

EURASIAN JOURNAL OF BUSINESS AND MANAGEMENT

<http://www.eurasianpublications.com>

ANALYSIS OF THE WEEKEND EFFECT ON THE MARKETS OF 121 EQUITY INDICES AND 29 COMMODITIES

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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 weekend effects of the market of 121 equity indices and 29 commodities with the following four approaches: Friday close – Monday open, Friday close – Monday close, Friday close – Tuesday open and Friday close – Tuesday close prices. Calculations presented in this paper indicate the presence of the monthly effect in the following cases: 36 (I approach), 58 (II approach), 57 (III approach) and 66 (IV approach).

Keywords: Market Efficiency, Commodity Market, Equity Market, Calendar Anomalies

1. Introduction

Efficient market hypothesis (EMH), the core of the influential paper of Fama (1970), has been a cornerstone of financial economics for many decades. Although current definitions differ from that developed by Fama, the efficiency of markets prevents systematic beating of the market, usually in a form of above-average risk-adjusted returns. The problem of the financial markets efficiency, especially of equity markets, has been discussed in a number of academic works, which has led to a sizable set of publications examining this subject. In many empirical works dedicated to the time series analysis of rates of return and stock prices, there were found statistically significant effects of both types, i.e. calendar effects and effects associated with the size of companies. These effects are called anomalies, because their existence testifies against market efficiency. Discussion of the most common anomalies in the capital markets can be found, among others, in Simson (1988) or Latif *et al.* (2011).

One of the most common calendar anomalies observed on the financial markets are:

a) Day-of-the-week effect – daily average rates of return registered on the stock market differ for various days of the week. One of the first works dedicated to this type of effect, was developed by Kelly (1930), who proved that the average rate of return of US stock markets on Monday are lower than average rates of return for other days of the week. Empirical work of Hirsch (1987) confirmed the existence of the day-of-the-week effect. In his study, he examined behavior of the SP 500 index in the period from June 1952 to June 1985, proving that the index close on Monday was lower in 57% than the index close on the preceding Friday. For other days of the week, the following trend was observed - the index close on one session was higher than the index close on the previous session (Tuesdays/Monday of in 43% observations, Wednesday/Tuesday in 55.6%, Thursday/Wednesday in 52.6%, Friday/Thursday in 58%). The

day-of-the-week effect in the US market was also presented, among others, in the works of Jaffe *et al.* (1989), French (1980), and Lakonishok and Maberly (1990). The evidence for UK market was examined by Theobald and Price (1984), Jaffe and Westerfield (1985), Board and Sutcliffe (1988), Agrawal and Tandon (1994), Peiro (1994), Mills and Coutts (1995), Dubois and Louvet (1996), and Coutts and Hayes (1999). Peiro (1994), Agrawal and Tandon (1994), Dubois and Louvet (1996) and Kramer (1996) provided evidence of negative Monday and Tuesday returns for Frankfurt exchange. In works of Solnik and Bousquet (1990), and Agarwal and Tandon (1994), there was found an evidence of negative Tuesday rates of return in Paris market, while Condoynanni *et al.* (1987) and Peiro (1994) demonstrated negative Monday and Tuesday rates or return on the same market and Barone (1990) in Milan. Research regarding the rates of return on other market was performed in the work of Kato *et al.* (1990), and also by Sutheebanjard and Premchaiswadi (2010). Islam and Sultana (2015) proved for the CASPI Index (Chittagong Stock Exchange) that the day-of-the-week effects on stock returns and volatility are persistent in the stock market.

b) Monthly effect – achieving by portfolio replicating the specified stock index, different returns in each month. The most popular monthly effect is called “January effect”, i.e. the tendency to observe higher average rate of return of stock market indices in the first month of the year. For the first time, this effect was observed by Keim (1983), who noted that the average rate of return on stocks with small capitalization is highest in January. In case of large and mid-capitalization companies the effect was not so perceptible. Although January was the best single month in UK, the period from December to April consisted of months, which on average produced positive returns (Rozeff and Kinney, 1976; Corhay *et al.* 1988). Bernstein (1991), taking into consideration the behavior of the US equity market in the period from 1940 to 1989, discovered the interdependence between rates of returns in each month. Modern researches, e.g. Gu (2003) and Schwert (2002) proved that in the last two decades of the twentieth century, phenomenon of the month-of-the-year effect was much weaker. This fact would suggest that the discovery and dissemination of the monthly effect in world financial literature contributed to the increase of market efficiency.

c) Other seasonal effects– the following calendar effects can be found in the financial literature:

1. *The weekend effect* – Cross (1973) found that markets tend to rise on Fridays and fall on Mondays. His findings generated a flood of research (Lakonishok and Levi, 1982; Jaffe and Westerfield, 1985; Condoynanni *et al.* 1987; Connolly, 1991; Coutts and Hayes, 1999). In the literature two ways of computing weekend rates of return are implemented. In the first, Friday close and Monday open prices are used, while in the second Friday close and Monday close prices are employed.
2. *The holiday effects* – markets before holidays or other trading breaks tend to rise. In the US there are a number of studies looking at this, e.g., Fields (1934), Ariel (1987; 1990), Lakonishok and Smidt (1988) and Cadsby and Ratner (1992).
3. *Within-the-month effect*– positive rates of returns only occur in the first half of the month (Ariel, 1987; Kim and Park, 1994).
4. *Turn-of-the month effect* – average rate of return calculated for the last day of the month and for three days of the next month, was higher than the average rate of return calculated for the month, for which the rate of return of only one session, was taken (Cadsby and Ratner, 1992). Lakonishok and Smidt (1988) found that the four days at the turn-of-the-month averaged a cumulative rate of increase of 0.4730% versus 0.0612% for and average four days. The average monthly increase was 0.3490%, i.e., the DJIA went down during non-turn-of-the-month period.

The aim of this paper is to examine the prevalence of weekend effect on the markets of 121 equity indices and 29 commodities. The paper is divided into four parts - analysis of the seasonality effects will apply to the returns calculated on the basis of the following prices: (1) Friday close – Monday open, (2) Friday close – Monday close, (3) Friday close – Tuesday open

and (4) Friday close – Tuesday close. Prices of commodities quotations are taken from the Reuters.

2. Literature Review

The earliest study of day-of-the-week effect was made by Fields (1934), who found that the US market tended to rise on Saturdays (the market used to open for a couple of hours on Saturdays). Cross (1973) discovered the Fridays rates of return were positive, while on Mondays were negative. His findings generated a flood of research reporting so called “Blue Monday” effect with rates of return endeavoring to be higher at the end of the trading week (Lofthouse, 1994; Lakonishok and Smidt, 1988).

French (1980) noted that the average return of the SP 500 was reliably negative over weekends in the period 1953–1977. His observations were confirmed by Schwert (2002) and Keim and Stambaugh (1984).

The weekend effect was also examined for countries different than US (Jaffe and Westerfield, 1985; Condoyanni *et al.* 1987). Board and Sutcliffe (1988) found evidence of the weekend effect in the UK in the period of 1962-1986. According to Choy and O’Hanlon (1989) the day-of-the-week effect seemed to be stronger on the UK market than in the US. Kamara (1997) proved that the weekly effects declined in the period of 1962-1993 because of increased institutional trading in large cap stocks. His result were confirmed by Steeley (2001), who revealed that the weekend effect disappeared in the 1990s.

Ziembra (1993) found that Fridays average rates of return were positive and Mondays negative when the session on Friday was the last session in the week, while the average rates of return on Sundays were highly positive in the weeks with Saturday trading.

According to Chen and Singal (2003) the Fridays increase and Mondays falls of prices were caused by covering short position and opening new ones, respectively. Chan *et al.* (2004) argued that Monday negative rates of return were due to the individual not institutional investors - the Monday average return was the same as on the other four sessions in the week for equities with high institutional holdings.

Branch and Ma (2006) analyzing socks quoted on the NYSE, AMEX and Nasdaq in the period of 1994-2005 and breaking them into six categories, found a strong negative autocorrelation between the overnight return (e.g. between the market close and its opening the next working day) and the intraday returns. According to the authors the cause of the anomaly was related to the following factors: market makers’ behavior, strategies implemented by market specialist and expectations of the next session opening prices regarding their assigned stock.

Cooper *et al.* (2008) demonstrated that the US equity premium in the period of 1993-2006, for stocks characterized by intraday return close to zero, was a result of overnight returns. According to them the majority of analyzed stock returns quoted on NYSE, AMEX, Nasdaq and Chicago Mercantile Exchange, was generated when the market was close and the difference between night and daily return was between 2,61 and 7,61 basis points per day.

Stoll and Whaley (1990) reported that open-to-open returns are more volatile than close-to-close returns. Wang *et al.* (2009) investigated that the two components of the total daily return ($close_t - close_{t+1}$), the overnight return ($close_t - open_{t+1}$), and the intraday return ($open_t - close_t$) for 2215 NYSE stocks in the period of 1988-2007 tended to be auto-correlated and found that the cross correlations between the three different returns (total, overnight and intraday) were quite stable over the entire 20 year period for the NYSE stocks.

3. Data and Methods

The research is divided into four parts. The calculation were proceeded concerning 121 world stock indices and 29 commodities – in the parenthesis are indicated the first month and year considered in the process of rates of return calculation.

World stock indices (in brackets the date of the first session included in the analysis): ADX (01.07.2001), AEX (03.01.1983), ALL ORDINARIES (01.01.1980), ALSIUG (03.08.2004), AMEX (02.01.1995), AMM FR FLT (29.12.1999), ATHEX (02.01.1987), ATX (25.09.1991), BEL

20 (02.01.1992), BELEX 15 (04.10.2005), BET (31.10.2000), BUMIX (01.06.2004), BUX (02.01.1991), BOVESPA (12.07.1989), CAC40 (08.01.1965), CASA ALL Shares (02.01.2002), CDAX (15.03.2004), CNX NIFTY (03.11.1995), CNX NIFTY TR (17.09.2007), CRB (03.01.1994), CROBEX (19.10.2009), CSE ALL Shares (06.06.1994), CSI 300 (08.04.2005), CYMAIN (06.09.2004), DAX (28.09.1959), DF MAIN (31.12.2003), DJ Composite (23.12.1980), DJ Eurostoxx (08.08.2002), DJIA (02.01.1900), DJTA (02.01.1900), DJUA (02.01.1929), EGX 30 (01.01.1998), EGX 70 (01.03.2009), EGX 100 (02.01.2006), EOE (01.02.1995), ESTX 50 PR (31.12.1986), ESTX PR (23.02.1998), EURONEXT 100 (15.03.2001), FTSE 100 (22.10.1992), FTSE 250 (30.12.1985), FTSE EUROTOP 100 (20.11.1990), FTSEMIB (01.02.1998), FTSEurofirst 300 (28.07.1997), HANG SENG (24.11.1969), HEX (02.01.1995), HSCE (01.08.1994), IBEX (05.01.1987), ICEX (31.12.1992), IGBC (27.11.2001), IPC (08.11.1991), IPSA (02.01.1987), ISEQ (19.02.1992), JCI (04.04.1983), JKSE (20.07.1995), KARACHI 100 (25.05.1994), KLCI (03.01.1977), KLSE (13.04.1992), KOSPI (04.01.1980), KW MAIN (05.03.1997), KW WEIGHTED IDW (26.01.2009), LIMA GENERAL (09.02.1995), MDAX (29.02.1996), Merval (04.04.1988), MICEX (22.09.1997), MSCI AC WORLD (14.07.2003), MSCI WORLD (14.07.2003), MSE (27.12.1995), MSM MAIN 30 (01.01.1992), mWIG40 (31.12.1997), NASDAQ (03.01.1938), NASDAQ 100 (01.10.1985), NEXT 150 IDX (13.03.2001), NIKKEI (01.03.2014), NSE ALL Shares (14.01.2000), NZX 50 (03.01.2001), OBX (07.09.1999), OMX Riga (03.01.2001), OMX Stockholm (30.09.1986), OMX Tallinn (03.01.1980), OMX Vilnius (01.01.2001), OSE (03.01.1983), PFTS (25.08.1998), PLE MAIN (11.02.1997), PSEI (02.01.1986), PSI20 (31.12.1992), PX (03.09.1993), QE MAIN 20 (10.08.1998), RTS (01.09.1995), RUSSEL (04.03.1999), SAX (03.07.1995), SBITOP (04.04.2006), SDAX (15.03.1999), SESESLCT (02.01.2003), SENSEX (03.04.1979), SET (02.07.1987), SMI (01.07.1988), SOFIX (26.11.2001), SP 500 (02.01.1900), SP ASX 200 (03.04.2000), SP TSX Composite (03.01.1961), SSE B-Shares (04.01.2000), SSE Composite (19.12.1990), Straits Times (28.12.1987), STXE 50 (23.02.1998), STXE 600 (23.02.1998), sWIG80 (29.12.1994), TAIEX (05.01.1995), TASE MAIN 100 (08.10.1992), TECDAX (16.09.1999), TDW MAIN (19.10.1998), TOPIX (02.04.1990), TSE 300 (15.08.1989), TUN MAIN Index (31.12.1997), TWII (12.03.1992), UK 100 (13.11.1935), UX (03.11.1997), VNI (28.07.2000), WIG (16.04.1991), WIG20 (14.04.1994), XU 30 (02.01.1997), XU 100 (02.01.1990).

The CRB index is a commodity index but as an index was classified to the group of the equity indices.

Commodities (in brackets the date of the first quotation included in the analysis): Brent oil (30.03.1983), canola (01.09.1998), cocoa (01.07.1959), coffee (17.08.1973), copper (01.07.1969), corn (01.01.1967), cotton (01.07.1959), crude oil (30.09.1983), feeder cattle (06.09.1973), gas oil (01.09.1998), gasoline (01.09.1998), gold (02.06.1969), heating oil (06.03.1979), lean hogs (25.06.1969), live cattle (05.01.1970), lumber (01.09.1998), natural gas (03.04.1990), orange juice (01.02.1967), palladium (05.01.1977), platinum (01.03.1968), rubber (23.01.1990), silver (13.06.1963), rough rice (01.09.1998), soybean (01.07.1959), soybean meal (01.09.1998), soybean oil (01.09.1998), sugar (04.01.1961), wheat (01.07.1959), wheat KCBT (01.09.1998) – data from Reuters service.

For both stock indices and commodities the last session considered in the process of calculating rates of return was 30.06.2015.

The adapted methodology in the paper can be divided into:

1. Testing the null hypothesis regarding equality of variances of rates of return in two populations,
2. Testing the null hypothesis regarding equality of averages rates of return in two populations.

3.1. Testing the Null Hypothesis Regarding Equality of Variances of Rates of Return in Two Populations

The null and alternative hypothesis can be formulated as follows:

$$\begin{aligned} {}^F_0H: S_1^2 &= S_2^2 \\ {}^F_1H: S_1^2 &\neq S_2^2 \end{aligned} \quad (1)$$

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.

As the last part of the calculation will be carried out using the F-statistics (so called Fisher-Snedecor statistics) for equality of variances of two population rates of return, where $F = \frac{S_i^2}{S_j^2}$, with the condition that: $S_i^2 > S_j^2$ and the degrees of freedom are equal:

n_i – for variance in the numerator of F,

n_j – for variance in the denominator of F.

If F-test (computed for $\alpha=0,05$) is lower than F-statistics, e.g. the ratio F-test to F-statistics is lower than 1, there is no reason to reject the null hypothesis.

3.2. Testing the Null Hypothesis Regarding Equality of Average Rates of Returns in Two Populations

According to the adopted methodology, the survey covers two populations of returns, characterized by normal distributions. On the basis of two independent populations of rate of returns, which sizes are equal n_1 and n_2 , respectively, the hypotheses H_0 and H_1 should be tested with the use of statistics z (Osinska, 2006, pp.43-44):

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

where:

\bar{r}_1 – average rate of return in the first population,

\bar{r}_2 – average rate of return in the second population.

The Formula 2 can be used in case of normally distributed populations, when the population variances are unknown but assumed equal. The number of degrees of freedom is equal to: $df(1) = n_1 + n_2 - 2$.

When the population variances are unequal, the number of degrees should be modified according to the following formula (Defusco *et al.* 2001, p.335):

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

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

$$\begin{aligned} H_0: E(r_1) &= E(r_2) \\ H_1: E(r_1) &\neq E(r_2) \end{aligned} \quad (4)$$

In particular:

1. For the analysis of the overnight rates of return for individual days of the week, if \bar{r}_1 is the overnight average rate of return on day Y (the first population), then \bar{r}_2 is the overnight average rate of return in all other days, except day Y (the second population).
2. For the analysis of the one-session rates of return for individual days of the week, if \bar{r}_1 is the one-session average rate of return on day Y (the first population), then \bar{r}_2 is the one-session average rate of return in all other days, except day Y (the second population).

In all analyzed cases, the *p-values* will be calculated with the assumption that the populations variances are unknown, but:

1. population variances are assumed equal – *p-value(1)*,
2. population variances are assumed unequal – *p-value(2)*.

In case, when there is no reason to reject the null hypothesis about equality of variances of two observed returns, the *p-value(1)* should be compared with the critical value 0,05; otherwise the *p-value(2)* will be used - that explains the reason of applying *p-value* in the following part of the paper. If the *p-value* (*p-value(1)* or *p-value(2)*) is less than or equal to 0,05; then the hypothesis H_0 is rejected in favor of the hypothesis H_1 . Otherwise, there is no reason to reject hypothesis H_0 . In the part 3 of the paper, the *p-value* listed in the tables are equal to *p-value(1)* or *p-value(2)* depending on the result of testing the null hypothesis, concerning the equality of variance in two populations of rates of returns.

In the first part, the test for equality of two overnight average rates of return will be exemplified for rates of return in two populations. Assuming, that if the first population is composed of the rates of return calculated for Friday close and Monday open prices, then the second population determines the overnight rates of return for all remaining overnight rates of return. While the sessions were also held on Saturdays weekend rates of return were calculated as follows: Saturday close-Monday open. In case of the Islamic countries the Thursday close and Sunday open prices have been taken into account.

In the second part, the test for equality of two one-session average rates of return will be exemplified for rates of return in two populations. Assuming, that if the first population is composed of the daily rates of return calculated for Friday close and Monday close prices, then the second population determines the one-session rates of return for all remaining daily rates of return (with an appropriate adjustment while sessions were held on Saturdays in the analyzed period). In case of the Islamic countries the Thursday close and Sunday close prices will be applied.

In the third part, the test for equality of two average rates of return will be exemplified for rates of return in two populations. Assuming, the if the first population is composed of the daily rates of return calculated for Friday close and Tuesday open prices, then the second population determines the one-session plus overnight rates of return for all remaining rates of return (with an appropriate adjustment while sessions were held on Saturdays in the analyzed period). In case of the Islamic countries the Thursday close and Monday open prices will be applied.

In the fourth part, the test for equality of two average rates of return will be exemplified for rates of return in two populations. Assuming if the first population is composed of the daily rates of return calculated for Friday close and Tuesday close prices, then the second population determine the two-session rates of return for all remaining rates of return (with an appropriate adjustment while sessions were held on Saturdays in the analyzed period). In case of the Islamic countries the Thursday close and Monday close prices have been applied.

4. Analysis of Results

4.1. Analysis of the Weekend Effect: Friday Close – Monday Open

The results of testing zero hypothesis with the use of average rates of returns for two different populations permit to draw following conclusions:

1. The null hypothesis regarding equality of variances of daily average rates of return in two populations, was rejected (for $\alpha=5\%$) in the following 130 cases: AEX, ALL ORDINARIES, ALSIUG, AMEX, AMM FR FLT, ATHEX, ATX, BEL 20, BELEX 15, BET, BOVESPA, BUMIX, BUX, CAC40, CDAX, CNX NIFTY TR, CRB, CROBEX, CSE ALL Shares, CYMAIN, DAX, DF MAIN, DJ Composite, DJ Eurostoxx, DJIA, DJTA, DJUA, EGX 30, EGX 70, EGX 100, EOE, ESTX PR, ESTX 50 PR, EURONEXT 100, FTSE 100, FTSE 250, FTSE EUROTOP 100, FTSEMIB, FTSEurofirst, HEX, HANG SENG, IBEX, ICEX, IGBC, IPC, IPSA, ISEQ, JCI, JKSE, KLCI, LIMA GENERAL, mWIG40, MDAX, Merval, MICEX, MSCI AC WORLD, MSE, MSM MAIN 30, NASDAQ, NASDAQ 100, NEXT 150 IDX, NIKKEI, NSE ALL Shares, NZX50, OMX Stockholm, OMX Talin, OMX Vilnius, OSE, PFTS, PLE MAIN, PSEI, PX, QE MAIN 20, RTS, RUSSELL, SASESLCT, SAX, SDAX, SENSEX, SET, SBITOP, SMI, SP 500, SP TSX Composite, SSE B-Shares, SSE Composite, Straits Times, STXE 50, sWIG80, TAIEX, TASE MAIN 100, TDW MAIN, TOPIX, TSE 300, TUN MAIN Index, TWII, UK 100, UX, VNI, WIG, WIG20, XU 30, XU 100, Brent oil, canola, cocoa, coffee, copper, corn, cotton, crude oil, feeder cattle, gasoline, gold, heating oil, lean hogs, live cattle, lumber, natural gas, orange juice, palladium, platinum, rubber, silver, soybean, soybean meal, soybean oil, sugar, wheat, wheat KCBT.
2. The null hypothesis regarding equality of two average rates of return was rejected for the following 36 indices and commodities (*p-value* shown in parenthesis): AEX (0.0025), ALSIUG (0.0096), CAC40 (0.0012), CRB (0.0023), DAX (0.0001), DJ Composite (0.0007), DJ Eurostoxx (0.0418), DJIA (0.0036), DJTA (0.0001), DJUA (0.0001), EGX 30 (0.0002), FTSE 250 (0.0010), HANG SENG (0.0183), IPSA (0.0001), ISEQ (0.0001), KLCI (0.0001), KW MAIN (0.0028), Merval (0.0005), NASDAQ (0.0001), NIKKEI (0.0001), PSEI (0.0481), QE MAIN 20 (0.0001), SDAX (0.0014), SET (0.0216), SMI (0.0466), SP 500 (0.0001), SP TSX Composite (0.0001), Straits Times (0.0047), sWIG80 (0.0087), XU 100 (0.0743), copper (0.0002), corn (0.0021), cotton (0.0263), palladium (0.0396), platinum (0.0046), rubber (0.0257).

In all other cases, there was no reason to reject the null hypothesis in favor of the alternative hypothesis but the *p-value* higher than 0.05 and lower than 0.1 was registered in the following cases: BET (0.0924), BOVESPA (0.0900), ESTX 50 PR (0.0581), MSE (0.0852), PLE MAIN (0.0566), cocoa (0.0605).

4.2. The Analysis of the Weekend Effect: Friday Close – Monday Close

The results of testing zero hypothesis with the use of average rates of returns for two different populations permit to draw following conclusions:

1. The null hypothesis regarding equality of variances of daily average rates of return in two populations, was rejected (for $\alpha=5\%$) in the following 131 cases: AEX, ALSIUG, AMM FR FLT, ATHEX, ALL ORDINARIES, AMEX, ATX, BEL 20, BELEX 15, BET, BOVESPA, BUX, CAC40, CASA ALL Shares, CDAX, CNX NIFTY, CNX NIFTY TR, CRB, CSI 300, CYMAIN, DAX, DF MAIN, DJ Composite, DJ Eurostoxx, DJIA, DJTA, DJUA, EGX 30, EGX 70, EGX 100, EOE, ESTX PR, ESTX 50 PR, EURONEXT 100, FTSE 100, FTSE 250, FTSE EUROTOP 100, FTSEurofirst, FTSEMIB, HANG SENG, HEX, HSCE, IBEX, ICEX, IGBC, IPC, IPSA, JCI, KARACHI 100, KLCI, KLSE, KOSPI, KW MAIN, KW WEIGHTED IDW, mWIG40, MDAX, MICEX, Merval, MSCI AC WOLRD, MSCI WORLD, MSE, MSM MAIN 30, NASDAQ, NASDAQ 100, NEXT 150

IDX, NIKKEI, NSE ALL Shares, OBX, OMX Stockholm, OMX Talin, OMX Vilnius, OSE, PFTS, PLE MAIN, PSEI, PSI 20, PX, QE MAIN 20, RTS, RUSSELL, SASESLCT, SAX, SDAX, SENSEX, SET, SMI, SOFIX, SP 500, SP ASX 200, SP TSX Composite, SSE B-Shares, Straits Times, STXE 50, STXE 600, sWIG80, TAIEX, TASE MAIN 100, TECDAX, TOPIX, TSE 300, TUN MAIN Index, TWII, UK 100, UX, VNI, WIG, XU 30, XU 100, Brent oil, canola, cocoa, coffee, corn, cotton, crude oil, gold, heating oil, live cattle, lean hogs, lumber, natural gas, orange juice, platinum, rubber, silver, soybean, soybean meal, soybean oil, sugar, wheat, wheat KCBT.

2. The null hypothesis regarding equality of two average rates of return was rejected for the following 58 indices and commodities (*p-value* shown in parenthesis): ALSIUG (0.0095), BET (0.0366), BOVESPA (0.0026), CAC40 (0.0082), CNX NIFTY (0.0002), CRB (0.0030), CROBEX (0.0001), CSI 300 (0.0001), CSE ALL Shares (0.0006), CYMAIN (0.0108), DAX (0.0002), DJ Eurostoxx (0.0335), DJIA (0.0001), DJTA (0.0001), DJUA (0.0001), EGX 70 (0.0435), EGX 100 (0.0032), FTSE 250 (0.0002), HANG SENG (0.0078), HSCE (0.0001), ICEX (0.0188), IPC (0.0083), IPSA (0.0001), JCI (0.0403), JKSE (0.0001), KARACHI 100 (0.0177), KLCI (0.0001), KLSE (0.0003), Merval (0.0001), NASDAQ (0.0001), NIKKEI (0.0001), OMX Riga (0.0032), PLE MAIN (0.0231), PSEI (0.0051), QE MAIN 20 (0.0003), SASESLCT (0.0004), SET (0.0001), SP 500 (0.0001), SP ASX 200 (0.0001), SP TSX Composite (0.0001), Straits Times (0.0001), TAIEX (0.0065), TOPIX (0.0127), XU 30 (0.0110), XU 100 (0.0068), Brent oil (0.0006), cocoa (0.0002), copper (0.0001), cotton (0.0277), crude oil (0.0403), gasoline (0.0001), gold (0.0242), heating oil (0.0003), lumber (0.0298), palladium (0.0250), platinum (0.0014), silver (0.0160), sugar (0.0056).

In all other cases, there was no reason to reject the null hypothesis in favor of the alternative hypothesis but the *p-value* higher than 0.05 and lower than 0.1 was registered in the following cases: BELEX 15 (0.0810), BUX (0.0918), MSE (0.0832), NASDAQ (0.0936), OSE (0.0737), TUN MAIN Index (0.0698), TWII (0.0854), VNI (0.0846), gas oil (0.0761), soybean (0.0647).

4.3. The Analysis of the Weekend Effect: Friday Close – Tuesday Open

The results of testing zero hypothesis with the use of average rates of returns for two different populations permit to draw following conclusions:

1. The null hypothesis regarding equality of variances of daily average rates of return in two populations, was rejected (for $\alpha=5\%$) in the following 113 cases: ADX, AEX, ALL ORDINARIES, ALSIUG, AMEX, AMM FR FLT, ATX, BEL 20, BELEX 15, BOVESPA, BUX, CASA ALL Shares, CDAX, CRB, CROBEX, CSE ALL Shares, CYMAIN, DAX, DF MAIN, DJ Composite, DJ Eurostoxx, DJTA, DJUA, EGX 30, EGX 70, EOE, ESTX PR, ESTX 50 PR, EURONEXT 100, FTSE 100, FTSE 250, FTSE EUROTOP 100, FTSEurofirst, FTSEMIB, HEX, ICEX, IGBC, IPC, IPSA, JCI, KARACHI 100, KLCI, KLSE, KOSPI, KW MAIN, LIMA GENERAL, MDAX, Merval, MSCI AC WOLRD, MSCI WORLD, MSE, MSM MAIN 30, NEXT 150 IDX, NIKKEI, NSE ALL Shares, NZX50, OBX, OMX Stockholm, OMX Talin, OMX Vilnius, OSE, PFTS, PLE MAIN, PSEI, PSI 20, PX, QE MAIN 20, RTS, RUSSELL, SASESLCT, SDAX, SMI, SOFIX, SP 500, SSE B-Shares, SSE Composite, SP TSX Composite, Straits Times, STXE 50, STXE 600, sWIG80, TAIEX, TASE MAIN 100, TECDAX, TOPIX, TSE 300, TWII, UK 100, UX, WIG, WIG20, XU 30, XU 100, Brent oil, coffee, copper, corn, cotton, crude oil, gas oil, heating oil, lean hogs, live cattle, natural gas, orange juice, palladium, rubber, silver, soybean, soybean meal, sugar, wheat, wheat KCBT.
2. The null hypothesis regarding equality of two average rates of return was rejected for the following 57 indices and commodities (*p-value* shown in parenthesis): ALSIUG (0.0049), BELEX 15 (0.0438), BOVESPA (0.0060), CAC40 (0.0003), CRB (0.0068), CROBEX (0.0001), CYMAIN (0.0145), DAX (0.0001), DJIA (0.0001), DJTA (0.0001),

DJUA (0.0001), FTSE 250 (0.0015), HANG SENG (0.0004), ICEX (0.0334), IGBC (0.0001), IPC (0.0082), IPSA (0.0001), JCI (0.0001), JKSE (0.0001), KARACHI 100 (0.0067), KLCI (0.0001), KLSE (0.0010), Merval (0.0003), MSE (0.0418), NASDAQ (0.0001), NIKKEI (0.0001), OMX Riga (0.0224), PSEI (0.0007), PLE MAIN (0.0042), SASESLCT (0.0003), SENSEX (0.0118), SET (0.0001), SP 500 (0.0001), SP TSX Composite (0.0001), SSE Composite (0.0316), Straits Times (0.0001), TAIEX (0.0030), TOPIX (0.0008), TUN MAIN Index (0.0096), TWII (0.0122), WIG (0.0413), VNI (0.0013), XU 30 (0.0108), XU 100 (0.0068), Brent oil (0.0003), cocoa (0.0002), copper (0.0001), crude oil (0.0101), gas oil (0.0001), gasoline (0.0001), gold (0.0187), heating oil (0.0011), lumber (0.0002), palladium (0.0172), platinum (0.0007), silver (0.0010), sugar (0.0014).

The *p-value* higher than 0.05 and lower than 0.1 was registered in the following cases: ATHEX (0.0826), BET (0.0536), EGX 70 (0.0662), MDAX (0.0916), OSE (0.0507), PSI 20 (0.0934), SBITOP (0.0691), SMI (0.0643), lean hogs (0.0612), live cattle (0.0778).

4.4. The Analysis of the Weekend Effect: Friday Close – Tuesday Close

The results of testing zero hypothesis with the use of average rates of returns for two different populations permit to draw following conclusions:

1. The null hypothesis regarding equality of variances of daily average rates of return in two populations, was rejected (for $\alpha=5\%$) in the following 75 cases: ADX, ALL ORDINARIES, ALSIUG, AMM FR FLT, BELEX 15, BOVESPA, BUMIX, BUX, CDAX, CNX NIFTY, CROBEX, RB, CSI 300, CYMAIN, DAX, DJIA, DJTA, DJUA, ESTX 50 PR, EURONEXT 100, HANG SENG, HEX, HSCE, ICEX, IGBC, JCI, JKSE, KLCI, KLSE, KOSPI, KW WEIGHTED IDW, Merval, MSE, MSM MAIN 30, NIKKEI, NSE ALL Shares, OMX Stockholm, OMX Talin, OMX Vilnius, PFTS, PLE MAIN, PX, QE MAIN 20, RUSSELL, SASESLCT, SENSEX, SBITOP, SOFIX, SP 500, SP ASX 200, SP TSX Composite, SSE Composite, Straits Times, sWIG80, TDW MAIN, TECDAX, TOPIX, TSE 300, UX, WIG, WIG20, XU 30, coffee, copper, corn, gas oil, gasoline, lean hogs, live cattle, natural gas, orange juice, palladium, platinum, soybean, soybean meal.
2. The null hypothesis regarding equality of two average rates of return was rejected for the following 66 indices and commodities (*p-value* shown in parenthesis): ALSIUG (0.0048), AMM FR FLT (0.0427), ATHEX (0.0421), ALL ORDINARIES (0.0207), AMEX (0.0318), BELEX 15 (0.0096), BET (0.0228), BOVESPA (0.0368), CAC40 (0.0012), CRB (0.0104), CROBEX (0.0003), CSE ALL Shares (0.0001), CYMAIN (0.0345), DAX (0.0004), DJIA (0.0009), DJTA (0.0001), DJUA (0.0001), FTSE 250 (0.0006), HANG SENG (0.0005), ICEX (0.0039), IGBC (0.0005), IPSA (0.0234), JCI (0.0001), JKSE (0.0001), KARACHI 100 (0.0371), KLCI (0.0001), KLSE (0.0065), KW MAIN (0.0015), MDAX (0.0344), Merval (0.0007), MSE (0.0409), NIKKEI (0.0001), NASDAQ (0.0001), OMX Riga (0.0122), OSE (0.0282), PLE MAIN (0.0026), PSEI (0.0001), SASESLCT (0.0022), SENSEX (0.0165), SET (0.0001), SBITOP (0.0039), SOFIX (0.0439), SP 500 (0.0001), SP TSX Composite (0.0001), SSE Composite (0.0180), Straits Times (0.0001), TAIEX (0.0018), TOPIX (0.0138), TUN MAIN Index (0.0011), TWII (0.0026), VNI (0.0003), WIG (0.0334), XU 30 (0.0017), XU 100 (0.0068), Brent oil (0.0001), cocoa (0.0334), copper (0.0001), crude oil (0.0026), gas oil (0.0219), gasoline (0.0001), heating oil (0.0007), lean hogs (0.0107), live cattle (0.0056), lumber (0.0001), platinum (0.0135), silver (0.0115), sugar (0.0003).

The *p-value* higher than 0.05 and lower than 0.1 was registered in the following cases: CSI 300 (0.0852), HSCE (0.0669), IPC (0.0612), LIMA GENERAL (0.0654), mWIG40 (0.0798), sWIG80 (0.0981), TSE 300 (0.0603), cotton (0.0568), feeder cattle (0.0929), soybean (0.0919).

The correlation coefficients can be calculated for the rates of return in two groups:

1. Group 1: Friday close – Monday open and Friday close – Monday close

2. Group 2: Friday close – Tuesday open and Friday close – Tuesday close
It has been confirmed strong dependence between correlation coefficients in these two groups – see Figure 1. Dependence between correlation coefficient in the Group 2 (y) and the correlation coefficient in Group 1 (x) is described with the following equation:

$$y = 2,4985 \cdot x - 1,4534 \quad (5)$$

The R^2 is equal to 0.831.

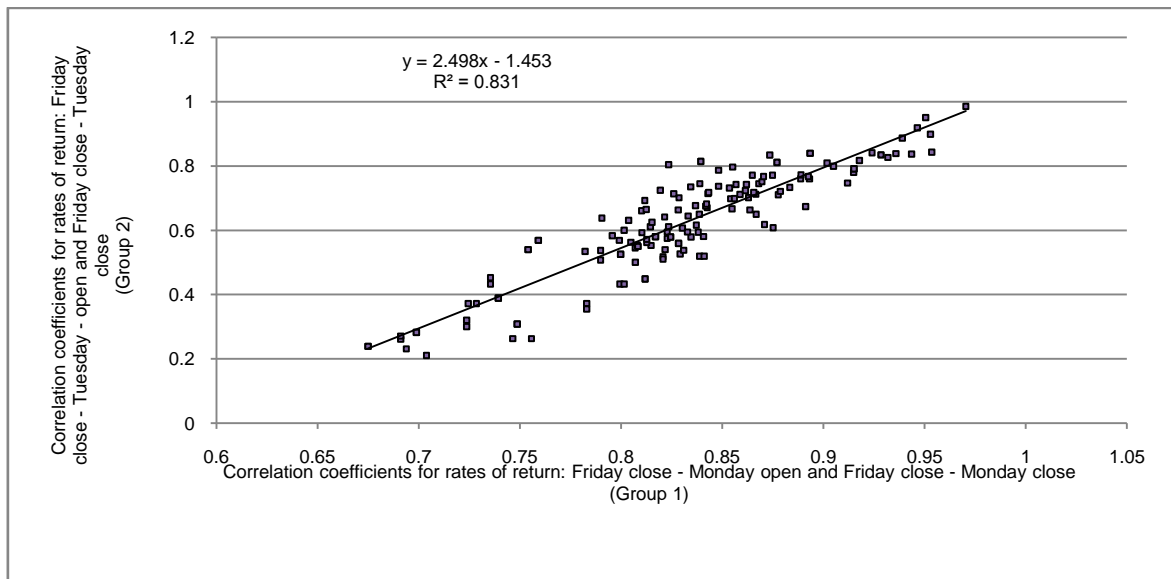


Figure 1. Linear Regression for Correlation Coefficients in Group 1 and Group 2

5. Conclusion

The aim of this study was to determine the prevalence of the weekend effect on the markets of 121 equity indices and 29 commodities. Analysis of the effects of seasonality included an examination of the rates of return calculated for four approaches:

1. Friday close – Monday open prices,
2. Friday close – Monday close prices,
3. Friday close – Tuesday open prices,
4. Friday close – Tuesday close prices.

Calculations presented in this paper indicate the presence of the weekend effect in the following cases: 36 (I approach), 58 (II approach), 57 (III approach) and 66 (IV approach). The existence of seasonality effects occurred in both developed and emerging stock markets as well as on the commodity markets. The weekend effect, in its modified version, was also observed in the Islamic countries. In case of 20 equity indices and commodities, the weekend effect was observed for all four approaches (ALSIUG, CAC40, CRB, DAX, DJIA, DJTA, DJUA, FTSE 250, HANG SENG, IPSA, KLCI, Merval, NASDAQ, NIKKEI, PSEI, SET, SP 500, Straits Times, copper, platinum). For all three remaining approaches, the number of the indices and commodities observed in each of them was equal to: 22, 19 and 33, respectively. The weekend effect was observed in three out of four approaches for the following indices: BOVESPA, CROBEX, CYMAIN, ICEX, JCI, JKSE, KARACHI, KLSE, OMX Riga, PLE MAIN, SASESLCT, TAIEX, TOPIX, XU 100, Brent oil, cocoa, crude oil, gasoline, heating oil, palladium, silver, and sugar.

The main limitation of this research is the assumption of normal distribution of return rates of analyzed indices and commodities along with the use of price data gained from Reuters

data source as well as the unequal intervals of observations for different equity indices and commodities.

The outcome may be regarded as a part of the ongoing discussions on the hypothesis of financial markets efficiency, which was introduced by Fama (1970).

Results obtained in the paper regarding the weekend effect on the gold market are consistent with those of French (1980), Schwert (1990), Keim and Stambaugh (1984), and Board and Sutcliffe (1988). Further research on the occurrence of weekend anomalies in the financial markets should cover the currency market.

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