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MARKET EFFICIENCY ANALYSIS OF THE HUNGARIAN STOCK MARKET

Two economists are walking along the street. One of them spies a $100 bill lying on the pavement, and leans down to retrieve it. The second one restrains him. Don't be ridiculous, John! If that were really a $100 bill, someone would already have picked it up. [1]

INTRODUCTION

After the re-establishment of the Budapest Stock Exchange in 1990, the first tests to measure market efficiency were made in 1999. [2] Since then several studies have been published on the topic, nevertheless numerous misinterpretations can be found in publications and in the press.

This study makes an attempt to clarify the misconstructions, analyses the efficiency of the Hungarian Stock Exchange. It compares the new results with the international outcomes and with the results which were based on the time serials up till 1999, and *reductio ad absurdum* gives evidence of inefficiency of technical analysis and proves the unpredictability of share prices.

1. EFFICIENCY OF THE CAPITAL MARKET

If we accept that risk free investments are accessible for everyone then active portfolio management can support the value maximizing aims of the investors by constructing risky portfolios. Furthermore, because the process also has costs, active portfolio management makes sense only if the earnings surplus of the active portfolio management surpasses the supplementary costs. [3]

Passive portfolio management – which is practically cost free - is closely linked to the definition of capital market efficiency which was formulated by EUGENE FAMA: *"The market in which prices fully reflect available information is called efficient."* [4]

1.1. Early studies

Bachelier wrote in his dissertation about capital market efficiency. He established that in mathematical understanding the expectation of a stock market speculator was zero. [5] His work was initially slightly known, however, after some years it had a significant effect on the statistic and mathematic description of the Brown motion, which is closely related to the theory of efficient capital markets.

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KEYNES in its article from 1923 (Some Aspects of Commodities Markets) stated, that the investors in the financial markets should know better what will happen in the future than the market itself. This is the consequence of the hypothesis of the efficient capital markets.

An article by ALFRED COWLES [6] analysed with statistical tools 20 financial advisors' 7500 recommendations. Firstly, he could not demonstrate that the recommendations would have been more successful than the market average. Secondly, he compared the investments of 20 fire insurance companies to those of financial advisor companies, but he could not prove advantage in the advisors' investments. Thirdly, he examined the forecasts of an analyst of the Wall Street Journal over a three-year long period. He found over the course of 90 events the analyst made 45 proper and 45 false forecasts. In addition, by analysing 24 forecasting companies' quarterly data he concluded that even the best ones could only just get ahead of the market average.

1.2. Fama's approach

OSBORNE in his publication from 1962 [7] analysed the Brownian motion of the stock prices and found that it can not be proved that prices move by following any rational structure. Three years later FAMA's two famous articles were published.[8] In his second work is the statement in which he laid down the uselessness of the "chartist" analyses. *"If the random walk model is a valid description of reality, the work of the chartist, like that of the astrologer, is of no real value in stock market analysis."* Based on the other conclusion of this article, if the share prices moves randomly, and if the capital markets are efficient, then in every second the prices approximate the internal, fundamental value of the shares.

One year later MANDELBROT demonstrated that in competitive markets, with rational, risk-neutral investors the future prices were unpredictable, and the prices follow the martingal process. It means that taking into consideration all the earlier events, in a constant environment, the best forecast for the forthcoming period is the value of the previous period. [9]

The next milestone was published in the famous article of FAMA (1970) about the efficient capital markets, in which the previously mentioned definition was included. In the conclusions of this paper the different levels of the efficient market were set down.

The efficient capital market hypothesis became widely known and came to the forefront after MALKIEL's famous book was published in 1973. [10] In this book MALKIEL summarized the substance in plain language and made the area more understandable.

GROSSMAN and STIGLITZ argued that because information was costly, prices could not perfectly reflect the information available, since if they did, those who spent resources to obtain it would receive no compensation, leading to the conclusion that efficient information flow in the market was impossible. [11] The next important article was published in 1985, [12] WERNER F. M. DEBONDT and RICHARD THALER discovered that stock prices overreact, evidencing substantial weak form of market inefficiencies. This paper marked the start of behavioural finance. As a result of the first analyses in this topic, CHOPRA and co-authors [13] strengthened the overreacting effect. In 1994 MALKIEL found that the portfolios, chosen by professional portfolio managers, were not overperforming the market average. In 1997 CHAN, GUP and PAN analysed the capital markets in 18 countries and concluded that the world equity markets were at least weak-form efficient. [14]

1.3. Latest findings – Progressive market theory

In 2001 MARK RUBINSTEIN reexamined some of the most serious historical evidence against market rationality and concluded that the capital markets were rational. [15]

In 2003 MALKIEL [16] examined the attacks on the efficient market hypothesis and concluded that our stock markets were far more efficient and far less predictable than some recent academic papers would have us believe. The final conclusion of the article: *"Periods such as 1999 where 'bubbles' seem to have existed, at least in certain sectors of the market, are fortunately the exception rather than the rule. Moreover, whatever patterns or irrationalities in the pricing of individual stocks that have been discovered in a search of historical experience are unlikely to persist and will not provide investors with a method to obtain extraordinary returns. If any $100 bills are lying around the stock exchanges of the world, they will not be there for long."*

In the same year WILLIAM SCHWERT [17] showed that when anomalies were published, practitioners implemented strategies implied by the papers and the anomalies subsequently weakened or disappeared. In other words, research findings cause the market to become more efficient, therefore the market is progressing. As a proof of this in 2006 TÓTH and KERTÉSZ analysed the New York Stock Exchange and found evidence that in progressing over time this market's efficiency was increasing.

1.4. Three categories of efficient capital markets

About perfect capital market pricing, it is statable that if the observable prices in a capital market in a given minute fully reflect all available information, thus the prices are in equilibrium and it will be constant until new relevant information appears. Furthermore, if such information comes out, the market would correctly and instantly react to it. Therefore, in the $t + 1$ time period the observed price indicates the "correct" value of a given company.

This approach cannot be tested due to its generality. But taking into account the CAPM model – as a general equilibratory model – the normal yield is separable from abnormal yields. The effective market hypotheses concede the abnormal yields exist, but they state that the abnormal yields follow normal distribution and therefore predict zero as expected value. It follows from this that the price of a given instrument is influenced only by events in the future. By this approach the capital market can be considered efficient, if the abnormal yields are unpredictable and the prices are sorted by the normal yields and the capital market transactions are zero net present value deals.

The accessibility of the infomation follows a normal distribution. It means that the impact of the insider information on the prices is consistent with the effect of the delayed outsider information. It is proposed that in the price/information/time range, the price/information surface corrugates, but the expected value is a plain surface. This general description's categorized form is FAMA's classification. [18]

Based on FAMA's approach (1991) [19] the three levels of capital market efficiency are:
- *Weak form of capital market efficiency:* when prices fully reflect the available relevant historical information. (instantly and correctly)
- *Semi-strong form of capital market efficiency:* if the prices fully reflect the publicly announced information regarding the future of the companies.
- *Strong form of capital market efficiency:* if the non-public, insider information infiltrates into the prices.

2. THE DATA

This analysis was based on the daily and monthly data of 10 Hungarian stocks. In the case of the monthly data, the time serials start on 31st May 1999 and end on 31st March 2008. The daily data contains the last 517 day-close figures up till 31st March 2008. Regarding the indices for representing the Hungarian market the BUX index was used, as a world index the Morgan Stanley World Equity index was chosen. The source of data was in both cases the PPPro application from Reuters. The MSCI World Index is from the Bloomberg Trading System. The necessary corrections were made based on the information from Reuters. The source of the FX rates was the home page of the Hungarian National Bank's official FX database.

The yields of the shares and indices were calculated using a discrete and continuous yield calculation method in original currency and in USD (the conversion was made using the official middle rate of the Hungarian National Bank). For the completion of the calculations the MiniTab statistical software was used.

3. THE ANALYSIS OF CAPITAL MARKET EFFICIENCY OF THE HUNGARIAN STOCK MARKET

As a basis for this analysis the yield forecasting of the Hungarian capital market from ORMOS-SZABO article was used, [2] and for theoretic basis the ANDOR-ORMOS: Investments [3] working paper was applied.

The efficient market hypothesis does not contradict the consistence of the abnormal yields, but it presumes that its expected value is zero. The changes result from information and if the market is efficient the price shifts immediately. Therefore, if the effect of the information does not result in prompt changes in the prices for the investors, they would have the possibility to identify the process and gain higher yields.[22]

If the downflow is adequately fast, the overmentioned identification is not possible, thus the price changes correspond to a random process. As a consequence, the predictability tests investigate the random character of the price changes. If the historical price changes follow random process, it means that our analyses are no longer able to forecast the price changes, so in practice the "technical analysis" is useless.

3.1 Time series tests

In chain tests the price changes are typified only by their direction, so the bias caused by the protrusion can be eliminated. The chain of +,- and 0 values are compared to a theoretic random movement. If the observed value is less than the theoretic value, we could conclude a positive linkage, because after a positive value, the probability of the next one's positivity is higher.

The first research in this topic was done by EUGENE FAMA in his article Behavior of Stock Market Prices [20] in 1965. By analysing the data of 30 American companies in the case of empirical figures he found a value of 735 opposed to a theoretical figure of 760.

The *Table I* summarizes the result of my calculation for 517 days.

Table I
The result of the chain-test in the case of 10 Hungarian stocks,
BUX and MSCI indices converted to the theoretical value of 1000

		Indices		Shares									
		MSCI	BUX	MOL	OTP	RICHTER	RABA	TVK	EGIS	MTELEK	ZWACK	FOTEX	SYNERG
Number of chains	In USD	901	936	971	959	936	894	986	990	963	863	944	936
	In HUF	-	967	1014	996	1031	948	1044	992	1019	956	1015	985

The random character of the results is unambigous, and proves at least the weak form of the capital market efficiency of the Hungarian capital market. The empirical values are very close to the theoretical figures. This underlines the assumption of un-predictability over the expected yield, so based on this the market is tenably effective.

Table II
Comparison of the actual and the previous empirical analyses

		Indices		Stocks									
		MSCI	BUX	MOL	OTP	RICHTER	RABA	TVK	EGIS	MTELEK	ZWACK	FOTEX	SYNERG
Number of sequences	Actual analysis	901	936	971	959	936	894	986	990	963	863	944	936
	Ormos - Szabó 1999	814	906	895	964				879		886	913	
The average of 10 Hungarian stocks (actual analysis)											944		
The average of 18 stocks (ORMOS – SZABÓ, [2])											889		
FAMA 1965 based on the data of 30 American companies											967		

In *Table II* comparing this analysis to the data of 1999 we get closer figures to the theoretical values. Compared to these theoretical values, the results are tendentially lower, which means that narrow positive correlation is demonstrable, but the extent decreased and the market became more efficient.

3.2 Correlation analyses

The correlation tests are viable to prove the independence of the daily yields. The most frequently used form of the tests is the analysis of the auto-correlation instruments, in which auto-correlations are calculated for daily values. If it is showable that the price changes follow the stochastic process, then it proves the unpredictability of the prices.

In this article the auto-correlation test was calculated for 10 Hungarian shares and for 2 indices based on a 517-day long historical time series. The *Tables III and IV* contain the results of the calculation, and correspond to the ORMOS – SZABÓ article in retrospect from one day to five.

Table III
Auto-correlation analyses for 10 Hungarian equities,
MSCI and BUX indices on 517-day long historical data converted to USD

USD	Auto-correlations				
	1day	2days	3days	4days	5days
MSCI	*0.0894*	*0.0131*	*-0.0569*	*0.0126*	*-0.0139*
BUX	*0.1355*	*0.0016*	*-0.0103*	*0.0223*	*-0.0134*
MOL	0.1080	-0.0099	-0.0203	0.0004	-0.0022
OTP	0.1403	-0.0565	-0.0492	0.0107	0.0106
RICHTER	0.1260	-0.0423	-0.0237	-0.0595	-0.0282
RABA	-0.0148	-0.0366	0.0641	0.0852	0.0318
TVK	-0.0501	0.0107	-0.0111	0.0376	-0.0278
EGIS	0.0320	-0.0711	-0.0222	0.0320	0.0141
MTELEK	-0.0347	0.0015	0.0224	-0.0122	0.0314
ZWACK	-0.1117	-0.0434	-0.0144	-0.0697	0.0267
FOTEX	-0.0376	0.0024	-0.0050	0.0240	0.0112
SYNERG	0.0307	-0.0483	0.0029	-0.0163	-0.0813
Highest value	0.1403	0.0131	0.0641	0.0852	0.0318
Lowest value	-0.1117	-0.0711	-0.0569	-0.0697	-0.0813
Mean	0.0344	-0.0232	-0.0103	0.0056	-0.0034
Standard deviation	0.0848	0.0294	0.0315	0.0421	0.0324
Avg. of the abs. values	0.0759	0.0281	0.0252	0.0319	0.0244

Table IV
Auto-correlation analyses for 10 Hungarian equities,
MSCI and BUX indices on 517-day long historical data in original currency

HUF and USD	Auto-correlations				
	1day	2days	3days	4days	5days
MSCI	*0.0894*	*0.0131*	*-0.0569*	*0.0126*	*-0.0139*
BUX	*0.1090*	*-0.0075*	*-0.0270*	*0.0570*	*-0.0093*
MOL	0.1047	-0.0363	-0.0426	0.0143	0.0090
OTP	0.0992	-0.0610	-0.0621	0.0042	0.0264
RICHTER	0.1156	-0.0685	-0.0223	-0.0285	-0.0486
RABA	-0.0393	-0.0341	0.0932	0.1164	-0.0031
TVK	-0.0895	0.0253	-0.0166	0.0091	-0.0092
EGIS	0.0100	-0.0500	-0.0025	0.0171	-0.0032
MTELEK	-0.0781	-0.0258	-0.0117	-0.0094	0.0313
ZWACK	-0.1601	-0.0772	-0.0485	-0.0946	0.1004
FOTEX	-0.0892	0.0506	0.0001	0.0557	-0.0138
SYNERG	0.0076	-0.0487	0.0299	0.0152	-0.0875
Highest value	0.1156	0.0506	0.0932	0.1164	0.1004
Lowest value	-0.1601	-0.0772	-0.0621	-0.0946	-0.0875
Mean	0.0066	-0.0267	-0.0139	0.0141	-0.0018
Standard deviation	0.0967	0.0396	0.0428	0.0508	0.0451
Avg. of the abs. values	0.0826	0.0415	0.0345	0.0362	0.0296

The calculated correlation coefficients are very small, therefore, based on the data in the two tables is statable, that the figures of the consecutive days show characteristically stochastic movements. Considering the grade of the relation, the *Table V* shows the calculated determination coefficients based on one-day and one-week data. [21]

Based on the calculated coefficients it is representable that the figures from the previous day on average have an influence on the data of the next day by 0.85%, furthermore, in case of five-day data this value drops to 0.1%. Only the share price of the illiquid Zwack shares shows the value of 2.5% as for the one-day figures, but as for the 5-day data, things are settling into shape, the result drops back to 0.07%. Compared to the results of the ORMOS-SZABÓ article, the data does not measurably vary from the results of this article. In those article the beetling figures of the IBUSZ shares showed a high determination coefficient in case of the smallest values, as in our calculation Zwack did. Consequently, the market only just slightly becomes more efficient since the prior article.

Table V
Calculated determination coefficients in HUF and in USD

	Determination coefficients				ORMOS - SZABÓ [2]
	HUF	HUF	USD	USD	USD
	1day	5days	1day	5days	5days
MSCI	*0.80%*	*0.02%*	*0.80%*	*0.02%*	
BUX	*1.19%*	*0.01%*	*1.84%*	*0.02%*	*0.00%*
MOL	1.10%	0.01%	1.17%	0.00%	
OTP	0.98%	0.07%	1.97%	0.01%	0.06%
RICHTER	1.34%	0.24%	1.59%	0.08%	
RABA	0.15%	0.00%	0.02%	0.10%	
TVK	0.80%	0.01%	0.25%	0.08%	
EGIS	0.01%	0.00%	0.10%	0.02%	0.00%
MTELEK	0.61%	0.10%	0.12%	0.10%	
ZWACK	2.56%	1.01%	1.25%	0.07%	0.01%
FOTEX	0.80%	0.02%	0.14%	0.01%	
SYNERG	0.01%	0.76%	0.09%	0.66%	
Highest value	2.56%	1.01%	1.97%	0.66%	0.11%
Lowest value	0.01%	0.00%	0.02%	0.00%	4.16%
Mean	0.86%	0.19%	0.78%	0.10%	0.03%
St. dev.	0.70%	0.34%	0.75%	0.18%	0.28%

Based on the above mentioned results, the weak form of market efficiency is acceptable. The results coincide with the results of the previous Hungarian and international analyses.

4. SUMMARY

Summarizing the two types of calculation it is provable that both demonstrated random movement of the prices, lending countenance to the weak form of market efficiency. The empirical analysis did not show any result which is entirely inconsistent with hypothesis of unpredictability. Collaterally with the mainstream standpoint, this result gives evidence of the inefficiency of the technical analysis and proves the unpredictability of the share prices.

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