

The day-of-the-week effect for Istanbul stock exchange: a stochastic dominance approach

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Abstract

Using the Stochastic Dominance (SD) approach, this paper revisits the day-of-the-week effect for a developing market, the Istanbul Stock Exchange (ISE). SD results provide different results independent of distribution assumptions. The results indicate that Monday and Tuesday cannot be dominated by all other days of the week. Monday is dominated by only Wednesday, Thursday and Friday, and Tuesday is dominated by Wednesday and Friday. The day with the highest number of significant test results is Friday, but Friday dominates all days, except Wednesday. On the other hand, the days with the least number of significant results are Monday and Tuesday. Even though SD results confirm low Monday and Tuesday, high Friday returns, one single day can neither separately dominate other days of the week nor is dominated by other days. Therefore, based on SD results the day-of-the-week effect is limited in the ISE contrary to previous studies finding a significant day-of-the week effect in the ISE.

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1 Introduction

The calendar anomalies have been tested for many developing and developed countries. Calendar anomalies are not only important for traders to get abnormal returns but also for the test of efficient markets. According to the Efficient Market Hypothesis, prices reflect all available information in the market, meaning that any trader cannot get a return above the market systematically. However, in case of a calendar anomaly, such as the day-of-the-week effect (low returns on Fridays, high returns on Mondays) or the January effect (low returns on each January), the market would no longer be efficient.

Early study of Fields [21] examines the Dow-Jones Index closing prices on Saturday comparing with arithmetic mean of index on Friday and Monday. Another study of French [22] states that Monday average returns on Standard and Poor's composite portfolio are significantly lower than returns on other days of the week for each five year sub-periods from 1953 to 1977. Considering the literature on the-day-of-the-week effect, the studies generally adopt regression analysis with dummy variables, ANOVA, non-parametric tests (such as Kruskal-Wallis Test) or E-GARCH/GARCH modeling. To illustrate; by adopting a GARCH model, Berument and Kiyamaz [14] indicate significant day-of-the-week effect in both mean and volatility equations for Canada, Germany, Japan, the United Kingdom and the United States over 1988-2002. Other studies using GARCH model also find the-day-of-the-week effect (Alexakis and Xanthakis [4]; Choudry [17]; Al-Loughani and Chappell [6]; Tonchev and Kim [31]; Yakop et al. [33]). Another study by Bayar and Kan [12] presents international evidence from 19

countries over 1993-1998 to support the-day-of-the-week effect in terms of both local and dollar returns via regression model. On the other hand, Ajayi et al. [1] find negative Monday returns in 6 out of 11 Eastern European emerging markets, where only 2 of these negative returns are significant.

The studies on Turkey support the significance of the-day-of-the-week effect for Istanbul Stock Exchange. Balaban [10] confirms the existence of the-day-of-the-week effect for Istanbul Securities Exchange Composite Index for 1988-1994 based on a regression model. Balaban explains that even though the-day-of-the-week effect exists, the magnitude and direction of this effect changes over time. The results of Metin et al. [27] support the conclusions of Balaban: there is a strong Friday effect but insignificant and negative effect on Mondays. Metin et al. underline the difference between TL based and US dollar based returns, which causes a change in the sign (positivity or negativity) of Monday effect. The parametric and nonparametric test results of Demirer and Karan [20] conclude that Friday returns are statistically different from other days of the week, even after excess returns are corrected for inflation and overnight interest rates. Nevertheless, apart from Friday returns they find no consistent day-of-the-week effect for the period 1988-1996. On the other hand, Oguzsoy and Guven [28] consider not only ISE 100 but also ISE 30 over 1988-1999 via regression model, and conclude that there is a significant day-of-the-week effect for both of the indices. For ISE 100 lower returns are realized on Monday and Tuesday whereas higher returns are experienced on Wednesday and Friday. For ISE 30, the days with lower returns are again Monday and Tuesday, but the highest returns are observed on Fridays.

Bildik [15] supports the existence of the-day-of-the-week effect for ISE 100 index over 1988-1999 by adopting a regression model for the intra-day data. According to his results, the stock returns follow W-shaped pattern. Especially, opening, closing, and overnight returns are significantly large and positive, and volatility is higher at the openings. Another study focusing on the sessions rather

than daily data by Oran and Guner [29] indicates that low Monday and high Friday effect is supported in the ISE, but whenever the sessions are separately investigated, low Monday returns are found out to be related with low Monday afternoon returns. Besides, all afternoon session returns are lower than morning sessions. Additionally, their results underline the importance of the previous day's returns (i.e., positive or negative returns) on the following day's returns. Low-beginning-of-the-week returns are observed depending on negative previous day returns, whereas high-end-of-the-week returns are independent of the previous day's returns.

The GARCH Model based study of Aktas and Kozoglu [2] find out significant and positive returns on Thursday and Friday over 2001:7-2007:6 for ISE 30, ISE 100, ISE National, ISE National-Industry, ISE National-Financial and ISE National-Services Indices. Aktas and Kozoglu state that the day-of-the-week effect in the ISE cannot be explained with the systematic risk factor. GARCH models of Atakan [8] also confirm the low Monday and high Friday returns. Another study adopting EGARCH-M model by Yalcin and Yucel [34] examine 20 emerging stock markets, and emphasize 5 countries, including Turkey, where the lowest and highest returns are on Monday and Friday, respectively. At 1 per cent significance level, for 13 out of 20 countries the day-of-the-week effect is reported in neither returns nor volatilities.

The study of Akyol [3] states that the day-of-the-week, weekend and turn of the month effects still exist for the ISE by estimating a regression over 1987-2006. Nevertheless, this study underlines the disappear of January effect but persistence of other anomalies over the last years due to the fact that the market becomes more efficient each day as traders become more knowledgeable. Cinko [19] also finds no evidence for the January effect in the ISE (ISE 100 index) between 1989 and 2006. Tuncel [32] examines ISE 100 only over a recent dataset between 2002 and 2005 (after 2001 crisis period) and finds no evidence of day-of-the-week effect. Regression results of Basher and Sadorsky [11] from 21 emerging stock

markets indicate that the-day-of-the-week effect for Turkey presents over 1992-2003 but Turkish Stock Market is one of the countries where the-day-of-the-week effect disappears after accounting for conditional market risk. Chukwuogor [18] examines 40 countries, including Turkey (for ISE 100 index), and concludes that the-day-of-the-week effect exists for Turkey between 1997-2004 depending on a set of parametric and non-parametric tests (specifically, Kruskal-Wallis, Levene, W Test for normality). Also, he concludes that the-day-of-the-week effect exists for more than 62 per cent of the countries studied, and generally the daily returns are lower in the stock markets of the developed countries. These results provide valuable information to maximize portfolio returns through international diversification. A number of other studies on the ISE investigate the-day-of-the-week effect not only for the stock markets but also for the Turkish foreign exchange markets (such as Aydogan and Booth [9]; Berument et al. [13]). Nevertheless, the foreign exchange markets are beyond the scope of this paper.

In general, previous studies on Turkish Stock Market indicate that the-day-of-the-week effect exists even over different time periods. In other words, these studies account for evidence to support that the market is not efficient in Turkey. Nevertheless, this result is not line with the study of Buguk and Brorsen [16], where the random-walk hypothesis for ISE's composite, industrial, and financial index prices is tested by different tests (ADF unit root, GPH fractional integration, LOMAC variance ratio, and a modified variance ratio test). Another study by Kawakatsu and Morey [26] also supports the efficiency of the ISE. Lastly, Alparslan [7] finds only weak form efficiency and Balaban [10] concludes that the ISE is neither weak form nor strong form efficient. Therefore, there is not a common view on the efficiency of the ISE.

An alternative method to investigate the day-of-the-week effect in stock markets is the Stochastic Dominance (SD) approach. As parametric tests require the normality assumption, SD approach is not distribution dependent. An early

study by Groff and Wingender [23] apply SD for S&P 500 Composite Index from 1962 to 1985. Their results confirm the existence of the day-of-the-week effect: Monday returns are dominated by the returns of other days. The study of Al-Khazali et al. [5] applies SD to Athens Stock Exchange and finds out that a strong day effect, and weak week and January effects. Compared with previous studies, Al-Khazali et al. underline the misspecification and measurement problems of regression and GARCH models. Another paper by Hooi Hooi et al. [25] adopts SD test for Hong Kong, Indonesia, Malaysia, Japan, Singapore, Taiwan and Thailand over 1988-2002. The results show that the day-of-the-week effect exists for selected countries but January effect largely disappeared (except for Singapore). A number of other studies use SD approach not only for tests of the day-of-the-week effect but also for tests of January effect (Seyhun [30]).

The results of this paper contribute to the existing studies in three ways. First, different studies on the ISE consider various time periods. This paper analyzes an expanded data set over 1988-2010. Second, the empirical results for efficiency based on such a large dataset would be more reliable, since the efficiency of a market is not a short term characteristic but a test has to be carried out for a longer time period. Therefore, this paper provides reliable results for the efficiency of the ISE. Third, to my knowledge, there has not been any other study adopting SD for the ISE. Previous studies on the ISE rely on either simple regression or GARCH models, which are distribution dependent, and only a small number of them incorporate nonparametric tests. Nevertheless, SD provides a nonparametric approach without depending only on two moments. Therefore, this study would be a comprehensive study of day-of-the-week effect test for ISE 100 with a large dataset and SD approach.

This study is organized as follows: Part 2 explains the data. Then, Part 3 introduces the stochastic dominance approach. Part 4 discusses the empirical findings, and Part 5 concludes.

2 Data

This study covers a time period over 20 years from January 11, 1988 to August 10, 2010. Starting from the launch of the ISE in 1988, this dataset includes all available price data. The weeks with less than 5 trading days are excluded from the sample, since the even distribution of returns over week days is required in order to apply the SD procedure. The daily returns are calculated as follows:

$$R = \ln(P_{t+1}/P_t) * 100 \quad (1)$$

where the P denotes the closing prices of the corresponding day.

Table 1: Descriptive Statistics of Stock Returns for the Day of the Week

| | MONDAY | | TUESDAY | | WEDNESDAY | |
|------------------------|---------------|----------------|----------------|----------------|---------------|-----------------|
| | wo outliers | w outliers | wo outliers | w outliers | wo outliers | w outliers |
| Number of observations | 1028 | 1040 | 1028 | 1040 | 1028 | 1040 |
| Max | 4.621 | 5.349 | 4.761 | 7.719 | 4.191 | 7.424 |
| Min | -4.964 | -6.863 | -4.101 | -4.101 | -3.948 | -8.677 |
| Median | 0.002 | -0.001 | -0.061 | -0.061 | 0.059 | 0.063 |
| Mean | -0.013 | -0.028 | -0.035 | -0.027 | 0.102 | 0.092 |
| Std. | 1.387 | 1.447 | 1.101 | 1.150 | 1.132 | 1.209 |
| Skewness | -0.024 | -0.133 | 0.053 | 0.352 | 0.039 | -0.321 |
| Kurtosis | 1.381 | 1.986 | 1.554 | 3.277 | 1.220 | 5.429 |
| JB | 80.336 *** | 171.354 *** | 102.109 *** | 480.791 *** | 62.809 *** | 1279.963 *** |
| | THURSDAY | | FRIDAY | | | |
| | wo outliers | w outliers | wo outliers | w outliers | | |
| Number of observations | 1028 | 1040 | 1028 | 1040 | | |
| Max | 3.821 | 5.122 | 4.943 | 6.793 | | |
| Min | -4.694 | -6.108 | -4.101 | -5.226 | | |
| Median | 0.104 | 0.104 | 0.137 | 0.139 | | |
| Mean | 0.136 | 0.134 | 0.155 | 0.165 | | |
| Std. | 1.140 | 1.191 | 1.026 | 1.072 | | |
| Skewness | -0.154 | -0.218 | 0.216 | 0.385 | | |
| Kurtosis | 1.238 | 2.115 | 2.569 | 4.188 | | |
| JB | 68.430 *** | 199.083 *** | 286.581 *** | 776.137 *** | | |

*** Significant at 1% level.

In Table 1 the descriptive statistics of daily returns are summarized. Considering the changes from day to day the losses over -5 per cent and gains over 5 per cent are omitted. The returns outside the range of (-5,+5) per cent would imply a great loss or profit in one day, which can be triggered by unexpected shocks. Therefore, the descriptive statistics may be sensitive to these outliers. Consequently, the weeks including these “outlier” days are also excluded from the sample. Therefore, the final sample size decreases from 5,200 (1,040 returns per day) to 5,140 (1,028 returns per day).

The mean returns are negative only on Monday and Tuesday. The highest returns are observed on Friday (0.155 per cent) and the lowest returns are experienced on Tuesday (-0.035 per cent). This finding is similar to Al Khazali et al. even though all returns are positive in the Greek Stock Market. Besides, negative returns on Monday are again in line with the “weekend effect”. Similar to the Greek Stock Market, the standard deviations of returns is highest (lowest) on Monday (Friday). Except Monday and Thursday, skewness and kurtosis values are positive indicating a leptokurtic distribution. Besides, Jarqua-Bera test statistics verify the significant non-normality of returns. Therefore, any test based on normality assumption would be invalid. Non-parametric tests, such as the SD method, are needed to analyze the day-of-the-week effect.

3 Stochastic Dominance Approach

There are three types of SD: first-order SD (FSD), second-order SD (SSD) and third-order SD (TSD). FSD is defined as follows: an asset X first-order stochastically dominates an asset Y if and only if $F_1(x) < G_1(x)$, for all x values, where F_1 is the cumulative density function of X and G_1 is the cumulative density function of Y. Therefore, X dominates Y by FSD refers that F completely lies to the right of G. On the other hand, asset X dominates asset Y by SSD if and only if,

$F2(x) < G2(x)$, for all values of x , where $F2$ and $G2$ are the areas under the $F1$ and $G1$, respectively. Therefore, SSD enables the cumulative density functions to cross as long as the area constraint is satisfied. Lastly, asset X dominates asset Y by TSD, if and only if, $\mu_x > \mu_y$ and $F3(x) < G3(x)$ for all possible x , where μ 's are the expected returns, and $F3$ and $G3$ are the areas under $F2$ and $G2$, respectively. Considering the definitions, FSD (SSD) is stronger than SSD (TSD). Therefore, FSD implies both SSD and TSD.

In order to employ the SD method, the CDFs are calculated by ranking the daily returns from smallest to largest. Returns are assumed to occur with an equal probability. Considering the sample size of 1,028 returns per day, for the lowest return the probability of occurrence is equal to $1/1,028$. For the second lowest return the cumulative probability becomes $2/1,028$. Repeating this procedure, the probability for the highest return is equal to 1 ($1,028/1,028$). The plot of the cumulative probabilities against the returns gives the empirical CDF. Then, the type of SD can be determined comparing the shapes of CDF for each day.

4 Empirical Findings

Table 2 summarizes the results of the SD analysis. In order to perform the empirical SD test, the application of Heyer [24] is followed. The results indicate that both Monday and Tuesday cannot dominate any other day of the week. On the other hand, Monday and Tuesday cannot be dominated by all other days of the week. Monday is dominated by only Wednesday, Thursday and Friday, and Tuesday is dominated by Wednesday and Friday. The day with the highest number of significant test results is Friday, but Friday dominates all days, except Wednesday. On the other hand, the days with the least number of significant results are Monday and Tuesday. Lastly, none of the days dominate any other day by FSD.

Table 2: Stochastic Dominance Test Results, day to day comparisons

| Day | Monday | Tuesday | Wednesday | Thursday | Friday |
|-----------|--------|---------|-----------|----------|--------|
| Monday | | NSD | SSD | SSD | SSD |
| Tuesday | NSD | | SSD | NSD | TSD |
| Wednesday | NSD | NSD | | NSD | NSD |
| Thursday | NSD | NSD | NSD | | SSD |
| Friday | NSD | NSD | NSD | NSD | |

Note: FSD, SSD, TSD, and NSD denote first-order, second-order, third-order, and no-order stochastic dominance, respectively. An entry in the table means that the daily returns on the column dominate daily returns on the row.

Figure 1 shows the empirical CDF of daily returns over the period. Because none of the functions totally lie to the right of the other functions, none of them can dominate any other day by FSD. All CDFs intersect at some points. Depending on the area below the CDFs, Friday dominates other days, except Wednesday.

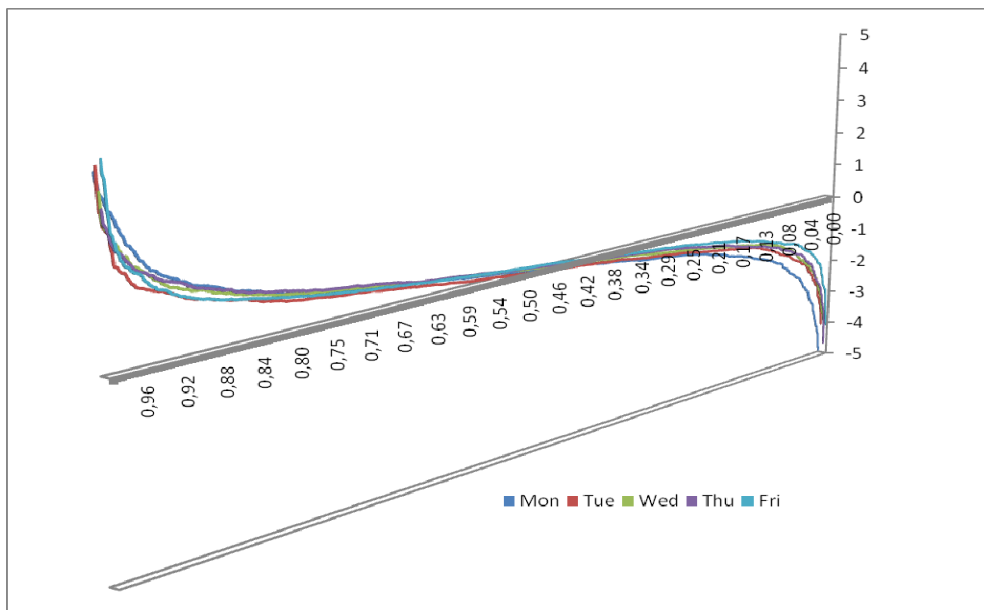


Figure 1: Cumulative Distribution Functions for days of the week

The results indicate that the evidence for the day-of-the-week is limited in the ISE. These results partially support the studies of Balaban [10], Metin et al. [27] and Demirer and Karan [20], which find a significant Friday but insignificant Monday effect. Similar to Demirer and Karan, SD analysis indicates that only Friday returns stochastically dominate the other days of the week, but in contrary to these studies Friday returns cannot dominate the Wednesday returns in this study. Similar to study of Oguzsoy and Guven [28] over 1988-1999, Monday and Tuesday are the days with the lowest returns. Therefore, both days are jointly stochastically dominated by other days of the week. Considering other studies reporting the day-of-the-week effect (Bildik [15]; Aktas and Kozoglu [2]; Akyol [3]; Atakan [8]) SD results only confirm the “partial” dominance of Fridays, and dominance of Monday and Tuesday returns by other days of the week together (but not only the Monday returns separately). Nevertheless, none of the previous studies investigate the same problem with the SD methodology and they ground their results on the normality assumption. Therefore, SD methodology offers new results independent of assumptions.

One of the extensions of this study is to apply the SD on intra-day data. The studies of Bildik [15] and Oran and Guner [29] underline the importance of the intraday data for Turkey as interpreting the results. According to their results, day-of-the-week effects must be analyzed together with the effect of sessions, since the use of sessions may alter the results.

5 Conclusion

The calendar anomalies have been tested for many developing and developed countries. Calendar anomalies are not only important for traders to get abnormal returns but also for the test of efficient markets. According to the Efficient Market

Hypothesis, prices reflect all available information in the market, meaning that any trader cannot get a return above the market systematically. In case of a calendar anomaly, such as the day-of-the-week effect (low returns on Friday, high returns on Monday) or the January effect (low returns on each January), there would be a violation of an efficient market. Therefore, investigation of the calendar anomalies at the stock exchanges has a vital importance not only for theoretical purposes but also for traders.

Using the Stochastic Dominance approach, this paper revisits the day-of-the-week effect over 1988-2010 for a developing market, the Istanbul Stock Exchange. The results imply that Monday and Tuesday cannot be dominated by all other days of the week (i.e., Monday is dominated by only Wednesday, Thursday and Friday, and Tuesday is dominated by Wednesday and Friday). The day with the highest number of significant test results is Friday, but Friday dominates all days, except Wednesday. On the other hand, the days with the least number of significant results are Monday and Tuesday. Even though SD results confirm low Monday and Tuesday, high Friday returns, none of the days can separately dominate any other. Therefore, the day-of-the-week effect is limited in the ISE.

The results have implications for both academics and traders. From the point of academics, the day-of-the-week effect is partially supported. Whenever Monday and Tuesday returns are jointly considered, other days of the week dominate. Friday returns dominate other days, except Wednesday. Therefore, for traders the results offer a simple strategy: buy on Monday and/or Tuesday and sell on Friday.

Previous studies on the ISE, which find significant or ambiguous day-of-the-week effect, rely on either simple regression or GARCH models, which are distribution dependent and only a small number of them corporate nonparametric tests. Nevertheless, SD provides a nonparametric approach without depending only on two moments. The results indicate how the SD results may

significantly differ from the other studies adopting distribution dependent methods. Therefore, this study provides a more comprehensive study of day-of-the-week effect test for ISE 100 with a larger dataset and SD approach.

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