DO FUNDAMENTALLY-ADJUSTED VALUATION MULTIPLES IMPROVE VALUATION ACCURACY? THE CASE OF THE POLISH STOCK MARKET

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ABSTRACT

A series of popular stock investment strategies are based on buying stocks with low valuation multiples. These strategies assume that low multiples signal undervaluation. However, the low multiples can be justified by fundamentals. In such cases even stocks with very low multiples can be overvalued. In this paper regression analysis is used to identify the impact of fundamentals on multiples. The multiples are the dependent variable and the accounting ratios are the explanatory variables. Such a regression enables the estimation of the fundamentally-adjusted multiple. The regression residuals measure the scope of undervaluation / overvaluation. Using this approach, the most undervalued (overvalued) stocks are those with the most negative (positive) residuals (and not the stocks with the lowest actual multiples). We compared the profitability of strategies based on low actual multiples with the profitability of strategies based on actual and fundamentally-adjusted multiples. Data from the Polish stock market from 1998-2010 are examined. The research found that allowing for the impact of accounting fundamentals on multiples can increase the accuracy of valuation in the case of P/S multiple but not in the case of P/E and P/BV multiples.

JEL: G11, C21

KEYWORDS: corporate valuation, relative valuation, investment strategies, valuation multiples

INTRODUCTION

The efficient market theory argues that "the market takes into account all information that is relevant to the valuation of assets when setting the price (such as earnings estimates, management team skill, industry conditions, estimated demand, etc.), and thus it is nothing but a big waste of time and money to try to outsmart the market" (Jones, 2008). However, this theory is in sharp contrast with abundant research indicating that using simple stock market investment strategies such as buying stocks with low values of valuation multiples can in the medium- and long-run generate returns significantly exceeding returns of the market as a whole as well as returns of more sophisticated (allowing for much more data) strategies (Fama, French, 1998).

These investment approaches assume that low valuation multiples signal a relative undervaluation. However, in many cases, the low values of multiples are justified by fundamental factors. In such cases even stocks with very low valuation multiples can be considerably overvalued (Damodaran, 2004; Goedhart, Koller, Wessels, 2005). The tool that enables at least partial allowance for the impact of the fundamentals on multiples is linear regression in which the actual multiples of individual stocks constitute the dependent variable and the selected historical or forecasted accounting ratios are the explanatory variables. The residuals of the regression measure the scope of relative undervaluation / overvaluation of the individual stocks. In this approach, the most undervalued (overvalued) are the stocks with the most negative (positive) regression residuals (and not the stocks with the lowest actual valuation multiples).

In the paper we compared the profitability of investment strategies based on actual valuation multiples with the profitability of the strategies based on comparison of the actual and fundamentally-adjusted valuation multiples on the Polish stock market in 1998-2010 years. The analysis embraced price-to-net-

earnings, price-to-book-value and price-to-sales multiples (referred further as P/E, P/BV and P/S, respectively).

The remainder of the paper is organized as follows. In the next section we discuss the relevant literature. Next the data and methodology used in the study are described. Then the section that presents the empirical results follows. The paper closes with concluding comments.

LITERATURE REVIEW AND THEORETICAL FOUNDATIONS

The comprehensive research conducted by Schreiner (2007) states that "multiples generally approximate market values reasonably well". However, choosing the universally best multiple is not viable. Schreiner (2007) found that different industries are associated with different best multiples. Other research states that "the accuracy and bias of value estimates, as well as the relative performance of the multiples, vary greatly by company size, company profitability, and the extent of intangible value in the company" (Lie, Lie, 2002). Others found that "contrary to the results in the extant studies valuation errors for multiples based on sales are often lowest", as compared to book-value-based multiples and earnings-based multiples (Deng, Easton, Yeo, 2010). Another research states that contrary to the theory, valuations based on earnings multiples are much more accurate than valuations based on cash flow multiples (Liu, Nissim, Thomas, 2006). Penman (2010) found that combining valuations obtained from different multiples reduce the valuation errors (as compared to valuations based on the individual multiples). Other research found that using multiples based on earnings averaged over the last several years (instead of only previous year's earnings) significantly increases accuracy of valuation (Anderson, Brooks, 2006; Sommer, Wöhrmann, Wömpener, 2009). Hence the application of relative valuation requires choosing between the types of multiples used.

The theoretical foundations of the multiples can be derived from the concept of valuing stocks on the basis of discounted cash flows. The P/E multiple, which is the most frequently used valuation multiple (Fernandez, 2002), is derived from the dividend discount model (Jones, 1998). However, given the findings of the empirical research, indicating that discounting accrual earnings instead of cash flows results in improvement of valuation accuracy (Penman, Sougiannis, 1997), let's substitute net earnings for dividends and let's consider the case of constant growth. In this case the price of the stock is determined by the equation:

$$P_t = \frac{E_t(1+g)}{r-g} \tag{1}$$

where:

P_t - price of the common stock at the end of period *t*;

E_t - net earnings per share in period *t*,

r - appropriate discount rate,

g - constant growth rate of earnings in the future.

Dividing both sides of equation (1) by net earnings per share or book value of equity per share or net sales per share gives the theoretical foundation for P/E, P/BV and P/S multiple, respectively.

As can be seen in Table 1, the multiples are related to company's expected growth of earnings, its cost of capital and its profitability. Hence the expected values of these factors can be used in evaluating whether the current valuation multiples of individual stocks are justified on the grounds of fundamentals. But in practice, when applying these concepts of valuation, one must choose the extent to which the inputs are based on historical vs. expected (forecasted) data. Theoretically, all the inputs should have predicted

values. But forecasting (especially long-run) is difficult and time-consuming and the abundant research points to the rather disappointing accuracy of long-run earnings forecasts, both made by analysts as well as mechanical methods. (O'Brien, 1988; Brown, 1996; Dreman, 1998; Malkiel, 2007; Rothovius, 2008). Some practitioners therefore prefer to base relative valuation only on historical accounting data, arguing that these data are much more solid and credible as compared to any forecasts. However, the empirical research confirms that forward (i.e. based on expected data) valuation multiples, although burdened with complexity and high level of forecast uncertainty, result in more accurate valuations than in the case of valuations based on historical data (Moonchul, Ritter, 1999; Schreiner, 2007; Liu, Nissim, Thomas, 2002). In practice it implies a significant trade-off between the valuation accuracy (which is generally higher when one uses forecasted data) and valuation timeliness and simplicity.

Table 1: Theoretical Derivation of Selected Valuation Multiples

Derivation of P/E multiple	Derivation of P/BV multiple	Derivation of P/S multiple
$P_t / E_t = \frac{1+g}{r-g}$, **where:**	$P_t / BV_t = \frac{E_t}{BV_t}\frac{1+g}{r-g}$, where:	$P_t / S_t = \frac{E_t}{S_t}\frac{1+g}{r-g}$, where:
P_t / E_t **- price-to-earnings multiple at the end of period *t*, other denotations as in equation (1).**	P_t / BV_t - price-to-book-value multiple at the end of period *t*, BV_t - book value of equity per share at the end of period *t*, other denotations as in equation (1).	P_t / S_t - price-to-sales multiple at the end of period *t*, S_t - net sales per share in period *t*, other denotations as in equation (1).

This table shows the theoretical derivation of P/E, P/BV and P/S valuation multiples, by dividing both sides of equation (1) by net earnings per share, book value of equity per share and net sales per share, respectively.

On the developed capital markets expected fundamentals can be approximated by consensus analysts' forecasts. On these markets the application of valuation tools based on expected fundamentals is not very troublesome (even for someone lacking forecasting skills) if only there are consensus forecasts available for a significant number of companies. However, the task is much more difficult in the case of many emerging markets because the consensus forecasts are available only for a small number of the biggest companies and in the case of most stocks there are not even single regular analysts' forecasts produced. In these cases one has to choose between forecasting each valued company' fundamentals on herself or basing the valuation solely on the historical data. Therefore, despite the generally higher valuation accuracy of forward-looking multiples, using this future-based approach is not always viable. As a result, many investors on emerging markets ignore any relationships between multiples and fundamentals (on the ground that analyzing relationships between valuation multiples and historical data makes no sense because there are not such relationships and analyzing the relationships between expectations and the multiples is not practically viable).

To summarize the discussion so far, the valuation multiples are consistent with finance theory because they can be derived from the discounted cash flow models. However, their use is not as simple as it may seem on the face of it. This is so because the accuracy of valuation is dependent on the availability of financial forecasts and these forecasts are not always obtainable and/or are very uncertain. Hence in many situations (especially in the case of emerging markets) constructing stock portfolios on the basis of valuation multiples implies the necessity of using only historical data (which probably limits the valuation accuracy). Therefore many emerging markets investors limit their relative valuation techniques to just comparing the raw multiples without any reference to the relationships between those multiples and fundamentals. However, one of the potential ways of allowing for these relationships is the use of the regressions between the multiples and the accounting ratios (with the assumption that these historical data can at least partially approximate the expectations). This approach is not new in the literature. The previous research (related to capital markets more developed then the Polish one) generally confirms its usefulness (Bhojraj, Lee, 2002; Hermann, Richter, 2003; Dittmann, Weiner, 2005). In the context of the

Polish market the previous research (based on shorter periods than in this paper) initially corroborated the usefulness of regression-based fundamental adjustment in the case of P/S multiple (Welc, 2009), but the research concerning other multiples has been lacking to date.

DATA AND METHODOLOGY

In order to evaluate the impact of valuation multiples' fundamental adjustment on the portfolios' profitability we compared the nominal returns of strategies based on regressions of the multiples (enabling the estimation of fundamentally-adjusted multiples) with the nominal returns generated by alternative strategies based on actual multiples. The analysis comprised the period between the end of February 1998 and the end of February 2010 (the earlier periods were omitted due to quite a small number of then listed companies). Because multiples show long-term tendency of reverting toward the mean (White, Sondhi, Fried, 2003) we assumed annual rebalancing of all the alternative portfolios under investigation.

In order to evaluate the profitability of strategies based on fundamentally-adjusted multiples we applied the regressions of companies' multiples with several accounting ratios as explanatory variables. At the end of February of each year we classified stocks on the basis of three cross-section regressions, in which the dependent variables were P/E, P/BV and P/S multiples of companies listed on the Warsaw Stock Exchange. We estimated the regressions for P/E and P/BV for every year in the period under investigation and in the case of P/S multiple we used the regressions presented in the work of Welc (2009) for the period between 1999 and 2008 and we estimated the missing regressions. The regressions estimated at the end of February of each year enabled the calculation (for all the companies listed at that time, excluding those for which the calculation of multiple is nonsensical) of fundamentally-adjusted multiples (as the fitted values of the regressions' observations). The comparisons of the fundamentally-adjusted and actual values of the multiples enabled the evaluation of the scope of overvaluation / undervaluation of every stock at a given date.

In every regression the dependent variable is a given multiple, computed as follows:

$$VM = \frac{P_t}{VD_t / n} \tag{2}$$

where:

VM - a given valuation multiple (P/E, P/BV or P/S) at the end of February,

P_t - common stock price at the end of February,

VD_t - the company' value driver (net earnings in the previous calendar year in the case of P/E multiple, book value of equity at the end of the previous calendar year in the case of P/BV multiple and net sales in the previous calendar year in the case of P/S multiple),

n - the number of company' common shares at the end of February.

We computed the multiples at the end of February in order to allow for the time lag between the end of the previous year and the time when all the quarterly reports concerning that year are available. The stock prices data were obtained from *money.pl* database, and historical financial results were obtained from *parkiet.com.pl* database. We computed the multiples for all the companies for which all the necessary data were available and for which the calculation of a given multiple makes economic sense. Due to significant accounting differences we omitted all the financial companies as well as The National Investment Funds. The summary statistics of the multiples are presented in Tables 2, 3 and 4.

Table 2: Summary Statistics Computed for P/S Multiple in the Analyzed Samples

Multiples at the end of:	Arithmetic average	Median	Standard deviation	Coefficient of variation
February 1998	0.78	0.50	0.88	111.9%
February 1999	0.48	0.30	0.61	125.8%
February 2000	0.68	0.36	1.25	182.6%
February 2001	0.56	0.25	1.03	184.3%
February 2002	0.39	0.20	0.54	139.2%
February 2003	0.40	0.23	0.52	129.5%
February 2004	0.83	0.49	0.92	110.1%
February 2005	1.04	0.64	1.28	123.6%
February 2006	1.45	0.79	1.89	130.2%
February 2007	2.30	1.28	3.30	143.6%
February 2008	2.33	1.09	5.00	214.6%
February 2009	0.79	0.42	1.19	151.5%

This table shows the summary statistics computed for P/S multiple on the Polish stock market.
Source: money.pl; parkiet.com.pl; author's calculations.

Table 3: Summary Statistics Computed for P/E Multiple in the Analyzed Samples

Multiples	Arithmetic	Median	Standard	Coefficient
February 1998	14.96	12.75	8.66	57.9%
February 1999	13.30	8.05	20.05	150.8%
February 2000	24.78	11.22	56.80	229.2%
February 2001	22.88	9.45	54.16	236.7%
February 2002	95.00	15.21	458.52	482.6%
February 2003	28.07	11.37	84.71	301.8%
February 2004	42.33	18.62	126.26	298.3%
February 2005	32.66	14.05	84.04	257.3%
February 2006	55.36	18.71	197.88	357.4%
February 2007	64.48	23.65	171.32	265.7%
February 2008	92.39	17.84	925.52	1001.7%
February 2009	16.18	9.49	23.44	144.8%

This table shows the summary statistics computed for P/E multiple on the Polish stock market.
Source: money.pl; parkiet.com.pl; author's calculations.

Table 4: Summary Statistics Computed for P/BV Multiple in the Analyzed Samples

Multiples at the end of:	Arithmetic average	Median	Standard deviation	Coefficient of variation
February 1998	1.61	1.37	1.06	65.8%
February 1999	1.02	0.70	1.00	97.8%
February 2000	1.66	0.92	2.54	152.7%
February 2001	1.15	0.74	1.49	129.6%
February 2002	0.99	0.74	0.85	86.4%
February 2003	0.90	0.67	0.79	88.0%
February 2004	1.88	1.45	1.98	104.8%
February 2005	2.23	1.65	1.98	88.9%
February 2006	2.93	1.99	2.64	90.3%
February 2007	3.79	2.87	3.56	94.1%
February 2008	2.67	2.04	2.23	83.7%
February 2009	1.37	0.70	3.63	265.5%

This table shows the summary statistics computed for P/BV multiple on the Polish stock market.
Source: money.pl; parkiet.com.pl; author's calculations.

In the case of every regression the identification of outliers was carried out after completing the data. To this end we applied the method based on the analysis of the significance of regression' coefficients obtained for dummy variables constructed for potential outliers (Evans, 2003). We started with an estimation of a given regression based on all the potential explanatory variables and all the available observations at a given date. In order to identify potential outliers we computed the residuals of the regression and found the residual with the highest absolute value. Then we constructed a dummy variable with the value of unity in the case of primary regression' highest residual and zero values for all the remaining observations. This variable was added to the regression and the coefficients were re-estimated. If the dummy variable turned out to be statistically significant we assumed this observation to be an outlier and removed it from the sample. Next, we re-estimated the primary regression and again found the residual with the highest absolute value, for which we again constructed a dummy variable with the value of unity in the case of identified highest residual and zero values for all the remaining observations. This dummy variable was added to the regression and the coefficients of this regression were re-estimated and tested for statistical significance. The procedure of outliers' elimination was repeated until the dummy variable for another potential outlier turned out to be statistically insignificant.

In the case of every regression we tested several accounting ratios as potential explanatory variables. In selecting explanatory variables we used the following procedure (Nilsson, Nilsson, 1994):

1) we estimated *i* simple regressions of the form:

$$VM = \alpha_0 + \alpha_1 EV_i + \varepsilon \tag{3}$$

where:

VM - the dependent variable, being the respective valuation multiple (P/E, P/BV or P/S),
α_0, α_1 - regression' coefficients,
EV_i - *i*-th potential explanatory variable,
i – the number of potential explanatory variables under investigation in stage 1,
ε – random factor,
and chose the potential variable EV_1 with the highest value of adjusted R-squared statistic.

2) then we estimated *i*-1 regressions of the form:

$$VM = \alpha_0 + \alpha_1 EV_1 + \alpha_2 EV_n + \varepsilon \tag{4}$$

where:

EV_1 - the explanatory variable selected in stage 1,
n – the number of potential explanatory variables under investigation in stage 2 (n=i-1),
and chose the potential variable EV_2 with the highest value of adjusted R-squared statistic.

3) we reiterated the procedure, adding more variables, until the number of variables in the regression reached the point at which the adjusted R-squared had the maximum value.

Apart from the adjusted R-squared, the analysis of the significance of explanatory variables was conducted on 5% significance level (*t*-statistics were used). In order to mitigate the distorting impact of potential heteroscedasticity on the significance tests the procedure of weighted least squares estimation was applied in all the regressions (Nowak, 1994).

We used only ratios based on historical (and not forecasted) data, as potential explanatory variables. This is due to the fact, that (as was stated earlier) on the Polish stock market the consensus earnings forecasts are available only for several companies and in the case of most companies there are not even single regular analysts' forecasts produced. For the same reason we considered as the dependent variables only trailing (and not forward) multiples. As was demonstrated, the valuation multiples are related to companies' growth, profitability and cost of capital. Therefore we used the ratios of sales growth (as the proxy for growth), return on equity, sales margin and assets turnover (as the proxies for profitability) and the leverage ratio (as the proxy for financial risk), as explanatory variables. This set of ratios is generally consistent with other studies (Henschke, Homburg, 2009). We also used two dummy variables as the additional proxies for risk and profitability. The accounting ratios used in the regressions were defined as follows:

$$Growth_t = S_t / S_{t-1} \tag{5}$$

where:

$Growth_t$ - sales growth in year *t*,

S_t - net sales in year *t*.

$$ROE_t = E_t / SE_t \tag{6}$$

where:

ROE_t - return on equity in year *t*,

E_t - net earnings in year *t*,

SE_t - book value of shareholders' equity at the end of year *t*.

$$Margin_t = OP_t / S_t \tag{7}$$

where:

$Margin_t$ - sales margin in year *t*,

OP_t - operating profit in year *t*.

$$Turnover_t = S_t / A_t \tag{8}$$

where:

$Turnover_t$ - assets turnover in year *t*,

A_t - total assets at the end of year *t*.

$$Leverage_t = TL_t / A_t \tag{9}$$

where:

$Leverage_t$ - leverage ratio in year *t*,

TL_t - total liabilities and provisions at the end of year *t*.

The additional dummy explanatory variables were defined as follows:

$DummyProfit_t$ - equaling 1 in the case of positive net earnings in year *t* and 0 otherwise,

$DummyProfitChange_t$ - equaling 1 in the case of net earnings' growth in year *t* and 0 in the case of net earnings' decline in year *t* (as compared to year *t-1*).

On the basis of the estimated regressions we computed the fundamentally-adjusted multiples for all the companies (also these that were eliminated as outliers during process of regression' estimation) listed at the end of February of each analyzed year, excluding these for which the calculation of a given multiple was nonsensical. We did this by introducing appropriate values of the explanatory variables into regressions. Next, we computed the residuals that measure the scope of relative overvaluation or undervaluation of individual stock at a given date. The positive residuals imply overvaluation and the negative residuals imply undervaluation. In the case of every multiple, at the end of February of each analyzed year all the (then listed) stocks, excluding those with nonsensical (i.e. negative) values of a given multiple, were sorted in order of decreasing values of the residuals and divided into five portfolios in such a way that the first portfolio consisted of 20% most overvalued stocks (the 20% stocks with the highest positive residuals) and the fifth portfolio consisted of 20% most undervalued stocks (the 20% stocks with the highest negative residuals). Because in most cases the whole sample didn't divide equally by five we adjusted the number of stocks in the last portfolio.

In order to verify the effectiveness of the estimated regressions in detection of overvalued and undervalued stocks we treated all portfolios as alternative investment strategies. Hence, we assumed that buying stocks from the first portfolio is equivalent to strategy of investing in 20% most overvalued stocks and buying stocks from the fifth portfolio is equivalent to strategy of investing in about 20% most undervalued stocks. Within all the alternative portfolios the equal weights for all the stocks were applied.

For all the portfolios we computed annual nominal returns (for the periods between the end of February of a given year and the end of February of the next year). Next**,** we calculated the geometric average nominal annual returns in the period between the end of February 1998 and the end of February 2010. We applied geometric average because it represents the constant return an investor must earn every year to arrive at the same final value that would be produced by a series of variable returns (Cornell, 1999). The dividends and transaction costs were disregarded in all our calculations, due to the lack of any database regarding them.

In order to evaluate the relative profitability of individual strategies we compared the average nominal annual returns of the portfolios constructed on the basis of estimated P/E, P/BV and P/S regressions with the average nominal annual returns obtained from simple strategies based on actual multiples as well as with the nominal annual returns of indexing strategy (based on the Warsaw Stock Exchange WIG Index). In the case of simple strategies all the stocks were sorted in order of decreasing actual values of a given multiple in such a way that the first portfolio consisted of 20% stocks with the highest values of a given multiple (at a given date) and the fifth portfolio consisted of about 20% stocks with the lowest values of a given multiple. Because in most cases the whole sample didn't divide equally by five we adjusted the number of stocks in the last portfolio.

RESULTS

Table 5, 6 and 7 show the results of the regressions' estimations. The regressions are characterized by relatively good fit to the empirical data in the case of P/S multiple (with adjusted R-squared statistics usually above 0.45), but not in the case of P/E and P/BV multiples. Also F statistics point out to considerably higher statistical significance of P/S regressions. Furthermore, the P/S regressions are much more consistent as regards the structure of explanatory variables as well as the signs of the parameters (it suggests the presence of some spurious regressions in the case of P/E and P/BV multiples). This is probably mainly due to relatively high share of outliers remaining in the samples in the case of P/E and P/BV regressions as well as the distorting impact of inter-company differences in accounting policies (that are distorting P/E and P/BV multiples to a greater extent than P/S multiple). One of the reasons causing poor quality of P/E and P/BV regressions could also be the introduction of IFRS (instead of Polish accounting standards) in 2005 (after joining the European Union) by the companies publishing

consolidated financial statements (companies publishing only separate statements are still allowed to prepare them in accordance to Polish accounting laws). This further limited the inter-company comparability of earnings and book value numbers (with much lower distorting effect in the case of net sales data).

Table 5: The Results of Estimation of the P/E Regressions

Regression at the end of:	Dependent variable: P/E multiple	Additional statistics		
	Regression' explanatory variables (signs of parameters in parentheses)	Sample 1 / Sampie 2 [1)]	Adjusted R-squared	F statistic [2)]
February 1998	ROE(-), Leverage(+), Growth(-)	64 / 73	0.116	3.75**
February 1999	ROE(-)	88 / 104	0.096	10.21***
February 2000	ROE(-), Growth(+), DummyProfit(-)	85 / 94	0.332	14.92***
February 2001	ROE(-), DummyProfitChange(-)	75 / 84	0.100	5.15***
February 2002	ROE(+), DummyProfitChange(-)	53 / 65	0.250	9.66***
February 2003	Turnover(-), DummyProfitChange(-)	61 / 76	0.268	11.98***
February 2004	ROE(-), Turnover(-), Growth(+), DummyProfitChange(-)	59 / 95	0.342	8.54***
February 2005	ROE(-), DummyProfitChange(-)	74 / 117	0.570	49.40***
February 2006	ROE(-), Leverage(+)	97 / 141	0.308	22.36***
February 2007	ROE(-)	122 / 155	0.129	18.97***
February 2008	ROE(-), Turnover(+), DummyProfitChange(-)	192 / 230	0.208	17.69***
February 2009	ROE(-), Turnover(+), Growth(+)	170 / 210	0.267	21.47***

This table shows the results of the regressions estimated for P/E multiple on the Polish stock market.
[1)] Sample 1 consists of all the observations used in regression' estimation; Sample 2 consists of all the observations used in portfolios' construction at a given date (including outliers removed from Sample 1 in the process of regression' estimation)
*[2)] *, ** and *** denote statistical significance at the 10, 5 and 1 percent levels, respectively*
Source: money.pl; parkiet.com.pl; author's calculations.

Table 6: The Results of Estimation of the P/BV Regressions

Regression at the end of:	Dependent variable: P/BV multiple	Additional statistics		
	Regression' explanatory variables (signs of parameters in parentheses)	Sample 1 / Sampie 2 [1)]	Adjusted R-squared	F statistic [2)]
February 1998	ROE(+), Turnover(-), Leverage(+)	61 / 83	0.452	17.51***
February 1999	ROE(-), Leverage(+), Turnover(+), Growth(+),	111 / 126	0.466	20.23***
February 2000	Growth(+), DummyProfitChange(+)	117 / 138	0.390	38.14***
February 2001	ROE(-), Leverage(+), DummyProfitChange(+)	117 / 133	0.067	3.78**
February 2002	ROE(-)	78 / 122	0.129	12.44***
February 2003	ROE(-), Growth(+)	85 / 120	0.402	29.20***
February 2004	ROE(+), Leverage(+), Turnover(-), Growth(+)	85 / 128	0.142	4.48***
February 2005	ROE(+), Leverage(+)	91 / 135	0.432	35.26***
February 2006	ROE(-), Growth(+), DummyProfitChange(+)	129 / 172	0.506	44.72***
February 2007	ROE(+), Growth(+), DummyProfitChange(+)	149 / 179	0.192	12.74***
February 2008	ROE(+), Turnover(+)	188 / 256	0.343	49.81***
February 2009	ROE(+), Turnover(+), DummyProfit(+)	247 / 294	0.239	26.82***

This table shows the results of the regressions estimated for P/BV multiple on the Polish stock market.
[1)] Sample 1 consists of all the observations used in regression' estimation; Sample 2 consists of all the observations used in portfolios' construction at a given date (including outliers removed from Sample 1 in the process of regression' estimation)
*[2)] *, ** and *** denote statistical significance at the 10, 5 and 1 percent levels, respectively*
Source: money.pl; parkiet.com.pl; author's calculations.

Table 7: The Results of Estimation of the P/S Regressions

Regression at the end of:	***Dependent variable: P/S multiple***	**Additional statistics**		
	Regression' explanatory variables (signs of parameters in parentheses)	**Sample 1 / Sampie 2 [1)]**	**Adjusted R-squared**	**F statistic [2)]**
February 1998	Margin(+), Turnover(-), Leverage(-)	76 / 84	0.521	28.22***
February 1999	Margin(+), Turnover(-), Leverage(-)	97 / 128	0.454	27.62***
February 2000	Margin(+), Turnover(-), Leverage(-)	118 / 141	0.499	39.89***
February 2001	Margin(+), Turnover(-), Leverage(-)	120 / 136	0.481	37.80***
February 2002	Margin(+), Turnover(-), Leverage(-)	112 / 130	0.527	42.21***
February 2003	Margin(+), Turnover(-), Leverage(-)	92 / 145	0.505	31.90***
February 2004	Margin(+), Turnover(-), Leverage(-)	86 / 131	0.564	37.63***
February 2005	Margin(+), Turnover(-), Leverage(-)	125 / 139	0.529	47.38***
February 2006	Margin(+), Turnover(-), Leverage(-)	121 / 183	0.570	53.93***
February 2007	Margin(+), Turnover(-), Leverage(-)	109 / 179	0.674	75.34***
February 2008	Margin(+), Turnover(-), Leverage(-)	242 / 259	0.540	95.30***
February 2009	Margin(+), Turnover(-), Leverage(-)	231 / 294	0.473	69.90***

This table shows the results of the regressions estimated for P/BV multiple on the Polish stock market.
[1)] Sample 1 consists of all the observations used in regression' estimation; Sample 2 consists of all the observations used in portfolios' construction at a given date (including outliers removed from Sample 1 in the process of regression' estimation)
*[2)] *, ** and *** denote statistical significance at the 10, 5 and 1 percent levels, respectively*
Source: Welc (2009); money.pl; parkiet.com.pl; author's calculations.

On the basis of the regressions we classified (at the end of February of each year) the companies in order of their over- or undervaluation. Next, we sorted all the stocks in order of decreasing residuals. The stocks sorted in this way were divided into five portfolios. Then the profitability of the most overvalued and the most undervalued portfolios based on the three multiples' regressions were compared with the returns of strategies using actual P/E, P/BV and P/S multiples as well as with the indexing strategy. The returns are shown in Table 8.

Table 8: The Average Returns of the Alternative Portfolios

Strategy based on:	***Fundamentally-adjusted multiples***		**Actual multiples**	
	Most overvalued portfolio*	**Most undervalued portfolio***	**Most overvalued portfolio****	**Most undervalued portfolio****
Price-to-earnings multiple	1.2%	16.0%	1.0%	19.2%
Price-to-book-value multiple	2.0%	18.4%	1.5%	20.8%
Price-to-sales multiple	-4.1%	21.7%	-3.0%	19.1%
WIG Index	6.8%			

This table shows the geometric average nominal annual returns of portfolios constructed on the basis of fundamentally-adjusted multiples, actual multiples and indexing strategy (between the end of February 1998 and the end of February 2010).
** most overvalued portfolio comprised 20% of stocks with the highest difference between actual and implied (from the regression) multiple (the most overvalued stocks); most undervalued portfolio comprised 20% of stocks with the lowest difference between actual and implied (from the regression) multiple (the most undervalued stocks).*
*** most overvalued portfolio comprised 20% of stocks with the highest value of the multiple (the most overvalued stocks); most undervalued portfolio comprised 20% of stocks with the lowest value of the multiple (the most undervalued stocks).*
Source: money.pl; parkiet.com.pl; author's calculations.

The data confirm the supremacy of all strategies focused on the most undervalued stocks over the strategies based on buying the most expensive stocks. In the analyzed twelve-year period the highest average returns were generated by the strategy of buying 20% of companies with the highest differences

between actual and implied (from the regressions) P/S multiples. It confirms the previous research (Welc, 2009), conducted on the shorter period data, that selecting stocks on the basis of fundamentally-adjusted P/S multiples on the Polish stock exchange can constitute a profitable strategy with high potential of generating above-average returns. The results obtained for strategies based on P/E and P/BV regressions are much less encouraging. In both cases the average returns of strategies focused on most undervalued stocks as indicated by actual multiples were significantly greater than the returns from regression-based strategies. This could be expected given the poor quality of most regressions estimated for P/E and P/BV multiples, resulting in producing more noise rather than explaining the true relationships between the multiples and fundamentals.

The above analysis does not allow for the risk associated with the alternative strategies. The high returns of some strategies can entail above-average risk. The table below shows Betas of the portfolios under investigation. The Betas were computed as the slope coefficients of the linear regressions with the given portfolio' annual returns as dependent variable and the Warsaw Stock Exchange WIG Index' annual returns as an explanatory variable.

Table 9: Beta Coefficients of the Alternative Portfolios

Strategy based on:	**Fundamentally-adjusted multiples**		**Actual multiples**	
	Most overvalued portfolio*	**Most undervalued portfolio***	**Most overvalued portfolio***	**Most undervalued portfolio***
Price-to-earnings multiple	0.89	1.73	0.96	2.01
Price-to-book-value multiple	0.93	1.67	0.97	1.84
Price-to-sales multiple	1.03	1.83	1.08	1.95

This table shows the Beta coefficients of portfolios constructed on the basis of fundamentally-adjusted multiples and actual multiples (between the end of February 1998 and the end of February 2010).
** portfolios constructed in the same way as in Table 8*
Source: money.pl; parkiet.com.pl; author's calculations.

All the strategies focused on most undervalued stocks, although bringing above-average returns, are also associated with the above-average risk. However, this positive risk-return relationship does not hold when comparing the individual portfolios composed of 20% most undervalued stocks, because the portfolio built on the basis of fundamentally-adjusted P/S multiples (having the highest average annual return) is characterized by Beta coefficient lower than in the case of all three strategies focused on the most undervalued stocks as indicated by actual multiples.

CONCLUDING COMMENTS

We attempted to evaluate the effectiveness of relative valuation with the use of simple linear regressions of valuation multiples. The analysis of the average returns in the period between the end of February 1998 and the end of February 2010 showed that in the case of the Warsaw Stock Exchange the strategy of buying 20% most undervalued stocks as indicated by the regressions of P/S multiples generated the average returns exceeding returns of strategies based on actual P/E, P/BV and P/S multiples as well as the average return of the market as a whole. It confirmed the previous research stating that on the Warsaw Stock Exchange allowing for the relationships between P/S multiples and accounting ratios increases the accuracy of valuation. These results are promising given the fact that P/S regressions under investigation are based solely on the historical accounting data. However, the results obtained for P/E and P/BV multiples are much less encouraging, because in these cases the simplest strategies of buying stocks with the lowest actual multiples generated returns beating those obtained with the use of the regressions.

In the case of all the strategies based on buying 20% most undervalued stocks relatively high returns are associated with relatively high risk (as measured by Beta coefficient) when compared to the strategies based on higher values of multiples. Therefore**,** investors following these strategies must face the necessity of tolerating relatively high risk. However, the positive risk-return relationship does not hold when comparing the individual portfolios composed of 20% most undervalued stocks, because the portfolio built on the basis of fundamentally-adjusted P/S multiples is characterized by Beta lower than in the case of all three strategies focused on the most undervalued stocks as indicated by actual multiples.

These results, corroborating relatively high accuracy of valuation with the use of fundamentally-adjusted P/S multiple, are encouraging given the usefulness of this multiple in the periods characterized by significant deterioration of companies' results. This is so because net sales are always positive, regardless of current phase of business cycle. Thanks to it this approach enables valuation of almost all listed companies (excluding small number of companies with no sales), opposite to the multiples based on earnings and book values.

However, among the significant limitations of the proposed approach are the lack of allowance for many potentially important factors (especially with the qualitative nature) influencing companies' market values (e.g. corporate strategies, growth potential, competitive advantages, etc.) as well as for potential non-linearity of the relationship between valuation multiples and the fundamentals.

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