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Abstract

Intraday price reversals in two indices listed on Istanbul Stock Exchange (BIST) are examined: BIST 30 Index and BIST Small Medium Enterprises and Industrial Index. The period of analysis is from December 2, 2013 to June 28, 2019. I show that there exist intraday price reversals in both indices. Observed days are defined as positive event days and negative event days with the filter of $\pm$ 0.5%. If overnight returns are moving more than $\pm$ 0.5%, then I classify it as a signal for an event, denoted as a filter. For the stocks of the following days of the negative signal, there exist significant reversals in BIST 30 Index. On the other hand, on the following days of the positive signal, there exist significant reversals in BIST Small Medium Enterprises and Industrial Index. The size of the signal is positively related to the significance of the reversal. In other words, as the overnight gap becomes larger, the significance of the reversal becomes larger. Therefore, it can be said that magnitude effect takes place. I also find a significant size effect: the smaller the market capitalization of the firm, the larger the size of the reversal. As a smaller firms index BIST Small Medium Enterprises and Industrial Index gives higher returns than BIST 30 index on average. Profitable trading strategies can be established, however, the profits from those activities are reduced after taking transaction costs into account.

Sammendraget

Studiet undersøker intradag pris-reversering i to indekser notert på Istanbul Børs (BIST): BIST 30 Index og BIST Small Medium Enterprises and Industrial Index. Studiet gjøres i tidsperioden 2. desember 2013 til 28. juni 2019. Jeg finner eksisterende intradag pris-reversering i begge indekser. De observerte dagene er definert som positive hendelser eller negative hendelser, filtrert $\pm$ 0.5%. Dersom over natten-avkastninger overstiger $\pm$ 0.5% klassifiseres det som et signal på en hendelse, med betegnelsen filter. For aksjer med negativt signal i kommende dager, foreligger det signifikante reverseringer i BIST 30 Index. På den andre siden, i dager med positive signaler eksisterer det signifikante reverseringer i BIST Small Medium Enterprises og Industrial Index. Størrelsen på signalet er positivt relatert til signifikansen på reverseringen. Med andre ord, når over natten-gapet øker så øker signifikansnivået på reverseringen. Derfor kan man si at det oppstår en omfangs-effekt. Videre finner jeg en signifikant størrelseseffekt: jo mindre markedskapitaliseringen til selskapet er, jo større er størrelsen på reverseringen. Når mindre selskaper, er avkastningen i gjennomsnitt høyere i BIST Small Medium Enterprises og Industrial Index. Dette kan være resultater av lønnsome trading-strategier. Avkastninger fra denne typen strategi tar derimot ikke høyde for transaksjonskostnader.

To my mother

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Introduction

1 Introduction

In this thesis, I examine intraday price reversals after large price changes in the Turkish Stock Exchange which is called Borsa Istanbul (BIST). Price reversal means an opposite movement to an ongoing price movement (De Bondt and Thaler 1985). I will analyze two indices: BIST 30 Index (XU030) and BIST Small- Medium Enterprises and Industrial Index (XKOBI). BIST 30 Index consists of 30 biggest company stocks traded in Istanbul Stock Exchange (Is Investment 2020). BIST Small Medium Enterprises and Industrial Index (BIST SME) consists of Small and Medium Enterprises and industrial companies traded in the Istanbul Stock Exchange ("KOBİ Sanayi Endeksi" 2020). The reason I choose these two indices is to see the differences and similarities of the market movements between large companies and smaller companies. I find price reversals both in BIST SME and BIST 30 indices. Those reversals are significant on average following a negative price gap in BIST 30 index and following a positive price gap in BIST SME index. Additionally, magnitudes of those price reversals increase as the price changes become larger. Since smaller index gives higher returns, there exists a size effect. Profitable trading strategies can be established in both indices.

The purpose of this thesis is to detect market anomalies such as price reversals, price momentums, size effect in the Turkish Stock Exchange, and to test if those anomalies can be exploited in order to build profitable trading strategies. Another aim is to establish and benefit from these trading strategies. I aim to test overreaction in two Turkish Stock Exchange indices and see the similarities and differences. Yet another purpose of this thesis is to see if BIST 30 and BIST SME indices comply with the empirical results from previous studies regarding intraday price reversals.

Intraday price reversals and other anomalies I examine are a part of a bigger discussion between classical finance theory and behavioral finance theory. Starting from mean variance theory, classical finance ignored behavioral aspects of investment decisions and the human logic behind the financial investment decisions (Fromlet 2001). After presenting the assumptions of those two disciplines I provide a deeper review of studies on overreaction hypothesis. Overreaction, as a behavioral term, is used to describe investors' drastic reactions to the news coming to the market (De Bondt and Thaler 1985). In fact, if a bad news is treated as a worse news and a good news is treated as a better news in the market, then it can be said that overreaction takes place.

After reviewing overreaction hyptothesis, another phenomenon related to overreaction, "price reversals", is going to be reviewed in detail. How is the price reversal related to the overreaction? If overreaction takes place in the market, sooner or later it is going to be "corrected" by the market. Price reversals are the symptoms of overreaction as it can be seen as a "correction" movement to an overreaction in the market (De Bondt and Thaler 1985). Large price movements, either positive or negative, are supposed to be overreaction if those movements are reversed afterwards. Thus, price reversals which are seen in the market might be a sign of the overreaction.

Starting from classical finance and behavioral finance comparison and going deeper in the overreaction and the price reversals phenomena, the main subject of this thesis can be introduced: intraday price reversals. I use very high frequency data to track intraday price movements: second by second tick data. There is plenty of research regarding the intraday price reversals by using the historical tick data. The results from international markets are presented and reviewed in detail, below. It is going to be checked if this thesis provides similar results with the previous literature on intraday price reversals. The hardest thing with analyzing intraday price reversals is that it is quite sophisticated work to sort out the high frequency data and retrieve an analyzable sequence of the data. Methods used in the previous literature on the intraday price reversals are benefited and referred properly within this thesis.

An opposite term to the price reversals is the price momentums phenomenon. If a price movement is followed by a movement with the same direction, it is called price momentum (Jegadeesh and Titman 1993). The literature on the price momentums and the intraday price momentums are presented and detailed below. It is covered in this thesis also whether or not the price momentums exist in Istanbul Stock Exchange.

After introducing two opposite movements: price reversals and price momentums, it might be useful for the readers to get familiar with the terms such as the magnitude and size effect. Magnitude is the measurement of the price movements. After tracing whether or not any price reversals or price momentums take place in the subject indices, the magnitudes of these movements are going to be presented and the magnitudes of the indices are going to be compared. It will be tested whether or not a larger overnight gap results in a more significant price reversal or momentum. If this is the case, it can be said that there exists a magnitude effect (Fabozzi et al. 1995). In addition to this, a comparison between BIST 30 and BIST SME is going to be executed at the end of the all analyses. This comparison might give us clues of whether or not size effect takes place between those two indices. Size effect suggests higher return and higher risk for smaller firms (Banz 1981) which is going to be tested as well.

In general, price reversals are related to the efficient market hypothesis as these movements violate the hypothesis' assumptions. Efficient capital markets can be defined as the capital markets where all the information about the assets is reflected in their prices at any moment

(Fama 1970). There are three forms of the efficiency: weak form, semi-strong form and strong form. The weak form requires only that historical price data is publicly available. The semi-strong form of efficiency, on the other hand, means that there are public announcements of share splits, annual or quarterly reports, additional security issues, etc. If there are no privileged groups or persons among investors who might privately access inside information, then a strong form of efficiency occurs. If a capital market fulfills those conditions, it can be considered an efficient capital market (Fama 1970). In such markets, prices follow a random walk and it is hard to beat the market as an investor. Fama (1970) shows that the US financial market is efficient in all levels. The intraday price reversals I find in the Turkish Stock Exchange breach the assumptions of the efficient market hypothesis. If the market was efficient, intraday price reversals would not exist.

The efficient capital markets hypothesis has been challenged by a huge number of scholars, academic papers etc. such that a new approach called behavioral finance came to the scene. As a discipline challenging traditional finance, behavioral finance refuses the assumption of that individuals are rational. In fact, people are not rational but "normal" according to Statman (2017). "Normal" implies neither rationality nor irrationality for the investors. Another main foundation undermined by the behavioral finance is mean-variance portfolio theory. According to classical finance theory, investors' only purpose on the market is to build high expected return, low variance portfolios. In other words, investor should diversify the assets while at the same time maximize the discounted expected return (Markowitz 1952). Below, the components of the mean variance theory is presented to show that there does not exist any behavioral aspect in the formulas.

Let Y be a portfolio with the assets of $y_1, y_2, ..., y_N$. Let the weight of y_1 in the portfolio be w_1 and y_2 be w_2 and so on, then the expected value of portfolio Y is shown as:

$$E(Y) = w_1 E(y_1) + w_2 E(y_2) + ... + w_N E(y_N)$$
$$E(Y) = \sum w_i E(y_i)$$

and variance of portfolio Y can be defined as:

$$Var(Y) = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + ... + w_N^2\sigma_N^2 + 2w_1w_2\sigma_1\sigma_2\rho_{1,2} + 2w_1w_3\sigma_1\sigma_3\rho_{1,3} + ...$$
$$+2w_1w_N\sigma_1\sigma_N\rho_{1,N} + 2w_2w_3\sigma_2\sigma_3\rho_{2,3} + ... + 2w_2w_N\sigma_2\sigma_N\rho_{2,N} + ...$$
$$+2w_{N-1}w_N\sigma_{N-1}\sigma_N\rho_{N-1,N}$$
$$Var(Y) = \sum w_i^2\sigma_i^2 + \sum w_iw_jCov(Y_i, Y_j)$$

where ρ is the correlation between the assets. Under Expected Return - Variance of Returns model the optimal asset allocation is found by maximization of $E(Y)$ given a constant $Var(Y)$, or minimization of $Var(Y)$ given a constant $E(Y)$ (Markowitz 1952).

Markowitz shows how the correlation between the assets is important to reduce the risk of portfolio. Correlation shows the level of fluctuating together for two assets. Correlation values differ between -1.0 and 1.0. A correlation coefficient of 1.0 represents a perfectly positive linear relationship between two variables. This means two assets move in the same direction with the same proportion. A correlation coefficient of -1.0, on the other hand, represents a perfectly negative linear relationship where two assets move in totally opposite directions with equal proportions. A correlation coefficient of 0 shows no relationship between the assets, any data from one asset shall not provide any information about the other asset.

These correlations help us to form a high expected return low variance portfolio in classical finance. "The efficient frontier", defined below, shows that classical finance does not take behavioral aspects into account when forming profitable portfolios. Behavioral finance, on the other hand, has an alternative approach to forming investment portfolios by taking "non-rational" investor behaviors into account (Chen 2016).

Mean-variance principles derived the formulation of an efficient frontier from which the investor could form a portfolio representing individual risk and return choices of the investor. One of the most important considerations under this theory is that one should evaluate an asset's co-movement with other assets as well as the mean and the variation of the asset itself. Taking co-movements and counter-movements of the assets into account reduces risk level at the same expected return level compared to ignoring these interactions between these assets (Elton and Gruber 1997).

One can easily realize from the formula above that negative correlations in the portfolio variance equation reduces the variance. Reducing variance means reducing risk. That is why assets with negative correlations will be preferable to add to the portfolio.

As one can see from the mean-variance formulas above, there is no social aspect included in the equation. The only consideration is to add negatively correlated assets to decrease the risk. The purpose of putting all these equations related to the mean-variance theorem in our analysis is to show that those formulas do not include social factors an investor might be affected by. On the other hand, behavioral finance adds factors like social status or social responsibility into the construction of an ideal portfolio. The individual's weak self-control breaches ideal savings and spending according to the behavioral perspective (Statman 2017). The most important deduction behavioral finance reaches is that markets are not efficient in the sense that it fully reflects the value of assets. Those philosophical debates are important to demonstrate the framework of this thesis.

Many studies are challenging the efficient market hypothesis. Narayan and Zheng (2010) capture market anomalies in the Chinese stock market in terms of firm size, the book-to-market ratio, the turnover rate except for momentum. Al-Khazali and Mirzaei (2017) present calendar anomalies in eight Dow Jones Islamic Indices. Chan et al. (2020) present market anomalies after presidential elections. They examine the first 100 days of a newly-elected president and document that there exist investment and profitability anomalies in that period. Diaz-Ruiz, Herrerias, and Vasquez (2020) find three types of anomalies out of 19 tested in the Mexican stock market. The robust anomalies are listed as momentum, idiosyncratic volatility, and the lottery effect.

Kahneman and Tversky (1977) study decision-making mechanisms which show that people overreact to unexpected news. De Bondt and Thaler (1985), in a breakthrough study, examine if the overreaction exists in financial markets and open a pave for analyses regarding overreaction phenomenon in the finance literature. De Bondt and Thaler (1985) apply this phenomenon in New York Stock Exchange to see if a similar behavior exists among the investors. They examine two different types of portfolios. "Loser portfolio" is a portfolio in which past excess returns have been negative, while the "winner portfolio" has given positive excess returns in the past. As a result, loser portfolio outperforms winner portfolio. Their study implies a substantial weak form of inefficiency in the capital markets. They show overreaction in the long-run for up to 5 years. However, I will examine high-frequency intraday data and see if the overreaction is corrected within minutes rather than years. When individuals contemplate their forecast, they are prone to overweight the recent information (De Bondt and Thaler 1985). As a result, today's price of the assets does not reflect the real value of the assets, and investors should follow a contrarian strategy, according to De Bondt and Thaler (1985). The results from my study also suggest that a contrarian strategy would be profitable to follow in BIST 30 and BIST SME indices but in intraday basis rather than years basis.

Overreaction has been studied widely within many markets including Spain (Alonso and Rubio 1990), South Africa (Page and Way 1992), Brazil (Costa 1994), New Zealand (Bowman and Iverson 1998), Hong Kong (Fung 1999), Australia (Gaunt 2000), Greece (Antoniou, Galariotis, and Spyrou 2005) and Germany (Lobe and Rieks 2011). All of those studies detect overreaction except for Gaunt (2000) on the Australian market. I also detect overreactions in both BIST 30 and BIST SME indices. Alonso and Rubio (1990) use the same methodology with De Bondt and Thaler (1985) and conclude that the "loser portfolio" outperforms the "winner portfolio" by 24.5% in the Spanish capital market. The results are robust to size adjustments. Page and Way (1992) examine Johannesburg Stock Exchange and find that the "loser portfolio" performs about 20% better than the "winner portfolio" three years after the construction of the portfolios. Costa (1994) examines Brazilian Stock Market for the period of 1970 and 1989 and detects price reversals in two years period. Bowman and Iverson (1998) examine periods following large price changes in New Zealand Stock Market. They find overreaction especially in case of negative changes in the price. However, the results are not robust to risk, size and seasonality. Fung (1999) examines overreaction in the Hong Kong stock market. The “loser portfolio” performs 9.9% better than the “winner portfolio” in one year according to their analysis. Additionally, buying the “loser portfolio” and shorting the “winner portfolio” is possible in the Hong Kong futures market, strengthening the overreaction. Gaunt (2000) states that there exist price reversals in the Australian equity market; however, it disappears when buy and hold strategy is applied. Besides that, the “loser portfolio” is comprised of small company stocks, which causes a lack of liquidity, making it harder to exploit profitability opportunities. Previous two pieces of research show no significant price reversals in the Australian market. Brailsford (1992) examines monthly data between 1958 and 1987 and reaches that price reversals are not significant in the Australian stock market, so the overreaction theory does not hold. Similarly, Allen and Prince (1995) present that the contrarian strategy would not work in the Australian market based on the data between 1974 and 1991. Antoniou, Galariotis, and Spyrou (2005) examine the Athens Stock Exchange. Weekly data for the period of January 1990 and August 2000 is used in their analysis, and significant reversals are detected. Contrarian profits are greater within the smaller firms than the larger firms, according to their study. Lobe and Rieks (2011) study the German stock market between 1988 and 2007 and finds strong evidence of price reversals regardless of firm size. However, transaction costs terminate profitability opportunities. Besides, Lobe and Rieks (2011) states that there exists no evidence for violation of market efficiency on the Frankfurt Stock Exchange.

Most of those studies prove overreaction in the long-term. I analyze intraday price reversals to see if the theory holds in the short-term. There are many studies researching intraday price reversals in the stock markets and the futures markets. Previously, Atkins and Dyl (1990) show price reversals on daily prices. They examine New York Stock Exchange (NYSE) stocks for January 1975 and December 1984. Within this period, 300 trading days are selected randomly to eliminate biases caused by daily or monthly patterns. On average, a dramatic fall in prices is corrected on the following day in their analysis. This effect is stronger when the price gap is negative. These results comply with the analysis by De Bondt and Thaler (1985). I find similar results in BIST 30. However, BIST SME gives a stronger overreaction in positive events. Similarly, Fabozzi et al. (1995) demonstrate a significant intraday price reversal movement after a large price change more significant for negative initial prices. They examine the New York Stock Exchange and American Stock Exchange data for the year 1989. There are two different filters they use: “large filter” and “small filter”. Large overnight gaps are detected by large filter and smaller overnight gaps are captured by small filter. They define large filter as between 3-13 times bigger in size compared to small filter. In my thesis, I use several filters but only one of them is presented in this thesis: 0.5%. Other filters are either too small to call it a large price change or too large to retrieve a significant sample. There is a deeper discussion about the filter choices below. Fung, Mok, and Lam (2000) find intraday price reversals in the S&P 500 and Hang Seng Index Futures contract in Hong Kong. They use tick price data of the

S&P 500 Futures between 1 September 1993 and 25 June 1996 and tick price data of the Hang Seng Index Futures starting from 18 March 1993 to 30 December 1996. They use filter sizes of $\pm 0.1\%$, $\pm 0.2\%$, $\pm 0.3\%$, $\pm 0.4\%$, $\pm 0.5\%$ for S&P 500 Futures and $\pm 0.1\%$, $\pm 0.15\%$, $\pm 0.2\%$, $\pm 0.25\%$, $\pm 0.3\%$ for Hang Seng Index Futures. The price reversals' magnitude is shown to be related to the initial price changes in both studies by Fabozzi et al. (1995) and Fung, Mok, and Lam (2000). There are comments on the magnitude effect in this thesis as well. Based on the significance level, I find a similar result as Fabozzi et al. (1995) and Fung, Mok, and Lam (2000) among others: As the size of the overnight price gap increases, the significance of the reversals increases. Overnight price gap means the difference between the value of the previous trading day's closing price and today's opening price. The study by Fung, Mok, and Lam (2000) is extended by Fung and Lam (2004) and they demonstrate that price reversals are so strong that the effect is carried to the next day in Hang Seng Index Futures. Additionally, they claim that trading strategies based on those anomalies are profitable even after transaction costs, execution time lag, risk adjustment, and bid-ask spreads are taken into account. They examine tick price data starting from 18 March 1993 to 29 December 2000. The large price decreases are being related to excess pessimism in this paper, and it is claimed that the prices rebound when this pessimistic view disappears. A similar result is found in my thesis, as BIST 30 index price is corrected after a negative overnight gap, which is a signal of overreaction and extreme pessimism. Grant, Wolf, and Yu (2005) examine S&P 500 futures for 15 years and show significant reversals within trading days. Note that those returns disappear after the transaction costs. They examine intraday tick prices from November 1987 to September 2002. Day of the week analysis is applied in this paper, and it is found that the continuation of the opening movements dominates Mondays, which is the opposite direction compared to the other trading days. Interestingly, the strength of the reversal movement is higher in positive price gap event days in the work of Grant, Wolf, and Yu (2005) unlike Fabozzi et al. (1995) and Fung, Mok, and Lam (2000). Parikakis and Syriopoulos (2008) detect overreaction and profitable opportunities in foreign exchange markets. They compare the currencies of two developed countries with those of two developing countries. Using euro as the base currency, developing country currencies the Turkish lira and the Brazilian real overreact while developed country currency the US dollar overreacts, but another developed country currency the British pound underreacts. Nevertheless, profitable trading strategies can be founded in all these markets based on a contrarian approach. I detect intraday price reversals and profitable trading strategies in both indices I observe. If transaction costs and bid-ask spreads are taken into account, those profits are reduced significantly.

Fung, Lam, and Lam (2010) prove the existence of intraday price reversals in the Asian index futures market after a dramatic change in the US market and that the profitability holds even after the transaction costs. According to the paper, those reversals are not caused by rational reasons like risk, spread, or liquidity. As a support to the behavioral approach, they observe a magnitude effect. Klößner, Becker, and Friedmann (2012) review the effects of good news and bad news on the stock markets and present significant overreaction to bad news. Kudryavtsev (2013) examines 30 stocks for the period from 2 January 2002 to 30 September 2011. He reveals the existence of the next-day stock price reversals following end-of-the-day price movements in the Dow Jones Industrial Index and detects profitability opportunities. Recently, Chu, Gu, and Zhou (2019) examine the Shanghai Composite Index from 04/04/2015 to 12/31/2015. They detect a significant Intraday reversal in the market. However, transaction costs sweep the profitable investment opportunities. Cingöz (2020) studies the Turkish Stock Exchange from 2 February 2007 to 2 February 2020 and finds that overreaction exists but disappears within minutes in The Istanbul Stock Exchange National 100 Index. He reveals a magnitude effect in those reversals. Similar to Cingöz (2020), I find a magnitude effect in both BIST 30 and BIST SME.

Studies on intraday price reversals show that a contrarian strategy is useful to exploit the financial markets as price reversals occur during the trading day. On the other hand, some studies promote the opposite strategy: relative strength strategy (Jegadeesh and Titman 1993). Relative strength strategy means investing in the past winner portfolios with the expectation of a better performance compared to the past losers. Contrarian strategy assumes that past loser portfolios are going to give better returns than the past winners, while a relative strength strategy assumes that “winner portfolios” will perform better. Therefore, such a strategy requires to buy a winner portfolio and sell loser portfolio.

As an opposite term to the price reversal, the phenomenon that an asset price movement is going to be followed by a movement in the same direction is named price momentum. There exist plenty of literature regarding price momentums. Jegadeesh and Titman (1993) follow a relative strength strategy for a three to twelve-month holding period by selling loser stocks and buying winner stocks. They find abnormal returns by this strategy over the next six months to a year. Rouwenhorst (1998) examines twelve countries from 1980 to 1995 and concludes that past winner portfolios outperform past losers in all twelve markets. This momentum lasts for around a year on average. Price momentum is stronger as the firms become smaller. Chui, Titman, and Wei (2000) examine eight Asian markets and document that price momentums take place in all markets but Japan. Price momentum is found more significant for firms with smaller market capitalization, lower book-to-market ratios, and higher turnover ratios. John M . Griffin , Xiuqing Ji (2003) examine a global portfolio and detect momentum profits. Those profits are robust to both good and bad economic states but reversed over one to five-year horizons.

Intraday price momentum for the stocks is examined for the first time by Gao et al. (2018). They use S&P 500 Exchange Traded Fund data between 1993 and 2013. Price momentums are detected between the first thirty minutes and the last thirty minutes returns in the market. This predictability is both economically and statistically significant and stronger in special event days, for example, on recession days and major macroeconomic news release days. Recently those momentum patterns are found in the Chinese stock index futures by Li et al. (2019). The first hour of the trading day can predict the last hour according to their study. The momentums are stronger in cases of high volume, volatility, and investor attention. According to Li et al. (2019), those results are robust to other futures, periods, and the sign of first trading-session returns, etc.

I will examine which one of those two patterns holds on the Istanbul Stock Exchange, either intraday price reversals or intraday price momentums. There is another possibility that prices in the market follow a random walk and cannot be predicted. This probability is also examined in this study. If any pattern cannot be detected following event days, it can be said that the prices follow a random walk in BIST 30 and BIST SME (Ibe 2013). If a negative event day ends with a more negative return at the end of the trading sessions, one can talk about price momentums. Similarly, in BIST 30 or BIST SME, a negative event day ends with a positive return, one can talk about price reversals. If a positive event day ends with larger positive returns within a trading day, one can talk about price momentums. If a positive event day ends up with a negative return, one can talk about price reversals. All three cases (price momentum, price reversal, random walk) are going to be examined individually for each type of events and indices.

Lastly, the size effect is going to be examined in BIST 30 and BIST SME. It is expected that smaller firm stocks tend to give higher returns than larger firm stocks (Banz 1981). I am going to examine if this theory holds for BIST SME and BIST 30. Note that BIST 30 is more than 100 times larger than BIST SME. I am going to refer BIST SME as a smaller firm index and BIST 30 as a larger firm index while these comparisons.

2 Data and Method

I have used historical tick data of the BIST 30 Index (XU030) and BIST Small Medium Enterprises and Industrial Index (XKOBI) from the Istanbul Stock Exchange (Borsa Istanbul). The data is high-frequency data and consists of every second of the trading days within the period of analysis. BIST 30 index consists of 30 stocks selected from the stocks presented in Borsa Istanbul. The stocks in BIST 30 are selected based on two criteria: free-float market value and daily average traded value (Is Investment 2020). The process is as follows: "If there is any stock which is in the first place in both lists, it is assigned to the first place in the final list. If there is no stock which is in the first place in both lists, it is examined whether there is any stock in the first two places. These steps are repeated until a stock which will be assigned to the first place in the final list is found. After finding the stock to be assigned to the first place in the final list, the above steps are repeated for the succeeding places. If two stocks are eligible to be placed in the first 'n' places in both lists, then the one with the higher market value is assigned to the upper rank in the final list" (Is Investment 2020). The index is constantly reviewed and updated every third month. BIST Small Medium Enterprises and Industrial Index (which is going to be referred to as BIST SME for the rest of this paper) consists of stocks of Small Medium Enterprises and Industrial companies traded in Borsa Istanbul. The constitution of BIST SME is on December 2, 2013, so I start my analysis on that day. The data goes until June 28, 2019. The reason I choose these two indices is to compare an index with larger companies and an index with small medium enterprises. Note that BIST 30 consists of mostly the largest companies' stocks in the Istanbul Stock Exchange. On May 5, 2019, the total Weighted Free Float Market Value of BIST 30 was 172,680,000,000 Turkish Lira (TL), and that of BIST KOBI was 978,817,767.6 TL (Borsa Istanbul 2020). This means more than 100 times difference in size for these two indices. It seems more than enough to see the size effect on the analysis. Among 1398 trading days, 312 days are recorded as positive event days, and 102 days are recorded as negative event days for BIST SME. On the other hand, among 1398 trading days, BIST 30 has 252 positive event days and 133 negative event days. S&P 500 daily data is downloaded from Yahoo Finance (2020).

To constitute a sample of event days with large overnight gaps, I find overnight returns first. Overnight returns are found as follows:

$$OR_i = \frac{P_{i,0} - P_{i-1,c}}{P_{i-1,c}}$$

where OR_i stands for Overnight Return on trading day i, $P_{i,0}$ represents opening price on trading day i, $P_{i-1,c}$ represents closing price of the previous trading day $(i-1)$.

So, to define event days I use the filter as follows:

$OR_i \geq 0.005 \rightarrow$ positive event

$OR_i \leq -0.005 \rightarrow$ negative event

I will use 0.5% opening gap as my filter to define event days. It means that if the difference between opening price and previous day's closing price of an index is larger than 0.5% or lower than -0.5%, then that day counts as one of our event days.

Fung, Mok, and Lam (2000) use filter sizes of $\pm 0.1\%$, $\pm 0.2\%$, $\pm 0.3\%$, $\pm 0.4\%$, $\pm 0.5\%$ for S&P 500 Futures and $\pm 0.1\%$, $\pm 0.15\%$, $\pm 0.2\%$, $\pm 0.25\%$, $\pm 0.3\%$ for Hang Seng Index Futures. Grant, Wolf, and Yu (2005), on the other hand, use the filter of $\pm 0.2\%$ for the S&P 500 futures and add that they use other filters but because they all have similar results only the filter of $\pm 0.2\%$ is demonstrated in the study. I use the filter of $\pm 0.5\%$ because both BIST 30 and BIST SME are more volatile than S&P 500. For the period of December 2, 2013 and June 28, 2019, coefficient of variation of BIST SME is 0.223 on daily prices while that of S&P 500 is 0.149. On the other hand, Coefficient of variation of BIST 30 is a little larger than that of S&P 500, 0.156. I use filters of $\pm 0.2\%$, $\pm 0.3\%$ and $\pm 0.4\%$ as well but because they give similar results but lower significance, I depict only the filter of $\pm 0.5\%$ in this study. Other filter results can be provided upon request. This filter is applied to the overnight returns and among 1398 market days I detect 385 event days for BIST 30 and 414 event days for BIST SME. These numbers are large enough to have a significant sample. At the end of this paper, $\pm 0.3\%$ filter is presented as a robustness test and it provides a proof for the magnitude effect.

Cumulative returns are calculated as follows:

$$CR_{i,t} = \frac{P_{i,t} - P_{i,0}}{P_{i,0}}$$

Where $CR_{i,t}$ represents cumulative returns on day i and t minutes after opening, $P_{i,t}$ represents the price on day i and t minutes after opening and $P_{i,0}$ represents the opening price on day i.

Average cumulative returns can be found by the following formula:

$$ACR_t = \frac{\sum CR_{i,t}}{n}$$

where ACR_t represents average cumulative returns t minutes after opening $CR_{i,t}$ represents cumulative returns on day i and t minutes after opening and n represents the number of the event days. This methodology is similar to the methodology used by Fung and Lam (2004), Grant, Wolf, and Yu (2005) and Cingöz (2020) and other studies done on this topic.

Intraday return analyses are done for BIST 30 and BIST SME separately; positive event days and negative event days are also analyzed separately. The first 30 minutes are examined by 5 minute intervals (5, 10, 15, 20, 25 and 30th minutes), afterwards, every 15 minutes are recorded until

Table 4.1: Trading Hours Changes In BIST

Period	Morning Session	Afternoon Session
December 2, 2013 - November 27, 2015	9:35-12:30	14:15-17:30
November 30, 2015 - November 11, 2016	9:35-12:30	13:30-17:39
November 14, 2016 - June 28, 2019	10:00-13:00	14:00-18:09

120th minute (45, 60, 75, 90 and 120th minutes). At last, closing price is retrieved from the data. Note that the reason we jump to the closing from 120th minute is that Istanbul Stock Exchange has varying working hours which change occasionally and the first 120 minutes were always uninterrupted as the trading session break takes place always at a time after 120 minutes. The trading session changes are listed in Table 4.1:

I test the reversals to see whether or not those movements, if they exist, are significant. This is going to help us to discuss the strength of price reversals in addition to their existence. The significance of the average cumulative returns are found by t test:

$$t_{calc} = \frac{ACR_t - 0}{\sigma/\sqrt{n}}$$

where t_{calc} refers to t value which is calculated from the sample, ACR_t average cumulative return at time t, σ refers to the standard deviation of ACR_t and n refers to the number of observations.

On the significance tables On those tables, $*$ means that ACR is significantly different than zero in 90% confidence level, $**$ means ACR is significantly different than zero in 95% confidence level and $* * *$ means ACR is significantly different than zero in 99% confidence level.

Trading Strategies Formulas

To see the opportunities with those average cumulative returns, I have developed several trading strategies on the assumptional Exchange Traded Funds of the indices. In the trading strategy, there are two types of positions: long positions and short positions. For the long positions, the indices are assumed to have Exchange Traded Funds (ETFs) in the market. For the short positions, the indices are assumed to have Exchange Traded Funds (ETFs) and short selling is allowed in the market.

For the long positions, the buying price is 100 Turkish Lira (TL) and the selling price is calculated as follows for BIST SME:

$$p_{l,XKOBI} = 100 \times \frac{1 + ACR_{ts,XKOBI}}{1 + ACR_{tb,XKOBI}}$$

where $p_{l,XKOBI}$ stands for selling price of long position within BIST SME and $ACR_{tb,XKOBI}$ stands for average cumulative return of BIST SME at buying minute and $ACR_{ts,XKOBI}$ stands for average cumulative return of BIST SME at selling minute.

Rate of return from this transaction is calculated as follows:

$$r_{l,XKOBI} = \frac{p_{l,XKOBI}}{100} - 1$$

where $r_{l,XKOBI}$ represents rate of return from the long position within BIST SME and 100 is the buying price and $p_{l,XKOBI}$ is the selling price of the BIST SME ETF.

Similarly, for the long positions, buying price is 100 Turkish Lira (TL) and selling price is calculated as follows for BIST 30:

$$p_{l,XU030} = 100 \times \frac{1 + ACR_{ts,XU030}}{1 + ACR_{tb,XU030}}$$

where $p_{l,XU030}$ stands for selling price of long position within BIST 30 and $ACR_{tb,XU030}$ stands for average cumulative return of BIST 30 at buying minute and $ACR_{ts,XU030}$ stands for average cumulative return of BIST 30 at selling minute.

Rate of return from this transaction is calculated as follows:

$$r_{l,XU030} = \frac{p_{l,XU030}}{100} - 1$$

where $r_{l,XU030}$ represents rate of return from the long position within BIST 30 and 100 is the buying price and $p_{l,XU030}$ is the selling price of the assumptional BIST 30 ETF.

For the short positions, short selling price is 100 Turkish Lira (TL) and buying back price is calculated as follows for BIST SME:

$$p_{s,XKOBI} = 100 \times \frac{1 + ACR_{tb,XKOBI}}{1 + ACR_{ts,XKOBI}}$$

where $p_{s,XKOBI}$ stands for selling price of short position within BIST SME and $ACR_{tb,XKOBI}$ stands for average cumulative return of BIST SME at buying back minute and $ACR_{ts,XKOBI}$ stands for average cumulative return of BIST SME at short selling minute.

Rate of return from this transaction is calculated as follows:

$$r_{s,XKOBI} = \frac{100}{p_{b,XKOBI}} - 1$$

where $r_{s,XKOBI}$ represents rate of return from the short position within BIST SME and 100 is the short selling price and $p_{b,XKOBI}$ is the buying back price of the BIST SME ETF.

Similarly, for the short positions, short selling price is 100 Turkish Lira (TL) and buying back price is calculated as follows for BIST 30:

$$p_{s,XU030} = 100 \times \frac{1 + ACR_{tb,XU030}}{1 + ACR_{ts,XU030}}$$

where $p_{s,XU030}$ stands for buying price of short position within BIST 30 and $ACR_{tb,XU030}$ stands for average cumulative return of BIST 30 at buying minute and $ACR_{ts,XU030}$ stands for average cumulative return of BIST 30 at selling minute.

Rate of return from this transaction is calculated as follows:

$$r_{s,XU030} = \frac{100}{p_{s,XU030}} - 1$$

where $r_{s,XU030}$ represents rate of return from the short position within BIST 30 and 100 is the short selling price and $p_{a,XKOBI}$ is the buying back price of the assumptional BIST 30 ETF.

3 Conclusion

I have analyzed two indices: one with a large market capitalization rate (BIST 30) and another one with a smaller market capitalization rate (BIST SME). Although the returns are higher on average, the significance seriously damaged by the standard deviation in the smaller index. There exist significant price reversals following negative overnight gaps in BIST 30 and positive overnight gaps in BIST SME. In positive event days in BIST 30 and negative event days in BIST SME, the reversals exist on average but are not significant. Regarding contrarian strategy, average returns are higher in BIST SME following both positive and negative overnight gaps compared to BIST 30. This implies a size effect on the index returns. As the filter gets larger, the significance of the reversals increases. This implies a magnitude effect which I detect in both indices.

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Scientific article

INTRADAY PRICE REVERSALS IN ISTANBUL STOCK EXCHANGE

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Keywords Overreaction, Intraday Price Reversals, High Frequency, Istanbul Stock Exchange, Overnight Gap

1 Introduction

In this paper, I examine intraday price reversals after large price changes in the Turkish Stock Exchange which is called Borsa Istanbul (BIST). Price reversal means an opposite movement to an ongoing price movement (De Bondt and Thaler 1985). I will analyze two indices: BIST 30 Index (XU030) and BIST Small Medium Enterprises and Industrial Index (XKOBI). BIST 30 Index consists of 30 biggest company stocks traded in Istanbul Stock Exchange (Is Investment 2020). BIST Small Medium Enterprises and Industrial Index (BIST SME) consists of Small and Medium Enterprises and industrial companies traded in the Istanbul Stock Exchange ("KOBİ Sanayi Endeksi" 2020). The reason I choose these two indices is to see the differences and similarities of the market movements between large companies and smaller companies. I find price reversals both in BIST SME and BIST 30 indices. Those reversals are significant on average following a negative price gap in BIST 30 index and following a positive price gap in BIST SME index. Additionally, magnitudes of those price reversals increase as the price changes become larger. Since smaller index gives higher returns, there exists a size effect. Profitable trading strategies can be established in both indices.

In general, price reversals are related to the efficient market hypothesis as these movements violate the hypothesis' assumptions. Efficient capital markets can be defined as the capital markets where all the information about the assets is reflected in their prices at any moment (Fama 1970). There are three forms of the efficiency: weak form, semi-strong form and strong form. The weak form requires only that historical price data is publicly available. The semi-strong form of efficiency, on the other hand, means that there are public announcements of share splits, annual or quarterly reports, additional security issues, etc. If there are no privileged groups or persons among investors who might privately access inside information, then a strong form of efficiency occurs. If a capital market fulfills those conditions, it can be considered an efficient capital market (Fama 1970). In such markets, prices follow a random walk and it is hard to beat the market as an investor. Fama (1970) shows that the US financial market is efficient in all levels. The intraday price reversals I find in the Turkish Stock Exchange breach the assumptions of the efficient market hypothesis. If the market was efficient, intraday price reversals would not exist.

The efficient capital markets hypothesis has been challenged by a huge number of scholars, academic papers etc. such that a new approach called behavioral finance came to the scene. As a discipline challenging traditional finance, behavioral finance refuses the assumption of that individuals are rational. In fact, people are not rational but "normal" according to Statman (2017). "Normal" implies neither rationality nor irrationality for the investors. Another main foundation undermined by the behavioral finance is mean-variance portfolio theory. According to classical finance theory, investors' only purpose on the market is to build high expected return, low variance portfolios. On the other hand, behavioral finance adds factors like social status or social responsibility into the construction of an ideal portfolio. The individual's weak self-control breaches ideal savings and spending according to the behavioral perspective (Statman 2017). The most important deduction behavioral finance reaches is that markets are not efficient in the sense that it fully reflects the value of assets. Those philosophical debates are important to demonstrate the framework of this thesis.

Many studies are challenging the efficient market hypothesis. Narayan and Zheng (2010) capture market anomalies in the Chinese stock market in terms of firm size, the book-to-market ratio, the turnover rate except for momentum. Al-Khazali and Mirzaei (2017) present calendar anomalies in eight Dow Jones Islamic Indices. Chan et al. (2020) present market anomalies after presidential elections. Diaz-Ruiz, Herrerias, and Vasquez (2020) find three types of anomalies out of 19 tested in the Mexican stock market. The robust anomalies are listed as momentum, idiosyncratic volatility, and the lottery effect.

Kahneman and Tversky (1977) study decision-making mechanisms which show that people overreact to unexpected news. De Bondt and Thaler (1985), in a breakthrough study, examine if the overreaction exists in financial markets and open a pave for analyses regarding overreaction phenomenon in the finance literature. De Bondt and Thaler (1985) apply this phenomenon in New York Stock Exchange to see if a similar behavior exists among the investors. They examine two different types of portfolios. "Loser portfolio" is a portfolio in which past excess returns have been negative, while the "winner portfolio" has given positive excess returns in the past. As a result, loser portfolio outperforms winner portfolio. Their study implies a substantial weak form of inefficiency in the capital markets. They show overreaction in the long-run for up to 5 years. However, I will examine high-frequency intraday data and see if the overreaction is corrected within minutes rather than years. When individuals contemplate their forecast, they are prone to overweight the recent information (De Bondt and Thaler 1985). As a result, today's price of the assets does not reflect the real value of the assets, and investors should follow a contrarian strategy, according to De Bondt and Thaler (1985). The results from my study also suggest that a contrarian strategy would be profitable to follow in BIST 30 and BIST SME indices but in intraday basis rather than years basis.

Overreaction has been studied widely within many markets including Spain (Alonso and Rubio 1990), South Africa (Page and Way 1992), Brazil (Costa 1994), New Zealand (Bowman and Iverson 1998), Hong Kong (Fung 1999), Australia (Gaunt 2000), Greece (Antoniou, Galariotis, and Spyrou 2005) and Germany (Lobe and Rieks 2011). All of those studies detect overreaction except for Gaunt (2000) on the Australian market. I also detect overreactions in both BIST 30 and BIST SME indices. Alonso and Rubio (1990) use the same methodology with De Bondt and Thaler (1985) and conclude that the “loser portfolio” outperforms “winner portfolio” by 24.5% in the Spanish capital market. The results are robust to size adjustments. Page and Way (1992) examine Johannesburg Stock Exchange and find that “loser portfolio” performs about 20% better than “winner portfolio” three years after the construction of the portfolios. Costa (1994) examines Brazilian Stock Market for the period of 1970 and 1989 and detects price reversals in two years period. Bowman and Iverson (1998) examine periods following large price changes in New Zealand Stock Market. Besides, Lobe and Rieks (2011) state that there exists no evidence for violation of market efficiency on the Frankfurt Stock Exchange.

Most of those studies prove overreaction in the long-term. I analyze intraday price reversals to see if the theory holds in the short-term. Previously, Atkins and Dyl (1990) show price reversals on daily prices. On average, a dramatic fall in prices is corrected on the following day in their analysis. This effect is stronger when price gap is negative. Similarly, Fabozzi et al. (1995) demonstrate a significant intraday price reversal movement after a large price change more significant for negative initial prices. Fung, Mok, and Lam (2000) found intraday price reversals in the S&P 500 and HSI futures market. Magnitude of the price reversals is showed to be related to the initial price changes in the both studies by Fabozzi et al. (1995) and Fung, Mok, and Lam (2000). The study by Fung, Mok, and Lam (2000) is extended by Fung and Lam (2004) and they demonstrate that price reversals are so strong that the effect is carried to the next day in Hang Seng Index Futures. Grant, Wolf, and Yu (2005) examine S&P 500 futures for a 15 years span and show a significant reversal within the day. Note that those returns disappear after the transaction costs. Interestingly, the strength of the reversal movement is higher in positive price gap event days in the work of Grant, Wolf, and Yu (2005) unlike Fabozzi et al. (1995) and Fung, Mok, and Lam (2000). Parikakis and Syriopoulos (2008) detect overreaction and profitable opportunities in foreign exchange markets. I detect intraday price reversals and profitable trading strategies in both indices I observe. If transaction costs and bid-ask spreads are taken into account, those profits are reduced significantly.

Fung, Lam, and Lam (2010) prove the existence of intraday price reversals in Asian index futures market after a dramatic change in the US market. The profitability holds even after the transaction costs according to Fung, Lam, and Lam (2010). Klößner, Becker, and Friedmann (2012) review the effects of good news and bad news on the stock markets and present significant overreaction to bad news. Kudryavtsev (2013) reveals next-day stock price reversals following end-of-the-day price movements in Dow Jones Industrial Index and detects profitability opportunities. Recently, Chu, Gu, and Zhou (2019) detect a significant Intraday momentum and reversal in Chinese stock market. However, transaction costs sweep profitable investment opportunities. Cingöz (2020) studies Turkish Stock Exchange and finds that overreaction disappears within minutes in BIST 100 Index. Similar to Cingöz (2020), I find a magnitude effect in both BIST 30 and BIST SME.

2 Data

I have used historical tick data of the BIST 30 Index (XU030) and BIST Small Medium Enterprises and Industrial Index (XKOBI) from the Istanbul Stock Exchange (Borsa Istanbul). The data is high-frequency data and consists of every second of the trading days within the period of analysis. BIST 30 index consists of 30 stocks selected from the stocks presented in Borsa Istanbul. The stocks in BIST 30 are selected based on two criteria: free-float market value and daily average traded value (Is Investment 2020). The process is as follows: "If there is any stock which is in the first place in both lists, it is assigned to the first place in the final list. If there is no stock which is in the first place in both lists, it is examined whether there is any stock in the first two places. These steps are repeated until a stock which will be assigned to the first place in the final list is found. After finding the stock to be assigned to the first place in the final list, the above steps are repeated for the succeeding places. If two stocks are eligible to be placed in the first 'n' places in both lists, then the one with the higher market value is assigned to the upper rank in the final list" (Is Investment 2020). The index is constantly reviewed and updated every third month. BIST Small Medium Enterprises and Industrial Index (which is going to be referred to as BIST SME for the rest of this paper) consists of stocks of Small Medium Enterprises and Industrial companies traded in Borsa Istanbul. The constitution of BIST SME is on December 2, 2013, so I start my analysis on that day. The data goes until June 28, 2019. The reason I choose these two indices is to compare an index with larger companies and an index with small medium enterprises. Note that BIST 30 consists of mostly the largest companies' stocks in the Istanbul Stock Exchange. On May 5, 2019, the total Weighted Free Float Market Value of BIST 30 was 172,680,000,000 Turkish Lira (TL), and that of BIST KOBI was 978,817,767.6 TL (Borsa Istanbul 2020). This means more than 100 times difference in size for these two indices. It seems more than enough to see the size effect on the analysis. Among 1398 trading days, 312 days are recorded as positive event days, and 102 days are recorded as negative event days for BIST SME. On the other hand, among 1398 trading days, BIST 30 has 252 positive event days and 133 negative event days. S&P 500 daily data is downloaded from Yahoo Finance (2020).

3 Empirical Results

To constitute a sample of event days with large overnight gaps, I find overnight returns first. Overnight returns are found as follows:

$$OR_i = \frac{P_{i,0} - P_{i-1,c}}{P_{i-1,c}}$$

where OR_i stands for Overnight Return on the trading day i, $P_{i,0}$ represents the opening price on the trading day i, $P_{i-1,c}$ represents the closing price of the previous trading day $(i-1)$.

So, to define event days I use the filter as follows:

$OR_i \geq 0.005 \rightarrow$ positive event

$OR_i \leq -0.005 \rightarrow$ negative event

I will use 0.5% the opening gap as my filter to define event days. It means that if the difference between the opening price and previous day's closing price of an index is larger than 0.5% or lower than -0.5%, then that day counts as one of our event days.

Fung, Mok, and Lam (2000) use filter sizes of $\pm 0.1\%$, $\pm 0.2\%$, $\pm 0.3\%$, $\pm 0.4\%$, $\pm 0.5\%$ for S&P 500 Futures and $\pm 0.1\%$, $\pm 0.15\%$, $\pm 0.2\%$, $\pm 0.25\%$, $\pm 0.3\%$ for Hang Seng Index Futures. Grant, Wolf, and Yu (2005), on the other hand, use the filter of $\pm 0.2\%$ for the S&P 500 futures and add that they use other filters but because they all have similar results only the filter of $\pm 0.2\%$ is demonstrated in the study. I use the filter of $\pm 0.5\%$ because both BIST 30 and BIST SME are more volatile than S&P 500. For the period of December 2, 2013 and June 28, 2019, coefficient of variation of BIST SME is 0.223 on daily prices while that of S&P 500 is 0.149. On the other hand, Coefficient of variation of BIST 30 is a little larger than that of S&P 500, 0.156. I use filters of $\pm 0.2\%$, $\pm 0.3\%$ and $\pm 0.4\%$ as well but because they give similar results but lower significance, I depict only the filter of $\pm 0.5\%$ in this study. Other filter results can be provided upon request. This filter is applied to the overnight returns and among 1398 market days I detect 385 event days for BIST 30 and 414 event days for BIST SME. These numbers are large enough to have a significant sample. At the end of this paper, $\pm 0.3\%$ filter is presented as a robustness test and it provides a proof for the magnitude effect.

Cumulative returns are calculated as follows:

$$CR_{i,t} = \frac{P_{i,t} - P_{i,0}}{P_{i,0}}$$

Where $CR_{i,t}$ represents cumulative returns on day i and t minutes after the opening, $P_{i,t}$ represents the price on day i and t minutes after the opening and $P_{i,0}$ represents the opening price on day i.

Average cumulative returns can be found by the following formula:

$$ACR_t = \frac{\sum CR_{i,t}}{n}$$

where ACR_t represents average cumulative returns t minutes after the opening $CR_{i,t}$ represents cumulative returns on day i and t minutes after the opening and n represents the number of the event days. This methodology is similar to the methodology used by Fung and Lam (2004), Grant, Wolf, and Yu (2005) and Cingöz (2020) and other studies done on this topic.

Intraday return analyses are done for BIST 30 and BIST SME separately; positive event days and negative event days are also analyzed separately. The first 30 minutes are examined by 5 minute intervals (5, 10, 15, 20, 25 and 30th minutes), afterwards, every 15 minutes are recorded until 120th minute (45, 60, 75, 90 and 120th minutes). At last, the closing price is retrieved from the data. Note that the reason we jump to the closing from 120th minute is that Istanbul Stock Exchange has varying working hours which change occasionally and the first 120 minutes were always uninterrupted as the trading session break takes place always at a time after 120 minutes.

I test the reversals to see whether or not those movements, if they exist, are significant. This is going to help us to discuss the strength of price reversals in addition to their existence. The significance of the average cumulative returns are found by t test:

$$t_{calc} = \frac{ACR_t - 0}{\sigma/\sqrt{n}}$$

where t_{calc} refers to t value which is calculated from the sample, ACR_t average cumulative return at time t, σ refers to the standard deviation of ACR_t and n refers to the number of observations.

On the significance tables On those tables, $*$ means that ACR is significantly different than zero in 90% confidence level, $**$ means ACR is significantly different than zero in 95% confidence level and $***$ means ACR is significantly different than zero in 99% confidence level.

Trading Strategies Formulas

To see the opportunities with those average cumulative returns, I have developed several trading strategies on the assumptional Exchange Traded Funds of the indices. In the trading strategy, there are two types of positions: long positions and short positions. For the long positions, the indices are assumed to have Exchange Traded Funds (ETFs) in the market. For the short positions, the indices are assumed to have Exchange Traded Funds (ETFs) and short selling is allowed in the market.

For the long positions, buying price is 100 Turkish Lira (TL) and selling price is calculated as follows for BIST SME:

$$p_{l,XKOBI} = 100 \times \frac{1 + ACR_{ts,XKOBI}}{1 + ACR_{tb,XKOBI}}$$

where $p_{l,XKOBI}$ stands for selling price of long position within BIST SME and $ACR_{tb,XKOBI}$ stands for average cumulative return of BIST SME at buying minute and $ACR_{ts,XKOBI}$ stands for average cumulative return of BIST SME at selling minute.

Rate of return from this transaction is calculated as follows:

$$r_{l,XKOBI} = \frac{p_{l,XKOBI}}{100} - 1$$

where $r_{l,XKOBI}$ represents rate of return from the long position within BIST SME and 100 is the buying price and $p_{l,XKOBI}$ is the selling price of the BIST SME ETF.

Similarly, for the long positions, buying price is 100 Turkish Lira (TL) and selling price is calculated as follows for BIST 30:

$$p_{l,XU030} = 100 \times \frac{1 + ACR_{ts,XU030}}{1 + ACR_{tb,XU030}}$$

where $p_{l,XU030}$ stands for selling price of long position within BIST 30 and $ACR_{tb,XU030}$ stands for average cumulative return of BIST 30 at buying minute and $ACR_{ts,XU030}$ stands for average cumulative return of BIST 30 at selling minute.

Rate of return from this transaction is calculated as follows:

$$r_{l,XU030} = \frac{p_{l,XU030}}{100} - 1$$

where $r_{l,XU030}$ represents rate of return from the long position within BIST 30 and 100 is the buying price and $p_{l,XU030}$ is the selling price of the assumptional BIST 30 ETF.

For the short positions, short selling price is 100 Turkish Lira (TL) and buying back price is calculated as follows for BIST SME:

$$p_{s,XKOBI} = 100 \times \frac{1 + ACR_{tb,XKOBI}}{1 + ACR_{ts,XKOBI}}$$

where $p_{s,XKOBI}$ stands for selling price of short position within BIST SME and $ACR_{tb,XKOBI}$ stands for average cumulative return of BIST SME at buying back minute and $ACR_{ts,XKOBI}$ stands for average cumulative return of BIST SME at short selling minute.

Rate of return from this transaction is calculated as follows:

$$r_{s,XKOBI} = \frac{100}{p_{b,XKOBI}} - 1$$

where $r_{s,XKOBI}$ represents rate of return from the short position within BIST SME and 100 is the short selling price and $p_{b,XKOBI}$ is the buying back price of the BIST SME ETF.

Similarly, for the short positions, short selling price is 100 Turkish Lira (TL) and buying back price is calculated as follows for BIST 30:

$$p_{s,XU030} = 100 \times \frac{1 + ACR_{tb,XU030}}{1 + ACR_{ts,XU030}}$$

where $p_{s,XU030}$ stands for buying price of short position within BIST 30 and $ACR_{tb,XU030}$ stands for average cumulative return of BIST 30 at buying minute and $ACR_{ts,XU030}$ stands for average cumulative return of BIST 30 at selling minute.

Rate of return from this transaction is calculated as follows:

$$r_{s,XU030} = \frac{100}{p_{s,XU030}} - 1$$

where $r_{s,XU030}$ represents rate of return from the short position within BIST 30 and 100 is the short selling price and $p_{a,XKOBI}$ is the buying back price of the assumptional BIST 30 ETF.

Table 5.1: BIST SME Negative Overnight Gap

Minute	Mean	Median	Sum	SE Mean	Variance	Stdev	Skewness	Kurtosis
Opening	0	0	0	0	0	0	NaN	NaN
5	-0.00068	-0.000059	-0.069403	0.001019	0.000106	0.010288	1.690965	9.696606
10	0.000076	-0.000411	0.007802	0.000883	0.00008	0.008919	0.386151	1.142355
15	-0.00002	-0.000133	-0.002044	0.000998	0.000102	0.010081	0.067511	0.765622
20	0.000667	0.000504	0.068056	0.001283	0.000168	0.012953	1.76123	10.997118
25	0.001194	0.000422	0.121814	0.001376	0.000193	0.013897	1.244874	7.374909
30	0.000413	0.000423	0.042146	0.001499	0.000229	0.015138	0.319846	4.50997
45	0.000321	0.000583	0.032792	0.001664	0.000282	0.016804	-0.400256	4.207975
60	0.001297	0.000706	0.132297	0.001926	0.000378	0.019448	0.797684	5.030214
75	0.000074	0.001794	0.007511	0.002015	0.000414	0.020355	-0.207813	4.866071
90	0.000667	0.000553	0.068042	0.00205	0.000429	0.020703	0.0397	3.547108
105	0.000225	0.000085	0.022999	0.002072	0.000438	0.020923	-0.122738	3.532079
120	0.000025	0.000098	0.002589	0.002218	0.000502	0.022398	-0.330117	3.515747
Closing	0.003132	0.001882	0.319443	0.003108	0.000985	0.031387	-0.057335	2.914894

Table 5.2: BIST SME Positive Overnight Gap

Minute	Mean	Median	Sum	SE Mean	Variance	Stdev	Skewness	Kurtosis
Opening	0	0	0	0	0	0	NaN	NaN
5	0.000518	0.000772	0.161761	0.000251	0.00002	0.004425	-0.439764	2.662277
10	0.000509	0.000497	0.158936	0.000293	0.000027	0.005177	0.277833	6.431519
15	0.000363	0.000275	0.113268	0.000349	0.000038	0.006172	-0.208056	6.515706
20	0.000324	0.000306	0.101082	0.000348	0.000038	0.006138	0.30751	6.099784
25	0.00018	0.000077	0.056253	0.000374	0.000044	0.006609	0.023099	3.417726
30	-0.000056	-0.000284	-0.017512	0.000389	0.000047	0.006871	0.485011	3.270386
45	-0.000377	-0.000525	-0.11759	0.000443	0.000061	0.007816	0.117255	3.23735
60	-0.00094	-0.000633	-0.293393	0.000491	0.000075	0.008678	-0.396457	4.239763
75	-0.001436	-0.001079	-0.447936	0.000529	0.000087	0.009338	-1.026099	8.747178
90	-0.001762	-0.001154	-0.549761	0.000537	0.00009	0.009482	-1.317431	9.094446
105	-0.001766	-0.001052	-0.551108	0.00053	0.000088	0.009365	-0.935245	5.92095
120	-0.001674	-0.001471	-0.522444	0.000585	0.000107	0.010324	1.129283	14.413759
Closing	-0.001754	-0.001324	-0.547234	0.000885	0.000245	0.015637	0.25856	4.160097

Table 5.3: BIST 30 Negative Overnight Gap

Minute	Mean	Median	Sum	SE Mean	Variance	Stdev	Skewness	Kurtosis
Opening	0	0	0	0	0	0	NaN	NaN
5	-0.000206	-0.000471	-0.027363	0.00036	0.000017	0.00415	-0.490186	7.781503
10	0.000263	0.000484	0.035031	0.000433	0.000025	0.004996	-0.178193	4.323835
15	0.000805	0.000524	0.107084	0.000405	0.000022	0.004667	0.46252	3.433976
20	0.000842	0.000551	0.111961	0.000472	0.00003	0.005447	0.849736	4.096428
25	0.000801	0.000456	0.106578	0.000507	0.000034	0.005843	0.990441	5.855496
30	0.000819	0.000305	0.108924	0.000486	0.000031	0.005602	1.216249	6.320451
45	0.000845	0.000979	0.112405	0.000568	0.000043	0.006549	1.093014	4.329278
60	0.000867	0.001202	0.115265	0.000596	0.000047	0.006871	0.479199	2.84254
75	0.00071	0.001134	0.094364	0.000649	0.000056	0.007487	-0.280973	3.591218
90	0.000717	0.000481	0.095358	0.000701	0.000065	0.008085	-0.096065	2.153594
105	0.00036	0.000281	0.047929	0.000777	0.00008	0.008965	-0.44413	2.228669
120	0.000274	0.000438	0.036452	0.000843	0.000094	0.009717	-0.543047	3.079762
Closing	0.000422	-0.001609	0.056178	0.00134	0.000239	0.015457	-0.461414	1.129406

Table 5.4: BIST 30 Positive Overnight Gap

Minute	Mean	Median	Sum	SE Mean	Variance	Stdev	Skewness	Kurtosis
Opening	0	0	0	0	0	0	NaN	NaN
5	0.000214	0.000643	0.053965	0.000148	0.000006	0.002354	-1.122569	2.463947
10	0.000312	0.000684	0.078503	0.000189	0.000009	0.003003	-1.269697	4.563987
15	0.000234	0.000556	0.059053	0.000188	0.000009	0.002984	-0.999296	2.775677
20	0.000432	0.00082	0.108762	0.000205	0.000011	0.003248	-1.250965	4.459781
25	0.000489	0.000833	0.123232	0.000235	0.000014	0.003736	-1.395426	6.446981
30	0.000521	0.000874	0.131382	0.000238	0.000014	0.00378	-1.088939	4.098885
45	0.000286	0.000952	0.071958	0.000296	0.000022	0.004706	-1.252297	4.72153
60	0.000261	0.001103	0.065739	0.000335	0.000028	0.005321	-1.462151	5.617206
75	-0.000019	0.000768	-0.004674	0.000366	0.000034	0.005804	-1.723865	5.67965
90	-0.000047	0.000625	-0.011825	0.000397	0.00004	0.006309	-1.659016	5.290874
105	-0.000166	0.000756	-0.041915	0.000447	0.00005	0.007103	-1.595932	4.862202
120	-0.000143	0.000805	-0.035929	0.000473	0.000056	0.007505	-1.434658	3.866953
Closing	-0.00014	0.000532	-0.035321	0.000855	0.000184	0.013566	-0.667336	2.380853

Those results show the existence of intraday price reversals in BIST 30 and BIST SME indices. But how significant are those results? Table 5.5, 5.6, 5.7 and 5.8 show the significance level of average cumulative returns. On those tables, $*$ means that ACR is significantly different than zero in 90% confidence level, $**$ means ACR is significantly different than zero in 95% confidence level and $***$ means ACR is significantly different than zero in 99% confidence level.

Table 5.5: BIST SME Negative Overnight Gap

Minute	ACR %	t_{calc}	p value
Opening			
5	-0.068	-0.668	0.506
10	0.0076	0.087	0.931
15	-0.002	-0.02	0.984
20	0.0667	0.52	0.604
25	0.1194	0.868	0.388
30	0.0413	0.276	0.783
45	0.0321	0.193	0.847
60	0.1297	0.674	0.502
75	0.0074	0.037	0.971
90	0.0667	0.325	0.746
105	0.0225	0.109	0.914
120	0.0025	0.011	0.991
Closing	0.3132	1.008	0.316
$*: 90\%$	$**: 95\%$	$***: 99\%$	conf.

Table 5.6: BIST SME Positive Overnight Gap

Minute	ACR %	t_{calc}	p value
Opening			
5	0.0518**	2.07	0.039
10	0.0509*	1.738	0.083
15	0.0363	1.039	0.3
20	0.0324	0.932	0.352
25	0.018	0.482	0.63
30	-0.0056	-0.144	0.885
45	-0.0377	-0.852	0.395
60	-0.094	-1.914	0.057
75	-0.1436***	-2.716	0.007
90	-0.1762***	-3.283	0.001
105	-0.1766***	-3.332	0.001
120	-0.1674***	-2.865	0.004
Closing	-0.1754**	-1.981	0.048
$*: 90\%$	$**: 95\%$	$***: 99\%$	conf.

Table 5.7: BIST 30 Negative Overnight Gap

Minute	ACR %	t_{calc}	p value
Opening			
5	-0.0206	-0.572	0.568
10	0.0263	0.608	0.544
15	0.0805**	1.99	0.049
20	0.0842*	1.782	0.077
25	0.0801	1.582	0.116
30	0.0819*	1.686	0.094
45	0.0845	1.488	0.139
60	0.0867	1.455	0.148
75	0.071	1.093	0.276
90	0.0717	1.023	0.308
105	0.036	0.464	0.644
120	0.0274	0.325	0.745
Closing	0.0422	0.315	0.753
$*: 90\%$	$**: 95\%$	$***: 99\%$	conf.

3.1 Comparison

As you can see from Figure 5.1, in negative case the reversals are stronger with BIST SME but because of higher standard deviation, the significance is lower than BIST 30 (see Table 5.1 and 5.3 to see the difference in standard deviations). On the other hand, observable from Figure 5.2, both the reversals and their significance levels are stronger in BIST SME following positive overnight gap (see Table 5.2 and 5.4 to see the difference in standard deviations).

3.2 Magnitude Effect

When we apply smaller filters, the ACR results show lower significance. This means that as the price movements get larger the significance of the price reversals increase. In other words, the magnitude of the price movements is positively correlated with the significance of the price reversals. So, it can be said that there exists a magnitude effect as in the most of the papers in the literature (Fabozzi et al. 1995) (Fung, Mok, and Lam 2000) (Fung, Lam, and Lam 2010)(Cingöz 2020).

3.3 Size Effect

Following a negative overnight gap, BIST 30 gives 0.1048% return while BIST SME gives 0.3815% return by a profitable trading strategy (See: trading strategies part of this paper). Following a positive overnight gap, BIST 30 gives 0.0687% return while BIST SME gives 0.2288% return by a profitable trading strategy. In both cases, BIST SME returns are higher than BIST 30 returns more than three times. As smaller index gives a higher return, it can be

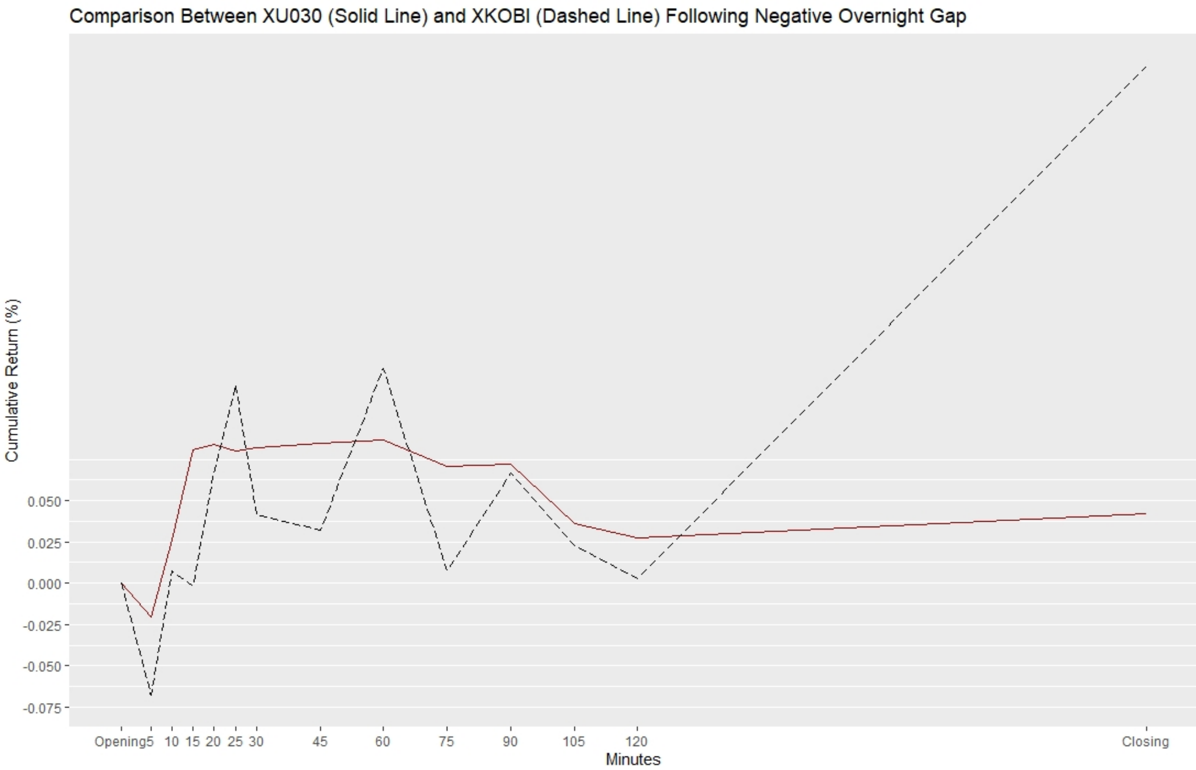

Figure 5.1: Negative Events: BIST 30 (XU030) and BIST SME (XKOBI)

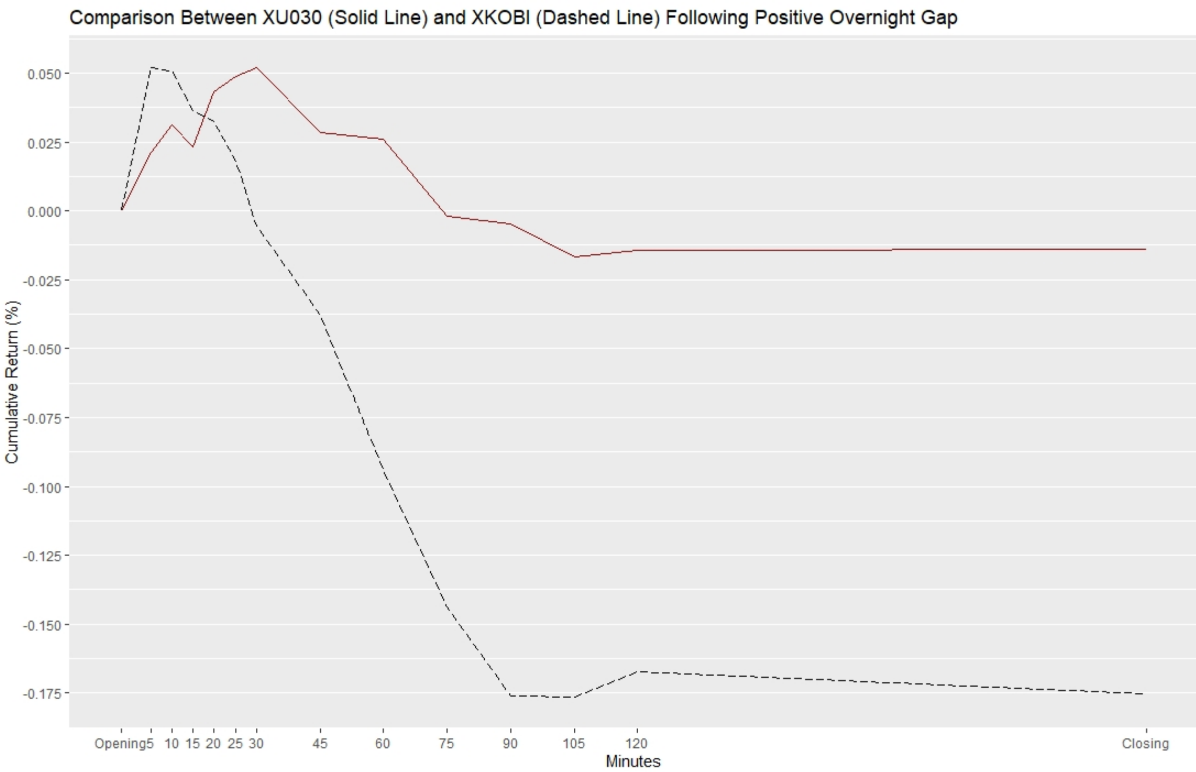

Figure 5.2: Positive Events: BIST 30 (XU030) and BIST SME (XKOBI)

Table 5.8: BIST 30 Positive Overnight Gap

Minute	ACR %	t_{calc}	p value
Opening			
5	0.0214	1.444	0.15
10	0.0312	1.647	0.101
15	0.0234	1.247	0.214
20	0.0432**	2.11	0.036
25	0.0489**	2.078	0.039
30	0.0521**	2.19	0.029
45	0.0286	0.963	0.336
60	0.0261	0.778	0.437
75	-0.0019	-0.051	0.96
90	-0.0047	-0.118	0.906
105	-0.0166	-0.372	0.71
120	-0.0143	-0.302	0.763
Closing	-0.014	-0.164	0.87
$*: 90\%$	$**: 95\%$	$***: 99\%$	conf.

said that the size effect takes place in the price reversals as Banz (1981) suggests.

3.4 Significance test for BIST SME

First of all, although the values seem very strong, in BIST SME negative overnight gap event, the numbers are not statistically significant (see: Table 5.5). So, we can say that there exists no significant average cumulative return mostly because of the high volatility. On the other hand, as you can see from Table 5.6, there are several significant cumulative returns on average in case of the positive overnight gap. Negative ACR is significantly positive in 95% confidence level 5 minutes after the opening. Additionally, ACR is significantly positive in 90% confidence level 10 minutes after the opening. Negative reversals become significant 75 minutes after the opening in 99% confidence level. This significance level is held until the closing and the closing price significance reduces to 95% confidence level.

3.5 Significance test for BIST 30

Unlike BIST SME, BIST 30 has statistically significant reversals for the negative event days (see: Table 5.7). 15 minutes after the opening, ACR is significantly positive in 95% confidence level. Then, 20 minutes after the opening and 30 minutes after the opening, ACR becomes significantly positive in 90% confidence level. For positive event days, there exists no significant reversals (see: Table 5.8).

3.6 Trading strategies

Based on the average cumulative returns depicted above, we can employ several trading strategies in both BIST SME and BIST 30. We assume that there exist exchange traded funds (ETFs) of BIST 30 and BIST SME. Additionally, the transaction costs and the bid-ask spread are not taken into account in these analyses.

For example, if an investor buys 100 Turkish Lira (TL) worth of BIST SME exchange traded fund (ETF) 5 minutes after the opening following a negative overnight gap, it will become 100.3815 TL at the end of the trading day as it is showed in the equation below (see: Table 5.9). However, this return is statistically not significant even in 90% confidence level (see: Table 5.5).

$$
\begin{aligned}
p_{l,XKOBI} &= 100 \times \frac{1+0.003132}{1-0.00068} \simeq 100.3815 \\
r_{l,XKOBI} &= \frac{100.3815}{100} - 1 \simeq 0.003815
\end{aligned}
$$

If the investor follows the same strategy in BIST 30 ETF and buys at the fifth minute of the trading day, the return is going to be significant on the twentieth minute in 90% confidence level (see: Table 5.7). In that case, 100 TL would become 100.1048 TL if the investor sells it at the twentieth minutes (see: Table 5.9). Note that, the rate of return would be higher at the sixtieth minute but I prefer a more significant result rather than a higher result (see: Table 5.7).

$$
\begin{aligned}
p_{l,XU030} &= 100 \times \frac{1+0.000842}{1-0.000206} \simeq 100.1048 \\
r_{l,XU030} &= \frac{100.1048}{100} - 1 \simeq 0.001048
\end{aligned}
$$

If short selling is allowed for these indices, BIST SME might create statistically significant positive returns following a positive overnight gap. If the investor shorts 100 TL worth of BIST SME ETF at the fifth minute, they are going to pay 99.7717 TL to close the position at the 105th minute (See: Table 5.10). This means around 0.2288% rate of return (see: equation below). Note that the average cumulative return at the fifth minute is significantly positive in 95% confidence level and the average cumulative return at the 105th minute is significantly negative in 99% confidence level (See: Table 5.6). This means that the shorting return is not only positive but also significant for BIST SME.

$$p_{s,XKOBI} = 100 \times \frac{1 - 0.000518}{1 + 0.001766} \simeq 99.7717$$
$$r_{s,XKOBI} = \frac{100}{99.7717} - 1 \simeq 0.002288$$

Similarly, if an investor shorts 100 TL worth of BIST 30 at the thirtieth minute, they are going to pay 99.9313 TL to close the position and make 0.0687% return at the 105th minute (See: Table 5.8). This positive return, however, is not significant in 90% confidence level (See: Table 5.10).

$$p_{l,XU030} = 100 \times \frac{1 - 0.000521}{1 + 0.000166} \simeq 99.000687$$
$$r_{l,XU030} = \frac{100}{99.7717} - 1 \simeq 0.000687$$

Table 5.9: Long Position Following Negative Overnight Gap

Index	Buy minute	Sell Minute	Buy at	Sell at	Return (%)
BIST SME	5	Closing	100	100.3815	0.3815
BIST 30	5	20	100	100.1048	0.1048

Table 5.10: Short Position Following Positive Overnight Gap

Index	Short Minute	Buy minute	Short for	Buy for	Return (%)
BIST SME	5	105	100	99.7717	0.2288
BIST 30	5	105	100	99.9313	0.0687

It is possible to construct profitable trading strategies with and without significant returns. However, these profits do not take the transaction costs into account and those costs might significantly reduce the profits, especially considering high bid-ask spreads and transaction costs of smaller firm stocks, this effect might be stronger for the assumptional BIST SME index ETFs.

4 Robustness Test

It is mentioned above that there are other filters I use and $\pm$ 0.5% is chosen in this paper because it gives more significant results and a proper sample size for the analysis. It might be useful to show that an alternative filter would not give that significant results. I can show that as a smaller filter, $\pm$ 0.5% filter gives less significant results by t test (Table 5.11). This will show the robustness of the filter used in this article ($\pm$ 0.5%). Additionally, magnitude effect claimed above is supported by the fact that a smaller overnight price gap creates a less significant average cumulative return.

Table 5.11: Significance Level of The Average Cumulative Returns With an Alternative Filter: 0.3%

Minute	BIST SME	Positive Event	BIST SME	Negative Event	BIST 30	Positive Event	BIST 30	Negative Event
	t_{calc}	p value	t_{calc}	p value	t_{calc}	p value	t_{calc}	p value
Opening								
5	3.941***	0	-0.889	0.375	3.273	0.001	-0.886	0.377
10	1.593	0.112	-0.722	0.471	2.033	0.043	0.668	0.505
15	0.724	0.469	-0.946	0.345	2.072	0.039	0.992	0.322
20	0.367	0.713	-0.245	0.807	2.043	0.042	1.016	0.311
25	-0.275	0.783	0.231	0.818	1.66	0.097	0.725	0.469
30	-1.267	0.206	-0.33	0.742	1.06	0.29	0.772	0.441
45	-2.369**	0.018	-0.15	0.881	-0.081	0.935	1	0.319
60	-3.631***	0	0.439	0.661	-0.834	0.405	0.827	0.409
75	-4.466***	0	-0.535	0.593	-1.523	0.128	0.636	0.525
90	-5.129***	0	-0.508	0.612	-1.777	0.076	0.528	0.598
105	-5.45***	0	-0.753	0.452	-2.11	0.035	0.024	0.981
120	-5.173***	0	-0.911	0.364	-1.857	0.064	-0.118	0.906
Closing	-3.661***	0	0.414	0.68	-2.221	0.027	-0.013	0.99
$*: 90\%$	$**: 95\%$	$***: 99\%$	conf					

As you can see from the table 5.11, when we apply the filter of ±0.3%, only BIST SME ACR values following positive overnight price gaps are significant and the other cases are not significant. On the other hand, when ±0.5% filter is applied, both BIST SME ACR values following positive overnight price gaps and BIST 30 ACR values following negative overnight price gaps are significant. This means that as the price movements get larger the significance of the price reversals increase. So, there exists a magnitude effect.

5 Conclusion

I have analyzed two indices in the Istanbul Stock Exchange: one with a large market capitalization rate (BIST 30) and another one with a smaller market capitalization rate (BIST SME). Weighted Free Float Market Value of BIST 30 is more than 100 times larger than that of BIST SME. I have used $\pm$ 0.5% filter to detect large overnight gaps. I have calculated average cumulative returns of the indices separately after large overnight gaps. I have tested the significance of price reversal movements. Although the returns are higher on average, the significance seriously damaged by the standard deviation in the smaller index. I detect significant and not significant price reversals on both indices. There exist significant price reversals following negative overnight gaps in BIST 30 and positive overnight gaps in BIST SME. In positive event days in BIST 30 and negative event days in BIST SME, the reversals exist on average but are not significant. I have applied a contrarian strategy to exploit those price reversals. For the trading strategies, assumptional index ETFs are used. Regarding contrarian strategy, average returns are higher in BIST SME following both positive and negative overnight gaps compared to BIST 30. This implies a size effect on the index returns. As the filter gets larger, the significance of the reversals increases. I compare the filter of $\pm$ 0.5% and $\pm$ 0.3% particularly and show that the significance of the reversals is higher with $\pm$ 0.5% filter. This trend holds for other filters which are tested but not presented. This implies a magnitude effect which I detect in both indices.

6 Appendix

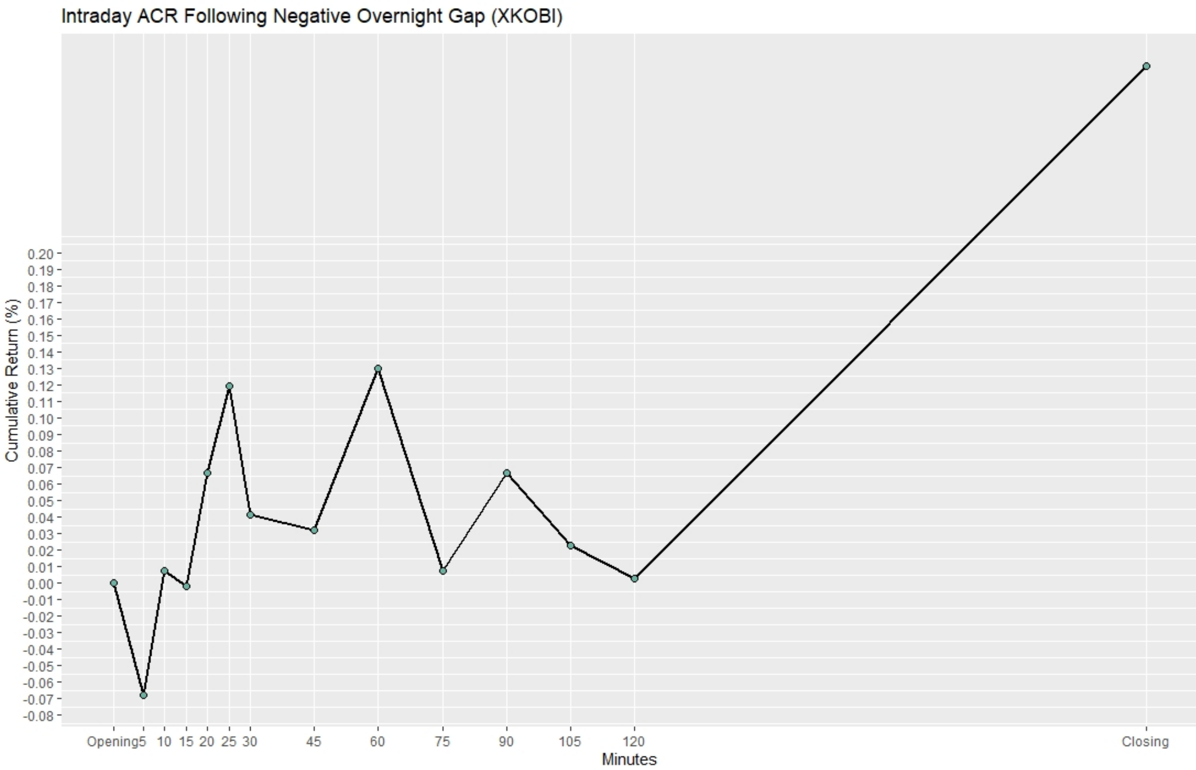

Figure 5.3: Average cumulative returns in BIST SME index after negative overnight gaps

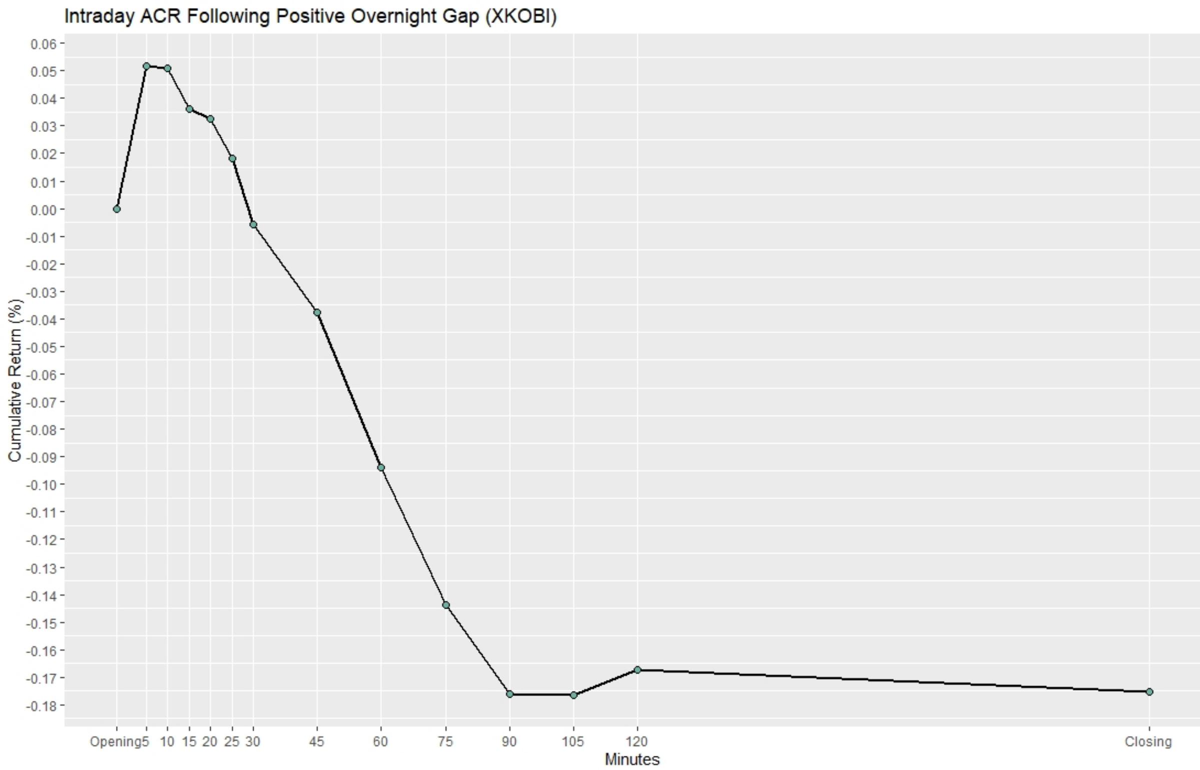

Figure 5.4: Average cumulative returns in BIST SME index after positive overnight gaps

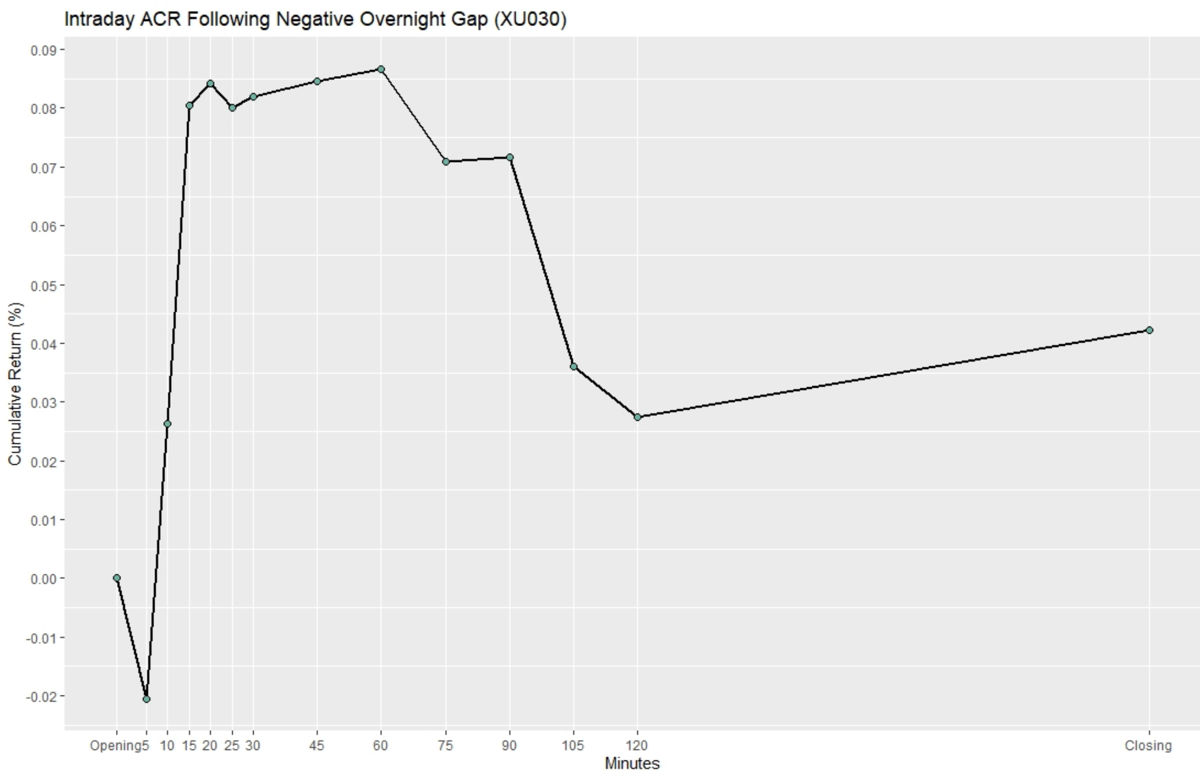

Figure 5.5: Average cumulative returns in BIST 30 index after negative overnight gaps

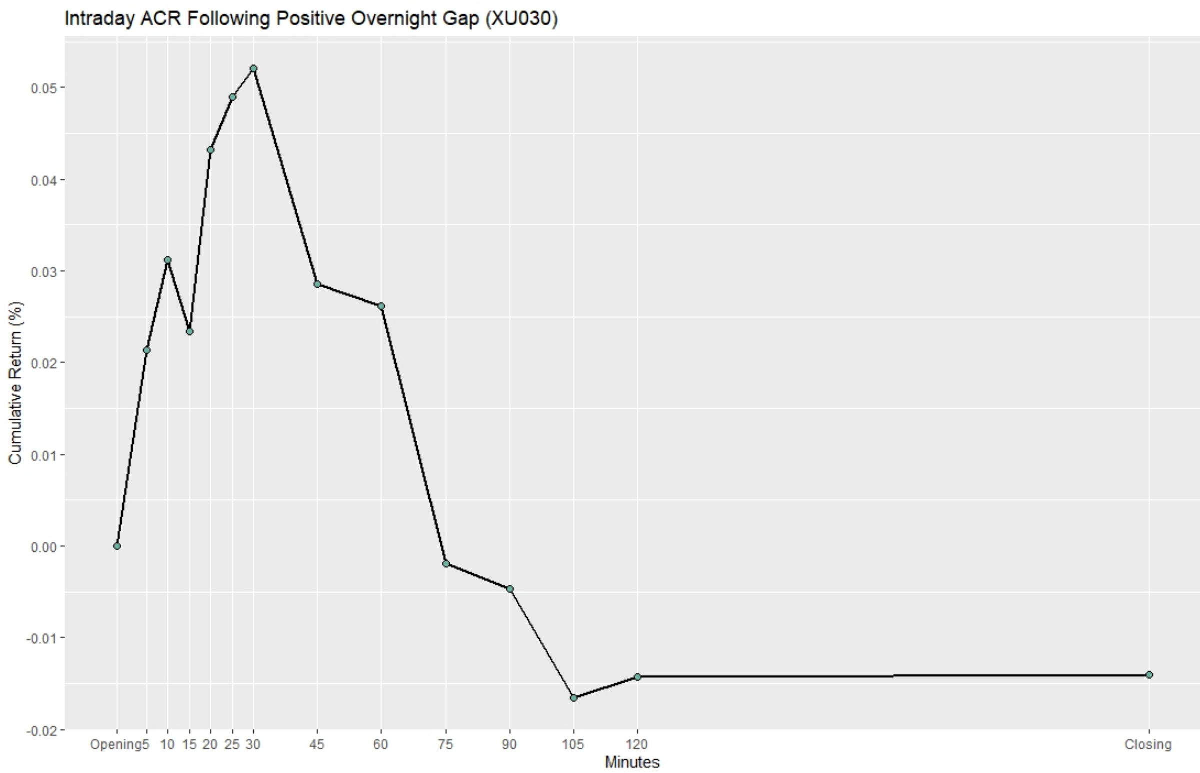

Figure 5.6: Average cumulative returns in BIST 30 index after positive overnight gaps

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