



ISSN: 2543-6821 (online)

Journal homepage: <http://ceej.wne.uw.edu.pl>

Monika Bolek,
Agata Gniadkowska-Szymańska,
Katerina Lyroudi

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To cite this article

Bolek M., Gniadkowska-Szymańska A., Lyroudi K. (2022). Covid-19 Pandemic and Day-of-the-week Anomaly in Omx Markets. Central European Economic Journal, 9(56), 158-177.

DOI: 10.2478/ceej-2022-0010

 To link to this article: <https://doi.org/10.2478/ceej-2022-0010>



Monika Bolek 

University of Lodz, Faculty of Economics and Sociology, 39 Rewolucji 1905, 90-214 Lodz, Poland

Agata Gniadkowska-Szymańska 

University of Lodz, Faculty of Economics and Sociology, 39 Rewolucji 1905, 90-214 Lodz, Poland
corresponding author: agata.gniadkowska@uni.lodz.pl

Katerina Lyrouti

Hellenic Open University, Par. Aristotle 18, 263 35, Patras, Greece

Covid-19 Pandemic and Day-of-the-week Anomaly in Omx Markets

Abstract

This paper aims to discuss market efficiency due to the changes that appeared in this field after the COVID-19 outburst. The OMX exchange and its indices are taken into consideration because they represent markets not analysed in such a context before (a) Baltic: Estonia, Latvia and Lithuania; (b) Scandinavian: Denmark, Finland, Iceland, Norway and Sweden). Two periods before and during the COVID-19 pandemic are considered (January 2009 to January 2020 and February 2020 to February 2021), and the efficient market hypothesis is tested together with the day-of-a-week effect anomaly to recognize the differences in market efficiency that could appear under special conditions, such as a pandemic. The results indicated that the impact of this pandemic on market efficiency was positive in most of the OMX markets studied. The added value of the article is related to supplementing the theory of market efficiency and showing that in difficult times investors make more rational decisions.

Keywords

COVID-19 | market efficiency | day-of-a-week anomaly

JEL Codes

G14, G10, G12

1. Introduction

In the beginning of 2020, there appeared a new disease, a coronavirus, that spread all over the world and caused infections and deaths at a very high speed and at very high rates, so that on March 11th 2020 the World Health Organization (WHO) proclaimed it a pandemic. The governments imposed severe measures to contain this pandemic, which had the negative effect of hurting their economies, since they suffered total lockdowns. The stock markets were also hit severely in the beginning of this pandemic, since investors' behaviour changed due to fear and panic caused by this health crisis.

Many researchers (Alamet et al., 2020; Apergis & Apergis, 2020; Baker et al., 2020; Ben Salem et al., 2020; Fanelli & Piazza, 2020; Gupta et al., 2020b; Huo et al., 2020; Just & Echaust, 2021; Khattak et al., 2021; Lee, 2020; Ozili & Arun, 2020; Ramelli & Wagner, 2020; and Roosa et al., 2020) have investigated this impact of COVID-19 on stock market performance, either for the whole market or for selected industries in many countries. However, they have not yet investigated the effect of the coronavirus pandemic on the day-of-the-week effect, a market anomaly, a part of the efficient markets hypothesis (EMH) (Fama et al., 1969). If the EMH holds, then there is no difference in the average daily returns among the days of a week when a stock exchange is operating. However, the currently

available literature shows that there appears to be an anomaly in the above hypothesis, and the returns vary significantly among the weekdays for some markets and for various time periods. This phenomenon of unequal returns influences investors' behaviour, so it is an important matter for study. The change in the behaviour of investors can affect the efficiency of the markets taken into consideration in a positive or negative way.

This study tries to fill the gap in the literature of the examination of the day-of-the-week anomaly during the coronavirus period from February 2020 to February 2021 by comparing it with the period between January 2009 and January 2020. Since the whole psychology of investors has changed, as well as all the known market conditions, it is expected that the market anomaly of the day-of-the-week effect that was observed in many markets before the pandemic might have been differentiated, which will have an impact on investors' behaviour and practitioners' strategies.

Most of the time, investors followed a certain strategy depending on their preferences. When a financial crisis occurs, investors' first goal is to protect their investments, so they have to respond fast, based on lessons learned from previous analyses of market crises in order to make the correct decisions and cover their exposure, as well as gain from the new conditions by changing and adjusting their portfolios accordingly. Therefore, the objective of the present study is to investigate how the investors' behaviour has changed regarding the day-of-the-week effect during the COVID-19 pandemic period.

We focus on the Baltic and Scandinavian markets, since there is no prior study focusing only on these specific markets to such an extent. There have been only a few studies examining this market anomaly for some of the selected markets among other markets, but never before grouped as Baltic and Scandinavian markets. The first group, the Baltic markets, are emerging and younger, with fewer listed companies, while the latter Scandinavian markets are all older markets, more mature with more listed companies and more developed, except for Iceland. We used daily trading data from January 1, 2009 to February 17, 2021 for all the indices that comprised the two groups of markets, since we wanted to capture this phenomenon after the 2008 global financial crisis.

The goal of this paper is related to the analysis of the EMH theory and the day-of-the-week effect before

and after February 2020, along with the difference tests on OMX markets. It is expected that there is a difference between periods, during the COVID-19 pandemic, depending on the day of the week on which OMX markets were analysed. The day-of-the-week-effect anomaly has been observed in developed and emerging economies, indicating that market development is not a factor determining the lack of market efficiency.

This paper adds to the literature on the OMX markets' EMH analysis before and after the COVID-19 outburst, indicating the influence of the pandemic on market behaviour, with special consideration of the day-of-the-week effect. It might be interesting to investigate investors' behaviour and decision-making under conditions of fear and uncertainty during a major health crisis.

In order to achieve our purpose, the paper is structured as follows: the next section contains a brief review of the literature regarding the phenomenon of the day-of-the-week effect in selected markets and the markets' reaction to the COVID-19 pandemic. The third section presents the methodology, the data, and the testable hypotheses. The fourth section presents and analyses the empirical results; it is followed by the discussion section; the last section summarizes and offers comments and suggestions for further research.

2. Review of the Literature

The literature related to COVID-19 and financial markets covers the analysis of a majority of stock exchanges around the world in relation to the period of the pandemic or to the comparison with the period before COVID-19. Researchers tend to test theories and apply different methods in the pandemic condition analysing COVID-19's influence on investors' and markets' behaviour. Such analyses are important for theories and market tests in abnormal situations. All of the empirical studies related to market analysis during the pandemic can help one to understand the results that are presented in this research related to market efficiency and market anomalies that appear as a consequence of irrational investor decisions.

The EMH in terms of COVID-19 was analysed by Okorie and Lin (2021a), who tested the impact of the COVID-19 outbreak on stock markets' adaptive information efficiency through shock analysis and found that the pandemic outburst affected these

markets' information efficiency. Vasileiou (2021) found that the U.S. stock market was not always efficient during the COVID-19 outbreak. Malafeyev et al. (2019) analysed the stock markets of two countries, China and India, and revealed that these stock markets did not exhibit market efficiency in its weak form. Caporale et al. (2020) analysed five European stock indices (but not the OMX) and found the presence of long memories, which could undermine market efficiency in its weak form. Market efficiency in relation to COVID-19 was analysed by Aslam et al. (2020), Dias et al. (2020), Niroomand et al. (2020), and Wang and Wang (2021), who found that prices on the exchanges did not fully reflect the information available and that changes in prices were not independent and identically distributed. Additionally, Njindan (2020) provided the evidence of market efficiency and predictability on emerging markets. Pardal et al. (2020) found very significant levels of stock market integration, which decreased the chances of portfolio diversification in the long term. Frezza et al. (2021) analysed the impact of the COVID-19 pandemic on the efficiency of 15 financial markets from Europe, the U.S., and Asia. They found that the Asian markets (Hang Seng, Nikkei 225, Kospi) have recovered full efficiency, while the European and the U.S. markets—after an initial rebound—have not yet returned to pre-crisis levels of efficiency.

COVID-19 was taken into consideration in OMX market analyses (Ashraf, 2020a, 2020b, 2021; Aslam et al., 2020; Bash, 2020; Chundakkadan & Nedumpambil, 2021; Khan et al., 2020; Pardal et al., 2020; Vera-Valdes, 2021; Yang & Deng, 2021) but researchers did not compare the day-of-the-week effect and market efficiency in the pre-COVID and COVID periods.

There are numerous studies regarding this market anomaly for several countries in all continents in developed and developing markets. Here we focus only on those studies that examined this phenomenon for some of the Baltic and the Scandinavian countries, among other markets selected, since there is no prior study focusing only on these specific markets. For instance, Zhang et al. (2017) investigated the day-of-the-week anomalies in stock returns of main indices in 28 markets from 25 countries over the world with the calendar effect performance ratio to measure the significance of day-of-the-week anomalies. The stock markets of Estonia, Latvia, and Lithuania are small, young, and developing, which implies that there should be inefficiencies compared to more

mature and developed stock markets like the Nordic markets. The weak form efficiency for Latvia and Lithuania was examined by Butkute and Moscinskis (1998), Klimasauskiene and Moscinskis (1998), Kvedaras and Basderant (2002), and Mihailov and Linowski (2002), but only later studies in the new century showed that these Baltic markets were weak form efficient. Furthermore, Kiete and Uloza (2005), tested the Lithuanian and Latvian stock markets for the semi-strong form efficiency by examining the markets' reactions to earnings announcements from 2001 to 2004. They found that both markets were inefficient regarding earnings announcements, implying that brokers and investors could find several investment opportunities.

Based on the literature, as early as 1973, the day-of-the-week anomaly was observed, with significant negative returns on Mondays and the highest positive returns on Fridays (Cross, 1973; Gibbons & Hess, 1981; Keim & Stambaugh, 1984; Rogalski, 1984; Theobald & Price, 1984). Apolinario et al. (2006) found abnormal volatility for the market of Denmark on Mondays and Fridays and for Sweden on Tuesdays and Fridays. However, there are other studies that found the presence of the day-of-the-week anomaly on another day. Particularly, negative returns were observed on Tuesdays, while the highest positive returns were observed also on Fridays, as above. Martikainen and Puttonen (1996) found a Tuesday effect for the Finnish market, giving as explanation the fact that this market was small and had infrequent trading, which increased the phenomenon whereby the selling orders placed on Mondays were not always executed on Mondays, but after one day, on Tuesdays.

Some other studies found no day-of-the-week-effect market anomaly, since the returns on each weekday were not statistically different or significant. Lyroudi et al. (2003) for the period 1997 to 2002 examined the presence of the day-of-the-week-effect anomaly for the markets of Romania, Hungary, Latvia, the Czech Republic, Russia, Slovakia, Slovenia, and Poland. This phenomenon was not present for the Latvian market. No day-of-the-week anomaly was found by Chukwuogor-Ndu (2006) for the markets of Switzerland and Denmark; by Apolinario et al. (2006) for the period 1997 to 2004 for Austria, Belgium, the Czech Republic, Denmark, France, Germany, Holland, Italy, Portugal, Spain, Sweden, and Switzerland; by Lyroudi (2007) for the period 2004 to 2007 for the Baltic markets comprising the OMX Baltic All-Share Index and by Borges (2009) for the period 1994 to

2007 for Austria, Denmark, France, Hungary, Italy, Poland, Portugal, Spain, Switzerland, and the United Kingdom.

Another day-of-the-week phenomenon we observed was positive Monday returns, a reverse Monday effect, as it is called. Brusa and Liu (2004) tried to explain the “reverse” Monday effect in the U.S. stock markets for the period 1988 to 1998 and found that there was a positive relation between the trading activities of institutional investors and the positive Monday returns, because the former provided excess liquidity to the market. Such a reverse Monday effect for the period October 6, 2006 to January 22, 2019, for the Swedish stock market was found by Sandahl (2019).

Ajayi et al. (2004) in studies of the Eastern European countries of Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, and Slovenia for the period 1994 or 1999 to 2002 found significant negative Monday returns for the Estonian and Lithuanian markets, and negative Tuesday returns for the Lithuanian market.

Yalcin and Yucel (2006) observed negative Monday returns for Estonia, Indonesia, Lithuania, Malaysia, Mexico, Slovenia, Thailand, and Turkey. India, Lithuania, Mexico, and South Korea had the highest Wednesday positive returns, while the Czech Republic, Estonia, and Hungary had the highest positive Thursday returns. So, the phenomenon varies across countries.

Borges (2009), for the period 1994 to 2007, found positive Friday returns in Greece, Iceland, Ireland and Norway, positive Tuesday returns in Germany, and negative Monday returns in Iceland.

Oprea and Tilica (2014), for the former East European post-Communist stock markets of Bosnia, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, and Ukraine from January 2005 to March 2014, found that most of them had no significant day-of-the-week-effect anomaly. Only Bosnia, Croatia, and Latvia had significant negative Friday average returns.

Cinko et al. (2015), for the period 1999 to 2013, found that there was a significant positive Thursday effect for Norway and significant positive returns on Fridays for Denmark, Finland, and Norway. Sandahl (2019), studying the Swedish stock market for the period October 6, 2006 to January 22, 2019, found a reverse Monday effect (positive Monday returns) and

positive Thursday returns for small-capitalization stocks and positive Wednesday, Thursday, and Friday returns for mid-capitalization stocks, while for large-capitalization stocks, there was no day-of-the-week anomaly.

The added value to the literature of the research results presented in the following sections is related to market efficiency testing concerns the OMX exchange, the securities listed there, and their response to the global problem, i.e., the pandemic.

3. Data, Methodology, and Hypotheses

For the achievement of the objective of this study, closing prices of the OMX indices were used to calculate the daily returns. The data used in the present study have been collected from the EIKON Thomson data base for the period after the economic crisis of 2008, from January 1, 2009 up to February 15, 2021. The entire research period was divided into two sub-periods:

- the pre-COVID period, from January 2009 to January 2020
- the period of the COVID pandemic, from February 2020 to February 2021

We stopped at the middle of February 2021 for two reasons: (a) because it was one year since the pandemic started in February 2020; and (b) because in February 2021 the vaccinations for COVID-19 were given permission to start being implemented. Therefore, the conditions, at least psychologically, with the introduction of the vaccine, had changed and were giving different signals, while we wanted to have noncontaminated data.

The Baltic markets examined are the Estonian, Latvian, and Lithuanian, whereby the equivalent indices are the Estonian in the stock exchange of Tallinn represented by OMXTGI, the Latvian in the stock exchange of Riga represented by OMXRGI, and the Lithuanian in the stock exchange of Vilnius represented by OMXVGI. There is also the OMX BGI index, the OMX Baltic All-Share Index, which consists of selections of equity securities listed on each of the Nasdaq Baltic Exchanges (AB Nasdaq Vilnius, Nasdaq Riga, AS, Nasdaq Tallinn AS). A security must be listed on one of the Nasdaq Baltic Exchanges (AB

Nasdaq Vilnius, Nasdaq Riga, AS, Nasdaq Tallinn AS) for inclusion in that Exchange's All-Share Index.

The Nordic group is composed of the Scandinavian markets of Denmark, Finland, Iceland, Norway, and Sweden represented by the equivalent indices. The OMXN40 Index is the OMX Nordic 40, a stock market index for the regional Nordic Stock Exchange that is a capitalization-weighted index composed of 40 most-traded stocks from the four stock markets operated by the OMX Group in the Nordic countries: Copenhagen, Helsinki, Reykjavík, and Stockholm. The OMXCPI Index is the OMX Copenhagen stock market index for the Copenhagen Stock Exchange. The OMXHPI Index is the OMX Helsinki All-Share Index that includes all the shares listed on the Helsinki Stock Exchange. The OMXH25 is the former HEX25 Index for the Helsinki Stock Exchange, which consists of the 25 most-traded stock classes. The OMXIPI is the OMX Iceland All-Share Index that includes all the shares listed on the OMX Nordic Exchange Iceland. The OBX Index is the main stock market index, which consists of the 25 most liquid companies of the Oslo Stock Exchange. The OSEAX index is the Oslo Børs All-Share Index, which consists of all shares listed on the Oslo Børs. The OMXS30 Index is the OMX Stockholm 30 Index, which is a capitalization-weighted index composed of the 30 most-traded stock classes in the Stockholm Stock Exchange; the OMXSPI index is a stock market index of all shares that trade on the Stockholm Stock Exchange.

To test the hypothesis for the presence of the day-of-the-week effect in each of the OMX stock markets we used the following regression formula:

$$R_t = \alpha_1 Mon_t + \alpha_2 Tues_t + \alpha_3 Wed_t + \alpha_4 Thu_t + \alpha_5 Fri_t + \varepsilon_t \quad (1)$$

where: R_t is the index return on day t ; Mon_t is the dummy variable equal to 1 if t is a Monday and 0 otherwise; $Tues_t$ is the dummy variable equal to 1 if t is a Tuesday and 0 otherwise; Wed_t is the dummy variable equal to 1 if t is a Wednesday and 0 otherwise; Thu_t is the dummy variable equal to 1 if t is a Thursday and 0 otherwise; Fri_t is the dummy variable equal to 1 if t is a Friday and 0 otherwise; ε_t is the error term.

The coefficients of the above regression equation (a_1, a_2, a_3, a_4, a_5) are the average returns for Monday through Friday. The OLS heteroskedasticity-corrected panel data method with dummy variables for each day of the week was followed by Ajayi et al. (2004), Balaban (1995), Brooks and Persaud (2001), Condoyanni et al.

(1987), French (1980), Gibbons and Hess (1981), Jaffe and Westerfield (1985a, 1985b), Kok and Wong (2004), Miralles and Miralles (2000), Mookerjee and Yu (1999), and Wong and Yuanto (1999).

The use of OLS in testing calendar anomalies should adhere to the assumptions of constant variance and no serial correlation among the error terms. Thus, tests should be performed to control for homoskedasticity, which states that all error terms have the same variance, and for any form of autocorrelation between error terms (Verbeek, 2012; Wooldridge, 2009). Accordingly, Durbin, Watson, and White's tests are conducted to test for any violation of the above stated assumptions.

In order to compare the two sample (pre-COVID-19) and (COVID-19) average returns for each weekday, we use the t -test statistic of two sample means.

Based on the research question of whether the COVID-19 health crisis caused any impact on the day-of-the-week anomaly in the Baltic and Scandinavian markets, we formed the following hypothesis that is tested in this study:

H_0 : According to the EMH by Fama et al. (1969), the average daily returns of each OMX index are expected to be the same for all the weekdays (Monday to Friday) in the selected stock exchanges, in both the pre-COVID-19 period and in the COVID-19 period.

If the average daily returns of each index are found to be statistically different for each weekday in the selected stock exchanges for both the pre-COVID-19 period and the COVID-19 period, this will imply rejection of the EMH and the existence of this calendar anomaly. Furthermore, if the average daily returns are found to be statistically different between the pre-COVID-19 period and the COVID-19 period for the equivalent weekday in the selected stock exchanges, then it can be assumed that there is a significant impact of COVID-19 on the markets.

4. Results and Analysis

In a first step, we provide information about the tested groups. The statistics for the indices in the periods before the COVID-19 outburst and during the pandemic are presented in Table 1.

Table 1. Statistics on the samples

	Pre-COVID-19 Period			COVID-19 Period		
	Number of Observations	Mean Returns	Standard Deviation	Number of Observations	Mean Returns	Standard Deviation
OMXTGI. OMX TALLINN – Estonia	2776	0.000603	0.009463	258	0.000408	0.012807
OMXRGI. OMX RIGA – Latvia	2776	0.000561	0.012448	258	0.000584	0.015723
OMXVGI. OMX VILNIUS – Lithuania	2776	0.000543	0.008687	258	0.059855	1.064850
OMX BGI – Baltic Countries	8328	0.000569	0.010326	776	0.000549	0.013152
OMXN40 – Four Nordic countries: Denmark, Finland, Iceland, and Sweden	4573	0.000216	0.014102	262	0.000844	0.015689
OMXCPI – Copenhagen, Denmark	6023	0.000434	0.010654	260	0.001020	0.013617
OMXHPI – OMX All-Share – HELSINKI – Finland	8298	0.000740	0.036425	262	0.000625	0.016920
OMXH25 – OMX HELSINKI 25 – Finland	7952	0.000344	0.014269	262	0.000632	0.017543
OMXIPI – OMX All-Share – REYKJAVIK – Iceland	6732	0.000309	0.012496	259	0.001503	0.014045
OBX – OSLO Norway	5121	0.000467	0.014687	262	0.000408	0.017277
OSEAX – OSLO Børs All-Share Norway	9305	0.000542	0.012786	264	0.000411	0.017313
OMXS30 – OMX STOCKHOLM 30 – Sweden	8365	0.000417	0.014129	262	0.000623	0.017515
OMXSPI – STOCKHOLM – Sweden	9239	0.051219	0.878145	262	0.000817	0.017238

Source: Own study

Based on the data provided in Table 1, the positive average rates of return were observed for all the analysed indices, both in the pre-COVID-19 and COVID-19 periods. Indices related to the Nordic countries are characterised by higher average rates of return than those of the Baltic countries, both in the pre-COVID-19 and COVID-19 periods. The volatility of the analysed rates of return, measured by the standard deviation, was also higher in the case of the Nordic countries. There is one exception related to the Lithuanian market OMXVGI Index, which, during the COVID-19 pandemic, was characterised by the highest average rate of return but also the highest volatility among all analysed indices.

In line with the testable hypothesis, we looked for the EMH confirmation, and we expected the average daily returns of each OMX index for each equivalent day of the week to be statistically different in the pre-COVID-19 period and the COVID-19 period for the equivalent day of the week on selected exchanges. Additionally, we analysed whether the

anomalies appeared or disappeared in the tested periods. Therefore, to address the first part of our hypothesis, we tested the parameters of Eq. (1) for each market index to investigate whether our testable hypothesis held. The regression results (coefficients, R-squared, *t*-statistics and F-statistic) are depicted in Table 2 for the pre-COVID-19 period and in Table 3 for the COVID-19 period for all indices. We ran the regular OLS model with heteroscedastic correction. The model specification was also analysed using the RESET test, which indicated the correctness of the model by using the *p*-value > 0.05. The RESET test results showed that the specification of the variables in the model was correct.

The regressions based on Eq. (1) for the chosen markets in the pre-COVID 19 period are presented in Table 2.

When analysing the results for the pre-Covid-19 period presented in Table 2, it can be observed that for all Baltic countries the null hypothesis concerning

Table 2. OLS regression results for the day-of-the-week effect: pre-COVID 19 period

	Sample	Const.	Mon	Tues	Wed	Thu	Fri	R ² %	Adj. R ² %	F-stat.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Explained variable: average daily returns										
OMXTGI.	2778	-0.000117998 (t = -0.0041)	0.000649 (t = 0.0225)	-8.41744e-05 (t = -0.0029)	0.001356 (t = 0.0471)	0.001191 (t = 0.0413)	0.000497 (t = 0.0173)	0.2916	0.1117	1.621343
OMX TALLINN - Estonia										
OMXRGI.	2778	0.010796 (t = 0.3179)	-0.0100172 (t = -0.2949)	-0.0102966 (t = -0.3031)	-0.0106046 (t = -0.3122)	-0.00959593 (t = -0.2825)	-0.0106924 (t = -0.3148)	0.1087	-0.0714	0.60357
OMX RIGA - Latvia										
OMXVGI.	2778	0.000842 (t = 0.3034)	-0.000134135 (t = -0.0479)	-0.000302315 (t = -0.1080)	-0.000735549 (t = -0.2628)	-0.000614961 (t = -0.2196)	0.000296 (t = 0.1057)	0.1699	-0.0101	0.943669
OMX VILNIUS - Lithuania										
BALTIC COUNTRIES	8334	0.00384 (t = 0.3669)	-0.0031676 (t = -0.3026)	-0.00356105 (t = -0.3402)	-0.00332814 (t = -0.3179)	-0.00300669 (t = -0.2872)	-0.00329957 (t = -0.3152)	0.0332	-0.0268	0.553843
OMXN40 - Denmark, Finland, Iceland, and Sweden	3977	-0.0250465 *** (t = -3.7691)	0.0254 *** (t = 3.5864)	0.02532 *** (t = 3.2024)	0.02605 ** (t = 3.2839)	0.02496 *** (t = 3.5379)	0.02576 *** (t = 3.3957)	0.3820	0.2036	0.30555**
OMXCPI - Copenhagen - Denmark	6023	0.0295 ** (t = 2.196)	-0.0286900 ** (t = -2.134)	-0.0294050 ** (t = -2.188)	-0.0285388 ** (t = -2.123)	-0.0293689 ** (t = -2.185)	-0.0286922 ** (t = -2.135)	0.6706	0.4907	1.644199 **
OMXHPI - OMX All-Share Helsinki - Finland	6737	-0.00173527 *** (t = -2.4188)	0.00165 ** (t = 1.8740)	0.00196 ** (t = 1.8028)	0.00256 (t = 0.2895)	0.00183 * (t = 1.400)	0.0022 (t = 0.1973)	0.0685	-0.1115	0.365847 *
OMXH25 - OMX HELSINKI 25 - Finland	7954	0.00067 (t = 0.1317)	-0.000679944 * (t = -1.866)	-0.000364358 (t = -0.2455)	0.00023 (t = 0.4946)	-0.000183178 (t = -0.4502)	-4.33138e-05 (t = -0.1493)	0.0541	-0.1258	0.001583
OMXIPI - OMX All-Share Reykjavik - Iceland	6737	0.00172 *** (t = 3.513)	-0.00240921 *** (t = -5.055)	-0.00150751 *** (t = -3.769)	-0.00106412 *** (t = -3.450)	-0.000763445 * (t = -1.883)	-0.000986440 *** (t = -2.870)	0.4257	0.2449	<0.0001 ***
OBX - OSLO - Norway	5121	-0.0315254 (t = -.0,0312)	0.03168 *** (t = 3.3093)	0.03222 *** (t = 3.7840)	0.03259 *** (t = 3.3676)	0.0317 ** (t = 2.0832)	0.03243 ** (t = 2.0962)	0.5188	0.3396	0.031827 *
OSEAX - OSLO Børs All-Share - Norway	9305	0.01695 (t = 0.7229)	-0.0169607 *** (t = -3.1255)	-0.0163644 *** (t = -2.8047)	-0.0160213 *** (t = -3.6203)	-0.0168485 ** (t = -2.6564)	-0.0159748 ** (t = -2.6140)	0.2578	0.0782	0.061277 **
OMXS30 - OMX STOCKHOLM 30 - Sweden	8365	-0.0206415 *** (t = -2.4585)	0.02055 *** (t = 3.3173)	0.02103 *** (t = 3.2603)	0.02126 ** (t = 2.1654)	0.0209 *** (t = 3.7251)	0.02161 *** (t = 3.1664)	0.2993	0.1197	0.033458 **
OMXSPI - Stockholm - Sweden	9239	-0.00917498 *** (t = -5.4412)	0.00911 *** (t = 3.6534)	0.0096 *** (t = 3.4262)	0.00992 ** (t = 1.8090)	0.0095 ** (t = 1.5332)	0.01021 *** (t = 2.7115)	0.161	-0.0188	0.070897 **

Note: */**/** indicate significance at the 10%/5%/1% level, respectively, of a two-tailed test.

Source: Own study.

Table 3. OLS regression results, COVID-19 period

	Sample	Const.	Mon	Tues	Wed	Thu	Fri	R ² %	Adj.R ² %	F-stat.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Explained variable: average daily returns										
OMXTGI. OMX TALLINN - Estonia	259	-0.00806343 (t = -0.6371)	0.012248 (t = 0.9588)	0.008246 (t = 0.6454)	0.007198 (t = 0.5635)	0.01009 (t = 0.7895)	0.004602 (t = .0.3601)	4.2437	2.3513	2.242461
OMXRGI. OMX RIGA - Latvia	259	-0.00117418 (t = -0.0749)	0.004642 (t = 0.2934)	0.000865 (t = 0.0547)	0.002482 (t = 0.1569)	0.003359 (t = 0.2122)	-0.00277662 (t = -0.1754)	2.5863	0.6611	1.343395
OMXVGI. OMX VILNIUS - Lithuania	259	0.009522 (t 0.9140)	-0.0084585 (t = -0.8043)	-0.00988527 (t = -0.9400)	-0.00690233 (t = -0.6562)	-0.00805887 (t = -0.7659)	-0.0112542 (t = -1.0696)	2.3496	0.4197	1.217484
BALTIC COUNTRIES	777	-0.00905749 (t = -0.6951)	0.011963 (t = 0.9152)	0.008842 (t = 0.6756)	0.010122 (t = 0.7744)	0.011023 (t = 0.8431)	0.006028 (t = 0.4611)	2.4806	1.8482	3.922341
OMXN40 - Denmark, Finland, Iceland, and Sweden	263	-0.0432432 *** (t = -2.8169)	0.045843 *** (t = 2.9585)	0.048156 *** (t = 3.1088)	0.044532 *** (t = 2.8744)	0.040679 *** (t = 2.6243)	0.041578 *** (t = 2.6813)	6.0921	4.2651	3.334466 **
OMXCPI - Copenhagen - Denmark	261	0.00294 (t = 0.2146)	-0.00118914 (t = -0.0860)	-0.000729008 (t = -0.0527)	-0.00127875 (t = -0.0925)	-0.00361197 (t = -0.2610)	-0.0031384 (t = -0.2267)	0.7139	-1.2329	0.3667
OMXHPI - OMX All-Share Helsinki - Finland	263	0.06388 *** (t = 3.8940)	-0.0637046 *** (t = -3.8478)	-0.0589557 *** (t = -3.5610)	-0.0630593 *** (t = -3.8088)	-0.0666889 *** (t = -4.0259)	-0.0654264 *** (t = -3.9482)	7.7922	5.9982	4.34364 ***
OMXH25 - OMX HELSINKI 25 - Finland	263	0.009535 (t = 0.5481)	-0.00940854 (t = -0.5359)	-0.00337906 (t = -0.1925)	-0.0082862 (t = -0.4720)	-0.0126644 (t = -0.7209)	-0.0115474 (t = -0.6570)	3.5336	1.6568	1.882797
OMXIPi - OMX All-Share Reykjavik - Iceland	260	0.015659 (t = 1.1284)	-0.0167938 (t = -1.1987)	-0.00978353 (t = -0.6987)	-0.0126375 (t = -0.9023)	-0.0167773 (t = -1.1968)	-0.0156065 (t = -1.1132)	4.2628	2.3783	2.61947
OBX - OSLO - Norway	263	0.052586 *** (t = 3.1320)	-0.0541017 *** (t = -3.1922)	-0.0468051 *** (t = -2.7622)	-0.0512983 *** (t = -3.0278)	-0.057061 *** (t = -3.3650)	-0.0530697 *** (t = -3.1296)	7.3553	5.5528	4.080755 **
OSEAX - OSLO Børs All-Share - Norway	265	-0.0186745 (t = -1.0953)	0.016583 (t = 0.9636)	0.025383 (t = 0.4754)	0.019528 (t = 0.1351)	0.014792 (t = 0.8594)	0.019174 (t = 1.1133)	4.8611	3.0245	2.646715
OMXS30 - OMX STOCKHOLM 30 - Sweden	263	-0.0123319 (t = -0.7127)	0.014953 (t = 0.8562)	0.018098 (t = 1.0365)	0.013151 (t = 0.7531)	0.008259 (t = 0.4726)	0.009823 (t = 0.5620)	4.2598	2.3971	2.28633
OMXSPI - Stockholm - Sweden	263	-0.0328851 * (t = -1.9357)	0.034436 ** (t = 2.0085)	0.038514 ** (t = 2.2467)	0.034724 ** (t = 2.0250)	0.029323 * (t = 1.7094)	0.031634 * (t = 1.8434)	4.7284	2.8748	2.550992 *

Note: */**/** indicate significance at the 10%/5%/1% level, respectively, of a two-tailed test.

Source: Own study.

market efficiency should be confirmed. However, for all Scandinavian countries, the null hypothesis should be rejected.

In the next stage, parameters of Eq. (1) were tested to investigate our testable hypothesis for the COVID-19 period. In this case, the period of one year related to the pandemic from February 2020 to February 2021 was analysed for all selected indices. Table 3 depicts the regression results (coefficients, R-squared, *t*-statistic and F-statistic) for the analysed markets during the COVID-19 period.

When analysing the results for the COVID-19 period presented in Table 3, it can be observed that for the Baltic Countries the null hypothesis concerning market efficiency should be confirmed. However, based on the results related to the Nordic countries, it can be stated that in some cases there was a day-of-the-week-effect anomaly identified during the pandemic.

This result is inconsistent with the EMH, which causes the rejection of our hypothesis except for Denmark, Finland (represented by the OMXH25 Index), Iceland and Norway (represented by the OSEAX Index), and Sweden (represented by the OMXS30 Index).

Table 4 reports the descriptive statistics (average daily returns and standard deviations) for the returns' distribution for the two periods examined for each OMX index. As can be observed, the average daily returns are not identical among the weekdays as it is presented in Table 4. The last column of Table 4 depicts the *p*-value of the *t*-statistic of two sample means, where the average daily returns between the pre-COVID-19 and the COVID-19 periods for each day for each examined index were compared.

For all the Baltic markets, the average returns for each weekday were all positive for the pre-COVID-19 period, with the highest average daily returns on

Table 4. Descriptive statistics of average daily returns for each index in pre- and COVID-19 periods and the comparison of two sample means *t*-tests

	Pre-COVID 19 Period			COVID 19 Period			Comparison
	Number of Observations	Mean Returns	Standard Deviation	Number of Observations	Mean Returns	Standard Deviation	<i>p</i> -value for means <i>t</i> -stat
OMXTGI. OMX TALLINN – Estonia							
All Days	2776	0.000603	0.009463	258	0.000408	0.012807	0.7596
Monday	551	0.000531	0.010847	53	0.004184	0.008230	0.0173*
Tuesday	560	-0.000202	0.008635	53	0.000183	0.007335	0.7536
Wednesday	561	0.001238	0.008705	52	-0.000866	0.015826	0.0001*
Thursday	552	0.001073	0.009292	50	0.002027	0.009165	0.4867
Friday	552	0.000379	0.009640	50	-0.003461	0.018689	0.0151*
OMXRGI. OMX RIGA – Latvia							
All Days	2776	0.000561	0.012448	258	0.000584	0.015723	0.9779
Monday	550	0.000779	0.011032	53	0.003467	0.019925	0.0001*
Tuesday	561	0.000499	0.012194	53	-0.000309	0.010163	0.6405
Wednesday	561	0.000191	0.013148	52	0.001308	0.012363	0.5561
Thursday	552	0.001200	0.013840	50	0.002185	0.008272	0.6207
Friday	552	0.000104	0.011795	50	-0.003951	0.022738	0.0356*
OMXVGI. OMX VILNIUS – Lithuania							
All Days	2776	0.000543	0.008687	258	0.059855	1.064850	0.0034*
Monday	550	0.000708	0.007501	53	0.103917	0.702093	0.0006*
Tuesday	561	0.000540	0.007727	53	-0.042913	1.169705	0.3756
Wednesday	561	0.000107	0.009181	52	0.256496	1.024408	0.0001*

Continued **Table 4.** Descriptive statistics of average daily returns for each index in pre- and COVID-19 periods and the comparison of two sample means *t*-tests

	Pre-COVID 19 Period			COVID 19 Period			Comparison
	Number of Observations	Mean Returns	Standard Deviation	Number of Observations	Mean Returns	Standard Deviation	<i>p</i> -value for means <i>t</i> -stat
OMXVGI. OMX VILNIUS – Lithuania							
Thursday	552	0.000227	0.009835	50	0.144732	0.555500	0.0001*
Friday	552	0.001139	0.008971	50	-0.185058	1.566919	0.0050*
OMX BGI BALTIC COUNTRIES							
All Days	8328	0.000569	0.010326	776	0.000549	0.013152	0.9599
Monday	1650	0.000673	0.009921	159	0.002905	0.013075	0.0087*
Tuesday	1683	0.000279	0.009712	159	-0.000215	0.009746	0.5400
Wednesday	1683	0.000512	0.010541	159	0.001064	0.013030	0.5371
Thursday	1656	0.000833	0.011176	149	0.001965	0.007748	0.2263
Friday	1656	0.000541	0.010210	150	-0.003029	0.018891	0.0002*
OMXN40 – Four NORDIC COUNTRIES – Denmark, Finland, Iceland, and Sweden							
All Days	4573	0.000216	0.014102	262	0.000844	0.015689	0.4861
Monday	908	0.000181	0.015724	53	0.002599	0.017434	0.2797
Tuesday	925	-0.000128	0.013536	55	0.004912	0.014118	0.0088*
Wednesday	927	0.000493	0.013987	54	0.001289	0.013689	0.6841
Thursday	910	0.000175	0.014298	51	-0.002564	0.018873	0.1918
Friday	903	0.000361	0.012827	49	-0.001665	0.011415	0.2793
OMXCPI – COPENHAGEN – Denmark							
All Days	6023	0.000434	0.010654	260	0.001020	0.013617	0.3914
Monday	1190	0.000551	0.011734	53	0.001750	0.015417	0.4735
Tuesday	1234	0.000181	0.010246	55	0.002211	0.011513	0.1530
Wednesday	1233	0.000526	0.010697	55	0.001661	0.012991	0.4460
Thursday	1187	0.000023	0.010470	49	-0.000672	0.016718	0.6678
Friday	1179	0.000898	0.010042	48	-0.000199	0.011127	0.4602
OMXHPI – OMX ALL-SHARE HELSINKI – Finland							
All Days	8298	0.000740	0.036425	262	0.000625	0.016920	0.9594
Monday	1654	0.000156	0.015388	54	0.000175	0.020499	0.9922
Tuesday	1687	0.001415	0.064659	54	0.004924	0.013589	0.6904
Wednesday	1689	-0.000320	0.023239	54	0.000820	0.015212	0.7204
Thursday	1646	0.000707	0.017483	51	-0.002809	0.019444	0.1589
Friday	1622	0.001174	0.014644	49	-0.001547	0.011123	0.1975
OMXH25 – OMX HELSINKI 25 – Finland							
All Days	7952	0.000344	0.014269	262	0.000632	0.017543	0.7498
Monday	1583	-0.000006	0.014977	54	0.000127	0.021140	0.9496
Tuesday	1614	-0.000054	0.014248	55	0.006156	0.016508	0.0016*
Wednesday	1618	0.000113	0.014478	54	0.001249	0.015809	0.5825
Thursday	1580	0.000668	0.014311	51	-0.003129	0.019910	0.0661*
Friday	1557	0.001023	0.013252	48	-0.002012	0.011588	0.1170

Continued **Table 4.** Descriptive statistics of average daily returns for each index in pre- and COVID-19 periods and the comparison of two sample means *t*-tests

	Pre-COVID 19 Period			COVID 19 Period			Comparison
	Number of Observations	Mean Returns	Standard Deviation	Number of Observations	Mean Returns	Standard Deviation	<i>p</i> -value for means <i>t</i> -stat
OMXIPI – OMX ALL-SHARE REYKJAVIK – Iceland							
All Days	6732	0.000309	0.012496	259	0.001503	0.014045	0.1332
Monday	1298	-0.000499	0.009211	52	-0.001135	0.018370	0.6435
Tuesday	1383	-0.000638	0.021791	55	0.005876	0.010077	0.0275*
Wednesday	1384	0.000505	0.008206	54	0.003022	0.010615	0.0291*
Thursday	1310	0.000926	0.008455	49	-0.001118	0.017174	0.1151
Friday	1357	0.001254	0.008368	49	0.000053	0.011266	0.3304
OBX – OSLO – Norway							
All Days	5121	0.000467	0.014687	262	0.000408	0.017277	0.9499
Monday	1003	0.000101	0.016232	53	-0.001516	0.022900	0.4903
Tuesday	1040	0.000448	0.013719	54	0.005781	0.011996	0.0052*
Wednesday	1043	0.000072	0.014299	55	0.001288	0.012954	0.5472
Thursday	1008	0.000764	0.015105	50	-0.004475	0.018890	0.0183*
Friday	1027	0.000955	0.014010	50	-0.000484	0.014988	0.4798
OSEAX – OSLO Børs ALL-SHARE -- Norway							
All Days	9305	0.000542	0.012786	264	0.000411	0.017313	0.8711
Monday	1824	0.000081	0.014129	53	-0.002092	0.023514	0.2813
Tuesday	1894	0.000227	0.012656	55	0.006708	0.013852	0.0002*
Wednesday	1896	0.000305	0.012558	55	0.000853	0.013268	0.7501
Thursday	1827	0.000700	0.012976	52	-0.003883	0.018458	0.0853
Friday	1864	0.001397	0.011481	49	0.000499	0.013914	0.5911
OMXS30 – OMX STOCKHOLM 30 – Sweden							
All Days	8365	0.000417	0.014129	262	0.000623	0.017515	0.8210
Monday	1650	0.000209	0.015907	54	0.002621	0.021219	0.2788
Tuesday	1702	0.000242	0.013351	55	0.005766	0.015538	0.0027*
Wednesday	1702	0.000288	0.013931	54	0.000819	0.014988	0.7833
Thursday	1672	0.000502	0.014070	50	-0.004073	0.020223	0.0257*
Friday	1639	0.000858	0.013257	49	-0.002509	0.012995	0.0798
OMXSPI – STOCKHOLM – Sweden							
All Days	9239	0.051219	0.878145	262	0.000817	0.017238	0.3529
Monday	1812	0.034482	0.692521	54	0.001551	0.021093	0.7269
Tuesday	1875	0.041690	0.825746	55	0.005629	0.015026	0.0012*
Wednesday	1879	0.030688	0.610717	53	0.001839	0.014346	0.7310
Thursday	1844	0.038302	0.764754	51	-0.003562	0.020407	0.6960
Friday	1829	0.111683	1.321152	49	-0.001251	0.011967	0.5498

Note: For all *p*-value < 0.05, the difference of means is considered to be statistically significant.

Source: Own study

Thursdays, while in the COVID-19 period, there was a negative Tuesday and Friday effect, and the highest average daily returns were observed on Mondays. This result shows that the market impact of COVID-19 is proven for Mondays and Fridays, which allows for the alternative hypothesis confirmation.

More specifically, the results presented in Table 4, last column, indicated that in the Estonian market the average returns were statistically different on Mondays, Wednesdays, and Fridays between the two periods taken into consideration. The most significant effect of COVID-19 was identified in the case of the Lithuanian market, where the average returns were different in all weekdays except for Tuesdays. In the Latvian market, the average returns were statistically different only on Mondays between the two periods. When we examined the index for all Baltic countries (OMXBGI), the differences between the average returns in the two tested periods were significant on Mondays and Fridays.

When the Scandinavian markets are taken into consideration in case of the OMXCPI and the OMXHPI indices, in Denmark and Finland, respectively, there was no significant difference between the average returns before COVID-19 and after the outburst of the pandemic. In case of the indices OMXN40, OMXSPI, OMXH25, and OSEAX, the average returns were statistically different on Tuesdays between the two periods. In case of the OMXS30 and the OBX, the average returns were statistically different on Tuesdays and on Thursdays in the two periods analysed, while for the OMXIPI, the average returns were statistically different on Tuesdays and Wednesdays.

The results presented in Table 4 confirm the alternative hypothesis for some Scandinavian countries (OMXN40, whereby it is composed of the markets in the Nordic countries of Denmark, Finland, Iceland, and Sweden; OMXH25 - OMX HELSINKI 25 - Finland; OMXIPI - OMX ALL-SHARE REYKJAVIK - Iceland; OBX - OSLO - Norway; OSEAX - OSLO Børs ALL-AHARE - Norway; OMXS30 - OMX STOCKHOLM 30 - Sweden; OMXSPI - STOCKHOLM - Sweden), and in the case of the Baltic countries, the alternative hypothesis can be confirmed for all countries.

Table 5 summarises and presents the existence of the specific anomaly of the day of the week based on the results presented in Tables 2 and 3 in the periods before and during the COVID-19 pandemic. Based on this juxtaposition, it is possible to verify and state

whether the market efficiency appeared or disappeared in relation to the COVID-19 pandemic outburst.

The results presented in Table 5 show that taking into account the Baltic countries (together and separately), the day-of-the-week effect was not recognized in the period before and after the outbreak of the COVID-19 pandemic, which results in acceptance of the EMH, with no day-of-the-week anomaly. In the case of the Scandinavian markets, the anomaly of the weekday effect persisted on the OMXN40, OMXSPI, and OBX indices for all days of the week before and during the COVID-19 pandemic. On the other hand, in the case of the OMXCPI, OMXS30, OSEAX, and OMIPI indices, there was a day-of-the-week effect in the period before COVID-19 for all days of the week. However, for the same indices in the COVID-19 period, the day-of-week effects were not found on all days of the week. For the OMXHPI index, no weekday effect was observed on Wednesdays and Fridays before COVID-19, but it was observed in the COVID-19 period on all the days of the week, which results in confirmation of the alternate hypothesis. For the OMXH25, no weekday effect was observed after the COVID-19 period on all the days of the week, while before COVID-19, it was only observed on Mondays, which results in confirmation of the alternate hypothesis.

5. Discussion

Regarding the pre-COVID-19 period, the Baltic markets were not affected by the day-of-the-week-effect anomaly based on the results in Table 2. Similar results were found for Estonia by Yalcin and Yucel (2006) and Oprea and Tilica (2014) and for Latvia by Lyroudi et al. (2003) for the period 1997 to 2002, while Oprea and Tilica (2014) found that the Latvian market had significant negative returns on Fridays. Furthermore, our results contrast with Ajayi et al. (2004) for the period 1994 to 2002, who found significant negative Monday returns for the Estonian market and significant negative Monday and Tuesday returns for the Lithuanian market.

Based on the above results, since the average returns for each weekday were not statistically significant, we can assume that they were the same. This result is in accordance with the EMH of Fama et al. (1969). In other words, the EMH holds for the OMX Baltic markets during the examined period.

Table 5. Difference between effects on markets taken into consideration

	Before COVID-19	COVID-19 Period	Result after Outburst
OMXTGI. OMX TALLINN – Estonia			
Monday	-	-	No change
Tuesday	-	-	No change
Wednesday	-	-	No change
Thursday	-	-	No change
Friday	-	-	No change
OMXRGI. OMX RIGA – Latvia			
Monday	-	-	No change
Tuesday	-	-	No change
Wednesday	-	-	No change
Thursday	-	-	No change
Friday	-	-	No change
OMXVGI. OMX VILNIUS – Lithuania			
Monday	-	-	No change
Tuesday	-	-	No change
Wednesday	-	-	No change
Thursday	-	-	No change
Friday	-	-	No change
OMXBGI – BALTIC COUNTRIES			
Monday	-	-	No change
Tuesday	-	-	No change
Wednesday	-	-	No change
Thursday	-	-	No change
Friday	-	-	No change
OMXN40 – Four NORDIC COUNTRIES - Denmark, Finland, Iceland, and Sweden			
Monday	+	+	No change
Tuesday	+	+	No change
Wednesday	+	+	No change
Thursday	+	+	No change
Friday	+	+	No change
OMXCPI – COPENHAGEN – Denmark			
Monday	+	-	Change
Tuesday	+	-	Change
Wednesday	+	-	Change
Thursday	+	-	Change
Friday	+	-	Change
OMXHPI – OMX ALL-SHARE HELSINKI – Finland			
Monday	+	+	No change
Tuesday	+	+	No change
Wednesday	-	+	Change
Thursday	+	+	No change
Friday	-	+	Change
OMXH25 – OMX HELSINKI 25 – Finland			
Monday	+	-	Change
Tuesday	-	-	No change
Wednesday	-	-	No change
Thursday	-	-	No change
Friday	-	-	No change
OMXIPI – OMX ALL-SHARE REYKJAVIK – Iceland			
Monday	+	-	Change
Tuesday	+	-	Change
Wednesday	+	-	Change
Thursday	+	-	Change
Friday	+	-	Change
OBX – OSLO – Norway			
Monday	+	+	No change
Tuesday	+	+	No change
Wednesday	+	+	No change
Thursday	+	+	No change
Friday	+	+	No change
OSEAX – OSLO Børs ALL-SHARE – Norway			
Monday	+	-	Change
Tuesday	+	-	Change
Wednesday	+	-	Change
Thursday	+	-	Change
Friday	+	-	Change
OMXS30 – OMX STOCKHOLM 30 – Sweden			
Monday	+	-	Change
Tuesday	+	-	Change
Wednesday	+	-	Change
Thursday	+	-	Change
Friday	+	-	Change
OMXSPI – STOCKHOLM – Sweden			
Monday	+	+	No change
Tuesday	+	+	No change
Wednesday	+	+	No change
Thursday	+	+	No change
Friday	+	+	No change

Source: Own study

However, this does not mean that the OMX Baltic markets are strongly efficient, or semi-strong or weak form efficient. This investigation is beyond the scope of this paper.

Table 2 also depicts the regression results for the Scandinavian markets of Denmark, Finland, Iceland, Norway, and Sweden and the OMX40 Index (all the above markets except Norway). For the OMX40 Index, there was a day-of-the-week effect observed. For the stock market of Denmark, there was a negative and significant effect on all weekdays, which contrasts with the study of Chukwuogor-Ndu (2006), who found no day-of-the-week effect for the Danish market. On the other hand, the study of Apolinario et al. (2006) found that the market of Denmark had a Monday and a Friday effect for the period 1997 to 2004. This result is inconsistent with the EMH.

For the market of Finland, two indices were analysed, whereby the OMXHPI index showed the reverse Monday effect and Tuesday and Thursday positive effect and the OMXH25 Index indicated only a Monday effect. These results are in accordance partially with the study of Martikainen and Puttonen (1996), who found a Tuesday effect for the market of Finland, while we found a Monday effect. Our result is inconsistent with the study of Borges (2009), who found significant positive average returns on Fridays in the period 1994–2007 in Finland.

For the market of Iceland, there was also a negative and significant effect on all weekdays, as in the case of Denmark. This result is partially consistent with the study of Borges (2009) in the sense that he also found significant returns on a weekday, Fridays, for the period 1994 to 2007 for Iceland, but his results gave positive Friday returns, while we found negative ones. Based on the above results, since the average returns for each weekday were statistically significant, we can assume that they are not the same. This result is inconsistent with the EMH.

For the market of Norway, the OBX Index had a positive day-of-the-week effect on all the weekdays, which means a reverse Monday effect, while the OSEAX Index had a negative and statistically significant day-of-the-week effect on all the weekdays. Our results contrast with Borges (2009), who found only a Friday effect, with the returns being positive and significant for Norway, but it was for the period 1994 to 2007. Based on the above results, since the average returns for each weekday were statistically significant, we can assume that they were not the

same. This result is inconsistent with the EMH (Fama et al., 1969).

For the market of Sweden, the day-of-the-week effect anomaly was present for the examined period 2009–2020, with positive effects on all days for both indices. Hence, we observed a reverse Monday effect in this market. Our results are similar to those of Sandahl (2019), who found positive significant returns on Mondays and Thursdays for small capitalisation firms and positive Wednesday, Thursday, and Friday returns for mid-capitalization firms, while there was no day-of-the-week effect for the large capitalisation firms for the period 2006 to 2019. Based on the above results, since the average returns for each weekday were statistically significant, we can assume that they are not the same. This result is inconsistent with the EMH (Fama et al., 1969).

Regarding the COVID-19 period, Table 3 depicts the regression results for all the examined indices. The Baltic markets individually and as a group did not have this market anomaly. These results are consistent with previous studies for Estonia, such as those by Yalcin and Yucel (2006) and Oprea and Tilica (2014). Based on the above results, since the average returns for each weekday were not statistically significant, we can assume that they are the same. This result is in accordance with the EMH of Fama et al. (1969). In other words, the EMH holds for the OMX Baltic markets during the examined period. We can infer that this health and financial crisis did not influence the Baltic markets in terms of market efficiency and calendar anomalies.

For the Baltic markets, we have observed that there is no day-of-the-week anomaly in the period before the pandemic or in the period after the pandemic, but the average daily returns are significantly different between the two periods. In this case, we can deduce that, for these markets, there is not a COVID-19 effect. The means of the daily returns are different for different time periods, but the pattern does not change due to the pandemic.

However, for the Scandinavian markets, we have observed that there is the day-of-the-week market anomaly. For the OMX40 Index, based on Table 3, the day-of-the-week-effect anomaly was present, with positive significant effects on all days. Based on the above results, since the average returns for each weekday were statistically significant, we can assume that they were not the same. This result is inconsistent with the EMH of Fama et al. (1969).

For the market of Denmark, the day-of-the-week-effect anomaly was not present for the COVID-19 period, based on the OMXCPI Index. This result is similar to the study of Chukwuogar-Ndu (2006), who found no day-of-the-week effect for the Danish market. Based on the above results, since the average returns for each weekday were not statistically significant, we can assume that they are the same. This result is consistent with the EMH (Fama et al., 1969). In other words, the EMH holds for the stock market of Denmark during the COVID-19 period, in contrast to the pre-COVID-19 period, where it existed.

For the market of Finland, the OMXH25 Index did not have the day-of-the-week anomaly, while the OMXHPI Index was characterized by significant effects on all weekdays for the COVID-19 period. Since the OMXHPI Index represents all the stocks listed in the Finnish market, we can infer that for this market, the day-of-the-week anomaly holds for all weekdays. These results are in accordance partially with the study of Martikainen and Puttonen (1996), who found a Tuesday effect for the market of Finland, while we found a negative effect on each weekday. Our result is inconsistent with the study of Borges (2009), who found significant positive returns on Fridays in the period 1994–2007 in Finland.

For the market of Iceland, the day-of-the-week anomaly did not exist for the COVID-19 period. This result is not in line with the study of Borges (2009), who found significant positive returns on Fridays in the period 1994–2007 for Iceland. Based on the above, we can assume that the EMH holds for the stock market of Iceland during the last year of the COVID-19 period, while it did exist for the pre-COVID-19 period.

For the market of Norway, the OBX Index presents a negative and significant effect on all weekdays for the COVID-19 period, while for the OSEAX Index, such anomalies were not observed. In this period, the results for each index are opposite to those in the pre-COVID-19 period. So, based on the OSEAX Index, we can conclude that the day-of-the-week effect anomaly was present in the stock market of Norway for both analysed periods. Our results are in contrast to Borges (2009), who found an effect only on Friday, with the returns being positive and significant, but for the period 1994 to 2007.

For the market of Sweden, the OMXSPI Index showed a significant positive day-of-the-week effect on all weekdays, while for the OMXS30 Index, such

anomalies were not observed for the COVID-19 period. Our results for the OMXSPI Index confirm the results obtained by Sandahl (2019), who found positive significant returns on Mondays and Thursdays for small capitalization firms and positive Wednesday, Thursday, and Friday returns for mid-capitalization firms, while there was no day-of-the-week effect for the large capitalization firms for the period 2006 to 2019. Here we observe a reverse Monday effect too, and for the OMXSPI Index, the existence of a market anomaly was not influenced by the COVID-19 pandemic.

For all Scandinavian markets except two (Denmark and Finland), there is a significant difference between the pre-COVID-19 period and the COVID-19 period in the average daily returns, and the days also change, so we can say that there is a pandemic effect for these markets.

6. Conclusions

This study examined the OMX stock exchanges in the Baltic and Scandinavian markets and investigated empirically the existence of the day-of-the-week-effect anomaly for the equivalent indices of each of these markets individually and for the group of the Baltic markets. The capital markets efficiency hypothesis shows that changes in stock prices occur randomly, so that the analysis of past price developments does not provide information on the basis of which rates of returns could be achieved higher than those resulting solely from the riskiness of a given security, as measured by the beta coefficient. This fundamental principle is challenged by research that denies the existence of certain seasonal dependencies in the distribution of rates of return. It turns out that even in highly developed markets, which have the best chance of meeting the efficiency conditions, the rate of return may depend on the day of the week or the time of the day.

To summarize, first of all, it was found that all Scandinavian markets were not efficient, and all Baltic countries were efficient before the COVID-19 outburst. During the pandemic, the EMH appeared on the same Nordic markets (OMXCPI – COPENHAGEN – Denmark; OMXH25 – OMX HELSINKI 25 – Finland; OSEAX – OSLO Børs ALL-SHARE – Norway; OMXS30 – OMX STOCKHOLM 30 – Sweden) and hold on all the Baltic markets. The

difference between average returns was significant on all the Baltic markets, indicating the impact of COVID-19. Moreover, the efficiency changed on the Scandinavian markets where some of them (OMXCPI – COPENHAGEN – Denmark; OMXH25 – OMX HELSINKI 25 – Finland; OSEAX – OSLO Børs ALL-SHARE – Norway; OMXS30 – OMX STOCKHOLM 30 – Sweden) became efficient after the pandemic outburst. In case of the OMXSPI Index, we observed a reverse Monday effect too, and for this market, the existence of market anomaly was not influenced by the COVID-19 pandemic, possibly because in Sweden the government did not take any severe measures against the pandemic, which did not cause any fear or terror in the investors and therefore, the latter did not change their behaviour.

Before the pandemic outburst, all Baltic markets were efficient, the same as during the COVID-19. On the other hand, all Scandinavian markets were not efficient, but some of them became efficient: OMXN40 – Nordic Countries: Denmark, Finland, Iceland, and Sweden; OMXIPI – OMX ALL-SHARE REYKJAVIK – Iceland; OSEAX – OSLO Børs ALL-SHARE – Norway; and OMXS30 – OMX STOCKHOLM 30 – Sweden. This may indicate that a specific set of information about the pandemic is not included in the valuation of shares or is taken into account with a long delay, which at the same time leads to the possibility of achieving above-average rates of return based on the above information. Based on the results, it can be stated that there is a positive impact of the COVID-19 pandemic on some markets' efficiency found in this paper.

Future research could focus on examining the effect of COVID-19 on the market efficiency and calendar anomalies of all the European countries; they could be distinguished into developed and developing markets for further insights. The same hypotheses can be examined for the U.S. and the Canadian markets. The results of these studies, apart from enriching the pertinent literature, could provide insights to policymakers and the governments when faced with dangerous health crises.

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