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Dissertation Paper

Testing the Informational Efficiency of the Romanian Capital Market

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1. Introduction

Several very important implications for security valuation are derived from the theory of market efficiency.

The main premises of an efficeint market are: first assumption is that the market consists of a large number of profit-maximizing agents who operate independently and, in order to achieve their goals, they analize and valuate stocks. A second assumption is that new information concerning securities comes to the market in a random way, and anouncements over time are generally independent from one another. A third assumption is that investors adjust security prices rapidly in order to reflect the effect of arrival of new information. The adjustment of the security prices takes place rapidly because of the large number of profit-maximizing agents. The joint effect of information comming in a random, independent way and the numerous investors who adjust stock prices rapidly in order to reflect the arrival of new information is that the price changes should be independent and random, so, according to the efficient market hypothesis, they should reflect all available information, including the risk involved.

According to Eugene Fama[1], taking into account the way the different types of information are reflected in securities prices, there are three forms of market efficiency: the weak form, the semi-strong form and the strong form.

Under the weak form of the efficient market hypothesis, stock prices are assumed to reflect any information contained in the historical stock price. If this hypothesis is true, a trader cannot obtain abnormal profit (profit above the average) by taking into account only the historical stock price, because information set is already included in the stock price. As a result, technical analysis or charting becomes ineffective. In this situation it is said that the stock price's movements are random walk.

Under the semi-strong form of the efficient market hypothesis, all publicly available information is presumed to be reflected in the securities' price. This includes information in the stock price series as well as information in the firm's accounting reports, the reports of competing firms, announced information relating to the state of the economy, and any other publicly available information relevant to the valuation of a firm. Again, if a trader takes into account only all available information, he/she cannot obtain abnormal profit, because all

[1] Fama, Eugene F. (1970); „Efficient Capital Markets: a Review of Theory and Empirical Work"; The Journal of Finance

available information set is already included in the stock prices. As a result, fundamental analysis becomes ineffective.

The strong form of the efficient market hypothesis takes the notion of market efficiency to the ultimate extreme. If this form of efficiency is true, all information is reflected in the stock prices. This includes private, or inside information as well as that which is publicly available. Under this form, those who acquire inside information, act on it and quickly force the price to reflect the information. But, the initial acquisition of new pieces of this information is a matter of chance, and since the stock prices already reflect the existing inventory of inside information, an investor cannot obtain above the average returns.

In the next chapters I test the validity of those three forms of informational market efficiency on the Romanian capital market.

In chapter two I test the random walk hypothesis and the implication of the validity of this assumption on estimating risk and volatility. The random walk model of stock prices generates several important implications for practitioners. Two of them are: First, that stock returns should follow a Normal distribution; and second, that the risk of a security should scale proportionally to the square root of time (the $T^{\frac{1}{2}}$ rule). The first implication is important because investors need to assume a given distribution in order to estimate the risk of their securities. The second implication is important because it says that investors can estimate the risk of a security in any time interval, and subsequently estimate the implied risk in any other time interval through a linear rescaling.

The third chapter presents tests of the weak form of market efficiency: tests for seasonality of market returns, tests of the efficiency of using transactions rules. These tests show whether or not an investor can obtain abnormal profit using only the information provided by the history of the stock prices.

In the forth chapter, there are tests for the semi-strong form of market efficiency. Some of the best moments to test whether or not all the publicly available information are reflected in the stock prices are by looking at the return of the stock before and after a stock split and also by looking at the evolution of the stock market prices of a company after it becomes publicly traded on a stock market.

In the fifth chapter I perform a test of the strong form of market efficiency. I assume that, if the market were strong form efficient, a professional portfolio manager couldn't obtain abnormal returns only if he/she used insider information.

2. Tests of the Random Walk Hypothesis

The definition of a random walk is: $y_t = y_{t-1} + \varepsilon_t$, where y_t is a time series and ε is a stationary random disturbance term. The series *y* has a constant forecast value, conditional on *t*, and the variance is increasing over time. The random walk is a difference stationary series since the first difference of *y* is stationary: $y_t - y_{t-1} = (1-L)y = \varepsilon_t$. A difference stationary series is said to be integrated and is denoted as *I(d)* where *d* is the order of integration. The order of integration is the number of unit roots contained in the series, or the number of differencing operations it takes to make the series stationary. For the random walk above, there is one unit root, so it is an *I(1)* series. Similarly, a stationary series is *I(0)*.

This condition is not sufficient for a time series to be random walk. The other conditions are: the error term is normally distributed and there is no linear or non-linear correlation between the error terms. For a series of stock market prices, y_t is the logarithm of the stock prices series, and, as a result, the first difference $y_t - y_{t-1}$ is the series of returns.

I test in this part whether stock prices behave as a random walk using the three main indexes on the Romanian stock markets: the BET Index, the index which take into account the evolution of the ten most liquid companies on the Bucharest Stock Market; the BETC Index, which is the composite index of the Bucharest Stock Exchange and the RASDAQC Index, the composite index of the Romanian OTC market – RASDAQ.

The first step in analysis consists in testing for a unit root in the time series. For testing, I used Augmented Dickey-Fuller and Phillips-Perron tests. Because the results of those tests were similar, I will present only the result of the Augmented Dickey-Fuller test.

To illustrate the use of Dickey-Fuller tests, consider first an AR(1) process: $y_t = \mu + \varphi y_{t-1} + \varepsilon_t$, where μ and φ are parameters and ε_t is assumed to be white noise. *y* is a stationary series if $-1 < \varphi < 1$. If $\varphi = 1$, *y* is a non-stationary series. If the absolute value of φ is greater than one, the series is explosive. The difference between a unit root (non-stationary) series and a stationary series is that in a stationary series, a random shock will be absorbed in time, but in a unit root series, a random shock will never be absorbed. The test, performed with Eviews 3.0 will return an *ADF Test Statistic*, which is the *t* test for rejecting the null hypothesis (the series is unit root). To reject the null hypothesis, the value of the *t* statistic must be less than the critical value for the chosen significance level.

Then I test if the returns are normally distributed, and if there is or not linear or non-linear correlation between the error terms (stock returns).

For linear dependence I used those two regressions: $\ln(I_t) = \mu + \rho \ln(I_{t-1}) + \varepsilon_t$ and $\varepsilon_t = \phi_0 + \phi_1 \varepsilon_{t-1}$, where I_t is the value of an index in day *t*. In order to exist linear dependence, ϕ_1 should be statistical significant. This is equivalent to an ARMA(1,1) process for $\ln(I_t)$.

For nonlinear dependence I tested whether or not the returns are a GARCH(p,q) process. The form of a GARCH(p,q) model is:

$$r_t = \beta_0 + \beta L(r_t) + \varepsilon_t$$

$$\varepsilon_t \approx N(0, h_t)$$

$$h_t = \alpha_0 + \alpha(L)\varepsilon_t^2 + \gamma(L)h_t .$$

The finding that stock prices do not follow a random walk has implications on volatility and betas. If stock prices do not follow a random walk, the volatility cannot be estimated through a linear rescaling (the $T^{\frac{1}{2}}$ rule). In reality, the monthly volatility (computed on the monthly returns) is greater than the volatility computed through a linear rescaling. The betas, under the random walk hypothesis, should be independent from the frequency of the data used to compute them. But in reality the monthly betas are larger than the daily betas, so the investors would underestimate the systematic risk.

2.1. Unit Root Tests and Dependence Tests for the Romanian Capital Market

2.1.1. BET Index[2]

ADF Test

Level:

ADF Test Statistic	-1.554272	1% Critical Value*	-3.9772
		5% Critical Value	-3.4191
		10% Critical Value	-3.1318

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGBET)
Method: Least Squares
Sample(adjusted): 6 634
Included observations: 629 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGBET(-1)	-0.004597	0.002958	-1.554272	0.1206
D(LOGBET(-1))	0.354188	0.040026	8.848942	0.0000
D(LOGBET(-2))	-0.077318	0.042429	-1.822281	0.0689
D(LOGBET(-3))	0.070805	0.042432	1.668666	0.0957
D(LOGBET(-4))	-0.020733	0.039994	-0.518410	0.6044
C	0.027353	0.019316	1.416050	0.1573
@TREND(1)	2.26E-06	5.26E-06	0.430762	0.6668

R-squared	0.122965	Mean dependent var	-0.000993
Adjusted R-squared	0.114505	S.D. dependent var	0.022728
S.E. of regression	0.021388	Akaike info criterion	-4.840945
Sum squared resid	0.284521	Schwarz criterion	-4.791487
Log likelihood	1529.477	F-statistic	14.53465
Durbin-Watson stat	1.998541	Prob(F-statistic)	0.000000

First difference:

ADF Test Statistic	-10.07556	1% Critical Value*	-3.9772
		5% Critical Value	-3.4191
		10% Critical Value	-3.1318

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGBET,2)
Method: Least Squares
Sample(adjusted): 7 634
Included observations: 628 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGBET(-1))	-0.668346	0.066333	-10.07556	0.0000
D(LOGBET(-1),2)	0.021817	0.061792	0.353069	0.7242
D(LOGBET(-2),2)	-0.058797	0.055900	-1.051819	0.2933
D(LOGBET(-3),2)	0.010590	0.047753	0.221773	0.8246
D(LOGBET(-4),2)	-0.017336	0.040054	-0.432810	0.6653
C	-0.002580	0.001751	-1.472882	0.1413
@TREND(1)	5.92E-06	4.75E-06	1.244252	0.2139

R-squared	0.340371	Mean dependent var	-3.39E-05
Adjusted R-squared	0.333997	S.D. dependent var	0.026268

[2] For analisys were used the daily average values of the BET index between 09/22/1997 – 04/28/2000

S.E. of regression	0.021437	Akaike info criterion	-4.836315
Sum squared resid	0.285377	Schwarz criterion	-4.786797
Log likelihood	1525.603	F-statistic	53.40629
Durbin-Watson stat	1.998072	Prob(F-statistic)	0.000000

Linear dependence – ARMA(1,1):

Dependent Variable: LOGBET
Method: Least Squares
Sample(adjusted): 2 634
Included observations: 633 after adjusting endpoints
Convergence achieved after 20 iterations
Backcast: 1

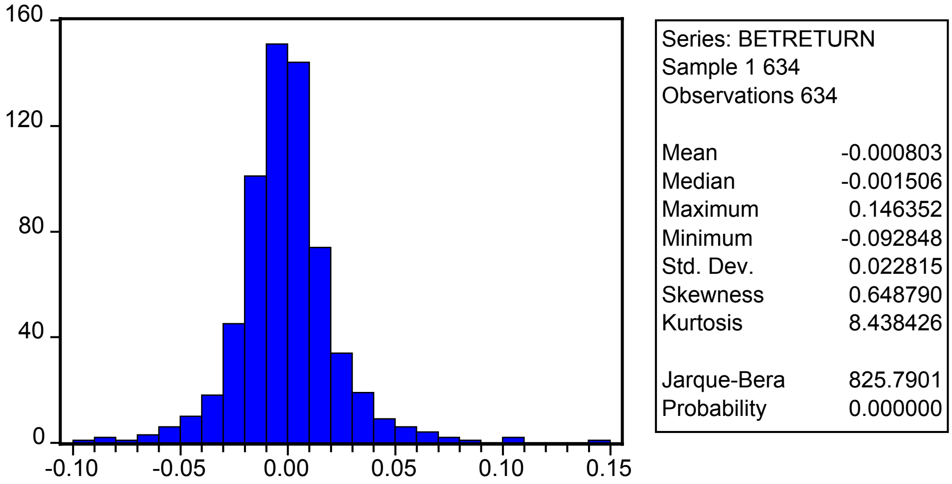
Variable	Coefficient	Std. Error	t-Statistic	Prob.
AR(1)	0.999812	0.000183	5456.451	0.0000
MA(1)	0.350380	0.037265	9.402281	0.0000
R-squared	0.995607	Mean dependent var		6.257467
Adjusted R-squared	0.995600	S.D. dependent var		0.322649
S.E. of regression	0.021402	Akaike info criterion		-4.847542
Sum squared resid	0.289018	Schwarz criterion		-4.833480
Log likelihood	1536.247	F-statistic		143011.1
Durbin-Watson stat	1.983114	Prob(F-statistic)		0.000000
Inverted AR Roots	1.00			
Inverted MA Roots	-.35			

Nonlinear dependence: GARCH(1,1):

Dependent Variable: BETRETURN
Method: ML - ARCH
Sample(adjusted): 2 634
Included observations: 633 after adjusting endpoints
Convergence achieved after 24 iterations
Backcast: 1

	Coefficient	Std. Error	z-Statistic	Prob.
MA(1)	0.339386	0.045178	7.512279	0.0000
		Variance Equation		
C	0.000133	2.00E-05	6.640666	0.0000
ARCH(1)	0.347547	0.051757	6.714986	0.0000
GARCH(1)	0.385771	0.071764	5.375574	0.0000
R-squared	0.112288	Mean dependent var		-0.001040
Adjusted R-squared	0.108054	S.D. dependent var		0.022718
S.E. of regression	0.021455	Akaike info criterion		-5.011506
Sum squared resid	0.289544	Schwarz criterion		-4.983383
Log likelihood	1590.142	F-statistic		26.52101
Durbin-Watson stat	1.957779	Prob(F-statistic)		0.000000
Inverted MA Roots	-.34			

Distribution of returns:



According to the unit root test, BET is an *I(1)* series. According to the linear dependence test, there is linear dependence between the returns. Also, BET is a GARCH(1,1) process. The distribution of the returns in not Normal, but Leptokurtotik. So, the BET series is not random walk.

2.1.2. BETC Index[3]

ADF test

Level

ADF Test Statistic	-2.565282	1% Critical Value*	-3.9810
		5% Critical Value	-3.4209
		10% Critical Value	-3.1329

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGBETC)
Method: Least Squares
Sample(adjusted): 6 496
Included observations: 491 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGBETC(-1)	-0.009616	0.003749	-2.565282	0.0106
D(LOGBETC(-1))	0.341672	0.045161	7.565639	0.0000
D(LOGBETC(-2))	-0.086600	0.047562	-1.820772	0.0693
D(LOGBETC(-3))	0.101429	0.047586	2.131485	0.0336
D(LOGBETC(-4))	-0.013976	0.045148	-0.309569	0.7570
C	0.059319	0.024380	2.433058	0.0153
@TREND(1)	1.27E-06	5.66E-06	0.225014	0.8221

R-squared	0.136118	Mean dependent var	-0.001616
Adjusted R-squared	0.125409	S.D. dependent var	0.016490
S.E. of regression	0.015421	Akaike info criterion	-5.492013

[3] For analisys were used the daily average values of the BETC index between 04/17/1998 – 04/28/2000

Sum squared resid	0.115099	Schwarz criterion	-5.432186
Log likelihood	1355.289	F-statistic	12.71027
Durbin-Watson stat	1.997414	Prob(F-statistic)	0.000000

First difference:

ADF Test Statistic	-8.127661	1% Critical Value*	-3.9810
		5% Critical Value	-3.4209
		10% Critical Value	-3.1329

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGBETC,2)
Method: Least Squares
Sample(adjusted): 7 496
Included observations: 490 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGBETC(-1))	-0.605114	0.074451	-8.127661	0.0000
D(LOGBETC(-1),2)	-0.048083	0.069967	-0.687219	0.4923
D(LOGBETC(-2),2)	-0.143968	0.063684	-2.260676	0.0242
D(LOGBETC(-3),2)	-0.035349	0.054191	-0.652302	0.5145
D(LOGBETC(-4),2)	-0.078532	0.045353	-1.731573	0.0840
C	-0.002838	0.001465	-1.936486	0.0534
@TREND(1)	7.46E-06	5.03E-06	1.482928	0.1387

R-squared	0.351464	Mean dependent var	1.22E-05
Adjusted R-squared	0.343407	S.D. dependent var	0.019119
S.E. of regression	0.015492	Akaike info criterion	-5.482810
Sum squared resid	0.115920	Schwarz criterion	-5.422889
Log likelihood	1350.288	F-statistic	43.62569
Durbin-Watson stat	2.005809	Prob(F-statistic)	0.000000

Linear dependence – ARMA(1,1)

Dependent Variable: LOGBETC
Method: Least Squares
Date: 06/21/00 Time: 14:07
Sample(adjusted): 2 496
Included observations: 495 after adjusting endpoints
Convergence achieved after 28 iterations
Backcast: 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AR(1)	0.999735	0.000149	6703.698	0.0000
MA(1)	0.354569	0.042117	8.418717	0.0000

R-squared	0.994927	Mean dependent var	6.316295
Adjusted R-squared	0.994917	S.D. dependent var	0.217279
S.E. of regression	0.015491	Akaike info criterion	-5.493087
Sum squared resid	0.118305	Schwarz criterion	-5.476099
Log likelihood	1361.539	F-statistic	96693.63
Durbin-Watson stat	1.995409	Prob(F-statistic)	0.000000

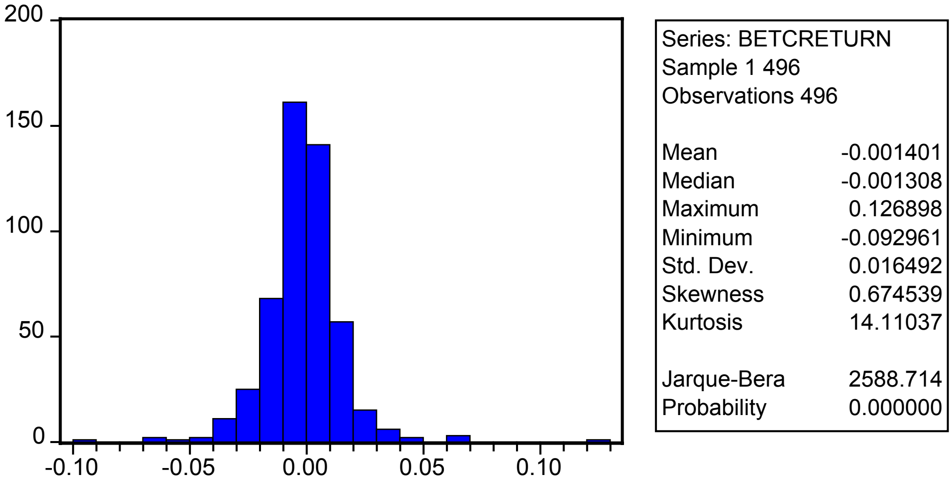
Inverted AR Roots	1.00
Inverted MA Roots	-.35

Nonlinear dependence GARCH(2,2)

Dependent Variable: BETCRETURN
Method: ML - ARCH
Sample(adjusted): 4 496
Included observations: 493 after adjusting endpoints
Convergence achieved after 30 iterations
Backcast: 3

	Coefficient	Std. Error	z-Statistic	Prob.
AR(2)	0.232879	0.052134	4.466965	0.0000
MA(1)	0.535703	0.046905	11.42094	0.0000
	Variance Equation			
C	7.99E-05	2.07E-05	3.858708	0.0001
ARCH(1)	0.617498	0.055781	11.06999	0.0000
ARCH(2)	0.270288	0.124595	2.169332	0.0301
GARCH(1)	-0.332439	0.154726	-2.148568	0.0317
GARCH(2)	0.220903	0.064907	3.403356	0.0007
R-squared	0.076346	Mean dependent var		-0.001617
Adjusted R-squared	0.064943	S.D. dependent var		0.016458
S.E. of regression	0.015915	Akaike info criterion		-5.824164
Sum squared resid	0.123097	Schwarz criterion		-5.764521
Log likelihood	1442.656	F-statistic		6.695178
Durbin-Watson stat	2.321493	Prob(F-statistic)		0.000001
Inverted AR Roots	.48	-.48		
Inverted MA Roots	-.54			

Distribution of returns:



According to the unit root test, BETC is an *I(1)* series. According to the linear dependence test, there is linear dependence between the returns. Also, BETC is a GARCH(2,2) process. The distribution of the returns in not Normal, but Leptokurtotik. So, the BETC series is not random walk.

2.1.3. RASDAQC Index

ADF Test

Level

ADF Test Statistic	-3.504723	1% Critical Value*	-3.9842
		5% Critical Value	-3.4224
		10% Critical Value	-3.1338

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGRASDAQC)
Method: Least Squares
Sample(adjusted): 6 421
Included observations: 416 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGRASDAQC(-1)	-0.050000	0.014267	-3.504723	0.0005
D(LOGRASDAQC(-1))	-0.227081	0.049070	-4.627689	0.0000
D(LOGRASDAQC(-2))	0.027667	0.050273	0.550332	0.5824
D(LOGRASDAQC(-3))	0.071748	0.050292	1.426642	0.1544
D(LOGRASDAQC(-4))	0.005371	0.048887	0.109859	0.9126
C	0.330091	0.094820	3.481243	0.0006
@TREND(1)	2.17E-06	7.99E-06	0.271225	0.7864

R-squared	0.092747	Mean dependent var	-0.000823
Adjusted R-squared	0.079438	S.D. dependent var	0.020202
S.E. of regression	0.019383	Akaike info criterion	-5.032113
Sum squared resid	0.153668	Schwarz criterion	-4.964289
Log likelihood	1053.679	F-statistic	6.968601
Durbin-Watson stat	1.999444	Prob(F-statistic)	0.000000

First difference:

ADF Test Statistic	-10.05960	1% Critical Value*	-3.9842
		5% Critical Value	-3.4224
		10% Critical Value	-3.1338

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGRASDAQC,2)
Method: Least Squares
Sample(adjusted): 7 421
Included observations: 415 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGRASDAQC(-1))	-1.295554	0.128788	-10.05960	0.0000
D(LOGRASDAQC(-1),2)	0.047048	0.115149	0.408580	0.6831
D(LOGRASDAQC(-2),2)	0.065977	0.099521	0.662947	0.5077
D(LOGRASDAQC(-3),2)	0.124486	0.078829	1.579180	0.1151
D(LOGRASDAQC(-4),2)	0.093458	0.049310	1.895293	0.0588
C	-0.002301	0.001978	-1.163287	0.2454
@TREND(1)	5.83E-06	8.06E-06	0.723761	0.4696

R-squared	0.628640	Mean dependent var	2.25E-05
Adjusted R-squared	0.623179	S.D. dependent var	0.031942
S.E. of regression	0.019608	Akaike info criterion	-5.009035
Sum squared resid	0.156865	Schwarz criterion	-4.941088
Log likelihood	1046.375	F-statistic	115.1106
Durbin-Watson stat	1.967785	Prob(F-statistic)	0.000000

Linear dependence – ARMA(1,1)

Dependent Variable: LOGRASDAQC
Method: Least Squares
Sample(adjusted): 2 421
Included observations: 420 after adjusting endpoints
Convergence achieved after 21 iterations
Backcast: 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AR(1)	0.999869	0.000111	8987.480	0.0000
MA(1)	-0.227423	0.047635	-4.774279	0.0000

R-squared	0.924188	Mean dependent var	6.631046
Adjusted R-squared	0.924007	S.D. dependent var	0.070936
S.E. of regression	0.019555	Akaike info criterion	-5.026448
Sum squared resid	0.159838	Schwarz criterion	-5.007208
Log likelihood	1057.554	F-statistic	5095.644
Durbin-Watson stat	2.035363	Prob(F-statistic)	0.000000
Inverted AR Roots	1.00		
Inverted MA Roots	.23		

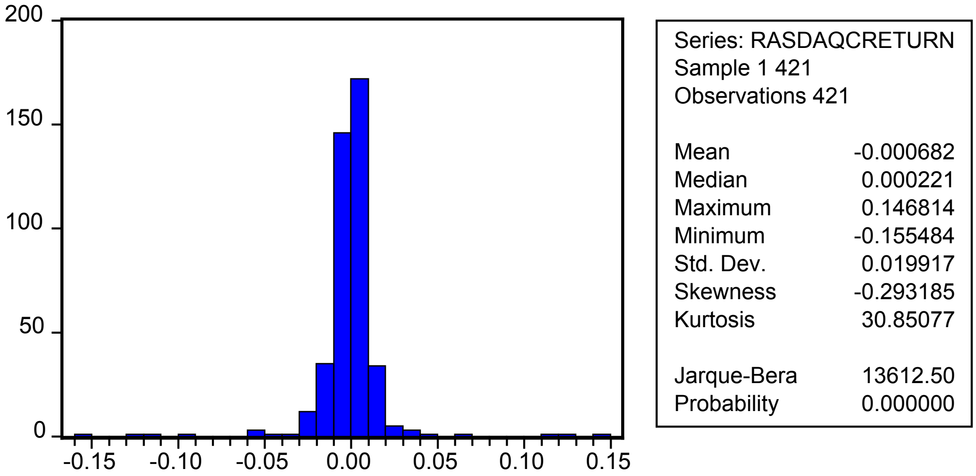
Nonlinear dependence GARCH(1,1)

Dependent Variable: RASDAQRETURN
Method: ML - ARCH
Sample(adjusted): 3 421
Included observations: 419 after adjusting endpoints
Convergence achieved after 39 iterations
Backcast: 2

	Coefficient	Std. Error	z-Statistic	Prob.
AR(1)	-0.736256	0.324897	-2.266120	0.0234
MA(1)	0.627347	0.344147	1.822905	0.0683
		Variance Equation		
C	8.42E-05	1.02E-05	8.295741	0.0000
ARCH(1)	0.374551	0.040243	9.307325	0.0000
GARCH(1)	0.513172	0.045388	11.30643	0.0000

R-squared	0.034994	Mean dependent var	-0.000831
Adjusted R-squared	0.025671	S.D. dependent var	0.020131
S.E. of regression	0.019871	Akaike info criterion	-5.343085
Sum squared resid	0.163476	Schwarz criterion	-5.294901
Log likelihood	1124.376	F-statistic	3.753251
Durbin-Watson stat	2.265926	Prob(F-statistic)	0.005174
Inverted AR Roots	-.74		
Inverted MA Roots	-.63		

Distribution of returns:



According to the unit root test, RASDAQC is an *I(1)* series with 5% significance level. According to the linear dependence test, there is linear dependence between the returns. Also, RASDAQC is a GARCH(1,1) process. The distribution of the returns in not Normal, but Leptokurtotik. So, the RASDAQC series is not random walk.

2.2. Implications of Nonrandom Walks

2.2.1. Volatility

If the stock prices do not follow a random walk, estimating volatility through a linear rescaling (the $T^{\frac{1}{2}}$) may be badly misleading. The table below[4] reports a quantification of the mistakes an investor could make if he or she estimates monthly risk on the basis of daily data.

Symbol	Daily volatility	Average day/month	Square root of time	Imply volatility	Monthly volatility	Relative difference
ALR	0.03175	21.5	4.6368092	0.147214	0.16122	**9.51%**
ARC	0.04834	21.5	4.6368092	0.224155	0.23512	**4.89%**
ATB	0.02209	21.5	4.6368092	0.10243	0.05093	**-50.28%**
AZO	0.04021	21.5	4.6368092	0.186455	0.25029	**34.24%**
DAC	0.02711	21.5	4.6368092	0.125708	0.13438	**6.90%**
ELJ	0.04549	21.5	4.6368092	0.210911	0.37179	**76.28%**
OIL	0.02777	21.5	4.6368092	0.12875	0.08637	**-32.92%**
OLT	0.04173	21.5	4.6368092	0.193472	0.21074	**8.93%**
PCL	0.04002	21.5	4.6368092	0.185588	0.09133	**-50.79%**
TLV	0.03283	21.5	4.6368092	0.15224	0.15926	**4.61%**

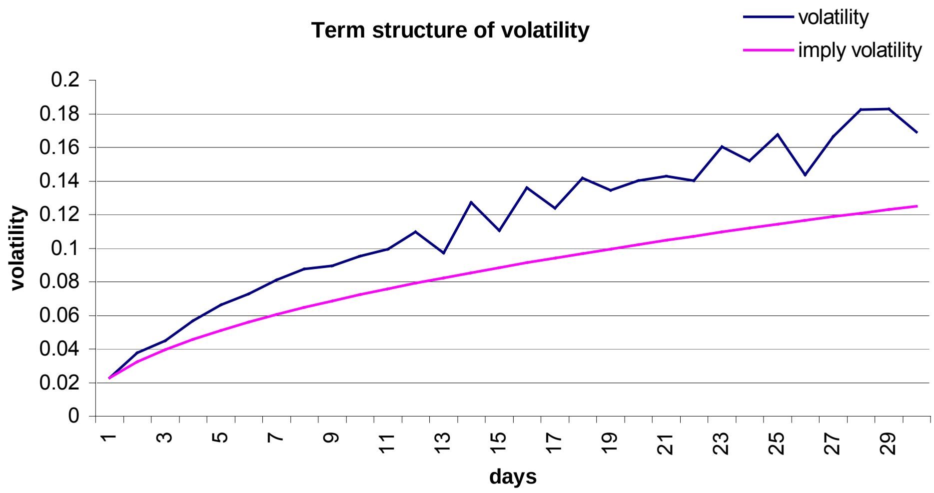
[4] For the testing were used ten of the most liquid companies traded on the Bucharest Stock Exchange in 1999

Imply volatility is the product between square root of time and daily volatility. Generally, imply volatility was lower than the observed volatility.

These findings show that, in short horizons, volatility scales at a faster rate than implied by the random walk, and the investors who mistakenly assuming that stock prices follow a random walk process will underestimate risk. These findings, also shows that volatility has a term structure. For the Bucharest Stock Exchange index – BET[5], the term structure of volatility is presented in the table below:

Day	Square root of time	Volatility	Imply volatility	Relative difference
1	1	0.022839	0.022839	0.0%
2	1.414214	0.037558	0.032299	16.3%
3	1.732051	0.044847	0.039558	13.4%
4	2	0.056939	0.045678	24.7%
5	2.236068	0.066378	0.05107	30.0%
6	2.44949	0.072752	0.055944	30.0%
7	2.645751	0.081103	0.060426	34.2%
8	2.828427	0.087581	0.064598	35.6%
9	3	0.089391	0.068517	30.5%
10	3.162278	0.095059	0.072223	31.6%
11	3.316625	0.09961	0.075748	31.5%
12	3.464102	0.109711	0.079117	38.7%
13	3.605551	0.097277	0.082347	18.1%
14	3.741657	0.127237	0.085456	48.9%
15	3.872983	0.110499	0.088455	24.9%
16	4	0.135982	0.091356	48.8%
17	4.123106	0.123953	0.094168	31.6%
18	4.242641	0.141826	0.096898	46.4%
19	4.358899	0.134555	0.099553	35.2%
20	4.472136	0.140225	0.102139	37.3%
21	4.582576	0.142876	0.104661	36.5%
22	4.690416	0.14014	0.107124	30.8%
23	4.795832	0.160443	0.109532	46.5%
24	4.898979	0.151969	0.111888	35.8%
25	5	0.16746	0.114195	46.6%
26	5.09902	0.143771	0.116457	23.5%
27	5.196152	0.166298	0.118675	40.1%
28	5.291503	0.182565	0.120853	51.1%
29	5.385165	0.182895	0.122992	48.7%
30	5.477226	0.169121	0.125094	35.2%

[5] For analisys were used the daily average values of the BET index between 09/22/1997 – 04/28/2000



2.2.2. Betas

The table below reports observed betas for the most liquid companies on the Bucharest Stock Exchange computed on the basis on both daily data and monthly data. Under the random walk hypothesis, the betas should be independent from the frequency of the data used to compute them. However, the table shows that, generally, monthly betas are larger than daily betas. Hence, use of daily data to compute monthly betas will lead investors to underestimate the systematic risk.

Symbol	Daily beta	Monthly beta	Relative difference
ALR	1.511494	1.82895941	21.00%
ARC	1.442529	2.2319071	54.72%
ATB	0.317241	0.43849276	38.22%
AZO	0.856322	2.05233165	139.67%
DAC	0.781609	0.77061367	-1.41%
ELJ	0.274138	2.63914173	862.71%
OIL	0.479885	-0.0050161	-101.05%
OLT	1.051724	1.99275122	89.47%
PCL	0.913793	0.4725385	-48.29%
TLV	0.775862	1.25808334	62.15%

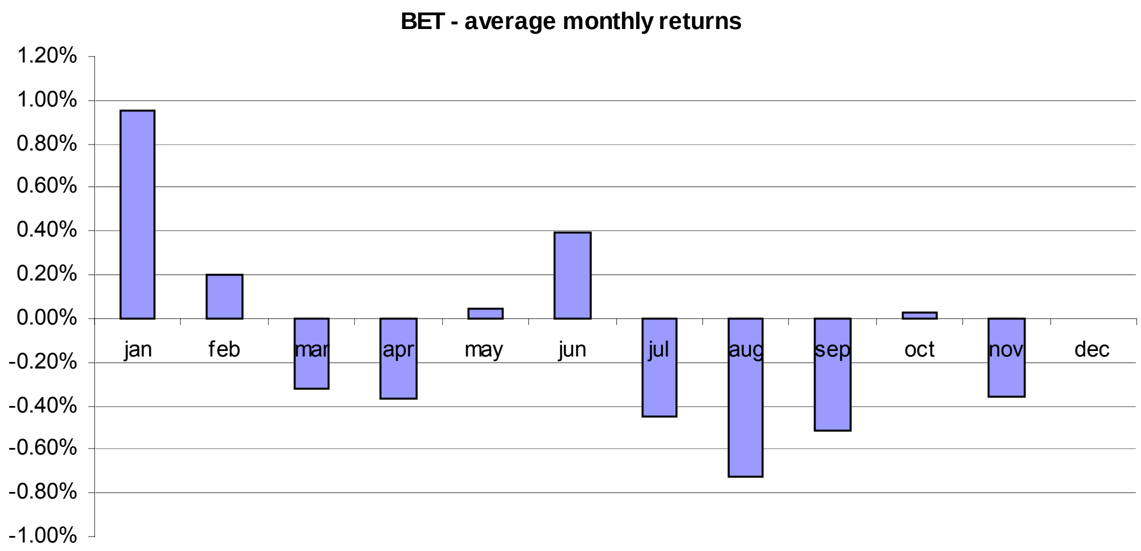
3. Tests of the Weak Form of Market Efficiency

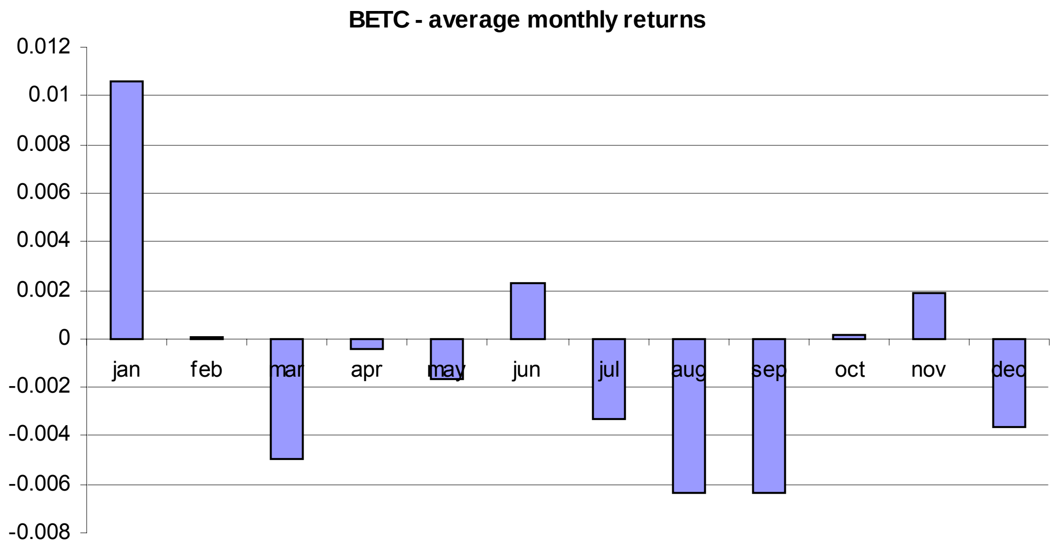
3.1. Seasonality of Returns

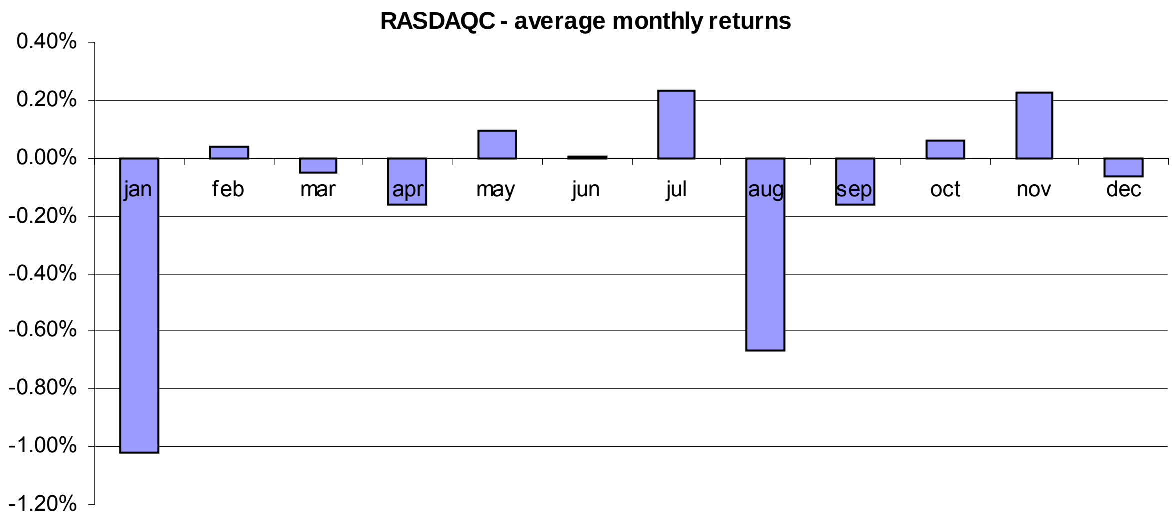
If the random walk hypothesis is valid, there should not be any consistent patterns in security returns. Some studies detect evidence of systematic patterns in stock returns. In the pictures below are presented the January Effect and the Weekly Effect for the Romanian capital market.

The January Effect refers to the fact that stock returns in January are greater than returns in other months. An explanation of that fact is tax-selling hypothesis: in December, individuals sell stocks that have declined in value during the year in order to realize a capital loss for tax purposes. Then, in January they reinvest their money, the demand rises and the returns are greater. But, this effect appeared in some countries with different tax legislation.

For the Bucharest Stock Exchange indexes (BET, BETC) and for the OTC market index (RASDAQC) the average monthly returns are shown below:



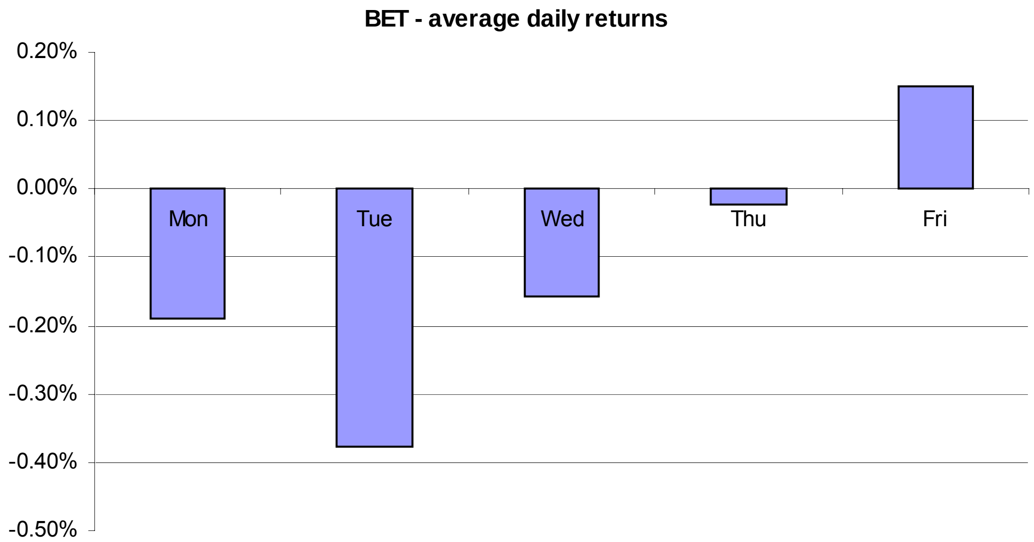


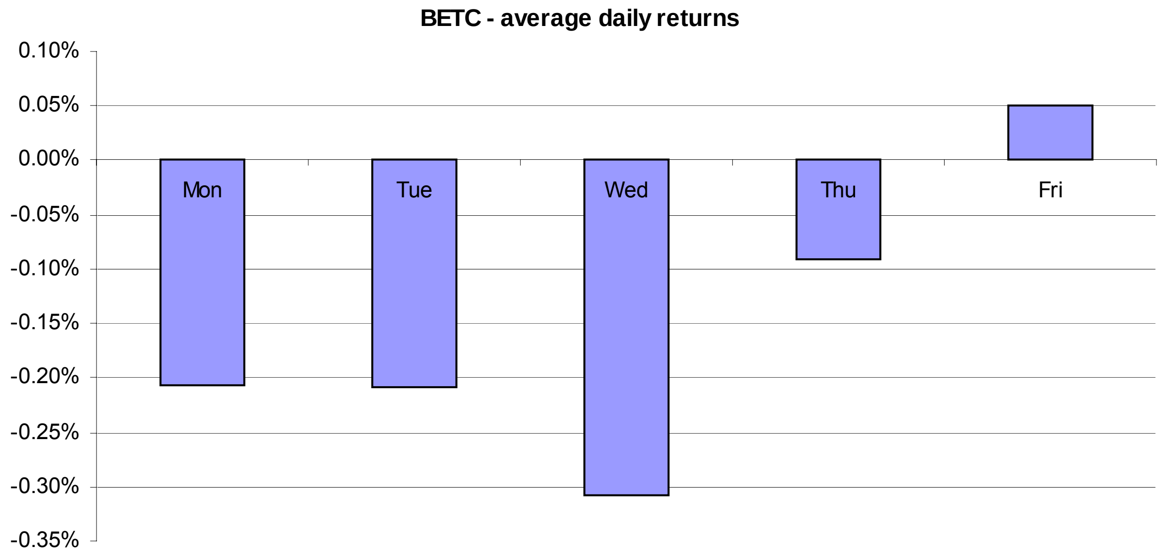


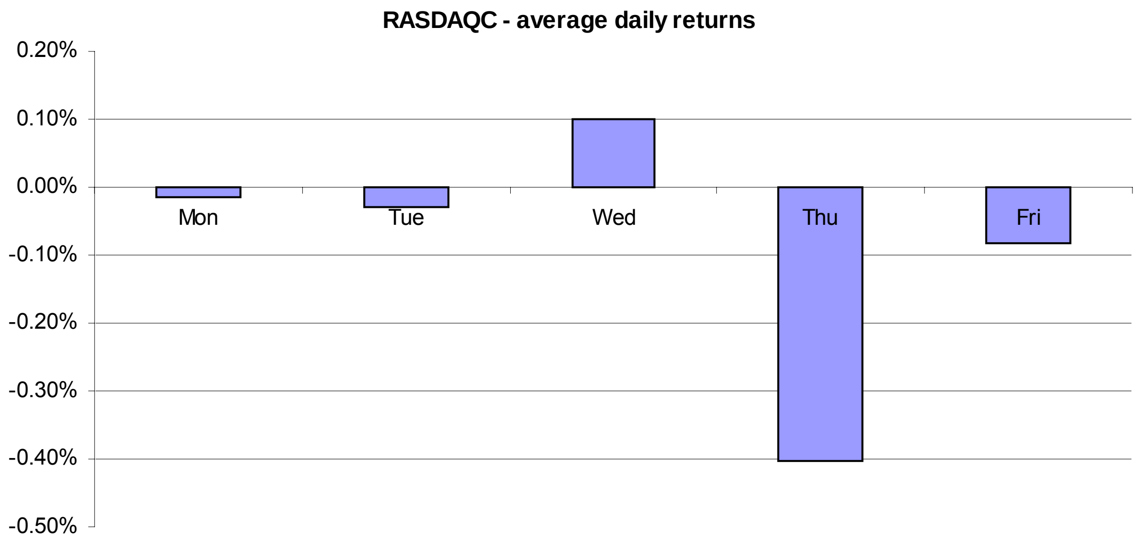
Although, the tax legislation is different from the countries in which the January Effect was discovered, there is a January Effect on the Bucharest Stock Exchange. But, on the OTC market, the January returns are the lower than any other month of the year.

The Weekly Effects refers to the unusual behavior of the stock returns on Monday versus other days of the week. On the evolved capital markets, evidence shows that Monday stock returns are substantially lower, on average, than those on other days of the week. An explanation is that firms release the bad news to the public on Friday.

The average daily return for the Romanian capital market are presented below:







On the Bucharest Stock Exchange the lowest return are in the first days of the week, but on the OTC market on Thursday.

3.2. Tests of the Trading Rules

Another group of tests of the weak form are the test of the trading rules. Advocates of an efficient market hypothesized that investors using any technical trading rule could not derive rates of return greater than returns from any buy and hold policy if the trading rule depended only on past market information. In a trading rule test, a simple buy and hold strategy is compared with the investment results of a trading rule simulation.

3.2.1. Tests of the Filter Rules

A filter rule is a mathematical rule that can be applied to produce buy and sell signals. In a filter rule, the stock is traded when its price change exceeds the filter set for it.

One type of filter rule: assuming an *x%* filter, when the stock price has risen *x%* from some base, the technical analyst thinks that this movement indicates a breakout, meaning that stock prices will continue to rise (so technical traders would acquire the stock to take advantage of the rise). An *x%* decline for some peak price would be a breakout on the downside, meaning the prices will continue to decline (so traders would sell the stock acquired previously). In the table below are the returns of the trading rules (applied on the most liquid shares traded on the Bucharest Stock Exchange in 1999) for a range of filters from 2% to 10%. The trading commission is set to 0.5%.

Symbol	Buy and hold	2%	3%	4%	5%	6%	7%	8%	9%	10%
ALR	89%	69%	50%	40%	23%	19%	30%	28%	28%	29%
ARC	12%	4%	10%	13%	1%	1%	6%	2%	7%	17%
ATB	-8%	-3%	-3%	-8%	-8%	-13%	-24%	-26%	-27%	-17%
AZO	120%	167%	164%	171%	184%	184%	141%	126%	110%	110%
DAC	20%	40%	43%	41%	37%	31%	29%	18%	25%	21%
ELJ	-41%	-46%	-45%	-34%	-41%	-39%	-34%	-34%	-42%	-39%
OIL	21%	17%	17%	11%	11%	11%	11%	11%	10%	10%
OLT	-12%	24%	22%	26%	30%	40%	25%	25%	25%	25%
PCL	-7%	-42%	-52%	-51%	-48%	-53%	-56%	-60%	-52%	-53%
TLV	5%	17%	9%	12%	-2%	1%	1%	1%	5%	4%
BETC	**2%**	**3%**	**4%**	**3%**	**1%**	**-4%**	**-4%**	**5%**	**2%**	**4%**
Average	**20%**	**25%**	**21%**	**22%**	**19%**	**18%**	**13%**	**9%**	**9%**	**11%**

The returns of the 2%, 3% and 4% filter are above the returns of a buy and hold strategy. This means that the market is not efficient in the weak form.

3.2.1. Tests of Moving Average Rules

The moving average rule is: if the stock's price moves above its moving average by *x%*, buy and hold until the price moves *x%* below its moving average and then sell.

In the tables below are the returns of the different moving average rules (applied on the most liquid shares traded on the Bucharest Stock Exchange in 1999) for 60, 100, 150 and 200-day moving average and a range of filters from 2% to 10%. The trading commission is set to 0.5%.

60-day moving average rule:

Symbol	Buy and hold	2%	3%	4%	5%	6%	7%	8%	9%	10%
ALR	89%	41%	47%	42%	42%	41%	23%	20%	20%	20%
ARC	31%	56%	49%	60%	50%	12%	9%	6%	4%	24%
ATB	1%	-16%	-19%	-29%	-24%	-14%	-1%	-1%	-1%	-13%
AZO	122%	113%	107%	130%	122%	122%	122%	122%	120%	160%
DAC	22%	-25%	-23%	-28%	-6%	-7%	-11%	-16%	-16%	-20%
ELJ	-40%	-2%	-3%	-6%	-7%	-9%	-9%	-13%	-14%	-14%
OIL	25%	-18%	-10%	-22%	-24%	-16%	-11%	-13%	-13%	-15%
OLT	-8%	43%	41%	47%	44%	44%	42%	40%	27%	27%
PCL	-7%	-34%	-34%	-35%	-36%	-44%	-45%	-37%	-35%	-43%
TLV	7%	-5%	11%	11%	15%	-10%	-11%	-13%	-13%	9%
BET	**31%**	**2%**	**4%**	**9%**	**4%**	**16%**	**14%**	**8%**	**6%**	**6%**
Average	**24%**	**15%**	**17%**	**17%**	**18%**	**12%**	**11%**	**10%**	**8%**	**13%**

100-day moving average rule:

Symbol	Buy and hold	2%	3%	4%	5%	6%	7%	8%	9%	10%
ALR	89%	50%	37%	36%	28%	28%	23%	23%	22%	17%
ARC	31%	36%	45%	44%	36%	36%	35%	28%	32%	23%
ATB	1%	-19%	-10%	-10%	0%	-3%	-7%	-10%	-10%	-16%
AZO	122%	127%	127%	105%	105%	135%	135%	135%	135%	129%
DAC	22%	-7%	-8%	-11%	-18%	-22%	-9%	-9%	-9%	-12%
ELJ	-40%	-12%	-9%	-11%	-13%	-14%	-14%	-18%	-18%	-2%
OIL	25%	-34%	-36%	-30%	-34%	-28%	-2%	-2%	-2%	-2%
OLT	-8%	16%	27%	30%	29%	23%	23%	23%	12%	8%
PCL	-7%	-30%	-25%	-27%	-34%	-34%	-38%	-23%	-24%	-5%
TLV	7%	26%	26%	26%	9%	9%	9%	9%	-9%	-9%
BET	**31%**	**12%**	**8%**	**6%**	**3%**	**1%**	**13%**	**10%**	**6%**	**6%**
Average	**24%**	**15%**	**17%**	**15%**	**11%**	**13%**	**16%**	**16%**	**13%**	**13%**

150-day moving average rule:

Symbol	Buy and hold	2%	3%	4%	5%	6%	7%	8%	9%	10%
ALR	89%	38%	44%	60%	60%	43%	43%	37%	36%	28%
ARC	31%	47%	44%	39%	34%	13%	13%	9%	9%	9%
ATB	1%	-11%	-12%	-16%	-16%	-21%	-24%	-11%	-15%	-15%
AZO	122%	125%	125%	121%	121%	121%	107%	107%	107%	107%
DAC	22%	-13%	-16%	-20%	-10%	0%	0%	-3%	-3%	-6%
ELJ	-40%	-21%	-20%	-13%	-2%	-2%	-2%	-2%	-2%	-2%
OIL	25%	-23%	-30%	-35%	-41%	-10%	-4%	-4%	-4%	-15%
OLT	-8%	-7%	-22%	-22%	-12%	-2%	-2%	-2%	-2%	-2%
PCL	-7%	-21%	-17%	-17%	-17%	-24%	-18%	-18%	-17%	-17%
TLV	7%	-18%	-13%	-13%	-5%	-5%	-3%	-10%	-10%	-10%
BET	**31%**	**23%**	**19%**	**17%**	**12%**	**8%**	**8%**	**3%**	**3%**	**29%**
Average	**24%**	**9%**	**8%**	**8%**	**11%**	**11%**	**11%**	**10%**	**10%**	**8%**

200-day moving average rule:

Symbol	Buy and hold	2%	3%	4%	5%	6%	7%	8%	9%	10%
ALR	89%	68%	68%	68%	68%	68%	66%	68%	68%	68%
ARC	31%	17%	16%	16%	16%	13%	13%	13%	13%	9%
ATB	1%	-12%	-16%	-20%	-24%	-25%	-29%	-29%	-28%	-15%
AZO	122%	103%	103%	95%	95%	95%	95%	87%	87%	87%
DAC	22%	-9%	-4%	-4%	10%	1%	1%	1%	21%	21%
ELJ	-40%	-2%	-2%	-2%	-2%	-2%	-2%	-2%	-2%	-26%
OIL	25%	-28%	-25%	-19%	-28%	-29%	-24%	-28%	-28%	-8%
OLT	-8%	-2%	-2%	-2%	-2%	-2%	-2%	-2%	-2%	-2%
PCL	-7%	-20%	-26%	-27%	-38%	-28%	-34%	-34%	-34%	-34%
TLV	7%	-10%	-10%	-10%	-10%	-10%	-12%	-12%	-12%	-14%
BET	**31%**	**35%**	**35%**	**35%**	**31%**	**31%**	**31%**	**27%**	**27%**	**27%**
Average	**24%**	**11%**	**10%**	**10%**	**9%**	**8%**	**7%**	**6%**	**8%**	**9%**

The returns of the moving average rules are below the returns of a buy and hold strategy, and, according to this test a trader cannot obtain higher than average profits using moving average rules.

4. Tests of the Semi-strong Form of Market Efficiency

4.1. The Response of Stock Prices to the Announcement of a Stock Split

The methodology for studying the response of stock prices to the announcement of a stock split was employed for the first time by Fama, Fisher, Jensen and Roll (FFJR) in 1969. According to the CAPM, stock returns are affected by both aggregate-market and company-unique information. In an attempt to isolate that part of a security's return, which was unique, to company events alone, FFJR examined the residual errors from the market model: $\tilde{R}_t = a + b(\tilde{R}\tilde{M}) + \tilde{e}_t$, where $\tilde{R}_t$ is the return on day *t*; *a* is the constant average daily return; *b* – the beta estimate for the stock; $\tilde{R}\tilde{M}_t$ **-** the return of the aggregate market portfolio during period *t* and $\tilde{e}_t$ - the residual error in period *t*, the proportion of the return due to firm-unique events. Estimates of *a* and *b* can be developed using a regression equation relating stock's historical return to historical market return. The $\tilde{e}_t$ values for each stock split during the period before the stock split and after the stock split, are calculated by using estimates of the *a*'s and *b*'s. Then, the average market model residual in month *t* is calculated: $AR_t = \frac{\sum_{i=1}^{N} e_{i,t}}{N}$, where AR_t is the average firm-unique return for month *t*. Second, a cumulative average firm-unique return (*CAR*) was calculated for each month: $CAR_t = \sum_{K=-29}^{t} AR_K$ **.**

Testing virtually all splits on the United States capital market between 1927 and 1959, FFJR found that: (1) Stocks that split appear to have had a dramatic increase in price during the 29 months prior to the split. This is reflected in the substantial growth in the *CAR* prior to the split date. However, these price increases cannot be attributed to the eventual split, since rarely was a split announced more than four months prior to the effective date of the split. (2) After the split date, the *CAR* is remarkably stable. This implies that from the split date forward, firm-unique returns were zero. The split had no immediate or long run impact on security prices.

On the Bucharest Stock Exchange, only four stock splits took place (companies Banca Agricola, Impact and Imsat split their shares). The cumulative average firm-unique returns are presented below. According to these tests, Romanian capital market is not semi-strong form efficient.

Banca Agricola (AGR)[6]

The stock split took place on September 29, 1999.

Regression $\tilde{R}_t = a + b\left(\tilde{R}\tilde{M}\right) + \tilde{e}_t$ before the stock split:

Dependent Variable: AGRRET
Method: Least Squares
Sample: 1 203
Included observations: 203
AGRRET=C(1)+C(2)*BETCRET

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.003149	0.004755	-0.662288	0.5085
C(2)	1.157502	0.392959	2.945601	0.0036

R-squared	0.041381	Mean dependent var	-0.001970
Adjusted R-squared	0.036611	S.D. dependent var	0.068773
S.E. of regression	0.067503	Akaike info criterion	-2.543499
Sum squared resid	0.915876	Schwarz criterion	-2.510856
Log likelihood	260.1651	F-statistic	8.676566
Durbin-Watson stat	1.547148	Prob(F-statistic)	0.003604

Regression $\tilde{R}_t = a + b\left(\tilde{R}\tilde{M}\right) + \tilde{e}_t$ after the stock split:

Dependent Variable: AGRRET
Method: Least Squares
Sample: 1 72
Included observations: 72
AGRRET=C(1)+C(2)*BETCRET

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.013676	0.021884	-0.624919	0.5341
C(2)	2.582281	1.021827	2.527122	0.0138

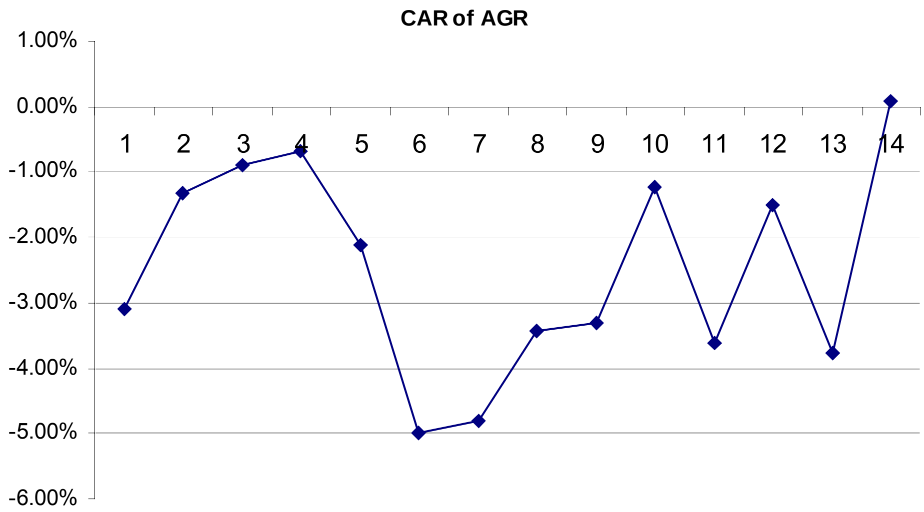
R-squared	0.083606	Mean dependent var	-0.015694
Adjusted R-squared	0.070514	S.D. dependent var	0.192477
S.E. of regression	0.185567	Akaike info criterion	-0.503420
Sum squared resid	2.410451	Schwarz criterion	-0.440179
Log likelihood	20.12310	F-statistic	6.386344
Durbin-Watson stat	1.925152	Prob(F-statistic)	0.013762

Table of average firm-unique return (*AR*) and cumulative average firm-unique return (*CAR*):

Month	AR	CAR
1	-3.09%	-3.09%
2	1.76%	-1.34%
3	0.44%	-0.90%
4	0.21%	-0.69%
5	-1.44%	-2.13%
6	-2.86%	-4.99%
7	0.18%	-4.81%
8	1.37%	-3.45%
9	0.14%	-3.31%
10	2.09%	-1.22%

[6] For the calculation of the *CAR* were used the daily average prices between December 1998 – January 2000

11	-2.40%	-3.62%
12	2.11%	-1.51%
13	-2.25%	-3.76%
14	3.84%	0.08%



The stock split took place in the tenth month. Before the split, the CAR rose, and after the split CAR fluctuated, but in a certain limits. The evolution of CAR after the split may not contradict the efficient market hypothesis.

Imsat (IMS)[7]

The stock split took place on the February 28, 2000.

Regression $\tilde{R}_t = a + b\left(\tilde{R}\tilde{M}\right) + \tilde{e}_t$ before the stock split:

Dependent Variable: RETIMS
Method: Least Squares
Sample: 1 462
Included observations: 462
RETIMS=C(1)+C(2)*RETBETC

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.001226	0.001977	0.620078	0.5355
C(2)	0.608058	0.117989	5.153516	0.0000

R-squared	0.054585	Mean dependent var	0.000541
Adjusted R-squared	0.052530	S.D. dependent var	0.043566
S.E. of regression	0.042406	Akaike info criterion	-3.478733
Sum squared resid	0.827205	Schwarz criterion	-3.460830
Log likelihood	805.5873	F-statistic	26.55872
Durbin-Watson stat	1.822244	Prob(F-statistic)	0.000000

[7] For the calculation of the *CAR* were used the daily average prices between April 1998 – April 2000

Regression $\tilde{R}_t = a + b(\tilde{R}\tilde{M}) + \tilde{e}_t$ after the stock split:

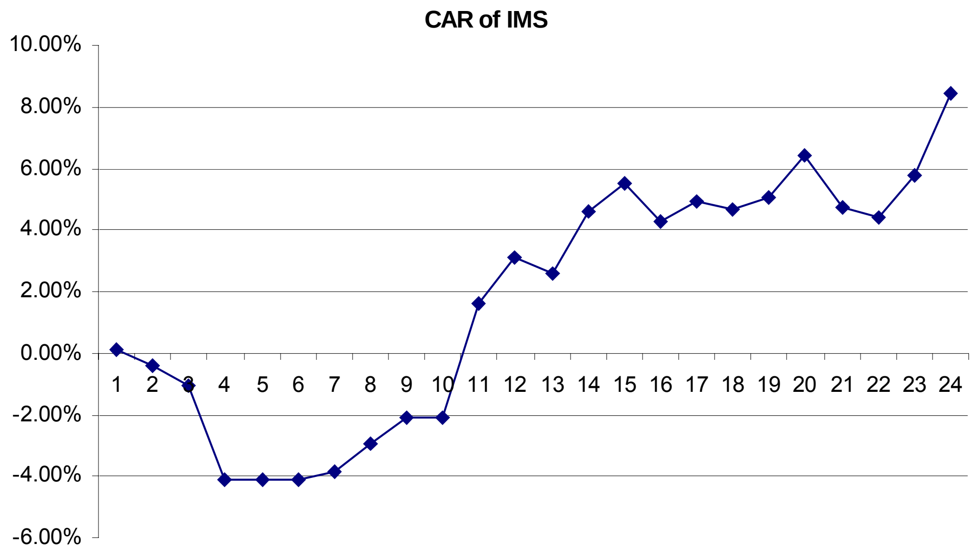
Dependent Variable: RETIMS
Method: Least Squares
Sample: 1 41
Included observations: 41
RETIMS=C(1)+C(2)*RETBETC

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.033504	0.021927	-1.527958	0.1346
C(2)	-2.206194	1.868443	-1.180766	0.2448

R-squared	0.034515	Mean dependent var	-0.023902
Adjusted R-squared	0.009759	S.D. dependent var	0.131032
S.E. of regression	0.130391	Akaike info criterion	-1.189007
Sum squared resid	0.663071	Schwarz criterion	-1.105418
Log likelihood	26.37463	F-statistic	1.394210
Durbin-Watson stat	1.231332	Prob(F-statistic)	0.244847

Table of average firm-unique return (*AR*) and cumulative average firm-unique return (*CAR*):

Month	AR	CAR
1	0.11%	0.11%
2	-0.49%	-0.38%
3	-0.66%	-1.03%
4	-3.06%	-4.10%
5	-0.05%	-4.14%
6	0.06%	-4.09%
7	0.21%	-3.87%
8	0.91%	-2.97%
9	0.87%	-2.10%
10	0.02%	-2.08%
11	3.69%	1.61%
12	1.52%	3.12%
13	-0.56%	2.56%
14	2.04%	4.60%
15	0.88%	5.49%
16	-1.18%	4.31%
17	0.65%	4.96%
18	-0.29%	4.66%
19	0.40%	5.07%
20	1.36%	6.42%
21	-1.67%	4.75%
22	-0.32%	4.43%
1	1.35%	5.78%
2	2.68%	8.46%



Stock split took place in the twentysecond month. After the split, *CAR* raised, which contradicts the efficient market hypothesis. A possible explanation is that the company took the decision to split the shares in order to make the shares more accessible to the general public.

Impact (IMP)[8]

The stock splits took place on August 3 1998 and November 9 1999.

Regression $\tilde{R}_t = a + b\left(\tilde{R}\tilde{M}\right) + \tilde{e}_t$ before the stock split on August 3 1998:

Dependent Variable: IMPRET
Method: Least Squares
Sample: 1 72
Included observations: 72
IMPRET=C(1)+C(2)*BETCRET

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.007767	0.008877	0.874989	0.3846
C(2)	-0.039614	0.590403	-0.067097	0.9467

R-squared	0.000064	Mean dependent var	0.007926
Adjusted R-squared	-0.014220	S.D. dependent var	0.072094
S.E. of regression	0.072604	Akaike info criterion	-2.380196
Sum squared resid	0.368999	Schwarz criterion	-2.316955
Log likelihood	87.68705	F-statistic	0.004502
Durbin-Watson stat	2.940102	Prob(F-statistic)	0.946696

[8] For the calculation of the *CAR* were used the daily average prices between April 1998 – April 2000

Regression $\tilde{R}_t = a + b(\tilde{R}\tilde{M}) + \tilde{e}_t$ between August 3 1998 and November 9 1999:

Dependent Variable: IMPRET
Method: Least Squares
Sample: 1 327
Included observations: 327
IMPRET=C(1)+C(2)*BETCRET

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.002394	0.004248	0.563519	0.5735
C(2)	0.095726	0.257892	0.371185	0.7107

R-squared	0.000424	Mean dependent var	0.002283
Adjusted R-squared	-0.002652	S.D. dependent var	0.076528
S.E. of regression	0.076630	Akaike info criterion	-2.293562
Sum squared resid	1.908445	Schwarz criterion	-2.270382
Log likelihood	376.9974	F-statistic	0.137778
Durbin-Watson stat	1.904382	Prob(F-statistic)	0.710742

Regression $\tilde{R}_t = a + b(\tilde{R}\tilde{M}) + \tilde{e}_t$ after November 9 1999:

Dependent Variable: IMPRET
Method: Least Squares
Sample: 1 104
Included observations: 104
IMPRET=C(1)+C(2)*BETCRET

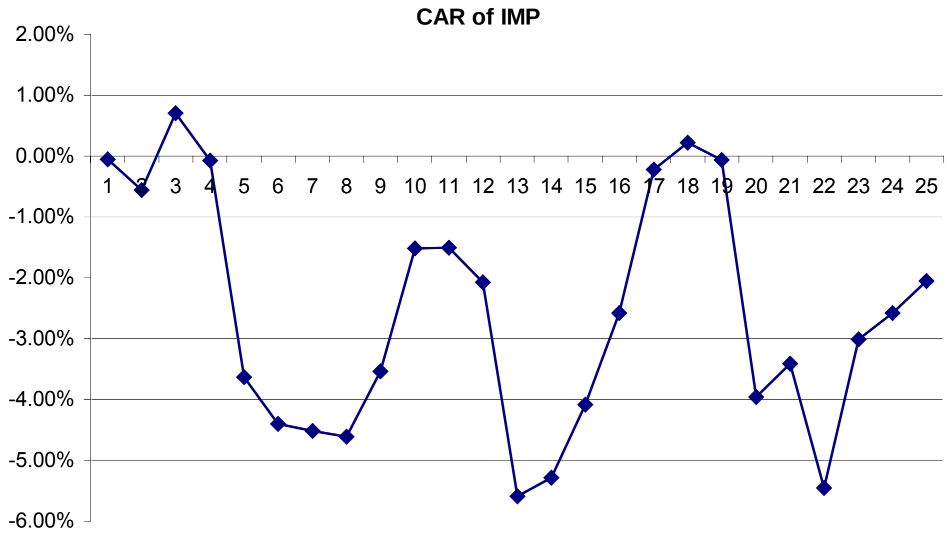
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.005716	0.010184	-0.561320	0.5758
C(2)	0.621094	0.595752	1.042537	0.2996

R-squared	0.010543	Mean dependent var	-0.005870
Adjusted R-squared	0.000843	S.D. dependent var	0.103888
S.E. of regression	0.103844	Akaike info criterion	-1.672803
Sum squared resid	1.099933	Schwarz criterion	-1.621949
Log likelihood	88.98575	F-statistic	1.086884
Durbin-Watson stat	2.041920	Prob(F-statistic)	0.299627

Table of average firm-unique return (*AR*) and cumulative average firm-unique return (*CAR*):

Month	AR	CAR
1	-0.05%	-0.05%
2	-0.51%	-0.56%
3	1.26%	0.71%
4	-0.78%	-0.08%
5	-3.55%	-3.63%
6	-0.77%	-4.40%
7	-0.11%	-4.51%
8	-0.09%	-4.61%
9	1.07%	-3.54%
10	2.02%	-1.52%
11	0.01%	-1.50%
12	-0.57%	-2.08%
13	-3.52%	-5.59%
14	0.30%	-5.29%
15	1.21%	-4.08%
16	1.51%	-2.57%
17	2.35%	-0.22%

18	0.45%	0.22%
19	-0.29%	-0.07%
20	-3.89%	-3.96%
21	0.55%	-3.41%
22	-2.05%	-5.45%
23	2.44%	-3.01%
24	0.44%	-2.58%
25	0.53%	-2.05%

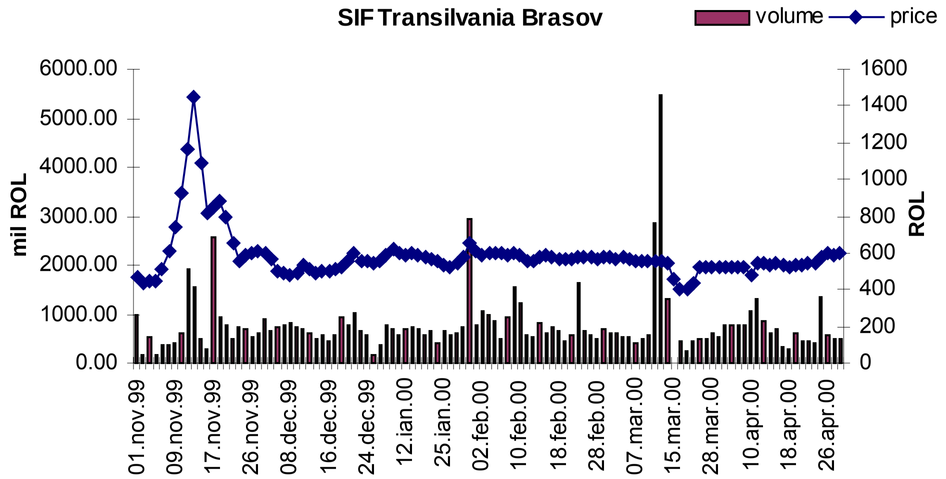


Splits took place in the fourth month and in the nineteenth month. After the first stock split, *CAR* decreased and after the second split the *CAR* raised. Both reactions contradict the efficient market hypothesis.

4.2. The Response of the Stock Prices after a New Company is listed on a Stock Exchange

Another economic event that is expected to have a significant impact on a firm and its stock is the decision to become listed on a national exchange. There are two questions of interest. First, does the listing on a major exchange permanently increase the value of the firm? Second, given the change in expectations or perceptions surrounding the listing, it is possible to derive abnormal returns from investing in the stock at the time of actual listing? According to the efficient market hypothesis, an investor cannot obtain abnormal profits from this event.

In the pictures below is shown the evolution of the share price of five ”Financial Investment Companies (SIF)” after their listing on the Bucharest Stock Exchange. Those companies are closed end funds, and because of that, the “real” value of their stocks is easy to estimate, because their portfolio is accessible to the general public.


SIF Transilvania Brasov
volume
price
mil ROL
ROL
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
1600
1400
1200
1000
800
600
400
200
0
01.nov.99
09.nov.99
17.nov.99
26.nov.99
08.dec.99
16.dec.99
24.dec.99
12.ian.00
25.ian.00
02.feb.00
10.feb.00
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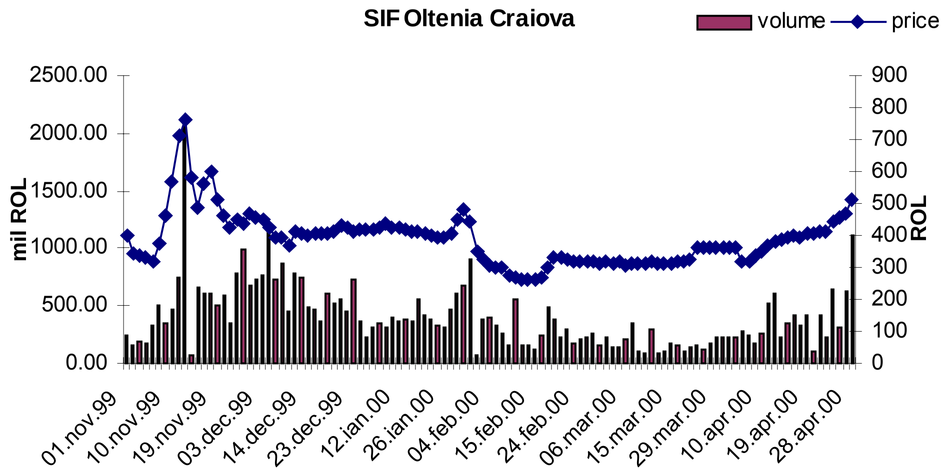
18.apr.00
26.apr.00


SIF Oltenia Craiova
volume
price
mil ROL
ROL
2500.00
2000.00
1500.00
1000.00
500.00
0.00
900
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700
600
500
400
300
200
100
0
01.nov.99
10.nov.99
19.nov.99
03.dec.99
14.dec.99
23.dec.99
12.ian.00
26.ian.00
04.feb.00
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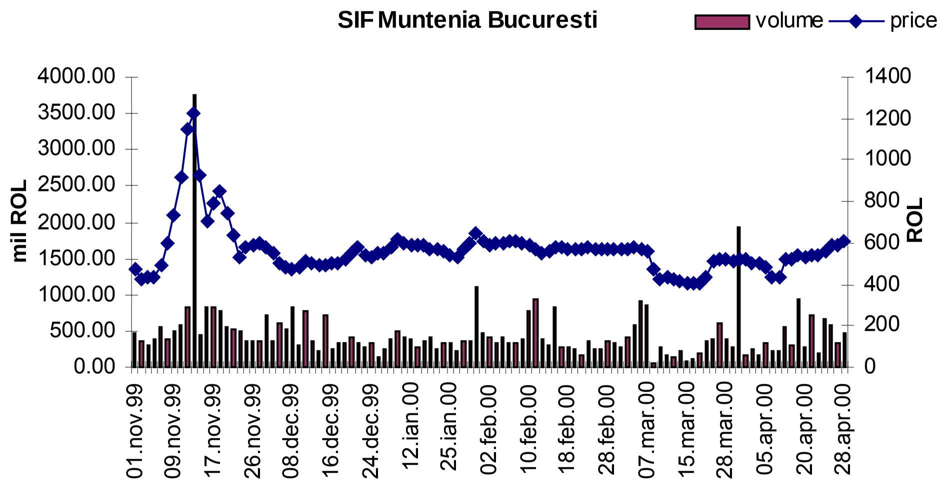
19.apr.00
28.apr.00


SIF Muntenia Bucuresti
volume
price
mil ROL
ROL
4000.00
3500.00
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2500.00
2000.00
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500.00
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1400
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01.nov.99
09.nov.99
17.nov.99
26.nov.99
08.dec.99
16.dec.99
24.dec.99
12.ian.00
25.ian.00
02.feb.00
10.feb.00
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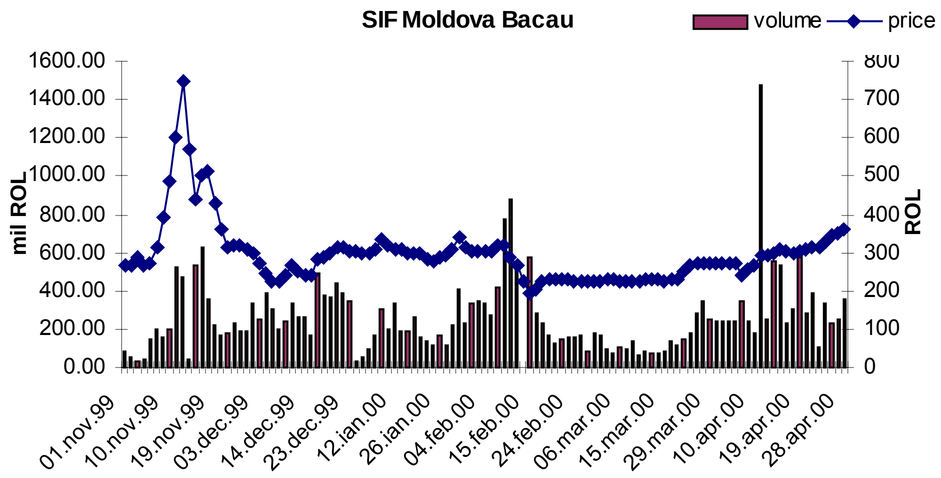
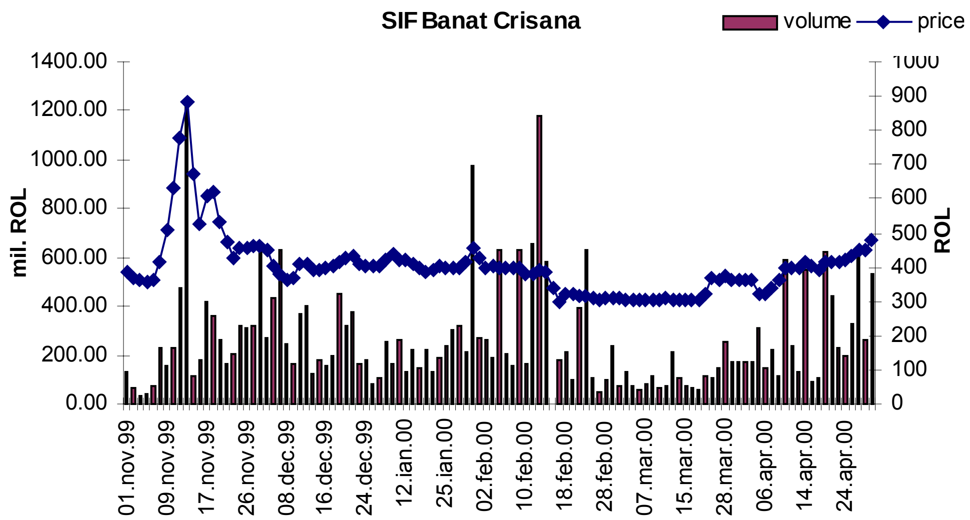
20.apr.00
28.apr.00





After the listing, the stock price of all companies rose sharply, and then it decreased sharply and became stable. These events suggest that it was an over-reaction of the market, which contradicts the semi-strong form of market efficiency. The abnormal price changes could generate large abnormal profits (after taking into account the transaction costs), which also contradict the semi-strong form of market efficiency.

5. Tests of the Strong Form of Market Efficiency

One category of individuals who could have monopolistic access to the information, and their investment performance can be measured are portfolio managers. If the strong form of market efficiency is valid, the return of a mutual fund cannot exceed the return of a buy and hold strategy.

For testing the strong form of market efficiency for the Romanian capital market, I compared the performance of the mutual funds in 1999 with the return of a buy and hold strategy. The excess return is the difference between the realized returns of the mutual funds and the return of a buy and hold strategy. If the excess return is significant and positive, the portfolio managers could have monopolistic access to information.

The mutual funds used were:

- Active Clasic
- Active Dinamic
- Active Junior
- Ardaf
- Armonia
- Capital Plus
- FCE
- FIDE
- Fortuna Clasic
- Stabilo
- Tezaur
- Transilvania

Aggregate portfolio structure of mutual funds:

Month	Cash (%)	Treasury Bonds (%)	Deposits (%)	Stocks (%)	Other instruments (%)
Jan	1.4577	21.5459	63.8073	2.8093	10.3797
Feb	1.1318	30.7556	50.8695	2.3329	14.8923
Mar	2.0294	45.5122	40.0638	2.4652	9.9420
Apr	4.0792	45.0512	36.9476	1.7918	12.1302
May	8.6513	61.4811	25.1148	1.6090	3.1436
Jun	2.2765	72.5609	21.0963	0.8443	3.2351
Jul	1.7773	73.4176	20.8656	0.6262	3.3142
Aug	2.1870	74.5352	20.2917	0.5424	2.4323
Sep	1.1402	65.2318	29.6013	0.3995	3.6387
Oct	0.7547	69.9136	21.1069	0.5076	7.7314
Nov	0.6126	69.7395	19.9723	0.5790	9.0966
Dec	0.6954	74.2801	13.3261	0.5508	11.3631

Mutual funds aggregate realized return:

Month	Monthly realized return	Annualized return
Jan	4.3974%	68%
Feb	6.0743%	103%
Mar	7.2286%	131%
Apr	7.0861%	127%
May	7.3352%	134%
Jun	7.1895%	130%
Jul	6.6706%	117%
Aug	5.5318%	91%
Sep	4.4416%	68%
Oct	3.9377%	59%
Nov	3.6605%	54%
Dec	4.0573%	61%

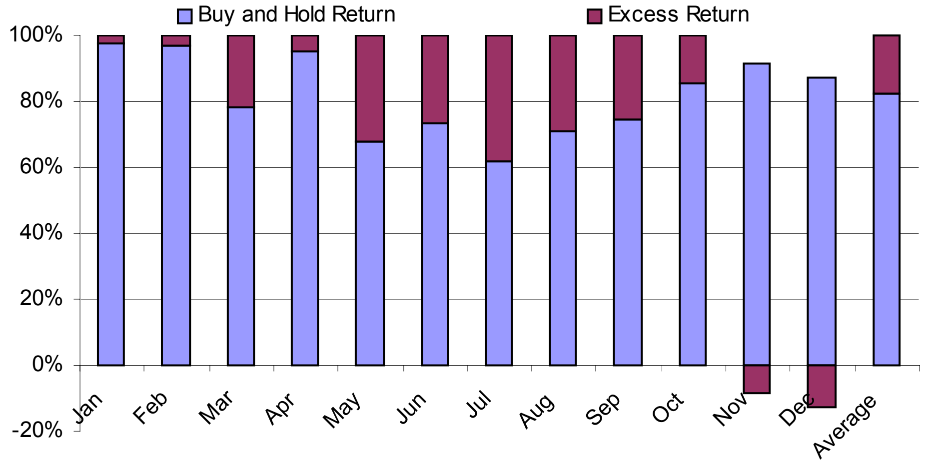
Annualized rates of return for a buy and hold strategy:

Month	Current Account	Treasury Bonds	Bank Deposits	Stocks	Other Instruments	Annual Return (buy and hold)
Jan	5.00%	70.36%	68.06%	1.68%	70.36%	**66.01%**
Feb	5.00%	89.57%	110.24%	-2.16%	110.24%	**100.05%**
Mar	5.00%	78.51%	132.89%	-5.98%	132.89%	**102.14%**
Apr	5.00%	111.80%	143.57%	-5.54%	143.57%	**120.93%**
May	5.00%	106.97%	84.97%	13.47%	106.97%	**91.12%**
Jun	5.00%	100.40%	88.84%	16.47%	100.40%	**95.09%**
Jul	5.00%	74.40%	72.54%	-3.28%	74.40%	**72.29%**
Aug	5.00%	68.99%	54.63%	10.91%	68.99%	**64.35%**
Sep	5.00%	55.85%	42.74%	-7.45%	55.85%	**51.14%**
Oct	5.00%	52.11%	46.40%	0.50%	52.11%	**50.29%**
Nov	5.00%	62.79%	50.61%	-4.36%	62.79%	**59.62%**
Dec	5.00%	73.47%	65.78%	-4.90%	73.47%	**71.70%**

The rate of return for "other instruments" is set to the maximum between the rates of return for current account, treasury bonds, bank deposits and stocks. The rate of return for stocks is set to the rate of return of the Bucharest Stock Exchange Composite Index (BETC).

Excess return of the mutual funds:

Month	Return	Buy and Hold Return	Excess Return
Jan	67.60%	66.01%	**1.59%**
Feb	102.92%	100.05%	**2.87%**
Mar	131.06%	102.14%	**28.92%**
Apr	127.40%	120.93%	**6.47%**
May	133.83%	91.12%	**42.72%**
Jun	130.05%	95.09%	**34.96%**
Jul	117.04%	72.29%	**44.75%**
Aug	90.81%	64.35%	**26.46%**
Sep	68.45%	51.14%	**17.31%**
Oct	58.96%	50.29%	**8.66%**
Nov	53.94%	59.62%	**-5.67%**
Dec	61.16%	71.70%	**-10.53%**
Average	**95.27%**	**78.73%**	**16.54%**



The excess returns are significant, which contradicts the strong form of market efficiency.

6. Alternatives to the Efficient Market Hypothesis

Peters in 1994[9] proposed a theory – Fractal Market Hypothesis - in which he said that information didn't have a uniform impact on stock prices; each investor according to his investment horizon assimilates it differently.

Peters' theory proposes the following:

1. The market is stable when it consists of investors covering a large number of investment horizons.
2. The information set is more related to market sentiment and technical factors in the short term than in the longer term. As investment horizons increase, longer-term fundamental information dominates. Thus, price changes may reflect information important only to that investment horizon
3. In an event occurs that makes the validity of fundamental information questionable, long-term investors either stop participating in the market or begin trading based on the short-term information set. When the overall investment horizon of the market shrinks to a uniform level, the market becomes unstable. There are no long-term investors to stabilize the market by offering liquidity to short-term investors.
4. Price reflects a combination of short-term technical trading and long-term fundamental valuation. Thus, short-term price changes are likely to be more volatile, or noisier, than long term trades. The underlying trend in the market is reflective of changes in expected earnings, based on the changing economic environment. Short-term trends are more likely the result of crowd behavior. There is no reason to believe that the length of the short-term trends is related to the long-term economic trend.
5. If a security has no tie to the economic cycle, then there will be no long-term trend. Trading, liquidity and short-term information will dominate.

[9] Peters, Edgar E. (1994); „Fractal Market Analysis. Applying Chaos Theory to Investment and Economics"; John Wiley & Sons, Inc.

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