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RELATIONSHIP BETWEEN P/E RATIO, P/BV RATIO AND MARKET CAPITALISATION AND COMMON STOCK RETURNS. THE EVIDENCE FOR THE WARSAW STOCK EXCHANGE

First objective of the paper is to present an essence of the 'P/E Ratio Effect', 'P/BV Effect' and 'Size Effect' (known also as the 'Small Capitalisation Firms Effect'). Second and the main objective of the paper is to investigate whether or not the effects mentioned above have occurred at the Warsaw Stock Exchange.

P/E Ratio versus return from the investment

In sixties Francis Nicholson published two articles in which he suggested that firms with the lowest P/E ratios generate higher returns than firms characterised by the P/E ratios above the average.¹ In the article from 1960 Nicholson stated that appreciation (increase of value) of 5 stocks of the firms with the lowest P/E ratio was 56% on the average in the period of 3 years, while the increase in value of the 5 firms characterised by the highest P/E ratio was merely 21% in the same duration. At that time the results of Nicholson's research were rather surprising because majority of the financial analysts claimed that stocks with high P/E ratio are bought because of the expected significant increase of their returns.

¹ S.F. Nicholson, Price-Earnings Ratios, *Financial Analyst's Journal* 16 (July- August 1960, s. 43-45 oraz S.F. Nicholson, Price-Ratios in Relation to Investment Results, *Financial Analyst's Journal* 24 (January-February 1968), s. 105-109.

Ten years after the publication of the Nicholson's second article, S. Basu started his research on P/E ratio effect.² The results obtained by him questioned CAPM model, especially Efficient Market Hypothesis which determines its basis. In contradistinction to Nicholson, Basu could apply CAPM model paradigm, that enabled to measure the risk thanks to β . Moreover Basu had additional advantage because he could use computer data bases like COMPUSAT, CRSP so he could analyse results of 1400 firms quoted on the New York Stock Exchange (NYSE) during the period from September 1956 to August 1971. The main conclusion from Basu's research was that statistically significant difference between returns generated by portfolios with different P/E ratios exists. Mentioned difference between an average annual return from portfolio characterised by the lowest P/E ratio (in the examined group of firms P/E was 9,8) and the one generated by the companies with the highest P/E ratio (in the examined group of firms P/E was 35,8) exceeded 7%. This differentiation appeared stable in both seven years long sub-periods constituting Basu research. β failed in the sense that as far as annual figures were concerned portfolios with the lowest P/E ratios generated higher returns than the other ones.

Market value versus return from the investment

In march 1981 articles of Rolf W. Banz and Marc R. Reinganum were published in which the authors suggested that it is possible to gain economically and statistically significant returns above the average thanks to dividing firms into groups with different market capitalisation (Market Capitalisation: number of shares outstanding multiplied by their price). Both of the authors proved that average returns generated by the firms with the lowest market value were significantly higher than those generated by the firms with high capitalisation.³

Banz analysed monthly returns that occurred on New York Stock Exchange (NYSE) and demonstrated that returns on the 50 smallest firms quoted on mentioned stock exchange were on average 1,01% monthly higher than returns on the 50 biggest ones. Banz's research also

² S. Basu, Investment Performance of Common Stocks in Relation to Their Price-Earnings Ratios: A Test of the Efficient Market Hypothesis, *Journal of Finance* 32 (June 1977), s. 663-682.

³ R.W. Banz, The Relationship between Return and Market Value of Common Stocks, *Journal of Financial Economics* 9 (March 1981), s. 3-18; M.R. Reinganum, Misspecification of Capital Pricing: Empirical

proved that so called 'Size Effect' is not linear; significantly above average returns are obtained when the financial resources are invested in very small firms.

Reinganum studied the influence of the 'size effect' in a shorter period of time: from 1963 to 1977. Nevertheless in his research he included all of the firms quoted on both: New York Stock Exchange (NYSE) and American Stock Exchange (ASE). Reinganum proved that portfolios consisting of the smallest firms generated average annual return that was 0,05% higher than the one obtained in the whole examined population while the profits from portfolio created from the biggest companies were 0.0345 lower than the average ones. Reinganum's research also revealed the existence of the real monotonic correlation between market capitalisation and returns that were considered as above the market average ones. Relying on the annual data, Reinganum evaluated the difference between big and small companies which oscillated around 23,3%.⁴

Both of them, Banz and Reinganum noticed that influence of the 'Size Effect' differed in various periods. There were even sub-periods when 'Size effect' worked in the other direction. Volatility in the time of the described phenomenon is the subject of many scientific dissertations⁵. Nevertheless the existence of the 'Size Effect' itself is questioned very rarely.

The question if the 'Size Effect' and 'P/E Ratio Effect' are the same thing or completely independent phenomenon is a kind of side result of the research in the 'Size Effect' area. Apart from the many publications presenting different points of view in this subject, all of the outcomes prove that β coefficient cannot explain differences in the average returns.

The importance of the Banz's and Reinganum's researches issues from the fact that they proved existence of differences in the average returns which cannot be explained by the differences in the estimated β coefficients applied in the CAPM model. Inconsistency between the real and anticipated, thanks to β coefficient, earning capacity of the small companies is both statistically and economically significant.

Anomalies Based on Earnings' Yields and Market Values, Journal of Financial Economics 9 (March 1981), s. 19-46.

⁴ M.R. Reinganum, Portfolio Strategies Based on Market Capitalization, The Journal of Portfolio Management 9 (Winter 1983). s. 29-36.

The results of the Arnott's survey also confirm existence of the 'Size Effect' – sometimes referred to as the 'Small Capitalisation Firms Effect'.⁶

In fact capitalisation combines into one two elements: 'Size Effect' and 'Value effect'. When the other measures of the 'Value effect' like net profit, sales revenue or book value were applied, the value of correlation coefficients occurred to be mathematically significant but the strengths of these correlation were not as big as it was in the case of the capitalisation.

Capitalisation may be analysed as 'Sales Effect' joined with 'Value Effect' constructed as sales per one stock or sales per price of one stock ratios. It can be also perceived as 'Net Profit Effect' combined with 'P/E Ratio Effect' or as 'P/BV Effect' merged with 'Book Value/Market Value Ratio'.⁷ Hence, if small companies generally generate higher returns than the big ones and if the value measures like P/E ratio are also correlated with returns, than it does not surprise that capitalisation is much better indicator of returns than internal measures of the company's value.

Possible explanation for existence of the 'P/E Ratio Effect' and 'Size Effect'

There were also many articles published where the researchers using various methods and arguments were trying to explain the reasons of the phenomenon characterised by Banz and Reinganum. Some of them like R. Roll questioned for example the correctness of the β coefficients estimation.⁸ Others, like H.R. Stoll, R.E. Whaley, P. Schultz, investigated if the transaction costs did not eliminate profits from 'Size Effect' phenomenon.⁹ More and more

⁵ See for example P. Brown, A.W. Kleidon, T.A. Marsh, New Evidence on the Nature of Size-related Anomalies in Stock Prices, *Journal of Financial Economics* 12 (June 1983), s. 33-56.

⁶ R.D. Arnott, What Hath MPT Wrought: Which Risks Reap Rewards? W: F. Fabozzi (editor), *The Institutional Investor Focus on Investment Management*, Ballinger Publishing Company, Cambridge, 1989, s. 28.

⁷ S. Basu, The Relation between Earnings' Yield, Market Value and Return, *Journal of Financial Economics* 12 (June 1983), s. 129-156; T. Cook, M. Rozeff, Size and Earnings/Price Ratio Anomalies: One Effect or Two?, *Journal of Financial and Quantitative Analysis* 19 (December 1984), s. 449-466.

⁸ R. Roll, A Possible Explanation of the Small Firm Effect, *Journal of Finance* 36 (September 1981), s. 879-888.

⁹ H.R. Stoll, R.E. Whaley, Transaction Costs and the Small Firm Effect, *Journal of Financial Economics* 12 (June 1983), s. 57-80 oraz P. Schultz, Transaction Costs and the Small Firm Effect: A Comment, *Journal of Financial Economics* 12 (June 1983), s. 81-88.

research projects that have been run lately attempts to combine 'Size Effect' with risk measures derived from APT theory (Arbitrage price Theory), nevertheless the outcomes of these projects cannot be interpreted explicitly.

A very logical and practical question may be posed here: if 'Size Effect' really exists why do not the stock market players start buying the small companies stocks to make capital of the described phenomenon finally suppressing profits accruing from 'Size Effect'. Again it is the problem of the perceived risk. For example non many investors would judge Maine Public Service company as more safe than General Telephone. Maine Public does not have any strong institutional supporters, it is not a well known firm and its stocks are not easy to liquidate. Maybe the most important is fact that majority of the clients would excuse big loss generated by General Telephone much easier than the one caused by Maine Public Service. Nevertheless Maine Public Service is characterised by much lower price volatility, smaller systematic risk level (β) and generated on the average 5% higher annual return than General Telephone in the period from 1975 to 1982.

The other probable source of 'Small Firms Effect', closely connected with the perceived risk, is the structure of the ownership in the firm: who owns the stocks and what kind of risk is important for them? The ownership in big companies is usually dominated by institutional investors with very well diversified portfolios. Institutional investors like to know the firm so they are interested in stocks currently analysed by professionals. Moreover they favour shares that are easy to liquidate and they prefer big enterprises which stocks are sold in big packages. Institutional investors are punished for spending money on unknown, 'mysterious' small firms and this fact also encourages them to concentrate on big, famous companies. Wide diversification applied by institutional investors means that to substantiate an investment they require a moderate premium in expected returns in comparison to potential investments undertaken outside the stock exchange market. And finally small sizes of the small issues exclude big investment undertakings so in many cases small issues are perceived as too small to be bothered about them. In small firms the individuals are usually the stockholders whose portfolios are often not very well diversified. It usually happens in the case of the small investors that cannot afford diversification and natural owners (often firm's founders) with quite big not diversified participation in their own companies. It is obvious that those

investors whose portfolios are not diversified require much higher returns in order to justify investments in such small enterprises' stocks.

An application of the 'P/E Ratio Effect' and the 'Size Effect' in investment decision making.

At least a few strategies based on the difference between perceived and expected nondiversifiable risk are likely to be worked out. The strategies can lead to higher than average returns in a long run and do not increase risk at the same time: these elements of the perceived risk which can be diversified are eliminated thanks to the diversification.

What does an application of any of mentioned strategies mean? In order to achieve above the average results in a long run one should invest in stocks which are perceived as very risky by business. By definition it is a contrary strategy as it entails a sale of 'wonderful, safe' stocks and a purchase of 'not loved dogs' which are a risky investment. As the risky stocks are more exposed to price fluctuation, the strategy can result in a very spectacular flop which should be more than compensated by spectacular profit afterwards. It has become evident that often investors prefer to loose conventionally than achieve a success unconventionally. None of managers managing a portfolio was relieved from buying IBM shares. Therefore, the discussed strategy leads to uncomfortable and unconventional decisions.

Can the strategy of increasing the perceived risk, which is not a systematic risk, cause a failure? Yes. Two facts may cause worse results. Firstly, a measure of perceived risk used in a given strategy should be diversified. If in consequence of the strategy application it turns out that the risk is a systematic one, then the diversification does not reduce the portfolio's risk and buying the perceived risk may not result in above the average profits. Secondly, if aversion towards an element of perceived risk increases in time (if the phenomenon 'flight towards safety' occurs), then the strategy based on this element fails.

Description of the applied method

In order to reveal potential regularity concerning existence of the three analysed anomalies (effects) at the Warsaw Stock Exchange the authors adopted the following procedure. Starting point of the research was chosen when twenty companies had been quoted, so the benchmark date is 12.10.1993. Then a division into three groups of companies was carried out.

- Group 1 – five stocks with the lowest P/E ratio (portfolio No 1);
- Group 2 – ten stocks with an average P/E (portfolio No 2);
- Group 3 - five stocks with the highest P/E ratio P/E (portfolio No 3).

Each group was considered as a separate portfolio having an equal proportion of stocks which compose it. Every six months returns on the three portfolios were compared, so that H_0 hypothesis: $\mu_2 = \mu_1$, which means that the return on portfolio No 2 is equal to the return on portfolio No 1, was verified, against the alternative H_1 hypothesis: $\mu_2 < \mu_1$, saying that the return on the portfolio No 2 is lower than the return on portfolio No 1. H_0 hypothesis was verified every consecutive moment of the analysis. The same procedure was applied to compare portfolio No 3 against portfolio No 1 consisting of stocks with the highest and the lowest P/E ratios, respectively. The last comparison should indicate statically significant difference between the returns on the portfolios in order to confirm occurrence of ‘P/E Ratio Effect’.

Significance test of this hypothesis is conducted as follows. Weighted means of returns of each portfolio \bar{x}_1 i \bar{x}_2 and then statistics u are computed according to the formula:¹⁰

$$u = \frac{\bar{x}_2 - \bar{x}_1}{\sqrt{\frac{\delta_1^2}{n_1} + \frac{\delta_2^2}{n_2}}}$$

This statistic has a Normal Distribution $N(1,0)$ if H_0 hypothesis is true. Normal Distribution tables are used to determine the critical value u_α at the assumed level of significance so that the equation $P\{|U| \geq u_\alpha\} = \alpha$ is satisfied. The inequality in brackets determines two-sided critical interval, therefore reckoned statistic u is compared against u_α taken from Normal Distribution tables. If the inequality $|u| \geq u_\alpha$ is satisfied then the H_0 hypothesis is rejected in

¹⁰ Refer to: J. Greń: Statystyka matematyczna. Modele i zadania. PWN, Warszawa 1982, s. 65.

favour of H_1 . In case when the inequality is inverse, $|u| < u_\alpha$, then there is no sufficient evidence to reject H_0 hypothesis.

Note. For the alternative H_1 hypothesis: $m_1 < m_2$, a test having left-sided critical interval $U \leq u_\alpha$ should be used. The critical value u_α should be taken from Normal Distribution tables so that $P\{U \leq u_\alpha\} = \alpha$. However, for the alternative hypothesis $H_1: m_1 > m_2$, a test having right-sided critical interval $U \geq u_\alpha$ should be applied. The critical value u_α should be taken from Normal Distribution tables so that $P\{U \geq u_\alpha\} = \alpha$.

The percentage returns on portfolios on 12.04.94, 12.10.94, 12.04.95, 12.10.95, 12.04.96, 12.10.96, 11.04.97, 13.10.97 and 14.04.98 were calculated comparing to the benchmark quotation from 12.10.1993. The allocation of the companies made on 12.10.93 was the first step of the analysis. In order to eliminate impact of unique factors on the allocation day, the presented procedure was repeated. Analogous portfolios were formed according to the level of P/E ratio one year later, i.e. on 12.10.1994. Again the set of data was obtained where the returns on 12.04.95, 12.10.95, 12.04.96, 12.10.96, 11.04.97, 13.10.97 and 14.04.98 were computed comparing to the other benchmark date.

Aiming at additional confirmation whether the assumed hypothesis is true the next three much larger portfolios were created and analysed:

- Portfolio No 1 – fifteen stocks with the lowest P/E ratio;
- Portfolio No 2 – thirty stocks with an average P/E ratio;
- Portfolio No 3 – fifteen stocks with the highest P/E ratio.

These portfolios were formed according to P/E ratios on 24.06.1996. Afterwards returns of the portfolios were compared every six months, it means on 23.12.96, 23.06.97, 23.12.97 and 23.06.98 against the quotation on 24.06.1996. Similarly to the analysis of the thirty companies, the procedure was repeated for analogues set of portfolios in accordance to P/E ratio one year after the first allocation, i.e. on 23.12.1997. This time, due to a relatively short

period of comparison, analysis covered changes in the portfolios values only on 23.12.97 and 23.06.98 comparing to mentioned benchmark date (23.12.97).

The above procedure was repeated twice more when analysing relationship between returns on different portfolios created on the basis of:

1. P/BV ratio,
2. market capitalisation.

The most crucial results and possible explanation are presented in the next section.

Results of the research - the 'P/E Ratio Effect'

Having compared returns from the portfolio consisting of the firms with the lowest P/E ratio with returns generated by the portfolio with the stocks characterised by the highest P/E (table 2) we may conclude that in first two years (four and half year periods) profits from the portfolio No 3 were higher then the ones from portfolio No 1. So we can't confirm existence of the 'P/E Ratio Effect' in this period. After 2,5 years (in the fifth period of comparison) since the moment when stocks had been allocated into appropriate portfolios, returns from the portfolio No 1 and 3 were equal. In the following periods returns generated by portfolio No 1 become much higher than profits from portfolio No 3, and, as far as research conducted on 13.10.97 is concerned, discussed difference is statistically significant.

The comparison of the returns from portfolios No 1 and No 2 may seem to be even more interesting. In all the periods of the survey returns from portfolio No 1 were far higher than returns from portfolio No 2. Moreover, in three cases the observed differences were statistically significant, while as far as the others are concerned the value of statistic is quite high and stable - what may support the hypothesis claiming existence of the 'P/E Ratio Effect'. Nevertheless, we can't forget that analysed portfolios are in a way unique, because they consist of very small number of firms divided into three groups in an arbitrarily chosen moment (12.10.93).

Existence of the 'P/E Ratio Effect' may be confirmed by comparison of the returns from portfolios No 1 and 2, which were created again (on the basis of the P/E ratio criterion) one

year after the first allocation (12.10.94). In each analysed period except one results obtained from the survey confirm relationship between the P/E ratio and return, however only in one case the difference is statistically significant. Nevertheless, the observed differences between returns are quite substantial.

Subsequent comparisons of the returns from the portfolios in various configuration confirm the existence of the 'P/E Ratio Effect' (tables 4-8). In the case of portfolio allocated on 12th November 1994 only in two periods returns from portfolio No 3 were higher than returns from the portfolio No 1. Although the mentioned differences are quite visible, they are not statistically significant. Results obtained from the portfolios allocated (on the basis of the P/E ratio criterion) on 24th July 1996 also can't prove existence of the 'P/E Ratio Effect', because in all of the analysed periods the return from the portfolio No 1 was lower than returns generated by portfolios No 2 and 3 (tables 5 and 6). Furthermore, the comparison of the results of the portfolios allocated on 23rd July 1997 (tables 7 and 8) can't confirm existence of the 'P/E Ratio Effect' on the Warsaw Stock Exchange.

Having conducted research we can't conclude explicitly. Comparison of the returns from the portfolios allocated on the basis of the lowest, average and the highest P/E ratio criterion shows that firms characterised by the lowest P/E ratio are more profitable but only in a long run. The survey proves that observed phenomenon occurs after 2-3 years from the moment of the initial allocation. That is why choosing financial strategy based on this relationship may be profitable only if we undertake medium-term and long-term investments. The further research is recommended to approve or disapprove the phenomenon.

Results of the research – the 'P/BV Ratio Effect'

The comparison of the results obtained from the portfolios allocated on the basis of the P/BV ratio criterion seems to be very interesting. Portfolio No 1 (created from the stocks with the lowest P/BV ratio) generated higher returns than portfolio No 2 (created from the stocks with an average P/BV ratio) and portfolio No 3 (created from the stocks with the highest P/BV ratio). When comparing results of the portfolios No 1 and No 2 the differences are evident. As far as the allocation from 12th November 1993 is considered, presented differences are

statistically significant (table 10). Also differences noticed during the following allocation - 12th November 1994 (table 11) - are statistically significant (except last period). Presented output of the conducted research may be an interesting hint for the investors interested in medium-term and long-term horizon investments. Nevertheless further research should be undertaken to confirm described relationship. Mentioned phenomenon did not occur with regard to the portfolio created in June 1996 and 1997 (table 12 and 13). The probable explanation may be the short horizon of the analysis (in the first case 2 years, in the second case 1 year).

Results of the research – the ‘Size Effect’

On the Warsaw Stock Exchange we deal with the phenomenon which can be called the ‘Big Capitalisation Firms Effect’ as something opposite to the relationships described above and known as the ‘Small Capitalisation Firms Effect’. Investments in the stocks of the companies with the highest market values have been more profitable than the ones with the lowest market value in a short and in a long run. Comparison of the ratings based on market value of the firms and returns generated thanks to investing financial resources in stocks is characterised by very high correlation coefficient.

According to many analysts this situation is an effect of so called ‘Top 10’ strategy advised for the investors interested in emerging markets. If it is recommended to increase the volume of one country’s shares in the portfolio ‘Top 10’ strategy assumes buying stocks characterised by the biggest capitalisation and the highest liquidity. Application of this strategy enables gaining high returns and it is possible to close the position very quickly after having decided about withdrawing from the given market. More averse risk investors realise modified ‘Top 10’ strategy, which recommends buying a dozen or so firms (it enables better diversification of the portfolio). Nevertheless the rules are more or less the same.

Undertaken research confirms existence of the ‘Big Capitalisation Firms Effect’. The objective of the study was to verify hypothesis saying that we face in Poland something opposite - the ‘Small Firms Effect’. Analysis of the returns from the portfolios created on the capitalisation criterion enables us to come to the conclusion that returns from the portfolios

(portfolios No 3) consisting of firms with high market value are higher than the ones generated from the portfolios (portfolios No 1) created from small firms (in almost all of the periods). As far as the allocation made on 12th November 1993 is considered, noticed differences are statistically significant in 6 cases (there were 9 of them altogether), 4 of them were the last ones (table 14). Differences in returns from portfolios created in November 1994 occurred statistically significant in 5 cases (again they are the last ones) for 7 (table 15). The 'Big Capitalisation Firms Effect' was also confirmed by the comparison of the returns from the portfolios allocated in June 1996 (table 16) and June 1997 (table 17).

Polish experiences are probably not anything unique. It would be interesting to compare researched phenomenon with the ones that occurred on stock exchanges in other Central European and Eastern European countries. The strategies of the big, institutional foreign investors may lead to significant underevaluation of the small firms. Because this companies are characterised by comparable efficiency (sometimes they are even more efficient), present difference in market valuation will have to deteriorate sooner or later.

Conclusion

In the sixties and seventies many facts convinced the 'Efficient Market Hypothesis'. It seemed that changes in stock prices have a random character, hence the differences in average returns among stocks were caused by their risk level measured by β coefficient. However, the researches conducted in the eighties and later were a serious challenge for these fundamental and generally accepted assumptions. One of the surveys provided evidence which indicated that share prices fluctuations do not appear in a way which could be described as an independent and identical one. Some predictable patterns of share prices behaviour were brought to light. The average returns in January appeared to be higher than the returns in other months. Particularly small companies experienced above the average returns in January, especially at the beginning of this month. Other studies proved that positive changes in values on capital market in a long run occurred almost only in the first and third part of months and hardly ever in the second part. Other words speaking, average returns in the first part of a month are positive, but in the second part are equal zero.

Numerous surveys confirmed the β coefficient failure as a tool for explanation of above the average returns in a long run. A few other investment strategies can lead to higher rates of return even when allowing for risk computed with beta. Two of the strategies which attracted particular attention are based on P/E ratio and market capitalisation level. Fairly, stocks with a lower P/E ratio gain a better rate of return than those with a higher P/E ratio. In a sense this can be confirmed by the authors of this article, with reference to companies quoted at the Warsaw Stock Exchange. Next small capitalisation firms experience higher average returns than big capitalisation companies. The study conducted for companies quoted in Warsaw do not show any occurrence of this anomaly. Moreover, an adverse phenomenon was observed which can be named as the 'Big Capitalisation Effect'. It might be one of the first proofs to convince the thesis stating that on emerging markets an anomaly adverse to the 'Small Capitalisation Effect' exists. The latter was often analysed in the reference to well developed markets. Further studies within this area should provide a better explanation.

Results of some surveys suggest that the 'P/E Ratio Effect' and the 'Size Effect' can be interrelated, which means they are not independent from each other. Empirical studies, however, indicate that investment strategies based on β coefficient can be beaten by other strategies, such as the P/E ratio strategy or market capitalisation strategy taking into account 'Small Capitalisation Effect' (stock exchanges on well developed markets) and - what would call for further studies - 'Big Capitalisation Effect' (stock exchanges on emerging markets).

What caused such a reconsideration of the classical point of view on capital markets functioning and why has it happened very recently? It seems that the answer should not be searched in quality and scale of former surveys. In reality most of the previous studies concerning the Random Walk Theory and asset valuation thanks to the CAPM (Capital Asset Pricing Theory) allowed for more detailed and deeper cognisance of price fluctuations. The answer is - at least partially - connected with the technological headway. Tools available for researchers in the late eighties and nowadays are much more efficient comparing to those existing 20-30 years ago. Total computerisation and easy access to data basis has radically changed research possibilities. In the sixties collecting data for thirty companies was a very serious intention. Together with the technological progress it is easier to reveal capital market secrets.

Objections and doubts relating to the Efficient Market Hypothesis do not mean that information about asset valuation is ignored. But the mentioned objections and doubts, produced by plenty of empirically examined anomalies indicate that efforts in reality modelling should be more sophisticated. Changing of stock prices cannot be perceived as a purely random process. Anticipated patterns of price fluctuations require a finding of coherent and homogeneous explanation, what can be elaborated even in this decade.

A comparison of the return on stocks with the lowest P/E ratio (portfolio No 1) against the return on stocks with an average P/E ratio (portfolio No 2)

Table 1

Date	12.IV.94	12.X.94	12.IV.95	11.X.95	12.IV.96	11.X.96	11.IV.97	13.X.97	14.IV.98
Return on portfolio No 1	33,44	27,57	-0,11	-13,67	19,91	73,51	96,55	132,74	155,89
Return on portfolio No 2	19,02	-1,73	-22,80	-24,19	-5,07	9,81	8,30	16,00	38,67
Variance of returns on portfolio No 1	868	982	1173	669	2579	9851	7361	18812	35475
Variance of returns on portfolio No 2	706	1846	1513	3167	7105	15780	10144	10018	22760
Statistic u	-0,908	-1,462	-1,131	-0,477	-0,691	-1,044	-1,731	-1,672	-1,195
u_{α}	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28
P/E Ratio Effect	No	Yes	No	No	No	No	Yes	Yes	No

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 12.10.1993. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Both portfolios were created according to P/E ratio level on 12.10.1993. Portfolio No 1 consists of 5 stocks with the lowest P/E ratio, whereas portfolio No 2 consists of 9 stocks with an average P/E ratio (one stock having a negative P/E ratio was excluded from the analysis).

A comparison of the return on stocks with the lowest P/E ratio (portfolio No 1) against the return on stocks with the highest P/E ratio (portfolio No 3)

Table 2

Date	12.IV.94	12.X.94	12.IV.95	11.X.95	12.IV.96	11.X.96	11.IV.97	13.X.97	14.IV.98
Return on portfolio No 1	33,44	27,57	-0,11	-13,67	19,91	73,51	96,55	132,74	155,89
Return on portfolio No 3	72,88	48,53	5,97	7,73	19,78	31,40	45,73	32,27	-1,27
Variance of returns on portfolio No 1	868	982	1173	669	2579	9851	7361	18812	35475
Variance of returns on portfolio No 3	2730	1940	1153	2559	1882	3972	2063	926	823
Statistic u	1,470	0,867	0,282	0,843	-0,004	-0,801	-1,171	-1,599	-1,845
u_{α}	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28
P/E Ratio Effect	No	No	No	No	No	No	No	Yes	Yes

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 12.10.1993. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Both portfolios were created according to P/E ratio level on 12.10.1993. Portfolio No 1 consists of 5 stocks with the lowest P/E ratio, whereas portfolio No 3 consists of 5 stocks with the highest P/E ratio.

A comparison of the return on stocks with the lowest P/E ratio (portfolio No 1) against the return on stocks with an average P/E ratio (portfolio No 2)

Table 3

Date	12.IV.95	11.X.95	12.IV.96	11.X.96	11.IV.97	13.X.97	14.IV.98
Return on portfolio No 1	-30,47	-33,84	-6,61	46,70	34,68	34,07	70,35
Return on portfolio No 2	-22,83	-37,97	-24,72	-18,83	-5,13	14,42	7,78
Variance of returns on portfolio No 1	197	608	2008	7840	5121	5926	11906
Variance of returns on portfolio No 2	266	428	1357	3882	4114	8784	14074
Statistic u	0,941	-0,322	-0,781	-1,482	-1,051	-0,433	-1,017
u_{α}	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28
P/E Ratio Effect	No	No	No	Yes	No	No	No

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 12.10.1994. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Both portfolios were created according to P/E ratio level on 12.10.1994. Portfolio No 1 consists of 5 stocks with the lowest P/E ratio, whereas portfolio No 2 consists of 10 stocks with an average P/E ratio.

A comparison of the return on stocks with the lowest P/E ratio (portfolio No 1) against the return on stocks with the highest P/E ratio (portfolio No 3)

Table 4

Date	12.IV.95	11.X.95	12.IV.96	11.X.96	11.IV.97	13.X.97	14.IV.98
Return on portfolio No 1	-30,47	-33,84	-6,61	46,70	34,68	34,07	70,35
Return on portfolio No 3	-19,91	-1,62	12,50	21,68	48,87	38,99	33,54
Variance of returns on portfolio No 1	197	608	2008	7840	5121	5926	11906
Variance of returns on portfolio No 3	127	1964	2280	2163	5881	6017	6271
Statistic u	1,313	1,421	0,652	-0,559	0,303	0,101	-0,610
u_{α}	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28
P/E Ratio Effect	No	No	No	No	No	No	No

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 12.10.1994. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Both portfolios were created according to P/E ratio level on 12.10.1994. Portfolio No 1 consists of 5 stocks with the lowest P/E ratio, whereas portfolio No 3 consists of 5 stocks with the highest P/E ratio.

A comparison of the return on stocks with the lowest P/E ratio (portfolio No 1) against the return on stocks with an average P/E ratio (portfolio No 2)

Table 5

Date	23.XII.96	23.VI.97	23.XII.97	23.VI.98
Return on portfolio No 1	-7,84	7,11	-9,67	-26,33
Return on portfolio No 2	-0,96	21,07	-0,34	-0,93
P/E Ratio Effect	No	No	No	No

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 24.06.1996. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Both portfolios were created according to P/E ratio level on 24.06.1996. Portfolio No 1 consists of 15 stocks with the lowest P/E ratio, whereas portfolio No 2 consists of 27 stocks with an average P/E ratio (3 stocks having negative P/E ratios were excluded from the analysis). Due to a lower return on portfolio No 1 comparing to return on portfolio No 2 there was no need of verifying the hypothesis saying that returns on analysed portfolios were equal against the alternative hypothesis saying that portfolio No 1 should produce a higher profitability.

A comparison of the return on stocks with the lowest P/E ratio (portfolio No 1) against the return on stocks with the highest P/E ratio (portfolio No 3)

Table 6

Date	23.XII.96	23.VI.97	23.XII.97	23.VI.98
Return on portfolio No 1	-7,84	7,11	-9,67	-26,33
Return on portfolio No 3	6,52	24,31	7,62	2,89
P/E Ratio Effect	No	No	No	No

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 24.06.1996. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Both portfolios were created according to P/E ratio level on 24.06.1996. Portfolio No 1 consists of 15 stocks with the lowest P/E ratio, whereas portfolio No 3 consists of 15 stocks with the highest P/E. Due to a lower return on portfolio No 1 comparing to return on portfolio No 3 there was no need of verifying the hypothesis saying that returns on analysed portfolios were equal against the alternative hypothesis saying that portfolio No 1 should produce a higher profitability.

A comparison of the return on stocks with the lowest P/E ratio (portfolio No 1) against the return on stocks with an average P/E ratio (portfolio No 2)

Table 7

Date	23.XII.97	23.VI.98
Return on portfolio No 1	-19,21	-6,60
Return on portfolio No 2	-17,17	-21,58
Variance of returns on portfolio No 1	317	2283
Variance of returns on portfolio No 2	527	1061
Statistic u	0,312	-1,069
u_{α}	-1,28	-1,28
P/E Ratio Effect	No	No

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 23.06.1997. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Both portfolios were created according to P/E ratio level on 23.06.1997. Portfolio No 1 consists of 15 stocks with the lowest P/E ratio, whereas portfolio No 2 consists of 24 stocks with an average P/E ratio (6 stocks having negative P/E ratios were excluded from the analysis).

A comparison of the return on stocks with the lowest P/E ratio (portfolio No 1) against the return on stocks with the highest P/E ratio (portfolio No 3)

Table 8

Date	23.XII.97	23.VI.98
Return on portfolio No 1	-19,21	-6,60
Return on portfolio No 3	-9,44	-15,39
Variance of returns on portfolio No 1	317	2283
Variance of returns on portfolio No 3	430	2101
Statistic u	1,385	-0,514
u_{α}	-1,28	-1,28
P/E Ratio Effect	No	No

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 23.06.1997. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Both portfolios were created according to P/E ratio level on 23.06.1997. Portfolio No 1 consists of 15 stocks with the lowest P/E ratio, whereas portfolio No 3 consists of 15 stocks with the highest P/E ratio.

A comparison of the return on stocks with the lowest P/BV ratio (portfolio No 1) against the return on stocks with an average P/BV ratio (portfolio No 2)

Table 9

Date	12.IV.94	12.X.94	12.IV.95	11.X.95	12.IV.96	11.X.96	11.IV.97	13.X.97	14.IV.98
Return on portfolio No 1	31,87	16,09	-14,08	-12,37	18,53	82,10	95,08	107,52	123,41
Return on portfolio No 2	49,68	28,14	-1,48	-5,02	17,22	30,96	35,40	38,70	41,24
Variance of returns on portfolio No 1	705	596	725	2223	4428	13986	10204	25700	46603
Variance of returns on portfolio No 2	2322	2005	927	1966	4191	11579	7021	6065	15425
Statistic u	0,922	0,674	0,817	0,290	-0,036	-0,813	-1,139	-0,908	-0,788
u_{α}	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28
P/BV Ratio Effect	No	No	No	No	No	No	No	No	No

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 12.10.1993. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Both portfolios were created according to P/BV ratio level on 12.10.1993. Portfolio No 1 consists of 5 stocks with the lowest P/BV ratio, whereas portfolio No 2 consists of 10 stocks with an average P/BV ratio.

A comparison of the return on stocks with the lowest P/BV ratio (portfolio No 1) against the return on stocks with the highest P/BV ratio (portfolio No 3)

Table 10

Date	12.IV.94	12.X.94	12.IV.95	11.X.95	12.IV.96	11.X.96	11.IV.97	13.X.97	14.IV.98
Return on portfolio No 1	31,87	16,09	-14,08	-12,37	18,53	82,10	95,08	107,52	123,41
Return on portfolio No 3	19,54	3,21	-21,26	-35,37	-26,45	-28,29	-15,83	0,67	9,59
Variance of returns on portfolio No 1	705	596	725	2223	4428	13986	10204	25700	46603
Variance of returns on portfolio No 3	667	3135	2998	3153	3914	2018	3710	6560	11328
Statistic u	-0,745	-0,472	-0,263	-0,702	-1,101	-1,951	-2,102	-1,330	-1,057
u_{α}	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28
P/BV Ratio Effect	No	No	No	No	No	Yes	Yes	Yes	No

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 12.10.1993. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Both portfolios were created according to P/BV ratio level on 12.10.1993. Portfolio No 1 consists of 5 stocks with the lowest P/BV ratio, whereas portfolio No 3 consists of 5 stocks with the highest P/BV ratio.

A comparison of the return on stocks with the lowest P/BV ratio (portfolio No 1) against the return on stocks with the highest P/BV ratio (portfolio No 3)

Table 11

Date	12.IV.95	11.X.95	12.IV.96	11.X.96	11.IV.97	13.X.97	14.IV.98
Return on portfolio No 1	-18,78	-4,84	4,91	32,40	62,40	52,42	40,93
Return on portfolio No 3	-34,44	-43,96	-37,47	-19,31	-21,90	-12,99	-12,12
Variance of returns on portfolio No 1	174	2128	2940	4012	5416	6836	9108
Variance of returns on portfolio No 3	212	334	528	2924	3683	3686	7595
Statistic u	-1,784	-1,763	-1,609	-1,388	-1,976	-1,426	-0,918
u_{α}	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28
P/BV Ratio Effect	Yes	Yes	Yes	Yes	Yes	Yes	No

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 12.10.1994. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Both portfolios were created according to P/BV ratio level on 12.10.1994. Portfolio No 1 consists of 5 stocks with the lowest P/BV ratio, whereas portfolio No 3 consists of 5 stocks with the highest P/BV ratio.

A comparison of the return on stocks with the lowest P/BV ratio (portfolio No 1) against the return on stocks with the highest P/BV ratio (portfolio No 3)

Table 12

Date	23.XII.96	23.VI.97	23.XII.97	23.VI.98
Return on portfolio No 1	-3,45	14,81	-8,64	-16,62
Return on portfolio No 3	0,81	12,34	-0,58	0,43
P/BV Ratio Effect	No	No	No	No

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 24.06.1996. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Both portfolios were created according to P/E ratio level on 24.06.1996. Portfolio No 1 consists of 15 stocks with the lowest P/BV ratio, whereas portfolio No 3 consists of 15 stocks with the highest P/BV ratio. Due to a lower return on portfolio No 1 comparing to return on portfolio No 3 there was no need of verifying the hypothesis saying that returns on analysed portfolios were equal against the alternative hypothesis saying that portfolio No 1 should produce a higher profitability.

A comparison of the return on stocks with the lowest P/BV ratio (portfolio No 1) against the return on stocks with an average P/BV ratio (portfolio No 2) and the highest P/BV ratio (portfolio No 3)

Table 13

Date	23.XII.97	23.VI.98
Return on portfolio No 1	-17,59	-13,93
Return on portfolio No 2	-19,81	-23,69
Return on portfolio No 3	-10,92	-15,45
P/BV Ratio Effect	No	No

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 24.06.1997. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. Three portfolios were created according to P/E ratio level on 24.06.1997. Portfolio No 1 consists of 15 stocks with the lowest P/BV ratio, portfolio No 2 consists of 30 stocks with an average P/BV ratio whereas portfolio No 3 consists of 15 stocks with the highest P/BV ratio. Due to similar level of returns on analysed portfolios there was no need of verifying the hypothesis saying that returns on analysed portfolios 1 and 2 as well as 1 and 3 are equal against the alternative hypothesis saying that portfolio No 1 should produce a higher profitability.

A comparison of the return on stocks with the lowest capitalisation (portfolio No 1) against the return on stocks with an average capitalisation (portfolio No 2) and the highest capitalisation (portfolio No 3)

Table 14

Date	12.IV.94	12.X.94	12.IV.95	11.X.95	12.IV.96	11.X.96	11.IV.97	13.X.97	14.IV.98
Return on portfolio No 1	47,15	5,09	-24,77	-26,69	-13,41	-8,39	-7,31	-11,16	-32,98
Return on portfolio No 2	35,52	17,16	-12,76	-11,53	12,91	17,22	33,60	50,88	63,04
Return on portfolio No 3	32,59	36,19	11,98	-8,04	14,23	89,67	90,14	95,44	122,39
Variance of returns on portfolio No1	2207	1153	1179	2972	3620	7858	5874	4422	1945
Variance of returns on portfolio No3	98	931	1261	2404	1877	20919	9673	6929	27691
Statistic u	0,678	-1,523	-1,663	-0,569	-0,834	-1,293	-1,748	-2,247	-2,018
u_{α}	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28
Size effect	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 12.10.1993. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. The three portfolios were created according to a capitalisation value on 12.10.1993. Portfolio No 1 consists of 5 stocks with the lowest capitalisation, whereas portfolio No 2 consists of 10 stocks with an average capitalisation and portfolio No 3 consists of 5 stocks with the highest capitalisation. Due to a higher level of return on portfolio No 3 in all analysed periods (except first one) comparing to returns on portfolios No 1 and No 2, alternative hypothesis $H_1: \mu_3 > \mu_1$, saying that Portfolio No 3 produces a higher profitability than portfolio No 1 was tested.

A comparison of the return on stocks with the lowest capitalisation (portfolio No 1) against the return on stocks with an average capitalisation (portfolio No 2) and the highest capitalisation (portfolio No 3)

Table 15

Date	12.IV.95	11.X.95	12.IV.96	11.X.96	11.IV.97	13.X.97	14.IV.98
Return on portfolio No 1	-29,66	-31,09	-26,24	-16,02	-3,53	-17,01	-30,86
Return on portfolio No 2	-19,82	-28,44	-14,24	-9,92	6,40	13,51	5,47
Return on portfolio No 3	-26,75	-23,42	11,16	66,57	64,01	91,89	139,38
Variance of returns on portfolio No1	197	1025	1222	3498	5357	2650	2008
Variance of returns on portfolio No3	215	605	2411	7586	4594	9157	16214
Statistic u	-0,321	-0,425	-1,387	-1,754	-1,514	-2,241	-2,820
u_{α}	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28	-1,28
Size effect	No	No	Yes	Yes	Yes	Yes	Yes

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 12.10.1994. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. The three portfolios were created according to a capitalisation value on 12.10.1994. Portfolio No 1 consists of 5 stocks with the lowest capitalisation, whereas portfolio No 2 consists of 10 stocks with an average capitalisation and portfolio No 3 consists of 5 stocks with the highest capitalisation. Due to a higher level of return on portfolio No 3 in all analysed periods (except first one) comparing to returns on portfolios No 1 and No 2, alternative hypothesis $H_1: \mu_3 > \mu_1$, saying that Portfolio No 3 produces a higher profitability than portfolio No 1 was tested.

A comparison of the return on stocks with the lowest capitalisation (portfolio No 1) against the return on stocks with an average capitalisation (portfolio No 2) and the highest capitalisation (portfolio No 3)

Table 16

Date	23.XII.96	23.VI.97	23.XII.97	23.VI.98
Return on portfolio No 1	-13,48	13,35	-9,95	-28,24
Return on portfolio No 2	5,01	25,02	2,87	-3,61
Return on portfolio No 3	1,58	8,84	-0,83	13,54
Size effect: a comparison of portfolios No 3 and No 1	Yes	No	No	Yes

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998).

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 24.06.1996. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. The three portfolios were created according to a capitalisation value on 24.06.1996. Portfolio No 1 consists of 15 stocks with the lowest capitalisation, whereas portfolio No 2 consists of 30 stocks with an average capitalisation and portfolio No 3 consists of 15 stocks with the highest capitalisation. Due to a higher level of return on portfolio No 3 in all analysed periods (except second one) comparing to returns on portfolio No 1, alternative hypothesis $H_1: \mu_3 > \mu_1$, saying that Portfolio No 3 produces a higher profitability than portfolio No 1 was tested.

A comparison of the return on stocks with the lowest capitalisation (portfolio No 1) against the return on stocks with an average capitalisation (portfolio No 2) and the highest capitalisation (portfolio No 3)

Table 17

Date	23.XII.97	23.VI.98
Return on portfolio No 1	-22,36	-38,95
Return on portfolio No 2	-20,44	-21,57
Return on portfolio No 3	-6,23	5,84
Size effect: a comparison of portfolios No 3 and No 1	Yes	Yes

Source: Elaboration based on research conducted by Zarzecki, Byrka, Kozłowska-Nalewaj in Poland (1998) No.

The significance level was assumed as 0,1. The return on portfolio is defined as a percentage change in portfolio value on a given day comparing to its value on 23.06.1997. The dividend payments were not taken into account as their value was not significant for the return level on investment in analysed stocks. The three portfolios were created according to a capitalisation value on 23.06.1997. Portfolio No 1 consists of 15 stocks with the lowest capitalisation, whereas portfolio No 2 consists of 30 stocks with an average capitalisation and portfolio No 3 consists of 15 stocks with the highest capitalisation. Due to a higher level of return on portfolio No 3 in all analysed periods comparing to returns on portfolio No 1, alternative hypothesis $H_1: \mu_3 > \mu_1$, saying that Portfolio No 3 produces a higher profitability than portfolio No 1 was tested.