USEFULNESS OF MULTI-CRITERIA TAXONOMY IN COMPARATIVE VALUATION OF STOCKS – THE POLISH EXPERIENCE

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Abstract

One of the most relevant issues in comparative valuation of stocks is a selection of so-called "peers", i.e. companies which may be considered similar to the one which is valued (where similarity means similar profitability, expected growth and investment risk). When applying comparative valuation techniques analysts usually deem firms from the same industry to be similar and comparable. However, one of the alternative and more objective approaches to selecting comparables is based on a statistical multi-criteria analysis, where those firms are considered comparable which share similar operating and financial features, regardless of their industrial classifications. In our paper we empirically examine the usefulness of taxonomy-based approach in identifying "peers" for comparative valuation, on the basis of data from the Polish stock market for 2003-2013. We found that in our sample "peer-based" stock portfolios were unable to "beat" the portfolios formed on the ground of raw multiples (where no any inter-company differences in fundamentals are taken into consideration).

Key words: stock valuation, taxonomy, comparative valuation

JEL Code: G11, C21

Introduction

Comparative valuation is one of the two primary approaches to valuing stocks. This approach is considered more objective and less prone to manipulations than discounted cash flow method. However, a comparative valuation is not entirely free from some significant practical problems (Lie, Lie, 2002; Penman, 2010). One of the relevant issues is a selection of "peers", i.e. companies which may be considered similar to the one which is valued.

When applying comparative valuation analysts usually deem firms belonging to the same industry as being comparable ("peers"). The argument is that those firms are exposed to similar market conditions and face similar risks. However, such assumption is questionable because even competitors may have diverse operating and financial features (e.g. profitability

or indebtedness). Another drawback of industry-based approach is its vulnerability to subjectivity of defining the scope of the industry.

One of alternative approaches is based on a statistical multi-criteria analysis. Under this approach, those firms are considered comparable which share similar operating and financial features, regardless of whether they belong to the same industry. Previous studies from developed markets found that this approach tend to be superior in identifying "peers" then industry-based methods. However, empirical research for emerging markets (where the number of public companies from the same industry is often very limited) is lacking.

In our paper we empirically examine the usefulness of taxonomy-based approach in identifying "peers", on the basis of data from the Polish stock market. Our study covers a period between 2003 and 2013 and is based on four fundamental variables, based on accounting data. To our knowledge, this is the first paper addressing the usefulness of statistical methods in comparative valuation of stocks, in the case of then Central European markets.

The remainder of the paper is organized as follows. In the next section we discuss relevant literature and theoretical foundations. 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.

1 Theoretical foundations and literature review

The fundamental model of valuing stocks is based on discounted cash flows. However, in the long-run the sum of earnings should not differ significantly from the sum of cash flows. Thus, for simplicity's sake cash flows can be substituted for earnings. Let's assume the case of constant growth, where the fundamental stock value is derived from the following formula:

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

where:

P_t - fundamental value of a common stock at the end of *t*-th period,

E_t - corporate earnings per share in *t*-th period,

r - discount rate (cost of capital),

g - expected growth rate of earnings.

According to formula (1), stock value is a derivative of current earnings, expected earnings growth and cost of capital. Valuation multiples also have their theoretical

foundations in the same model. Price-to-earnings multiple, which is most frequently used by analysts (Fernandez, 2002), can be derived from formula (1) by dividing its left side by earnings per share. Analogous transformations made for the other multiples enable obtaining their theoretical foundations. This is presented in Table 1.

Tab. 1: Theoretical foundations of valuation multiples

Price-to-earnings multiple	Price-to-book-value multiple	Price-to-sales multiple
$P_t / E_t = \frac{1+g}{r-g}$, where: P_t / E_t - price-to-earnings multiple at the end of period *t*, remaining notations as in formula (1).	$P_t / BV_t = \frac{E_t}{BV_t}\frac{1+g}{r-g}$, where: P_t / BV_t - price-to-book-value multiple at the end of period *t*, BV_t - shareholders' equity per share at the end of period *t*, remaining notations as in formula (1).	$P_t / S_t = \frac{E_t}{S_t}\frac{1+g}{r-g}$, where: P_t / S_t - price-to-sales multiple at the end of period *t*, S_t - net sales per share in period *t*, remaining notations as in formula (1).

Source: author's work

As can be seen, multiples are related to the expected growth of earnings, cost of capital and profitability. Thus, the expected values of these factors can be used in evaluating whether 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. forecasted data. Theoretically, all inputs should have predicted values. But forecasting is difficult and abundant research points to the disappointing accuracy of long-run earnings forecasts, both made by analysts as well as mechanical methods (O'Brien, 1988; Brown, 1996; Rothovius, 2008). Despite it, research confirms that forward (based on expected data) multiples, although burdened with complexity and forecast uncertainty, result in more accurate valuations than in the case of valuations based on historical data (Moonchul, Ritter, 1999; Liu, Nissim, Thomas, 2002). Thus, choosing between forecasted and past data implies a trade-off between valuation accuracy and valuation timeliness and simplicity.

On the developed markets expected fundamentals can be approximated by analysts' forecasts. On these markets valuation based on expected fundamentals is not very troublesome if only there are forecasts available for a significant number of companies. However, the task is more difficult on emerging markets where forecasts are available only for a small number of stocks. In these cases one has to choose between forecasting each

company's fundamentals on herself or basing the valuation solely on historical data. For practical reasons the latter approach is usually followed. Previous research on developed markets generally confirms its usefulness (Bhojraj, Lee, 2002; Dittmann, Weiner, 2005).

To summarize the discussion so far, valuation multiples are consistent with finance theory because they can be derived from discounted cash flow models. They are related to company's expected growth of earnings, cost of capital and profitability. It means that stocks with similar expected profitability, growth and risk should have similar values of multiples. However, because of the unavailability of forecasts for individual companies, in many situations (especially on emerging markets) applying comparative valuation implies the necessity of using historical data only. In such circumstances, one of the available ways of allowing for the fundamentals in valuation is to identify "peers" on the ground of their past accounting numbers, with the assumption that these historical data can serve as useful proxies for the expected future results. We will follow such multi-criteria identification of "peers", based on historical accounting data, in our empirical study.

2 Methodology

Our research covered ten-year period between February 2003 and February 2013. Although the Warsaw Stock Exchange operates since the beginning of the 1990s we omitted all the years before 2003 due to the relatively small number of then listed companies. Stock prices data were obtained from *money.pl*, and financial results were obtained from *Notoria Serwis*. 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. Due to accounting differences, in the analysis we omitted all the financial companies as well as National Investment Funds.

We tested nominal long-term returns and variability of returns of the investment portfolios (with annual rebalancing assumed), formed on the ground of the following metrics:

1. Raw price-to-book-value (P/BV) multiples,
2. Raw price-to-sales (P/S) multiples,
3. Differential price-to-book-value (P/BV) multiples,
4. Differential price-to-sales (P/S) multiples.

In the case of the first two of these approaches, at the end of February of each year we sorted all the companies in order of decreasing values of a given multiple and then we divided the stocks into five portfolios so that the first portfolio embraced 20% of companies with the

highest multiples and the fifth portfolio comprised 20% of companies with the lowest multiples. Then, in order to verify the usefulness of raw multiples in detection of overvalued and undervalued stocks, we treated the two extreme portfolios as alternative investment strategies. Thus, we assumed that buying stocks from the first / fifth portfolio is equivalent to strategy of investing in 20% most expensive / cheapest companies. Within all portfolios equal weights for all stocks were applied. For all portfolios we computed annual nominal returns (between the end of February of a given year and the end of February of the next year) and then we calculated geometric average annual returns as well as coefficients of variation of annual returns in the period between the end of February 2003 and the end of February 2013. Dividends and transaction costs were disregarded due to the lack of any database regarding them.

The approach based on raw multiples, explained above, implies an *implicite* assumption that all stocks on the market are "peers", because the multiples of all companies are directly compared, without any consideration for inter-company differences in fundamentals (profitability, growth and risk). In contrast, under the approaches based on differential multiples, we classified stocks (as "expensive" or "cheap") after dividing the whole universe of companies into more homogenous sub-groups, on the ground of selected proxies for fundamentals. Here, at the end of February each year, the following procedure was applied:

1. All companies were divided into homogenous groups of "peers", on the ground of the methodology and grouping criteria described below.
2. For each group of "peers" median valuation multiples (P/BV and P/S) were computed.
3. For each stock, the difference between its actual valuation multiple and the median of the same multiple for its "peers" (a differential multiple) was computed.
4. All the companies were sorted in order of decreasing values of differential multiples and then divided into five portfolios, so that the first portfolio embraced 20% of companies with the highest differential multiples and the fifth portfolio comprised 20% of companies with the lowest differential multiples.

For such portfolios formed on the ground of differential multiples the analysis of average long-terms returns and risks were conducted.

On the ground of our previous studies (Welc, 2014), we used the following four variables (which on the Polish stock market show statistically significant relationships with valuation multiples) as the criteria for evaluating similarity of companies:

1. MARGIN = operating profit in the previous year / sales revenues in the previous year,

2. LEVERAGE = total liabilities at the end of the previous year / total assets at the end of the previous year,
3. TURNOVER = sales revenues in the previous year / total assets at the end of the previous year,
4. EARNINGS SMOOTHNESS, measured by R-squared of a linear five-year trend of past net earnings.

In dividing a whole universe of stocks into sub-groups of "peers", the following six-step procedure of multi-criteria taxonomy was performed:

1. Specification of a diversification between individual companies by means of Squared Euclidean Distance.
2. Hierarchical classification of companies into homogenous groups by means of a Ward method (Grabinski, Wydymus, 1989).
3. Presentation of initial classification results on a dendrogram and the diagram of distance integration in relation to integration stages.
4. Initial multivariate position referring to the number of groups of companies.
5. Multi-criteria classification of companies by means of *k*-means method.
6. Identification of optimal classification by means of Caliński-Harabasz classification quality indicator (Calinski, Harabaszm 1974).

3 Results

The applied taxonomical grouping resulted in creation of four homogenous groups of companies for each of the periods in the sample. Medians of P/BV and P/S multiples within the obtained groups are presented in Table 2. As might be seen, in all the periods the medians of both multiples show discernible dispersion between the groups. Thus, it may be concluded that the obtained groups of companies differ not only in terms of the four criteria of grouping, but also in their averaged valuation metrics. It seems therefore that the inter-company differences in the values of four grouping variables are reflected in their relative market valuations.

Tab. 2: Medians of P/BV and P/S multiples within the obtained groups of companies.

	Group 1	Group 2	Group 3	Group 4
Medians of P/BV multiples within individual groups:				
Feb 2003	0.70	0.68	0.66	0.38
Feb 2004	1.96	1.41	1.31	1.05
Feb 2005	2.07	1.76	1.58	1.17
Feb 2006	3.36	2.34	1.65	1.52
Feb 2007	3.16	3.04	2.07	1.92
Feb 2008	3.28	2.28	1.85	1.79
Feb 2009	1.08	0.69	0.61	0.58
Feb 2010	1.75	1.22	1.17	1.07
Feb 2011	1.60	1.58	1.33	1.13
Feb 2012	1.06	0.99	0.97	0.89
Medians of P/S multiples within individual groups:				
Feb 2003	0.25	0.24	0.21	0.11
Feb 2004	0.72	0.55	0.48	0.34
Feb 2005	0.79	0.78	0.55	0.26
Feb 2006	1.45	0.91	0.56	0.51
Feb 2007	1.82	1.26	1.01	0.67
Feb 2008	1.66	1.07	0.78	0.27
Feb 2009	0.61	0.46	0.34	0.33
Feb 2010	0.90	0.75	0.69	0.64
Feb 2011	1.03	1.01	0.80	0.61
Feb 2012	1.17	0.48	0.48	0.47

Source: money.pl, Notoria Serwis, author's work

More confusing results were obtained for "short-selling" strategies, where the overvalued (expensive) stocks are picked. In the case of both P/BV as well as P/S ratios, the portfolios formed on the ground of the differential metrics generated returns which are slightly lower than those offered by raw multiples (with no significant differences in variability of those returns). Thus, it seems that differential multiples are more useful in picking overvalued than undervalued stocks. However, any short-selling strategy may be profitable only if it is able to identify stocks with negative returns, and not just relatively low (but positive) ones. In the

investigated sample all four strategies based on the 20% most expensive stocks generated positive average returns, which makes them unhelpful in short-selling.

Tab. 3: Stock returns and variability of returns of investigated portolios.

	20% most expensive stocks		20% cheapest stocks	
	Average annual return	Variability of annual returns	Average annual return	Variability of annual returns
Raw P/BV	9.7%	35.0%	27.9%	67.6%
Differential P/BV	7.7%	35.7%	27.0%	68.2%
Raw P/S	7.0%	40.5%	33.1%	63.8%
Differential P/S	6.6%	38.4%	26.9%	67.8%

Source: money.pl, Notoria Serwis, author's work

Conclusion

In the paper we compared the profitability and risk of stock investment strategies, based on raw and differential valuation multiples, on the Polish stock market between 2003 and 2013. We tested if picking over- and undervalued stocks on the ground of a comparative valuation, where groups of "peers" (similar companies) are identified by means of a multi-criteria taxonomy with historical accounting information, brings results (returns and risks) superior to simpler strategies, based on raw valuation metrics (where no any inter-company differences in fundamentals are taken into consideration).

We found that in our sample the "peer-based" portfolios (where stocks were classified as "expensive" or "cheap" according to their differential multiples) were unable to "beat" the portfolios formed on the ground of raw multiples. In our opinion, there may be two primary reasons responsible for that:

1. Under the "peer-based" valuation an average multiple within a group of similar companies constitutes a benchmark. It may be, therefore, that a given stock is compared to the group of other stocks, which tend to be under- or overpriced on average. If, for example, a market is over-optimistic about the prospects of a particular group of companies (e.g. from the same industry), then seemingly cheap / expensive stock (as compared to its "peers") may still be overpriced / underpriced.

2. Although research studies for developed markets found that historical accounting data may be informative about future financial results, it does not have to be the case for less mature economies (like the Polish one), where past and future corporate fundamentals may be less correlated. In such circumstances picking "peers" on the ground of past data may result in forming groups of spuriously similar companies.

However, our study has relevant limitations. First of all, the ten-year period covered is pretty short and includes only few stock market cycles (which means that any single year could significantly impact the final findings). Moreover, during the years under investigation Polish economy did not experience any single year of a recession. This means that the computed long-term returns of some portfolios can be biased. Finally, other findings could be obtained if the identification of „peers" is based on forecasted (instead of historical) financial results or if some non-financial criteria are taken into consideration (e.g. industry classifications or marketing-related variables). Regrettably, refining our research to adjust for the above shortcomings is not currently viable, owing to the data availability limitations.

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