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VARIATION OF THE MONTH EFFECT IN CENTRAL AND EASTERN EUROPE STOCK MARKETS

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Abstract: The aim of this paper is to analyze the change in the manifestation of the month effect in Eastern and Central European countries during periods of intense fluctuations. Following stock indexes that best reflect the situation in thirteen Eastern and Central European stock markets were used in this research: the Bulgarian stock index SOFIX, Polish – WIG, Romanian – BET, Serbian – BELEX15, Slovenian – SBITOP, Bosnia and Herzegovina – BIRS, Croatian – CROBEX, Slovak – SAX, Hungarian – BUX, Czech – PX, Lithuanian – OMXV, Latvian – OMXR, Estonian – OMXT. The daily closing prices of the indexes for the years 2009-2025 were used in the study. To assess the change in the manifestation of the month effect, the study period was divided into 2 subperiods: 2009-2019 and 2020-2025. The results obtained after using the GARCH(1,1) and EGARCH models for the study evidenced that since 2020, with the onset of intense fluctuations in the stock markets of Eastern and Central Europe, month effects have changed significantly as compared to previous periods, and this should be noted by investors.

Keywords: calendar anomalies, month effect, stock return, Central and East Europe stock markets, GARCH estimation

1. INTRODUCTION

Proponents of the efficient market hypothesis hold the view that anomalies in financial markets should not exist, which means that systematic fluctuations that allow investors to earn abnormal returns should not appear in the markets. However, many studies have shown that calendar anomalies do exist, and one such anomaly is the month-of-the-year effect (month effect). The object of most such studies is the well-developed stock markets of the United States and Western Europe (Rozeff & Kinney, 1976; Keim, 1983; Bhardwaj & Brooks, 1992; Haugen & Jorion, 1996; Giovanis, 2009; Van Dijk, 2011; Rossi & Gunardi, 2018; Chikhi et al., 2019), while there are very few studies of the such effect in the stock markets of Eastern and Central

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Europe. Moreover, the results obtained in these markets are quite contradictory, and the period of most of such research ends in 2019. Phenomena that occur in large, long-established markets do not necessarily occur to the same extent in relatively young and small stock markets. Most Eastern and Central European markets are small, illiquid, and less efficient, so the expression of various anomalies, including the month effect, may be completely different from that in Western European and US markets. On the one hand, these markets are growing quite rapidly, which may lead to increased efficiency in them, but on the other hand, the COVID-19 pandemic that broke out in 2020, the war in Ukraine that began in February 2022, and various geopolitical upheavals that occurred later in this region, caused extreme and frequent fluctuations in stock markets, and all this could lead to the disappearance of calendar anomalies. Thus, the month effects that appeared before 2020 may have in fact disappeared or perhaps even more intensified.

The aim of this paper is to analyze the change in the manifestation of the month effect in Eastern and Central European countries during periods of intense fluctuations. The results of such a study will help investors make more informed investment portfolio optimization decisions.

2. LITERATURE REVIEW

The month-of-the-year effect (or month effect) is commonly defined as a calendar anomaly in which stock returns display persistent and statistically significant variation across calendar months, suggesting the presence of predictable seasonal regularities inconsistent with market efficiency (Rozeff & Kinney, 1976).

One of the earliest studies of the month effect in Eastern and Central Europe was the study by Asteriou & Kovetsos (2006), which proved the existence of the January effect in Poland, Romania, Hungary, and Slovakia. Tilica (2014), who studied the month effect in 18 Eastern European countries from 2004 to 2014, found that the January effect existed in five of the countries, i.e. Croatia, Lithuania, FYR Macedonia, Montenegro, and Slovakia. However, the results of this study denied the existence of this effect in Bosnia, Bulgaria and Estonia. The author of the study noted that in six of the countries analyzed, the month of July also displayed statistically significant higher returns than other months.

Norvaisiene et al. (2015) conducted a study of seasonality in the Baltic stock markets using data of 2003-2014 and identified that the Estonian market was characterized by January and October effects during that period, while in the Lithuanian market, an increase of stock returns was observed in January, August and November, and a seasonal decrease of returns – in October. The Latvian market did not show any seasonal fluctuations in 2003-2014.

Podgorski (2018) examined stock returns up to 2013 in European countries that joined the EU after 2004 (Poland, Lithuania, Latvia, Estonia, the Czech Republic, Slovakia, Slovenia and Hungary) and found that the January effect exists and tends to strengthen in these markets.

Milos & Milos (2019) studied the January effect in 11 Central and Eastern European countries (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia) and concluded that during the period of 2009-2018, higher returns were earned in January if compared to other months in the stock markets of Bulgaria, Croatia, Estonia, and Latvia, but this effect did not appear in the other stock markets studied.

Arendas et al. (2021) used stock index values from the beginning of their creation until 2019, studied the January effect in Romania, Hungary, Latvia, Estonia, Lithuania, the Czech Republic, Slovakia, Bulgaria, and Poland, and found that this effect revealed itself in the stock markets of the Baltic countries, the Czech Republic, and Romania.

Norvaisiene & Stankeviciene (2022) analyzed the occurrence of the month effect in the Baltic States in 2004-2019 and confirmed the existence of the January effect, as well as a statistically significant higher return in July if compared to other months. They used the GARCH(1,1) model and found that the seasonal increase in stock prices in the Baltic States during the study period also occurred in April and November. Alekneviciene et al. (2022) also confirmed the existence of the January and July effect in the Baltic stock market.

Milos et al. (2024) studied the occurrence of calendar effects in eight Eastern and Central European countries during the period of 2010-2019: Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia. These authors identified clear signs of the January effect in Romania, Croatia, the Czech Republic, Slovenia and Bulgaria. At the same time, the authors of this study noted that the Polish stock market is characterized by higher efficiency and no significant calendar anomalies were observed in this market.

A review of studies of the month effect conducted in the stock markets of Eastern and Central Europe evidence that the study periods and study samples are quite different, as well as the results obtained; the latter are different even when studies cover the same countries and periods. The rather different results obtained by different researchers may also appear due to different methodological approaches. Statistical significance tests of monthly return differences prevailed in early studies of calendar effects, later studies used regression analysis with dummy variables, and the latest studies in this area are often based on the use of GARCH models, which allow obtaining more reliable results.

The COVID-19 pandemic, the war that began in 2022, and subsequent geopolitical events have severely shaken stock markets, causing large and frequent volatility spikes. All of this has had a particularly significant impact on the stock markets of Eastern and Central Europe, so it is necessary to assess how calendar effects are changing in the context of fundamentally changed market volatility.

3. DATA AND METHODOLOGY

To study the manifestation of the month effect in the stock markets of Central and Eastern European countries, stock indexes that best reflect the situation in the stock markets of these countries were used: Bulgarian stock index SOFIX, Polish – WIG, Romanian – BET, Serbian – BELEX15, Slovenian – SBITOP, Bosnia and Herzegovina – BIRS, Croatian – CROBEX, Slovak – SAX, Hungarian – BUX, Czech – PX, Lithuanian – OMXV, Latvian – OMXR, Estonian – OMXT. The research period covers the years from 2009 to 2025. To assess the change in the manifestation of the month effect in the context of intensified market fluctuations, the research period is divided into 2 subperiods: 2009-2019 and 2020-2025. Panel data was used for the research. All data used in the study was collected from the Bloomberg Professional Platform.

The daily closing prices of the stock indexes were transformed into daily returns R_t by using the natural log difference of the market index at day t and day t-1:

$$R_t = ln\frac{I_t}{I_{t-1}} \times 100 \quad (1)$$

The equation of month effect testing is as follows:

$$R_t = \alpha_1 D_1 + \alpha_2 D_2 + \cdots + \alpha_{12} D_{12} + \varepsilon_t \quad (2)$$

where R_t is the natural log of the daily return in month t. The D_1, D_2,…, D_{12} are dummy variables so that D_1=1 if month t is January and zero otherwise; D_2=1 if the month t is February

and zero otherwise and so forth. The coefficients α_1 to α_{12} are the mean daily returns for January through December respectively and ε_t is the stochastic term.

Stock returns are often characterized by conditional heteroskedasticity, so considerable number of researchers (Giovanis, 2009; Georgantopoulos & Tsamis, 2014; Vasileiou & Samitas, 2015; Ahmed & Boutheina, 2017; Sawitri & Astuty, 2018; Filipovski & Tevdovski, 2019; Xiong et al., 2019; Adam et al., 2025) have used GARCH models to study calendar anomalies. This study uses the GARCH(1,1) model, which allows the estimation of both the short-term impact of shocks and the inertia of volatility, while eliminating the influence of returns of calendar effect series on the return of non-calendar effect. The conditional variance equation is:

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} \quad (3)$$

where h_t and h_{t-1} are the conditional variance of index return at time *t* and *t-1* respectively and ω is the long-run average level of conditional variance, α – the short-run impact of new information (shocks) on conditional volatility (ARCH effect), β reflects the persistence of volatility, representing the influence of past conditional variance on current volatility (GARCH effect). For the conditional variance to meet non-negativity constraints and be meaningful, the following conditions must be met: $\omega > 0$; $\alpha \geq 0$; $\alpha + \beta < 1$. According to Bollerslev (1986), the endurance of shocks on volatility is dependent on the sum of $\alpha + \beta$. Values close to unity suggest highly persistent volatility dynamics, where shocks have long-lasting effects.

Considering that large fluctuations in stock markets may increase the asymmetry effect when negative shocks increase volatility more strongly than positive ones, we additionally applied the EGARCH model, which allows the assessment of this effect. The equation of this model is as follows:

$$\ln(h_t^2) = \omega + \beta \ln(h_{t-1}^2) + \alpha \left|\frac{\varepsilon_{t-1}}{h_{t-1}}\right| + \gamma \frac{\varepsilon_{t-1}}{h_{t-1}} \quad (4)$$

The coefficient γ in this equation indicates the asymmetry effect. If it is negative and statistically significant, it proves that negative shocks have a greater impact on market volatility than positive ones.

4. RESULTS AND DISCUSSION

Descriptive statistics of daily returns in the stock markets of Central and Eastern European countries are presented in Tables 1 and 2. These statistics include average daily return, minimum and maximum return, standard deviation of return, kurtosis, skewness and number of observations (N).

Table 1. Descriptive statistics of stock returns in Central and Eastern Europe, 2009-2019

	SOFIX	WIG	BET	BELEX15	SBITOP	BIRS	CROBEX	SAX	BUX	PX	OMXV	OMXR	OMXT
Mean	0.017	0.027	0.045	0.013	0.003	-0.018	0.006	-0.001	0.048	0.010	0.050	0.049	0.056
Minimum	-4.89	-6.88	-13.12	-7.41	-6.06	-6.47	-7.02	-14.81	-7.57	-7.04	-11.94	-8.10	-6.44
Maximum	6.31	5.80	10.56	8.23	3.72	5.15	8.56	11.88	10.67	7.25	10.93	11.59	12.09
St.dev	0.93	1.08	1.30	0.96	0.86	0.74	0.85	1.17	1.35	1.10	0.86	1.18	0.95
Kurtosis	6.79	3.91	15.91	9.15	3.53	9.69	12.85	22.58	4.00	5.02	34.01	11.65	16.00
Skewness	0.35	-0.32	-0.95	0.35	-0.27	-0.43	0.21	-1.20	0.10	-0.20	0.06	0.91	0.94
N	2716	2748	2762	2772	2734	2751	2740	2730	2739	2757	2734	2735	2757

The analysis of the collected data evidenced that in 2009-2019 in the Central and Eastern European region, the highest return was earned in the stock markets of the Baltic countries (Estonia, Lithuania, Latvia) where it averaged from 0.049 to 0.056% per day. Very similar returns were earned by investors from stocks in the stock markets of Hungary and Romania. At the same time in the same markets, the largest fluctuations in daily stock returns were observed, reaching 1.3-1.35%. Negative average daily returns in 2009-2019 are observed in the stock markets of Bosnia and Herzegovina, as well as Slovakia. Large positive kurtosis values indicate a large number of extreme values, and skewness indicates data asymmetry.

Table 2. Descriptive statistics of stock returns in Central and Eastern Europe, 2020-2025

	SOFIX	WIG	BET	BELEX15	SBITOP	BIRS	CROBEX	SAX	BUX	PX	OMXV	OMXR	OMXT
Mean	0.048	0.047	0.060	0.031	0.067	0.023	0.043	-0.012	0.059	0.058	0.042	-0.008	0.031
Minimum	-10.81	-13.5	-10.08	-6.18	-9.38	-11.22	-10.73	-7.80	-12.3	-8.16	-9.83	-22.56	-10.60
Maximum	5.16	7.43	6.68	4.09	5.93	9.45	5.62	6.80	6.00	7.37	4.70	12.09	5.58
St.dev	0.82	1.38	1.03	0.66	0.95	1.03	0.82	0.91	1.34	1.03	0.66	1.27	0.88
Kurtosis	32.79	10.98	13.46	12.49	15.68	34.30	44.43	17.68	13.36	11.11	54.98	95.21	28.80
Skewness	-2.63	-1.09	-1.15	-0.99	-1.51	0.97	-3.46	-0.76	-1.51	-1.10	-3.75	-4.81	-2.06
N	1478	1502	1496	1500	1496	1482	1491	1483	1501	1504	1494	1496	1505

In the period of 2020-2025, many Central and Eastern European stock markets earned significantly higher returns than in 2009-2019: the average daily stock return in the Slovenian stock market reached 0.067%, in the Romanian, Hungarian, Czech stock markets 0.06%, in the Bulgarian, Polish markets stocks earned an average of 0.05% per day. However, stock of Baltic companies in 2020-2025 were characterized by lower average returns as compared to the previous research period. The largest fluctuations in stock returns in 2020-2025 occurred in Poland, Hungary and Latvia. The negative skewness values observed in all countries during the mentioned period indicate an even greater concentration of stock returns on the right side than in 2009-2019.

The results of the month effect manifestation in Central and Eastern European stock markets, based on GARCH(1,1) analysis, are presented in Tables 3 and 4.

Table 3. Results of the month effect of Central and Eastern European stock returns applying GARCH(1,1), 2009-2019

	SOFIX	WIG	BET	BELEX15	SBITOP	BIRS	CROBEX	SAX	BUX	PX	OMXV	OMXR	OMXT
JAN	0.129*	0.095	0.141**	0.050	0.069	-0.030	0.103**	-0.033	0.155**	0.091	0.357*	0.174**	0.173*
FEB	-0.043	0.002	0.152**	-0.023	0.003	-0.018	-0.007	0.044	-0.069	0.055	-0.006	0.009	-0.002
MAR	0.006	0.039	0.092	0.024	0.057	-0.031	-0.019	0.034	0.102	0.032	0.080**	-0.037	0.055
APR	-0.015	0.079	0.022	0.018	0.047	-0.015	-0.005	-0.004	0.137	0.041	0.081**	0.198*	0.055
MAY	-0.036	-0.071	-0.011	-0.043	0.000	-0.100*	-0.023	-0.094	0.054	-0.077	0.077*	0.066	-0.057
JUN	0.024	-0.051	-0.085	-0.139*	-0.069	-0.127*	-0.040	-0.005	-0.046	-0.085	-0.027	0.107	0.055
JUL	0.024	0.082	0.102	0.116*	0.012	-0.058	0.090**	-0.004	0.015	0.126	0.124*	0.088	0.072
AUG	0.000	0.054	0.168*	0.027	-0.065	0.019	0.013	0.085	0.058	-0.010	-0.023	-0.072	-0.049
SEP	-0.053	0.060	0.074	-0.007	0.004	0.033	0.032	-0.060	0.017	0.037	-0.003	0.087	-0.039
OCT	-0.080	0.032	0.028	0.047	0.034	0.021	-0.004	-0.008	0.154**	0.079	0.009	-0.007	0.039
NOV	-0.039	-0.020	-0.017	0.063	-0.031	0.001	-0.034	0.019	0.029	-0.013	0.022	0.046	0.083**
DEC	0.096**	0.061	0.298*	0.118*	0.046	-0.066	-0.050	0.029	0.091	0.066	-0.048	-0.069	0.004
ω	0.057	0.017	0.040	0.021	0.036	0.010	0.010	0.889	0.023	0.017	0.005	0.038	0.010
α	0.203	0.057	0.215	0.150	0.123	0.039	0.092	0.150	0.074	0.108	0.117	0.073	0.144
β	0.729	0.926	0.781	0.829	0.830	0.943	0.890	0.600	0.912	0.880	0.895	0.900	0.857

** significant at the 1% level, ** significant at the 5% level*

The results of the research obtained using the GARCH(1,1) model evidenced that in 2009-2019, the January effect manifested itself in the stock markets of Bulgaria, Romania, Croatia, Hungary, Lithuania, Latvia and Estonia. This effect is most notable in the Lithuanian

stock market, where the average daily stock return in January reached 0.357%. Latvian and Estonian investors earned a significantly higher return (0.17% per day) on stocks in January of 2009-2019 as compared to other months of the period. Stocks of Hungarian companies, which earned an average of 0.155% per day in January, and stocks of Romanian companies, whose daily return reached 0.141%, were not far behind. When analyzing the results obtained, it is possible to notice manifestations of the effect in other months as well. In the Romanian stock market, the highest return during the research period was not earned in January, but in December, when it reached an average of 0.298% per day. The December effect is also observed in the Bulgarian and Serbian stock markets. In the Serbian, Croatian and Lithuanian stock markets, significantly higher returns were also earned in July. In the Latvian stock market, the highest return, unlike in other markets, was earned in April (0.198%). In the Lithuanian stock market, statistically significant higher returns are also observed in March-May. In Hungary, investors in October earn a similar return as in January. In the Romanian market, in addition to January and December, significantly higher returns are also observed in August and February. The month of June in the Serbian as well as Bosnia and Herzegovina stock markets was distinguished by a price drop of 0.13-0.14% per day. In the Bosnia and Herzegovina market, stock prices also fell significantly in May during the research period. In 2009-2019, no manifestations of the month effect were found in the stock markets of Poland, Slovenia, Slovakia, and the Czech Republic. GARCH(1,1) model reveals high volatility persistence in all analyzed markets, indicating that volatility shocks decay slowly, implying that periods of high volatility tend to be followed by continued high volatility.

Table 4. Results of the month effect of Central and Eastern European stock returns applying GARCH(1,1), 2020-2025

	SOFIX	WIG	BET	BELEX15	SBITOP	BIRS	CROBEX	SAX	BUX	PX	OMXV	OMXR	OMXT
JAN	0.062	0.091	0.090	0.078	0.278*	-0.015	0.182*	-0.014	0.173**	0.171*	0.137*	0.071	0.213*
FEB	-0.025	0.098	0.060	0.036	0.353*	-0.143**	0.349*	0.020	0.157**	0.152**	0.005	-0.07**	0.008
MAR	0.267*	0.087	0.211**	0.085	0.075	-0.317*	0.121	-0.15**	-0.052	0.145	0.000	-0.020	0.210*
APR	0.065	0.129	0.001	-0.050	0.123	-0.047	0.014	0.038	0.096	0.026	0.138*	0.092	0.084
MAY	0.305*	0.214**	0.083	0.033	0.166*	-0.166*	0.033	0.039	0.157	0.000	0.111*	0.004	0.098**
JUN	0.019	0.074	0.038	0.010	0.070	-0.067	0.053	-0.028	0.156	-0.039	-0.063	1.030*	-0.020
JUL	-0.006	0.080	0.072	0.062	0.120	-0.045	0.042	-0.005	0.119	0.222	0.046	0.071	-0.029
AUG	0.049	-0.041	0.056	0.089	-0.033	0.000	0.036	-0.047	0.145**	0.012	0.081*	0.122**	-0.11**
SEP	-0.046	-0.110	0.088	0.000	-0.017	0.100	-0.030	-0.035	-0.074	0.043	-0.017	-0.030	-0.11**
OCT	-0.016	0.123	0.004	-0.001	0.013	-0.004	0.041	-0.035	0.146	0.047	0.109*	0.055	-0.046
NOV	0.055	0.160	0.116	0.050	0.188*	0.004	0.055	-0.049	0.228*	0.159	0.058	0.061	0.142*
DEC	0.235*	0.197	0.262*	0.057	0.060	-0.113*	0.134*	0.063	0.066	0.193	0.116*	-0.001	0.154*
ω	0.112	0.114	0.062	0.048	0.123	0.042	0.030	0.112	0.066	0.036	0.022	0.044	0.080
α	0.326	0.112	0.201	0.097	0.363	0.137	0.199	0.070	0.154	0.183	0.458	0.534	0.353
β	0.513	0.823	0.738	0.780	0.498	0.845	0.763	0.801	0.805	0.789	0.588	0.617	0.543

** significant at the 1% level, ** significant at the 5% level*

After examining the returns of Central and Eastern European stocks for the period of 2020-2025, it was found that the January effect was evident in six of the thirteen markets studied: Slovenia, Croatia, Hungary, the Czech Republic, Lithuania and Estonia. The stock markets of Bulgaria, Romania, Croatia, Lithuania and Estonia also evidenced significantly different returns in December as compared to other months. The December effect was also evident in Bulgaria and Romania in previous years, but the January effect disappeared in these markets in 2020-2025. Bulgarian stocks generated the highest returns in May and March in 2020-2025, while in the previous period, stock returns in these months were not statistically significantly different from the returns of other months. In the Polish market, unlike in the previous period, significantly higher returns were earned in May. This month, the seasonal effect of stock return growth is also observed in the stock markets of Slovenia, Lithuania and

Estonia. In the Lithuanian market, the seasonal increase in stock prices in May was also observed in the previous period of 2009-2019. In 2020-2025, stock of Latvian companies generated the highest return in July. In the Slovenian, Hungarian and Estonian markets, November is also significant for investors, although in previous years the November effect was observed only in the Estonian stock market. It is worthy of note that in the Bosnia and Herzegovina market, significant negative stock returns are observed in separate months: the largest price drop (reaching an average of 0.317% per day) occurred in March, smaller drops were observed in February, May and December. Although three months stood out significantly in the Serbian stock market in 2009-2019, no seasonal trends were observed in separate months in 2020-2025. In the Slovak stock market, only March was characterized by a more significant change in stocks prices as compared to other months during this period. The results of the ARCH effect research for this period also evidenced that short-term shock effects have intensified in some Eastern and Central European stock markets, leading to a greater reaction to news, and this was particularly evidenced in the markets of Bulgaria, Slovenia, Lithuania, Latvia and Estonia.

Table 5. Results of the month effect of Central and Eastern European stock returns applying EGARCH, 2009-2019

	SOFIX	WIG	BET	BELEX15	SBITOP	BIRS	CROBEX	SAX	BUX	PX	OMXV	OMXR	OMXT
JAN	0.123*	0.075	0.175*	0.115*	0.059	-0.170*	0.122*	-0.100**	0.151**	0.083	0.163*	0.145**	0.213*
FEB	-0.054	0.012	0.147*	-0.033	0.012	-0.049	-0.001	0.122**	-0.086	0.035	-0.018	-0.026	0.012
MAR	0.016	0.012	0.038	0.039	0.057	-0.002	-0.009	0.101	0.038	0.009	0.103*	-0.062	0.061
APR	-0.032	0.062	-0.004	0.037	0.035	-0.084*	-0.002	-0.034	0.126	0.043	0.074**	0.192*	0.045
MAY	-0.018	-0.059	-0.010	-0.021	0.016	-0.126*	-0.030	-0.139	-0.012	-0.119**	0.059	0.052	-0.068**
JUN	0.029	-0.049	-0.092	-0.123*	-0.090**	-0.077**	-0.002	-0.088	-0.108	-0.096**	-0.043**	0.175*	0.052
JUL	0.024	0.097	0.065	0.111*	0.013	-0.006	0.088**	-0.061	-0.001	0.120**	0.130*	0.082	0.070
AUG	0.032	0.059	0.126*	0.051	-0.062	0.045	0.043	0.009	0.026	0.008	-0.019	0.091**	-0.066**
SEP	-0.065	-0.002	0.043	-0.002	-0.011	0.034	0.035	-0.091	-0.052	0.012	0.001	0.070	-0.041
OCT	-0.106*	0.000	-0.036	0.057	0.022	0.039	-0.002	-0.048	0.148**	0.056	0.014	-0.005	0.051
NOV	-0.037	-0.073	-0.048	0.056	-0.047	0.012	-0.020	-0.031	-0.014	-0.051	0.028	0.026	0.074**
DEC	0.085**	0.034	0.233*	0.096*	0.042	-0.133*	-0.042	0.083	0.044	0.033	-0.054**	-0.102	-0.008
ω	-0.271	-0.090	-0.239	-0.238	-0.201	-0.089	-0.141	-0.033	-0.099	-0.157	-0.138	-0.147	-0.164
α	0.324	0.117	0.321	0.294	0.236	0.116	0.173	0.093	0.134	0.200	0.194	0.221	0.216
γ	-0.001	-0.053	-0.099	0.009	-0.014	0.045	-0.012	-0.043	-0.061	-0.055	-0.005	-0.021	-0.008
β	0.936	0.986	0.961	0.967	0.950	0.980	0.987	0.930	0.988	0.982	0.993	0.954	0.988

** significant at the 1% level, ** significant at the 5% level*

The results of the asymmetric EGARCH model confirmed the existence of the January effect in 2009-2019 in ten out of thirteen studied Central and Eastern European countries: Bulgaria, Romania, Serbia, Bosnia and Herzegovina, Croatia, Slovakia, Hungary, Lithuania, Latvia, and Estonia. However, unlike other markets, the Slovak as well as Bosnia and Herzegovina markets were characterized by significant negative stock returns in January. The negative June effect was evident even in five of the analyzed markets – Serbia, Slovenia, Bosnia and Herzegovina, the Czech Republic, and Lithuania. Meanwhile, in the Latvian market in 2009-2019, July was characterized by the highest return as compared to other months. The results of the EGARCH model also revealed that the August effect is manifested not only in the Romanian stock market, but also in Latvia, meanwhile in Estonia this month is characterized by a statistically significant negative return. The results of the EGARCH model also confirmed that a negative asymmetry effect is observed in many Central and Eastern European stock markets, i.e. negative news have a stronger impact on volatility than positive news.

Slightly different results of the manifestation of the month effect can be observed in the Central and Eastern European stock markets in 2020-2025, when analyzing the results of the EGARCH model. These results confirmed the existence of the January effect in Serbia,

Slovenia, the Czech Republic, Lithuania and Estonia. Although, based on the results of GARCH (1,1), it can be stated that the January effect manifests itself in the Hungarian stock market, the results of EGARCH did not confirm the existence of this effect. However, the January effect became evident in Serbia. In as many as seven of the markets studied, a significant effect is also observed in February.

Table 6. Results of the month effect of Central and Eastern European stock returns applying EGARCH, 2020-2025

	SOFIX	WIG	BET	BELEX15	SBITOP	BIRS	CROBEX	SAX	BUX	PX	OMXV	OMXR	OMXT
JAN	0.008	0.095	0.028	0.119*	0.269*	0.053	0.206*	-0.012	0.147	0.146*	0.127*	0.005	0.206*
FEB	-0.069	0.183**	0.047	0.011	0.339*	-0.076*	0.343*	0.248*	0.120	0.181*	0.010	0.009	0.134*
MAR	0.188*	-0.015	0.190**	0.103	0.026	-0.267*	0.087	-0.036	-0.032	0.120	-0.018	-0.144*	0.268*
APR	0.105**	0.034	-0.025	-0.005	0.116	-0.057*	-0.018	0.000	0.079	0.103	0.146*	-0.019	0.059
MAY	0.333*	0.111	0.078	-0.007	0.102	-0.146*	0.031	0.016	0.099	-0.054	0.070	0.021	0.061
JUN	-0.053	-0.001	0.026	-0.016	0.029	0.000	0.036	-0.003	0.045	-0.097	-0.066	0.670*	-0.043
JUL	-0.042	0.062	0.046	0.009	0.131*	0.024	0.025	0.037	0.035	0.171*	0.101*	0.036	-0.066
AUG	0.056	-0.080	0.028	0.097	-0.080	0.047	-0.011	-0.251*	0.097	-0.053	0.029	0.058	-0.059
SEP	-0.067	-0.173**	0.042	-0.036	-0.067	0.041	-0.048	-0.101*	-0.110	0.008	-0.024	-0.089**	-0.137*
OCT	-0.052	0.123	-0.019	-0.029	-0.005	-0.037	0.033	0.000	0.107	0.034	0.082*	-0.058	-0.047
NOV	0.028	0.041	0.125**	0.036	0.177*	-0.191*	0.018	-0.030	0.171**	0.114**	0.045	0.001	0.114*
DEC	0.247*	0.113	0.219*	0.192*	0.015	-0.105*	0.119*	0.067	0.020	0.161	0.116*	0.056	0.190*
ω	-0.430	-0.081	-0.257	-0.141	-0.436	-0.330	-0.258	-0.113	-0.152	-0.202	-0.327	-0.257	-0.417
α	0.419	0.124	0.312	0.133	0.475	0.490	0.289	0.173	0.208	0.244	0.380	0.345	0.452
γ	-0.117	-0.129	-0.099	-0.075	-0.115	0.277	-0.080	0.003	-0.110	-0.129	-0.044	-0.205	-0.090
β	0.834	0.962	0.927	0.951	0.848	0.887	0.943	0.911	0.959	0.955	0.961	0.951	0.890

** significant at the 1% level, ** significant at the 5% level*

In the markets of Poland, Slovenia, Croatia and Slovakia, namely in February stocks generated the highest returns. In 2020-2025, March was characterized by the highest loss in the markets of Bosnia and Herzegovina, as well as Latvia. In the Lithuanian market, the April effect, which also manifested itself in 2009-2019, became evident during the analysed period. The July effect remained only in the Latvian market. The results evidenced that in four markets – Poland, Slovakia, Latvia and Estonia – September in 2020-2025 was characterized by a significant negative return, although in the previous period the return of this month did not differ significantly from other months. In the markets of Romania, Slovenia, Hungary, the Czech Republic, and Estonia, a positive November effect also emerged, although in previous years it was characteristic only to the Estonian market. As in the previous period of 2009-2019, the positive December effect continued in the markets of Bulgaria, Romania and Serbia in 2020-2025 and newly emerged in the markets of Croatia, Lithuania and Estonia. The results of the EGARCH model highlighted a significantly increased short-term shock effect in many of the markets studied in 2020-2025, as well as an even stronger negative asymmetry effect as compared to 2009-2019, so this could have had a significant impact on changes in month effects.

5. CONCLUSION

Analysis of the previous research proves the existence of seasonal fluctuations, manifested as significant changes in stock returns in different months of the year in separate Eastern and Central European countries, but this is not a systematic and long-term unchanged phenomenon.

In 2009-2019, ten out of thirteen Central and Eastern European countries studied experienced the January effect, which persisted in five markets in 2020-2025, and newly emerged in one more market. In seven markets, the February effect became evident during this

period, and in six markets – the November effect. In 2020-2025, as in 2009-2019, a positive December effect remained in three markets, in one – a negative effect, and in three more markets this effect became apparent only in recent years.

The results of the EGARCH model confirmed that a negative asymmetry effect is observed in many Central and Eastern European stock markets, i.e. negative news have a stronger impact on volatility than positive news. And this effect became even more pronounced in 2020-2025. The results of the study evidenced that in 2020-2025, short-term shock effects intensified in the Eastern and Central European stock markets, leading to a greater reaction to news, and this was particularly pronounced in the markets of Bulgaria, Slovenia, Lithuania, Latvia and Estonia.

The results of this study confirm that since 2020, with the onset of intense fluctuations in the stock markets of Eastern and Central Europe, month effects have changed significantly as compared to previous periods, and this should be noted by investors. The results of the study will be valuable for investors, as they will help them make more informed decisions on investment portfolio optimization.

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