PERIODICA POLYTECHNICA SER. SOC. MAN. SCI. VOL. 7, NO. 1, PP. 29–45 (1999)

RETURN PREDICTABILITY IN THE HUNGARIAN CAPITAL MARKET

György ANDOR, Mihály ORMOS and Balázs SZABÓ

Department of Industrial Management and Business Economics
School of Social and Economic Sciences
Technical University of Budapest
H–1521 Budapest, Hungary

Received: Sept. 5, 1999

Abstract

The efficient market hypothesis for the Hungarian capital market is investigated in this paper, however, it gives a sort of international market outlook and a comparison of them. From the weak-, semi-strong-, and strong effectiveness the accomplishment of the weak form is studied. Our aim is to prove that the Hungarian security market shows at least the weak form of effectiveness so all information contained in historical prices is fully reflected in current prices therefore past price information cannot be exploited to develop successful trading strategies. By the proof of the above theory we state that those investment theories which use only past prices for decisions are unscientific.

Keywords: efficient market, return predictability, correlation test, runs test, cross correlation, return patterns.

1. Introduction

One of the dominant themes in the academic literature since the 1960s has been the concept of an efficient capital market. The investigations of the efficient market theory beyond the characteristics of the analysed capital market segment, and the disclosure of curiosities can give a relatively objective and indirect notion about the state of development, the regulation of the market and about the relationship to other ones. It can be stated that the results of efficiency tests can give the basis of advice and recommendations for further development and organisational decisions in the analysed market.

This paper is the first study on exemination of Hungarian capital market efficiency in our country. Its actuality is given by that the roughly ten years old Budapest Stock Exchange (BSE), the unbiased and clear HUF exchange regulation and the operation treasury bond market nowadays perform enough and analysable mass of data for the necessary statistical analyses.

The tests of the different market efficiency levels are usually clear, descriptive, easily understandable and explainable. The interpretation of results, the explanation of randomness in the results and the separation of operating, economic or cultural characteristics of the studied segment is a much more complex problem. This is not the main aim of the paper, so-formed beside the introduction of the overall

(comprehensive) analysis, mostly in the explanation of results only the general justifications and their completions will be given as it is usual in the international academic literatures.

By general definition when someone refers to efficient capital markets, it means that security prices fully (i.e. in the correct way and immediately) reflect all available information. A necessary condition for investors to have an incentive to trade until the prices fully reflect all information, however, this is true only if the cost of information acquisition and trading is zero. Since these costs are clearly positive, a more realistic definition is that prices reflect information until the marginal costs of obtaining information and trading no longer exceed the marginal benefit.

The tests of efficient markets are suggested to be subdivided into three categories – in the early papers of the Noble price winner FAMA (1970) – each dealing with a different type of information. Weak form tests are testing whether all information contained in historical prices is fully reflected in current prices. While the semi-strong form tests of the efficient market hypothesis are tests of wheather publicly available information is fully reflected in current stock prices. Finally, strong form tests of the efficient market theory are tests of exclusive information, which is fully reflected in security prices.

As it was stated these classifications were originally suggested by Fama, however, our paper is built to a slightly different definition of the three efficiency form. Fama suggests in his recent papers to change the classification of weak form test to a more general category test of predictability, while semi-strong form tests to event studies, and we will adopt this generalisation. For the strong form tests of the efficient market we accept the definition of ELTON and GRUBER (1995). They suggest that the strong form tests of the efficiency are tests of whether all information, whether public or private, are fully reflected in security prices, whether any types of investor can make an excess profit. (In contrast by Fama's definition the market has to be tested against only the non-public, i.e. confidential information.)

This article deals with return predictability in the Hungarian capital market, thus we test domestic capital market against the weak form of efficiency. It has to be clearly understood what and why these tests analyse, nevertheless the consequences of these test results have to be understood. The efficient market hypothesis does not deny that a positive information about a given security should increase its market price, it only states that this information cannot yield in excess return for the owner of this information whether historical price information whether any kinds of fundamental information. (It is already built into the price.) From this point it is concerned with the speed which information is impounded into security prices with. Assume that after positive announcement, the price gradually increases (say over a week) in response to the announcement. Investors examining the price sequence would observe that the price was moving away from that level at which it had previously traded (trends could be identified), purchasing the security on the basis of movements excess return could be realised. Tests of the predictability (formerly by Fama tests of the weak form of the efficient market hypothesis) are in part tests of whether this type of trading behaviour can lead to excess profits. If returns are not predictable from past returns, then new information is incorporated

in the security price sufficiently fast that, by the time an investor could tell from the price movements themselves that there had been a fundamental change in company prospects, the fundamental change is already fully reflected in price. It can easily be seen what are the next steps for the semi-strong and strong form of efficient market. The efficient market hypothesis has strong implications for security analysis. If our empirical tests find that future returns cannot be predicted from past returns (i.e. the market is at least weakly effective) then trading rules based on an examination of the sequence of past prices are worthless. In this case only two ways remain; to gain excess return; the trading rules based on publicly available information (react in time and in the good direction) or the non-public information has to be used.

Before the presentation of the tests it had to be defined what is meant on excess profit. The models on security or capital asset pricing (like the Capital Asset Pricing Model (CAPM) or the Arbitrage Pricing Theory (APT)) are searching the answers to what is the equilibrium price for a financial asset. They suppose that there exists an equilibrium price of the deviating future return opportunities. Normal (fair) return is defined as the expected return which results from any pricing model like CAPM or APT. The return above the previously mentioned normal or "fair" return is defined as the excess (or abnormal) return. So normal and abnormal returns can only be mentioned in statistical means. The tests of predictability generally examine the possibility to gain excess profit by using the historical data of a given security, examining the historical data of other securities or capital markets, studying the time pattern in security returns, analysing the information obtained about characteristics of a company or security market. Tests of return predictability analysing the excess return possibilities by information acquired on different characteristics of a company or capital market cannot be run yet because the lack of enough available data and in spite of the short period of time it seems to be early to run these tests.

We have to emphasise that this point has been source of great confusion. One frequently reads that, if the efficient market hypothesis holds, then the best estimate of tomorrow's price is today price, or an expected return of zero. This is not a correct implication of the efficient market model. Rather, the implication is that the past information contains nothing about the magnitude of the deviation of today's return from expected return.

In connection to the previously mentioned the random walk model has to be introduced. The random walk models assume that successive returns are independent and that the returns are identically distributed over time. The random walk model is a restricted version of the efficient market theory. The efficient market hypothesis does not require identical return distribution in the various periods (only the random deviation from the expected return), furthermore it does not imply the returns independent through time. So by all means the random walk is a sufficient but not necessary condition to fulfil the weak form of efficient market.

2. The Data

Our analyses are based on the data collected in the period of January in 1991 to June in 1999. The database of the study was the *Andor-Ormos-Szabó: International and Hungarian Capital Market Database (Technical University of Budapest, 1999.)*. This database in addition to the full Budapest Stock Exchange Price Index (BUX) data set contains the daily and monthly price and volume data for all Hungarian companies. These data were available by the Fornax and by the Journal of Hungarian Capital Markets. The major part of the international database was built on the collection of American public data. For the representation of the "world-economy" the aggregate world-index of Morgen Stanley Capital International (MSCI) was chosen. The database of the world-index was also a result of independent collection of public data. The database also contains daily foreign exchange rates, which were partly individual collection, partly granted by the Reuters.

All data in the database on Hungarian companies were corrected by dividend paid and by the splits of nominal value and on this way they give the basis of our analyses. The returns of the shares and indices (on the base of corrected data) were determined for the above-mentioned period in Hungarian Forint (HUF) as well as in USA dollar (USD). The returns were calculated by simple compound interest as well as by continuous compound interest. (The differences between the two methods can be found in details ANDOR, (1999)).

3. Predictability Tests Based on Past Prices of One Security or Index

3.1. Correlation Tests

The most fundamental predictability test types are the correlation tests. These tests

$$r_t = a + br_{t-1-T} + e_t \tag{1}$$

are built to the relation of regression, where

a and b are constants,
r_t is the current price (value) at time t of security, portfolio or index,
T is a positive integer,
e_t random variable with zero expected value.

If T is equal to zero, then the relationship between today's returns and yesterday's returns are investigated.

For the definition of returns two formulae are usual. The relation, where Div_t

$$r_t = \frac{P_t - P_{t-1} + \mathrm{Div}_t}{P_{t-1}} \tag{2}$$

symbolises the dividend paid, shows the logic of simple compound interest, while the

$$r_t = \ln \frac{P_t + \mathrm{Div}_t}{P_{t-1}} \tag{3}$$

relation follows the theory of continuous (ln the natural logarithm) interest. From the point of tests the two methods of calculation give only a little difference between the values, since one of the relations shows independence then the other must show the same.

In case of correlation tests at first the correlation relationships between r_t and r_{t-1-t} are examined, thus auto-correlations are calculated for time series of each security, portfolio and index. On the other hand, the stochastic relation is measured between the security returns of each day and the average returns of the previous days (more than one day earlier returns). The results of the analyses are summarised in three different Tables. The first Table introduces the results of the auto-correlation in $T = 0, 1, 2, 3$ and 4 day interval thus looking back from 1 day to five days. Some results of the 18 studied individual securities (BorsodChem, Danubius, Dunaholding, Egis, Fotex, Graboplast, Human, IBUSZ, Inter-Európa Bank, MOL, OTP, Pick, Pannonplast, Pannon-Flax, Prímagáz, Richter, TVK, Zalakerámia, Zwack) and the examined indices are presented as well as in *Table 1* by their summarised results. The Table was accomplished on daily data in a period of five years, back from the end of June in 1999.

Table 2 summarises the correlation between the daily returns and the preceding average returns of five and ten days. The database for the calculation was the same as we used for the previous one.

Table 3 gives the opportunity to compare our results with various international results of different academic literatures. It has to be remarked, that in individual references most of the data can be found with different "resolution" i.e. the most of the data is represented in weekly or 5 days and 10 days pattern. While in a usual case there are five exchange days a week for the easier comparison of results it seemed to be practical to represent the 5 days as a week and the 10 days as two weeks.

It can be seen from the Table that the measured correlation coefficients are extremely small. Disregarding the unique situation of the rarely traded share of company IBUSZ even in case of stronger relations only as high as 0.1 absolute correlation coefficients have been measured, thus approximately a 1% determination coefficient could be found. (The coefficient of determination shows the strength of stochastic relation in percentages and can be calculated as the square of the correlation coefficient.) This states that the daily prices of securities of domestic companies are influenced only 1% by the previous day prices. In case of five days (one week) and 10 days (two weeks) past averages it is given a determination coefficient of approximately 0.1%. It can be seen from *Table 3* that our results roughly coincide with the internationally measured ones, even these correlations indicate a more efficient market. It has to be remarked that our results of correlation tests – much more recent than the literature review available – on international

Table 1. Auto-correlations of returns for the previous 1 to 5 days from 07. 1994 to 06. 1999.

	Auto-Correlation T				
	1	2	3	4	5
Individual company shares					
BorsodChem USD	0.071	0.005	−0.019	0.004	−0.033
Egis USD	0.066	0.034	−0.036	−0.024	−0.027
IBUSZ USD	−0.232	0.003	−0.028	−0.064	−0.026
OTP USD	0.068	0.013	−0.036	−0.024	−0.072
Pick USD	0.082	0.036	−0.078	0.020	−0.051
Zwack USD	−0.051	−0.006	−0.048	0.086	0.002
Summarised statistics of 18 Hungarian securities					
Average	0.007	0.004	−0.005	−0.002	0.000
Standard Deviation	0.092	0.047	0.054	0.045	0.037
Highest Value	0.119	0.106	0.115	0.086	0.088
Smallest Value	−0.232	−0.074	−0.144	−0.088	−0.075
Averages of Absolute Values	0.072	0.038	0.048	0.035	0.031
Indices					
MSCI World index	0.071	0.015	−0.036	−0.027	−0.009
S&P 500 Comp. index	−0.018	−0.015	−0.041	−0.011	−0.048
NYSE Composite index	0.030	−0.015	−0.033	−0.008	−0.045
BUX Ft	0.060	0.056	−0.027	−0.024	−0.016
BUX USD	0.058	0.044	−0.037	−0.028	−0.037

indices (especially on the US markets) show a looser relation. In general it can be stated that the outcomes of the analyses on prices and indices indicate a random walk like value formation, so-forth they corroborate the weak form of efficient market hypothesis.

3.2. Runs Tests

Most of the tests of the usefulness of past return in predicting future return utilise correlation coefficients to examine efficiency. However, the correlation coefficient tends to be heavily influenced by extreme observations. Thus, results can be misleading due to one or two unusual observations. An alternative analysis, which eliminates the effect of extremely deviated observations, is to examine the sign of the price changes. These kinds of processes are called runs tests. A run is defined as the sequence of price changes occurred in the same direction. Thus, only the di-

Table 2. Correlations between daily returns and average returns of the preceding 5 and 10 days

	Correlation	
	previous 5 days	previous 10 days
Some security data		
BorsodChem USD	0.017	0.013
Egis USD	0.007	0.049
IBUSZ USD	−0.204	−0.148
OTP USD	−0.024	0.001
Pick USD	0.004	0.030
Zwack USD	−0.009	−0.002
Summarised statistics of 18 Hungarian securities		
Average	−0.018	0.011
Standard Deviation	0.053	0.051
Highest Value	0.033	0.068
Smallest Value	−0.204	−0.148
Average of absolute values	0.031	0.037
Correlation of Indices		
MSCI World index	0.006	0.020
S&P 500 Comp. index	−0.061	−0.048
NYSE Composite index	−0.031	−0.023
BUX Ft	0.021	0.084
BUX USD	−0.001	0.062

rection of price changes ($+$ or $-$) are counted the scale or measure of change is not. Zero price changes can be counted as a positive or a negative change (but we have to be consistent), in this paper conventionally the zero price changes are considered as negative price change. For instance a sequence of $+---++0--$ daily price change corresponds to four runs. There exists a theoretical (expected) number of runs for all sample sizes, which shows a totally random sequence of sign changes. The number of runs measured in our case has to be compared to the theoretical number of runs. If there was a positive relationship between price changes, there should be longer sequences of + and – than could be attributed to chance and fewer runs so it would be more likely that a + was followed by a $+$ and a $-$ by a $-$, than to have a reversal sign.

A lot of international researches showed a slightly positive correlation analysing daily data. Typical example taken by FAMA (1965), for one-day intervals 760 runs were expected and 735 were obtained (based on daily data of 30 securities of US companies in a period of 5 years). Thus, there were fewer runs than were expected, which is the evidence of a small positive relationship between successive returns.

Table 3. Correlation of return with returns in prior period of various countries (partial source: ELTON, E. and GRUBER, M., (1995))

Country	Author		Data	Variables	Time interval	Average Correlation Coefficients
			18 companies	price	1 day	0. 007
					1 week	−0. 025
					2 weeks	0. 002
				in price	1 day	0. 007
					1 week	−0. 018
					2 weeks	0. 011
Hungary			1 index	price	1 day	0. 059
					1 week	−0. 002
					2 weeks	0. 060
				in price	1 day	0. 058
					1 week	−0. 001
					2 weeks	0. 062
	MOOR	(1974)	30 companies	in price	1 week	−0. 056
	COOTNER	(1974)	45 companies	in price	1 week	−0. 047
	FAMA	(1965)	30 companies	in price	1 days	0. 026
USA					4 days	−0. 039
					9 days	−0. 053
					16 days	−0. 057
	KING	(1974)	63 companies	in price	1 mounth	0. 018
U.K.	KENDALL and		19 companies	price	1 week	0. 131
	ALEXANDER	(1971)			2 weeks	0. 134
					1 month	0. 006
Greece	NIARCHOS	(1971)	15 companies	in price	1 month	0. 036
Australia	PRAETZ	(1972)	16 index	in price	1 week	0. 000
			20 companies		1 week	−0. 118
Norway	JENNERGREN	(1975)	15 companies	in price	1 day	0. 068
					2 days	−0. 07
					1 week	−0. 004
Sweden	JENNERGREN and		30 companies	in price	1 day	0. 102
	KORSVOLD	(1975)			3 days	−0. 021
					1 week	−0. 016

JENNERGREN and KORSVOLD (1975) found 338 average runs in contrast to the expected 395 in the Norwegian, which shows a little greater positive correlation. It is remarkable that an investor must incur transaction costs to trade securities. (Thus, if the correlation is very low, transaction costs should more than eliminate any potential profits from attempting to take advantage of correlated series.) In an efficient market, transaction cost would set an upper limit to the amount of

correlation. One indication that markets are efficient would be if higher correlation observed in markets has higher transaction costs.

Norwegian like results were obtained in the Hungarian markets. Data of 1500 exchange days were processed back from June in 1999 for the above mentioned securities of eighteen Hungarian companies. (Not all stocks were listed for 1500 trading days, in these cases the theoretical number of runs were estimated on basis of the elapsed time after the listing.) For the same time interval some international index sequences were analysed. All returns were calculated using *Eq.* (3), our results are summarised in *Table 4*.

Table 4. Results of runs tests for some Hungarian security, the average of 18 domestic company shares and some international indices based on the returns of 1500 trading days, back from the 30th of June 1999

	Number of Runs	
	Actual	Expected
Some Hungarian Securities		
Danubius	615	726.47
Egis	523	595.86
Fotex	670	734.09
MOL	385	430.92
OTP	451	468.46
Pick	669	754.74
Zwack	597	674.66
Summarised statistics of 18 Hungarian Securities		
Average	497	558.74
Indices		
MSCI %	486	596.84
S&P500 %	732	754.91
NYSE %	716	755.27
BUX Ft %	642	752.79
BUX $ %	688	758.89

Runs tests were made for the data sequences processed in *Table 4* for the returns of four day average. The results can be found in *Table 5*.

Table 6 compares our results with FAMA's (1965) and JENNERGREN–KORSVOLD (1975). In order to compare the results in a simple manner, all actual data were recalculated to 1000 theoretical number of runs.

The results of runs tests indicate at least the weak form of efficient market. Random characteristics can easily be seen either the one day or the four day sequence, however, the four day series are closer to the theoretical values. The theoretically expected values were generally smaller than the actual values. This indicates a

Table 5. Results of runs tests for some Hungarian security, the average of 18 domestic company shares and some international indices based on the average returns of a four day interval for 1500 trading days, back from the 30th of June 1999

	Number of Runs (4 days)	
	Actual	Expected
Some Hungarian Securities		
Danubius	198	205.47
Egis	154	160.28
Fotex	191	204.33
MOL	109	114.58
OTP	120	122.99
Pick	186	204.85
Zwack	164	200.92
Summarised statistics of 18 Hungarian Securities		
Average	160.71	174.25
Indices		
MSCI %	153	160.7546
S&P500 %	216	194.467
NYSE %	206	194.467
BUX Ft %	184	200.335
BUX $ %	175	179.9972

Table 6. Comparison of runs tests results obtained by FAMA (1965), JENNERGREN–KORSVOLD (1975) and the authors. The results were recalculated as 1000 expected number of runs.

	Number of Actual Runs Fitted to the Value of 1000 Expected	
	1 day	4 days
MSCI %	814.29	951.76
S&P500 %	969.65	1110.73
NYSE %	948.01	1059.31
BUX Ft %	852.83	918.46
BUX $ %	906.58	972.24
Average of 18 Hungarian Securities	889.50	924.66
FAMA	967.49	999.43
JENNERGREN–KORSVOLD	857.07	no data

slight positive correlation, which disproves random walk feature of the market, while confirms the unpredictability of any return above the equilibrium expected return. Results of the Hungarian capital market corresponded to our expectation: they show a strong random nature, however, they still remain behind the more developed American markets.

4. Predictability Tests Based on Past Prices of Other Securities or Indices

A distinct category is to analyse predictability on "other" data, i.e. the tests of cross-correlation. No one can say that because the future return or price of a security or index is unpredictable by analysing its own past price or return, it follows another (independently a random variable itself) variable (security, index, etc.) shifted in time.

The theoretical background of the cross-correlation is very similar to that of the auto-correlation. Herein we have to set out from the

$$r_{i,t} = a + br_{j,t-1-T} + e_{ij} \tag{4}$$

regression equation, where

a and b	are constants,
$r_{i,t}$	is the current price (value) at time t of i security, portfolio or index,
$r_{i,t-1-T}$	is the current price (value) at time $t-1-T$ of j security, portfolio or index,
T	is a positive integer, if $T = 0$ then the relationship between yesterday's and today's return is examined.
e_{ij}	random variable with zero expected value.

Table 7 and *Table 8* summarise the relationship expressed by one day cross-correlation on some of Hungarian securities, the BUX (in terms of HUF and in USD) and some international indices. Interpreting the results that have to be taken into consideration there could be distortion in consequence of the time-lag or time-lead (e.g. trading the same day in USA and in Hungary, the Hungarian Stock Exchange is already closed when the Wall Street will open and the yesterday of returns of Wall Street has been treated as today return) between different same-date data. It is well known that the measured capital market data on an identical day from different capital market indicate strong correlation relationship. However, the "same-day" or "one day prior" are not clear definitions because of the time-lag. So the reason of strong correlation (relation) between the Budapest and overseas capital market data is the significant time-lag i.e. the transformation to a closer time of "today" and "yesterday" and not any other cause. Thus, in our case this should be interpreted as a kind of measurement error.

Table 7 and *Table 8* examine different time intervals. The closeness of the respective data of the two Tables show a relative stability of relations.

Table 7. Cross-correlation of daily returns for some Hungarian securities and indices, both of them are calculated in USD (except BUX HUF) in the period of 1st of July 1994 – 30th of June 1999

Cross-Correlation of Daily Returns								
	MSCI	NYSE	SP500	BUX USD	BUX HUF	Danubius	Zwack	Pick
MSCI		0.134	0.135	0.058	0.052	0.010	−0.016	0.036
NYSE	0.034		0.010	0.014	0.008	−0.019	−0.032	0.016
SP500	0.014	−0.030		0.015	0.007	-0.013	−0.032	0.021
BUX USD	0.129	0.324	0.322		0.095	0.028	0.041	0.098
BUX HUF	0.123	0.353	0.352	0.089		0.022	0.041	0.094
Danubius	0.094	0.206	0.206	−0.021	−0.018		0.024	−0.004
Zwack	0.063	0.096	0.098	−0.014	0.005	−0.012		0.006
Pick	0.128	0.232	0.234	0.039	0.041	0.007	0.017	

Table 8. Cross-correlation of daily returns for some Hungarian securities and indices, both of them are calculated in USD (except BUX HUF) in the period of 1st of July 1996 – 30th of June 1999

Cross-Correlation of Daily Returns							
	MSCI	NYSE	BUX USD	BUX HUF	Danubius	Zwack	Pick
MSCI		0.135	0.074	0.065	0.008	−0.025	0.061
NYSE	0.019		0.006	−0.005	−0.040	−0.041	0.019
BUX USD	0.165	0.374		0.043	−0.035	0.036	0.081
BUX HUF	0.159	0.391	0.043		−0.042	0.031	0.075
Danubius	0.119	0.272	−0.036	-0.041		0.041	−0.007
Zwack	0.065	0.145	−0.026	−0.019	−0.025		−0.150
Pick	0.151	0.293	0.026	0.020	−0.022	0.100	

Data of *Table 9* are partially looking for the answer whether the variation of the HUF/USD exchange rate has any delayed influence on Hungarian securities and on the other hand it examines the correlation relationship between returns of different securities measured in HUF.

Concluding this section of the paper, disregarding the high correlation relationship, which can be explained by the time-lags, the analyses show only a very low level of stochastic relations. Again an argument declares the nonpredictability hypothesis.

Table 9. Cross-correlation of daily returns for some Hungarian securities and the BUX index, in HUF in the period of 1st of July 1994 – 30th of June 1999.

Cross-Correlation of Daily Returns					
	BUX USD	Danubius	Pick	Zwack	USD
BUX HUF		0.021	0.094	0.041	−0.004
Danubius	−0.022		−0.006	0.025	0.011
Pick	0.036	0.002		0.016	−0.003
Zwack	0.000	−0.005	0.014		0.066
USD	−0.027	−0.031	−0.028	−0.009	

5. Analyses of Price – Volume Relation

One of the classic types of the weak form tests of efficient market hypothesis is the analysis of correlation relationship between security prices and trading volumes. It is an ordinary theory in the (non-scientific) daily journals that there can be found a string relation between the above mentioned variables, however, as it can be seen in *Table 10*, there does not exist a substantial relation.
It can be found that from all of the previously fulfilled analyses this one gave the lowest correlation coefficients. Obviously, it can be stated, that the stochastic relation between trading volume and security prices is insignificantly small.

6. Time Pattern Analyses of Security Returns

A particular array of tests can be found in academic research papers when security or index returns are connected to special dates of the calendar. Obviously, it would contradict the theoretical rules of efficient market hypothesis if the returns show a significantly different “behaviour” e.g. on day of a week or one mount of a year. However, a number of studies has reported some time patterns in security returns. It is hard to know what conclusion should be drawn from this literature. One explanation is that with hundreds of researchers examining the same data set, patterns will be found, and these patterns are simply random. If this is true then evidence from other markets and other time periods should not find similar patterns. A second possible explanation is that these patterns are induced by the market structure and order flow. The third possible answer is that markets are inefficient because one would expect that patterns would disappear as investors exploit them. The basic types of time pattern analyses will be carried out in the paper.

Table 10. Cross-correlation between price and trade volume in case of some listed securities in the Budapest Stock Exchange, from the previous 5 days to the subsequent 5 days

Companies	Cross-Correlation of Price and Volume										
	Days										
	−5	−4	−3	−2	−1	0	1	2	3	4	5
BorsodChem	0.02	0.003	0.002	−0.012	0.022	0.028	0.005	0	0.003	−0.036	−0.02
Danubius	0.017	0.008	0.02	−0.004	−0.002	0.015	−0.001	0.012	−0.012	−0.003	−0.008
DunaHolding	−0.005	0.003	0.004	0.01	0.032	−0.015	0.132	−0.015	−0.001	0.046	−0.046
Egis	−0.012	0	0.016	0.018	0.01	0.028	−0.016	−0.015	0.03	−0.003	0.015
Fotex	−0.018	0.004	0.009	0.006	0.01	−0.01	−0.006	−0.005	0.004	0.001	−0.007
GraboPlast	0.028	−0.003	0.025	0.034	−0.011	0.047	0.002	−0.014	−0.004	0.011	0.013
Humán	−0.01	−0.015	−0.003	−0.023	0.026	0.024	0.022	−0.01	−0.03	0.038	0.015
IBUSZ	0.022	−0.002	0.003	0.013	−0.009	0.048	−0.017	−0.021	0.001	−0.005	−0.013
InterEurópaBank	0.018	0.017	0.05	0.022	−0.031	−0.045	0.005	0.001	−0.057	−0.004	−0.007
MOL	0.024	−0.005	0.005	−0.008	−0.003	0.084	−0.092	−0.09	−0.04	−0.044	0.032
OTP	0.011	0.046	−0.01	−0.009	0.019	0.017	−0.031	−0.011	−0.009	−0.021	−0.02
Pannon Flax	−0.038	0	0.005	−0.007	0.05	−0.035	0.015	−0.008	0.002	−0.007	0.008
Pick	−0.042	−0.008	−0.024	0.031	0.018	0.019	−0.042	−0.017	0.014	−0.022	0.024
PannonPlast	−0.089	−0.017	0.019	0.25	−0.104	0.055	0.001	−0.031	−0.116	−0.064	0.042
Prímagáz	0.006	0.018	0.011	0.02	0.012	−0.008	−0.027	−0.001	−0.007	−0.008	−0.002
Richter	−0.031	−0.088	−0.006	0.038	0.014	0.037	0.058	0.076	0.038	−0.085	−0.037
TVK	0.005	−0.062	0.08	0.049	−0.058	0.193	−0.174	−0.056	−0.004	−0.024	−0.007
Zalakerámia	0.006	0.006	0.001	0.012	−0.002	0.004	−0.017	−0.003	0	0.004	0.105
Zwack	−0.034	0.02	0.025	−0.036	0.008	0.016	0.045	−0.054	−0.051	−0.031	0.003
Average	−0.0064	−0.0039	0.0122	0.0213	0.0001	0.0264	−0.0073	−0.0138	−0.0126	−0.0135	0.0047

6.1. Monthly Return Patterns

One who well knows the academic literature would expect the deviation in January and December returns. Numerous previous examinations (e.g. FAMA, 1991) stated that in January the expected returns are significantly higher than in other months. The "January-effect" was not only discovered in the US but in many other foreign markets like GULTEKIN et al. (1983) investigated 17 countries and observed the mentioned effect; KATO et al. (1985) have found similar results in Tokyo security market; KEIM and STANBAUGH (1984) examining the bond market came to the same conclusion.

Several explanations are offered for the high returns in January. The most important one is connected to tax savings. This is the "tax-selling hypothesis". A popular suggestion of investment advisers, at year end, is to sell securities for which the investor has incurred substantial losses before the end of the year and purchase an equivalent security. This creates a tax loss for the investor. If tax loss is substantial, it should more than cover transaction costs. Since the selling is in late December and the purchasing in early January, the argument is that prices are depressed at the end of December and rebound in January, creating high returns in January. Furthermore KEIM and STANBAUGH (1984) found that the tendency for stocks is to be at the bid price for the last trade in December. In addition, they have a higher bid-ask spread and lower price. Thus, part of the January effect can be explained by the prices having a tendency to be at the bid in December.

Our analyses discuss the period of 1991 to 1999. Monthly returns of three indices MSCI world index, NYSE and the BUX (all of them calculated in USD) were examined. The analyses were carried out by dividing the whole period into two equal parts as well, from 1991 to 1994 and from 1995 to 1999. (The MSCI world index was estimated only from the middle of 1994.)

Our results (see *Fig. 1*) do not verify the "January – December effect". January and December do not show – like the other months – any unusual differences. May be the result of August should be mentioned, which gave a lower return than the average. An explanation could be that the positions of investors are usually closed just before going on holiday.

6.2. Day of the Week Patterns

Similarly to the months the returns of the different days of the week can be compared. One can find a lot of scientific papers on this kind of analyses (like GIBBONS and HESS, 1981; HARRIS, 1986). The general conclusion of the literature has to be mentioned which states that one can find lower Monday returns and higher Friday returns. (There does not exist a generally accepted interpretation to this phenomenon.)

The results of our examinations (see *Fig. 2*) do not show similar behaviour of returns in international markets nor in domestic trade, even our results shows

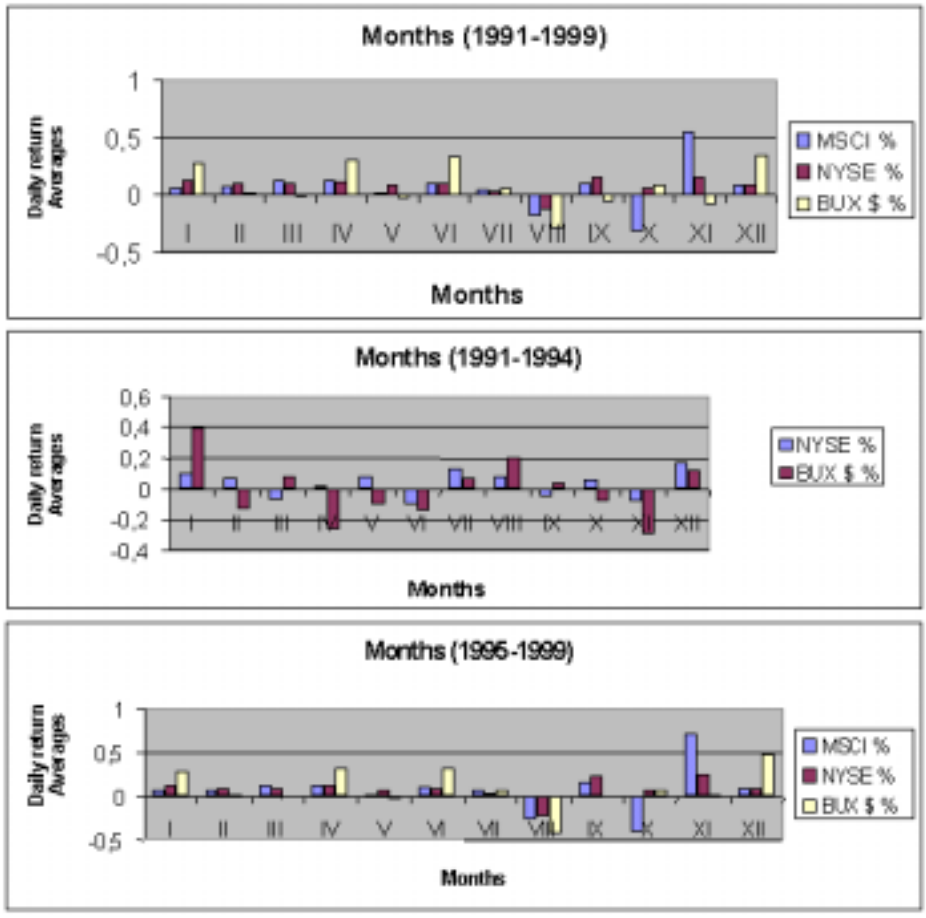

Fig. 1. Monthly average returns in the period of 1991–1999, 1991–1994, 1995–1999

opposite return behaviour. However, Thursday returns are significantly lower than that of other days.

7. Conclusions

Our analyses have not found any substantial phenomenon which would be a contradiction against the weak form of efficient market hypothesis which would correspond to the unpredictability of future returns. No results were found proving the predictability of returns in the Hungarian capital market nor in case of international ones, even we cannot reinforce the usual contradictions of the international

scientific literatures (January effect, lower Monday returns and so on).

Our results are not surprising in an international manner, however, they seem to dissipate the theories about the undeveloped Hungarian capital market and manifestations about its low efficiency.

References

[1] ANDOR, GY.: Mérnöki gazdaságtan, Budapesti Mûszaki Egyetem, MBA oktatási segédanyag, Budapest, 1999.

[2] COOTNER, P.: The Random Character of Stock Market Prices, (Cambridge, Mass.: MIT Press, 1974).

[3] ELTON, E. – GRUBER, M.: Modern Portfolio Theory and Investment Analysis, J. Wiley and Sons, Inc., New York, 1995.

[4] FAMA, E.: Efficient Capital Markets II, *Journal of Finance*, Vol. 26, No. 5., (Dec 1991), pp. 1575–1617.

[5] FAMA, E.: Efficient Capital Markets: A Review of Theory and Empirical Work, *Journal of Finance*, XXV, No.2., (March 1970), pp. 383–417.

[6] FAMA, E.: The Behaviour of Stock Market Prices, *Journal of Business*, 38 (Jan. 1965), pp. 34–105.

[7] GIBBONS, M. – HESS, P.: Day of the Week Effects and Asset Returns, *Journal of Business*, Vol. 54, (1981), pp. 579–596.

[8] GRIFFTHS, R.: Relative Strength – An Indicator for Investment in the Equity Market, thesis, Department of Statistics, Cranfield College, Cambridge, England: 1970.

[9] GULTEKIN, M. – GULTEKIN, B.: Stock Market Seasonality: International Evidence, *Journal of Financial Economics*, Vol. 12, (1983), pp. 469–481.

[10] HARRIS, L.: A Transaction Data Study of Weekly and Itradaily Patterns in Stock Returns, *Journal of Financial Economics*, Vol. 14, (May 1986), pp. 99–117.

[11] JENNERGREN, P. – KORSVOLD, P.: The Non-Random Character of Norwegian and Swedish Stock Market Prices, in ELTON – GRUBER, International Capital Markets, Amsterdam: North-Holland, 1975.

[12] JENNERGREN, P.: Filter Tests of Swedish Share Prices, in ELTON – GRUBER, International Capital Markets, Amsterdam: North-Holland, 1975.

[13] KATO, K. – SHALLHEIM, J.: Seasonal and Size Anomalies in the Japanese Stock Market, *Journal of Financial and Quantitative Analysis*, Vol. 20, No. 2., (June 1985), pp. 243–260.

[14] KEIM, D. – STAMBAUGH, R.: A Further Investigation of the Weekend Effect in Stock Returns, *Journal of Finance*, Vol. 39, No. 3, (July 1984), pp. 819–840.

[15] KENDALL & ALEXANDER, in COOTNER, P. The Random Character of Stock Market Prices, Cambridge, Mass.: MIT Press, 1974.

[16] KING, in COOTNER, P. The Random Character of Stock Market Prices, Cambridge, Mass.: MIT Press, 1974.

[17] MOOR, in COOTNER, P. The Random Character of Stock Market Prices, Cambridge, Mass.: MIT Press, 1974.

[18] NIARCHOS, N.: Statistical Analysis of Transactions on the Athens Stock Exchange, thesis, Nottingham England: Nottingham College, 1971.

[19] PRAETZ, P.: The Distribution of Share Price Changes, *Journal of Business*, Vol. 45, No. 1., (Jan. 1972), pp. 49–55.

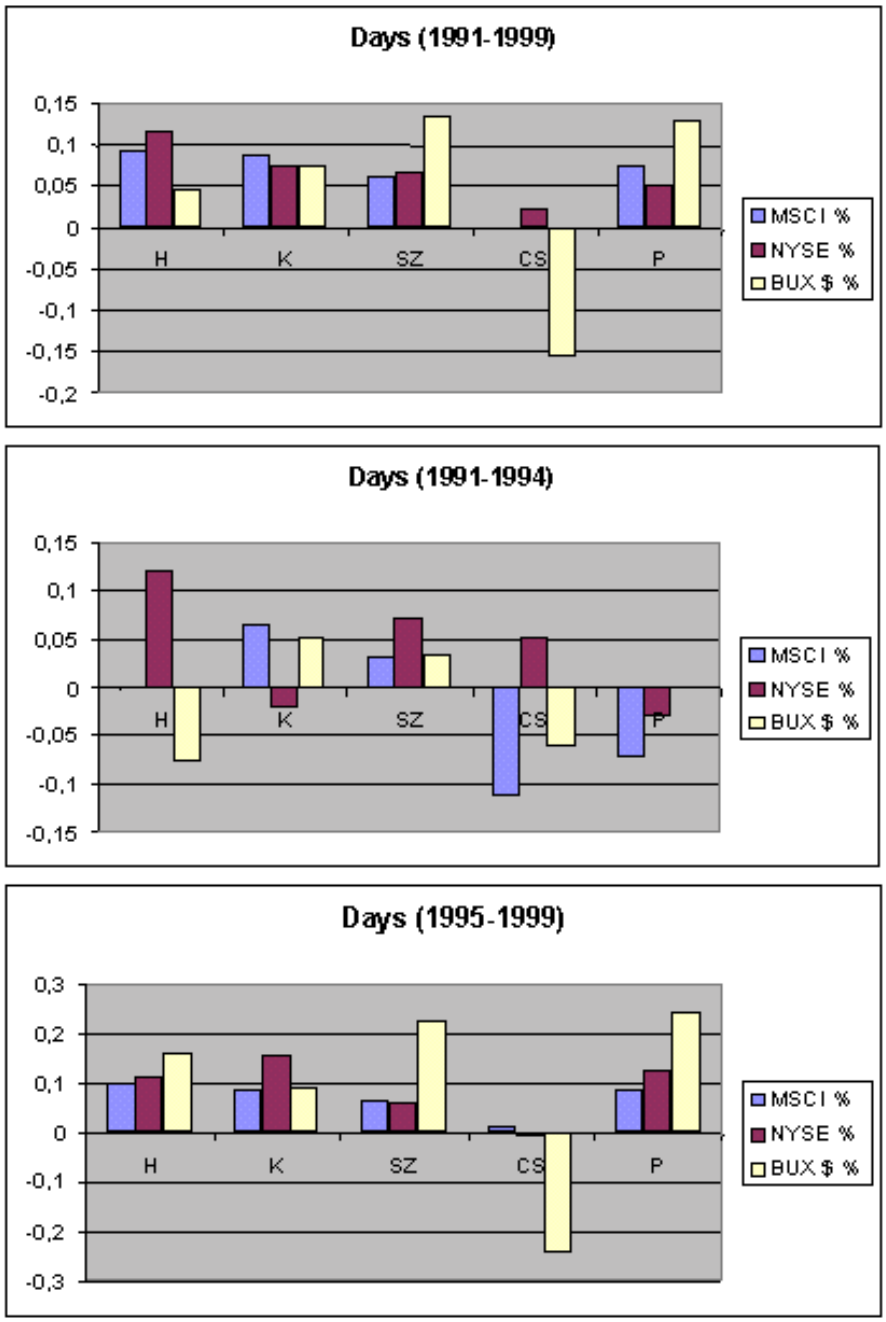

Fig. 2. Daily average returns in the period of 1991–1999, 1991–1994, 1995–1999.