The Interaction between the Return And Buying Appetite of Investors
THE INTERACTION BETWEEN THE RETURN AND BUYING APPETITE OF INVESTORS

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ABSTRACT

The aim of this paper is to explore the relationship between trading behaviors of individual investors and their previous day portfolio return. We try to find which one of the following two contradicting biases dominates the investor behavior: Namely, overconfidence and disposition effect. In order to explore the direction of this relationship, daily transactions of individual investors who trade in Borsa Istanbul between 2008 and 2012 (five years) are analyzed according to several variables such as portfolio size, gender, and age. To do this, we measure buying appetite with the widely used ‘buy-sell imbalance’ which is the ratio of net buying value to the total trading value of investors. Then we explore whether there is a relationship between buying appetite and the previous day portfolio return. The main finding is that there is a strong evidence on the dominance of disposition effect and buying appetite is found to be significantly smaller when the portfolio return increases. The other findings are as follows: (1) Large individual investors (individuals with high portfolio size) have higher buying appetite than that of small investors independent from portfolio returns. (2) Gender has a significant influence on the buying appetite. Male investors have higher buying appetite than their female counterparts. (3) The age and buying appetite are negatively correlated.

Keywords: Behavioral Finance, Overconfidence, Disposition Effect, Buy-Sell Imbalance, Loss Aversion, Portfolio Size Effect, Gender Effect, Age Effect. JEL codes: G02-G14
1. Introduction

The traditional economic theory assumes that economic agents (called Homo economicus by Adam Smith; 1986) who are acting in any market behave rationally, and as a result of these rational behaviors of all economic agents, the market would be as efficient as possible. According to well-designed economic models in the traditional theory; the framework and the processes are clear enough to shape the expectations and to predict the future.

If so, why there are so many economic crises? In 1979, Kahneman and Tversky developed a theory called Prospect Theory (PT) and ‘Behavioral Economics’ became popular in the sense that people can not be rational at all times. This theory is contradicted with Expected Utility Theory (EUT) introduced by Daniel Bernoulli (1738) and developed by von Neumann and Morgenstern (1947). EUT assumes that the probability assigned to any outcome is independent from gain/loss. However, PT defines different value functions for gain and loss domain. A certain amount of gain is weighted differently with the same amount of loss. Kahneman (1979) observed individuals and stated that tendency of risk aversion has strong influence rather than the desire to win.

After this innovation, many new discussion topics have emerged in the recent decades. What are the features of a rational man? How should the rational behavior be? Also, new concepts have begun to discuss according to irrationality. Generally, there are two classes of irrational tendencies: Cognitive Biases and Emotional Biases. The cognitive bias may be thought of as a rule of thumb that may or may not be factual. The emotional Bias is to believe in something for the sake of believing. Overconfidence is a type of Cognitive Bias while disposition effect (DE) is a type of Emotional Bias that are going to be described below in detail.

Odean (1998) found that the investors in financial markets are overconfident. The investors think that they are above the average, which leads to overestimation of their knowledge, underestimation of risks, and the exaggeration their abilities to control events. Their confidences lead them to believe that they are better than others at choosing the best stocks and the best times to enter/exit a position. Overconfidence leads investors to trade more frequently, and as a result, the portfolio performance decreases (Odean and Barber; 2000). In this context, we can say that when the investors get a positive return in a day, it adds to their overconfidence and become more likely to trade (especially buy) more in the next day, believing that their good luck will keep on going.

On the other hand, Shefrin and Statman (1985) were the first to introduce the disposition effect as a type of bias that can be explained as a selling stock whose price is above the purchasing price (reference point may be the previous price rather than the purchasing price in some cases), and holding stock whose price is below the purchasing price. Odean (1998) found that investors tend to realize gains in the early stage but do not want to realize losses so long although there is a tax advantage at selling the losing stocks. The tax advantage could break the power of DE bias only in December.

The disposition effect has been analyzed in terms of stocks as mentioned above. However, it is possible to think this bias as a wider concept. Let’s suppose that an investor gets positive and
significant returns in a day. Meanwhile, the return represents the value of portfolio holding throughout this paper. If this investor buys less (or sells more) in the next day, this action may be also caused by the disposition effect. The first important contribution of this paper is investigating DE based on investors rather than stocks and providing direct knowledge about DE bias of investors. Using investor-based measure rather than stock-based measure is a significant contribution since it provides more clear information about the behaviors of investors.

In this study, all transactions of selected individual investors (selection criteria is going to be explained at Section 3.1.) who trade in Borsa Istanbul between 2008 and 2012 are evaluated on a daily basis. It is found that there is a strong evidence concerning the dominance of DE on the trading behavior of investors. Also; gender, age and portfolio size have different roles on this bias. Large, male and young investors are more influenced by DE bias than small, female and old investors.

On the other hand, the panel regression is performed to measure the effect level of various variables on the buying appetite since there is a close relationship between the biases (Overconfidence and DE) and buying appetite: Overconfidence and buying appetite is positively related while DE and buying appetite is negatively related. Buy-sell imbalance (BSI), which is the widely used measurement tool when analyzing buying appetite, is regressed on the previous day market-adjusted portfolio return, exchange rate, and three dummy variables which are used to look at the effect of gender and age on BSI. Exchange rate is thought as a substitute of stock trading. The results of the panel regression are fully consistent with statistical analysis results. Previous day return has a negative effect on buying appetite since investors buy less as their previous day portfolio return increases. Buying appetite of male and young investors is higher than their female and old counterparts.

I hope this research is going to be helpful in explaining the investor behaviors in financial markets and make significant contributions to behavioral finance literature.

The remainder of this paper is designed as follows. The literature is summarized in section 2. Data and methodology are explained in section 3. Main results are presented in section 4 and the conclusion in section 5.

2. Literature Review

2.1. Behavioral Economics and Behavioral Finance

Traditional economic theories assume that all agents are rational in decision making process meaning that they try to maximize their own utilities with self-motivated utility functions subject to their budget constraints and the deviations from rationality can only be a random process. There is no systematic bias. On the other hand, behavioral economics claims that the people are do care about others and their irrational actions give us an evidence of the existence of systematic biases.
Herbert Simon (1955) was the first to use the term ‘Bounded Rationality’ to point out the causes of systematic bias. Bounded rationality says that people are not perfect utility-maximizers. They cannot process all information because of some limitations such as time and availability and their capability of accounting is not perfect as assumed in classical theory.

On the other hand, Daniel Kahneman and Amos Tversky (1979) have elaborated on decision making process from a psychological sense in their famous article ‘Prospect Theory’ and stated that people have different perceptions about gain and loss. Their theory has explained most of the gaps in traditional theory and became to be one of the main field of economics.

Subsequently, traditional finance theory which is called Efficient Market Hypothesis (EMH) (Fama; 1970) also assumes that investors make rational decisions, all information are available and they can use all information that should be used in a decision. Thus, financial markets are fully efficient in which all prices reflect all available information. Like in traditional economic theories, traditional finance theory also states that returns are unpredictable, prices follows a random walk at all places, trades of irrational investors are random therefore, have no effect on prices meaning that there is no arbitrage opportunity!

However, breakdown of the rationality assumption has activated the world of finance too. Shiller (1981), showed that stock market prices are more volatile than could be justified by a rational model. De Bondt and Thaler (1985), performed long-term analysis about comparing two portfolio groups which contain extreme loser and extreme winner stocks and found that past winners become the losers and past losers become the winners. This result can not be explained by using Capital Asset Pricing Model (CAPM) (Treynor; 1961, Sharpe; 1964, Lintner; 1965, Mossin; 1966) which is mostly used model to predict rate of return of an asset. Jagadeesh and Titman (1993), found an evidence of momentum in stock returns. They showed that movements in individual stock prices over a period of 6-12 months can be used to predict future price movements in the same direction. These earlier studies proved that investors do not always behave in a rational way. Thus, behavioral finance literature began to occur.

Systematic irrational actions of individuals are defined as biases. The two biases, which are analyzed comprehensively in this paper, explained below.

### 2.1.1. Overconfidence:

If people overestimate their knowledge, underestimate risks and exaggerate their ability to control events, it is an indicator of overconfidence. There are also two sub-concepts: illusion of control and illusion of knowledge. People have the tendency to believe that the accuracy of their forecasts increases with more information. This is the illusion of knowledge, but in some cases, more information does not lead to better decision making. For instance, many people may not have the training, the experience, or the skills to interpret the information they have. Especially the individual investors are often influenced by this bias because of limited skills. Also, people have the tendency to control or at least affect the results of an event even if it is not
possible most of the time. This is the illusion of control and there are some attributes that foster this bias such as choice, task familiarity or active involvement.

Most famous field study about overconfidence in terms of above than average bias is the study of Svenson (1981). In this study, the subjects were asked about their competences as drivers in relation to a group of drivers, and the results showed that 93% of American drivers rate themselves as better than the median. This is a clear indication of overconfidence.

On the other hand, the relation between overconfidence and trade frequency is one of the most researched areas since overconfident investors are certain about their opinions. Hence, they increase trading. Barber and Odean conducted various researches on this relation. They claim that turnover rate of overconfident investors is higher since they tend to trade more when overconfidence arise (2000). However, their portfolio performance decreases as turnover increases meaning that trading more decreases their return. They also state that male investors trade 45% more than females (2001).

Barber and Odean (2001), also found that negative effect of excessive trading on portfolio return is higher at male investors. Their returns decreases by 2.65 percent because of excessive trades while the female investors’ return decreases only by 1.72 percent.

Gervais and Odean (2001), stated that the reason of investors’ overconfidence is their successful trades. Consequently, they trade more after the period in which they get positive return. In addition to their findings about excessive trading in such a situation, we claim that investors have tendency to buy more (or sell less) after the period in which they get positive return because of DE bias. Therefore, the causal relationship between previous return and buy-sell imbalance should be investigated to introduce the power of DE bias.

In Turkey, Erdem et al. (2013), examines the daily trades in Borsa İstanbul of 20,000 individual investors and found that individual investors underperform the market. In addition, there is a reverse relation between the turnover and returns which is consistent with Odean’s findings. Also, they analyzed the effects of two demographic features on portfolio performance and found that men are trading more than women, hence they underperform the women and age has a positive effect on the portfolio returns. They analyzed the relation between trading frequency and portfolio performance and presented significant difference on portfolio performance, which represented by market-adjusted return, based on gender and age. We, on the other hand, try to demonstrate the causal relationship between the previous return and the buying appetite of individual investors in Turkey and whether or not there is a difference on this relation depending on gender and age as an extensive analysis.

2.1.2. Disposition Effect:

It can be explained by the concepts of loss aversion and regret aversion (discussed earlier). Investors do not want to realize loss but they strongly want to realize gain. Thus, they have the tendency of selling stocks whose prices are above the purchasing price and holding stocks whose prices are below the purchasing price. There is extremely large literature about this bias including both field experiments and controlled laboratory experiments.
Firstly, Weber and Camerer (1998), proved the existence of disposition effect by conducting controlled laboratory experiment with university students in Germany. Their findings showed strong evidence on the existence of disposition effect: “Subjects will tend to sell winners and keep losers.”

On the other hand, Odean (1998) analyzed transactions of 10,000 investors at a large discount brokerage firm between 1987 and 1993 and stated that: “... individual investors demonstrate a significant preference for selling winners and holding losers, except in December when tax motivated selling prevails.”

There is also demographic-based research that try to relate this bias with gender. Da Costa et al. (2008), found that the hypothesis about the existence of disposition effect collapse for female subjects when the reference point is the previous price instead of purchasing price. (Hypothesis: Subjects sell more (less) stocks when the sale price is above (below) the previous price).

Many researchers discuss the dimensions of this bias in terms of time horizons. For instance, Svedsater et al. (2009) claimed that disposition effect and feedback strategy have different roles depending on the time period. Investors have different perceptions in long-run and short-run and the probability to have that type of bias increases as the time period increases. In addition, Risfandy and Hanafi (2014) stated that “Investors behave as momentum trading when respond to short-run return and became contrarian trader when they react to long-run return”. Disposition effect exists clearly in the long-run.

Our research also makes a contribution to Behavioral Finance literature especially in the context of disposition effect. However, our approach is quite different from the previous ones and will be explained in detail in Section 3.

2.2. Buy-Sell Imbalance

The Buy-sell imbalance (BSI) is a ratio of net buying value to the total trading value and it is used as a measurement tool, especially to analyze buying behavior of investors in financial markets. Irrationality on the behaviors of investors breakdowns the basic assumptions of classical finance theory and creates inefficiency in the market since the systematic irrational behavior which is called ‘bias’ or ‘anomaly’ provide others - especially professional market makers - to obtain an unfair advantage by using the anomalies in a systematic way. Thus, investigating the behaviors of the investors and clarifying the reasons of them is substantially important to achieve an efficient and fair financial market.

In the earlier studies, classification of transactions was not publicly available, so researchers developed methods to classify buyer-initiated or seller-initiated trades through the whole transactions. The most frequently used method is the algorithm of Lee and Ready (1991)

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which defines the type of transaction (buy or sell) referring to the time between order of a transaction and realization of a transaction.

Chordia et al. (2002), use the term ‘OIBNUM’ as the number of buyer-initiated trades less the number of seller-initiated trades on a daily basis. Each transaction is determined whether it is buyer-initiated or seller-initiated transaction using the Lee and Ready algorithm and calculate stock-based order imbalance using historical transactions of US individual investors. They try to identify the direction of feedback trading strategy and the persistency of this strategy by regressing OIBNUM on day-of-the-week dummies, past lagged values of market return and also past lagged values of order imbalance (S&P500 Index is used as an aggregate market index). As a result, they found that investors use contrarian feedback strategy; they buy when the market declines and sell when the market rises. The validity period of contrarian strategy is just three days.

Kamesaka et al. (2003), on the other hand, calculates ‘Net Investment Flow (NIF)’ for each investor group as purchasing value minus selling value divided by total trading value on a weekly basis. Their investor groups consist of individual investors, foreign investors and five types of institutional investors. Vector Autoregression (VAR) Model is implemented for each investor group using NIF and Tokyo Stock Price Index (Topix) return as a dependent variables to test for Granger causality between trading of investor group and market returns. Also, to study the performance of investor groups after heavy buying and selling weeks, they divide each group into five equal sets. The Group 1 contains the weeks of highest positive NIF and called buy weeks, and the group 5 contains the weeks of largest negative weeks and called sell weeks. For each group, the average market return for the next period is analyzed to examine portfolio performance of each investor groups. As a result, they stated that “After taking into account investment flow autocorrelation using the bivariate VAR(4) model, foreign investors, companies, and Japanese individual investors appear to be short-term positive feedback traders.” Positive feedback trading means that, these investor groups buy after the market rises and sell after the market declines. On the contrary, banks, insurance firms, and investment trusts follow negative feedback trading strategy. Furthermore, they also analyzed portfolio performance and found that there is no exact relation between feedback trading strategy and portfolio performance.

Griffin et al. (2003), also try to investigate the relation between previous term return and current buy-sell imbalance. They stated that: “On the day following extreme return performance, stocks in the top decile of firm performance are 23.9% more likely to be bought in net by institutions (and sold by individuals) than those in the bottom decile of return performance”. Price increase in a stock is a buy signal for institutional investors while the same movement is a sell signal for individual investors. This result also shows that institutional investors are less affected by disposition effect bias than individual investors.

Kumar and Lee (2006), have studied with the data of large discount brokerage firm in the US and calculate two types of BSI: first one is monthly portfolio BSI which is well-known measurement for investor sentiment and second one is monthly investor BSI which is more similar to our measurement method. However, they stated that portfolio based BSI and investor based BSI generates similar results about herding behavior so it is unnecessary to analyze both of them and they continue to the analysis with portfolio based BSI. They also perform time
series regression by regressing portfolio BSI on unexpected inflation, monthly growth in industrial production, change in the term spread, change in the risk premium, monthly unemployment rate and innovations in average hourly earnings and lastly they added expected future cash flows as an explanatory variable. They conclude that “Even though changes in retail sentiment are likely to be partially induced by innovations in macroeconomic variables, the residual retail sentiment changes as captured by the residual BSI measure have considerable incremental power for explaining comovements in small-cap stock returns.”

Colwell et al. (2008), studied the impact of the trading imbalances of investor categories on stock returns in Australian stock market. They calculated time series of BSI for each stock aggregated by investor groups. Stock-based BSI is calculated as the number of shares of stock purchased minus the number of shares of stock sold divided by the total number of shares of stock traded. Bivariate VAR analysis is used to investigate the Granger-causality between BSI (for each stock and for each investor category) and stock returns lagged up to one week and one month. They found that Granger-causality between stock-based BSI and stock return exists both at daily and weekly intervals. However, only individual investors have the tendency to sell the stock after price increases which is referred to negative feedback strategy and also an evidence of disposition effect bias. Other categories such as institutional investors or foreign investors do not follow negative feedback trading strategy exactly.

Barber and Odean (2008), claimed that investors have limited attention when they make buying/selling decisions and attention-grabbing stocks are bought more rather than others. They defined three proxies for attention which are trading volume, return and news and calculate stock based BSI for each group of stocks to measure the net buying ratio. First, they calculated abnormal trading volume as the ratio of the stock’s trading volume of the day to its average trading volume over the previous one year and stated that if the stocks have higher abnormal trading volume, it is the signal of attention and these stocks are bought more than others. Second, they calculated previous day returns of each stock and stated that if the stocks have higher previous day return, it is also the signal of attention and these stocks are bought more. Lastly, they divided stocks whether the company’s name is on the Fortune 500 at that day or not and stated that if the daily news contain the company’s name, it is the signal of attention and these stocks are also bought more. Also, they calculated stock based BSI for each group of stocks to measure the net buying ratio.

Actually, the second proxy; ‘return’ is the related one to our research. Odean and Barber found that previous day return of a stock is a strong proxy of attention and buying ratio of that type of stocks is significantly higher especially for individual investors but there is u-shaped relation between them. On the other hand, institutional investors generally do not follow this pattern meaning that they are not affected from disposition effect Bias as a whole as individual investors affected.

Overall, BSI is calculated either based on stocks (the ratio of net buying to the total trading of a particular stock) or by summing up all purchasing and selling transactions of a particular investor group in the earlier studies. This type of ratio can only provide limited knowledge about the behavior of an investor. However, BSI; calculated in this paper can provide direct and obvious knowledge since it is calculated for each investor separately as the ratio of net buying
value to the total trading value of an investor. This is the first paper in which investor behavior is investigated by using investor-based BSI which is calculated on a daily basis for each investor. In this study, the focus group is only individual investors since it was proved in the earlier studies that DE is clearly seen on the behaviors of individual investors not of institutional investors.

3. Data & Methodology

3.1. Data

The actual source of the data is Central Registry Agency (MKK) which electronically keeps all the historical data which belongs to capital markets.

The data includes approximately 25,000 individual investors' transactions that were selected according to the following criteria:

- Investors having portfolio amount more than TRY 1,000 (or USD 500)
- Investors making at least one transaction in between the sampling period.

The selection of the data is preserved under stratified random data characteristics such as the age and portfolio size distribution of the sample is the same in the population.

The sampling period is between 01.01.2008 and 31.12.2012 and the data includes approximately 1259 observations of non-holiday regular weekdays.

The data consists of daily transaction values, transaction types as buy or sell, transaction name as stock names and balance of portfolio for each investors in which investors are defined as numbers because of privacy policy. In addition to transaction details, gender and age of investors are also known as a demographic information.

Two other variables are also derived from the data which are buy-sell imbalance and market-adjusted portfolio return (the derivation methods will be explained in Section 3.2.). All variables used in statistical analysis and regression analysis are available on a daily basis.

3.1.1. Descriptive Statistics

The whole data consists of approximately 31,475,000 observations for each variable since there are 25,000 investors and 1259 days. The investor data consists of 18,947 males and 6,049 females. The distribution of investors based on gender as percentage values (Male: 76% and female: %24), is consistent with the population of Turkey’s financial market since 26% of individual investors who are trading in Borsa İstanbul are female investors and 74% of them are male investors according to 2013 statistics of MKK. In addition to the gender distribution, the descriptive statistics about the age of investors are summarized in the Table 3.1
Table 3.1 Descriptive statistics of the investors' age.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of observation</td>
<td>24996</td>
</tr>
<tr>
<td>Mean</td>
<td>46</td>
</tr>
<tr>
<td>Median</td>
<td>45</td>
</tr>
<tr>
<td>Variance</td>
<td>149.12</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.59</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>3.17</td>
</tr>
</tbody>
</table>

The investors are divided into two subsamples as male and female and three age intervals which represent young adults, middle age and old investors. The age intervals are 18-35 for young adults, 36-55 for middle-aged adults and 56+ for old investors.³

Descriptive statistics of other variables (BSI and market-adjusted portfolio return) will be displayed at the next section after the explanations about the derivation processes.

3.2. Methodology

Mainly, there are two different analysis in this paper: statistical analysis and regression analysis. They are independent analysis in terms of implementation but produce closely related results. Two other variables (Buy-sell imbalance and market-adjusted portfolio return) are derived from the data collected from MKK in order to complete these analysis. Buy-sell imbalance is the widely used ratio to measure buying appetite and market-adjusted portfolio return is derived to display the relationship between previous day return and buying appetite of investors. Detailed explanation about derivation process is described below. Also, the model specification process for the regression analysis is driven with the help of conducted studies with panel data.⁴

1) Buy-sell imbalance:

It is calculated for each investor on a daily basis as the difference between purchasing value of all stocks, and selling value of all stocks in a given day divided by the sum of purchasing value of all stocks and selling value of all stocks in a given day. The value is calculated by multiplying price of that stock and quantity purchased or sold in a given day.

³ Information about the age of investors, which are collected from MKK, represents the age in 2008 and they are held constant during the five-year analysis.
\[ BSI_{j,t} = \frac{\sum_{i=1}^{s_i} PV_{i,t} - \sum_{i=1}^{s_i} SV_{i,t}}{\sum_{i=1}^{s_i} PV_{i,t} + \sum_{i=1}^{s_i} SV_{i,t}} \]

where, \( PV_{i,t} = Q_{i,t}^P P_{i,t} \) and \( SV_{i,t} = Q_{i,t}^S P_{i,t} \)

\( BSI_{j,t} \) is the buy-sell imbalance of investor \( j \) on day \( t \), \( PV_{i,t} \) is the purchasing value of stock \( i \) on day \( t \) and \( SV_{i,t} \) is the selling value of stock \( i \) on day \( t \). \( Q_{i,t}^P \) is quantity purchased on stock \( i \) on day \( t \), \( Q_{i,t}^S \) is quantity sold on stock \( i \) on day \( t \) and \( P_{i,t} \) is the price of that stock on day \( t \). \( s_i \) is the number of stocks purchased or sold on day \( t \).

\( BSI_{j,t} \) is a ratio between -1 and 1. If it is equal to -1, it means that investor does not buy anything, but instead sells stock(s). This action indicates the decrease in the buying appetite. If it is equal to 1, it means that the investor does not sell anything, but buys stock(s). That action indicates the increase in the buying appetite. If it is equal to 0, either investor does not trade any stock or the purchasing value and selling value of stock(s) are exactly the same.

BSI is usually calculated as the buy-sell imbalance of a stock rather than of an investor in the earlier studies. However, it is calculated for each investor to measure the buying appetite of investors separately, in this paper. This is the first important contribution of this paper, since the investor-based BSI provides direct knowledge about the investor’s behaviors.

2) Market-adjusted portfolio return:

\[ r_{j,t} = \sum_{i=1}^{s_{i,t}} p_{i,j,t} r_{i,t} - r_t^m \]

\( r_{j,t} \) is the market-adjusted portfolio return for investor \( j \) on day \( t \), \( p_{i,j,t} \) is the weight that is calculated by dividing the end-of-day market value for stock \( i \) to the end-of-day market value of portfolio held by investor \( j \) on day \( t \), \( r_{i,t} \) is daily return for stock \( i \) on day \( t \), \( s_{i,t} \) is the number of stocks held by investor \( j \) on day \( t \) and \( r_t^m \) is corresponding daily rate of return on BIST100 index.

Descriptive statistics of two variables (buy-sell imbalance and market-adjusted portfolio return) are summarized at Table 3.2.

Table 3.2 Descriptive statistics of the buy-sell imbalance (BSI) and the market-adjusted portfolio return based on investor types.
<table>
<thead>
<tr>
<th></th>
<th>Buy-sell imbalance (BSI)</th>
<th>Market-adjusted portfolio return</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.0052</td>
<td>0.01%</td>
</tr>
<tr>
<td>Median</td>
<td>0</td>
<td>-0.09%</td>
</tr>
<tr>
<td>Variance</td>
<td>0.0473</td>
<td>0.05%</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.0014</td>
<td>0.02%</td>
</tr>
<tr>
<td>Median</td>
<td>0</td>
<td>-0.07%</td>
</tr>
<tr>
<td>Variance</td>
<td>0.0267</td>
<td>0.04%</td>
</tr>
<tr>
<td><strong>Young</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.0086</td>
<td>0.01%</td>
</tr>
<tr>
<td>Median</td>
<td>0</td>
<td>-0.12%</td>
</tr>
<tr>
<td>Variance</td>
<td>0.0590</td>
<td>0.06%</td>
</tr>
<tr>
<td><strong>Old</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.0021</td>
<td>0.01%</td>
</tr>
<tr>
<td>Median</td>
<td>0</td>
<td>-0.06%</td>
</tr>
<tr>
<td>Variance</td>
<td>0.0348</td>
<td>0.04%</td>
</tr>
</tbody>
</table>

Note: There are 6049 female and 18947 male investors. 5243 of them are young and 5167 of them are old investors. Market-adjusted portfolio return exists for the days in which the investor makes any trading (buy-or-sell) for each investor. BSI exists independent of whether or not there is any trading.

3.2.1. Statistical Analysis

In this section, there are two types of analysis: First one shows the general relation between the buying appetite of investors which is evaluated with BSI and previous day portfolio return and the difference between large-small investors while the second gives detailed information about this relation based on investor categories.

In order to see the major link between portfolio return and BSI, similar methodology of Barber and Odean (2008)\(^5\) is implemented. Individual investors are sorted according to their previous day return and divided into five groups each of which has equal number of observations. This grouping operation is repeated for each day in the sampling period. Each day, there are five groups but the investors in these groups may change according to their previous day’s returns. Then, the average BSI values of each group are calculated for each day. At the end of this process, five time series data, which contain average BSI values are created. The first series represents the loser group which consists of market loser investors based on previous day portfolio returns while the fifth series represents the winner group that consists of market winner investors based on previous day portfolio returns. The following formula summarizes the process explained above.

\[
BSI_{p,t} = \frac{\sum_{j=1}^{n_{p,t}} BSI_{j,t}}{n_{p,t}}
\]

\(BSI_{p,t}\) is the buy-sell imbalance of group \(p\) on day \(t\), \(BSI_{j,t}\) is the buy-sell imbalance of investor \(j\) on day \(t\) and \(n_{p,t}\) is the number of investors in group \(p\), where \(p=1,\ldots,5\). If \(p\) is equal to one, it means that the group consists of market losers and if \(p\) is equal to five, it means that the group consists of market winners.

As explained in previous section, BSI is seen as a measure of buying appetite. It is between \(-1\) and \(1\). If it is equal to \(-1\), it means that investor does not buy anything but sell stock(s). This action indicates decreasing buying appetite. If it is equal to \(1\), it means that investor does not sell anything but buy stock(s). That action indicates increasing buying appetite. If it is equal to \(0\), either investor does not trade any stock or the purchasing value and selling value of stock(s) are exactly the same.

Furthermore, in order to see whether there is a difference between buying appetites of different investor categories, individual investors are divided into subsamples based on portfolio size, age and gender. Detailed results are demonstrated at Section 4.

### 3.2.2. Regression Analysis

In order to determine the effect of previous return and demographics on BSI, the panel regression is performed with the transactions of the whole investors between 2008 and 2012 and the investor is defined as a panel variable. BSI is regressed on the previous day market-adjusted portfolio return \((r_{j,t-1})\), exchange rate \((xr_{j,t})\): TRY/USD is used as a representative substitute of stock investment in Turkey) and three types of dummy variables that are used to measure the effect of gender and age on BSI. The simple linear regression model:

\[
BSI_{j,t} = \beta_0 + \beta_1 r_{j,t-1} + \beta_2 \Delta xr_{j,t} + \beta_3 \text{female} + \beta_4 \text{middle} + \beta_5 \text{old} + u_{j,t}
\]

\(r_{j,t-1}\) represents the market-adjusted portfolio return of investor \(j\) on day \(t-1\) and it is assumed to be stationary by the nature of return. BSI is also stationary series since it is strictly bounded with \(-1\) and \(1\). However, exchange rate is nonstationary series, so the first difference is calculated to make it stationary and it is represented as \(\Delta xr_{j,t}\) in the equation (Stationarity is checked with ADF test\(^6\)). Also, there are three dummy variables: female, middle and old. First one is gender dummy and it takes \(1\) for female investors and \(0\) for male investors. The second one is age dummy for middle age investors. It takes \(1\) for middle age investors and \(0\) for others. Last one is also age dummy for the old investors and it takes \(1\) for old investors and \(0\) for others.

\(^6\) See Appendix – Part C for the result of ADF test.
Young adult investor group is determined as reference category in this model and age intervals are defined the same as in the statistical analysis.

As a first step, the above model is used as a simple linear regression model with panel data which is called pooled OLS. Also, pooled OLS with cluster robust standard errors model is also implemented to see whether there is a correlation between explanatory variables and residuals. However, there is autocorrelation in residuals and it is proved by Wooldridge test which is used to test serial correlation in residuals in panel data.

Thus, fixed and random effect linear models with AR(1) disturbance term are used to analyze panel specific effects by assuming first order autocorrelation in residuals. The assumptions of the fixed effect model as following:

$$u_{jt} = \mu_j + v_{jt}$$

$$u_{jt}$$ is the disturbance term of the regression and assumed to satisfy usual conditions of linear regression. $$\mu_j$$ represents individual-specific, time invariant effects which are gender and age in this study, $$v_{jt}$$ represents both individual and time specific effects. Also the following assumptions exist in the model with random effect.

$$\mu_j \sim \text{i.i.d. } N(0, \sigma_\mu^2)$$

and

$$v_{jt} \sim \text{i.i.d. } N(0, \sigma_v^2)$$

According to fixed effect model, individual specific error terms are assumed to be fixed, but the effect of time invariant variables such as gender and age can not be seen because of collinearity. Although the Hausman specification test suggest that fixed effect model should be used, the random effect model is also employed to see the effect of time invariant variables.

4. Results

4.1. Statistical Results

Before dividing individuals into categories, we perform extensive analysis which gives a wider picture about the behaviors of all individual investors. Figure 4.1 indicates the result of this primary analysis. Group 1 represents minimum return group and group 5 represents maximum return group. Average BSI is positive but decreasing as previous day portfolio return increases meaning that buying appetite and portfolio returns are negatively correlated. These findings are consistent with the earlier studies on DE (Weber and Camerer; 1998, Odean; 1998, Costa et al; 2008, Svedsater et al; 2009, Talpsepp; 2010).

Figure 4.1 The relationship between the average BSI and previous day market-adjusted portfolio return.
Note: Investors are sorted based on previous day portfolio returns and divided into 5 groups. Group 1 consists of investors whose previous day portfolio returns are minimum. Group 5, on the contrary, consists of investors whose previous day portfolio returns are maximum. In each group, there are approximately 5,000 investors.

Below table (Table 4.1) shows the details of group variables. First two groups include market loser investors whose previous day market-adjusted portfolio returns are negative. Group 3 includes market neutrals who have both negative and positive market-adjusted portfolio returns but they are very close to zero meaning that their return is almost equal to the market return. Last two groups are market winners whose previous day portfolio returns are positive. Each group has approximately equal number of observations.

| Return Groups | Minimum Return | Maximum Return | Average Return | Average BSI | t value | t value for the group:
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (min)</td>
<td>-0.6643%</td>
<td>-0.0122%</td>
<td>-0.0248%</td>
<td>0.0056</td>
<td>1.6592*</td>
<td>1 and 2</td>
</tr>
<tr>
<td>2</td>
<td>-0.0122%</td>
<td>-0.0041%</td>
<td>-0.0078%</td>
<td>0.0050</td>
<td>3.1046***</td>
<td>2 and 3</td>
</tr>
<tr>
<td>3</td>
<td>-0.0041%</td>
<td>0.0023%</td>
<td>-0.0009%</td>
<td>0.0038</td>
<td>2.8439***</td>
<td>3 and 4</td>
</tr>
<tr>
<td>4</td>
<td>0.0023%</td>
<td>0.0110%</td>
<td>0.0062%</td>
<td>0.0025</td>
<td>5.5630***</td>
<td>4 and 5</td>
</tr>
<tr>
<td>5 (max)</td>
<td>0.0110%</td>
<td>4.9320%</td>
<td>0.0279%</td>
<td>0.0003</td>
<td>15.0321***</td>
<td>1 and 5</td>
</tr>
</tbody>
</table>

Note: The t statistics belong to BSI series. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.

As seen from the table, the previous day’s return significantly affects current day’s buying/selling decisions. For the minimum return group, average BSI, which is a measure of buying appetite, is 0.0056, while it is 0.0003 for the maximum return group. The test results indicate that there is a significant difference between the return groups. To compare the maximum and minimum return group, t statistic is 15.0321 which is sufficiently high to reject the hypothesis that the average BSI of investors in minimum return group is equal to the average BSI of investors in maximum return group. To summarize, the investors realize gains while they avoid to realize losses since they sell the stocks (meaning that BSI is lower) the day
after they won, but they do not sell the stocks the day after they lost. This is a strong evidence on the existence of disposition effect bias on the investor basis.

**4.1.1. Difference between Large-Small Individual Investors**

Conducted studies shows that trading behaviors of large and small individual investors may differ. Thus, we also divide the whole sample as large and small investors according to portfolio size and analyze the difference between BSI values of small (portfolio amount is smaller than TRY 10,000) and large (portfolio amount is larger than TRY 50,000) individual investors.

**Figure 4.2.** Average BSI values of large and small individual investors

![Average BSI values of large and small individual investors](image)

Note: Portfolio size of small investors < TRY 10,000. Portfolio size of large investors > TRY 50,000.

Figure 4.2 shows that buying appetite of large investors is higher than that of small investors at each return group. The significance of the difference is summarized at Table 4.2. Highly significant t values prove that buying appetite of large and small investors are substantially different.

**Table 4.2.** The comparison of the Average BSI values of large and small investors.

<table>
<thead>
<tr>
<th>Return Group</th>
<th>Portfolio Size</th>
<th>Average BSI</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (min)</td>
<td>Small</td>
<td>0.0018</td>
<td>-18.4574***</td>
</tr>
<tr>
<td>1 (min)</td>
<td>Large</td>
<td>0.0129</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Small</td>
<td>0.0017</td>
<td>-13.6422***</td>
</tr>
<tr>
<td>2</td>
<td>Large</td>
<td>0.0103</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Small</td>
<td>0.0009</td>
<td>-10.831***</td>
</tr>
<tr>
<td>3</td>
<td>Large</td>
<td>0.0081</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Small</td>
<td>0.0003</td>
<td>-8.9049***</td>
</tr>
<tr>
<td>4</td>
<td>Large</td>
<td>0.0059</td>
<td></td>
</tr>
<tr>
<td>5 (max)</td>
<td>Small</td>
<td>-0.0019</td>
<td>-11.7360***</td>
</tr>
<tr>
<td>5 (max)</td>
<td>Large</td>
<td>0.0049</td>
<td></td>
</tr>
</tbody>
</table>

---

Note: t values represents the difference between average BSI values of small and large investor groups at each return group. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.

After proving the existence of the bias and the difference between large and small investors, the analysis is expanded into investor categories in terms of age and gender that are explained in descriptive statistics section. The result provides similar findings when the data divided into two groups based on portfolio size. Thus, the analysis of descriptive differences is represented without dividing the data as large and small investors. Below figures shows the relationship between level of influence from this bias and demographics (age and gender).

**Figure 4.3** Comparison of young and old investors.  **Figure 4.4** Comparison of male and female investors.

Note: The entire data divided into two subsamples based on both age and gender. In order to provide more obvious results based on age, the middle age is dropped.

Figure 4.3 and Figure 4.4 show that young and male investors have relatively higher average BSI values than female and old investors. The higher average BSI value indicates that the investor group buys more (or sell less). It can be said that the buying appetite of young and male investors is higher than their old and female counterparts.

The result depends on gender effect is consistent with the literature about overconfidence and DE. On the other hand, age effect on buying behavior is not explored deeper in the literature although there are many papers that investigate the effects of age on the portfolio performance in terms of return. As the literature lacks the detailed analysis of age groups, our main findings about age make highly important contribution. The main findings show that young investors buy more (or sell less) with respect to other investor groups in this study since their average BSI values are always higher than other investor groups and it is an evidence that young investors have the highest buying appetite than other investor groups analyzed in this study.

---

8 See Appendix – Part A for the detailed results of large and small investors.
9 Detailed results including middle-age are provided on Appendix - Part B.
10 Odean, T. and B. M. Barber (2001) stated that male investors trade 45% more than females and excessive trading is seen as a signal of overconfidence. Also, Da Costa et al. (2008), found that the hypothesis about the existence of Disposition Effect is stronger on male investors.
11 Erdem et al. (2013) stated that age has a positive effect on the portfolio returns.
Table 4.3 and Table 4.4 compare young-old investors and male-female investors respectively at each return group. Their average BSI values and variances are provided in the table. In addition, the difference between BSI values of young-old investors and male-female investors is tested with t test and null hypothesis is rejected at 1% significance level. It means that the differences on BSI values between both young-old investors and male-female investors are statistically proved. Moreover, young and male investors buy more (or sell less) than the old and female investors since all t statistics are positive. To buy more is a signal of higher buying appetite. Thus, t values on Table 4.2 and Table 4.3 indicate that buying appetite of young investors is higher than their old counterparts and buying appetite of male investors is higher than their female counterparts respectively.

### Table 4.3 Within group analysis of age.

<table>
<thead>
<tr>
<th>Return Group</th>
<th>Investor Type</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Young</td>
<td>0.0079</td>
<td>0.0008</td>
<td>10.4640***</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>0.0030</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Young</td>
<td>0.0082</td>
<td>0.0002</td>
<td>11.1148***</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>0.0024</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Young</td>
<td>0.0064</td>
<td>0.0002</td>
<td>8.3075***</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>0.0017</td>
<td>0.0002</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Young</td>
<td>0.0045</td>
<td>0.0002</td>
<td>7.3989***</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>0.0003</td>
<td>0.0002</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Young</td>
<td>0.0012</td>
<td>0.0002</td>
<td>4.6866***</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>-0.0013</td>
<td>0.0001</td>
<td></td>
</tr>
</tbody>
</table>

Note: The entire data divided into subsamples based on age. (H₀: Average BSI values of young and old investors are the same). *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.

### Table 4.4 Within group analysis of gender.

<table>
<thead>
<tr>
<th>Return Group</th>
<th>Investor Type</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>0.00655</td>
<td>0.00009</td>
<td>13.34186***</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.00199</td>
<td>0.00006</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Male</td>
<td>0.00609</td>
<td>0.00012</td>
<td>11.07864***</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.00175</td>
<td>0.00007</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>0.00472</td>
<td>0.00015</td>
<td>9.14591***</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.00085</td>
<td>0.00007</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>0.00343</td>
<td>0.00014</td>
<td>8.90356***</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>-0.00024</td>
<td>0.00008</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>0.00099</td>
<td>0.00012</td>
<td>8.22095***</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>-0.00220</td>
<td>0.00007</td>
<td></td>
</tr>
</tbody>
</table>

Note: The entire data divided into subsamples based on gender. (H₀: Average BSI values of male and female investors are the same.). *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.
To sum up, when investors are divided into subsamples according to their ages and gender, it is obvious that disposition effect bias is still alive in all categories since the average BSI values have decreasing trend at all investor categories as moving from minimum return group (group 1) to the maximum return group (group 5). Furthermore, maximum BSI values belong to young investors meaning that young investors are the most enterprising group in the market in terms of excessive buying.

4.2. Regression Results

All regressions are employed with panel data in which panel dimension consists of approximately 25000 individual investors and all analysis are driven by using Stata software. Panel data coefficients show the average effect of the explanatory variables \( r_{j,t-1}, \Delta x_{j,t}, \text{female}, \text{middle} \) and \text{old} \) on the dependent variable \( BSI_{j,t} \) when explanatory variable changes across time and between individuals.

Table 4.5 represents the results of first two models (pooled OLS and pooled OLS with cluster robust standard errors). All coefficients are significant at 1% significance level, and the signs of return and dummy variables provide consistent results with statistical analysis. However, Wooldridge\(^{12}\) test statistics (displayed on the bottom line of Table 4.5) indicates that there is first-order autocorrelation in residuals. Thus, the panel specific models (Fixed Effect (FE) and Random Effect (RE) models) with AR(1) disturbance terms are also implemented since the first two models (pooled OLS and pooled OLS with cluster robust standard errors) do not consider autocorrelation.

<table>
<thead>
<tr>
<th></th>
<th>Pooled OLS</th>
<th>Pooled OLS with cluster robust standard errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>( r_{j,t-1} )</td>
<td>-0.0750</td>
<td>-0.0750</td>
</tr>
<tr>
<td>( \Delta x_{j,t} )</td>
<td>0.1192</td>
<td>0.1192</td>
</tr>
<tr>
<td>Female</td>
<td>-0.0041</td>
<td>-0.0041</td>
</tr>
<tr>
<td>Middle</td>
<td>-0.0026</td>
<td>-0.0026</td>
</tr>
</tbody>
</table>

Old
(-36.5)***
-0.0050
(-23.11)***
0.0076
(75.22)***
(75.22)***
Constant
0.0076
0.0076
(11.46)***
(21.03)***
R²
0.0003
0.0003
Wooldridge test
1696.212

Note: The t statistics are in parentheses and all coefficients are significant at 1% significance level. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.

In order to see the panel specific effects, Fixed Effect (FE) and Random Effect (RE) models with AR(1) disturbance term are employed and the results are demonstrated in Table 4.6. According to FE model, individual specific error terms are assumed to be fixed, but the coefficients of time invariant variables (dummy variables) cannot be calculated because of collinearity. Although Hausman Test result states that FE model should be used, RE model is also employed to see the effects of time invariant variables.

All coefficients in RE model are significant at 1% significance level and they provide consistent results with the previous analysis in Section 4.1. In this context, the first coefficient implies that when previous day portfolio return increase by 1, BSI decreases by 0.068 on average. Second one implies that there is a positive causality between BSI and exchange rate. If exchange rate increases by 1, BSI also increases by 0.1078 on average. If exchange rate is assumed to be a substitute of stock investment, this positive causality can be accepted because of two reasons. Firstly, when exchange rate increases, it means that domestic currency (TRY) depreciates and investing in Turkey would be cheaper for foreign investors. If there is an expectation that foreign investors will increase their investment in Turkey, individual investors also increase their stock investments (meaning that they will buy more stocks) since they expect that there will be a positive shock in the stock market. Secondly, when exchange rate decreases, it means that foreign currency (USD) depreciates and individual investors may transfer their money from stock market to the foreign exchange market (meaning that they will sell more stocks) since they can buy more foreign currency with their domestic currency. Above reasons indicate that the positive causality between exchange rate and BSI can be acceptable and it is also consistent with the literature, although there are contradicting views.

The coefficients of dummy variables are statistically significant and also give consistent results with the statistical analysis. The coefficient of the gender dummy implies that female investors’ BSI is lower than male investors by 0.0038. Also the middle age investors’ BSI is lower than young adult investors’ BSI by 0.0021 and old investors’ BSI is lower than young adult

---

13 Clark and Linzer (2012) investigated commonly-used Hausman test and stated that “It is neither a necessary nor sufficient statistic for deciding between fixed and random effects”.

14 Traditional approach about the role of exchange rate (Dornbusch and Fischer, 1980).

15 Portfolio balance approach about the role of exchange rate (Branson, 1983).
investors’ BSI by 0.0043. It means that the BSI relation of investors categorized by age and gender as following:

\[
BSI_{young} > BSI_{middle} > BSI_{old} , \quad BSI_{male} > BSI_{female}
\]

Table 4.6 Estimation results of panel specific models with AR(1) disturbance term.

<table>
<thead>
<tr>
<th>Dependent Variable: ( BSI_{j,t} )</th>
<th>( \text{FE} )</th>
<th>( \text{RE} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( r_{j,t-1} )</td>
<td>-0.0680</td>
<td>-0.0681</td>
</tr>
<tr>
<td></td>
<td>(-35.25)***</td>
<td>(-35.35)***</td>
</tr>
<tr>
<td>( \Delta x r_{j,t} )</td>
<td>0.1079</td>
<td>0.1078</td>
</tr>
<tr>
<td></td>
<td>(37.17)***</td>
<td>(37.16)***</td>
</tr>
<tr>
<td>Female</td>
<td>0</td>
<td>-0.0038</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-12.52)***</td>
</tr>
<tr>
<td>Middle</td>
<td>0</td>
<td>-0.0021</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-6.39)***</td>
</tr>
<tr>
<td>Old</td>
<td>0</td>
<td>-0.0043</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-10.64)***</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0037</td>
<td>0.0059</td>
</tr>
<tr>
<td></td>
<td>(84.4)***</td>
<td>(20.05)***</td>
</tr>
<tr>
<td>( R^2 ) (within)</td>
<td>0.0001</td>
<td>0.0001</td>
</tr>
<tr>
<td>( R^2 ) (between)</td>
<td>0.0005</td>
<td>0.0054</td>
</tr>
<tr>
<td>( R^2 ) (overall)</td>
<td>0.0001</td>
<td>0.0003</td>
</tr>
<tr>
<td>Fraction of variance due to residuals ( \left( u_{j,t} \right) )</td>
<td>0.0152</td>
<td>0.0065</td>
</tr>
<tr>
<td>Number of observations</td>
<td>24,509,141</td>
<td>24,509,141</td>
</tr>
<tr>
<td>( \rho )</td>
<td>-0.0458</td>
<td>-0.0458</td>
</tr>
</tbody>
</table>

Note: The t statistics are in parentheses. Dummy variables (female middle and old) are dropped because of collinearity in FE model. \( \rho \) is the estimated autocorrelation coefficient. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.
On the other hand, $R^2$ of the model is sufficiently low, meaning that the observed outcomes are not fully replicated by the model. The primary reason of this issue can be unobservable variables. The decision making is highly complex process and there are a lot of factors (including macroeconomic\textsuperscript{16}, political, sociological and also neurological factors\textsuperscript{17}) which affect this process. However, only small part of them are observable and unobservable parts leads to a decrease in power of the model because of omitted variable bias.

There is also an ongoing debate on very low $R^2$ in the literature. McDonald and Henn (2011) explains this issue as dummy variables can not boost $R^2$ by much despite being highly statistically significant, because they only take the value of ‘1’ for a small number of observations. This can be one reason of very low $R^2$ of our model since there are three dummy variables and only two other variables in the regression.

Another cause of very low $R^2$ can be the variance of noise. Arthur Charpentier (2012)\textsuperscript{18} states that ‘The higher the variance, the lower the R-squared’. Table 4.6 also includes fraction of variance due to $u_{jt}$, for both FE and RE models, and the reason of lower $R^2$ at FE model may be the fraction of variance due to residuals. He also shows that $R^2$ converges to zero more quickly when number of observation increases. Our data consists of 24,509,141 observations and it is big enough to reach the convergence level of $R^2$. Thus, the number of observation could be another reason of very low $R^2$.

5. Conclusion

The classical theories in economics and the finance literature assume that people always behave in a rational way although decision making process substantially includes irrational actions. In recent years, the strict perception about rationality began to change with the evolution of behavioral sciences which try to identify behavior of individuals and find reasonable explanations of their irrational actions that contradict with the assumptions of classical theories. In the behavioral finance literature, one can find a lot of explanations of irrational actions of investors and they are named as biases.

Overconfidence and disposition effect (DE) are widely known biases in the literature. If positive and significant portfolio return leads investors to buy more, this behavior may be explained by ‘Overconfidence’. If investors sell the stocks after the price increases (meaning positive or higher portfolio return), but hold after the price decreases (meaning negative or lower portfolio return), this behavior may be explained by DE. Actually, they might be interpreted as contradictory biases and we try to detect which one dominates the behaviors of individual investors in this paper.


The daily transactions of individual investors who invest in one of the biggest emerging financial market - Borsa İstanbul - are investigated between 2008 and 2012 and the findings show that the individual investors have tendency to realize gains in a short time but they avoid to realize losses. It is a strong evidence of disposition effect (DE) bias on the investor basis. The portfolio size, age and gender effects are also analyzed in this context and according to the findings, small and female investors are less affected by DE bias since their average BSI values are lower than large and male investors at all age intervals. Also, the negative relationship between age and BSI is found meaning that effect level of DE is decreasing as investors’ experience increases. The literature lacks the detailed analysis of age groups, so our results about age make highly important contribution.

On the other hand, the other importance of this paper is about the methodology. BSI is widely used measurement tool in the literature but it is usually calculated based on stocks. However, it is calculated based on investors to see the power of DE bias in this study and it is the biggest contribution since this is the first paper in which investor behavior is investigated by using investor-based BSI which is calculated on a daily basis for each investor and investor-based BSI gives direct knowledge about DE of investors. Also, using daily data rather than weekly or monthly data when calculating BSI is another contribution since more frequent data is better in financial analysis.

The results are also supported with the panel regression including exchange rate as one of the explanatory variable in addition to previous day market adjusted portfolio return, age dummies and a gender dummy. According to the results of panel regression; young investors have the highest BSI values relative to the middle-age and old investors. In addition, male investors also have higher BSI values than female investors. Remember that high BSI value is seen as an indicator of increasing buying appetite in this study.

Overall, this paper provides substantial findings about the behaviors of individual investors, particularly the effects of demographic features on their behaviors. However, it should be kept in mind that there are also various other determinants that would influence investor behaviors during the decision making process. Therefore, future research may add to our existing knowledge through focusing on the invisible sides of this process.

References


Appendix

Part A: Detailed statistical results based on portfolio size.

1. Small Investors

Table A.1.1. Within group analysis of age for the small investors.

<table>
<thead>
<tr>
<th>Return Group</th>
<th>Investor Type</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Young</td>
<td>0.00384</td>
<td>0.00021</td>
<td>7.91594***</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>-0.00003</td>
<td>0.00009</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Young</td>
<td>0.00463</td>
<td>0.00017</td>
<td>11.27051***</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>-0.00033</td>
<td>0.00007</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Young</td>
<td>0.00332</td>
<td>0.00019</td>
<td>8.87092***</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>-0.00069</td>
<td>0.00007</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Young</td>
<td>0.00186</td>
<td>0.00019</td>
<td>6.75016***</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>-0.00120</td>
<td>0.00007</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Young</td>
<td>-0.00165</td>
<td>0.00023</td>
<td>1.52019</td>
</tr>
<tr>
<td></td>
<td>Old</td>
<td>-0.00242</td>
<td>0.00010</td>
<td></td>
</tr>
</tbody>
</table>

Note: Small investors are divided into subsamples based on age. (H₀: Average BSI values of young and old investors are the same for small investors). *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10.

Table A.1.2. Within group analysis of gender for the small investors.

<table>
<thead>
<tr>
<th>Return Group</th>
<th>Investor Type</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>0.00176</td>
<td>0.00005</td>
<td>6.10040***</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>0.00003</td>
<td>0.00005</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Male</td>
<td>0.00181</td>
<td>0.00005</td>
<td>7.33504***</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>-0.00016</td>
<td>0.00005</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>0.00092</td>
<td>0.00005</td>
<td>4.77575***</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>-0.00038</td>
<td>0.00004</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>0.00029</td>
<td>0.00005</td>
<td>5.79287***</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>-0.00128</td>
<td>0.00004</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>-0.00203</td>
<td>0.00006</td>
<td>2.95129***</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>-0.00296</td>
<td>0.00006</td>
<td></td>
</tr>
</tbody>
</table>

Note: Small investors are divided into subsamples based on gender. (H₀: Average BSI values of male and female investors are the same for small investors). *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10.
2. Large Investors

### Table A.2.1. Within group analysis of age for the large investors.

<table>
<thead>
<tr>
<th>Return Group</th>
<th>Investor Type</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Young Old</td>
<td>0.01429</td>
<td>0.00216</td>
<td>3.58791***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.00883</td>
<td>0.00075</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Young Old</td>
<td>0.01239</td>
<td>0.00185</td>
<td>4.21217***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.00621</td>
<td>0.00085</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Young Old</td>
<td>0.00958</td>
<td>0.00206</td>
<td>3.28458***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.00451</td>
<td>0.00093</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Young Old</td>
<td>0.00602</td>
<td>0.00195</td>
<td>2.63226***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.00210</td>
<td>0.00083</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Young Old</td>
<td>0.00535</td>
<td>0.00191</td>
<td>3.10558***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.00084</td>
<td>0.00074</td>
<td></td>
</tr>
</tbody>
</table>

Note: Large investors are divided into subsamples based on age. (H$_0$: Average BSI values of young and old investors are the same for large investors). *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10.

### Table A.2.2. Within group analysis of gender for the large investors.

<table>
<thead>
<tr>
<th>Return Group</th>
<th>Investor Type</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male Female</td>
<td>0.01264</td>
<td>0.00035</td>
<td>8.09456***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.00522</td>
<td>0.00070</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Male Female</td>
<td>0.01012</td>
<td>0.00047</td>
<td>6.51157***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.00381</td>
<td>0.00070</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Male Female</td>
<td>0.00797</td>
<td>0.00053</td>
<td>6.04794***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.00200</td>
<td>0.00070</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Male Female</td>
<td>0.00605</td>
<td>0.00046</td>
<td>6.41326***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.00003</td>
<td>0.00067</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Male Female</td>
<td>0.00476</td>
<td>0.00035</td>
<td>7.11006***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.00159</td>
<td>0.00065</td>
<td></td>
</tr>
</tbody>
</table>

Note: Large investors are divided into subsamples based on gender. (H$_0$: Average BSI values of male and female investors are the same for large investors). *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10.
Part B: Detailed statistical results based on gender and age.

1. Age Analysis

Table B.1.1. Within group analysis of age for the first (minimum) return group.

<table>
<thead>
<tr>
<th>Group 1 (min. return group)</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
<th>t statistics for the difference between ages:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (18-35)</td>
<td>0.00790</td>
<td>0.00017</td>
<td>5.38775***</td>
<td>18-35 and 36-55</td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00550</td>
<td>0.00008</td>
<td>6.60711***</td>
<td>36-55 and 56+</td>
</tr>
<tr>
<td>Male (18-35)</td>
<td>0.00790</td>
<td>0.000174</td>
<td>10.4640***</td>
<td>18-35 and 56+</td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00550</td>
<td>0.00010</td>
<td>6.13852***</td>
<td>36-55 and 56+</td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>0.00237</td>
<td>0.00033</td>
<td>0.23555</td>
<td>18-35 and 36-55</td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>0.00223</td>
<td>0.00010</td>
<td>2.69723***</td>
<td>36-55 and 56+</td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>0.00237</td>
<td>0.00033</td>
<td>2.18615**</td>
<td>18-35 and 56+</td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>0.00223</td>
<td>0.00018</td>
<td>3.03488***</td>
<td>36-55 and 56+</td>
</tr>
</tbody>
</table>

Note: Null hypothesis for the t test: H₀: BSI of investors in first (minimum) return group is independent of age. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.

Table B.1.2. Within group analysis of age for the second return group.

<table>
<thead>
<tr>
<th>Group 2</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
<th>t statistics for the difference between ages:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (18-35)</td>
<td>0.00505</td>
<td>0.0001</td>
<td>6.40199***</td>
<td>18-35 and 36-55</td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00235</td>
<td>0.00014</td>
<td>6.13852***</td>
<td>36-55 and 56+</td>
</tr>
<tr>
<td>Male (18-35)</td>
<td>0.00819</td>
<td>0.0002</td>
<td>11.1483***</td>
<td>18-35 and 56+</td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00205</td>
<td>0.0001</td>
<td>1.10362</td>
<td>18-35 and 36-55</td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>0.00266</td>
<td>0.00028</td>
<td>3.03488***</td>
<td>36-55 and 56+</td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>0.00205</td>
<td>0.0001</td>
<td>3.36190***</td>
<td>18-35 and 56+</td>
</tr>
</tbody>
</table>

Note: Null hypothesis for the t test: H₀: BSI of investors in first (minimum) return group is independent of age. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.
Note: Null hypothesis for the t test: $H_0$: BSI of investors in second return group is independent of age. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.

### Table B.1.3. Within group analysis of age for the third return group.

<table>
<thead>
<tr>
<th>Group 3</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
<th>t statistics for the difference between ages:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (18-35)</td>
<td>0.00635</td>
<td>0.00023</td>
<td>4.90317***</td>
<td>18-35 and 36-55</td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.0378</td>
<td>0.0012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00378</td>
<td>0.00012</td>
<td>4.43410***</td>
<td>36-55 and 56+</td>
</tr>
<tr>
<td>Male (56+)</td>
<td>0.00165</td>
<td>0.00017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (18-35)</td>
<td>0.00635</td>
<td>0.00023</td>
<td>8.30754***</td>
<td>18-35 and 56+</td>
</tr>
<tr>
<td>Male (56+)</td>
<td>0.00165</td>
<td>0.00017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>0.00105</td>
<td>0.00028</td>
<td>-0.49159</td>
<td>18-35 and 36-55</td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>0.00132</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>0.00132</td>
<td>0.0001</td>
<td>3.74016***</td>
<td>36-55 and 56+</td>
</tr>
<tr>
<td>Female (56+)</td>
<td>-0.00042</td>
<td>0.00017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>0.00105</td>
<td>0.00028</td>
<td>2.43747**</td>
<td>18-35 and 56+</td>
</tr>
<tr>
<td>Female (56+)</td>
<td>-0.00042</td>
<td>0.00017</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Null hypothesis for the t test: $H_0$: BSI of investors in third return group is independent of age. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.

### Table B.1.4. Within group analysis of age for the fourth return group.

<table>
<thead>
<tr>
<th>Group 4</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
<th>t statistics for the difference between ages:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (18-35)</td>
<td>0.00445</td>
<td>0.00024</td>
<td>3.12925***</td>
<td>18-35 and 36-55</td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00281</td>
<td>0.00011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00281</td>
<td>0.00011</td>
<td>5.49868***</td>
<td>36-55 and 56+</td>
</tr>
<tr>
<td>Male (56+)</td>
<td>0.00032</td>
<td>0.00015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (18-35)</td>
<td>0.00445</td>
<td>0.00024</td>
<td>7.39894***</td>
<td>18-35 and 56+</td>
</tr>
<tr>
<td>Male (56+)</td>
<td>0.00032</td>
<td>0.00015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>-0.00021</td>
<td>0.00031</td>
<td>-0.39233</td>
<td>18-35 and 36-55</td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>0.00002</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>0.00002</td>
<td>0.00017</td>
<td>2.08417**</td>
<td>36-55 and 56+</td>
</tr>
<tr>
<td>Female (56+)</td>
<td>-0.00095</td>
<td>0.00017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>-0.00021</td>
<td>0.00031</td>
<td>1.18862</td>
<td>18-35 and 56+</td>
</tr>
<tr>
<td>Female (56+)</td>
<td>-0.00095</td>
<td>0.00017</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Null hypothesis for the t test: $H_0$: BSI of investors in fourth return group is independent of age. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.
Table B.1.5. Within group analysis of age for the fifth (maximum) return group.

<table>
<thead>
<tr>
<th>Group 5 (max. return group)</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
<th>t statistics for the difference between ages:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (18-35)</td>
<td>0.00116</td>
<td>0.00024</td>
<td>1.34321</td>
<td>18-35 and 36-55</td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00047</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (56+)</td>
<td>0.00047</td>
<td>0.0001</td>
<td>4.36369***</td>
<td>36-55 and 56+</td>
</tr>
<tr>
<td>Male (18-35)</td>
<td>0.00116</td>
<td>0.00024</td>
<td>4.68662***</td>
<td>18-35 and 56+</td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00135</td>
<td>0.00012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>0.00244</td>
<td>0.00037</td>
<td>-0.78445</td>
<td>18-35 and 36-55</td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>0.00196</td>
<td>0.0001</td>
<td>0.9781</td>
<td>36-55 and 56+</td>
</tr>
<tr>
<td>Female (56+)</td>
<td>0.00243</td>
<td>0.00018</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>0.00244</td>
<td>0.00037</td>
<td>-0.02433</td>
<td>18-35 and 56+</td>
</tr>
<tr>
<td>Female (56+)</td>
<td>0.00243</td>
<td>0.00018</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Null hypothesis for the t test: \( H_0 \): BSI of investors in fifth (maximum) return group is independent of age. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.

2. Gender Analysis

Table B.2.1. Within group analysis of gender for the first (minimum) return group.

<table>
<thead>
<tr>
<th>Group 1 (min. return group)</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
<th>t statistics for the difference between:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (18-35)</td>
<td>0.0079</td>
<td>0.00017</td>
<td>8.71510***</td>
<td>male and female (18-35)</td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>0.00237</td>
<td>0.00033</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00549</td>
<td>0.00008</td>
<td>8.84014***</td>
<td>male and female (36-55)</td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>0.00223</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (56+)</td>
<td>0.00302</td>
<td>0.0001</td>
<td>4.35148***</td>
<td>male and female (56+)</td>
</tr>
<tr>
<td>Female (56+)</td>
<td>0.00097</td>
<td>0.00018</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Null hypothesis for the t test: \( H_0 \): BSI of investors in the first (minimum) return group is independent of gender. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.
Table B.2.2. Within group analysis of gender for the second return group.

<table>
<thead>
<tr>
<th>Group 2</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
<th>t statistics for the difference between:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (18-35)</td>
<td>0.00819</td>
<td>0.0002</td>
<td>8.96815***</td>
<td>male and female (18-35)</td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>0.00266</td>
<td>0.00028</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00505</td>
<td>0.0001</td>
<td>7.56084***</td>
<td>male and female (36-55)</td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>0.00205</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (56+)</td>
<td>0.00235</td>
<td>0.00014</td>
<td>3.40146***</td>
<td>male and female (56+)</td>
</tr>
<tr>
<td>Female (56+)</td>
<td>0.00066</td>
<td>0.00017</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Null hypothesis for the t test: H₀: BSI of investors in the second return group is independent of gender. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.

Table B.2.3. Within group analysis of gender for the third return group.

<table>
<thead>
<tr>
<th>Group 3</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
<th>t statistics for the difference between:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (18-35)</td>
<td>0.00635</td>
<td>0.00023</td>
<td>8.32000***</td>
<td>male and female (18-35)</td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>0.00105</td>
<td>0.00029</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00378</td>
<td>0.00012</td>
<td>5.97536***</td>
<td>male and female (36-55)</td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>0.00132</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (56+)</td>
<td>0.00166</td>
<td>0.00017</td>
<td>3.94858***</td>
<td>male and female (56+)</td>
</tr>
<tr>
<td>Female (56+)</td>
<td>-0.00042</td>
<td>0.0002</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Null hypothesis for the t test: H₀: BSI of investors in the third return group is independent of gender. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.

Table B.2.4. Within group analysis of gender for the fourth return group.

<table>
<thead>
<tr>
<th>Group 4</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
<th>t statistics for the difference between:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (18-35)</td>
<td>0.00445</td>
<td>0.00024</td>
<td>7.01529***</td>
<td>male and female (18-35)</td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>-0.00021</td>
<td>0.00031</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00281</td>
<td>0.00011</td>
<td>6.98406***</td>
<td>male and female (36-55)</td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>0.00002</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (56+)</td>
<td>0.00032</td>
<td>0.00015</td>
<td>2.47800**</td>
<td>male and female (56+)</td>
</tr>
<tr>
<td>Female (56+)</td>
<td>-0.00095</td>
<td>0.00017</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Null hypothesis for the t test: H₀: BSI of investors in the fourth return group is independent of gender. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.
Table B.2.5. Within group analysis of gender for the fifth (maximum) return group.

<table>
<thead>
<tr>
<th>Group 5 (max. return group)</th>
<th>Average BSI</th>
<th>Variance</th>
<th>t value</th>
<th>t statistics for the difference between:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (18-35)</td>
<td>0.00116</td>
<td>0.00024</td>
<td>5.17567***</td>
<td>male and female (18-35)</td>
</tr>
<tr>
<td>Female (18-35)</td>
<td>-0.00244</td>
<td>0.00037</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (36-55)</td>
<td>0.00047</td>
<td>0.00009</td>
<td>6.17823***</td>
<td>male and female (36-55)</td>
</tr>
<tr>
<td>Female (36-55)</td>
<td>-0.00196</td>
<td>0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (56+)</td>
<td>-0.00134</td>
<td>0.00012</td>
<td>2.19092**</td>
<td>male and female (56+)</td>
</tr>
<tr>
<td>Female (56+)</td>
<td>-0.00243</td>
<td>0.00018</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Null hypothesis for the t test: H₀: BSI of investors in the fifth (maximum) return group is independent of gender. *** refers to significance at 1%, ** refers to significance at 5%, * refers to significance at 10%.

Part C: ADF test result for exchange rate ($\Delta x_{j,t}$)

<table>
<thead>
<tr>
<th>Dickey-Fuller test for unit root</th>
<th>Number of obs. = 1257</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interpolated Dickey-Fuller</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Test Statistic</td>
<td>1% Critical Value</td>
</tr>
<tr>
<td>Z(t)</td>
<td>-34.739</td>
</tr>
</tbody>
</table>

MacKinnon approximate p-value for Z(t) = 0.0000

Note: Null hypothesis of nonstationarity can be rejected at 1% significance level. Thus, $\Delta x_{j,t}$ is stationary.