EUROPEAN INTEGRATION AND CAPITAL MARKET EFFICIENCY IN CEE COUNTRIES

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Abstract: *The European Integration process involves radical changes into the inner-workings of the financial system of a country. From higher volumes of foreign direct investments to the development of the banking system or capital markets the European Integration process can ultimately lead to a better allocation of resources across the entire economy. This paper examines if the European Union Integration process increased the capital market efficiency in Bulgaria, Czech Republic, Poland, Romania, Slovakia and Hungary. We use two distinct samples of data in order to test the weak form of market efficiency: an ex-ante EU sample made up from all the data available up until joining the European Union, and an ex-post EU sample made up from all the data from joining the European Union up until March 2016. We employ a wide array of statistical tools for testing market efficiency such as: autocorrelation test, runs test, unit root test, and four variance ratios tests, performed on the daily return of the most important stock indices in the selected markets. While our results indicate that neither of our analyzed markets follows strictly the random walk model in both ex-ante and ex-post samples, we find evidence that after joining the European Union market efficiency increased in certain countries. We find in the ex-ante sample that only the Slovakian capital market exhibited signs of efficiency according to the autocorrelation, runs and variance ratio tests. Meanwhile, in the ex-post samples we find partial market efficiency in Hungary, Slovakia, Poland, Czech Republic and Romania in the variance ratio tests, while the autocorrelation test provided additional evidence for Bulgaria and the runs test for Slovakia. This suggests, that joining the European Union was not the decisive factor in improving market efficiency in Central and Eastern European capital markets, despite the potential positive effect of joining the EU on information efficiency. Thus, we can still use historical data in order to predict future price movements in CEE capital markets.*

Keywords: European integration, market efficiency, weak form of efficiency

JEL classification: G11, G14, G15, F36.

1. Introduction

The Efficient Market Hypothesis (hereafter EMH) is one of the most controversial economic theories that shapes the modern financial theory. While a market is deemed efficient if it's prices reflect at any time all the available information, achieving a true informational efficient market limits the possibility of predicting future price movements, thus ensuring a better capital allocation and economic development.

Fama (1970) argues that if in the *weak-form* of efficient market the assets prices reflect all the available historical information, then in its *semi-strong* form of

efficiency the markets reflect all the available public information from historical data to earnings and current statements, while in its *strong-form* market efficiency implies that the prices reflect both private and public information limiting the effectiveness of insider information. Therefore, Nurunnabi (2012) argues that in an efficient capital market, the pricing mechanism is able to ensure that resources are channeled from savers only in highly efficient investments, which ultimately allows for a better capital allocation and economic development.

Despite the abundant numbers of economic studies regarding weak form of efficiency, a small number of studies investigate the influence of European Integration on capital market efficiency as indicated by Urquhart (2014). While many of the recent studies like (Borges, 2010; Smith, 2012; Urquhart, 2014) focus only on the influence of the European Integration process on developed economies, older studies such as (Smith, 2012) don't take into consideration further developments.

This study aims to provide additional insight into the implications of the European integration process on information efficiency of Central and Eastern European Countries (hereafter CEE).

In our opinion, studying the effect of European Integration process on the capital markets from CEE is important because the latter involves radical changes into the inner-workings of the financial system of a country. From the increase of foreign direct investments to the development of the banking system and capital markets, European Integration process can lead to a better capital allocation across the entire economy. In order to achieve our goal, we will use a wide array of instruments to test for market efficiency such as: autocorrelation test, runs test, unit root test, and four different variance ratios tests.

The rest of this paper is organized as follows: section 2 marks the literature review, section 3 presents the data, section 4 presents the methodology, while section 5 presents the empirical results and section 6 concludes.

2. Literature review

Nurunnabi (2012) argues that in an efficient market the valuation mechanism of assets prices is optimal, because investors are unable to predict future price movements. Therefore, in an efficient market resources are channeled only to beneficial investments improving capital allocation and economic development. By encouraging the development of the capital markets, the European Integration process can help increase the information efficiency, allowing for a better asset price fixing mechanism.

Due to the specifics weak-form of efficiency testing, pinpointing the exact moment when a shift in the efficiency of a market is hard to achieve. In a comprehensive review of the existing literature regarding efficiency Lim and Brooks (2011), argue that the majority of literature that studies the determinant factors that lead to an increase in market efficiency, prefer to split the data in two different samples in order to test the shift. Their study reveals that there are five distinct factor that can cause a shift in market efficiency: the implementation of a price limiting system, the financial crisis, changes in regulatory framework and technology advances.

Borges (2010) argues that European Integration process could also be a determining factor in increasing capital market efficiency for members of the EU. His study of the weak-form capital market efficiency of six important capital

markets in Europe: United Kingdom (UK), France, Germany, Spain, Greece and Portugal from January 1993 to December 2007, reveal a potential shift in efficiency after the Euro adoption. The results indicate that in the case of Portugal and Greece, despite rejecting the weak form of EHM for the whole period, when testing a sample from 2003 to 2007 both countries tend to approach weak-form of capital market efficiency. In the case of UK and France the EHM is rejected for all the samples while in the case of Germany and Spain EHM is accepted.

Moreover, Smith (2012) argues that capital market efficiency of European countries evolved at the beginning of the new millennia, under the influence of several factors like: European integration, market development and the influence of the recent financial crisis. His results indicate that between February 2000 and December 2009 the efficiency across countries varied significantly. While for the Turkish, UK, Hungary and Polish markets weak form of efficiency was attained for the whole period, during the financial crisis between 2007-2008 weak form of efficiency is lost for Croatian, Hungarian, Polish, Portuguese, Slovakian and UK markets. Meanwhile, the crisis didn't exert any influence on the efficiency of capital markets from: Greece, Latvia, Romania, Russia and Turkey.

In addition, the results of Urquhart (2014) indicate that the adoption of the Euro in western economies, was not a decisive factor in the behavior of stock returns in European markets, with beneficial results for Spain and Finland and detrimental for France while in the case of Netherlands and Italy the Euro had little effect.

In the case of CEE countries, previous studies like (Dragotă and Țilică, 2014; Cărăușu, 2015) have indicated that weak-form efficiency can be attained during certain periods of time, under certain conditions but the results could vary when changing testing instruments and/or sample period. Thus, in the case of CEE countries, when assessing the weak form of efficiency we need to use the term „partial efficiency" as suggested by Lim and Brooks (2011).

Based upon the theoretical and empirical results we derive our main hypothesis:

H_1: *The European Integration Process improves market efficiency in CEE countries*.

3. Data

The data used in our analysis is made up from the daily returns of the most important capital market indices from our analyzed countries as follows: SOFIX – Bulgaria, PX – Czech Republic, WIG – Poland, BET – Romania, SAX – Slovakia, and BUX – Hungary. In order to test if joining the EU had a direct influence on capital market efficiency in CEE countries we will use two distinct samples for each country. An *ex-ante joining the EU* sample made up from the first day of trade for each individual indices until the last day before joining the EU, namely 31 December 2003 for Czech Republic, Poland, Slovakia and Hungary and 31 December 2006 for Bulgaria and Romania. The second sample, an *ex-post joining the EU* consist from the first day a country became member of the EU up until 31 March 2016.

For testing the weak form of capital market efficiency will use log normal returns of the daily returns of indices calculated as in equation (1):

$$R_t = \ln\left(\frac{P_t}{P_{t-1}}\right) \qquad (1)$$

Where: R_t – is the daily return, P_t and P_{t-1} – are the prices at the time t and t –

1.

Table 1: Descriptive statistics

Indices	BET	BUX	PX	SAX	SOFIX	WIG
Before Joining the EU						
N	1505	3243	2420	2059	1247	2722
Mean	0.00180	0.00069	0.00027	0.00000	0.00204	0.00111
Median	0.00108	0.00045	0.00000	0.00000	0.00120	0.00052
Max	0.14576	0.13615	0.15390	0.09573	0.08387	0.14783
Min	-0.11901	-0.18033	-0.07566	-0.11483	-0.08238	-0.11347
Std. Dev.	0.01535	0.01677	0.01447	0.01416	0.01353	0.02356
Skewness	0.47359	-0.83875	1.37735	-0.38189	0.25897	-0.02285
Kurtosis	13.2274	17.9518	17.0812	9.47796	10.0489	7.47642
Jarque-Bera	6615.65	30588.4	20758.4	3650.21	2595.65	2272.92
Prob.	0.00000	0.00000	0.00000	0.000000	0.00000	0.00000
After Joining the EU						
N	2284	3075	3070	2326	3021	3061
Mean	0.00044	0.00010	0.00027	0.00007	0.00020	0.00033
Median	-0.00002	0.00063	0.00062	0.00025	0.00000	0.00052
Max	0.07292	0.12364	0.06083	0.12846	0.11880	0.13176
Min	-0.11360	-0.16185	-0.08288	-0.11824	-0.14810	-0.12648
Std. Dev.	0.01301	0.01457	0.01251	0.01634	0.01169	0.01600
Skewness	-0.91588	-0.54436	-0.48876	-0.51215	-1.12048	-0.11166
Kurtosis	13.0316	17.8632	6.83012	12.2714	24.0293	9.70877
Jarque-Bera	9896.22	28456.9	1998.75	8432.54	56298.4	5746.70
Prob.	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Source: Author calculations

The descriptive statistics of our data depicted in table 1, indicate that on average each individual capital market exhibited growth both in the ex-ante and the ex-post samples. Because none of our samples is normally distributed according to the Jarque-Bera normality test, we need to take extra-caution when assessing certain tests of the weak form of efficiency.

4. Methodology

In order to test the weak form of market efficiency we will use several statistics test such as: autocorrelation test, runs test, unit root test, and four variance ratios test.

4.1. Autocorrelation test

The *autocorrelation test* reveals if there is any relationship between the current price of an asset and its previous price. When testing, the weak form of efficiency for a series Y and a lag k, we will test each individual lag ρ_k from equation (2) against the Ljung–Box Q test. In order to confirm weak form of efficiency, each individual autocorrelation indicator ρ_k, shouldn't be statistically significant for any

lag k, considering the average return $\bar{r}$, and the current return r_t, for each individual value in our entire series N.

$$\rho_k = \frac{\frac{\sum_{t=1}^{N-K}(r_t - \bar{r})(r_{t+k} - \bar{r})}{N-k}}{\sum_{t=1}^{N}\frac{(r_t - \bar{r})^2}{N}} \quad (2)$$

4.2. Run test

The *run test* is a non-parametric test, that tries to predict future price movement of an asset by following successive trading days that ended up in a rise or fall. In order to determine if a market is efficient we need to compute the Z function by comparing the random R with m simulated values, against the standard deviation of σ_m as in equation (3). If the Z function is positive and statistically significant then we accept weak form efficiency and reject the hypothesis otherwise.

$$Z = \frac{R - m \pm 0{,}5}{\sigma_m} \sim N(0,1) \quad (3)$$

4.3 Unit root

The *unit root test* is able to detect the weak form of efficiency, by comparing the price movement of an asset against a random walk process. In order to test, weak efficiency we use the Augumented Dickey Fuller test - ADF (Dickey and Fuller, 1981) with a constant and trend as in equation (4). In order to accept weak form of capital market efficiency when using the ADF test we need to reject the null Hypothesis that our series has a unit root.

$$\Delta y_t = \varphi y_{t-1} + \beta + \gamma t + \sum_{t=1}^{p} \delta_i \Delta y_{t-1} + \varepsilon_t \quad (4)$$

4.4. Variance ratios tests

Variance ratios tests are statistics tests specifically designed for testing the weak form of EHM. Because each individual variance test has specific characteristics and advantages we need to reject all tests in order to confirm weak form of EHM.

4.4.1 The Lo and Mackinley variance test

The Lo and Mackinley variance test (Lo and MacKinlay, 1988) compares the empirical $VR(q)$ value for each lag against the value of 1 as in equation (5). If the computed $z(q)$ it's not statistically significant, we accept the weak form of EHM, and reject it otherwise.

$$z(q) = \frac{VR(q) - 1}{\sqrt{v(q)}} \sim N(0,1) \quad (5)$$

4.4.2 The Chow Denning significance test

The Chow Denning significance test (CD) (Chow and Denning, 1993) compares the multiples test values $VR(q)$ to a studentized maximum modulus (SMM) distribution with m and T degrees of freedom as in equation (6). In addition, we will

use the bootstrap version of the CD_2 test proposed by (Kim, 2006) due to better treatment of small samples.

$$CD_1 = \sqrt{T}_{1 < j < m}^{max} \left| M_2 \left(k_j \right) \right| \qquad (6)$$

4.4.2 The Wright signs and ranks variance tests

The Wright signs and ranks variance tests suggested by (Wright, 2000) is more efficient in detecting weak efficiency under the assumption of heteroscedasticity for the sign-based test, while the rank-based test is more efficient in the presence of low-size distortion under heteroscedasticity. In addition we will use the (Kim and Shamsuddin, 2008) methodology of estimating a multiples test values as in equation (7) for the rank test $R_j(k)$ and equation (8) for the sign tests $S_j(k)$.

$$R_j(k) = \left(\frac{(Tk)^{-1} \sum_{t=l}^{T} \left(r_{jt} + \cdots + r_{jt-k+1} \right)^2}{T^{-1} \sum_{t=1}^{T} r_{jt}^2} - 1 \right) \left(\frac{2(2k-1)(k-1)}{3kT} \right)^{-\frac{1}{2}} \qquad (7)$$

$$S_j(k) = \left(\frac{(Tk)^{-1} \sum_{t=l}^{T} \left(s_{jt} + \cdots + s_{jt-k+1} \right)^2}{T^{-1} \sum_{t=1}^{T} s_{jt}^2} - 1 \right) \left(\frac{2(2k-1)(k-1)}{3kT} \right)^{-1/2} \qquad (8)$$

5. Empirical results

The autocorrelation test results depicted in table 2 reveal some intriguing results, regarding the ex-ante and ex-post EU samples.

Table 2: Autocorrelation results

	Before Joining the EU				After Joining the EU			
Lag	**1**	**2**	**5**	**10**	**1**	**2**	**5**	**10**
BG	0.102***	0.097***	-0.056***	-0.007***	0.136***	0.118***	0.104	0.077
	(12.96)	(24.68)	(30.56)	(38.35)	(42.09)	(73.98)	(111.9)	(146.7)
CZ	0.332***	0.214***	-0.009***	0.080***	0.058***	-0.077***	0.044***	0.018
	(267.1)	(378.3)	(448.3)	(465.4)	(10.47)	(28.66)	(41.75)	(45.80)
PL	0.293***	-0.001***	0.031***	0.017***	0.093***	-0.033***	0.002***	0.014***
	(234.4)	(234.4)	(247.1)	(260.8)	(26.39)	(29.74)	(30.26)	(33.66)
RO	0.114***	-0.019***	0.001***	-0.028***	0.091***	-0.025***	0.012***	0.042***
	(19.47)	(20.00)	(21.46)	(33.05)	(19.08)	(20.57)	(22.80)	(45.29)
SK	-0.024	-0.047*	0.010	0.014	-0.063***	0.033***	0.002***	0.032***
	(1.194)	(5.75)	(6.488)	(14.36)	(12.17)	(15.50)	(17.01)	(26.64)
HU	0.105***	0.041***	-0.009***	0.083***	0.059***	-0.063***	0.030***	0.011***
	(36.09)	(41.52)	(47.57)	(84.13)	(10.59)	(22.81)	(40.45)	(64.54)

Notes: First row is the coefficient, second row in the parenthesis the Q-Stat. ***, **, * denotes significant at 1%, 5% and 10%.

Source: Author calculations

Our results indicate that only the Slovakian capital market was efficient in the weak form for ex-ante sample. Meanwhile, when assessing the ex-post sample only Bulgaria has weak signs of efficiency for lags higher than 5. This implies than in Bulgaria current assets prices are linked to past values in the short run but differ in

holding period is larger than 5 days. For the rest of our samples we reject the weak form of efficiency because all of the Q-statistics coefficient are statistically significant at 1% level. This implies that the current assets prices in our analyzed countries is linked to historical data.
Our autocorrelation results indicate that joining the EU process didn't influence the market information efficiency but due high degree of sensitivity of autocorrelation tests in the absence of normality, further analysis is required. In this regard the results from the run test depicted in table 3 are more adequate due to better treatment of lack of normality and sample size.

Table no. 3: Run test results

	Before Joining the EU				After Joining the EU			
Test	**N>0**	**N<0**	**N-real**	**Z**	**N>0**	**N<0**	**N-real**	**Z**
BG	727	520	561	-2.699***	1141	1143	1059	-3.516***
				(0.007)				(0.000)
CZ	1219	1201	990	-8.985***	1615	1460	1522	-0.455***
				(0.000)				(0.649)
PL	1406	1316	1199	-6.199***	1581	1489	1543	0.303
				(0.000)				(0.762)
RO	829	676	664	-4.259***	1191	1135	1091	-3.002***
				(0.000)				(0.003)
SK	1096	963	1070	1.939*	1886	1135	1469	1.972**
				(0.053)				(0.049)
HU	1693	1550	1470	-5.256***	1558	1503	1519	-0.434***
				(0.000)				(0.664)

Notes: First row is the coefficient, second row in the parenthesis is the probability of the Z run test function score. N>0 is the number of days with increase. ***, **, * denotes significant at 1%, 5% and 10%.
Source: Author calculations

The run test indicates that only the Slovakian capital market was efficient in the weak form with a probability of 90% for the ex-ante sample and a 95% probability for the ex-post sample. In the case of Poland even if the value of the Z function is positive for the ex-post sample, it's not statistically significant, thus the evidence of efficiency is weak. On a general note, if we compare the ex-ante and ex-post samples for each individual country we can observe that in all countries except Bulgaria, the coefficients indicate an indirect improvement in market efficiency.
The results of the unit root tests for each country in both ex-ante and ex-post samples from table 4, indicate that price movement of assets doesn't follow a random walk, thus all capital markets are inefficient in the weak form. Even if the ADF test indicated that none of our analyzed markets is efficient in the weak form, we need to acknowledge that the ADF test is sensitive to the lack of normality which can invalidate the results in certain environments.

Table 4: Unit root test

	Before Joining the EU				After Joining the EU			
Test	**1%**	**5%**	**10%**	**ADF**	**1%**	**5%**	**10%**	**ADF**
BG	-3.965	-3.341	-3.128	-21.73***	-3.962	-3.411	-3.127	-19.29***

				(0.000)				(0.000)
CZ	-3.961	-3.411	-3.127	-34.82***	-3.961	-3.411	-3.127	-41.26***
				(0.000)				(0.000)
PL	-3.961	-3.411	-3.127	-34.19***	-3.961	-3.411	-3.127	-50.49***
				(0.000)				(0.000)
RO	-3.964	-3.412	-3.128	-34.54***	-3.961	-3.411	-3.127	-43.97***
				(0.000)				(0.000)
SK	-3.962	-3.411	-3.127	-46.51***	-3.961	-3.411	-3.127	-58.55***
				(0.000)				(0.000)
HU	-3.960	-3.411	-3.127	-51.19***	-3.961	-3.411	-3.127	-40.57***
				(0.000)				(0.000)

Notes: First row is the coefficient, second row in the parenthesis is probability of the ADF test. ***, **, * denotes significant at 1%, 5% and 10%.
Source: Author calculations

The Lo and Mackinley VR test results from table 5 indicate a potential progress between the ex-ante and ex-post samples. We can spot that in the ex-ante sample the Slovakian capital market is efficient in all the selected lags, while the capital markets from Bulgaria, Romania and Hungary are efficient for lags higher than 8 or 16. This implies that in the ex-ante samples from Bulgaria, Romania and Hungary current prices were correlated to past results in the short term, but followed a random walk model in the long run. Thus, we find partial evidence of efficiency.

Table 5: Lo and Mackinley VR test results

	Before Joining the EU				**After Joining the EU**			
Lag	**2**	**4**	**8**	**16**	**2**	**4**	**8**	**16**
BG	1.103**	1.240***	1.128**	1.215	1.136***	1.361***	1.660***	2.154***
	(2.119)	(2.774)	(2.122)	(1.110)	(2.690)	(3.781)	(4.518)	(5.724)
CZ	1.332***	1.786***	2.153***	2.256***	1.058	0.991	0.990	1.028
	(4.782)	(6.452)	(6.722)	(5.828)	(1.213)	(-0.90)	(-0.06)	(0.146)
PL	1.293***	1.449***	1.622***	1.846***	1.092***	1.112**	1.139*	1.183
	(7.312)	(6.143)	(5.575)	(5.384)	(3.931)	(2.478)	(1.866)	(1.627)
RO	1.114***	1.148**	1.179	1.314**	1.093**	1.104	1.115	1.254
	(2.659)	(1.962)	(1.642)	(2.061)	(2.374)	(1.350)	(0.962)	(1.486)
SK	0.976	0.923	0.927	1.024	0.936***	0.927*	0.919	1.033
	(-0.86)	(-1.47)	(-0.86)	(0.200)	(-3.00)	(-1.85)	(-1.35)	(0.364)
HU	1.106**	1.182**	1.213*	1.464***	1.058	1.008	1.020	1.021
	(2.395)	(2.378)	(1.933)	(3.026)	(1.639)	(0.138)	(0.217)	(0.152)

Notes: First row is the coefficient; second row is value of the Z-statistic for heteroscedasticity robust standard estimates. ***, **, * denotes significant at 1%, 5% and 10%.
Source: Author calculations

In the case of the ex-post samples we can observe an increase in the number of capital markets that exhibit weak efficiency. We find that Hungary and Czech Republic capital markets were efficient when considering all lags while Slovakian and Romanian markets efficient after the 4 and 2 lag. This could indicate an improvement in the market efficiency after joining the EU for CEE capital markets.

The joined significance variance ratio results from table 6 reveals some interesting results between the two periods. In the case of the ex-ante sample we find that only the Slovakian market efficient with the Chow-Denning joined significance test CD_1 and the Chow Denning bootstrap test CD_2, and partial evidence for the Joint sign JS_1 test. Meanwhile, when reassessing the ex-post samples, we find that several capital markets become efficient in the weak form under certain tests. Therefore, we find that Hungary is the most efficient capital market in our sample passing all four joints tests (CD_1, CD_2, Joint rank JR_1 and JS_1), while in the case of Czech Republic efficiency is attained according to the CD_2, JR_1 and JS_1 tests and Poland only JS_1, while for Romania only CD_2. This miss-matching results, can be attributed to the ability of the joined sign and rank test, to detect finer differences under the presence of heteroscedasticity. On a general note, we can see that after joining the EU an improved information efficiency in certain capital markets.

Table 6: Variance ratio join tests results

	Before Joining the EU				After Joining the EU			
Test	**CD_1**	**CD_2**	**JR_1**	**JS_1**	**CD_1**	**CD_2**	**JR_1**	**JS_1**
BG	4.534***	2.774***	-6.679***	6.935***	12.53***	5.724***	10.31***	6.640***
	(23.55)		(50.41)	(52.35)	(166.0)		(114.5)	(45.72)
CZ	20.67***	6.722***	11.38***	0.022***	3.255***	1.213	2.028	1.485
	(442.8)		(162.1)		(37.77)		(15.20)	(4.466)
PL	15.33***	7.312***	11.11***	5.520***	5.148***	3.931***	2.744**	1.119
	(255.0)		(143.2)	(33.08)	(29.55)		(12.25)	(2.679)
RO	4.441***	2.659***	5.378***	4.253***	3.914***	2.374*	4.461***	3.193***
	(25.59)		(31.98)	(22.50)	(25.04)		(26.44)	(18.81)
SK	1.865	1.472	2.368**	2.263*	10.97***	3.008**	4.596***	8.753***
	(9.298)		(22.07)	(17.18)	(125.0)		(36.99)	(124.3)
HU	6.039***	3.026***	4.246***	7.495***	1.692	1.639	1.692	0.632
	(85.79)		(35.80)	(70.86)	(9.005)		(9.005)	(6.469)

Notes: First row is the coefficient, second row in the parenthesis is Wald Chi-Square statistics. ***, **, * denotes significant at 1%, 5% and 10%.
Source: Author calculations

6. Conclusions

The aim of this paper was to examine if the European Union Integration process increased the capital market efficiency in Bulgaria, Czech Republic, Poland, Romania, Slovakia and Hungary. We employed a wide array of statistical tools for testing market efficiency such as autocorrelation test, runs test, unit root test, and four variance ratios tests, performed on the daily return of the most important stock indices in the selected markets.

While our results indicate that neither of our analyzed markets follows strictly the random walk model in both ex-ante and ex-post samples, we find evidence that after joining the European Union market efficiency increased in certain countries. We find in the ex-ante samples that only the Slovakian capital market exhibited signs of efficiency according to the autocorrelation, runs and variance ratio tests. Meanwhile, in the ex-post samples we find partial market efficiency in Hungary, Slovakia, Poland, Czech Republic and Romania in the variance ratio tests, while the autocorrelation reveals efficiency in Bulgaria and the runs test in Slovakia.

This suggests, that joining the European Union was not the decisive factor in improving market efficiency in Central and Eastern European capital markets, despite the potential positive effect of joining the EU on information efficiency. Thus, we can still use historical data for predicting future price movement.
Even if we observed a potential increase in market efficiency after joining the EU, European Integration process it's not the sole factor involved. The recent economic crisis or the changes in regulatory framework could also act can as an important factor in improving information efficiency. In addition, the use of additional testing tools of could yield different results, due to the inherent limits in testing EHM.

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