	0.654
INTEGER	43.54	131.49	304.02	0.431
INTERCARS	9.65	19.72	164.20	0.354
IPOPEMA	–46.55	–40.77	–48.80	0.633
JUTRZENKA (COLIAN)	–40.41	–43.52	–8.55	0.352
JWCONSTRUCTION	–66.07	–74.58	–67.86	0.323
KOFOLA-HOOP	–43.59	–15.71	10.26	0.309
KORPORACJA BUDOWLANA DOM	–58.48	–60.78	–90.77	0.150
KREZUS	140.00	636.00	500.00	0.663
KRUSZWICA	–22.83	–56.11	–4.66	0.347
KULCZYK OIL VENTURES	–16.88	–14.29	–24.68	0.155
LC CORP	–41.61	–21.48	11.41	0.501
LENTEX	–19.83	–4.22	79.32	0.322
LUBAWA	–47.41	–48.15	25.93	0.300

Enterprise	Rate of return after 1 year (%)	Rate of return after 2 years (%)	Rate of re turn after 3 years (%)	Tmai
MENNICA	–9.48	87.01	28.18	0.373
MILKILAND	–68.79	–67.67	–71.42	0.349
MIRBUD	–54.45	–68.70	–60.31	0.317
MNI	–46.15	–54.77	–48.00	0.349
MOSTOSTAL WARSZAWA	–73.33	–79.08	–92.52	0.345
MOSTOSTAL ZABRZE	–53.45	–58.55	–28.73	0.309
NEUCA	–7.10	33.04	303.33	0.373
OCTAVA	68.34	–64.32	–59.30	0.428
OPTIMUS (CD PROJEKT RED)	–15.92	5.10	177.07	0.281
PBS FINANSE (BEEFSAN)	–58.39	–61.93	–68.13	0.262
PGF (PELION)	–44.97	–39.40	111.99	0.318
POLAQUA	–72.40	–80.81	–78.05	0.240
POLICE	32.77	65.27	231.93	0.325
PZU	–5.98	41.79	62.52	0.661
RAFAKO	–39.37	–33.94	–49.61	0.319
SANOK	57.41	272.22	366.67	0.351
STALEXPORT	–7.58	5.30	86.36	0.335
STALPROFIL	–40.89	–27.29	0.57	0.299
SYGNITY	19.22	–4.24	31.68	0.299
ŚNIEŻKA	–43.25	0.09	20.19	0.351
TRAKCJA	–83.41	–85.61	–68.54	0.324
VISTULA	–61.54	–48.08	–10.10	0.329
WAWEL	17.70	95.73	209.45	0.363
ZELMER	–25.89	9.36	10.34	0.343

Table 9.2. Statistics of companies from sWIG80
Source: own development based on the research.

Table 9.3 includes the similar data as table 9.2, however, it has been aggregated in groups. The second column concerns the fraction of stocks which had the lowest TMAI value. The figure '6%' denotes that the line with data covers information about stocks which are embraced in a group of shares which had the lowest TMAI value. So, in this case, it focuses on the 6% of the firms with the lowest TMAI (6% of sWIG80 equals to the number of 5 companies). As an example, a line with 50% means that the data concerns almost 40 companies out of 80 in the sWIG80 index. There are presented mean and median rates of return 1, 2 or 3 years after buying shares. There are significant differences between the I. and the XIV. group of stocks. To compare properly the data in the table, it is desirable to contrast two extreme values – for group I. and XIV. When it comes to mean rate of return, after 1 year it varies from -34.15% for I. to -26.6% for XIV. After 2 years it varies from -45.4% to -12.68%. The rate of return counted at the beginning of 2014 has the most considerable deviation. The market value of the first group fell by more than 62%. Contrarily, the market value of the XIV. group rose by 22%. When it comes to median rates of return, the differences are also significant. For the 1-year change the spread in the median profitability between I. and XIV. group amounts to almost 20%. It is even higher for 2-years and 3-years change, 45% and 68% respectively. The variation in the rate of return level of I. and XIV. group cannot be coincidental because the data listed in the table 9.3 indicate the steady, one-directional trend. With decreasing TMAI value the mean and median rate of return of a group plummets too. It is clearly visible that lower TMAI is connected to worse stock performance, whereas higher TMAI supports generally better returns. Such a favorable trend regarding 3-years rate of return is presented in chart 9.1 and chart 9.2 with mean and median profitability respectively. These findings are also confirmed by the data in table 9.4. It presents the rate of return of 3 indices on the Warsaw Stock Exchange: WIG, WIG20 and sWIG80. Naturally, in this research sWIG80 plays the most important role as the benchmark because it is related to the performance of companies which were the objects of the study. It includes medium enterprises that are characterized by less capitalization and less liquidity than companies from WIG20 and mWIG40. The comparison between the data in both tables proves that shares with the lowest TMAI value (e.g. group I., II., III. etc.) have by far lower rates of return (average and median) than benchmark (sWIG80). Interestingly, for higher groups i.e. XIII. or XIV. the mean return is higher than sWIG80 rate of return. Presumably, such a situation can be caused by the relatively large stake of companies with high TMAI. It would signify that, on the contrary to the low TMAI values, the high one's characterize stocks with relatively good growth prospects.

Another important thing is the correlation analysis. The Pearson's correlation between rate of return of stocks and their TMAI values varied between 24% to 36%. It appears that the relation is positive, however, not very strong. With growing TMAI value, in general, rates of return grew too. Just the opposite situation occurs when the TMAI is low. Then also returns are likely to decrease. Stocks from the first groups (such as I., II., III. etc.) would bring handsome profits if included in a short-sell portfolio.

No. of the group	The percent of companies with the lowest TMAI (%)	Mean			Median		
		The rate of return after 1 year (%)	The rate of return after 2 years (%)	The rate of return after 3 years (%)	The rate of return after 1 year (%)	The rate of return after 2 years (%)	The rate of return after 3 years (%)
I.	6	–34.15	–45.40	–62.16	–58.39	–60.78	–68.13
II.	13	–38.54	–39.53	–23.93	–49.64	–44.04	–57.74
III.	19	–38.86	–41.31	–20.00	–47.41	–48.15	–28.73
IV.	25	–28.44	–33.41	–24.76	–45.50	–42.82	–39.32
V.	31	–30.95	–30.98	–13.71	–44.97	–37.50	–33.75
VI.	38	–30.65	–27.73	–6.47	–45.69	–38.45	–39.32
VII.	44	–30.37	–28.01	–6.31	–43.59	–39.40	–28.73
VIII.	50	–31.63	–25.60	1.68	–43.04	–35.72	–26.70
IX.	56	–32.18	–26.12	3.87	–42.50	–33.94	–24.03
X.	63	–32.62	–25.32	3.49	–42.27	–35.72	–19.64
XI.	69	–30.77	–17.48	12.29	–41.07	–31.21	–8.55
XII.	75	–29.63	–15.63	17.53	–40.98	–22.91	–3.08
XIII.	81	–28.14	–12.91	21.44	–39.37	–14.29	0.57
XIV.	88	–26.60	–12.68	22.00	–39.89	–16.55	–0.47

Table 9.3. The profitability of companies in terms of TMAI value
Source: own development based on the research.

Index	% price change		
	1–year	2–years	3–years
WIG	–20.83	–0.06	7.99
WIG20	–21.85	–5.87	–12.51
sWIG80	–30.47	–14.54	17.32

Table 9.4. Rates of return of the benchmarks
Source: own study based on the data from Stooq.pl portal.

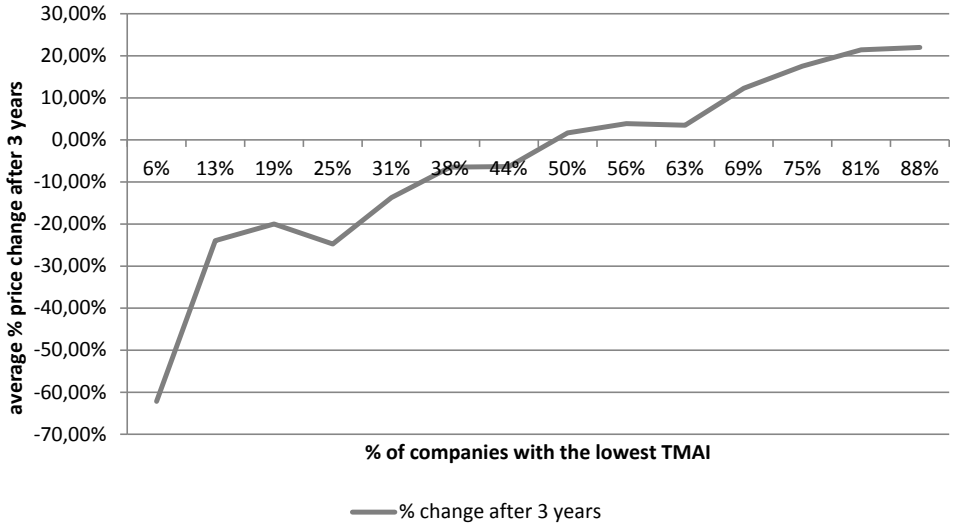

Chart 9.1. The mean profitability of companies in terms of TMAI value
Source: own development based on the research.

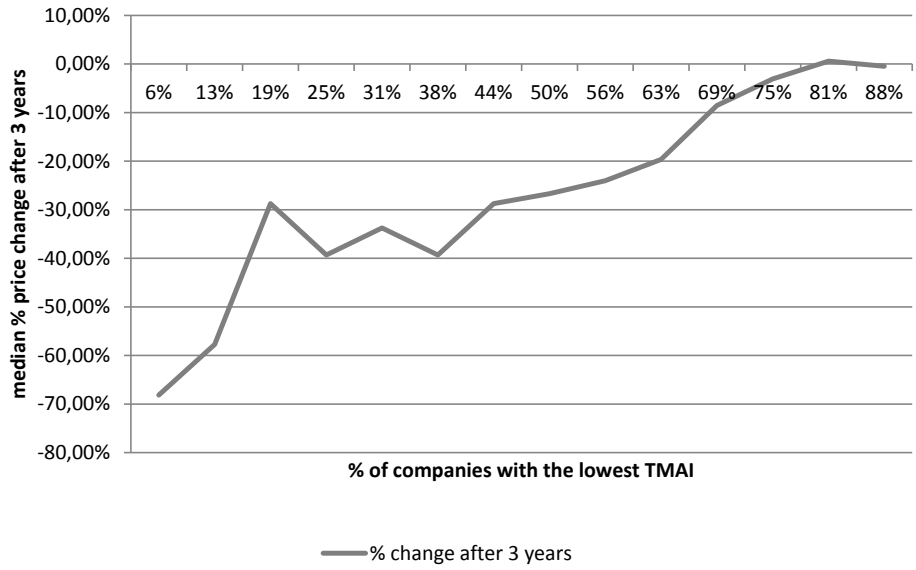

Chart 9.2. The median profitability of companies in terms of TMAI value
Source: own development based on the research.

Conclusion

In the article TMAI serves as a tool for stock selection. However, apart from this ratio, there are also other crucial factors which need to be taken into consideration while making investment decisions. To these factors belong, inter alia: risk, the rate of return and the desired level of diversification. These concepts are crucial in understanding the efficiency of stock portfolios.

One of the important issues which have not been raised thoroughly in the article is the "weighted" variety of TMAI. Sometimes there occur some reasons to suppose that variables are of different importance. It can derive from previous researches or the author's knowledge. In such cases variables must have various influence on the final synthetic measure. To take it into account, special weights of each variable should be introduced. In other words, weight is the stake in the variability of the synthetic measure. One type of weight is the expert's weight (granted by researchers or practitioners being proficient in the given subject) and the second is a statistical weight which is estimated with the use of statistical tools. Variables of the highest changeability are preferred and are given top weights due to their strongest impact on diversifying TMAI final value (Tarczyński and Łuniewska, 2006, p. 44–45). The application of "weighted" TMAI would bring interesting results. Undeniably, this issue would give rise to further discussion.

On the whole, the research gave an empirical evidence that TMAI, in certain circumstances that appeared on the Polish capital market in 2009–2014, can be a very useful tool for selecting companies to short-sell portfolios. It proved that in the market conditions which occurred during 2009–2014 on the Warsaw Stock Exchange, it was helpful in building stock portfolios which had extraordinary falls in value. This would be economically justified as companies with the lowest TMAI value have in general the worse financial situation and tend to be managed in a less efficient way which leads to downturns in their stock prices. Therefore, TMAI can be used to take both long and short positions in the instance of its extreme values. Very high values would suggest buying stocks. In turn, very low values indicate that it would be worth short-selling a particular stock. Of course, it is important to emphasize that in spite of the fact that a correlation analysis proved the existence of this relationship, interdependence of these variables is rather weak or moderate. It seems that in such a context TMAI can be a useful, however, there should also be used other methods which would confirm its indications.

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