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# Predicting Intra-Day and Day of the Week Anomalies in Turkish Stock Market

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*According to Efficient Market Hypothesis, investors cannot gain abnormal returns. But various anomalies such as day or intra-day effect which are frequently observed at the stock markets provide some abnormal returns to investors. In the literature, many studies have found various anomalies for different national and international stock markets. But most of the applied studies used aggregate data in their econometric analysis. The question is whether the same anomalies exist in sub-indexes such as communication, technology, sports and services, etc. The purpose of this study is to investigate whether there are the same anomalies such as intra-day effect and day of the week effect for an aggregated index and 23 sub-indexes of Borsa Istanbul. The data which used in this study is daily and covers the period of 2005-2015 for Turkey. Findings show that there is evidence for intra-day effect in all 24 indexes and day of the week effect in 2 sub-indexes.*

*Keywords: Intra-day effect; day of the week effect; Borsa Istanbul; capital markets*

*JEL Classification: G11, G12, G14*

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## 1. Introduction

Efficient Market Hypothesis (EMH) which is presented by Fama (1965) assumes that stock prices reflect all relevant information. Therefore, investors cannot gain any abnormal returns. It is recognized that EMH is based on the assumption that investors behave rationally and all information reaches all investors quickly; therefore the stock price will occur again in accordance with this information. However, in the literature, there have been some findings that conflict with EMH and these are referred to as anomalies. A variety of these anomalies are the calendar anomalies. Calendar anomalies arise hourly, daily, weekly, monthly, yearly or at a specific pre or post-time of a period.

An inefficient market can allow investors to gain abnormal returns with some degree of risk. In other words, calendar anomalies can help investors earn higher returns at certain times. Hence, the examination of the calendar anomalies plays an important role in the decision-making process and has an extensive place in finance literature. Intra-day and day of week effects have often been tested in empirical studies on various stock markets. Among these studies, Wood et al. (1985) found that the returns were higher in the first 30 minutes and the last minute of the trading day than the rest of the day. Several researchers (i.e., Harris, 1986; Jain & Joh, 1988; McInish & Wood, 1990; Lockwood & Linn, 1990) reached similar results for USA stock markets. The existence of intra-day effect was also investigated for Spain (Camino, 1996) Greece (Niarchos & Alexakis, 2003), Poland (Strawinski & Slepaczuk, 2008), Czech Republic (Deev & Linnertova, 2012) and Turkey (Ozmen, 1997; Bildik, 2000; Gokce & Sarioglu, 2004; Kucukkocaoglu, 2008; Abdioglu & Degirmenci, 2013). All those research had common evidence of intra-day effect. The existence of intra-day effect was even determined for Hong Kong (Cheung, 1995) and China (Tian & Guo, 2007).

In the finance literature, day of the week effect was also tested for different countries and different periods. Some of the studies that show strong evidence for day of the week effect can be listed as Cross (1973); French (1980); Berument and Kıymaz (2001) for USA stock markets, Solnik and Bousquet (1990); Lyroudi and Subeniotis (2002); Kenourgios and Samitas (2008) for European stock markets and Jaffe and Westerfield (1985); Poshakwale (1996); Chen et al. (2000); Nath and Dalvi (2004); Raj and Kumari (2006); Chia et al. (2008) for Asian stock markets. On the other hand, there was no evidence for day of the week effect for India (Nageswari et al., 2011; Al-Jafari, 2012; Mitra & Khan, 2014). Furthermore, many researchers (i.e., Dicle & Hassan, 2007; Hamarat & Tufan, 2008; Guneyusu & Yamak, 2011; Abdioglu & Degirmenci, 2013; Cicek, 2013; Konak & Kenderli, 2014) found strong evidence for day of the week effect for the Turkish stock market.

Almost all existing studies in the related literature used aggregate data in econometric analysis. The question is whether the same anomalies exist in the sub-indexes such as communication, technology, sports and services, etc. In the study, both 23 sub-indexes of Borsa Istanbul (BIST) as well as an aggregate index (BIST-100) are separately used to determine whether there are intra-day and day of the week anomalies. The aim of this study is to examine whether the same anomalies exist in the disaggregated data. The rest of the paper is organized as follows: Section 2 summarizes the literature; Section 3 describes the data and methodology; Section 4 presents the empirical findings; and Section 5 represents conclusion.

## **2. Literature Review**

In the current literature, the existence of intra-day and the day of the week anomalies have examined in different countries, different indexes and different periods. Among these studies, Wood et al. (1985) examined whether there was an intra-day effect in NYSE by

considering minute-by-minute price changes and found that the returns realized in the first 30 minutes and the last minute of the trading day were more than the rest of the day. McInish and Wood (1990) reached similar results for the USA. Moreover, Harris (1986) analyzed the trading day into 15 minute periods in order to investigate intra-day effect. He concluded that intra-day effect existed in terms of returns. Jain and Joh (1988) examined the existence of intra-day effect by using hourly returns in S&P 500 Index for the period of 1979-1983. The results showed that Monday was the only day of the week on which negative return was gained. Lockwood and Linn (1990) detected that returns in NASDAQ followed a decreasing trend an hour after the trading began, but then it followed a rising trend.

For the European stock markets, Camino (1996) investigated the intra-day effect by dividing the IBEX-35 Index into 15 minute periods and found that the returns were statistically different in the first 4 hours following the opening of trade. Niarchos and Alexakis (2003) repeated the same research for the Athens stock market by using 15 minute periods and found that statistically negative and significant returns showed up at 11:30 am. Strawinski and Slepaczuk (2008) found similar results for Poland by dividing the sessions into 5 minute periods. The findings showed that the volatility in the morning sessions was higher than the afternoon sessions. Deev and Linnertová (2012) used 5 minute periods of data in the Czech stock market and indicated that positive returns could be gained during the opening of trade on Monday and Thursday.

For the Asian stock markets, Cheung (1995) concluded that intra-day effect in terms of returns existed in the Hong Kong stock market. However, Cheung et al. (1994) found that there was no significant difference between the morning and afternoon session returns in the Hong Kong stock market. Tian and Guo (2007), for the Shanghai stock market, examined the existence of the effect by dividing the

sessions into 5 minute periods. The findings showed that the volatility in the morning session was higher than the afternoon session.

For the Turkish stock market, Ozmen (1997) found that the lowest return was gained on Monday during the afternoon session for the period of 1988-1996. Similarly, Bildik (2000) investigated the existence of intra-day effect by using 15 minute periods of data. He found that the returns were quite high and positive towards the opening and closing hours of the day. Gokce and Sarioglu (2004) studied the intra-day effect for the period of 1995-2003. The findings showed that there was an intra-day effect and the highest returns realized were in the morning sessions of Tuesdays and in the afternoon sessions of Fridays. Furthermore, Kucukkocaoglu (2008) investigated whether there was an intra-day effect for the period of 2000-2002, by using 15 minute periods of data for 8 different stocks and for different indexes. The findings indicated that the volatility was the highest in the mornings until 2001, after which the volatility decreased significantly. Abdioglu and Degirmenci (2013) found the existence of intra-day effect for 2012.

In the related literature, day of the week effect was also studied for different countries and different periods. Among these studies, Cross (1973) examined whether there was a day of the week anomaly in the S&P Index during the period of 1953-1970. The findings showed that the returns were negative on Mondays and positive on Fridays. Similar results were also found by French (1980). Berument and Kıymaz (2001) investigated the day of the week anomaly for the S&P Index and concluded that the highest and the lowest returns for the USA were gained on Wednesday and on Monday, respectively.

For the European markets, while Solnik and Bousquet (1990) found that the lowest return was obtained on Tuesdays in France. Lyroudi and Subeniotis (2002) found that negative returns were gained on Tuesday for the Athens stock market. Similarly, Kenourgios and

Samitas (2008) implied that there was a significant day of the week effect on both returns and volume in the Athens stock market.

For the Asian markets, Jaffe and Westerfield (1985) investigated the day of the week effect for the Japanese stock market and found that the lowest return was obtained on Tuesdays. Poshakwale (1996) showed that the returns were negative on Mondays and positive on Fridays for India. Chen et al. (2000) found that negative returns were gained on Tuesdays for China. Nath and Dalvi (2004) indicated that returns were negative on Mondays and positive on Fridays for India. However, Raj and Kumari (2006) detected that negative returns were gained on Tuesdays. Chia et al. (2008) tested the effect in the Taiwan, Singapore, Hong Kong and South Korea stock markets. The findings showed negative effects on Mondays and positive effects on Fridays in the stock markets of Taiwan, Singapore and Hong Kong. Nageswari et al. (2011) examined the existence of the day of the week anomaly in the Indian stock market and found the highest and lowest returns on Mondays and on Fridays, respectively. However, there was no evidence of the existence of the day of the week effect for the Oman stock market (Al-Jafari, 2012) and for the Indian stock market (Mitra & Khan, 2014).

In Turkey, Dicle and Hassan (2007) examined the existence of day of the week effect for all the indexes of ISE by covering the period of 1987-2005. They found that while the return was negative on Mondays, it was positive on Thursdays and Fridays. The same results were also found by Cinko and Avcı (2009) for ISE 100 Index. Hamarat and Tufan (2008) also pointed out that there was a day of the week effect in the Tourism sector. Guneyusu and Yamak (2011), Abdioglu and Degirmenci (2013) showed that there was a day of the week effect in the ISE. Cicek (2013) examined the effect in BIST 100, financial, services, industry and technology indexes for the period of 2008-2012. The findings showed that the returns, except for the financial index, were positive and high on Mondays. On the other

hand, Konak and Kenderli (2014) found a negative Monday effect for the period of 2005-2012.

### 3. Data and Methodology

This study investigates whether there are intra-day and day of the week anomalies for Turkish stock market. Disaggregated price indexes which are obtained from the official site of Borsa Istanbul are used in the current study. The names of indexes used in the empirical analysis are shown in Table 1.

**Table 1**

Indexes used in the study	
Index Name	Index Name
BIST 100	Tourism
Industrials	Wholesale and Retail Trade
Food Beverage	Telecommunication
Textile Leather	Sports
Wood Paper Printing	Financials
Chemical Petroleum Plastic	Banks
Nonmetal Mineral Products	Insurance
Basic Metal	Leasing Factoring
Metal Products Machinery	Holding and Investment
Services	Real Estate Investment Trusts
Electricity	Technology
Transportation	Information Technology

#### 3.1. Testing of Intra-day Effect

For testing of intra-day effect closing prices of the morning and afternoon sessions of each index are used for computation of session returns in equation 1 as follows:

$$R_t = \ln\left(\frac{P_t}{P_{t-1}}\right) \quad (1)$$



In equation 1,  $R_t$  is the session return for price index,  $P_t$  is the closing value of the price index on session  $t$ ,  $P_{t-1}$  is the closing value of the price index on session  $t-1$  and “ln” is the naturel logarithm.

Firstly, the dummy variables are created to examine intra-day anomalies, and the significance level of each dummy variable is reported by t-test statistics under ordinary least squares (OLS) equations. Secondly, following previous studies (see for example Badrinath and Chatterjee, 1991; Arsad and Coutts, 1997) used non-parametric Kruskal-Wallis (K-W) statistics which are also estimated by assuming that stock returns were non-normal. Finally, the F-statistic is computed for the coefficients of dummy variables.

In order to determine the existence of intra-day effect the following equation is estimated for each index.

$$R_t = \beta_1 D1 + \beta_2 D2 + \beta_3 D3 + \beta_4 D4 + \beta_5 D5 + \beta_6 D6 + \beta_7 D7 + \beta_8 D8 + \beta_9 D9 + \beta_{10} D10 + \varepsilon_t \quad (2)$$

In equation 2,  $D1 \dots D10$  represent dummy variables.  $D1$  is a dummy variable which takes the value of 1 if the session is a Monday morning session and 0 otherwise,  $D2$  is a dummy variable which takes the value of 1 if session is Monday afternoon session, and 0 otherwise; and so on.  $R_t$  is the session return of each index. The OLS coefficients  $\beta_1$  to  $\beta_{10}$  are the mean returns for the morning session of Monday through the afternoon session of Friday, respectively. The stochastic term is denoted by  $\varepsilon_t$ . The null hypothesis is  $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = \beta_{10} = 0$  and the alternative is  $H_1$ : All  $\beta$ 's are not equal. If the null hypothesis is rejected then the returns must exhibit some intra-day effect.



### 3.2. Testing of Day of the Week Effect

Using the closed prices of each index in the study, returns of each index are separately computed using equation 3:

$$R_t = \ln\left(\frac{P_t}{P_{t-1}}\right) \quad (3)$$

In equation 3,  $R_t$  is the daily return for day  $t$  of each index,  $P_t$  is the price of each index on day  $t$ ,  $P_{t-1}$  is the price of the index on day  $t-1$ .

$$R_t = \beta_1 D1 + \beta_2 D2 + \beta_3 D3 + \beta_4 D4 + \beta_5 D5 + \varepsilon_t \quad (4)$$

In order to investigate day of the week anomalies, five dummy variables are created and included in equation 4. Then, t-statistics of coefficients of dummy variables are estimated by the OLS. On account of distributional property of the stock returns, Kruskal-Wallis statistic and F-statistic are estimated. In equation 4,  $R_t$  represents the daily return on each index,  $D1$  is a dummy variable which takes the value of 1 if the day is Monday and 0 otherwise,  $D2$  is a dummy variable which takes the value of 1 if the day is Tuesday and 0 otherwise; and so on. The OLS coefficients  $\beta_1$  to  $\beta_5$  are the daily mean returns from Monday to Friday. The stochastic term is represented by  $\varepsilon_t$ . The null hypothesis is  $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$  and the alternative is  $H_1$ : All  $\beta$ 's are not equal. If the null hypothesis is rejected, there must be a statistically significant difference among the coefficients. This means that there must be day of the week effect in Borsa Istanbul.

### 4. Empirical Results

Descriptive statistics of average returns for each index are reported in Table 2. As can be seen from the table, the average returns for each index are positive. In addition, the highest and lowest average returns appear in the Wholesale and Retail Trade sector, and Electricity sector, respectively. According to the standard deviations, the highest volatility appears in Tourism sector and the lowest appears in the

Nonmetal Mineral Product sector. Furthermore, index returns are non-normal and display leptokurtic “fat tailed” properties.

**Table 2**  
**Descriptive statistics of index returns**

Index	Mean	Max.	Min.	Std. Deviation	Skewness	Kurtosis	Jarque Bera
BIST 100	0.0002	0.085	-0.078	0.0120	-0.3502	7.226	3876.
Industrials	0.0002	0.059	-0.072	0.0101	-0.8566	9.286	8965.
Food Beverage	0.0002	0.082	-0.096	0.0129	-0.3091	7.209	3822.
Textile Leather	0.0002	0.088	-0.095	0.0114	-1.1281	12.57	20440
Wood Paper Printing	0.0000	0.085	-0.090	0.0131	-0.6521	7.589	4807.
Chemical Petroleum	0.0002	0.066	-0.074	0.0124	-0.5257	7.362	4251.
Nonmetal Mineral	0.0002	0.060	-0.071	0.0100	-0.8549	9.935	10775
Basic Metal	0.0003	0.088	-0.097	0.0147	-0.2615	7.977	5289.
Metal Products	0.0002	0.073	-0.087	0.0121	-0.6526	8.380	6473.
Services	0.0002	0.077	-0.074	0.0105	-0.2692	7.858	5045.
Electricity	0.0000	0.093	-0.105	0.0151	-0.1992	9.717	9561.
Transportation	0.0003	0.084	-0.089	0.0156	-0.1473	6.300	2318.
Tourism	0.0000	0.089	-0.105	0.0160	-0.4986	7.955	5394.
Wholesale and Retail	0.0004	0.098	-0.086	0.0123	-0.1149	8.965	7525.
Telecommunication	0.0001	0.107	-0.132	0.0148	-0.0473	8.432	6233.
Sports	0.0001	0.105	-0.112	0.0147	-0.0994	11.43	15031
Financials	0.0002	0.098	-0.081	0.0140	-0.2023	6.665	2871.
Banks	0.0002	0.103	-0.087	0.0153	-0.0845	6.019	1931.
Insurance	0.0002	0.087	-0.094	0.0144	-0.4035	8.083	5594.
Leasing Factoring	0.0001	0.091	-0.098	0.0150	-0.0385	9.162	8020.
Holding and	0.0001	0.093	-0.083	0.0130	-0.4469	7.736	4906.
Real Estate Inv. Trusts	0.0000	0.068	-0.090	0.0126	-0.7316	8.010	5754.
Technology	0.0003	0.071	-0.096	0.0129	-0.7136	8.923	7839.
Information	0.0001	0.073	-0.098	0.0136	-0.6298	9.237	8549.

The regression results for intra-day effect are shown in Table 3. Whether there is a significant difference between session returns is tested by K-W statistics.

Table 3

## Regression results of intra-day effect

	BIST 100	Industrials	Food Beverage	Textile Leather	Wood Paper	Chemical Petroleum
	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$
Mon1	1.89E-05	0.0006	-0.0001	0.0015 <sup>a</sup>	0.0021 <sup>a</sup>	0.0001
Mon2	0.0004	0.0001	0.0005	-0.0007	-0.0012 <sup>b</sup>	0.0005
Tue1	0.0006	0.0011 <sup>a</sup>	0.0007	0.0017 <sup>a</sup>	0.0023 <sup>a</sup>	0.0006
Tue2	-0.0001	-0.0001	6.93E-06	-0.0010 <sup>b</sup>	-0.0012 <sup>b</sup>	0.0002
Wed1	0.0012 <sup>b</sup>	0.0015 <sup>a</sup>	0.0016 <sup>a</sup>	0.0016 <sup>a</sup>	0.0026 <sup>a</sup>	0.0012 <sup>b</sup>
Wed2	-0.0012 <sup>b</sup>	-0.0017 <sup>a</sup>	-0.0006	-0.0027 <sup>a</sup>	-0.0035 <sup>a</sup>	-0.0014 <sup>b</sup>
Thu1	0.0019 <sup>a</sup>	0.0015 <sup>a</sup>	0.0016 <sup>a</sup>	0.0027 <sup>a</sup>	0.0031 <sup>a</sup>	0.0010 <sup>c</sup>
Thu2	-0.0011 <sup>b</sup>	-0.0012 <sup>a</sup>	-0.0007	-0.0014 <sup>a</sup>	-0.0036 <sup>a</sup>	-0.0007
Fri1	0.0007	0.0010 <sup>b</sup>	0.0002	0.0015 <sup>a</sup>	0.0026 <sup>a</sup>	0.0011 <sup>b</sup>
Fri2	-0.0001	-0.0005	-0.0005	-0.0011 <sup>b</sup>	-0.0022 <sup>a</sup>	-0.0001
KW/F	39.2 <sup>a</sup> /3.17	107.5 <sup>a</sup> /6.30	30.7 <sup>a</sup> /2.26 <sup>b</sup>	253.6 <sup>a</sup> /12.2	342.4 <sup>a</sup> /20.7	42.3 <sup>a</sup> /2.41 <sup>a</sup>
	Nonmetal mineral	Basic Metal	Metal Products	Services	Electricity	Transport.
	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$
Mon1	0.0012 <sup>a</sup>	0.0011 <sup>c</sup>	0.0009 <sup>c</sup>	0.0001	0.0021 <sup>a</sup>	0.0017 <sup>b</sup>
Mon2	-0.0007 <sup>c</sup>	0.0001	0.0004	0.0002	-0.0014 <sup>b</sup>	-0.0002
Tue1	0.0015 <sup>a</sup>	0.0013 <sup>b</sup>	0.0015 <sup>a</sup>	0.0005	0.0010	0.0024 <sup>a</sup>
Tue2	-0.0002	0.0001	-0.0006	-0.0003	-0.0013 <sup>b</sup>	-0.0002
Wed1	0.0022 <sup>a</sup>	0.0014 <sup>b</sup>	0.0014 <sup>a</sup>	0.0007	0.0018 <sup>a</sup>	0.0024 <sup>a</sup>
Wed2	-0.0023 <sup>a</sup>	-0.0022 <sup>a</sup>	-0.0018 <sup>a</sup>	-0.0010 <sup>a</sup>	-0.0028 <sup>a</sup>	-0.0025 <sup>a</sup>
Thu1	0.0018 <sup>a</sup>	0.0016 <sup>b</sup>	0.0016 <sup>a</sup>	0.0014 <sup>b</sup>	0.0031 <sup>a</sup>	0.0019 <sup>a</sup>
Thu2	-0.0017 <sup>a</sup>	-0.0009	-0.0019 <sup>a</sup>	-0.0009 <sup>b</sup>	-0.0025 <sup>a</sup>	-0.0017 <sup>b</sup>
Fri1	0.0012 <sup>a</sup>	0.0010	0.0013 <sup>b</sup>	0.0016 <sup>a</sup>	0.0012 <sup>b</sup>	0.0016 <sup>b</sup>
Fri2	-0.0007	-0.0004	-0.0005	0.0004	-0.0008	-0.0016 <sup>b</sup>
KW/F	206.4 <sup>a</sup> /12.	59.8 <sup>a</sup> /3.55 <sup>a</sup>	97.03 <sup>a</sup> /6.28 <sup>a</sup>	47.7 <sup>a</sup> /3.65 <sup>a</sup>	178.9 <sup>a</sup> /9.01	91.1 <sup>a</sup> /7.17 <sup>a</sup>
	Tourism	Wholesale and Retail	Telecommunication	Sports	Financials	Banks
	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$
Mon1	0.0018 <sup>a</sup>	0.0008	-0.0012 <sup>c</sup>	0.0007	-6.05E06	0.0001
Mon2	-0.0017 <sup>b</sup>	9.65E-05	0.0006	-0.0001	0.0004	0.0003
Tue1	0.0017 <sup>b</sup>	0.0001	7.29E-05	0.0003	0.0005	0.0007
Tue2	-0.0013 <sup>c</sup>	-0.0001	-0.0003	3.71E-06	-0.0002	-0.0002
Wed1	0.0020 <sup>a</sup>	0.0009 <sup>c</sup>	-0.0001	0.0012 <sup>b</sup>	0.0014 <sup>b</sup>	0.0016 <sup>b</sup>
Wed2	-0.0034 <sup>a</sup>	-0.0011 <sup>b</sup>	-0.0001	-0.0026 <sup>a</sup>	-0.0012 <sup>b</sup>	-0.0013 <sup>b</sup>
Thu1	0.0035 <sup>a</sup>	0.0015 <sup>a</sup>	0.0008	0.0019 <sup>a</sup>	0.0022 <sup>a</sup>	0.0025 <sup>a</sup>
Thu2	-0.0026 <sup>a</sup>	-0.0007	-0.0003	-0.0011 <sup>c</sup>	-0.0011 <sup>c</sup>	-0.0012 <sup>c</sup>
Fri1	0.0025 <sup>a</sup>	0.0020 <sup>a</sup>	0.0015 <sup>b</sup>	0.0018 <sup>a</sup>	0.0004	0.0005
Fri2	-0.0019 <sup>a</sup>	0.0006	0.0007	-0.0008	-0.0003	-0.0005
KW/F	232.1 <sup>a</sup> /11.	44.6 <sup>a</sup> /3.52 <sup>a</sup>	16.5 <sup>c</sup> /1.36	111.7 <sup>a</sup> /4.50	34.7 <sup>a</sup> /2.89 <sup>a</sup>	34.3 <sup>a</sup> /2.97 <sup>a</sup>

	Insurance	Leasing Factoring	Holding Investment	Real Estate Inv. Trust	Technology	Information Technology
	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$
Mon1	-0.0006	0.0010	-0.0006	0.0015 <sup>a</sup>	0.0028 <sup>a</sup>	0.0024 <sup>a</sup>
Mon2	1.72E-05	-0.0009	0.0009 <sup>c</sup>	-3.52E-05	-0.0008	-0.0011 <sup>b</sup>
Tue1	0.0011 <sup>c</sup>	0.0025 <sup>a</sup>	-7.07E05	0.0011 <sup>b</sup>	0.0008	0.0008
Tue2	-0.0001	-0.0008	0.0001	-0.0013 <sup>b</sup>	-0.0005	-0.0006
Wed1	0.0018 <sup>a</sup>	0.0022 <sup>a</sup>	0.0005	0.0015 <sup>a</sup>	0.0018 <sup>a</sup>	0.0019 <sup>a</sup>
Wed2	-0.0019 <sup>a</sup>	-0.0025 <sup>a</sup>	-0.0009	-0.0024 <sup>a</sup>	-0.0028 <sup>a</sup>	-0.0030 <sup>a</sup>
Thu1	0.0022 <sup>a</sup>	0.0028 <sup>a</sup>	0.0016	0.0019 <sup>a</sup>	0.0026 <sup>a</sup>	0.0025 <sup>a</sup>
Thu2	-0.0006	-0.0026 <sup>b</sup>	-0.0007 <sup>a</sup>	-0.0023 <sup>a</sup>	-0.0019 <sup>a</sup>	-0.0020 <sup>a</sup>
Fri1	0.0012 <sup>b</sup>	0.0015 <sup>b</sup>	9.82E-05	0.0021 <sup>a</sup>	0.0018 <sup>a</sup>	0.0017 <sup>a</sup>
Fri2	-0.0006	-0.0013 <sup>b</sup>	0.0006	-0.0012 <sup>b</sup>	-0.0007	-0.0010 <sup>c</sup>
KW/	47.1 <sup>a</sup> /4.04	165.8 <sup>a</sup> /9.18	21.2 <sup>b</sup> /1.94	177.9 <sup>a</sup> /9.40	192.8 <sup>a</sup> /11.20	191.2 <sup>a</sup> /10.06

<sup>a, b, c</sup> denotes significance at the 1%, 5% and 10% level respectively.

The values of K-W statistics in all indexes indicate that there is a significant difference between morning and afternoon sessions. Therefore, average return is positive for morning sessions and negative for afternoon sessions in 12 out of 24 sub-indexes (BIST 100, industrials, textile leather, wood paper printing, nonmetal mineral products, electricity, transportation, tourism, leasing factoring, real estate investment trust, technology and information technology).

In addition, 17 of the 24 indexes morning sessions have higher returns than the afternoon sessions<sup>4</sup>. Additionally, both session returns of all days are found to be different for the Wood Paper Printing sector and the Tourism sector. All other session returns, except afternoon sessions of Mondays, are different from each other for Textile Leather and Real Estate Investment Trust sectors. It is also determined that there is a difference among all other session returns except afternoon sessions of Tuesdays and Fridays for Nonmetal Mineral Products, morning sessions of Tuesdays and afternoon sessions of Fridays for Electricity, afternoon session of Mondays and Tuesdays for

<sup>4</sup> BIST 100, industrials, textile leather, wood paper printing, nonmetal mineral products, basic metal, metal products machinery, electricity, transportation, tourism, wholesale and retail trade, telecommunication, sports, leasing factoring, real estate investment trust, technology, information technology.

Transportation, and morning and afternoon sessions of Tuesdays for Information Technology.

It is also found that all session returns, except on Mondays are statistically different from each other, afternoon sessions of Tuesdays and Fridays for Metal Products Machinery sector, morning and afternoon sessions of Mondays and afternoon sessions of Tuesdays for Leasing Factoring sector returns. Other session returns are statistically different except for the morning sessions of Mondays as well as afternoon sessions of Mondays, Tuesdays, and Fridays returns for Industrial sector. All other session returns except afternoon sessions of Mondays, Fridays as well as morning and afternoon sessions of Tuesdays are statistically different for Technology sector. Returns of five sessions in Basic Metal, Sports and Insurance sectors, and four sessions in BIST 100, Chemical Petroleum Plastic, Services, Wholesale and Retail Trade, Financials and Banks sectors are different from other session returns. Morning sessions of Wednesdays and Thursdays in the Food Beverage sector, morning sessions of Mondays and Fridays in Telecommunication sector and afternoon sessions of Mondays and Thursdays in Holding and Investment sector returns are also different from other session returns.

Table 4 presents the results of the regression model in equation 4 for testing the day of the week effect. Findings show that Monday's returns are significantly positive for the Metal Products Machinery, Real Estate Investment Trust and Technology sectors; Tuesday's returns are significantly positive for the Nonmetal Mineral Products, Transportation and Leasing Factoring sectors; Thursday's returns are significantly positive for the Textile Leather and Insurance sectors; and Friday's returns are significantly positive for the Services, Wholesale and Retail Trade and Telecommunication sectors.

Table 4

## Regression results of the day of week effect

	BIST 100	Industrials	Food Beverage	Textile Leather	Wood Paper Printing	Chemical Petroleum Plastic
	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$
Mon	0.0004	0.0007	0.0003	0.0008	0.0009	0.0007
Tue	0.0004	0.0010	0.0007	0.0006	0.0010	0.0008
Wed	4.37E-05	-5.33E05	0.0010	-0.0010	-0.0008	-2.27E05
Thu	0.0007	0.0003	0.0008	0.0013 <sup>c</sup>	-0.0004	0.0002
Fri	0.0005	0.0004	-0.0002	0.0004	0.0003	0.0009
KW/F	1.08/0.4	2.01/0.92	1.79/0.79	12.29 <sup>b</sup> /1.6	5.79/0.47	1.04/0.67
	Non- metal Mineral	Basic Metal	Metal Products Machinery	Services	Electricity	Transport.
	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$
Mon	0.0005	0.0011	0.0014 <sup>c</sup>	0.0003	0.0005	0.0015
Tue	0.0013 <sup>b</sup>	0.0014	0.0008	0.0001	-0.0003	0.0021 <sup>b</sup>
Wed	-0.0001	-0.0007	-0.0002	-0.0002	-0.0008	4.11E-05
Thu	0.0001	0.0007	-0.0002	0.0004	0.0006	0.0001
Fri	0.0005	0.0005	0.0007	0.0021 <sup>a</sup>	0.0004	-6.35E05
KW/F	3.50/1.1	3.93/1.45	3.64/1.21	5.96/2.19 <sup>c</sup>	4.03/0.40	3.96/1.41
	Tourism	Wholesale and Retail	Tele communicatio	Sports	Financials	Banks
	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$
Mon	0.0002	0.0008	-0.0005	0.0004	0.0004	0.0004
Tue	0.0003	8.30E-05	-0.0003	0.0004	0.0003	0.0004
Wed	-0.0012	-0.0002	-0.0003	-0.0013	0.0001	0.0003
Thu	0.0009	0.0008	0.0003	0.0007	0.0011	0.0012
Fri	0.0005	0.0026 <sup>a</sup>	0.0023 <sup>b</sup>	0.0010	0.0001	-4.18E05
KW/F	5.05/0.5	10.96 <sup>b</sup> /2.7	5.43/1.46	7.16/0.87	1.54/0.37	1.69/0.37
	Insurance	Leasing Factoring	Holding and Investment	Real Estate	Technology	Information Technology
	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$	$\beta$
Mon	-0.0005	0.0001	0.0003	0.0014 <sup>b</sup>	0.0019 <sup>b</sup>	0.0012
Tue	0.0010	0.0016 <sup>c</sup>	-2.47E-05	-0.0001	0.0002	0.0001
Wed	-6.72E05	-0.0002	-0.0003	-0.0008	-0.0008	-0.0009
Thu	0.0016 <sup>c</sup>	0.0002	0.0009	-0.0003	0.0006	0.0005
Fri	0.0005	0.0002	0.0007	0.0008	0.0010	0.0007
KW/F	3.86/1.0	3.34/0.63	2.31/0.46	7.55/1.19	7.40/1.89 <sup>c</sup>	4.04/0.97

<sup>a, b, c</sup> denotes significance at the 1%, 5% and 10% level respectively.

Furthermore, for Nonmetal Mineral Products, Metal Products Machinery, Services, Transportation, Telecommunication, Insurance, Leasing Factoring and Real Estate Investment Trust sectors and Technology someday returns are individually significant but the K-W statistics are not statistically significant. Therefore, these findings imply that there is no evidence of day of the week effect. Moreover, the significant results of the K-W statistics for the Textile Leather and Wholesale Retail Trade indexes indicate that the day of the week effect is present in these two sectors.

### **5. Conclusion**

Efficient Market Hypothesis assumes when the information is disclosed, it is reflected in the stock prices instantly; hence investors cannot gain abnormal returns. But anomalies such as day and intra-day effect which are frequently observed at stock markets provide some abnormal returns to investors. The purpose of this study is to examine whether the day and intra-day anomalies exist in the disaggregated data. Therefore, 23 sub-indexes of Borsa Istanbul are examined during the period of 2005-2015. Each index returns are computed, and then the dummy variables are created within the framework of anomalies to reach this purpose. Dummy variables are included to the right side of the regression equation as explanatory variables and tested whether there is a difference among the returns. Our findings provide empirical evidence for intra-day effect in all 24 indexes. These findings have important implications for market participants such as investors and regulatory authorities. Existence of intra-day effect enables the investors to predict the future stock prices with more confidence and can help to devise investment strategies to gain abnormal returns for investors. The findings also indicate that regulatory authorities put more emphasis on precautions for the improvement of market efficiency.



The lowest returns occur on afternoon sessions of Wednesdays for 19 sectors<sup>5</sup>: Wood Paper Printing, Metal Products Machinery, Leasing Factoring sectors; on afternoon sessions of Thursdays, for the Telecommunication sector on morning sessions of Mondays. The highest returns occur; on morning sessions of Thursdays for 16 sectors<sup>6</sup>, on morning sessions of Fridays for Services, Wholesale and Retail Trade, Telecommunication and Real Estate Investment Trust sectors, on morning sessions of Wednesdays for Chemical Petroleum Plastic, Nonmetal Mineral Products and Transportation sectors, on morning sessions of Mondays for the Technology sector.

In terms of the day of the week effect, returns on Mondays in Metal Products Machinery, Real Estate Investment Trust and Technology sectors, returns on Tuesdays in Nonmetal Mineral Products, Transportation and Leasing Factoring sectors, returns on Thursdays in Textile Leather and Insurance sectors, and returns on Fridays in Services, Wholesale and Retail Trade and Telecommunication sectors are different compared to the other days of the week. These results present some evidence for the gaining of abnormal returns with the timing of the trading decision in Borsa Istanbul. However, someday returns are statistically and individually significant, while the K-W statistics are statistically significant only for the Textile Leather and Wholesale Retail Trade sectors. The Textile Leather sector displays significantly higher returns on Thursdays and Wholesale Retail Trade sector displays significantly higher returns on Fridays than other days of the week. As the presence of the day of the week anomaly shows

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<sup>5</sup> BIST 100, Industrials, Textile Leather, Chemical Petroleum Plastic, Nonmetal Mineral Products, Basic Metal, Services, Electricity, Transportation, Tourism, Wholesale and Retail Trade, Sports, Financials, Banks, Insurance, Holding and Investment, Real Estate Investment Trust, Technology and Information Technology sectors.

<sup>6</sup> BIST 100, Industrials, Food Beverage, Textile Leather, Wood Paper Printing, Basic Metal, Metal Products Machinery, Electricity, Tourism, Sports, Financials, Banks, Insurance, Leasing Factoring, Holding and Investment and Information Technology sectors.

that investors can beat the market and gain abnormal returns in these two sectors. However, investors who are trading in the rest of the sectors should maintain their stock positions because of no opportunity to gain abnormal returns.

As a result, temporal predictability of returns in the BIST sectors is under a strong intra-day effect and weak day of the week effect. Moreover, the existence of anomalies in the stock market demonstrates that investors are not rational. In other words, these anomaly patterns are too weak to validate the Efficient Market Hypothesis in the context of Borsa Istanbul.

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