THE RETURN AND RISK PROFILE OF EQUITIES AND EQUITY PORTFOLIOS AT THE BUDAPEST STOCK EXCHANGE*

GYÖNGYI BUGÁR[1] – GIANNI BARATTO[2] – ISTVÁN PREHOFFER[3]

This paper examines the risk and return characteristics of equities listed and traded in category 'A' at the Budapest Stock Exchange in the time period of 2001–2002. The performance of two portfolio strategies is also evaluated. It is shown empirically that a systematic portfolio allocation has several advantages to stock picking. Indeed, the portfolio strategies examined performed well not only on an ex post but also on an ex ante basis.

KEYWORDS: Risk and return of equities. Equity portfolios. Budapest Stock Exchange.

In response to the world-wide market downturn since 2000 and because of some unfavourable governmental steps and taxation reasons, the turnover and the capitalisation on the equity market of the Budapest Stock Exchange (BSE) has fallen significantly. Particularly, in 2001 the market turnover fell by 60 percent and the capitalisation of equities decreased by 16 percent as compared to the end of the year 2000 (*Statistical Report* [2001], p. 6–8). The negative trends of the earlier year seemed to take an upward turn in 2002. It is indicated by the fact that both the turnover and capitalisation of the equity market have increased by more than 9 and 3.5 percent, respectively (*Statistical Report* [2002], p. 3–4).

The aim of this paper is to study the risk and return characteristics of equities listed in category 'A' of the BSE over the period 2001–2002. The performance of two portfolio strategies is also analysed. We intend to show that a systematic portfolio allocation has several advantages over the approach of picking some individual equities to invest in, especially in times of undesirable market processes.

The structure of the paper is as follows. The next section provides a description of the database used in the analysis and the methodology applied. Empirical results are presented next, followed by some concluding remarks.

* The first author was generously supported in writing this paper by the Hungarian Academy of Sciences in the framework of the Bolyai Scholarship. The authors wish to thank *Eszter Kocsis* (Information Centre of the Budapest Stock Exchange) for all her help in data collection and providing up-to date information.

[1] Associate Professor, University of Pécs, Faculty of Business and Economy.

[2] Finalist Student, University of Padua, Faculty of Economics at the time of writing the paper: ERASMUS Student at the University of Pécs.

[3] Supply Chain Leader, Elcoteq Hungary. At the time of writing the paper: Finalist Student, University of Pécs, Faculty of Business and Economics, Business Degree Programmes in English.

DATA AND METHODOLOGY

The database for the analysis consists of the daily closing prices of the equities listed and traded in category 'A' at the Budapest Stock Exchange and those of the BUX index within the period of 3 January 2001 to 23 December 2002. In 2001, the category system for equities at the BSE was revised and equities were grouped into two categories, 'A' and 'B', using a modified set of criteria (*Annual Report* [2001], p. 21.). The capitalisation of the equities listed in category 'A' represented more than 90 percent of the total equity capitalisation in both years studied in our current paper (*Statistical Report* [2001] and [2002], p.14.).

Firstly, we excluded from our analysis the time series that were not complete, since it is not possible to compare securities on the base of different (or in any case, excessively different) time series. In particular, we excluded Graboplast and Csopak. The former was removed from the trading list in December 2001 and the latter was delisted in January 2002. Although, Pick was also removed from the trading list on 7 November 2002, in that particular case, we had enough data to perform the analysis.

Therefore, there were altogether 24 securities included in the study: Antenna Hungária, BorsodChem, Danubius, DÉMÁSZ, Egis, Fotex, Globus, Graphisoft, Humet, Inter-Európa Bank, MATÁV, Mezőgép, MOL, NABI, OTP Bank, Pannonplast, Pick, Prímagáz, RÁBA, Richter Gedeon, Synergon, TVK, Zalakerámia and Zwack Unicum. We also considered the BUX index.

Moreover, we had to find and adjust the prices resulting from split and reverse split[4]:

– In case of OTP, there was a 10-to-1 split in March 2002. It means that each shareholder received 10 new shares with the face value of 1/10th of the original for each 'old' (pre-split) shares held, and the old shares were withdrawn. This type of transaction has the direct result that the face value of all shares held remains unchanged. In order to handle the above-mentioned split properly, we multiplied all the after-split values (closing prices) in the time series by 10.

– In case of Humet, a 1-to-10 reverse split was made in September 2002, in which the existing stocks were replaced by new ones, for each 10 'old' share a new share was given with a face value 10 times higher than the original one. Therefore, we divided the after-split prices by 10.[5]

We decided to use weekly returns as the basis for the analysis. In our opinion, to a large extent this time unit is not influenced by the events that have but a limited and only daily impact on the trading of securities and, at the same time, it has the right sensitivity to the changes in the trend of the time series. For this reason, we took the closing prices of Wednesdays, as it is a day in the middle of the week and therefore their prices do not carry the effect of variables related to the beginning nor the end of the week. In those few cases, when Wednesdays were not applicable for ordinary business reasons we took the nearest day at our disposal.

[4] The announcement on split/reverse split can always be found among the BSE News (Press Releases/Orders) on the homepage of the BSE: www.bse.hu.

[5] Throughout the analysis we took the viewpoint of the investor who keeps the security once acquired during the whole period studied, i.e. we considered "buy-and-hold" decisions. Doing it otherwise, especially in case of split/reverse split, one can easily make a mistake when calculating returns based on unmodified security prices.

Based on the Wednesdays' prices, the weekly rates of return were calculated as follows:

$$R_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \qquad /1/$$

where $P_{i,t}$ and $R_{i,t}$ are the price and the rate of return on equity *i* on the week *t*, respectively. The weekly return defined above is given in percentage and can be regarded as a relative measure of profitability. After this step we had altogether 51 data in each time series of weekly returns for both years (the only exception was Pick, for which 44 return data were available in 2002).

From the time series of the weekly returns we calculated[6] the following values for each equities:

Average (weekly) return:

$$\overline{R}_i = \frac{1}{T}\sum_{t=1}^{T} R_{i,t} \qquad /2/$$

where *T* is the number of weeks considered.

Standard deviation of return[7]:

$$\sigma_i = \sqrt{\frac{1}{T}\sum_{t=1}^{T}(R_{i,t} - \overline{R}_i)^2} \qquad /3/$$

Covariance of return with that of the BUX:

$$\sigma_{i,BUX} = \frac{1}{T}\sum_{t=1}^{T}\left(R_{i,t} - \overline{R}_i\right)\left(R_{BUX,t} - \overline{R}_{BUX}\right) \qquad /4/$$

where $R_{BUX,t}$ is the return on the BUX index on the week *t* and $\overline{R}_{BUX}$ is the average return on the BUX.

Risk index beta with respect to the BUX:

$$\beta_i = \frac{\sigma_{i,BUX}}{\sigma_{BUX}^2} \qquad /5/$$

where σ_{BUX} denotes the standard deviation of return of the BUX.

Correlation of returns for each pairs of equities:

$$\rho_{i,j} = \frac{\frac{1}{T}\sum_{t=1}^{T}(R_{i,t} - \overline{R}_i)(R_{j,t} - \overline{R}_j)}{\sigma_i \sigma_j} \qquad /6/$$

[6] Strictly speaking, we estimated the parameters in question relying on the sample, namely on the time series of weekly returns.

[7] To be more exact, instead of the above formula we used the empirical unbiased estimator for the standard deviation.

The risk index beta above is regarded as a measure of market related risk, often referred to as systematic risk (*Levy–Sarnat* [1984], p. 428–451). It can be interpreted and estimated as the slope of the linear time-series regression of the security return ($R_{i,t}$) on the return of the market portfolio, the BUX ($R_{BUX,t}$). In our case:

$$R_{i,t} = \alpha_i + \beta_i R_{BUX,t} + e_{i,t} \qquad /7/$$

where $e_{i,t}$ is the error term (the deviation from the regression line) and α_i is the regression constant (vertical intercept).

Assuming that the error term is uncorrelated with the return on the market portfolio and taking the variance of both sides of Equation /7/ we obtain:

$$\sigma_i^2 = \beta_i^2 \sigma_{BUX}^2 + \sigma_e^2 \qquad /8/$$

At this point we had all the input data to make a portfolio optimisation based on *Markowitz's* [1999] theory, the Mean-Variance criterion. A portfolio is a combination of the different securities selected by the investor. Technically, it is a vector of weights, i.e. the percentages of the total capital invested into the different securities. The return on a security as well as on the portfolio of securities must be handled as a random variable, because it is unknown at the beginning of the investment period when the investment decision making takes place.

In the Markowitz model the rule upon which the selection between different investment options is made is the following: an option F is preferred to an option G if and only if

$$E_F(R) \geq E_G(R) \quad \text{and} \quad \sigma_F^2(R) \leq \sigma_G^2(R) \qquad /9/$$

for all values of *R* (with strict inequality for at least one value of *R*).[8] In /9/ $E(R)$ and $\sigma^2(R)$ denote the expected return and variance (the square of the standard deviation) of return, respectively.

The expected return is taken as an indicator of the investment's average profitability; the variance of return serves as an indicator of its risk. Instead of the variance, the standard deviation of return can also be regarded and interpreted as a risk measure. As an estimator of the expected return, the average return (i.e. the mean) $\overline{R_i}$ can be used. In this context formula /8/ can be referred to as the decomposition of risk, where $\beta_i^2 \sigma_{BUX}^2$ is the systematic risk component and σ_e^2 is the non-systematic risk component (the former can also be called non-diversifiable risk and the latter is cited as diversifiable risk).

The return on a portfolio can be formulated as:

$$R_p = \sum_{i=1}^{N} x_i R_i \qquad /10/$$

[8] Regarding a more detailed discussion of the above mentioned Mean-Variance Efficiency Criterion and its applications see e.g. *Markowitz* [1999], p. 129–201 or *Levy–Sarnat* [1984], p. 235–355.

where R_i is the return on security *i*, x_i is the weight in security *i* (i.e. the proportion of money invested in it) and *N* is the number of securities held in the portfolio.

In order to determine the expected return on a portfolio, the weighted average of the expected returns of the securities it includes need to be calculated. Therefore, the portfolio's expected return can be expressed as:

$$E_p = \sum_{i=1}^{N} x_i \overline{R}_i \qquad /11/$$

where $\overline{R}_i$ is the average return on security *i*.

The variance of a portfolio is influenced both by the variance of the individual securities within and by the correlation between the various pairs of securities:

$$\sigma_p^2 = \sum_{i=1}^{N} x_i^2 \sigma_i^2 + 2\sum_{i=1}^{N} \sum_{\substack{j=1 \\ j>i}}^{N} x_i x_j \sigma_i \sigma_j \rho_{i,j} \ . \qquad /12/$$

The portfolios we seek to identify are the efficient portfolios. A portfolio is efficient if there is no other portfolio preferred with respect to the conditions in /9/. It means that an efficient portfolio is the investment with the highest expected return on a certain level of risk or it is the one with the lowest risk on a certain level of expected return.

In order to determine the combinations of securities that comprise the efficient portfolios one has to solve the optimisation problem as follows:

$$\min \sigma_p^2 = \sum_{i=1}^{N} x_i^2 \sigma_i^2 + 2\sum_{i=1}^{N} \sum_{\substack{j=1 \\ j>i}}^{N} x_i x_j \sigma_i \sigma_j \rho_{i,j}$$

subject to

$$E_p = \sum_{i=1}^{N} x_i \overline{R}_i \qquad /13/$$

$$\sum_{i=1}^{N} x_i = 1 \qquad 0 \le x_i \le 1 \qquad i = 1, 2, ..., N$$

The objective function expresses the aim to identify the portfolio weights (x_i) for each feasible expected portfolio return (E_p) so that the risk of the portfolio (σ_p^2) is minimised. The expected return, the standard deviation of return of each security and the correlation matrix of returns are used as the input parameters estimated from the sample. The last constraint in /13/ means that only long positions are allowed, i.e. short sales are excluded. It implies that it is not possible to sell securities the investor does not own and use the proceeds to invest in other securities. This restriction is in coincidence with the regulation predominant at the BSE where short sales are forbidden.[9]

[9] A detailed discussion of short sales can be found in *Sharpe–Alexander* [1990].

To make the optimisation in practice we used the software Invest[10], which has been developed to accompany 'Modern Investment Theory' by *Haugen* [1997].

EMPIRICAL RESULTS

The main figures on risk and return characteristics of the equities are presented in Table 1 and Table 2, for the year 2001 and 2002, respectively. In addition to the equities, the BUX index is also shown in the tables. The BUX index is used as the proxy of the market portfolio, namely the benchmark with respect to the beta values are estimated. Beyond the average (weekly) return and the standard deviation, we report the performance ratio, defined as the average return per unit of standard deviation. Because the standard deviation is considered as a measure of risk, the performance ratio can be regarded as the risk-adjusted average return.[11] Furthermore, we list the beta, the t-statistic (that shows whether beta is significantly different from 0), the R^2 (that indicates the explanatory power of the model /7/) and also the term labelled by risk ratio. According to our definition, the last one is the ratio of the non-systematic (or the so-called diversifiable) and the total risk component (see the decomposition of risk given by formula /8/).

Table 1

The main risk and return figures of category 'A' equities of the BSE in 2001

Equity	Average return (percent)	Standard deviation (percent)	Performance ratio	Beta	Risk ratio	*t*-value	R^2
ANTENNA	–1.23	6.21	–	0.89	0.82	3.30*	0.18
BCHEM	–0.39	7.16	–	1.56	0.58	6.00*	0.42
DANUBIUS	–0.43	4.36	–	0.15	0.99	0.75	0.01
DÉMÁSZ	–0.60	5.20	–	0.22	0.98	0.90	0.02
EGIS	0.18	3.89	0.05	0.57	0.81	3.41*	0.19
FOTEX	–0.54	7.53	–	1.06	0.82	3.26*	0.18
GLOBUS	0.70	6.08	0.11	0.96	0.78	3.73*	0.22
GRAPHISOFT	–1.07	8.53	–	1.32	0.79	3.64*	0.21
HUMET	–0.64	9.15	–	0.38	0.98	0.89	0.02
IEB	0.28	4.93	0.06	0.60	0.87	2.71*	0.13
MATÁV	–0.11	6.60	–	1.87	0.28	11.16*	0.72
MEZŐGÉP	–0.27	4.72	–	0.56	0.87	2.67*	0.13
MOL	0.21	4.36	0.05	1.14	0.39	8.75*	0.61
NABI	–0.30	4.75	–	0.79	0.75	4.01*	0.25
OTP	0.20	3.18	0.06	0.69	0.58	6.00*	0.42
PICK	–0.72	7.09	–	0.78	0.89	2.46*	0.11
PPLAST	–0.92	5.89	–	1.11	0.68	4.76*	0.32
PRÍMAGÁZ	0.59	8.67	0.07	1.12	0.85	2.94*	0.15
RÁBA	–0.81	5.57	–	0.85	0.79	3.57*	0.21
RICHTER	–0.03	3.14	–	0.44	0.82	3.25*	0.18
SYNERGON	0.35	12.96	0.03	1.70	0.85	2.98*	0.15
TVK	–0.34	8.48	–	1.65	0.66	5.03*	0.34
ZALAKERÁMIA	–0.59	6.11	–	0.90	0.80	3.46*	0.20
ZWACK	0.00	3.41	–	0.31	0.93	1.95**	0.07
BUX	–0.05	2.99	–	1.00	–	–	–

* β is significantly different from zero at 5 percent level.
** β is significantly different from zero at 10 percent level.

[10] The software was programmed by David Y. Tan, Joe Dada III, Kim Peters and Craig Lewis.

[11] However, one should be cautious in using the performance measure when the average return is negative because its value is completely misleading. If we compare two securities with the same negative return, the negative performance ratio is higher for the security which is less risky. That is why we simply omitted the values in the case of equities with negative average return.

The first result we got from our research is that the number of stocks with positive average return is only 7 in 2001 and 13 in 2002 out of the total pool of 24 equities analysed (the rows of the tables belonging to the securities with positive returns are highlighted). Indeed, the market passed through a crisis for which the main causes are well-known. The negative trend in security returns was a global phenomenon and therefore we consider it to be a 'systematic' reaction of the Budapest Stock Exchange to a world-wide recession. It is confirmed by a working paper (*A csatlakozás előtt álló*... [2003], BSE Publication, p. 6) that describes the main characteristics of the stock exchanges of the accession countries of Central and Eastern Europe in the period of 2001-2002. As an indicator of the global downturn in Europe, the study refers to a –35 percent change in the value of the FTSE Eurotop 100 index (which consists of the shares of 100 blue-chip companies in the European Union) from 2001 to 2002.

In 2001 the average weekly return ranged between –1.23 and 0.7 percent and the standard deviation of returns altered between 3.14 and 12.96 percent. In 2002, the average return was within the range of –2.08 and 1.47 percent, while the standard deviation of returns was between 2.53 and 12.91 percent.

The performance ratio seems to be quite low on average: few stocks have a good payout for the risk implicit in the share. In 2001, the highest performance ratio (0.11) was registered for the equity with the highest average return (Globus). In 2002 IEB has shown the highest performance (0.2) with a relatively big average return (1.12%) and modest risk (5.7%).

Table 2

The main risk and return figures of category 'A' equities of the BSE in 2002

Equity	Average return (percent)	Standard deviation (percent)	Performance ratio	Beta	Risk ratio	*t*-value	R^2
ANTENNA	-0.16	5.90	–	0.89	0.72	4.41*	0.28
BCHEM	0.19	3.67	0.05	0.45	0.81	3.36*	0.19
DANUBIUS	0.41	4.89	0.08	-0.11	0.99	-0.54	0.01
DÉMÁSZ	0.38	3.45	0.11	0.30	0.91	2.25*	0.09
EGIS	0.60	5.42	0.11	0.89	0.66	5.02*	0.34
FOTEX	-0.62	5.80	–	0.94	0.67	4.89*	0.33
GLOBUS	0.16	4.35	0.04	0.37	0.91	2.18*	0.09
GRAPHISOFT	-1.49	5.67	–	0.78	0.76	3.90*	0.24
HUMET	-2.08	12.91	–	0.42	0.99	0.81	0.01
IEB	1.12	5.70	0.20	0.73	0.80	3.55*	0.20
MATÁV	-0.06	4.61	–	1.06	0.33	9.95*	0.67
MEZŐGÉP	-0.50	5.29	–	0.56	0.86	2.80*	0.14
MOL	0.24	3.93	0.06	0.85	0.42	8.26*	0.58
NABI	-0.18	3.93	–	0.37	0.89	2.46*	0.11
OTP	0.75	5.17	0.15	1.33	0.17	15.45*	0.83
PICK	0.39	4.91	0.08	0.02	1.00	0.11	0.00
PPLAST	-1.43	4.69	–	0.65	0.76	3.97*	0.24
PRÍMAGÁZ	1.47	12.42	0.12	0.90	0.93	1.85**	0.07
RÁBA	-1.02	3.61	–	0.34	0.89	2.50*	0.11
RICHTER	0.07	4.81	0.01	1.03	0.43	8.04*	0.57
SYNERGON	-0.45	5.81	–	1.02	0.61	5.57*	0.39
TVK	0.57	4.42	0.13	0.12	0.99	0.68	0.01
ZALAKERÁMIA	-0.27	4.40	–	0.47	0.86	2.83*	0.14
ZWACK	0.15	2.53	0.06	-0.01	1.00	-0.05	0.00
BUX	0.26	3.54	–	1.00	–	–	–

* β is significantly different from zero at 5 percent level.
** β is significantly different from zero at 10 percent level.

Based on the figures reported in Table 1 and Table 2, we can observe some improvement throughout the two-year period. The crisis had its worst effects in 2001 and this line of reasoning can be supported by several facts:

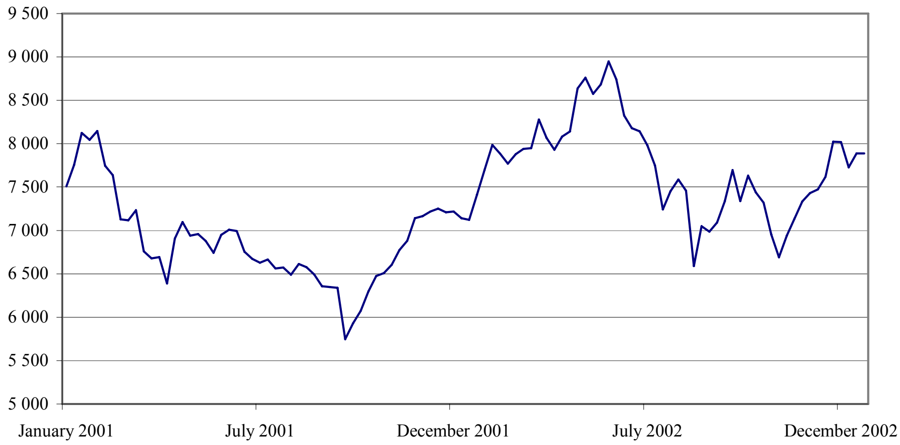
– there were only 7 securities with positive average returns in 2001 against 13 in 2002.

– when comparing the values of average return and standard deviation of return (risk) for the same security we realise that in 16 cases (out of the 24) the average return was higher, and in 16 cases the risk was lower in 2002 than in 2001. 10 equities had a preferable risk and return profile (i.e. the higher return and lower risk at the same time) in 2002 than in the previous year. Consequently, in 2002 there were only two securities with lower average return and higher risk as compared to 2001.

– the grand mean of the average returns was higher in 2002 (–0.07%) than in 2001 (–0.27%) but it was still negative, and it was accompanied by a lower mean risk (standard deviation). For the latter the respective values were 5.35 percent (in 2002) and 6.17 percent (in 2001).

– by looking at Figure 1, where the values of the BUX index are displayed over the period studied, it is easy to recognise that the negative trend of price movements has changed to a positive one. This can be confirmed by calculating and comparing the annual returns. In fact, the annual return of the BUX index was –4.91 percent in 2001 and 10.7 percent in 2002. According to the Annual Report (*BSE* [2002], p. 4), considering the return on the BUX in 2002, the BSE became the fourth best-performing exchange in the world.

Figure 1. The values of the BUX index from January 2001 to December 2002



It is worth mentioning that the annualised standard deviations[12] fall into the range of 22.6–93.5 percent in 2001 and 18.2–93.1 percent in 2002, respectively. The annualised

[12] The annualised standard deviation can be calculated by multiplying the weekly standard deviation by $\sqrt{52}$.

mean values of the standard deviation are 44.5 percent (2001) and 38.6 percent (2002). These values are high even in the context of emerging markets (for comparison see *Bernstein* [2000], p. 6 and 9-28).

When looking at the 'evolution' of betas it can be observed that in 18 cases out of 24 the beta of the same equity has decreased over the period studied. The average value of beta was 0.9 in 2001 and 0.6 in 2002. In 2001 altogether 9 equities fell into the aggressive category, with a beta higher than 1. In 2002 there were only 4 aggressive equities. All in all, the equities seemed to become more defensive in 2002 than they were in 2001.

With only a few exceptions, the *t*-statistics support the notion that beta is significantly different from zero. However, the explanatory power of model /8/ which explains the changes in equity prices through that of the market (represented by the BUX) is very low in general. The equity with the highest R^2 value is MATÁV in 2001 and OTP in 2002. This can be explained by the fact that these are the equities with the highest capitalisation, and also with the highest weight in the BUX basket (*Statistical Report* [2001], p. 10, 18 and also *Statistical Report* [2002], p. 5, 14). Consequently, the overall performance of the market is highly influenced by price fluctuations of these securities (maybe rather than the other way around).

So far we have not discussed the risk ratio, namely the ratio of the non-systematic and the total risk. As shown in Table 1 and Table 2, the risk ratio is very high in general. On average, it is almost the same in the two years studied (0.77 in 2001 and 0.76 in 2002).

It is remarkable that the risk ratio and the value of R^2 sum up to 1. It is simply a technical result, implied by the definition of beta and the derivation of formula /8/ for decomposition of risk.[13]

The results gained from our study on individual securities confirm that the BUX has quite a low influence on the equity prices. It follows that the resulting beta values need to be interpreted and used with caution. Therefore, we do not suggest to apply beta as a risk measure instead of the standard deviation of returns (or equivalently the variance), since a fair amount of volatility in security returns is not accounted for[14].

In the construction of portfolios for each year we decided to involve securities with positive return only. This way, the number of equities involved in the portfolio optimisation was 7 in 2001 and 13 in 2002. As mentioned before, the input parameters for portfolio optimisation are the average returns, the standard deviations of returns (see highlighted values in Table 1 and 2) and the correlations between the different pairs of security returns. It is clear (see formula /12/) that the lower the correlation terms of the different pairs of security returns are, the higher the risk reduction benefit of a portfolio can be.

The correlation terms for the equities with positive average return are reported in Table 3 and Table 4.

In 2001, all the correlation coefficients were positive, with values below 0.5. The highest term was experienced between the returns of MOL and Inter-Európa-Bank (0.47). The average of the correlation terms is 0.23 (by excluding the ones located in the diagonal).

[13] A proof of this statement can be found in *Levy–Sarnat* [1984], p. 436-437.
[14] An overview of the problems related to beta as a risk measure is given in *Bugár* [1998a].

Table 3

Correlation matrix of equity returns in 2001

Equity	EGIS	GLOBUS	IEB	MOL	OTP	PRÍMAGÁZ	SYNERGON
EGIS	1.00	0.32	0.08	0.35	0.20	0.04	0.02
GLOBUS		1.00	0.30	0.36	0.23	0.22	0.20
IEB			1.00	0.47	0.03	0.36	0.07
MOL				1.00	0.31	0.23	0.10
OTP					1.00	0.28	0.33
PRÍMAGÁZ						1.00	0.43
SYNERGON							1.00

Table 4

Correlation matrix of equity returns in 2002

Equity	BCHEM	DANUBIUS	DÉMÁSZ	EGIS	GLOBUS	IEB	MOL	OTP	PICK	PRÍMAGÁZ	RICHTER	TVK	ZWACK
BCHEM	1.00	–0.04	0.04	0.15	0.27	0.02	0.37	0.45	0.06	0.07	0.26	0.42	–0.08
DANUBIUS		1.00	0.05	–0.02	–0.15	0.22	–0.03	–0.13	0.09	–0.02	0.07	0.30	–0.05
DÉMÁSZ			1.00	0.27	0.04	0.33	0.26	0.20	–0.04	–0.03	0.19	0.05	0.24
EGIS				1.00	0.10	0.27	0.36	0.41	–0.08	0.03	0.57	0.09	0.11
GLOBUS					1.00	0.12	0.36	0.32	0.11	0.06	0.23	–0.04	0.19
IEB						1.00	0.29	0.31	–0.12	0.14	0.40	–0.02	0.00
MOL							1.00	0.64	0.01	0.25	0.37	0.17	0.26
OTP								1.00	0.05	0.17	0.65	0.08	–0.08
PICK									1.00	0.07	–0.01	0.01	0.33
PRÍMAGÁZ										1.00	0.23	0.15	0.09
RICHTER											1.00	0.07	–0.14
TVK												1.00	0.02
ZWACK													1.00

In 2002, the average is significantly lower, with the value of 0.15. We can also observe the presence of 17 negative coefficients (out of 78), which amount to about one-fifth of the terms. The highest correlation registered is 0.65 (for the pair of OTP and Richter) and the lowest one is –0.15 (in case of Danubius and Globus).

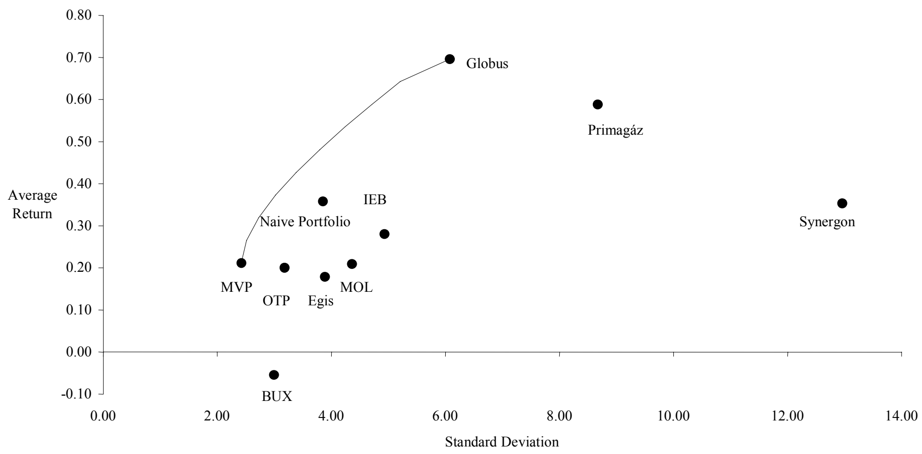
With a view to the portfolio optimisation, we made the calculations for each year with the help of the software Invest, excluding short sales as they are not applied in practice (otherwise, it would be a mere theoretical exercise).

The results in terms of efficient frontiers are shown in Figure 2 and 3. The continuous curve in each figure represents the efficient frontier. The risk and return combination of the individual equities involved in portfolio optimisation is given by the discrete points (each point is labelled by the name of the equity). In addition, the risk and return combination for the so-called Naïve Portfolio and that of the BUX is also plotted in the figures. The Naïve Portfolio is the equally weighted portfolio, which contains all the securities included in the portfolio selection process with equal proportion for each. Clearly, there is a special portfolio denoted by MVP (Minimum-Variance-Portfolio), the efficient portfolio with the lowest possible risk (variance of return).

Prior to performing the analysis of the efficient portfolios there is an important issue that needs clarification. Technically, we have an infinite number of efficient portfolios represented by the different risk-expected return combinations to choose from. As it can be seen in Figures 1 and 2, the average return is a strictly (monoton) increasing function of the risk (measured by the standard deviation). It means that undertaking a higher risk is compensated by a higher level of expected return. The software we applied to conduct the research gives an opportunity to choose any portfolio on the efficient frontier by typing in the required return on the portfolio. However, in reality the investor has to select a particular portfolio among the efficient ones, i.e. to follow a specific investment strategy. We regard it as a systematic portfolio allocation. In this paper we evaluate the performance of two portfolios, namely we simulate two investment strategies. The first one creates the Naïve Portfolio (NP) the second one constitutes the Minimum-Variance-Portfolio (MVP). Constructing the NP is probably the simplest way to benefit from diversification without requiring any sophisticated method for portfolio optimisation. The advantage of the MVP, especially in a risky period with highly volatile equity returns, is that it has the highest potential for reducing the risk. In brief, these were the reasons for choosing the above mentioned two portfolio allocation strategies.

Looking at and comparing Figure 2 and 3 it can be realised that the equity with the highest average return, as the extreme right point of the curve, is contained in the efficient frontier (in 2001 the equity with the highest return was Globus and Prímagáz in 2002). It is always the case when short sales are excluded. In general, the portfolio is becoming more diversified, i.e. contains more securities as we are "going down" on the efficient frontier towards the MVP.[15]

Figure 2. Risk and Return of Equities and Efficient Portfolios in 2001
(percent)

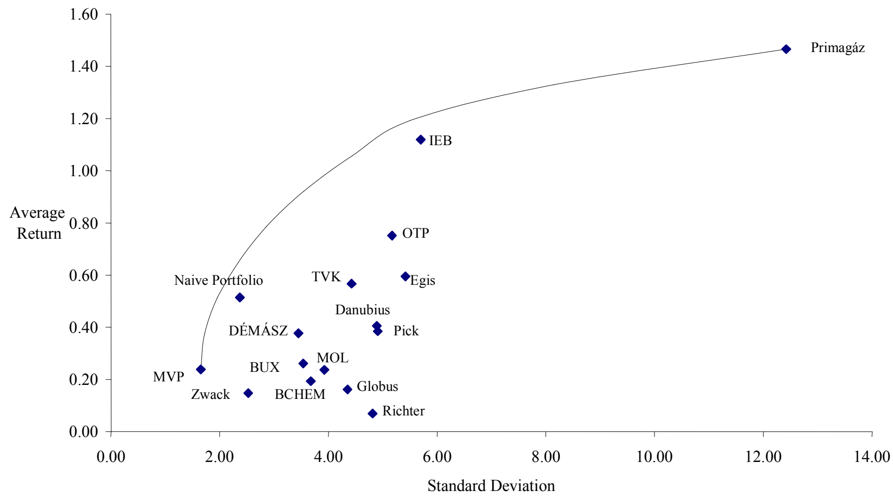


[15] Here we will not report the composition of the efficient portfolios other than the MVP. For readers interested, the results are available from the authors upon request.

In 2001, the average return and the risk of the efficient portfolios was in the range of 0.21–0.70 percent and 2.42–6.08 percent, respectively. Looking at Figure 2 it can be observed that all individual equities (except Globus) and the BUX are far from being efficient. In choosing any of them, there is always an efficient portfolio with dominant risk-return characteristics, namely one with a higher average return for the same level of risk or with a lower risk for the same level of expected return. The above statement is more or less true for 2002 as well, with the exception of Prímagáz (which is efficient). But in that year there is one more exception: Inter-Európa-Bank, which is 'nearly efficient'. Needless to say, it was the equity with the highest performance. In both years the performance of the NP seems to be quite good (below this issue is analysed more in detail). In 2002 the ranges, in which the average return and the risk of the efficient portfolios fell, were wider than those of 2001. The range of the average return was 0.24–1.47 percent and the risk fell into the interval of 1.66–12.42 percent.

It is remarkable that the position of those equities involved in the 2001 and 2002 portfolio as well has changed greatly on the 'risk-return map', referring to a change both in their risk-return profile and in their performance from 2001 to 2002. The only exception is MOL with a relatively stable risk and average return. However, in five cases out of the total six, we can report an improvement in performance.

Figure 3. Risk and Return of Equities and Efficient portfolios in 2002
(percent)



In Table 5 the composition of the MVP is presented for both years. In 2001, the MVP has contained only 3 equities out of the 7 included in the portfolio optimisation. In 2002, it was more balanced in this sense, excluding only 4 out of the total pool of 13 securities considered. Obviously, each year, the equity with the lowest risk (standard deviation of return) had the highest weight in the MVP (see Tables 1 and 2 for comparison). In 2001 OTP and in 2002 Zwack had the highest proportion, 50.1 percent and 40.4 percent, respectively. It might seem surprising that MOL had no part in the portfolios of the years studied, despite the fact that it had lower risk than some of the equities that are included.

Table 5

Composition of the Minimum Variance Portfolio (MVP)
(percent)

Equity	2001	2002
BCHEM	–	16.7
DANUBIUS	–	11.4
DÉMÁSZ	–	11.6
EGIS	28.5	0.0
GLOBUS	0.0	5.6
IEB	21.4	1.2
MOL	0.0	0.0
OTP	50.1	0.0
PICK	–	2.7
PRÍMAGÁZ	0.0	0.0
RICHTER	–	7.0
SYNERGON	0.0	–
TVK	–	3.4
ZWACK	–	40.4

A likely explanation is that MOL's return on average has a higher correlation with the other security returns involved in portfolio optimisation than the other equities. According to formula /12/, when the risk of the portfolio is being minimised, it is not only the risk of the individual equities taken into account but the correlation between the returns as well.

Next, we examine the performance of the MVP and that of the NP. The BUX index is used as a benchmark for evaluation. The results are summarised in Tables 6 and 7.

Table 6

The main characteristics of two portfolio strategies and the BUX index in 2001

Denomination	Average Return	Standard Deviation	Performance Ratio	Beta	Risk Ratio
	percent				
MVP	0.21	2.42	0.087	0.64	0.38
Naïve Portfolio	0.36	3.85	0.094	0.97	0.43
BUX	–0.05	2.99	–	1.00	–

In drawing a comparison of the risk of the MVP in Table 6 to the risk of the individual equities involved in the portfolio optimisation (see highlighted rows in Table 1), it can be calculated that the standard deviation of the MVP is about 24 percent and 81 percent lower than that of the individual equity with the lowest and the highest standard deviation, respectively. Therefore, in 2001 the risk reduction benefit from creating the MVP can be regarded as quite good. Further, the risk and return parameters of the MVP as compared to those of the NP are quite distinct. The return on the MVP is lower and it is a less risky portfolio. In itself, the MVP is designed to reduce the risk, hence its lower exposure to risk through investment does not come as a surprise. Still, it is remarkable that the performance of the NP is superior to that of the MVP. Both portfolio allocation strategies show a low performance but still a better one than the individual equities (except Globus[16]). It is also worth mentioning that the NP has a higher beta[17] and the higher risk ratio as well. Using the BUX index as a benchmark to evaluate the performance of the two portfolios, all in all, we can conclude that their performance is not bad compared to the general state of the stock market in 2001.

In 2002, both the performance of the BUX and the two portfolio allocation strategies have improved greatly as compared to 2001. It is due to the higher average returns and, in case of the two portfolio allocation strategies, to a lower level of risk as well. The performance ratio of the MVP is more than one and a half times higher than it was in 2001.

Table 7

The main characteristics of two portfolio strategies and the BUX index in 2002

Denomination	Average Return	Standard Deviation	Performance Ratio	Beta	Risk Ratio
	percent				
MVP	0.24	1.66	0.145	0.20	0.82
Naïve Portfolio	0.50	2.37	0.211	0.53	0.38
BUX	0.26	3.54	0.073	1.00	–

The NP has produced an even greater impovement in terms of performance: its performance ratio is more than two times higher in 2002 than it was in 2001. The betas of both portfolios are lower than they were in 2001. The risk ratio of the MVP is high, which is due to its low beta, namely its low sensitivity to the market volatility.

Comparing the results shown in Table 7 to those presented in Table 2 we can conclude that both portfolios outperform almost all individual equities. Indeed, for the NP we got a higher performance ratio than for any of the equities. The NVP was outperformed by IEB and OTP only. It is notable that the NP repeatedly had a better performance than the MVP in 2002. In a similar research made on blue-chips traded at BSE, *Bugár* [1998b] has also reported on the very good performance of the NP.

As shown in Figure 3, the NP is located rather close to the efficient frontier. Decidedly, the efficient portfolio with the same average return (0.5%) as the NP has a standard deviation of 1.93 percent. So, it has a performance ratio of 0.259, which is 23 percent higher than that of the NP. The creation of an efficient portfolio is a rather sophisticated process, requiring time and effort to estimate the parameters and to implement the portfolio optimisation. Taking this fact into account, we can safely say, it is not necessarily worth to carry out the process.

One can argue that our analysis was performed on an ex post basis. In fact, the problem of this approach is that it only reveals past the event what should have been done ear-

[16] An investment into Globus is much more risky than the above-mentioned portfolio selection strategies. Here it should be emphasised that portfolio allocation pays in terms of stabilising the return, i.e. reducing the risk but not necessarily in terms of increasing the performance.

[17] The beta of a portfolio is a weighted average of the securities' betas included in it.

lier on. Consequently, the benefits detected are potential only so they cannot be realised. In order to overcome this difficulty we also examined the performance of the MVP and the NP on an ex ante basis, i.e. we determined the returns which would have been realised on average in 2002 on the portfolios set up in 2001 and kept unaltered.

Based on the information in Table 2 and Table 5, the average (weekly) return in 2002 on the MVP(2001) is:

$$\overline{R}_{MVP\,(2001)} = 0.6 \cdot 0.285 + 1.12 \cdot 0.214 + 0.75 \cdot 0.501 \approx 0.79\ (\%)\ .$$

Similarly, the average return can be realised in 2002 on the NP(2001):

$$\overline{R}_{NP\,(2001)} = \frac{1}{7} \cdot (0.6 + 0.16 + 1.12 + 0.24 + 0.75 + 1.47 - 0.45) \approx 0.56\ (\%)\ .$$

As it can be seen the MVP outperformed the NP on an ex ante basis. Comparing these results to the average return on individual equities presented in Table 2, it is clear that in 2002 there are only two equities which performed better than the MVP(2001) and five equities which outperformed the NP(2001). In addition, based on the prior information on the average returns as well as the optimal portfolio weights in 2001, the average return was even higher on the portfolios set up at the end of 2001 than it was in case of the portfolios produced with the help of the data from 2002 and including the equities with positive return into the portfolio (see Table 7). It served as a lesson to prove that a systematic portfolio allocation by using a 'buy and hold' strategy can be more successful than continuously changing the equities selected and included in the portfolio. To conclude, in the long run it might be more profitable to apply the same portfolio strategy on the stable set of securities.

*

In this paper we studied the risk and return characteristics of equities listed and traded in category 'A' at the Budapest Stock Exchange over the time period 2001-2002. We also made a portfolio optimisation based on *Markowitz's* [1999] theory, the Mean-Variance criterion. The expected return was taken as an indicator of the investment's average profitability, and the standard deviation of return served as an indicator of its risk. Furthermore, we estimated the beta values, and tested the explanatory power of the linear regression model of security return on the return of the BUX index. The performance of two portfolio strategies was also evaluated. The major findings of the analysis can be summarised as follows.

Both the analysis of individual equities and the efficient portfolios supported that the stock exchange passed through a crisis which had its worst effects in 2001. Indeed, we experienced an increase of the average return and the performance and a decrease of the risk from 2001 to 2002.

It was found that the influence of the BUX on equity prices is quite low. As a consequence, the beta values we got should only be interpreted and used with care. On the basis of our empirical findings it cannot be recommended to apply beta as a risk measure instead of the standard deviation of returns, because in this case a large part of volatility in security returns would not be explained.

On an ex post basis the Naïve Portfolio had a better performance than the Minimum-Variance-Portfolio in both years. Considering that to create an efficient portfolio is a sophisticated process requiring time and effort to estimate the parameters and to implement the portfolio optimisation, it seems that we can be satisfied with the benefits promised by the naïve way of diversification.

On an ex ante basis the Minimum-Variance-Portfolio has shown a better performance than the Naïve Portfolio. However, both of them resulted in an even higher average return than their ex post counterparts. The ex post portfolios have been set up under the condition of using the data from 2002 and involving the equities with positive return into the portfolio, while their ex ante counterparts have been constructed on the basis of utilising prior information on the average returns as well as the optimal portfolio weights at the end of 2001. Therefore, it has been confirmed that a systematic portfolio allocation by using a 'buy and hold' strategy can be more successful than continuously changing the equities selected and included in the portfolio.

REFERENCES

Annual Report [2001]: *Budapest Stock Exchange*, p. 1–48.

Annual Report [2002]: *Budapest Stock Exchange*, p. 1–36.

BERNSTEIN, W. J. [2000]: *The intelligent asset allocator: How to build a portfolio to maximize returns and minimize risk*. McGraw-Hill. New York.

BUGÁR GY. [1998a]: Az értékpapírok piaci kockázatának méréséhez. *Bankszemle*. Vol. 42. No. 1–2. p. 54–62.

BUGÁR GY. [1998b]: Hatékony részvénykombinációk és kockázatcsökkentési stratégiák a BÉT-en. *Bankszemle.* Vol. 42. No. 8. p. 59–67.

A csatlakozás előtt álló kelet-európai országok részvénypiacai [2003]. *Budapest Stock Exchange Publication*. p. 1–7. (also published in the online business daily paper, Portfolio.hu: www.portfolio.hu/reszveny.tdp (8.15 a.m. 01.04. 2003))

HAUGEN, R. A. [1997]: *Modern investment theory*. Prentice-Hall. Englewood Cliffs. New Jersey.

LEVY, H. – SARNAT, M. [1984]: *Portfolio and investment selection – Theory and practice*. Prentice Hall. New Yersey.

MARKOWITZ, H. M. [1999]: *Portfolio selection: efficient diversification of investments*. Basil Blackwell. Oxford.

SHARPE, W. F. – ALEXANDER, G. J. [1990]: *Investments*. Prentice-Hall. Englewood Cliffs. New Jersey.

Statistical Report [2001]. *Budapest Stock Exchange*, p. 1–28.

Statistical Report [2002]. *Budapest Stock Exchange*, p. 1–23.