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Should Investors on Equity Markets Be Superstitious (on the Example of 52 World Stock Indices)?

Abstract

The problem of efficiency of financial markets, especially the weekend effect, has always fascinated scientists. The issue is significant from the point of view of assessing the portfolio management effectiveness and behavioral finance. This paper tests the hypothesis of the unfortunate dates effect upon52 equity indices in relation to the following four approaches: close – close, overnight, open-open, open-close calculated for the sessions falling on the 13th and 4th day of the month, Friday the 13th, Tuesday the 13th. In the following part of the paper, the statistical equality of one-session average rates of return (close-close) for sessions falling on Friday 13th and sessions falling on other Friday sessions will be compared, as well as for sessions falling on Tuesday the 13th and sessions falling on other Tuesdays. The last part of the paper consists of the analysis of the correlation coefficients of Friday the 13th (close-close) rates of return calculated for the analyzed equity indices' pairs.

Keywords: market efficiency, calendar anomalies, Friday the 13th, Tuesday the 13th, unfortunate dates effect
JEL Codes: G14, G15, C12

1. Introduction

The Efficient Market Hypothesis (EMH), introduced by Fama in 1970 belongs to the most important paradigms of the traditional financial theories[1]. According to this hypothesis, an efficient market was defined as a market with large numbers of rational individuals, maximizing their profit and actively competing with each other and trying to predict future market values of specific securities, and where all relevant information is freely available to investors[2]. The presence of calendar anomalies has been presented extensively for the last three decades in financial markets. The most common ones are the day-of-the-week effect, monthly effect, weekend effect, holiday effects, within-the-month effect, turn-of-the month effect, which were all analyzed by various researchers[3].

Another issue is the behavior of investors during the days considered by them to be unlucky. In Western Europe, every 13th day of a month, especially the 13th day of the month when falling on a Friday is believed to be unlucky. In turn, in Spanish-speaking countries (e.g. Spain, Uruguay, Argentina, Chile, Peru, Venezuela and Colombia), it is assumed that the date of bringing bad luck is Tuesday the 13th, which is expressed in the following Spanish proverb: *trece martes ni te cases,ni te embarques*

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[1] E. Fama, *Efficient capital markets: A review of theory and empirical work*, "Journal of Finance" 1970, Vol. 25, pp. 383–417.

[2] M. Latif, S. Arshad, M. Fatima, S. Rarooq, *Market efficiency, market anomalies, causes, evidences and some behavioral aspects of market anomalies*, "Research Journal of Finance and Accounting" 2011, Vol. 2, 9/10, pp. 1–14.

[3] For example:

1. M. Smirlock, M. Starks, *Day-of-the-week and intraday effects in stock returns*, "Journal of Financial Economics" 1986, Vol. 17, pp. 197–210.
2. R. Aggarval, P. Rivoli, *Seasonal and day-of-the week effects in four emerging stock markets*, "Financial Review" 1989, Vol. 24, pp. 541–550.
3. E. Barone, *The Italian stock market: Efficiency and calendar anomalies*, "Journal of Banking and Finance" 1990, Vol. 14, pp. 493–510.
4. K. Kato, S. Schwarz, W. Ziemba, *Day of the weekend effects in Japanese stocks, Japanese Capital Markets*, Ballinger, New York 1990.
5. A. Agrawal, K. Tandon, *Anomalies or illusions?: Evidence from stock markets in eighteen countries*, "Journal of International Money and Finance" 1994, Vol. 13, pp. 83–106.
6. D. Boudreaux, *The monthly effect in international stock markets: evidence and implications*, "Journal of Financial and Strategic Decisions" 1995, Vol. 8, 1, pp. 15–20.
7. W. Schwert, *Anomalies and market efficiency*, Simon School of Business Working Paper no. FR 02–13, 2002.
8. A. Gu, *The declining January effect: Evidence from U.S. equity markets*, "Quarterly Review of Economics and Finance" 2003, Vol. 43, pp. 395–404.
9. P. Sutheebanjard, W. Premchaiswadi, *Analysis of calendar effects: Day-of-the-week effect on the Stock Exchange of Thailand (SET)*, "International Journal of Trade, Economics and Finance" 2010, Vol.1, pp. 2010–2023.

(Tuesday the 13th, don't get married and don't travel). On the other hand, in China, an unlucky date is every fourth day of the month. Many Chinese people believe number 4 to be unlucky, whilst considering number 8 to be a lucky one[4]. In some Chinese dialects, number 8 is pronounced like the word "prosperity", while number 4 is similar to the word "death". Apparently, the Chinese vary in their definition of which numbers are lucky. Shum et al.[5] defined both 6 and 8 as lucky, while Hirshleifer et al. considered 6, 8 and 9 to be lucky[6].

Statistically, an important difference between daily average rates of return registered on the stock market considered by investors as an unlucky date and daily average rates of return calculated for the other days of the month can be called "the unfortunate dates effect". The number of studies on "the unfortunate dates effect" in scientific literature is rather low.

The aim of this paper is to examine the prevalence of the unfortunate dates effect on the markets of 52 equity indices. The paper is divided into six parts. In the first four parts, the analysis of the unfortunate dates effect will apply to the returns calculated on the basis of the following prices: (1) last session close – previous session close (close-close), (2) last session open – previous session close (overnight), (3) last session open – previous session open (open-open) and (4) last session close – last session open (open-close). All these calculations will be carried out for the following two populations: (1) the 13th day of the month rates of return vs rates of return for all other sessions, (2) Friday the 13th rates of return vs rates of return for all other sessions, (3) Tuesday the 13th rates of return vs rates of return for all other sessions and (4) the 4th day of month rates of return vs rates of return for all other sessions. In the fifth part of the paper, the one-session rates of return for Friday the 13th session will be compared with the one-session rates of return for all other Fridays. In turn, in the second part of the fifth part of the paper, a similar analysis for the rates of return for Tuesday the 13th and all other Tuesdays will be conducted. The last part of the paper consists of the analysis of the correlation coefficients of Friday the 13th (close-close) rates of return calculated for the analyzed equity indices' pairs.

Previous research focused on the calculation of rates of return only for the following scheme: Friday the 13th close – others Fridays' close. The author is not aware of the papers analyzing the Friday the 13th effect with the use of the rates of return

[4] S. Agarwal, J. He, H. Liu, I. Png, T. Sing, W. Wong, *Superstition and assets markets: Evidence from Singapore housing*, SSRN Working Paper, 2416832, 2014.

[5] M. Shum, W. Sun, G. Ye, *Superstition and 'lucky' apartments: Evidence from transaction-level data*, "Journal of Comparative Economics" 2014, Vol. 42, 1, pp. 109–117

[6] D. Hirshleifer, J. Ming, Z. Huai, *Superstition and financial decision making*, Working Paper, University of California, Irvine 2012.

different to the close-close scheme. This article attempts to fill this gap, as well as expand research for Tuesday the 13th and for the sessions falling on the 4th day of the month.

2. Literature Review

Belief in the ill-fortune that supposedly accompanies the of 13th as well as the date of Friday the 13th is widespread across the Western world and has ancient and somewhat uncertain origins[7]. Both number 13 and Friday are characterized by long and separate histories associated with "bad luck". It is believed that these two were combined in order to create an unfortunate date at the beginning of the 20th century[8]. In literature there are a lot of explanations for these two lines of superstitions: Christ was crucified on Friday, and the number of people seated at the table for the Last Supper was 13. Even in advanced countries, people are prone to superstitions such as daily newspapers publishing horoscopes to guide their readers. Nowadays many buildings skip the thirteenth floor, streets lack number 13th and hospitals decline to label their operating theatres with that number[9]. Fudenberg and Levine theorize that superstitious beliefs can persist if the probability of being exposed as untrue is sufficiently low[10]. If there is always any chance of a bad outcome when following the superstition and some chance of a good outcome when not following the superstition, any person might not realize that the belief is untrue, and, persists in the superstition[11]. Psychology and anthropology researchers suggest that people rely on superstition as a way to cope with misfortune and uncertainty, and to rationalize a complex world[12].

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[7] G. Boyle, A. Hagan, S. O'Connor, N. Whitwell, *Emotion, fear and superstition in the New Zealand stock market*, Working Paper New Zealand Institute for the Study of Competition and Regulation Inc., 2014.

[8] C. Chaundler, *Every Man's Book of Superstition*, A.R. Mowbray and Co., London 1970.

[9] For example:

1. G. Boyle, A. Hagan, S. O'Connor, N. Whitwell, *Emotion, fear and superstition in the New Zealand stock market*, Working Paper New Zealand Institute for the Study of Competition and Regulation Inc., 2014.
2. USA Today, *Some hotels don't skip the 13th floor anymore*, August 3, 2007.
3. T. Kramer, L. Block, *Conscious and non-conscious components of superstitious beliefs in judgment and decision-making*, "Journal of Consumer Research" 2008, Vol. 34, 6, pp. 783–793.

[10] D. Fudenberg, D. Levine, *Superstition and rational learning*, "American Economic Review" 2006, Vol. 96, 3, pp. 630–651.

[11] S. Agarwal, J. He, H. Liu, I. Png, T. Sing, Wong W., *Superstition and assets markets: Evidence from Singapore housing*, SSRN Working Paper, 2416832, 2014.

[12] For example:

1. E. Tsang, *Toward a scientific inquiry into superstitious business decision-making*, "Organization Studies" 2004, Vol. 25, 6, pp. 923–945.

Scanlon et al. found that the number of traffic accidents in the UK is higher on Friday the 13th, in spite of the smaller number of cars being on the roads[13]. Kolb and Rodriguez[14], in one of the first studies linking superstition with the stock market, proved that the average Friday 13th rates of return are significantly lower than the average rates of return for all other Fridays but the later papers of Dyl and Maberly[15], Agrawal and Tandon[16], Coutts[17] and Lucey[18] conceded the reverse pattern: the average returns on Fridays the 13th were higher than those on regular Fridays. Dyl and Maberly proved that in five out of the six analyzed periods, Friday the 13th rates of return turned out to be positive and higher compared to other Fridays and the only period when the Friday the 13th rates of return were in the red compared to other Fridays rates of return, fell during the 1970s[19].

Fortin et al. investigated the effect of superstition on the prices of single-family homes in Great Vancouver in Canada[20]. In the neighborhoods with relatively more Chinese residents and in repeated transactions, the sales of the houses with street address numbers ending in "4" were 2.2% lower, while those ending in "8" were 2.5% higher than other houses. According to Agarwal et al, on a per square meter basis, units with numbers ending in "4" were discounted by 1.1%, units on the floor with numbers ending in "4" were discounted by 0.5%, while units with numbers ending in "8" commanded a 0.9% premium[21]. Ng et al. studying the auction prices between 1997 and 2009 proved that the prices of license numbers including the lucky number 8 were systematically higher, while the prices of license numbers with the unlucky

2. G. Lepori, *Dark omens in the sky: Do superstitious beliefs affect investment decisions?*, SSRN Working Paper 1428792, 2009.
3. Y. Zhang, J. Risen, C. Hosey, *Reversing one's fortune by pushing away bad luck*, "Journal of Experimental Psychology" 2014, Vol. 143, 3, pp.1171–1184.

[13] T. Scalon, R. Luben, F. Scalon, N. Singleton, *Is Friday the 13th bad for your health?*, "British Medical Journal" 1993, Vol. 307, pp. 1584–1587.

[14] E. Kolb, R. Rodriguez, *Friday the thirteenth: part VII – a note*, "Journal of Finance" 1987, Vol. 42, pp. 1385–1387.

[15] E. Dyl, E. Maberly, *The anomaly that isn't there: A comment on Friday the Thirteenth*, "Journal of Finance" 1988, Vol. 43, pp. 1286–1295.

[16] A. Agrawal, K. Tandon, *Anomalies or illusions? Evidence from stock markets in eighteen countries*, "Journal of International Money and Finance" 1994, Vol. 13, pp. 83–106.

[17] J. Coutts, *Friday the thirteenth and the Financial Times industrial ordinary shares index 1935–94*, "Applied Economics Letters" 1999, Vol. 6, pp. 35–37.

[18] B. Lucey B., *Friday the 13th and the philosophical basis of financial economics*, "Journal of Economics and Finance" 2000, Vol. 24, pp. 294–301.

[19] E. Dyl, E. Maberly, *The anomaly that isn't there: A comment on Friday the Thirteenth*, "Journal of Finance" 1988, Vol. 43, pp. 1286–1295.

[20] N. Fortin, A. Hill, J. Huang, *Superstition in the housing market*, Discussion Paper No. 7484, IZA, Bonn, 2013.

[21] S. Agarwal, J. He, H. Liu, I. Png, T. Sing, Wong W., *Superstition and assets markets: Evidence from Singapore housing*, SSRN Working Paper, 2416832, 2014.

number "4", were lower[22]. Besides, the premium for "8" could also be interpreted as conspicuous spending to signal wealth or status[23].

Boyle et al., analyzing daily returns of the index NZSE40, the value-weighted capital index of the 40 largest securities by market capitalization on the New Zealand Stock Exchange in the period 01.01.1967–30.11.2001, certified the average rates of return for Fridays the 13th were not statistically different form the rates of return for regular Fridays[24]. The name of "the Friday the Thirteenth effect", introduced by Kolb and Rodriguez[25] has been regularly used by different researchers[26]. Coutts examining the Friday the 13th effect in the UK with the use of FTSE index in the period of 59 years, proved that in most cases the rates of return registered for Friday the 13th were positive and higher compared to other Fridays' rates of return but statistical significance was not observed[27]. Patel, analyzing the period of 58 years for NASDAQ and S&P 500 index, discovered that in four out of the seven periods, the rates of return for Friday the 13th were positive and higher than the rates of return calculated for other Fridays[28].

Hirshleifer et al. found that the superstition affected the pricing of initial public offerings in China in the period of 1991–2005[29]. On Shanghai and Shenzhen stock exchanges, listed companies are identified by a numerical code, which is the equivalent of the US ticker. Consistent with the superstition, newly listed equities with lucky

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[22] T. Ng, T. Chong, X. Du, *The value of superstitions*, "Journal of Economic Psychology" 2010, Vol. 31, 3, pp. 293–309.

[23] N. Feltovich, R. Harbaugh, T. To, *Too cool for school. Signaling and countersignalling*, "RAND Journal of Economics" 2002, Vol. 33, 4, pp. 630–649.

[24] G. Boyle, A. Hagan, S. O'Connor, N. Whitwell, *Emotion, fear and superstition in the New Zealand stock market*, Working Paper New Zealand Institute for the Study of Competition and Regulation Inc., 2014.

[25] E. Kolb, R. Rodriguez, *Friday the thirteenth: part VII – a note*, "Journal of Finance" 1987, Vol. 42, pp. 1385–1387.

[26] For example:

1. T. Chamberlain, C. Cheung, C. Kwan, *The Friday the Thirteenth effect: Myth or reality*, "Quarterly Journal of Business and Economics" 1991, Vol. 30, pp. 111–117.
2. J. Coutts, *Friday the thirteenth and the Financial Times industrial ordinary shares index 1935–94*, "Applied Economics Letters" 1999, Vol. 6, pp. 35–37.
3. J. Patel, *Recent evidence on Friday the thirteenth effect in U.S. stock returns*, "Journal of Business and Economics Research" 2009, Vol. 7, pp. 55–58.
4. F. Botha, *Stock returns and Friday the 13th effect in five African countries*, "African Review of Economics and Finance" 2013, Vol. 4, 2, pp. 247–253.
5. B. Auer, H. Rottman, *Is there a Friday the 13th effect in emerging Asian stock markets?*, OTH im Dialog: "Weidener Discussionpapiere", No. 35, ISBN 978-3-937804-37-8, 2013.

[27] J. Coutts, *Friday the thirteenth and the Financial Times industrial ordinary shares index 1935–94*, "Applied Economics Letters" 1999, Vol. 6, pp. 35–37.

[28] J. Patel, *Recent evidence on Friday the thirteenth effect in U.S. stock returns*, "Journal of Business and Economics Research" 2009, Vol. 7, pp. 55–58.

[29] D. Hirshleifer, J. Ming, Z. Huai, *Superstition and financial decision making*, Working Paper, University of California, Irvine 2012.

listing codes (that included at least one lucky digit and no unlucky digit) that initially traded at a premium dissipated within three years. Botha analyzed the Friday the 13th effect for the samples from stock exchanges in Kenya, Morocco, Nigeria, South Africa and Tunisia[30]. Auer and Rottmann proved that the Friday the 13th effect was not registered for the Stock Exchange in the Phillipines[31]. Kalayaan found out that the mean returns for Friday the 13th were inferior than that of other Fridays or other days and that the Friday the 13th effect was evident during the period from June 1992 to May 2015 for the PSEI index[32].

3. Data and Methods

The research is divided into six parts. The calculations were proceeded concerning 52 world stock indices (in the brackets the date of the first session included in the analysis, quotation from the Reuters Service):

AEX (03.01.1983), All Ordinaries (01.01.1980), AMEX (03.01.1995), ATHEX COMPOSITE (02.01.1987), BEL20 (02.01.1992), BOVESPA (02.01.1992), BUX (02.01.1991), CAC40 (02.01.1969), DAX (28.09.1959), DJIA (02.01.1900), DJTA (02.01.1900), DJUA (02.01.1929), EOE (02.01.1995), FTSE 250 (30.12.1985), FTSE MIB (02.01.1998), HANG SENG (24.11.1969), HEX (02.01.1995), IBEX (05.01.1987), ICEX (31.12.1992), IPC (08.11.1991), IPSA (02.01.1987), JCI (04.04.1983), KLCI (03.01.1977), KOSPI (04.01.1980), MERVAL (29.08.1988), MICEX (22.09.1997), NASDAQ COMPOSITE (03.01.1938), NASDAQ 100 (01.10.1985), NIKKEI (16.05.1949), OMX STOCKHOLM (30.09.1986), OSE (03.01.1983), PX (07.09.1993), PSEI (02.01.1986), PSI20 (31.12.1992), RTS (01.09.1995), SAX (03.07.1995), SENSEX (03.04.1979), SET (02.07.1987), SMI (01.07.1988), SOFIX (26.11.2001), S&P 500 (02.01.1900), SP TSX COMPOSITE (03.01.1961), SSE B SHARES (11.05.1998), SSE COMPOSITE (19.12.1990),STRAIT TIMES (28.12.1987), TAIEX (05.01.1995), TECDAX (16.09.1999), TSE 300 (15.08.1989), UK 100 (13.11.1935), UX (03.11.1997), WIG (16.04.1991), XU 100 (02.01.1990).

The last session considered in the process of calculating the rates of return was 30.12.2016.

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[30] F. Botha, *Stock returns and Friday the 13th effect in five African countries*, "African Review of Economics and Finance" 2013, Vol. 4, 2, pp. 247–253.

[31] B. Auer, H. Rottman, *Is there a Friday the 13th effect in emerging Asian stock markets?*, OTH im Dialog: "Weidener Discussionpapiere", No. 35, ISBN 978-3-937804-37-8, 2013.

[32] C. Kalayaan, *Superstition in the Philippine stock market*, "Review of Integrative Business and Economics Research" 2016, Vol. 5, 2, pp. 84–96.

In the case of two populations, the null hypothesis H_0 and the alternative hypothesis H_1 regarding equality of rates of return in two populations, can be formulated as follows:

$$H_0 : E(\overline{r_1}) = E(\overline{r_2})$$
$$H_1 : E(\overline{r_1}) \neq E(\overline{r_2}) \quad (1)$$

where:
$\overline{r_1}$ –average rate of return in the first population;
r_2 –average rate of return in the second population.

On the basis of two independent populations of the rates of return, whose sizes equal n_1 and n_2, respectively, the hypotheses H_0 and H_1 should be tested with the use of statistics z[33]:

$$z = \frac{\overline{r}_1 - \overline{r}_2}{\sqrt{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)}} \quad (2)$$

where:
S_1^2- variance of rates of return in the first population;
S_2^2- variance of rates of return in the second population;
n_1 – number of observations in the first population;
n_2 – number of observations in the second population.

In the case when the population variances are unknown and cannot be assumed that they are equal, the number of degrees of freedom will be expressed according to the following formula[34]:

$$df = \frac{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^2}{\frac{\left(S_1^2/n_1\right)^2}{n_1} + \frac{\left(S_2^2/n_2\right)^2}{n_2}} \quad (3)$$

In the following part of the analysis, parametric tests of Kruskal-Wallis will be implemented. The Kruskal-Wallis test statistics is given by[35]:

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[33] R. Defusco, D. McLeavey, J. Pinto, D. Runkle, *Quantitative Methods for Investment Analysis*, United Book Press, Baltimore 2001, p. 335.

[34] R. Defusco, D. McLeavey, J. Pinto, D. Runkle, *Quantitative Methods for Investment Analysis*, United Book Press, Baltimore 2001, p. 335.

[35] A. Vargha, H. Delaney, *Kruskal-Wallis test and stochastic homogeneity*, "Journal of Educational and Behavioral Statistics" 1998, Vol. 23, 2, pp. 170–192.

$$H = \frac{12}{N(N+1)} \sum_{i=1}^{i=g} n_i \overline{r_i}^2 - 3(N+1) \tag{4}$$

where:

N – total number of observations across all the groups;

$\overline{r_i} = \frac{\sum_{j=1}^{n_i} r_{ij}}{n_i}$ – average rank of all the observations in group i;

n_i – number of observations in group i;

r_{ij} – the rank (among all the observations) of observation j from group i.

In all the analyzed cases, the *p-values* will be calculated. If the *p-value* is less than or equal to 0.05, then hypothesis H_0 is rejected in favor of hypothesis H_1. Otherwise,there is no reason to reject hypothesis H_0.

For each of the analyzed indices the following rates of return will be calculated:

a) Close – Close: $\frac{C_t - C_{t-1}}{C_{t-1}}$ (last session close vs previous session close)

b) Overnight: $\frac{O_t - C_{t-1}}{C_{t-1}}$ (last session open vs previous session close)

c) Open – Open: $\frac{O_t - O_{t-1}}{O_{t-1}}$ (last session open vs previous session open)

d) Open – Close: $\frac{C_t - O_t}{O_t}$ (last session close vs last session open)

Where:

C_t – closing price in period t;

C_{t-1} – closing price in period t–1;

O_t – open price in period t;

O_{t-1} – open price in period t–1.

The paper consists of six parts:

In the first part, the test for equality of two average rates of return will be exemplified for the rates of return in two populations. Assuming that if the first population is composed of the rates of return calculated for the session on the 13th day of the month, then the second population determines the rates of return for all the remaining sessions.

In the second part, the test for equality of two one-session average rates of return will be exemplified for the rates of return in two populations. Assuming that if the first population is composed of the rates of return calculated for the session falling

on Friday the 13th day of the month, then the second population determines the rates of return for all the remaining sessions.

In the third part, the test for equality of two average rates of return will be exemplified for the rates of return in two populations. Assuming that if the first population is composed of the rates of return calculated for the session falling on Tuesday the 13th day of the month, then the second population determines the rates of return for all the remaining sessions.

In the fourth part, the test for equality of two average rates of return will be exemplified for the rates of return in two populations. Assuming that if the first population is composed of the rates of return calculated for the session falling on the 4th day of the month, then the second population determines the rates of return for all the remaining sessions.

In the fifth part, the test for equality of two average rates of return will be exemplified for the rates of return in two populations. Assuming that if the first population is composed of the rates of return calculated for the sessions falling on Friday the 13th, then the second population determines the rates of return for all the remaining Fridays. In the second part of the fifth part, the test for equality of two average rates of return will be computed under the assumption that the first group of data consists of the rates of return for sessions falling on Tuesday the 13th and the second group is composed of the rates of return for all the remaining Tuesdays. In this part only close-close rates of return will be calculated.

In the sixth part, the rates of return correlation coefficients will be calculated for 52 world equity indices. The rates of return (close – close) will be computed for the sessions falling on Friday the 13th.

The following scheme of presentation of results will be applied in the paper:
H_0^z – companies for which the null hypothesis was rejected with the use of z statistics. The value of parameter p is given in the brackets. In other cases, there was no reason to reject the null hypothesis in favor of the alternative hypothesis.
H_0^{KW} – companies for which the null hypothesis was rejected with the use of Kruskal-Wallis test. The value of parameter p is given in the brackets. In other cases, there was no reason to reject the null hypothesis in favor of the alternative hypothesis.
p_0^z – companies for which the value of parameter p calculated with the z statistics is greater than 0.05 and less than 0.1 The value of parameter p is given in the brackets.
p_0^{KW} – companies for which the value of parameter p calculated with the Kruskal-Wallis test is greater than 0.05 and less than 0.1 statistics. The value of parameter p is given in the brackets.

The names of the companies for which the null hypothesis was rejected both in terms of statistics and Kruskal-Wallis are presented in italics.

4. Analysis of the Results

4.1. The analysis of the calendar effect – 13th day of the month

The results of testing the zero hypothesis with the use of average rates of return for two different populations permit to draw the following conclusions (see also Table 1):

a) **Close – close rates of return**
H_0^z: *HANG SENG* (0.0228), IBEX (0.0254).
H_0^{KW}: ALL ORDINARIES (0.0333), *HANG SENG* (0.0345), KLCI (0.0308), MICEX (0.0128), SET (0.0130), STRAIT TIMES (0.0438), UX (0.0369) and WIG (0.0220), p_0^{KW}: ATHEX COMPOSITE (0.0538), DJTA (0.0761), JCI (0.0613), NASDAQ COMPOSITE (0.0655), RTS (0.0868), SENSEX (0.0760), S&P 500 (0.0570).

b) **Overnight rates of return**
H_0^z: HANG SENG (0.0032), JCI (0.0189) and *SET* (0.0093), p_0^z: BOVESPA (0.0824), IBEX (0.0567) and NASDAQ 100 (0.0986).
H_0^{KW}: DAX (0.0321), p_0^{KW}: ATHEX COMPOSITE (0.0558), BOVESPA (0.0868), IPC (0.0890), RTS (0.0823), *SET* (0.0565), S&P 500 (0.0506) and UX (0.0927).

c) **Open-Open rates of return**
H_0^z: *AEX* (0.0334), ALL ORDINARIES (0.0212), HANG SENG (0.0011), SET (0.0059) and UK 100 (0.0411), p_0^z: JCI (0.0722), UX (0.0845) and SOFIX (0.0693).
H_0^{KW}: *AEX* (0.0443), DAX (0.0472), IPC (0.0413) and SMI (0.0450), p_0^{KW}: PSEI (0.0682).

d) **Open-Close rates of return**
p_0^z: DJTA (0.0817) and XU 100 (0.0842).
H_0^{KW}: ALL ORDINARIES (0.0161), FTSE 250 (0.0389), HANG SENG (0.0480), MICEX (0.0041), NIKKEI (0.0151), PSEI (0.0226), SENSEX (0.0133), XU 100 (0.0281), p_0^{KW}: STRAIT TIMES (0.0813) and WIG (0.0613).

Table 1. Selected statistics of the rates of return for sessions falling on the 13th day of the month

	Highest percentage of positive returns	Lowest percentage of positive returns	The highest one-session average rate of return	The lowest one-session average rate of return	The number of indexes for which the positive one-session average rates of return were observed	The number of indexes for which the negative one-session average rates of return were observed
Close-close	IBEX (61.11)	SET (44.59)	UX (0.5834%)	ICEX (–0.2442%)	36 (69.23%)	16 (30.77%)
Overnight	OSE (63.98)	AMEX (40.00)	UX (0.6439%)	BEL20 (–0.1955%)	41 (78.85%)	11 (21.15%)
Open-Open	AMEX (57.53%)	SOFIX (40.32%0	UX (0.7828%)	HANG SENG (–0.2184%)	26 (50.00%)	26 (50.00%)
Open-Close	OMX Stockholm (60.00%)	XU (44.08%)	BEL 20 (0.1843%)	MICEX (–0.2635%)	24 (46.15%)	28 (53.85%)

Source: the author's own calculation.

The highest one–session average rate of return in three out of four cases was registered for UX index.

4.2. The analysis of the calendar effect – 13th day of the month falling on Friday

The results of testing the zero hypothesis with the use of average rates of return for two different populations permit to draw the following conclusions (see also Table 2):

a) **Close – close rates of return**
H_0^z: ATHEX COMPOSITE (0.0367), *HANG SENG* (0.0260), JCI (0.0429), KLCI (0.0135), MICEX (0.0488), SET (0.0049), STRAIT TIMES (0.0425) and WIG (0.0369), p_0^z: ALL ORDINARIES (0.0711), FTSE 250 (0.0800) and RTS (0.0619).
H_0^{KW}: DJUA (0.0186), *HANG SENG* (0.0481) and IBEX (0.0241), p_0^{KW}: ALL ORDINARIES (0.0681), SSE B SHARES (0.0764) and XU 100 (0.0932).

b) **Overnight rates of return**
H_0^z: DAX (0.0137), IPC (0.0207), JCI (0.0136), *OSE* (0.0454) and SET (0.0167), p_0^z: AMEX (0.0549), ATHEX COMPOSITE (0.0981), HANG SENG (0.0759), KLCI (0.0712) and RTS (0.0974).
H_0^{KW}: DJUA (0.0206), HANG SENG (0.0117), *OSE* (0.0149), *SET* (0.0089), p_0^{KW}: IBEX (0.0521), IPSA (0.0645) and RTS (0.0627).

c) **Open-Open rates of return**
H_0^z: DAX (0.0317), IPC (0.0406) and PSEI (0.0449), p_0^z: AEX (0.0765), DJIA (0.0595) and SET (0.0875).
H_0^{KW}: ALL ORDINARIES (0.0260), HANG SENG (0.0044), SET (0.0263) and SOFIX (0.0395), p_0^{KW}: PSI 20 (0.0803).

d) **Open-Close rates of return**
H_0^z: HANG SENG (0.0213), FTSE 250 (0.0303), MICEX (0.0068), NIKKEI (0.0091), STRAIT TIMES (0.0393) and WIG (0.0241), p_0^z: ALL ORDINARIES (0.0636), PSEI (0.0575) and SENSEX (0.0578).
H_0^{KW}: ALL ORDINARIES (0.0466), DJTA (0.0490), DJUA (0.0253) and XU 100 (0.0436), p_0^{KW}: NIKKEI (0.0884) and SSE B SHARES (0.0732).

Table 2. Selected statistics of the rates of return for sessions falling on the 13th day of the month and Friday

	Highest percentage of positive returns	Lowest percentage of positive returns	The highest one-session average rate of return	The lowest one-session average rate of return	The number of indexes for which the positive one-session average rates of return were observed	The number of indexes for which the negative one-session average rates of return were observed
Close-close	PSI 20 (60.00)	MICEX (33.33)	MERVAL (0.6645%)	MICEX (–1.1028%)	16 (30.77%)	36 (69.23%)
Overnight	MERVAL (68.24)	AMEX (30.00)	MERVAL (0.5029%)	BEL20 (–0.9853%)	22 (42.41%)	30 (57.69%)
Open-Open	XU 100 (60.00)	SOFIX (34.62)	XU 100 (0.6245%)	RTS (–1.1147%)	16 (30.77%)	36 (69.23%)
Open-Close	NASDAQ COMPOSITE (57.64)	MICEX (25.00)	IPC (0.2301)	MICEX (–0.7337%)	22 (42.31%)	30 (57.69%)

Source: the author's own calculation.

The lowest percentage of positive returns was registered in two cases out of four for MICEX index, as well as the lowest one-session average rate of return. In turn, the highest one-session average rate of return was observed for MERVAL index.

4.3. The analysis of the calendar effect – 13th day of the month falling on Tuesday

The results of testing the zero hypothesis with the use of average rates of return for two different populations permit to draw the following conclusions (see also Table 3):

a) **Close – close rates of return**
H_0^z: *BUX* (0.0341) and *EOE* (0.0306), p_0^z: ATHEX COMPOSITE (0.0642), BEL 20 (0.0532), IBEX (0.0790), MERVAL (0.0611) and PX (0.0561).
H_0^{KW}: BEL 20 (0.0328), *BUX* (0.0315), DJUA (0.0008), *EOE* (0.0066), IBEX (0.0475), JCI (0.0343), PX (0.0178) and TEC DAX (0.0095), p_0^{KW}: HEX (0.0537) and NASDAQ COMPOSITE (0.0655).

b) **Overnight rates of return**
H_0^z: AEX (0.0381), HANG SENG (0.0897), *DJTA* (0.0159), *DJUA* (0.0024) and *SET* (0.0220), p_0^z: BUX (0.0903), DJIA (0.0683) and S&P 500 (0.0650).
H_0^{KW}: *DJTA* (0.0402), *DJUA* (0.0002) and *SET* (0.0159), p_0^{KW}: BUX (0.0742) and IPSA (0.0941).

c) **Open-Open rates of return**
H_0^z: ALL ORDINARIES (0.0372) and OMX STOCKHOLM (0.0166), p_0^z: HANG SENG (0.0547), HEX (0.0708), PSI 20 (0.0961).
H_0^{KW}: ALL ORDINARIES (0.0153), OMX STOCKHOLM (0.0430), p_0^{KW}: WIG (0.0943).

d) **Open-Close rates of return**
H_0^z: AEX (0.0262), *BEL 20* (0.0330), *EOE* (0.0075), PX (0.0206) and *UX* (0.0098), p_0^z: ATHEX COMPOSITE (0.0998), IBEX (0.0766), OMX STOCKHOLM (0.0597) and SSE B SHARES (0.0703).
H_0^{KW}: *BEL 20* (0.0205), DJUA (0.0041), *EOE* (0.0168), HEX (0.0467), IBEX (0.0310), OMX STOCKHOLM (0.0390), PX (0.0042), SSE B SHARES (0.0280), TEC DAX (0.0124) and *UX* (0.0161), p_0^{KW}: BUX (0.0650), JCI (0.0569), PSI 20 (0.0846).

Table 3. Selected statistics of the rates of return for sessions falling on the 13th day of the month and Tuesday

	Highest percentage of positive returns	Lowest percentage of positive returns	The highest one–session average rate of return	The lowest one–session average rate of return	The number of indexes for which the positive one-session average rates of return were observed	The number of indexes for which the negative one-session average rates of return were observed
Close-close	EOE (74.29)	SSE B SHARES (33.33)	MERVAL (0.9460%)	ICEX (–1.1167%)	34 (65.38%)	18 (34.62%)
Overnight	SOFIX (59.30)	AMEX (28.00)	XU100 (0.6011%)	HANG SENG (–0.3073%)	31 (59.62%)	21 (40.38%)
Open-Open	BOVESPA (67.44)	MICEX (33.33)	BEL 20 (1.0144%)	HEX (–0.4470%)	26 (50.00%)	26 (50.00%)
Open-Close	UX (90.91)	SSE B SHARES (31.03)	UX (1.1069%)	MICEX (0.3068%)	42 (80.77%)	10 (19.23%)

Source: the author's own calculation.

The lowest percentage of positive returns was recorded in two cases out of four for SSE B SHARES index.

4.4. The analysis of the calendar effect – 4th day of the month

The results of testing the zero hypothesis with the use of average rates of return for two different populations permit to draw the following conclusions (see also Table 4):

a) **Close – close rates of return**
H_0^z: DJTA (0.0209), *SET* (0.0027) and XU 100 (0.0046), p_0^z: BUX (0.0800), MERVAL (0.0657) and SSE COMPOSITE (0.0971).
H_0^{KW}: *SET* (0.0015), SSE COMPOSITE (0.0054) and XU 100 (0.0056).

b) **Overnight rates of return**
H_0^z: AMEX (0.0422), PSI 20 (0.0446) and *SET* (0.0078), p_0^z: FTSE MIB (0.0879), MERVAL (0.0600), MICEX (0.0581), XU 100 (0.0682) and WIG (0.0560).
H_0^{KW}: *SET* (0.0064), SSE B SHARES (0.0182) and SSE COMPOSITE (0.0295), p_0^{KW}: CAC 40 (0.0707).

c) **Open-Open rates of return**
H_0^z: DJTA (0.0209), IPC (0.0443), *SET* (0.0001), *SSE B SHARES* (0.0116), *SSE COMPOSITE* (0.0312) and TAIEX (0.0409), p_0^z: AEX (0.0704) and WIG (0.0928).
H_0^{KW}: BOVESPA (0.0190), NASDAQ 100 (0.0155), PSEI (0.0149), *SET* (0.0001), *SSE B SHARES* (0.0023) and *SSE COMPOSITE* (0.0026), p_0^{KW}: DJTA (0.0643) and DJUA (0.0592).

d) **Open-Close rates of return**
H_0^z: DJTA (0.0235), JCI (0.0147), KOSPI (0.0205) and SAX (0.0346), p_0^z: SET (0.0617).
H_0^{KW}: UX (0.0276), p_0^{KW}: DJUA (0.0908), SET (0.0934) and SMI (0.0771).

Table 4. Selected statistics of the rates of return for sessions falling on the 4th day of the month

	Highest percentage of positive returns	Lowest percentage of positive returns	The highest one-session average rate of return	The lowest one-session average rate of return	The number of indexes for which the positive one-session average rates of return were observed	The number of indexes for which the negative one-session average rates of return were observed
Close-close	SSE COMPOSITE (61.29)	UX (44.97)	XU100 (0.6912%)	MERVAL (–0.0839%)	46 (88.46%)	6 (11.54%)
Overnight	MERVAL (65.37)	AMEX (48.94%)	XU 100 (0.3485%)	MERVAL (–0.0366%)	37 (71.15%)	15 (28.85%).

	Highest percentage of positive returns	Lowest percentage of positive returns	The highest one-session average rate of return	The lowest one-session average rate of return	The number of indexes for which the positive one-session average rates of return were observed	The number of indexes for which the negative one-session average rates of return were observed
Open-Open	MERVAL (56.82)	SOFIX (40.32)	UX (0.7828%)	HANG SENG (–0.2183%)	25 (48.07%)	27 (51.92%)
Open-Close	SMI (59.91)	UX (39%)	XU 100 (0.3420%)	FTSE MIB (–0.1925%)	36 (69.23%)	16 (30.77%)

Source: the author's own calculation.

The highest percentage of positive returns, in two cases out of four was registered for MERVAL index, as well as the lowest one-session average rate of return. In turn, the lowest percentage of positive returns was observed in two out of four cases for UX index and the highest one-session average rate of return in three out of four cases for XU 100 index.

4.5. The analysis of the calendar effect – the 13th day of the month falling on Friday vs other Fridays with the use of close-close rates of return

The results of testing the zero hypothesis with the use of average rates of return for two different populations permit to draw the following conclusion:
H_0^z: *ALL ORDINARIES* (0.0378), *FTSE 250* (0.0197), *MICEX* (0.0070), *NIKKEI* (0.0096), *PSEI* (0.0413), STRAIT TIMES (0.0468) and WIG (0.0273), p_0^z: HANG SENG (0.0603), OSE (0.0870), *SENSEX* (0.0612) and XU 100 (0.0987).
H_0^{KW}: *ALL ORDINARIES* (0.0076), *FTSE 250* (0.0221), *MICEX* (0.0054), *NIKKEI* (0.0094), *PSEI* (0.0127), *SENSEX* (0.0126) and XU 100 (0.0206), p_0^{KW}: DJTA (0.0821), OSE (0.0694) and WIG (0.0571).

The highest percentage of positive rates of return equal to 60.00% was registered for PSI and the lowest one equal to 33.33% for two indices: MICEX and UX. The number of percentage rates of return higher than 50% amounted to 9. The highest one–session average rate of return equal to 0.6645% was registered for MERVAL and the lowest equal to –1.1028% for MICEX. The positive one-session rates of return were observed for 16 indices (30.77%) and negative for 36 indices (69.23%) – see Table 5.

Table 5. Percentage of positive rates of return, one-session average rates of return for sessions falling on Friday the 13th and for other sessions falling on Friday.

Shaded boxes indicate the equity indices for which the difference between the average rates of return in two populations of rates of return was statistically significant regarding equality of two average rates of return.

Index	Percentage of positive rates of return Friday the 13th	One-session average rate of return Friday the 13th	One-session average rate of return all other Fridays	Index	Percentage of positive rates of return Friday the 13th	One-session average rate of return Friday the 13th	One-session average rate of return all other Fridays
AEX	43.860%	0.0526%	0.0232%	NASDAQ 100	53.846%	0.1226%	0.0885%
ALL ORD	35.484%	–0.2023%	0.0727%	NASDAQ COMP.	50.000%	–0.0995%	0.0810%
AMEX	48.649%	0.1227%	0.0109%	NIKKEI	48.696%	–0.1449%	0.0674%
ATHEX COM	41.667%	0.0968%	0.0841%	OMX STOCKHOLM	53.061%	0.0135%	0.0606%
BEL 20	51.163%	–0.8756%	0.0308%	OSE	43.396%	–0.0772%	0.0905%
BOVESPA	45.238%	–0.8756%	0.1264%	PX	42.500%	–0.1779%	0.0844%
BUX	38.636%	–0.5013%	0.0257%	PSEI	40.000%	–0.2135%	0.1385%
CAC40	52.439%	0.0731%	0.0820%	PSI20	60.000%	–0.0411%	0.0119%
DAX	48.387%	–0.1047%	0.0531%	RTS	38.889%	–0.5863%	0.1620%
DJIA	44.444%	–0.0016%	0.0291%	SAX	51.515%	0.1750%	0.0483%
DJTA	45.263%	–0.0449%	0.0651%	SENSEX	39.286%	–0.2324%	0.0769%
DJUA	45.263%	0.1168%	0.0338%	SET	36.957%	–0.0716%	0.0388%
EOE	43.243%	0.1093%	–0.0118%	SMI	44.681%	–0.0239%	0.0348%
FTSE 250	46.154%	–0.1748%	0.0730%	SOFIX	53.846%	–0.0239%	0.0360%
FTSE MIB	46.667%	–0.0403%	0.0134%	S&P 500	46.875%	–0.0169%	0.0342%
HANG SENG	44.872%	–0.4819%	0.0487%	SP TSX COM	47.059%	–0.0299%	0.0387%
HEX	45.714%	–0.1376%	0.0884%	SSE B SHARES	40.625%	–0.1719%	0.0528%
IBEX	46.939%	0.0689%	0.0402%	SSE COMP	47.619%	–0.1285%	0.0516%
ICEX	46.939%	0.2003%	0.1037%	STRAIT TIMES	39.583%	–0.3322%	0.0594%
IPC	50.000%	0.1819%	0.1036%	TAIEX	39.583%	–0.3883%	0.0291%
IPSA	49.351%	0.0622%	0.1021%	TEC DAC	46.667%	–0.1323%	0.0477%
JCI	40.385%	–0.3382%	0.0884%	TSE 300	44.444%	0.0266%	0.0218%
KLCI	44.776%	–0.3347%	0.0702%	UK 100	51.852%	0.0144%	0.2630%
KOSPI	46.667%	–0.0526%	0.0378%	UX	33.333%	–0.5838%	–0.0151%
MERVAL	59.574%	0.6645%	0.1938%	WIG	41.860%	–0.5458%	0.1852%
MICEX	33.333%	–1.1028%	0.1605%	XU 100	46.667%	–0.0589%	–0.0151%

Source: the author's own calculation.

The percentage of positive returns calculated for sessions falling on Friday the 13th was higher than 50% in 9 cases: BEL 20, CAC 40, MERVAL, NASDAQ 100, OMX STOCHOLM, PSI 20, SAX, SOFIX, UK 100. The highest percentage was observed for PSI 20 (60.00%) and the lowest one for two indices: MICEX and UX (33.33%).

The one-session average rate of return for Friday the 13th was positive in the case of 16 indices: AEX, AMEX, ATHEX COMPOSITE, CAC 40, DJUA, EOE, IBEX, ICEX, IPC, IPSA, MERVAL, NASDAQ 100, OMX STOCKHOLM, SAX, TSE 300, UK 100. Just only in one case the one-session average rate of return for Friday the 13th was statistically different than the average rate of return for all other Fridays: ATHEX COMPOSITE.

In all other remaining cases (36), the one-session average rates of return for Friday the 13th were negative, but only for 7 of them, the difference between one-session average rates of return for Friday the 13th and one-session average rates of return for all the remaining Fridays were statistically significant: ALL ORDINARIES, FTSE 250, MICEX, NIKKEI, PSEI, STRAIT TIMES and WIG.

The one-session average rates of return for Friday the 13th were higher than the one-session average rates of return for all the remaining Fridays in 12 cases (AEX, ALL ORDINAREIS, AMEX, DJUA, EOE, IBEX, ICEX, IPC, MERVAL, NASDAQ 100, SAX, TSE 300) but in none of these cases the difference between the average rates of return in two analyzed populations were not statistically important.

4.6. The analysis of the calendar effect – 13th day of the month falling on Tuesday vs other Tuesdays (close-close rates of return)

H_0^z: AEX (0.0404), ATHEX COMPOSITE (0.0347), *BEL 20* (0.0203), *EOE* (0.0103), *IBEX* (0.0386), *PX* (0.0170) and *UX* (0.0121), p_0^z: FTSE 250 (0.0697), FTSE MIB (0.0767), MERVAL (0.0502), OMX STOCKHOLM (0.0620) and SET (0.0716).
H_0^{KW}: *BEL 20* (0.0158), *EOE* (0.0249), DJUA (0.0317), *IBEX* (0.0111), *PX* (0.0028), TEC DAX (0.0238) and *UX* (0.0194), p_0^{KW}: ATHEX COMPOSITE (0.0757), FTSE MIB (0.0839), HEX (0.0506), OMX STOCKHOLM (0.0512), PSI 20 (0.0710), SET (0.0902), SSE B SHARES (0.0950).

4.7. The correlation coefficients for the rates of return (close-close) falling on Friday the 13th

The correlation coefficients for the rates of return (close-close) falling on Friday the 13th were calculated for 52 equity indices. It means that the calculation was derived

for $\binom{52}{2} = \frac{52!}{2!50!} = \frac{51 \cdot 52}{2} = 1360$ pairs of indices.

The highest value of the correlation coefficient equal to 0.9999 was registered for AEX/EOE and the lowest one equal to –0,6996 for AMEX/SOFIX. The positive value of the correlation coefficient was observed for 1064 pairs (80.24%) and for 262 pairs (19.76%) resulted to be negative.

Table 6. Number of positive and negative correlation coefficients for each of analyzed indexes.

Index	Number of positive correlation coefficients	Number of negative correlation coefficients	Index	Number of positive correlation coefficients	Number of negative correlation coefficients	Index	Number of positive correlation coefficients	Number of negative correlation coefficients
AEX – Holland	45	6	ICEX–Iceland	30	21	SENSEX–India	45	6
ALL ORDINARIES -Australia	35	16	IPC–Mexico	36	15	SET – Thailand	32	19
AMEX- USA	35	16	IPSA – Chile	47	4	SMI – Switzerland	45	6
ATHEX COM – Greece	46	5	JCI–Indonesia	35	16	SOFIX – Bulgaria	23	28
BEL 20 – Belgium	47	4	KLCI–Malaysia	42	9	S&P 500 – USA	35	16
BOVESPA – Brasil	36	15	KOSPI – Korea	35	16	SP TSX COMP – Canada	41	10
BUX – Hungary	46	5	MERVAL – Argentina	43	8	SSE B SHARES – China	43	8
CAC40 – France	47	4	MICEX – Russia	45	6	SSE COMP – China	38	13
DAX – Germany	48	3	NASDAQ 100 – USA	36	15	STRAIT TIMES – Singapore	40	11
DJIA – USA	35	16	NASDAQ COMP. – USA	37	14	TAIEX – Taiwan	40	11

Index	Number of positive correlation coefficients	Number of negative correlation coefficients	Index	Number of positive correlation coefficients	Number of negative correlation coefficients	Index	Number of positive correlation coefficients	Number of negative correlation coefficients
DJTA – USA	37	14	NIKKEI – Japan	38	13	TEC DAX – Germany	48	3
DJUA – USA	28	23	OMX STOCKHOLM – Sweden	49	2	TSE 300 – Canada	38	13
EOE – Holland	47	4	OSE – Norway	50	1	UK 100 – Great Britain	49	2
FTSE 250 – Great Britain	48	3	PX–Czech Republic	37	14	UX – Ukraina	42	9
FTSE MIB – Italy	46	5	PSEI – Philippines	27	24	XU 100 – Turkey	39	12
HANG SENG – Hong Kong	38	13	PSI20 – Portugal	49	2	WIG – Poland	47	4
HEX – Finland	48	3	RTS – Russia	49	2			
IBEX – Spain	48	3	SAX – Slovakia	38	13			

Source: the author's own calculation.

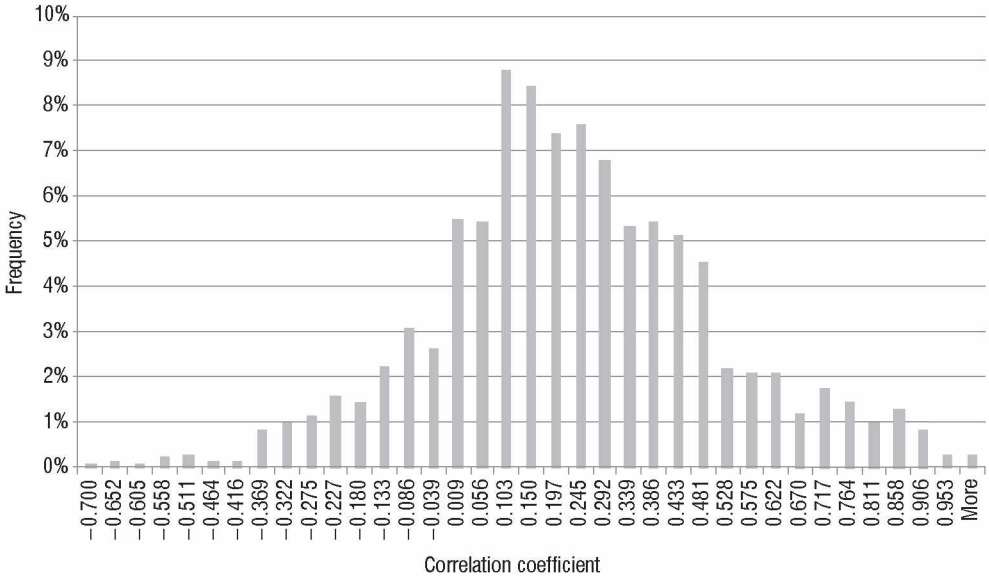
The highest value of positive correlation coefficients was registered for OSE (50), and the lowest one for SOFIX index (23) – see Table 6. The number of positive correlation coefficients higher or equal to 45 was observed for the following indexes: AEX (45), ATHEX COMPOSITE (46), BEL 20(47), BUX (46), CAC 40(47), DAX (48), EOE (47), FTSE 250(48), FTSE MIB (46), HEX (48, IBEX (48), IPSA (47), MICEX (45), OMX STOCKHOLM (49), OSE (50), PSI 20(49), RTS (49), SENSEX (45), SMI (45), TEC DAX (48), UK 100(49) and WIG (47).

The number of correlation coefficients higher than 0.6; 0.7, 0.8 and 0.9 was equal to, respectively: 122 (9.20%), 82 (6.18%), 38 (2.87%) and 9 (0.68%). The correlation coefficient higher than 0.8 was observed for the following pairs of indices: AEX/BEL 20 (0.8971), AEX/CAC 40 (0.8490), AEX/DAX (0.8224), AEX/EOE (0.9999), AEX/UK 100 (0.8848), AMEX/DJIA (0.9861), AMEX/DJTA (0.8643), AMEX/NASDAQ COMPOSITE (0.8387), AMEX/S&P 500 (0.9732), AMEX/SP TSX COMPOSITE (0.8518), AMEX/TSE 300 (0.8452), BEL 20/CAC 40 (0.8876), BEL 20/DAX (0.8783), BEL 20/EOE (0.9256), BEL 20/UK 100 (0.8705), CAC 40/EOE (0.8992), CAC40/FTSE MIB (0.8718), CAC 40/TEC DAX (0.8055), DAX/EOE (0.9042), DAX/FTSE MIB (0.8122), DAX/SMI (0.8325), DAX/TEC DAX (0.8326), DJIA/NASDAQ 100 (0.8185), DJIA/S&P 500 (0.9506), DJIA/SP TSX COMPOSITE (0.8114), DJIA/TSE

300 (0.8349), DJTA/S&P 500 (0.8459), DJTA/TSE 300 (0.8087), EOE/UK 100 (0.9060), FTSE MIB/IBEX (0.8288), MICEX/RTS (0.8121), NASDAQ 100/NASDAQ COMPOSITE (0.9710), NASDAQ 100/S&P 500 (0.8700), OMX/TEC DAX (0.8560), S&P 500/SP TSX COMPOSITE (0.8306), S&P 500/TSE 300 (0.8493), SP TSX COMPOSITE/TSE 300 (0.8669), SSE B SHARES/SSE COMPOSITE (0.9159).

The number of correlation coefficients lower than –0.3; –0.4 and –0.5 was equal to, respectively: 48 (3.62%), 17 (1.28%) and 12 (0.90%). The correlation coefficients lower than –0.5 was observed for the following pairs of indices: ALL ORDINARIES/AMEX (–0.5329), ALL ORDINARIES/DJUA (–0.5949), AMEX/SOFIX (–0.6996), DJUA/SOFIX (–0.6778), DJTA/SOFIX (–0.5663), DJUA/SOFIX (–0.6492), IPC/SOFIX (–0.5606), NASDAQ 100/SOFIX (–0.5196), NASDAQ COMPOSITE/SOFIX (–0.5783), SOFIX/S&P 500 (–0.6602), SOFIX /SP TSX COMPOSITE (–0.5211), SOFIX/TSE 300 (–0.5043). It is worth mentioning that 10 cases out of 12 regarded the SOFIX index.

Figure 1. Distribution of correlation coefficients frequency



Source: the author's own calculation.

5. Conclusion

The calculations presented in this paper indicate the presence of the unfortunate days effect– the results are presented in Table 7 and 8.

Table 7. Number of the unfortunate day effects (results of Kruskal-Wallis test in the brackets)

Type of rate of return	13th vs all other sessions	Friday 13th vs all other sessions	Tuesday 13th vs all other sessions	4th vs all other sessions	Friday 13th vs Fridays	Tuesday 13th vs Tuesdays
Close-close	2 (8)	8 (3)	2 (8)	3 (3)	7 (7)	7 (7)
Overnight	3 (1)	5 (4)	5 (3)	3 (3)		
Open-open	5 (4)	3 (4)	2 (2)	6 (6)		
Open-close	0 (8)	6 (4)	5 (10)	5 (1)		

Source: the author's own calculation.

Table 8. Index names for which null hypotheses were rejected with the use of both statistics, z and H

Type of rate of return	13th vs all other sessions	Friday 13th vs all other sessions	Tuesday 13th vs all other sessions	4th vs all other sessions	Friday 13th vs Fridays	Tuesday 13th vs Tuesdays
Close-close	HANG SENG	HANG SENG	BUX, EOE	SET	ALL ORDINARIES, FTSE 250, MICEX, NIKKEI, PSEI, SENSEX	BEL 20, EOE, IBEX, PX, UX
Overnight	SET	OSE, SET	DJTA, DJUA, SET	SET		
Open-open	AEX		ALL ORDINARIES, OMX STOCKHOLM	SET, SSE B SHARES, SSE COMPOSITE		
Open-close			BEL 20, EOE, UX			

Source: the author's own calculation.

The effect of the 13th day of the month was observed in two Asian countries (Hong Kong and Thailand) and one European (Holland). The same result was achieved for 13th and Friday (Hong Kong, Thailand and Norway). For close – close returns, both

anomalies occurred in Hong Kong, and in the case of overnight returns – in Thailand. In turn, the 13th day of the month and Tuesday was registered on the following continents: Australia, Asia (Thailand), Europe (Hungary, the Netherlands, Sweden, Belgium and Ukraine), North America (the USA) and also in the largest number of countries (8). For the EOE index this effect was observed for close-close as well as for open-close rates of return. It should be mentioned that the 13th and Tuesday effect was not registered on the Spanish stock market. The calendar effect of the 4th day of the month was recorded only in Asian countries (Thailand and China). In Thailand, it was registered for the following rates of return: close-close, overnight and open-open and in China only for the open-close rates of return. All of the analyzed calendar effects occurred on the Thai stock exchange for overnight returns. On the other hand, the effects of the 13th day of the month and the 13th day of the month and Friday for close-close rates of return were observed only in Hong Kong.

The effect of the 13th day of the month (vs. the rates of return for other Fridays) was registered on 3 continents: Asia (Japan, India and the Philippines), Europe (Great Britain, Russia) and Australia. In turn, the calendar effect on 13th day of the month and Tuesday (vs. the rates of return of other Tuesdays) was present only on the European stock exchanges: Belgian, Dutch, Czech, Ukrainian and Spanish ones.

The main limitation of this research is the price range of data gained from the Reuters data source as well as the unequal intervals of observations for different equity indices. The outcome may be regarded as part of the ongoing discussions on the hypothesis of financial markets efficiency, which was introduced by Fama[36].

The results obtained in the paper regarding the Friday the 13th effect for the following equity indexes: ALL ORDINARIES, FTSE 250, MICEX, NIKKEI, PSEI, STRAIT TIMES and WIG are consistent with those of Kolb and Rodriguez[37], i.e. the results do not support the outcomes reported by Agrawal and Tandon[38], Coutts[39] and Lucey[40]. Further research on the occurrence of "the unfortunate dates effect" in the financial markets should cover the currency and commodity market.

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In further research, the problem of the strength of the analyzed calendar effects on individual exchanges may also be raised.

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