Routledge
Taylor & Francis Group

Economic Research-Ekonomska Istraživanja

ISSN: 1331-677X (Print) 1848-9664 (Online) Journal homepage: https://www.tandfonline.com/loi/rero20

The accuracy of alternative stock valuation methods – the case of the Warsaw Stock Exchange

Błażej Prusak

To cite this article: Błażej Prusak (2017) The accuracy of alternative stock valuation methods – the case of the Warsaw Stock Exchange, Economic Research-Ekonomska Istraživanja, 30:1, 416-438, DOI: 10.1080/1331677X.2017.1305793

To link to this article: https://doi.org/10.1080/1331677X.2017.1305793

Published online: 07 Apr 2017.

ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA, 2017
VOL. 30, NO. 1, 416–438
https://doi.org/10.1080/1331677X.2017.1305793

Routledge
Taylor & Francis Group

The accuracy of alternative stock valuation methods – the case of the Warsaw Stock Exchange

Błażej Prusak

Faculty of Management and Economics, Department of Economic Analysis and Finance, Gdańsk University of Technology, Gdańsk, Poland

ABSTRACT

The main aim of this article is to examine the accuracy of different methods of share valuation used by Polish analysts in reports prepared in order to issue recommendations for companies listed on the Warsaw Stock Exchange. In the literature on the subject, the view which prevails is that the more sophisticated methods, i.e. those taking into account the discounting process, are characterised by higher valuation accuracy. However, the results of the present analysis show that Polish analysts achieve more accurate valuations using the market approach than the DCF model. Nevertheless, the highest level of accuracy is achieved by the target price, which in most cases is the value of the weighted average of valuations obtained via a market valuation and discounting methods. In terms of the multiples which are taken into account in this research, the highest accuracy is achieved with the use of EV/EBIT, although there are no statistically significant differences between the valuations calculated using this multiple and the results obtained with the P/E and EV/EBITDA multiples. Valuations prepared with the use of individual multiples usually generate greater errors compared to the DCF model and the market approach, which uses the weighted average of the valuations achieved with individual multiples.

ARTICLE HISTORY
Received 11 September 2014
Accepted 10 June 2016

KEYWORDS
Share valuation; stock recommendations; financial reports; fundamental analysis; DCF; market approach; multiples

JEL CLASSIFICATIONS
G11; G24; G32

1. Introduction

Stock recommendations are inherent to the functioning of stock exchanges. Their main aim is to present the opinion of analysts on the potential directions of changes in the share prices of companies, while at the same time they assist the clients of brokerage houses in their investment decisions. They may take the form of so-called sell-side and buy-side recommendations. Sell-side recommendations are usually issued by brokerage houses which prepare analytical reports for their clients or a wide audience, whereas the buy-side type of reports and recommendations are prepared by analysts working for financial institutions involved in asset management. They are internal documents and their main objective is to

CONTACT Błażej Prusak pb@zie.pg.gda.pl

indicate which assets the institution should invest in and which it should get rid of or avoid. This study will only focus on sell-side recommendations.

Stock recommendations are the final result of analyses carried out by analysts and those contained in financial reports. These reports are prepared by means of a fundamental analysis of the company and a valuation of it. In theory, there are many share valuation methods, but in reports of this type the income and the market (relative) approaches are most commonly used. The research presented so far in the literature has focused primarily on evaluating the accuracy of stock recommendations and on identifying the main determinants of this accuracy. However, particularly in the case of emerging markets, little attention has been given to examining which of the methods of share valuation are characterised by the highest level of accuracy. Hence, this is the main objective of this article. The research hypothesis assumed is that *the income method of share valuation (discounted cash flow – DCF) allows for greater accuracy (lower error), i.e. a valuation closer to the market price of the company, than that achieved via the market approach*. The article also examines which of the methods most commonly used in practice offers a valuation which is closest to the market price of shares, and it contains a detailed description of the methods used by Polish analysts. The study is based on the public analytical reports of companies listed on the Warsaw Stock Exchange. To the author's knowledge, it is the first study of its kind conducted on an emerging market.

The article is structured as follows. The second section reviews the literature on the effectiveness of recommendations, discusses current research results on the accuracy of stock recommendations in Poland and abroad, and sets out the types of share valuation methods used in practice and the key factors influencing their accuracy. The third section describes the methodology of the present study and characterises the types of share valuation method used in analytical reports. The fourth section contains the results and the final one provides a summary of the research and the conclusions of the analysis carried out.

2. Literature review

2.1. The effectiveness of stock recommendations

Stock recommendations are issued on the basis of analyses that take into account the valuation of shares. Their main purpose is to present information to the potential addressees of analytical reports to enable them to make the right investment decision. In practice, however, it turns out that the credibility and effectiveness of stock recommendations are questionable. The previous literature shows inconclusive results of research on this subject. The accuracy of recommendations has been examined either over the entire duration of their validity, or in the final moment of their validity, or after a specified period from the date of issue. For example, in a study conducted on the U.S. market, Asquith, Mikhail, and Au (2005) obtain a 54% level of accuracy of recommendations in the 12 months following their release, while Bradshaw, Brown, and Huang (2013) find levels of 64% for comparisons carried out throughout the entire duration of recommendations but only 38% at the end of the period of validity.[1]

Several studies on the effectiveness of recommendations have also been completed in Poland. Depending on the study period and the method adopted, the accuracy of recommendations ranges from 46% to 65.93%.[2] These results indicate that relying solely on stock recommendations in the process of stock selection is insufficient and may even result in

losses being incurred. Hence, it is necessary to intensify research aimed at improving the accuracy of stock recommendations and to analyse the factors that influence it.

2.2. Factors affecting the accuracy of stock recommendations

Due to the low credibility of stock recommendations, researchers have tried to find the factors responsible for their low levels of accuracy. They have looked for relations between the level of accuracy and different variables. On the basis of the literature, the most influential factors are:

- the accuracy of earnings forecasts;
- the quality level of institutions;
- psychological aspects;
- the previous performance of analysts;
- share valuation methods.

The accuracy of earnings forecasts

The accuracy of earnings forecasts is a key parameter. This is due to the fact that the earnings forecast is one of the key factors determining the value of shares in discounted valuation methods, and it also plays an important, albeit smaller, role in estimating the value of shares using multiples. However, in this case too the results of research are inconsistent.

Gleason, Johnson, and Li (2013) and Loh and Mian (2006) demonstrate a positive correlation between the accuracy of earnings forecasts and that of the target price. Nevertheless, Eames, Glover, and Kennedy (2006) point to a possible lack of correlation between these factors, which may be due to analysts consciously or unconsciously overestimating or underestimating earnings. For example, Hwang and Lou (2011) confirm the relationship, showing that analysts often intentionally manipulate earnings forecasts to achieve a better reliability of their recommendations. They call this phenomenon 'self-fulfilling stock recommendations.' In addition, the lack of a relationship between the accuracy of earnings forecasts and the accuracy of recommendations can result from incorrect forecasts of other key variables used in share valuation models.

The quality level of institutions

Studies on recommendations have also searched for the relationship between their accuracy and the quality level of institutions. Here too, however, the results of analyses are inconclusive. Bradshaw, Huang, and Tan (2012) conduct a cross-sectional study encompassing both developed and developing countries, and show that in countries with a better institutional infrastructure, the accuracy of recommendations is higher. This results from stronger investor protection, a more transparent flow of information on the financial market, and less volatile markets. Barniv, Hope, Myring, and Thomas (2010) achieve different results. They divide countries into ones with weak and strong investor protection, and check the accuracy of recommendations on this basis. It turns out that in countries with strong investor protection analysts rely mainly on heuristics, particularly on the PEG (price/earnings to growth ratio) measure and to a lesser extent on the discounted residual income model. As

a result, the accuracy of recommendations is significantly lower in countries with weaker investor protection, where analysts rely more on the discounted residual income model. The conclusion is that in countries with strong investor protection the accuracy of recommendations can be improved by assigning greater importance to the valuation of shares using the discounted residual income model than to heuristics. Much significance should also be attributed to the quality and accuracy of earnings forecasts, which have a large impact on share valuations via the discounted residual income method.

Psychological aspects

Another group of factors researched is that of psychological ones. A dominant role is attributed to sentiment and the herding effect. Bagnoli, Clement, Crawley, and Watts (2010) conduct a comprehensive study on this area and reach the conclusion that the accuracy of recommendations issued by analysts who follow sentiment is lower compared to that of analysts who are not influenced by it. Being led by sentiment and the herding effect usually result in the market prices of securities being different from their intrinsic value. The higher the level of sentiment, the greater the deviation, which results among other things in the formation of speculative bubbles in certain markets or instruments. Sudden changes in sentiment are particularly dangerous because exaggerated optimism turns into exaggerated pessimism, and the price level of securities falls dramatically from a level significantly exceeding their intrinsic value to one significantly below it.

The previous performance of analysts

Another important factor that has been observed is the relationship between the results previously obtained by analysts and the accuracy of their forecasts. Mikhail, Walther, and Willis (2004a) and Li (2005) prove that analysts whose recommendations have generated a higher rate of return in the past also obtain better results of forecasts in the future. In addition, Mikhail, Walther, and Wang (2004b) identify the factors which characterise analysts who achieve more accurate recommendations, and it turns out that they specialise in forecasting the stock prices of companies operating in only a few sectors, use a broader range of information, issue their recommendations before other analysts, tend to issue recommendations just a few days from the moment the quarterly reports of companies are made public, rarely seem to update their reports causing changes in the type of recommendation, and have more skills in predicting a deterioration in the financial situation of companies.

Share valuation methods

The choice of share valuation method is a very important issue in the context of the accuracy of recommendations. The view that dominates in theory is that more sophisticated methods, such as discounted cash flow (DCF) and discounted residual income (RIV), generate better results than the market approach (Demirakos, Strong, & Walker, 2004, p. 223; Koller, Goedhart, & Wessels, 2010, pp. 313, 332). In practice, however, it transpires that analysts in many countries are more likely to rely on simpler methods, such as the market approach, and are less likely to use discounted methods. For example, Block (1999) conducted a survey in the United States in October 1998 among the members of AIRM (Association for

Investment Management and Research). He received 297 complete responses (33.75% of all the forms sent out) and they showed that 15.2% of the respondents always used discounted techniques, 45.7% never did, and the remainder used them sometimes. Research carried out by Asquith et al. (2005) based on 1,126 financial reports issued between 1997 and 1999 shows that various discounted cash flow methods for share valuations were used in only 12.8% of the reports, while in 99.1% of them multiples based on different types of income (P/E – price to earnings; relative P/E; multiples built on EBITDA[3]) were used. Asset multiples were applied in 25.1% of the reports. Other share valuation methods were used very rarely, e.g. the PEG measure was applied in only 7 of the 1,126 reports. No relationship between the type of share valuation method and the accuracy of the recommendations was found. On the basis of research carried out on a sample of 103 financial reports, most of which were produced in the first quarter of 1999, Bradshaw (2002) observes that in a significant number of them the stock multiple P/E was used for the valuation. The PEG measure also appeared relatively frequently. Bradshaw (2004) later found that analysts mainly relied on heuristics, such as PEG and LTG (long term growth), and to a lesser extent on the discounted residual income model. Earnings projections were not adequately implemented in the discounted residual income model, which in turn resulted in a lack of correlation or the presence of a negative correlation between the share valuations made using this method and the recommendation issued, which generated a positive return on the investment. Demirakos, Strong and Walker (2004) report a study on the use of share valuation methods in 104 financial reports prepared in the period between 1997 and 2001 for UK companies. They show that the P/E ratio (88.5%) and sales multiples – P/S [price to sales] and EV[4]/S [enterprise value to sales] (50%) were used most frequently in share valuations. The DCF model was also used relatively frequently (38.5%). Regarding other better-known methods, the analysts rarely reached for the discounted residual income model (1.9%). Moreover, this study analyses three sectors – pharmaceuticals, electronics and beverage production – and finds a diversity of share valuation methods in the different sectors. For example, multiples were used more often for beverage production than in the pharmaceutical and electronics sectors.

The same authors later extended their study. On the basis of 490 financial reports on companies listed on the London Stock Exchange published between July 2002 and June 2004, they explored how the effectiveness of the market approach to share valuations and the DCF method developed. The multiples used most frequently were P/E, EV/EBIT[5], EV/EBITDA and PEG. Evaluation of the effectiveness of the valuation was carried out by means of target price accuracy and forecast errors, both over the 12-month period of the recommendations and at the end of the period. The main conclusions drawn are as follows: (1) throughout the test group, the market approach is used slightly more often than the DCF method (52.86% as opposed to 47.14%); (2) the market approach is more effective than the DCF method when it is tested throughout the duration of the recommendations; (3) examination of the effectiveness of valuations at the end of the validity period of recommendations does not show significant differences between the methods; (4) when taking into account specific factors differentiating the companies valued in the conditional analysis, the effectiveness of the DCF method improves and this method produces better results with the measurement error indicator calculated at the end of the 12-month recommendation period than the market approach; (5) the DCF model is used more often than the market approach for share valuations of companies which are small or more risky, generate losses, have extreme (very negative or very positive) levels of sales revenue growth, and for which there is a limited

number of comparable entities in the sector; (6) analysts use the market approach more often during rises in share prices (bull market) and the DCF method in periods of falling stock prices (bear market) (Demirakos, Strong, & Walker, 2010).

Simon and Curtis (2011) link the effect of reputation building and the type of share valuation method with the accuracy of recommendations. They show that analysts who have issued more accurate recommendations in the past use a more sophisticated method to value shares, i.e. discounted residual income instead of heuristics, such as the PEG multiple. For both 'buy' and 'sell' recommendations, analysts with a better reputation who use the discounted residual income method achieve positive returns on investment, in contrast to analysts issuing less accurate recommendations. A general conclusion can be drawn from these studies that the PEG model does not work in the valuation of shares, and in particular that its application by analysts with a weaker reputation generates inaccurate valuations.

Fernandez (2013) also conducts extensive research into the use of methods to value companies. It transpires from *Valuation Using Multiples. How Do Analysts Reach Their Conclusion?* that analysts still prefer to use simpler valuation methods, i.e. multiples, rather than more sophisticated methods which take into account the discounting process. The multiples most commonly used in the valuation process are P/E, EV/EBITDA, EV/S and P/S, and the choice of multiples depends on the sector in which the entities valued operate. Moreover, Fernandez proves that multiples are characterised by high dispersion, which in turn puts into question the correctness and accuracy of valuations prepared using them. The latest research on the Australian market conducted in 2015 by KPMG (2015) shows that the DCF and market approach are equally popular business valuation methods, with asset-based methods in third place. Among the multiples most favoured are EV/EBITDA, EV/EBIT, P/E and EV/S. In addition, analysts use P/EBT (price to earnings before tax) and P/BV (price to book value) fairly often. As for other multiples, business appraisers rarely employ EV/RAB,[6] EV/Reserves, EV/Production or EV/Passenger measures.

To sum up, it can be concluded that analysts use the market approach more often than discounted methods for share valuations. In recent years, however, there has been a tendency for analysts to also apply the latter. The most commonly used multiples are: P/E, EV/EBITDA, EV/EBIT, EV/S and PEG. Among the discounted methods, the most popular is DCF, followed by residual income. However, research carried out so far shows no clear significant advantage of either of these methods, but it indicates that the use of certain methods depends on the sector in which the companies analysed operate and on the profile of their business activity.

3. Data and methodology

3.1. Data

The first stage of the present study is collecting data on the methods and main principles of share valuation used by Polish analysts to determine target prices and issue their recommendations. For this purpose, financial reports of companies listed on the Warsaw Stock Exchange prepared for the period between 2009 and 2012 and available in the database of the financial portal BANKIER.PL (www.bankier.pl) are used. These reports contain a fundamental analysis of companies with valuations, in most cases together with a final recommendation. Analysis of each report leads to specifying the stock valuation methods used,

together with the fixed values which were established on that basis. In valuing shares, some institutions increase the value determined for a given day by the interest rate equal to the cost of equity, and make the conversion at the end of the recommendation validity period (see, e.g., DI BRE). The present analysis covers financial reports prepared by well-known Polish financial institutions, namely: BM BGŻ, BM DnB Nord, DI BRE, DM AmerBrokers, DM BDM, DM BOŚ, DM BPS, DM BZWBK, DM Noble Securities, DM PKO BP and Millenium DM. Data are collected from a total of 731 company financial reports.

Some of these reports are only presented in a shortened version, which results in the information obtained from them being limited, and therefore some observations being removed. In addition, updated versions of reports which were issued less than six months from the date of an earlier version of the report are also deleted from the database. The final result is 560 observations which include the following data: the target price, the valuation method and the value of the share determined on that basis.

The companies on which the reports are based belong to various industries, which influences the valuation method selected. Different valuation methods are employed for developers and financial institutions, mainly banks. For developers, the method frequently used is Net Asset Valuation (NAV), while for banks it is the dividend method (P/B – ROE[7]). Most of the valuations are carried out assuming continuation of the company's activity, but in some cases liquidation of the entity is assumed, which results in the application of the liquidation method to value the shares, among other methods. Information about the target price is available in the case of all the observations.

As it is presented in Table 1 the DCF method is applied in 511 observations; the market approach in 503 observations; the P/B-ROE (dividend discount model) method, which can be assigned to a group of income methods, in 44 observations; the Net Asset Valuation method in 10 observations; the discounted residual income method, which can be classified as an income method, in 5 observations; and valuation with the SOTP (the sum of the parts) method is employed in 1 observation. In the case of 6 observations, the SOTP method is used with the valuation of the key parts of the equity made using other methods, such as DCF. In these cases, SOTP is not considered the primary method of valuation and the method used to value the key assets is registered: the liquidation method in 4 observations and the Wilcox Gambler model in 1 observation. The valuation of one insurer was performed with the SOTP method (included in the SOTP observation group) with the valuation of the components conducted via the EEV (European Embedded Value) method, which was specifically designed for the valuation of such units.

In most cases, the target price is determined on the basis of two valuation methods and only rarely using just one method. The significance assigned to the individual methods is determined subjectively by the analysts. In addition, the results presented show that Polish analysts do not use the contingent claims approach to share valuation. There is no evidence to explain this, but we can assume that the reasons are as follows:

- The contingent claims approach is a more sophisticated method in comparison to others.
- The method requires a number of different assumptions to be met, which is particularly difficult for developing markets.

The multiples used most frequently for share valuations are: P/E, EV/EBITDA and EV/EBIT (see Table 2). One multiple applied less often but still relatively frequently compared

Table 1. Share valuation methods used in the analytical reports.

	Number of observations	%
DCF	511	91.25%
Market approach (multiples)	503	89.82%
P/B – ROE model	44	7.86%
NAV (net asset value)	10	1.79%
Residual income	5	0.89%
Liquidation approach	4	0.71%
SOTP (sum of the parts)	1	0.18%
Wilcox-Gambler model	1	0.18%
Total	560	

Source: Author's calculation.

Table 2. Multiples applied to share valuations.

	Number of observations	%
P/E (price to earnings)	461	91.65%
EV/EBITDA (enterprise value to EBITDA)	454	90.26%
EV/EBIT (enterprise value to EBIT)	146	29.03%
P/BV (price to book value)	69	13.72%
P/S or MC/S (price to sales or market capitalisation to sales)	36	7.16%
P/EBIT (price to EBIT)	23	4.57%
P/CE (price to cash earnings)	19	3.78%
EV/S (enterprise value to sales)	11	2.19%
PBV/ROE (P/BV to return on equity)	7	1.39%
EV/FCF (enterprise value to free cash flow)	2	0.40%
P/EV (price to embedded value) orMC/EV (market capitalisation to embedded value)	1	0.20%
Net Debt/Equity	1	0.20%
DY (dividend yield)	1	0.20%
P/AUM (price/assets under management)	1	0.20%
Total (the total number of observations where the market approach is used to value shares)	503	

Source: Author's calculation.

to others is P/BV. Compared to the results in Fernandez (2013), it can be seen that Polish analysts rarely apply EV/S in the valuation process.

It can also be established from the data how often the analysts used trailing multiples and forward multiples in the valuation process (see Table 3). Forward multiples are applied most often (84.55%). The combination of trailing and forward multiples was used less often (11.8% of cases), and in rare cases the valuation is prepared solely on the basis of trailing multiples (3.65% of the observations).

As information about the type of multiples – forward or trailing – used in some observations is missing, the total number of cases contained in this table differs from the number of observations regarding the application of methods using multiples included in Table 1.

From the perspective of the analysis, the significance given by the analysts to particular valuation methods to determine the target price is also important (see Table 4). For this purpose, the following methods are classified as income methods: DCF, discounted residual income (RIV) and the dividend method. The significance assigned to income methods is then compared to that of the market approach. The analysts attribute significance to individual methods in a subjective manner, but generally it can be established that they treat income methods and the market approach as having equal importance in about 69% of the cases and they favour income methods in about 30% of the observations, which suggests

Table 3. Multiples applied in share valuations, sorted into forward and trailing types.

	Number of observations	%
Both trailing and forward multiples used	55	11.80%
Only forward multiples used	394	84.55%
Only trailing multiples used	17	3.65%
Total	470	100.00%

Source: Author's calculation.

Table 4. Observations according to the importance assigned to particular valuation methods.

	Number of observations	%
Observations in which greater significance is given to income methods than the market approach	143	29.92%
Observations in which equal significance is given to income methods and the market approach	330	69.04%
Observations in which less significance is given to income methods than the market approach	5	1.04%
Total	478	100.00%

Source: Author's calculation.

that they prefer income methods to the market approach. Only in five cases do analysts assign greater importance to the market approach (about 1% of the cases).

3.2. Methodology

In the second, crucial, stage of this study, a comparison is made between the valuations obtained with different methods and the market price of the shares. The main objective of this study is to determine the types of share valuation methods characterised by the highest accuracy and at the same time the lowest valuation error. The analyses are performed for the end of the validity period of the recommendations and after 6, 9 and 12 months (static approach). Moreover, for 'buy' and 'sell' recommendations the accuracy of share valuation methods is verified over the entire duration of the recommendation and for periods of 6, 9 and 12 months from the date of issue (dynamic approach). Other types of recommendations such as 'hold' or 'accumulate' are omitted because the target prices in these cases differ slightly from the market prices on the report. Due to the relatively high volatility of stock markets, which is even greater in developing countries than in developed countries, differences between market prices and the intrinsic value of stock are normal. This could lead to a situation in which for the above-mentioned recommendations the share valuation methods would result in a high degree of accuracy due to the small difference between the target price and the market price at the time when the recommendations are prepared. Such high levels of accuracy could be misleading and would derive from the volatility of share prices on the market and not from the accuracy of the valuations.

Evaluation of the accuracy of the various valuation methods is performed using a valuation error indicator, which is calculated for each observation. In the static approach, the following formula is applied:

$$ERR_{END} = \left| \frac{V - P_{END}}{P_{END}} \right| \tag{1}$$

where:

ERR_{END} is the valuation error established at the end of the period – 6, 9 or 12 months from the date of the report or the end of the validity of the recommendation,

V is the valuation achieved using the given method,

P_{END} is the closing market price at the end of the period (as above).

In the dynamic approach, the formula has the following form:

$$ERR_{dynamic} = min\left|\frac{V - P_t}{P_t}\right| \tag{2}$$

where:

$ERR_{dynamic}$ is the valuation error representing the minimum error value obtained for the period (as above),

V is the share valuation achieved with the use of the given method,

P_t is the closing market price for each trading day in the period (as above).

The valuation methods with the lowest errors will have the highest accuracy.

The aim of this study is to verify the following hypothesis:

Hypothesis. The income method of share valuations (DCF) is more accurate than the market approach.

This hypothesis is compatible with many views presented in the literature (see Demirakos et al., 2004, p. 223; Koller et al., 2010, pp. 313-332). Alongside verification of the above hypothesis, calculations are also carried out to determine the accuracy ranking of the valuations obtained using the most commonly applied methods.

Certain problems and limitations are encountered in analysing the reports. Polish financial institutions adopt different periods for valuations and recommendations, i.e. 6, 9 and 12 months. Therefore, the analyses are performed for these periods regardless of the periods for which the individual recommendations were issued. In addition, another analysis is carried out taking into account the validity period of the recommendation for each company. Moreover, some financial institutions changed the valuation and recommendation validity period over time. Therefore, the assumed period of analysis (2009–2012) corresponds to periods in which individual institutions made no changes to the duration of their recommendations and valuations. Some institutions determine the duration of recommendations in periods of, for example, 6 to 9 months. In this case, the analysis takes into account the maximum periods of the recommendation. There are also institutions which state that their valuations and recommendations are valid for a given period of time or until a new update is released. In addition, there are cases in which updates are issued only a short time after the previous recommendation, which means that the recommendation is valid for a short period. Such changes are, however, difficult to include in an analysis, and such reports cannot automatically be recognised as long-term, which is a function they should fulfil as they are based on fundamental analysis. Therefore, in this analysis each report is treated independently.

Cases in which some information is missing, such as market prices, are removed from the available test group. The number of observations is then determined in such a way that appropriate valuation methods can be compared for each variant. This means that for each variant there has to be a valuation obtained with the use of each of the methods compared.

Statistics describing the use of the particular methods for share valuation presented in the first part of this section have been taken into consideration when choosing the methods to be compared. It is assumed, therefore, that the study will encounter errors in cases of mixed valuation: those based on the target price (this valuation is mostly calculated as the weighted average of valuations obtained with the use of different methods), the DCF, relative valuation methods (including the impact of different multiples) and valuations carried out using the following multiples: P/E, EV/EBIT and EV/EBITDA. Other valuation methods are used too rarely to be able to compare their accuracy. Thus, they are omitted from the analysis.

After selecting the observations with accurate collected data, the following numbers of observations remain:

Static approach

Variant I – target price (mixed valuation), DCF, market approach: 471 observations;

Variant II – target price (mixed valuation), DCF, market approach, P/E, EV/EBITDA, EV/EBIT: 136 observations;

Dynamic approach

Variant I – target price (mixed valuation), DCF, market approach: 202 observations;

Variant II – target price (mixed valuation), DCF, market approach, P/E, EV/EBITDA, EV/EBIT: 60 observations.

Next, a statistical test is chosen to compare the errors in the individual methods. Due to the fact that the error distributions are not normal, the non-parametric Friedman Two-Way ANOVA by Ranks Test is selected. This test indicates whether the measurement errors obtained in this study using different valuation methods are the same. Therefore, the following statistical hypotheses are tested:

H0 – The error distributions in valuations obtained by means of different methods are identical.

H1 (alternative) – The error distributions in valuations obtained by means of different methods are not always identical.

The Friedman test statistic (χ^2) measures the difference between the sums of the ranks for each variable and is calculated using the following formula (Sheskin, 2004):

$$\chi^2 = \frac{12}{nk(k+1)} \sum_{j=1}^{k} R_j^2 - 3n(k+1) \tag{3}$$

where:

k is the number of distributions of variables (types of valuation methods) compared,

n is the size of the test group,

R_j^2 is the sum of the ranks in j-time measurement of the variable (the sum of the ranks for particular test groups).

The analysis is carried out with an assumed significance level of $\alpha = 0.05$, which means that for $p<0.05$ the null hypothesis will be rejected in favour of the alternative hypothesis. From the standpoint of the analysis, it is expected that the null hypothesis will be rejected

in favour of the alternative one, which will mean that the distributions of the valuation errors obtained with the various methods are not identical.

The above method of statistical verification does not, however, answer the question of whether all the distributions of errors obtained by the various methods differ from each other. If the valuation errors calculated for two methods are different from one another, it is sufficient to reject the null hypothesis in favour of the alternative one. Therefore, in a further stage, the errors obtained for the different methods are analysed on the basis of the median and the mean value in order to determine a ranking of the methods in terms of their valuation accuracy. The lower the mean and the median, the lower the valuation error and the higher the valuation accuracy. However, in this type of analysis one should be careful when drawing conclusions because the error distributions of the valuations are not normal.

Following the results of the descriptive statistics of individual errors, a comparison of pairs of valuation errors achieved by means of the selected methods is next attempted. The following methods are compared: the target price (mixed valuation) with the market approach, the target price (mixed valuation) with DCF, the market approach with DCF, and valuations carried out using multiples such as P/E, EV/EBITDA and EV/EBIT. The non-parametric Wilcoxon Signed Rank Test is applied for this purpose. This test indicates whether the measurement errors obtained using two different methods of valuation are the same. Therefore, the following statistical hypotheses are tested:

H0 – The error distributions in valuations obtained via two different methods are identical.

H1 (alternative) – The error distributions obtained via two different valuation methods differ from each other.

Tables 9–11 show the statistics *T* and Z, although during the verification of these hypotheses the latter is applied as it is recommended for a large test group of observations ($n \geq 25$).[8] As with the Friedman ANOVA Test, the analysis is performed with an assumed significance level of $\alpha = 0.05$. This means that for a $p<0.05$ valuation the error distributions determined by two methods differ.

4. Empirical results

After the statistical analysis and guided by the Friedman ANOVA statistics, the null hypothesis is rejected for all variants in favour of the alternative hypothesis, which means that not all distributions of errors obtained by using different valuation methods are identical (see Tables 5–8; for each case $p < 0.05$).

Comparing the errors obtained using the target price (mixed valuation), DCF and market approaches, for different periods and in both the static and dynamic approaches it can be observed that the highest number of errors is attributed to DCF (see Tables 5–8). Comparing the DCF method with the market approach proves the existence of statistically significant differences in the distributions of errors, although only in the dynamic approach. This relationship is not observed in the static approach. Comparing the target price with DCF, there are statistically significant differences in the distributions of errors detected in both the static and dynamic approaches. This confirms the advantage of a mixed valuation over a valuation performed by means of the DCF method. Juxtaposing the results obtained from a comparison of the target price with the market approach shows the superiority of the former for calculations made using the static approach. No statistically significant differences in

Table 5. Comparison between target price, DCF method and market approach for 6- and 9-month periods.

Static approach											
6 months						9 months					
Friedman's ANOVA test, Chi-square ANOVA (N = 471, df 2)=20.42662, p = 0.00004						Friedman's ANOVA test, Chi-square ANOVA (N = 471, df 2)=11.98363, p = 0.00250					
	Mean Rank	Rank Sum	Median	Mean	Standard deviation		Mean rank	Rank sum	Median	Mean	Standard deviation
Error-target price	1.841826	867.500	0.184492	0.416232	1.589341	Error-target price	1.880042	885.5000	0.227119	0.511911	1.801200
Error-DCF	2.127389	1,002.000	0.225225	0.466824	1.715656	Error-DCF	2.099788	989.0000	0.264637	0.558749	1.941530
Error-market approach	2.030786	956.500	0.220671	0.448907	1.406919	Error-market approach	2.020170	951.5000	0.254062	0.532693	1.531565
Dynamic approach											
Friedman's ANOVA test, Chi-square ANOVA (N = 202, df 2)=18.27688, p = 0.00011						Friedman's ANOVA test, Chi-square ANOVA (N = 202, df 2 =14.46995, p = 0.00072					
	Mean rank	Rank sum	Median	Mean	Standard deviation		Mean rank	Rank Sum	Median	Mean	Standard Deviation
Error-target price	1.896040	383.0000	0.038053	0.100721	0.144086	Error-target price	1.891089	382.0000	0.019164	0.088863	0.131694
Error-DCF	2.235149	451.5000	0.084310	0.148786	0.202244	Error-DCF	2.207921	446.0000	0.061263	0.133097	0.183322
Error-market approach	1.868812	377.5000	0.014949	0.118063	0.186888	Error-market approach	1.900990	384.0000	0.007233	0.105556	0.175390

Source: Author's calculation.

Table 6. Comparison between target price, DCF method and market approach for the 12-month period and for the period of the stock recommendation validity.

Static approach											
12 months						Period of stock recommendation validity					
Friedman's ANOVA test, Chi-square ANOVA (N = 471, df 2) =10.59934, p = 0.00499						Friedman's ANOVA test, Chi-square ANOVA (N = 471, df 2) =15.87227, p = 0.00036					
	Mean rank	Rank sum	Median	Mean	Standard deviation		Mean rank	Rank sum	Median	Mean	Standard Deviation
Error-target price	1.885350	888.0000	0.285873	0.627436	2.171174	Error-target price	1.874735	883.000	0.223496	0.516000	2.117271
Error-DCF	2.090234	984.5000	0.307625	0.672854	2.322052	Error-DCF	2.130573	1,003.500	0.244094	0.566313	2.275444
Error-market approach	2.024416	953.5000	0.302649	0.646458	1.830682	Error-market approach	1.994692	939.500	0.245342	0.534841	1.744835
Dynamic approach											
Friedman's ANOVA test, Chi-square ANOVA (N = 202, df 2) =13.97230, p = 0.00092						Friedman's ANOVA test, Chi-square ANOVA (N = 202, df 2) =15.07337, p = 0.00053					
	Mean rank	Rank sum	Median	Mean	Standard deviation		Mean rank	Rank sum	Median	Mean	Standard Deviation
Error-target price	1.896040	383.0000	0.008882	0.082998	0.131228	Error-target price	1.893564	382.5000	0.021718	0.091866	0.135405
Error-DCF	2.202970	445.0000	0.032985	0.123616	0.183129	Error-DCF	2.212871	447.0000	0.058323	0.134708	0.189269
Error-market approach	1.900990	384.0000	0.004633	0.099440	0.170515	Error-market approach	1.893564	382.5000	0.007753	0.105895	0.172108

Source: Author's calculation.

Table 7. Comparison between target price, DCF method, market approach and P/E, EV/EBITDA, EV/EBIT multiples for 6- and 9-month periods.

Static approach

6 months						9 months					
Friedman's ANOVA test, Chi-square ANOVA (N = 136, df 5) =40.52781, p = 0.00000						Friedman's ANOVA test, Chi-square ANOVA (N = 136, df 5) =36.36823, p = 0.00000					
	Mean rank	Rank sum	Median	Mean	Standard deviation		Mean rank	Rank sum	Median	Mean	Standard deviation
Error – target price	2.764706	376.0000	0.149985	0.249406	0.302566	Error – target price	2.882353	392.0000	0.215816	0.353734	0.538437
Error -DCF	3.272059	445.0000	0.203229	0.282758	0.310074	Error -DCF	3.095588	421.0000	0.229385	0.366005	0.554929
Error – market approach	3.382353	460.0000	0.197740	0.293437	0.319170	Error – market approach	3.466912	471.5000	0.279392	0.393719	0.537990
Error – P/E	3.816176	519.0000	0.244330	0.332705	0.319660	Error – P/E	3.871324	526.5000	0.330073	0.431891	0.491128
Error – EV/EBITDA	3.738971	508.5000	0.274017	0.335143	0.334922	Error – EV/EBITDA	3.753676	510.5000	0.316943	0.433581	0.578708
Error – EV/EBIT	4.025735	547.5000	0.219670	0.333734	0.345185	Error – EV/EBIT	3.930147	534.5000	0.306887	0.417483	0.568570

Dynamic approach

Friedman's ANOVA test, Chi-square ANOVA (N = 60, df 5) =14.33755, p = 0.01360						Friedman's ANOVA test, Chi-square ANOVA (N = 60, df 5) =13.80010, p = 0.01693					
	Mean rank	Rank sum	Median	Mean	Standard deviation		Mean rank	Rank sum	Median	Mean	Standard deviation
Error – target price	2.908333	174.5000	0.019464	0.087749	0.133804	Error – target price	2.925,000	175.5000	0.005737	0.066217	0.116709
Error -DCF	3.833333	230.0000	0.080170	0.135500	0.176773	Error -DCF	3.558333	213.5000	0.025926	0.100125	0.146602
Error – market approach	3.083333	185.0000	0.011806	0.105899	0.152114	Error – market approach	3.133333	188.0000	0.004878	0.090544	0.146762
Error – P/E	3.816667	229.0000	0.031870	0.140697	0.205609	Error – P/E	3.983333	239.0000	0.027013	0.133218	0.201318
Error – EV/EBITDA	3.583333	215.0000	0.055791	0.133012	0.193765	Error – EV/EBITDA	3.666667	220.0000	0.033596	0.114295	0.190102
Error – EV/EBIT	3.775,000	226.5000	0.036489	0.124425	0.162573	Error – EV/EBIT	3.733333	224.0000	0.015480	0.097758	0.147566

Source: Author's calculation.

Table 8. Comparison between target price, DCF method, market approach and P/E, EV/EBITDA, EV/EBIT multiples for the 12-month period and for the period of the stock recommendation validity.

Static approach											
12 months						Period of stock recommendation validity					
Friedman's ANOVA test, Chi-square ANOVA (N = 136, df 5) =48.75158, p = 0.00000						Friedman's ANOVA test, Chi-square ANOVA (N = 136, df 5) =39.99579, p = 0.00000					
	Mean Rank	Rank sum	Median	Mean	Standard deviation		Mean rank	Rank sum	Median	Mean	Standard deviation
Error – target price	2.860294	389.0000	0.269239	0.444858	0.679859	Error – target price	2.808824	382.0000	0.191663	0.303269	0.454733
Error -DCF	2.937500	399.5000	0.235708	0.448540	0.700053	Error -DCF	3.165441	430.5000	0.210560	0.327447	0.496158
Error – market approach	3.507353	477.0000	0.303492	0.490191	0.676670	Error – market approach	3.419118	465.0000	0.237016	0.345084	0.441680
Error – P/E	3.992647	543.0000	0.373764	0.535597	0.668748	Error – P/E	3.797794	516.5000	0.286662	0.379840	0.433048
Error – EV/EBITDA	3.716912	505.5000	0.339175	0.522038	0.712860	Error – EV/EBITDA	3.819853	519.5000	0.299493	0.391349	0.488946
Error – EV/EBIT	3.985294	542.0000	0.338127	0.515062	0.666306	Error – EV/EBIT	3.988971	542.5000	0.285898	0.374978	0.435287
Dynamic approach											
Friedman's ANOVA test, Chi-square ANOVA (N = 60, df 5) =16.61489, p = 0.00529						Friedman's ANOVA test, Chi-square ANOVA (N = 60, df 5) =12.45079, p = 0.02911					
	Mean rank	Rank sum	Median	Mean	Standard deviation		Mean rank	Rank sum	Median	Mean	Standard deviation
Error – target price	2.866667	172.0000	0.004120	0.060293	0.116380	Error – target price	2.991667	179.5000	0.011084	0.080445	0.134506
Error -DCF	3.491667	209.5000	0.007548	0.084850	0.142720	Error -DCF	3.725,000	223.5000	0.022933	0.111545	0.175880
Error – market approach	3.133333	188.0000	0.003104	0.086054	0.145729	Error – market approach	3.058333	183.5000	0.004905	0.095657	0.150124
Error – P/E	4.016667	241.0000	0.022245	0.128319	0.201920	Error – P/E	3.850,000	231.0000	0.024317	0.132356	0.201512
Error – EV/EBITDA	3.666667	220.0000	0.027949	0.104260	0.187107	Error – EV/EBITDA	3.633333	218.0000	0.046551	0.121808	0.193240
Error – EV/EBIT	3.825,000	229.5000	0.013423	0.090961	0.146591	Error – EV/EBIT	3.741667	224.5000	0.016583	0.107993	0.159011

Source: Author's calculation.

Table 9. Results of pairwise comparisons of errors using the DCF method, the market approach and the mixed method (target price) (using the non-parametric Wilcoxon Signed Rank Test).

6 months				9 months				12 months				Period of stock recommendation validity			
DCF versus market approach – static approach (variant I)															
N	T	Z	p	N	T	Z	P	N	T	Z	P	N	T	Z	p
469	52,128.00	1.014567	0.310313	469	52,888.00	0.755775	0.449785	469	52,888.00	0.755775	0.449785	469	52,120.00	1.017291	0.309016
DCF versus market approach – dynamic approach (variant I)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
193	6,932.000	3.125422	0.001776	191	6,898.000	2.967323	0.003004	188	6,857.000	2.711843	0.006691	191	6,934.000	2.920264	0.003498
Target price versus market approach – static approach (variant I)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
464	45,918.00	2.775843	0.005506	464	48,151.50	2.002988	0.045179	464	48,494.00	1.884473	0.059502	464	48,346.00	1.935685	0.052907
Target price versus market approach – dynamic approach (variant I)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
186	8,691.000	0.006120	0.995117	181	8,200.000	0.050293	0.959889	178	7,927.000	0.055924	0.955403	184	8,339.000	0.236371	0.813145
Target price versus DCF method – static approach (variant I)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
431	31,292.50	5.895846	0.000000	431	33,467.50	5.055267	0.000000	430	35,416.50	4.233453	0.000023	430	32,305.00	5.440157	0.000000
Target price versus DCF method – dynamic approach (variant I)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
170	3,436.000	5.961764	0.000000	167	3,473.000	5.658434	0.000000	164	3,475.000	5.401815	0.000000	167	3,387.000	5.795860	0.000000

N: number of observations, T: T statistic recommended for a small test group of observations, Z: Z statistic recommended for a large test group of observations, p: p-value.
Source: Author's calculation.

Table 10. Results of pairwise comparisons of errors using P/E, EV/EBITDA and EV/EBIT multiples (using the non-parametric Wilcoxon Signed Rank Test).

6 months				9 months				12 months				Period of stock recommendation validity			
P/E versus EV/EBITDA – static approach (variant II)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
135	4,579.000	0.024159	0.980726	135	4,441.000	0.327243	0.743484	135	4,241.000	0.766496	0.443382	135	4,448.000	0.311870	0.755140
P/E versus EV/EBITDA – dynamic approach (variant II)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
59	833.0000	0.392495	0.694693	59	772.0000	0.852921	0.393704	59	764.0000	0.913305	0.361083	59	848.0000	0.279275	0.780034
P/E versus EV/EBIT – static approach (variant II)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
135	4,496.000	0.206449	0.836440	135	4,148.000	0.970749	0.331674	135	4,050.000	1.185983	0.235630	135	4,349.000	0.529300	0.596598
P/E versus EV/EBIT – dynamic approach (variant II)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
60	824.0000	0.669906	0.502918	60	709.0000	1.516490	0.129396	58	650.0000	1.591053	0.111599	58	710.0000	1.126512	0.259950
EV/EBITDA versus EV/EBIT – static approach (variant II)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
136	4,431.000	0.493083	0.621954	136	4,624.000	0.073854	0.941127	136	4,445.000	0.462673	0.643599	136	4,655.000	0.006517	0.994801
EV/EBITDA versus EV/EBIT – dynamic approach (variant II)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
59	864.0000	0.158507	0.874057	59	859.0000	0.196247	0.844417	59	866.0000	0.143412	0.885965	59	872.0000	0.098124	0.921834

Source: Author's calculation.

Table 11. Results of pairwise comparisons of errors using the DCF method, the market approach and the EV/EBIT multiple (using the non-parametric Wilcoxon Signed Rank Test).

6 months				9 months				12 months				Period of stock recommendation validity			
Market approach versus EV/EBIT – static approach (variant II)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
135	3,131.000	3.204350	0.001354	135	3,769.000	1.803133	0.071368	134	3,510.000	2.248564	0.024541	135	3,445.000	2.514723	0.011913
Market approach versus EV/EBIT – dynamic approach (variant II)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
57	581.0000	1.950549	0.051112	57	692.0000	1.068630	0.285237	57	647.0000	1.426165	0.153822	57	623.0000	1.616850	0.105912
DCF method versus EV/EBIT – static approach (variant II)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
136	3,455.000	2.613125	0.008972	136	3,434.000	2.658741	0.007844	136	2,990.000	3.623186	0.000291	136	3,282.000	2.988911	0.002800
DCF method versus EV/EBIT – dynamic approach (variant II)															
N	T	Z	p	N	T	Z	p	N	T	Z	p	N	T	Z	p
59	811.0000	0.558550	0.576469	59	874.0000	0.083028	0.933830	59	816.0000	0.520810	0.602499	59	856.0000	0.218891	0.826735

Source: Author's calculation.

the distributions of errors obtained via the aforementioned methods are found using the dynamic approach (see Table 9).

The next stage involves comparing valuation errors calculated with the use of the three previous methods and additionally comparing them with valuations obtained by means of multiples, such as P/E, EV/EBITDA and EV/EBIT (see Table 10). Comparing pairs of valuations prepared with the use of multiples reveals that there are no statistically significant differences between the errors attributed to them. According to the descriptive statistics, only the EV/EBIT multiple has a slight advantage over the other two. Therefore, a list of valuations made by means of this multiple is compared with valuations obtained using the market approach and DCF. The mean value and the median of the errors determined for the market approach are lower when compared to the results calculated for EV/EBIT. The Wilcoxon test (see Table 11) indicates the presence of statistically significant differences in the distributions of errors obtained with these methods, but only for the static approach (except for the 9-month period, where the differences are statistically significant but remain at the level of 0.07). Similarly, only using the static approach are statistically significant differences in the distributions of valuation errors assigned to the DCF method and the EV/EBIT multiple observed. The fact that the mean values and the median of the valuation errors calculated for the static approach with the DCF method are lower than those determined for the use of the EV/EBIT multiple confirms the superiority of the former method of valuation (see Table 8).

5. Conclusion

To make share valuations for the purpose of issuing recommendations, Polish analysts mostly apply the market approach and the DCF model. In some sectors, such as banks, developers, and insurance companies, specially designed methods for share valuation are used: PB-ROE, NAV and EEV respectively. The most frequently applied multiples on which valuations are based are P/E and EV/EBITDA. The EV/EBIT multiple also appears relatively often. Forward multiples appear most often in the valuation process. The final valuation of shares is calculated as the average of the valuations obtained using two or three methods. The approach which dominates is for the final valuation to be the average of those obtained by means of the market approach and DCF. In most cases, equal significance is given to the market and income approaches. The test group also includes many reports in which the analyst assigns greater significance to the income approach than to the market valuation method. On rare occasions, the market approach is considered superior to the income method.

The main objective of this study has been to verify the research hypothesis which assumes a greater accuracy (lower error) of valuations achieved via the DCF method than via the market approach or by means of multiples. Moreover, an attempt has been made to establish a hierarchy of valuation methods in terms of their accuracy.

On the basis of the research conducted, the hypothesis is not confirmed. The highest level of accuracy has been found for a mixed valuation, which most often involves a weighted average of valuations calculated using the market approach and DCF. This is followed by the market valuation method, which is mostly performed as a weighted average of valuations made by means of individual multiples. The DCF model comes in third place in terms of

accuracy. Independent valuations carried out by means of the multiples P/E, EV/EBITDA and EV/EBIT achieve comparable results regarding errors. Among these multiples, the lowest mean values and median of valuation errors are generated by EV/EBIT, but it achieves weaker results in the static approach than the DCF model and the market approach. For calculations made in the dynamic approach, there are no differences between the valuations obtained using EV/EBIT, DCF or multiples.

It has also been found that analysts who make share valuations by averaging the results of valuations carried out using different methods or indicators obtain a higher degree of accuracy (lower error) than that of results achieved by means of individual valuation methods. This is the case of the mixed valuation, which usually involves averaging valuations carried out using the DCF model and the market approach, and of the market valuation, which involves averaging valuations carried out by means of different multiples.

The following recommendations are suggested for the development of future research on this topic:

- to conduct a similar study but focusing on different sectors, and also for SMEs and large companies;
- to research the reasons for the low level of accuracy of the DCF model.

Furthermore, it is recommended:

- that Polish analysts preparing stock recommendations use more sophisticated methods for share valuations.

Notes

1. In these studies, accuracy is seen as the market price reaching the level of the target price, or higher (lower) for recommendations with a higher (lower) target price in relation to the market price on the date of issue.
2. The accuracy of recommendations obtained by Polish researchers is as follows: Adamczyk (2010): 57%; Konopko (2012): 47%; and Prusak (2010): 65.93%.
3. EBITDA: earnings before interest, taxes, depreciation and amortisation.
4. EV (enterprise value) = market value of common stock + market value of preferred equity + market value of debt + minority interest – cash and investments.
5. EBIT: earnings before interest and taxes.
6. RAB: regulated asset base.
7. More information about the P/B ROE model can be found in articles written by J. W. Wilcox and T.K. Philips (1984, 2005).
8. A detailed description of the Wilcoxon test, along with a presentation of the *T* and Z statistics can be found in *Statistics for Business & Economics* (McClave, Benson, & Sincich, 2008).

Disclosure statement

No potential conflict of interest was reported by the author.

ORCID

Błażej Prusak http://orcid.org/0000-0002-6526-0407

References

Adamczyk, C. (2010). Supplementation of their own thoughts and not the oracle. Retrieved October 10, 2010, from http://ekonomia.rp.pl/artykul/561419.html.

Asquith, P., Mikhail, M., & Au, A. (2005). Information content of equity analysts reports. *Journal of Financial Economics, 75*, 245–282.

Bagnoli, M., Clement, M., Crawley, M., & Watts, S. (2010). The relative profitability of analysts' stock recommendations: What role does investor sentiment play? Retrieved January 20, 2014, from http://www.olin.wustl.edu/docs/Faculty/Clement.pdf

Barniv, R., Hope, Ole-Kristian, Myring, M., & Thomas, W. B. (2010). International evidence on analyst stock recommendations, valuations, and returns. *Contemporary Accounting Research, 27*, 1131–1167.

Block, S. (1999). A study of financial analysts: Practice and theory. *Financial Analysts Journal, 55*, 86–95.

Bradshaw, M. T. (2002). The use of target prices to justify sell-side analysts' stock recommendations. *Accounting Horizons, 16*, 27–41.

Bradshaw, M. T. (2004). How do analysts use their earnings forecasts in generating stock recommendations?. *The Accounting Review, 79*, 25–50.

Bradshaw, M. T., Brown, L. D., & Huang, K. (2013). Do sell-side analysts exhibit differential target price forecasting ability?". *Review of Accounting Studies, 18*, 930–955.

Bradshaw, M. T., Huang, A. G., & Tan H. (2012). Analyst target prices and forecast accuracy around the world. Retrieved January 20, 2014, from http://www.rotman.utoronto.ca/FacultyAndResearch/AcademicAreas/Accounting/-/media/Files/Programs-and-Areas/Accounting/AcademicPapers/HTan.pdf

Demirakos, E. G., Strong, N. C., & Walker, M. (2004). What valuation models do analysts use? *Accounting Horizons, 18*, 221–240.

Demirakos, E. G., Strong, N. C., & Walker, M. (2010). Does valuation model choice affect target price accuracy? *European Accounting Review, 19*, 35–72.

Eames, M. J., Glover, S. M., & Kennedy, J. J. (2006). Stock recommendations as a source of bias in earnings forecasts. *Behavioral Research in Accounting, 18*, 37–51.

Fernandez, P. (2013). Valuation using multiples: How do analysts reach their conclusions? Retrieved January 22, 2014, from http://ssrn.com/abstract=274972

Gleason, C. A., Johnson, W. B., & Li., H. (2013). The earnings forecast accuracy, valuation model use, and price target performance of sell-side equity analysts. *Contemporary Accounting Research, 30*, 80–115.

Hwang, Byoung-Hyoun, & Lou D. (2011). Self-fulfilling stock recommendations. Retrieved January 16, 2014 from https://fisher.osu.edu/blogs/efa2011/files/BEH_3_3.pdf

Koller, T., Goedhart, M., & Wessels, D. (2010). *Valuation. Measuring and managing the value of companies* (5th ed.). New Jersey: John Wiley & Sons.

Konopko, Ł. (2012). Report: Verifiability of the recommendation prepared by brokerage houses. Retrieved April 13, 2012, from http://wiadomosci.stockwatch.pl/raport-sprawdzalnosc-rekomendacji-domow-maklerskich,strategie-inwestycyjne,23802

KPMG. (2015). Australian valuation practices. Survey 2015. Retrieved February 15, 2016, from https://www.kpmg.com/AU/en/IssuesAndInsights/ArticlesPublications/valuation-practices-survey/Documents/valuation-practices-survey-2015.pdf

Li, Xi (2005). The persistence of relative performance in stock recommendations of sell-side financial analysts. *Journal of Accounting and Economics, 40*, 129–152.

Loh, R. K., & Mian, G. M. (2006). Do accurate earnings forecasts facilitate superior investment recommendations? *Journal of Financial Economics, 80*, 455–483.

McClave, J. T., Benson, P. G., & Sincich, T. (2008). *Statistics for business & economics*. (10 Edition. London: Pearson Prentice Hall.

Mikhail, M. B., Walther, B. R., & Wang, Xin. (2004b). *Determinants of superior stock picking ability* (Working Paper). Tempe: Arizona State University.

Mikhail, M. B., Walther, B. R., & Willis, R. H. (2004a). Do security analysts exhibit persistent differences in stock picking ability? *Journal of Financial Economics, 74*, 67–91.
Prusak, B. (2010). Analysis of stock recommendations efficiency on Warsaw stock exchange. *Journal of Organization Review, 11*, 31–34.
Sheskin, D. J. (2004). *Handbook of Parametric and Nonparametric Statistical Procedures* (3rd ed.). Boca Raton: Chapman & Hall/CRC.
Simon, A., & Curtis, A. (2011). The use of earnings forecast in stock recommendations: Are accurate analysts more consistent? *Journal of Business Finance & Accounting, 38*, 119-144.
Wilcox, J. W. (1984). The P/B-ROE valuation model. *Financial Analysts Journal, 40*, 58–66.
Wilcox, J. W., & Philips, T. K. (2005). The P/B-ROE valuation model revisited. *The Journal of Portfolio Management, 31*, 56–66.