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Do Sleep Disorders Affect Stock Markets? Evidence from Borsa Istanbul

Uyku Bozuklukları Hisse Senedi Piyasalarını Etkiler mi? Borsa İstanbul Üzerine Bir Uygulama

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ÖZET

Bu çalışmanın amacı, 1988-2015 yılları arasında Borsa İstanbu'da faaliyet gösteren hisse senetleri üzerinde yaz saati uygulamasının etkisini araştırmaktır. Bu kapsamda, yaz saati uygulaması anomalisinin saat değişimlerini takip eden gün ve hafta içerisinde hisse senedi getirileri ve volatilite üzerindeki etkisi analiz edilmektedir. Araştırma sonuçları, hisse senedi getirileri ve volatilitenin yaz saati değişikliklerinden etkilenmediğini göstermektedir. Diğer bir ifadeyle, Borsa İstanbul'da yaz saati uygulamasının etkisine dair her hangi bir bulguya rastlanmamıştır.

Keywords:

Sleep Disorders,

Daylight Saving Time,

Borsa Istanbul.

ABSTRACT

The aim of this study is to investigate the effect of "daylight saving time" (DST) changes on Borsa Istanbul, covering the periods from 1988 to 2015. In this context, daylight saving anomaly was examined by using stock market returns and volatilities following DST changes on daily and weekly basis. The results indicate that both market returns and volatilities following daylight saving time changes do not differ from other days and weeks. Thus, it can be said that there is no evidence of daylight saving time effect in Borsa Istanbul.

1. INTRODUCTION

Sleep researchers argue that sleeping disorder can affect people by destroying their motivation and causing them deep depression (Kamstra, Kramer and Levi; 2000: 1005). Even minor sleep imbalances lead people to make mistakes because of the errors in judgment, anxiety, impatience, less efficient processing of information, and loss of attention (Coren, 1996: 269).

Clinical and controlled laboratory studies state that sleep deprivation is associated with emotional changes and increased risk taking. People with more sleeping problems tend to take more risk, and this higher risk taking behavior increases immediate threats (O'Brien and Mindell, 2005). For example, traffic accidents have increased with sleeping disorder on the days following daylight saving time changes, when clocks are adjusted twice a year in the spring and fall (Kamstra, Kramer and Levi; 2000, Varughese and Allen; 2001, Coren; 1996a, 1996b).

Kamstra, Kramer, and Levi (2000: 1005-1006) argue that stock market returns are also affected and expected to be lower on the first trading day following daylight saving time (DST) changes because of sleep desynchronosis. Because investors may not solve problems easily or reach rational decisions throughout the first trading days following a time change. Thus, these days are followed by large negative returns in stock markets and they are lower than those of normal market days (Berument and Dogan, 2011: 865).

This study, firstly, provides literature review. Then, the purpose of the study is covered, the data are described and the methodology is explained. At last, descriptive statistics and regression results are reported. The contribution and the suggestions for further research are provided in the conclusion part.

2. LITERATURE REVIEW

Many studies have also attempted to investigate the effect of daylight saving time changes in different stock markets. Firstly, Kamstra, Kramer and Levi (2000) have described a new stock market anomaly and examined the existence of daylight saving time effect in US, UK, Canada and Germany between the periods from 1967 to 1997. They have found that daylight saving time changes affect the stock returns negatively at the first day following changes and these stocks exhibit lower returns than regular weekend returns.

However, there is a conflict between the researchers in the literature. Pinegar (2002) has evaluated whether there is an effect of daylight saving time changes on stock returns or not in US market from 1967 to 1998. He did not agree with Kamstraet. al. (2000) and argued that there is no difference between the daylight saving and nondaylight saving weekend returns.

The existence of daylight saving anomaly has also been studied in the Australian stock market. Worthington (2003) has used, at first, a parametric analysis, and then, a regression analysis to test daylight saving effect over the period from 1980 to 2003. However, consistent with the results of Pinegar (2002), he has found no evidence of daylight saving effect in Australian stock market. Thus, it can be said that stock returns following daylight saving time changes do not differ from other days.

Lamb, Zuber and Gandar (2004) have used equally-weighted and value-weighted indices for the years 1967-1997 in USA to test the presence of daylight saving time anomaly. The results have implied that stocks exhibit lower returns only forweekends following fall changes than regular weekend returns. After a deeper analysis, negative returns were found during two weekends following DST changes in October. Thus, it can be said that October effect rather than DST effect has been observed, consistent with the results of Pinegar (2002).

Steigerwald and Conte (2007) have utilized daily stock returns to detect whether there is daylight saving effect or not for the Standard and Poor's (S&P) 500 index during the periods of 1962 and 2006. Accordingly, stocks do not exhibit lower returns than that of regular weekend returns and the daylight saving effect do not exist towards the index, not supporting the results of Kamstraet. al. (2000).

The effects of seasonal affective disorder and daylight saving time changes on trading volume changes have been investigated in the study of Wallemo (2007). Utilizing the S&P 500 (1970-2006) and the NASDAQ Composite (1984-2006) indexes, while he has found an evidence of seasonal affective disorder effect, daylight saving effect has not been observed on trading volume changes, as in Gerlach (2010).

The effect of daylight saving anomaly has been investigated in European bond and equity markets in the study of Müller, Schieeck, Simpson and Voigt (2009). They have used more robust econometric techniques and the results contradict those of Kamstra, Kramer and Levi (2000) who have found the existence of daylight saving effect.

Korkmaz, Başaran and Çevik (2010) have investigated the effects of DST changes in Borsa Istanbul 100 index in the period of October 1978 and June 2009 by using GARCH models. They have stated that DST changes had a negative effect only for the mean returns of springs.

Gerlach (2010) have used daily returns on value-weighted and equal-weighted indices from the NYSE, AMEX, NASDAQ, and S&P 500 to test the relationship between stock returns and DST changes. According to joint t-test and regression analysis, he has argued that correlation between stock returns and DST changes are affected by seasonal patterns in market-related information rather than daylight saving effect.

Gregory-Allen, Jacobsen and Marquering (2010) have performed an analysis of daily returns in 22 stock markets around the world: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Luxembourg, the Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. Based on the regression results, no evidence of daylight saving time effect on stock returns has been found, consistent with the results of Pinegar (2002), Worthington (2003), Lamb et. al. (2004) and Müller et. al.(2009). Thus, it can be argued that stock returns following DST changes do not differ from returns on normal trading days.

Berument, Dogan and Onar (2010) have tested the existence of daylight saving effect in US stock markets for the period between 1967 and 2007. They have extended the study by taking into account stock volatility as well as stock returns using an EGARCH specification and the results support the existence of daylight saving anomaly neither in stock returns nor in volatility, rejecting the study of Kamstraet. al. (2000).

Kamstra, Kramer and Levi (2010) have criticized the results of Berument, Dogan and Onar (2010) with ‘a comment’ and argued that stock market returns on Mondays following DST changes are still significantly lower than the mean return on all other Mondays. To examine the effect of daylight saving time changes, OLS, GARCH and EGARCH models were considered.

Berument and Dogan (2011) have replied the comment of Kamstra, Kramer and Levi (2010) and conducted an analysis between the periods from 1967 and 2007 in US markets. Their results have indicated consistency with the argument of Pinegar (2002), supporting the absence of the daylight saving effect on the stock market returns.

Kamstra, Kramer and Levi (2013) have criticized the results of Berumer and Dogan (2011) for their use of inappropriate estimation techniques, over-parameterized models, and low-power tests. They have rebutted and empasized that stock returns have implied evidence of large negative daylight-saving effect in US.

Patel (2012) has compared daylight saving weekend returns with that of other weekend returns to examine the effect of DST changes on stock returns. Using the value-weighted and equally-weighted equity indices, he has found that stock returns following these changes do not become lower than normal weekend returns. Therefore, it can be concluded that there is no evidence of daylight saving effect in US for the period 2001 to 2010.

Siganos (2019) has examined whether daylight saving time changes affect the decision making of investors when trading in firms targeted for mergers. He has obtained US domestic merger deals from SDC Thomson OneBanker between the periods of 1977 and 2017. Accordingly, targets exhibit more positive abnormal returns on Mondays following daylight saving time changes in contrast to other mergers because of sleep disorders.

Mugerman, Yidov and Wiener (2020) have tested the effect of the switch from summer time to winter time on stock markets around the gobe by using the daily returns of the stock market indexes of 45 countries between the years 2000 and 2017. They have conducted an ordinary least squares regression model and found that market returns are significantly affected from the daylight saving time changes, especially for the local, relatively small markets.

3. AIM OF THE STUDY

The main purpose of this study is to investigate the effect of daylight saving time changes in Borsa Istanbul. In this context, stock market returns on the first trading day and week following DST changes are compared to returns on other days and weeks. Stock market volatility is also taken into consideration to examine whether it moves with daylight saving time changes or not.

This study is the first attempt to measure the effect of DST changes on market volatility, as well as market return on daily and weekly basis, in Borsa Istanbul.

4. DATA AND METHODOLOGY

To test the existence of daylight saving time effect, daily and weekly closing prices of BIST 100 index were selected as the market indicator from 1988 to 2015. Daylight saving time (DST) changes has ended in Turkey, and clocks have not been turned back one hour, but have remained on the same time since 2016. There are 6965 daily observations and 1451 weekly observations in Borsa Istanbul for the study period. However, daily returns following DST changes were used only if the first trading day is Monday, if not, excluded. Because if Monday following DST changes is an official holiday, a decreased effect may be observed on other days of the week.

Daily and weekly closing prices were converted to daily and weekly logarithmic returns. The following formula was used to calculate returns:

$$R_{m,t} = ln\ (P_{m,t} / P_{m,t-1}) \qquad (1)$$

where $R_{m,t}$ is the market return at time t, $P_{m,t}$ is the closing price of the market at time t, and $P_{m,t-1}$ is the closing price of the market on time before.

To calculate market volatility values (σ_{mt}), squared returns were used as in Schwert (1989):

$$\sigma_{mt}^2 = \sum_{i=1}^{N_t} (r_{it} - \overline{r_t})^2 \qquad (2)$$

where $\overline{r_t}$ is the sample mean of the daily market returns and r_{it} is daily market return in month t, respectively. N_t is the number of daily returns in month t.

To test the presence of daylight saving effect on stock market returns, at first, daily (weekly) mean return for the first trading day (week) following spring, fall and combined spring and fall changes as well as the mean returns for all other trading days (weeks). Then, a regression analysis was considered. To examine first trading days following DST changes, two dummy variables were added to the model and used in the following regression equation.

$$R_{m,t} = a + \beta^S DST_t^S + \beta^F DST_t^F + \beta^C DST_t^C + \epsilon_t \qquad (3)$$

where $R_{m,t}$ is the BIST 100 index return at time t, α is the constant, DST_t^S is a dummy variable that equals to one on the first trading day following spring changes and equal to zero otherwise, DST_t^F is equal to one on the first trading day following fall changes and equal to zero otherwise, DST_t^C is equal to one on the first trading day following combined spring and fall changes and equal to zero otherwise, and ϵ_t is the error term.

A regression analysis was also conducted to detect the existence of daylight saving anomaly in stock market volatility. The first trading days following DST changes were captured by dummy variables, as well.

$$\sigma_{m,t} = a + \beta^S DST_t^S + \beta^F DST_t^F + \beta^C DST_t^C + \epsilon_t \qquad (4)$$

where $\sigma_{m,t}$ is the market volatility at time t.

5. EMPIRICAL FINDINGS

Table 1 reports daily and weekly mean returns and regression results for the equation of $R_{m,t} = a + \beta^S DST_t^S + \beta^F DST_t^F + \beta^C DST_t^C + \epsilon_t$. The coefficients of the dummy variables capture the extent of daylight saving time changes for spring, fall and combined spring and fall. Although, first trading returns following spring, fall, or combined spring and fall changes in daylight saving time are negative and lower compared with the first trading days following non-daylight saving weekends, t-statistics are statistically insignificant implying no effect of daylight saving time changes on stock market returns. However, weekly mean returns following DST changes are positive and this may confirm that the effect of DST changes decreases during the week.

Table 1. Regression Results of Daylight Saving Time Changes on Stock Market Returns

	Daily Results		Weekly Results	
	Mean Returns	t-Statistics	Mean Returns	t-Statistics
Fall	-0,003016	0,074905 (0,940293)	0,013218	-0,53622 (0,733998)
Spring	-0,00267	0,114094 (0,909166)	0,004112	-0,33988 (0,591889)
Both	-0,00284	-0,29754 (0,766063)	0,008665	0,504813 (0,613767)
Other	0,001328		0,006382	

* p-values in parentheses.

Notes: "Spring" refers to the spring daylight saving time change, "Fall" to the fall daylight saving time change, "Both" to combined spring and fall changes and "Other" to all days for daily results and all weeks for weekly results.

Table 2 shows the regression results based on daily and weekly stock market volatilities. It exhibits the findings of $\sigma_{m,t} = a + \beta^S DST_t^S + \beta^F DST_t^F + \beta^C DST_t^C + \epsilon_t$. According to the results, although daily and weekly mean volatilities for fall changes are higher than other days and weeks, statistically insignificant coefficients of spring, fall and combined spring and fall variables do not support the existence of daylight saving time effect in stock market volatility.

Table 2. Regression Results of Daylight Saving Time Changes on Stock Market Volatility

	Daily Results		Weekly Results	
	Mean Volatility	t-Statistics	Mean Volatility	t-Statistics
Fall	0,115281	-0,1963 (0,84438)	0,113523	0,21226 (0,831934)
Spring	0,100105	-0,82149 (0,411394)	0,083943	-0,4919 (0,622866)
Both	0,107693	0,643135 (0,520158)	0,098733	0,413698 (0,679156)
Other	0,103973		0,088042	

*p-values in parentheses.

Notes: "Spring" refers to the spring daylight saving time change, "Fall" to the fall daylight saving time change, "Both" to combined spring and fall changes and "Other" to all days for daily results and all weeks for weekly results.

CONCLUSION

Sleep disorders show positive correlation to many undesirable physical and mental conditions like impaired perception, slower reactions, poor memorizing, shematic thinking that results in wrong decision making, increased aggressiveness and depression (Fernando et. al.; 2013: 277-281, Gryglewska; 2010: 95).

Kamstra, Kramer and Levi (2000) have first introduced a new stock market anomaly called “daylight saving anomaly” which states that sleep disorders after daylight saving time changes effect the stock market returns, negatively.

In this study, it has been investigated that whether there is daylight saving anomaly in terms of market return and market volatility in Borsa Istanbul, or not. Daily and weekly data cover the period from 1988 to 2015. The daily and weekly effects of daylight saving anomaly on Borsa Istanbul have been examined by using regression analysis for fall, spring and combined fall and spring changes. According to empirical findings there is no statistically difference between mean returns and volatilities neither for daily nor for weekly data.

Daylight saving time effect (DST) has been widely tested in US stock markets, but there are few researches in emerging stock markets. There is only one study which is written by Korkmaz, Başaran and Çevik (2010) that investigates daylight saving anomaly in Borsa Istanbul. In their study, they have used stock market returns and volatilities and found that DST effect is observed only for spring changes, inconsistent with the results of our study. This may be because of analyzing different time periods or using different methodologies. Compared to other studies, our findings are consistent with the studies of Pinegar (2002), Worthington (2003), Gerlach (2010),

Gregory-Allen, Jacobsen and Marquering (2010), Berument,Doğan and Onar (2010), Lamb, Zuber and Gandar (2004), Patel (2012), Steigerwald and Conte (2007) and Wallemo (2007) and inconsistent with the study of Kamstra, Kramer and Levi (2000).

It is believed that the findings of this study will be useful for both individual and institutional investors who trade on Borsa Istanbul and will contribute to the daylight saving anomaly literature by looking from a different perspective and being a reference for further studies. In this context, because investors tend to take more risk when they have sleeping disorders, it could be suggested to examine the relation between DST changes and trading volume. In addition, the intraday trading returns of individual investors following DST changes would be a perfect indicator to measure the effect of daylight saving anomaly.

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