Analysis of Behavioral Biases Affecting Investment Decisions of Individual Investors using Analytical Hierarchy Process

Bireysel Yatırımcıların Yatırım Kararlarına Etki Eden Davranışsal Eğilimlerin Analitik Hiyerarşi Süreci İle Analizi

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ABSTRACT

Individual investors exhibiting irrational behaviors may encounter a difficult situation in financial markets. Investor trends, also known as behavioral trends, have been introduced under different headlines in different studies. Overconfidence, representation, anchoring, regret aversion, and herding were included in the research study. In this study, it was aimed to determine the order of importance of investor biases of individual investors trading in Borsa Istanbul. For this purpose, a survey questionnaire was applied to individual investors trading in BIST. Analytical Hierarchy Process was utilized in testing the research model. A total of 411 participants contributed to the study. As a result of the study, regret aversion bias and overconfidence bias were the leading biases to which individual investors attached importance. However, the criterion (C41) "I feel sorrow for the long-losing stocks I hold." was found to rank highest among all sub-criteria. This sub-criterion is part of regret aversion bias. Regret aversion bias was also the main criterion ranking highest among all criteria. Upon considering the other sub-criteria of regret aversion bias; C42, C43, and C44 sub-criteria were found to rank second, fourth, and eleventh, respectively. C12 criterion, which ranked third, was seen to belong to overconfidence bias, and this bias ranked second among the main criteria. This research would contribute to a better comprehension of the behavioral biases that affect the decision-making of individual investors trading in BIST. The obtained results of the study are thought to contribute to the behavioral finance literature.

JEL Codes: G40, G41, C91

Keywords: Behavioral Finance, Behavioral Biases, Individual Investor, Analytical Hierarchy Process

ÖZ

İrrasyonel davranışlar sergileyen bireysel yatırımcılar finansal piyasalarda zor durumlarla karşılaşabilmektedir. Davranışsal eğilimler olarak da bilinen yatırımcı eğilimleri, farklı çalışmalarda farklı başlıklar altında tanıtılmıştır. Aşırı güven, temsiliyet, çıpalama, pişmanlıktan kaçınma ve sürü eğilimi araştırma çalışmasına dâhil edilmiştir. Bu çalışmada Borsa İstanbul'da işlem gören bireysel yatırımcıların yatırımcı önyargılarının önem sırasının belirlenmesi amaçlanmıştır. Bu amaçla BIST'te işlem yapan bireysel yatırımcılara anket uygulanmıştır. Araştırma modelinin test edilmesinde Analitik Hiyerarşi Sürecinden yararlanılmıştır. Araştırmaya toplam 411 katılımcı katkı sağlamıştır. Araştırma sonucunda bireysel yatırımcıların önem verdiği önyargıların başında pişmanlıktan kaçınma eğilimi ve aşırı güven eğilimi gelmektedir. Ancak (C41) kriteri "Uzun süredir kayıpta olan hisse senetlerim için üzüntü duyuyorum." tüm alt kriterler arasında en üst sırada yer aldığı görülmüştür. Bu alt kriter pişmanlıktan kaçınma yanlılığının bir parçasıdır. Pişmanlıktan kaçınma yanlılığı da tüm kriterler arasında en yüksek sırayı alan ana kriter olmuştur. Pişmanlıktan kaçınma yanlılığının diğer alt kriterleri de dikkate alındığında; C42, C43 ve C44 alt kriterlerinin sırasıyla ikinci, dördüncü ve onbirinci sırada yer aldığı görüldü. Üçüncü sırada yer alan C12 kriterinin aşırı güven yanlılığına ait olduğu görüldü ve bu yanlılık ana kriterler arasında ikinci sırada yer aldı. Bu araştırma, BIST'te işlem yapan bireysel yatırımcıların karar vermelerini etkileyen davranışsal önyargıların daha iyi anlaşılmasına katkıda bulunacaktır. Araştırmadan elde edilen sonuçların davranışsal finans literatürüne katkı sağlayacağı düşünülmektedir.

JEL Kodları: G40, G41, C91

Anahtar Kelimeler: Davranışsal Finans, Yatırımcı Eğilimleri, Bireysel Yatırımcı, Analitik Hiyerarşi Süreci

Introduction

Conventional finance theories assume that participants in financial markets tend to act rationally (Ahmad and Shah, 2020). According to conventional finance, financial markets are information-efficient. Therefore, investors maintain their transactions in financial markets through abiding by simple rules and taking rational actions (Jain et al., 2019). Conventional financial theories assert that the prices of securities reflect the intrinsic value, and the stock prices in the market are correctly determined by the investors. Behavioral finance explains that, unlike conventional finance, financial markets would never be information-efficient (Ritter, 2003)

Since behavioral finance relies on psychological factors that affect investors' decision-making process, it attributes the inefficiency of markets to these factors. Behavioral finance elucidates investor emotions and cognitive biases that affect investment performance (Quddoos et al., 2020).

There are various biases that affect investors' decision-making in investment processes. These biases have the feature of affecting all the strategies of the investors in the investment processes. Biases are pertinent to the extent to which individuals process information to render an investment decision (Shefrin, 2000). There are different irrational approaches that measure investor biases. These approaches are divided into different groups as cognitive approaches, emotional approaches and social approaches. In the study, among these biases, overconfidence bias, representation bias, anchoring bias, regret aversion bias and herd bias were used.

In this study, it is tried to determine the order of importance of the behavioral biases that affect the investment decisions of the individual investor. In other words, it is desired to rank investment decisions for individual investors from the most important to the least important.

Upon examining studies in the literature, studies on investor biases under different market conditions and characteristics are, in general, study to prove the existence of behavioral biases in the markets. However, the number of studies on the order of importance of these biases for investors is quite limited in the literature. Jain et al., (2019), in their study conducted in India, listed the irrational investor biases of individual investors regarding their investment decisions. As a result of the study, the three most effective criteria for investors were determined such as herding bias, loss aversion bias, and overconfidence bias. This study constitutes the basis of our research. Upon examining the national literature, the shortcomings of studies in this field are noteworthy.

Investor tendencies have been classified and diversified in different ways in different studies of the behavioral finance literature. In this study, the overconfidence bias, the representativeness bias, the anchoring bias, the regret aversion bias, and the herding bias are taken into account among investor biases.

In this study, it is tried to determine the order of significance for investors of the investor biases exhibited by the investors in Borsa Istanbul. With this study, it is thought to make different contributions to the discipline. With this study, investors would be able to better comprehend the behavioral biases that affect their investment decisions and act accordingly upon trading in Borsa Istanbul. This study would provide them with a guide to the different behavioral biases they should consider upon making investment decisions. The results obtained in the study are the first for Borsa Istanbul, which is in the status of an emerging stock market. It is thought that the results obtained in this context will contribute significantly to the literature.

Literature Review

Studies on Behavioral Biases

Overconfidence is the bias to attribute more meaning to the knowledge and skills of individuals (Ackert & Deaves, 2010). Investors with overconfidence biases may ignore the risks of investments upon making investment decisions (Armansyah, 2021). According to Kufepaksi (2007), the overconfidence bias causes investors to make wrong decisions upon making investment estimates. Abbes et al., (2019) stated that individual investors with overconfidence biases ignore institutional evaluations, instead, they act according to their own evaluations.

Representativeness bias is the tendency to judge the probability of a hypothesis by the extent to which the available data are similar to it (Clegg et al., 2015). The representativeness bias is one of the cognitive biases that affect the investment decision. Influencing the investment decision also causes the stock prices to be affected. An investor who

connects a single representation factor to a growing stock may ignore other factors and make wrong decisions by overreacting (Irshad et al., 2016). Mokoaleli-Mokoteli et al., (2009) stated that investors tended to exhibit representative bias towards new recommendations made in stock investment decisions.

Anchoring bias is the situation in which investors primarily use the information they have upon making an assessment regarding any subject (Epley & Gilovich, 2006). Anchoring bias is the tendency of investors to use previous ideas and thoughts in their investments rather than new ideas. This bias indicates that investors remain attached to their past values and are reluctant to change these values (Bouteska and Regaieg, 2020). Anchoring is a psychological heuristic that can be claimed to occur when investors place undue emphasis on statistically random and psychologically determined 'anchors' and lead them to investment decisions that are essentially 'irrational'. When it is necessary to predict a good buy price for a stock, the investor would probably begin to invest using an initial value called an "anchor" without much analysis (Subash, 2012).

Regret aversion is a term used to describe the feeling of remorse that occurs when a bad choice is made and is experienced after making a choice. Regret aversion is primarily concerned with the extent to which anticipation of possible remorse may affect decision-making. This bias is a psychological theory suggesting that individuals feel remorse when they realize that the decisions they believed to be correct with their previous knowledge are wrong (Gazel, 2015). The regret aversion bias causes investors to adopt conservative attitudes. Because the bad investment experiences of investors in the past make them think about new investments in many cases. Investors who wish to invest in a narrow framework with a tendency of conservatism are only interested in certain assets (Awais & Estes, 2019: 754).

The herding bias is one of the behavioral biases witnessed in financial markets among investors in almost all asset categories. Therefore, researchers have been intensely interested in this bias. Especially the financial crisis in the 1990s caused this bias to be witnessed intensely in the markets (Mand et al., 2021). Devenow and Welch (1996) stated that investors felt more secure when they followed other investors. Kataria and Choudhary (2015) determined that herding biases among investors caused their securities to diverge from their fair value and led to market instability. Dong et al., (2010), Park and Sabourian (2011) found a relationship between herding behavior and prices and proved that herding bias rendered prices more volatile.

Studies on Ranking Behavioral Biases and Conceptual Research Model

Antony and Joseph (2017) determined the order of significance of these biases for investors by taking into account the overconfidence bias, representativeness bias, regret aversion bias, mental accounting bias, and herding bias among the irrational investor biases exhibited by investors in financial markets. As a result of the study, it was determined that the overconfidence bias and the regret aversion bias were the most crucial behaviors for investors.

Jain et al., (2019) listed the irrational investor biases of individual investors in their investment decisions. Questions measuring certain biases by which investors have been affected were asked of the investors. As a result of the study, the three most effective criteria for investors were determined such as the herding bias, loss aversion bias, and overconfidence bias.

Jain et al., (2021), in their study, conducted to determine the priorities of 168 investors trading in the Indian stock exchange, concluded that the stock selection methods, behavioral factors, commercial opportunities, and accounting knowledge level were the

three top priority factors among the findings.

Upon examining the studies in the literature, it is observed that a deficiency in determining the significance of the irrational investor behaviors exhibited by investors in the national literature. It is thought that this study would fill this gap in the national literature. In this context, the hierarchical structure of the investor biases exhibited by the investors and included in the study is illustrated in Figure 1. Among the investor biases, the overconfidence bias, the representativeness bias, the anchoring bias, the regret aversion bias, and the herding bias are taken into consideration. For each of the 5 biases, 4 questions are sent to the investors and the responses are analyzed by employing the AHP method. The variables used in the study were obtained from studies made in the literature and proven to measure groups.
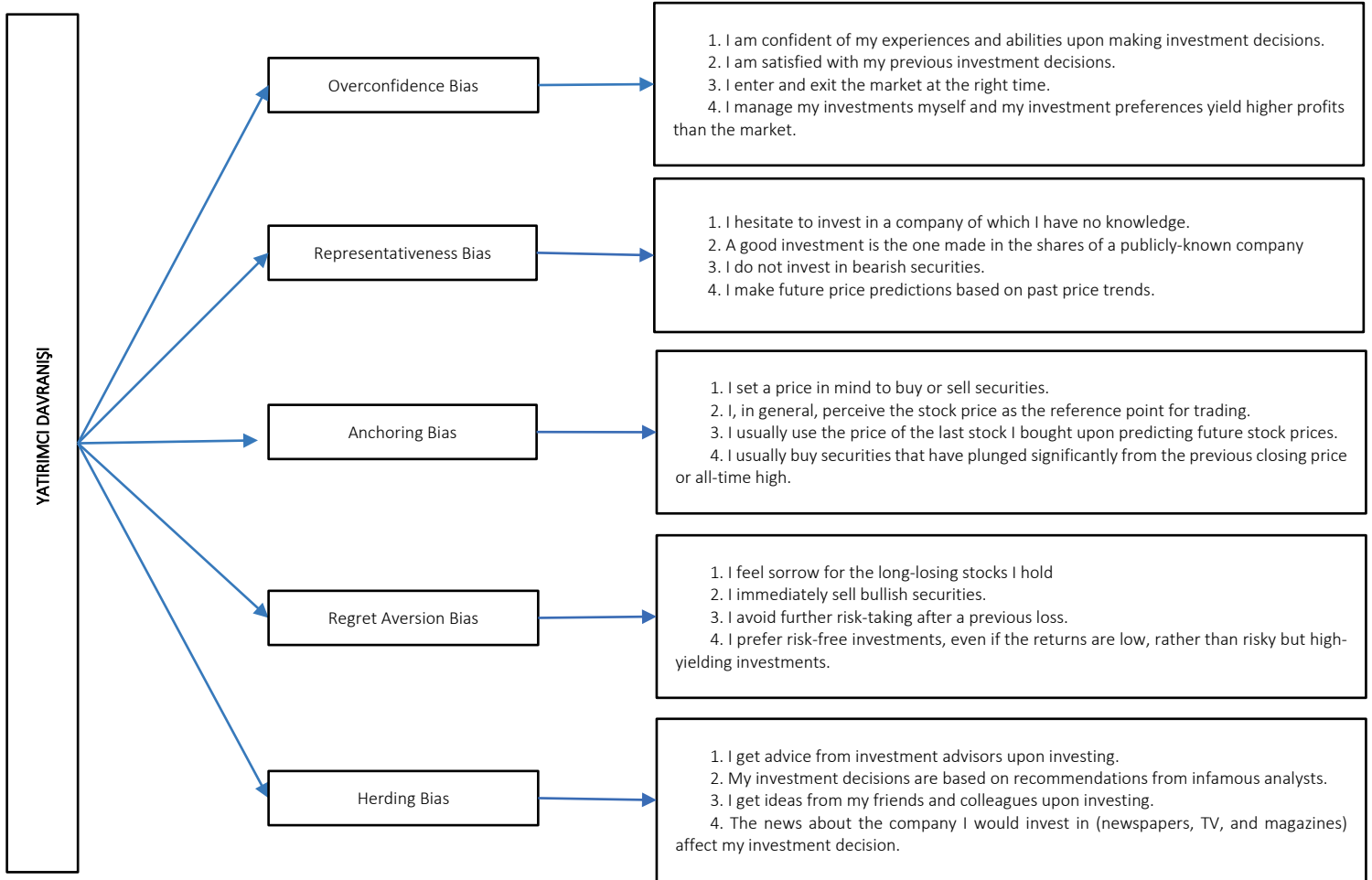

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Overconfidence Bias
1. I am confident of my experiences and abilities upon making investment decisions.
2. I am satisfied with my previous investment decisions.
3. I enter and exit the market at the right time.
4. I manage my investments myself and my investment preferences yield higher profits than the market.

Representativeness Bias
1. I hesitate to invest in a company of which I have no knowledge.
2. A good investment is the one made in the shares of a publicly-known company
3. I do not invest in bearish securities.
4. I make future price predictions based on past price trends.

Anchoring Bias
1. I set a price in mind to buy or sell securities.
2. I, in general, perceive the stock price as the reference point for trading.
3. I usually use the price of the last stock I bought upon predicting future stock prices.
4. I usually buy securities that have plunged significantly from the previous closing price or all-time high.

Regret Aversion Bias
1. I feel sorrow for the long-losing stocks I hold
2. I immediately sell bullish securities.
3. I avoid further risk-taking after a previous loss.
4. I prefer risk-free investments, even if the returns are low, rather than risky but high-yielding investments.

Herding Bias
1. I get advice from investment advisors upon investing.
2. My investment decisions are based on recommendations from infamous analysts.
3. I get ideas from my friends and colleagues upon investing.
4. The news about the company I would invest in (newspapers, TV, and magazines) affect my investment decision.

Figure 1. *Hierarchical Structure of Behavioral Biases Affecting Investment Decisions*

Method

Data Collection Tool and Process

A survey questionnaire is selected as the data collection tool in the study. The questionnaire form is delivered to investors who conduct their individual investment activities in BIST, and 411 questionnaires are responded to by the investors. The SPSS and Microsoft Excel software programs are used in the analysis of the obtained data. Due to the pandemic, investors are reached with the help of the snowball sampling method and different social media communication tools.

Permission was received for the research from Atatürk University Social and Human Sciences Ethics Committee (Decision Date: 31.08.2021, Decision Number: 88656144-000.E.2100228241). The purpose of the research was clearly explained to individual investors, and their verbal and written consent was obtained on a voluntary basis. It was also declared that they could withdraw from the research at any time.

Objective and Methodology of Research

The aim is to determine the relative significance of the irrational investor biases of individual investors trading in Borsa Istanbul (BIST) in shaping the investment behaviors of individual investors. 5 factors are taken into account for the study. These factors are; overconfidence bias, representativeness bias, anchoring bias, regret aversion bias, and herding bias.

Results

Descriptive Statistics

In this study, which is conducted to determine the relative significance of the irrational investor biases of individual investors in forming the investment behavior of individual investors, a survey questionnaire is applied to individual investors trading in BIST. In this part, descriptive statistics of 411 individual investors trading in BIST are presented. Descriptive statistics consist of two sections. In the first section, questions to determine the demographic variables of the investors are included, whereas, in the second section, questions to determine the investor profiles of individual investors are asked of the investors.

Table 1: *Descriptive Statistics of Individual Investors' Demographic Variables*

Variable	Type	Frequency	Percentage (%)
Gender	Women	146	35.5
	Men	265	64.5
Age	Under 25 years of age	80	19.5
	25-34 years of age	175	42.6
	35-44 years of age	72	17.5
	45-54 years of age	46	11.2
	55 and older	38	9.2
Marital Status	Married	199	48.4
	Single	212	51.6
Educational Status	High School Diploma	81	19.7
	Associate Degree	41	10.0
	Undergraduate Degree	210	51.1
	Graduate Degree	60	14.6
	Ph.D. Degree	19	4.6
Profession Group	Private Sector Employee	113	27.5
	Public Sector Employee	135	32.8
	Retired	19	4.6
	Unemployed	78	19.0
	Self-Employed	66	16.1

According to Table 1, 35.5% of the individual investors trading in the BIST are female, whereas 64.5% are male investors. According to Table 1, 19.5% of the individual investors trading in BIST within the sample are investors under the age of 25; 42.6% are between 25-34 years of age; 17.5% are between 35-44 years of age; 11.2% are between 45-54 years of age; and 9.2% are 55 years of age and older. According to Table 1, 48.4% of individual investors trading in BIST are married, whereas 51.6% are single investors. According to Table 1, 19.7% of the individual investors trading in BIST within the sample acquire high school diplomas at most; 10.0% acquire associate degrees; 51.1% acquire undergraduate degrees; 14.6% acquire graduate degrees; and 4.6% acquire Ph.D. degrees. According to Table 1, within the sample, 27.5% of the individual investors trading in BIST are private sector employees; 32.8% are public sector employees; 4.6% are retired; 19.0% are unemployed; and 16.1% consist of professional groups such as self-employed. The majority of the participants maintain their livelihood as public or private sector employees.

Table 2: *Descriptive Statistics of Investor Profiles of Individual Investors*

Variable	Type	Frequency	Percentage (%)
Transaction Frequency	Daily	115	28.0
	More than Once a Week	66	16.1
	Once a Week	48	11.7
	Once a Month	36	8.8
	Occasionally	146	35.5
Do you like risk-taking?	Always	78	19.0
	Usually	124	30.2
	Sometimes	143	34.8
	Rarely	54	13.1
	Never	12	2.9
Capital llocation	Lower than 10%	228	55.5
	10%-29%	81	19.7
	30%-49%	49	11.9
	50%-69%	28	6.8
	Higher than 70%	25	6.1
Duration of Investment	Less than 3 years	280	68.1
	3-7 years	71	17.3
	8-12 years	29	7.1
	13-17 years	13	3.2
	Over 17 years	18	4.4

According to Table 2, 28% of the individual investors trading in BIST within the sample conduct daily transactions; 16.1% conduct transactions more than once a week; 11.7% once a week; 8.8% once a month; and 35.5% consist of occasional traders. According to Table 2, 19% of the individual investors trading in BIST are always risk-takers; 30.2% are usually risk-takers; 34.8% are sometimes risk-takers; 13.1% are rarely risk-takers; and 2.9% never take risks. According to Table 2, 55.5% of the individual investors trading in BIST within the sample allocate less than 10% of their capital for investment; 19.7% allocate 10%-29% of their capital; 11.9% allocate 30%-49% of their capital; 6.8% invest with 50%-69% of their capitals; and 6.1% invest with more than 70% of their capitals. According to Table 2, 68.1% of the individual investors trading in BIST within the sample invest for less than 3 years; 17.3% invest for 3-7 years; 7.1% invest for 8-12 years; 3.2% invest for 13-17 years; and 4.4% invest for more than 17 years. This situation can be explained by the rise in the number of investors trading in BIST within recent years, as well as the participation of new investors in the market.

Analytical Hierarchy Process (AHP)

AHP is the analysis method employed in the study. AHP is employed to find the relative degrees of significance for behavioral biases of individual investors upon making investment decisions. AHS is one of the multi-criteria decision-making methods that were developed by Prof. Thomas L. Saaty in the 1970s. AHP is a method through which a decision is rendered by expert assessments, including subjective judgments as well as objective judgments. In the study, 5 distinct biases, namely, overconfidence, representativeness, anchoring, regret aversion, and herding biases which have impacts on investors, are taken into account. The questions prepared in the form of survey questionnaires are directed to experts in their fields who have been investing in BIST. In the survey, 5 biases constitute the main criteria, and each main criterion has 4 sub-criteria. The weights of the main criteria and sub-criteria are determined by the experts using Saaty's 1 - 9 scale with pairwise comparisons (Yıldırım and Önder, 2015). The obtained data are modeled in Microsoft Excel software and AHP is employed. The application phases of AHP are as follows.

Phase 1: The process is commenced with the generation of a hierarchical network. The hierarchical network consists of objectives, main criteria, and sub-criteria (Table 3). The primary objective for the AHP is determined and a hierarchical structure is formed with the biases (criteria) and 4 sub-criteria representing these biases in compliance with the objective. [Table 3 near here]

Table 3. *Main Criteria and Sub-Criteria*

Main Criteria		Sub-Criteria
Overconfidence Bias (C1)	C11	I am confident in my experiences and abilities upon making investment decisions.
	C12	I am satisfied with my previous investment decisions.
	C13	I enter and exit the market at the right time.
	C14	I manage my investments myself and my investment preferences yield higher profits than the market.
Representativeness Bias (C2)	C21	I hesitate to invest in a company of which I have no knowledge.
	C22	A good investment is the one made in the shares of a publicly-known company.
	C23	I do not invest in bearish securities.
	C24	I make future price predictions based on past price trends.
Anchoring Bias (C3)	C31	I set a price in mind to buy or sell securities.
	C32	I, in general, perceive the stock price as the reference point for trading.
	C33	Upon predicting future stock prices, in general, I base my last purchase price on the stock price.
	C34	I usually buy securities that have plunged significantly from the previous closing price or all-time high.

Table 3 Cont. *Main Criteria and Sub-Criteria*

Regret Aversion Bias (C4)	C41	I feel sorrow for the long-losing securities I hold.
	C42	I immediately sell bullish securities.
	C43	I avoid further risk-taking after a previous loss.
	C44	I prefer risk-free investments, even if the returns are low, rather than risky but high-yielding investments.
Herding Bias (C5)	C51	I get advice from investment advisors upon investing.
	C52	My investment decisions are based on advice from infamous analysts.
	C53	Upon investing, I get ideas from my friends and colleagues.
	C54	The news about the company I would invest in (newspapers, TV, and magazines) affects my investment decision.

Step 2: The weights (w) of the criteria are obtained as a result of pairwise comparisons. Pairwise comparisons are made using Saaty's 1-9 scale. A square matrix is developed with the criteria graded by the values in this scale. Since the diagonal components in the matrices are evaluated by themselves, they all assume the value of 1.

The comparison of n criteria by their relative significance weights, with the criteria a1,a2…,an and their weights w1,w2,…,wn, is shown below (Yıldırım and Önder, 2015: 24):

$$A=(a_{ij})= \begin{vmatrix} a_{11} & .. & a_{1j} & .. & a_{1n} \\ : & & : & & : \\ a_{i1} & .. & a_{ij} & .. & a_{in} \\ : & & : & & : \\ a_{n1} & .. & a_{nj} & .. & a_{nn} \end{vmatrix}$$

In the A square matrix (A), the value aij value indicates how significant the criteria in the ith row are according to the criteria in the jth column. Upon making these comparisons, the relative degrees of significance developed by Saaty presented in Table 4 are utilized. A normalized matrix is formed by dividing each component in the matrix by its column sum. By calculating the mean values of the rows in the normalized matrix, the relative weights (w) in each row are determined (Okan, Sarı, Peker, 2016: 184).

Table 4. *Table of Relative Degrees of Significance*

Degree of Significance	Definition	Explanation
1	Equally Significant	Both factors are equally significant.
3	Moderately Significant	One factor is **slightly more significant** than the other, based on experience and judgment.
5	Strongly Significant	One factor is **strongly more significant** than the other.
7	Very Strongly Significant	One factor is **very strongly more significant** than the other.
9	Absolutely Significant	One of the factors is **absolutely more significant** than the other.
2,4,6,8	Represent Intermediate Values	They are the intermediate values of the degrees of significance found in the explanations above in the preference between the two factors.
Mutual Values	If a value (x) is assigned upon comparing *i* with *j*; the value to be assigned would be (1/x) upon comparing *j* with *i*.	

Source: Yıldırım and Önder, 2015

Decision makers utilize 2,4,6,8 values as intermediate values. For instance, if decision-makers remain between 3 and 5, they may utilize the value of 4.

Phase 3: Consistency is considered to determine whether the decision makers are consistent upon making comparisons among criteria. Consistency Index (CI) and Consistency Ratio (CR) coefficients

are utilized for determining consistency. The calculation of the consistency index is shown in the following formula:

CI=((λmax-n))/((n-1))

The eigenvalues (λmax) of binary matrices are determined with the formula below:

λmax=Aw/w

This value is calculated by multiplying the weight values of each component in the A matrix and dividing the new values by the weight values. The calculation of the CR value, which is another coefficient, is shown in the formula below:

CR=CI/RI

Lastly, the consistency ratio (CR) is considered. The consistency ratio is calculated by dividing the Consistency Index by the Random Index (RI). RI assumes a standard value determined by Saaty. RI assumes value according to the number of criteria. These values are presented in Table 5. If CR ≤ .10, the comparisons are consistent. If CR>.10, the comparisons are inconsistent and AHP does not yield significant results.

Table 5: *Random Index Value*

N	1	2	3	4	5	6	7	8	9	10
RI	0	0	.52	.89	1.11	1.25	1.35	1.40	1.45	1.40

Analysis Results of AHP

In this study, it is aimed to list the individual stock investors' irrational behavioral tendencies that are influenced by the psychological, sociological, and anthropological factors upon making an investment decision. Behavioral tendencies constitute the main criteria. The 5 criteria included in the study consist of overconfidence, representativeness, anchoring, regret aversion, and herding biases. Each bias has 4 sub-criteria. The determined main and sub-criteria are compared and responded to by the field experts in compliance with the scale developed by Saaty. AHP is applied by obtaining the mean values of the responses. The following steps are followed in the application of AHP:

Step 1: Matrices are developed for the main and sub-criteria along with the given responses.

Step 2: The values in each row of the matrices are divided by their column sums and the matrix is normalized.

Step 3: In order to calculate the weight value (w), the components in each row of the normalized matrices are summed and averaged, and their priority values are determined.

Step 4: The weighted sum vector (Aw) is obtained by multiplying the weights (w) of the components in each row of the matrix formed in the first place.

Step 5: CI and CR are examined to determine whether or not the comparisons are consistent. If CR≤.10, it is concluded that the comparisons are consistent.

In Table 6, a comparison process is made for the behavioral biases that constitute the main criteria.

Table 6. *Degrees of Significance of the Main Criteria (Behavioral Biases)*

Behavioral Biases	C1	C2	C3	C4	C5	Priority Value (w)	Weighted Sum Vector (Aw)	Aw **/** w
C1	1.00	3.00	2.00	.50	2.00	.24	1.25	5.26
C2	.33	1.00	.50	.33	.20	.08	.40	5.08
C3	.50	2.00	1.00	.25	3.00	.17	.90	5.24
C4	2.00	3.00	4.00	1.00	3.00	.40	2.14	5.39
C5	.50	2.00	.33	.33	1.00	.12	.58	4.95
The comparison is consistent since $λ_{max}$ = 5.18 CI = .05 and CR = .04 ≤ .10.								

● C1: Overconfidence Bias, C2: Representiveness Bias, C3: Anchoring Bias, C4: Regret Aversion Bias, C5: Herding Bias

In Table 6, a matrix is established among the 5 behavioral biases, which constitute the main criteria. Upon considering the priority values, it is determined that individual investors are mostly prone to regret aversion bias, followed by overconfidence, and least prone to representativeness bias. Since the consistency ratio is CR ≤ .10, the comparison is seen to be consistent.

At the other application step, the sub-criteria representing each behavioral bias are compared and the priority order is determined. In Table 7, a matrix is established for the sub-criteria of the overconfidence bias.

Table 7: *Degrees of Significance of Sub-Criteria Associated with Overconfidence Bias*

Overconfidence Bias	C11	C12	C13	C14	Priority Value (w)	Weighted Sum Vector (Aw)	Aw / w
C11	1.00	.50	4.00	3.00	.29	1.21	4.22
C12	2.00	1.00	7.00	5.00	.53	2.23	4.21
C13	.25	.14	1.00	2.00	.10	.41	4.06
C14	.33	.20	.50	1.00	.08	.33	4.03
The comparison is consistent since λ_{max} = 4.13 CI = .04 and CR = .05 ≤ .10.							

- C11: I am confident with my experience and abilities upon making investment decisions.
- C12: I am satisfied with my previous investment decisions.
- C13: I enter and exit the market at the right time.
- C14: I manage my investments myself and my investment preferences yield higher profits than the market.

Considering Table 7, the sub-criterion (C12) "I am satisfied with my previous investment decisions" is selected with the highest priority value of .53. It is determined that the C12 criterion is more significant for the overconfidence bias. In Table 8, a comparison is made for the sub-criteria of the representativeness bias.

Table 8: *Degrees of Significance of Sub-Criteria Associated with Representativeness Bias*

Representativeness Bias	C21	C22	C23	C24	Priority Value (w)	Weighted Sum Vector (Aw)	Aw / w
C21	1.00	3.00	.20	.14	.09	.38	4.03
C22	.33	1.00	.17	.11	.05	.19	4.03
C23	5.00	6.00	1.00	.50	.32	1.34	4.21
C24	7.00	9.00	2.00	1.00	.54	2.26	4.17
The comparison is consistent since λ_{max} = 4.11 CI = .04 and CR = .04 ≤ .10.							

- C21: I hesitate to invest in a company of which I have no knowledge.
- C22: A good investment is the one made in the shares of a publicly-known company.
- C23: I do not invest in bearish securities.
- C24: I make future price predictions based on past price trends.

Considering Table 8, with the highest priority value of .54, the C24 sub-criterion "I make future price predictions based on past price trends." With a priority value of .05, the C22 sub-criterion "A good investment is the one made in the shares of a publicly-known company." has the least priority value. The C24 criterion is the most significant for representativeness bias; whereas the C22 criterion is found to be of the least significance. A consistency ratio that is lower than .10 indicates the consistency of the comparison. In Table 9, a comparison is made for the sub-criteria of anchoring bias.

Table 9. Degrees of Significance of Sub-Criteria Associated with Anchoring Bias

Anchoring Bias	C31	C32	C33	C34	Priority Value (w)	Weighted Sum Vector (Aw)	Aw / w
C31	1.00	4.00	3.00	2.00	.46	1.92	4.20
C32	.25	1.00	2.00	.50	.14	.60	4.18
C33	.33	.50	1.00	.20	.09	.38	4.06
C34	.50	2.00	5.00	1.00	.31	1.28	4.17
The comparison is consistent since λ_{max} = 4.15 CI = .05 and CR = .06 ≤ .10.							

- C31: I set a price in mind to buy or sell securities.
- C32: I, in general, perceive the stock price as the reference point for trading.
- C33: I usually use the price of the last stock I bought upon predicting future stock prices.
- C34: I usually buy securities that plunge significantly from the previous closing or all-time high price

Upon considering Table 9, the C31 sub-criterion "I set a price in mind to buy or sell securities" is seen to be highly significant for the anchoring bias; whereas the C33 sub-criterion, "I usually use the price of the last stock I bought upon predicting future stock prices" has the least significance. A consistency ratio (CR) of .06 indicates that the comparison is consistent. In Table 10, a comparison is made for regret aversion bias.

Table 10. *Degrees of Significance of Sub-Criteria Associated with Regret Aversion Bias*

Regret Aversion Bias	C41	C42	C43	C44	Priority Value (w)	Weighted Sum Vector (Aw)	Aw / w
C41	1.00	4.00	2.00	8.00	.53	2.30	4.37
C42	.25	1.00	2.00	4.00	.23	.97	4.14
C43	.50	.50	1.00	3.00	.18	.74	4.06
C44	.13	.25	.33	1.00	.06	.25	4.15
The comparison is consistent since λ_{max} = 4.18 CI = .06 and CR = .07 ≤ .10.							

- C41: I feel sorrow for the long-losing securities I hold.
- C42: I immediately sell bullish securities.
- C43: I avoid further risk-taking after a previous loss.
- C44: I prefer risk-free investments, even with low returns, over risky but high-yielding investments

In Table 10, the most significant sub-criterion in the regret aversion bias is (C41) "I feel sorrow for the long-losing securities I hold" with a value of .53; whereas the sub-criterion C44 "I prefer risk-free investments, even if they are risky but high-yielding investments have low returns" is seen to be the least significant one with the value of .06. A consistency ratio lower than .10 indicates that the comparison is consistent. Comparisons of the herding bias sub-criteria are shown in Table 11.

Table 11. *Degrees of Significance of Sub-Criteria Associated with Herding Bias*

Herding Bias	C51	C52	C53	C54	Priority Value (w)	Weighted Sum Vector (Aw)	Aw / w
C51	1.00	3.00	6.00	.17	.20	.87	4.26
C52	.33	1.00	3.00	.13	.09	.38	4.07
C53	.17	.33	1.00	.11	.05	.18	4.06
C54	6.00	8.00	9.00	1.00	.66	3.03	4.61
The comparison is consistent since λ_{max} = 4.25, CI = .08, and CR = .09 ≤ .10.							

- C51: I get advice from investment advisors upon investing.
- C52: My investment decisions are based on recommendations from infamous analysts.
- C53: I get ideas from my friends and colleagues upon investing.
- C54: News about the company I would invest in (newspapers, TV, and magazines) affect my investment decision.

Considering Table 11, the highest degree of significance for herding bias is seen as the C54 sub-criterion "News about the company I would invest in (newspapers, TV, and magazines) affect my investment decision."; whereas the C53 sub-criterion "I get ideas from my friends and colleagues upon investing" is observed to be the least significant one. It is seen that the consistency ratio (CR=.09) is lower than .10 and the comparison is consistent.

The tables created as a result of the AHP application in determining the priority degrees of the main and sub-criteria are presented above and the degree of significance of all criteria is presented in Table 12.

Table 12. *Priority Degrees of the Main and Sub-Criteria*

Main Criteria	Priority Value	Sub-Criteria	Priority Value	Integrated Priority Values	Degrees of Significance	Degrees of Significance
C1: Overconfidence Bias	.24	C11: I am confident in my experiences and abilities upon making investment decisions.	.29	.0551	7	2
		C12: I am satisfied with my previous investment decisions.	.53	.1007	3	
		C13: I enter and exit the market at the right time.	.10	.0190	14	
		C14: I manage my investments myself and my investment preferences yield higher profits than the market.	.08	.0152	15	
C2: Representativeness Bias	.08	C21: I hesitate to invest in a company of which I have no knowledge.	.09	.0081	18	5
		C22: A good investment is the one made in the shares of a publicly-known company	.05	.0045	20	
		C23: A good investment is the one made in the shares of a publicly-known company	.32	.0288	10	
		C24: I make future price predictions based on past price trends.	.54	.0486	8	
C3: Anchoring Bias	.17	C31: I set a price in mind to buy or sell securities.	.46	.0644	6	3
		C32: I, in general, perceive the stock price as the reference point for trading.	.14	.0196	13	
		C33: I usually use the price of the last stock I bought upon predicting future stock prices.	.09	.0126	16	
		C34: I usually buy securities that plunge significantly from the previous closing or all-time high price.	.31	.0434	9	
C4: Regret Aversion Bias	.40	C41: I feel sorrow for the long-losing stocks I hold	.53	.2385	1	1
		C42: I immediately sell bullish securities.	.23	.1035	2	
		C43: I avoid further risk-taking after a previous loss.	.18	.0810	4	
		C44: I prefer risk-free investments, even if the returns are low, rather than risky but high-yielding investments.	.06	.0270	11	
C5: Herding Bias	.12	C51: I get advice from investment advisors upon investing.	.20	.0240	12	4
		C52: My investment decisions are based on recommendations from infamous analysts.	.09	.0108	17	
		C53: I get ideas from my friends and colleagues upon investing.	.05	.0060	19	
		C54: The news about the company I would invest in (newspapers, TV, and magazines) affects my investment decision.	.66	.0792	5	

In Table 12, the degrees of importance of the main criteria and sub-criteria are determined, but for better understanding, the priority values of the main criteria and sub-criteria are multiplied to obtain integrated priority and integrated ranking.

The criterion (C41) "I feel sorrow for the long-losing stocks I hold." is found to have the highest rank among all sub-criteria. This sub-criterion is a part of regret aversion bias. Regret aversion bias is also the main criterion ranking highest among all criteria. Upon considering the other sub-criteria of regret aversion bias, it is seen that C42, C43, and C44 sub-criteria rank second, fourth, and eleventh, respectively.

It is seen that C12 criterion, which ranks third, belongs to the overconfidence bias, and this bias ranks second among the main criteria. In the study, it is determined that the vast majority of investors are satisfied with their investment decisions and confident in their skills and experiences.

The main criterion that ranks third is the anchoring bias. The majority of the investors seem to set a price in mind to purchase or sell stocks. Among the main criteria, herding and representativeness biases are found to be the criteria that least affect the investment decision of the investors.

Individual investors are affected by various behavioral biases upon making investment decisions. The impact of behavioral biases is analyzed using the AHP. The most common behavioral biases that affect investors' investment decisions are regret aversion, overconfidence, anchoring, herding, and representativeness biases, respectively. Among all behavioral biases, regret aversion bias has been identified as the bias that has the greatest impact on the investment decisions of investors.

Discussion and Conclusion

Contrary to conventional finance, which cannot explain the behavior of individuals in the event of risk and uncertainty, behavioral finance emphasizes that individuals are entities that exhibit irrational behaviors affected by psychological, sociological, and anthropological factors. Behavioral finance is a sub-discipline of finance that studies the extent to which behavioral factors generate differences in the investment decisions of individuals.

There are various investor biases, also known as irrational investment behaviors of individual investors. In this study, five factors such as overconfidence, representativeness, anchoring, regret aversion, and herding biases are taken into consideration. The aim of this study is to determine the relative significance of these five factors that affect the investment decision of individual investors.

The AHP method is employed to determine the relative weights of behavioral biases that affect the investment decision of individual investors. A hierarchical network model consisting of objective, main criteria, and sub-criteria is established for AHP, which is a multi-criteria decision-making method. While the objective of the model, behavioral

biases, and the main criteria consist of overconfidence, representativeness, anchoring, regret aversion, and herding biases; each bias consists of 4 sub-criteria. Once the AHP method is employed; in order to determine the degree of significance, a survey questionnaire, with a pairwise comparison between the scale developed by Saaty and the criteria, is prepared. Weight grades are determined by experts in the field of financial investment who invested in BIST. Binary matrices are established for each main and sub-criteria whose weights are averaged so that the matrices would become normalized. The degrees of significance are determined on the normalized matrices and the criteria are listed. At the same time, the consistency ratio is calculated to determine whether or not the survey questionnaire is solved consistently by the experts. The consistency rate is lower than .10. In other words, it is concluded that the data of the survey questionnaire are consistent.

As a result of AHP calculations, the degrees of significance of the main criteria whose priority values have been calculated are determined. The regret aversion bias mostly affects the investment behavior of individual investors trading in BIST, followed by the overconfidence bias, and the representativeness bias is determined as the least affecting one. Antony and Joseph (2017), in their study, identified the two most important biases among investors such as overconfidence and regret aversion. It is in compliance with the result obtained in the research. The priority values of each sub-criteria and the priority values of the main criteria are multiplied by each other and the integrated value is obtained. The sub-criterion with the highest significance among all the sub-criteria with integrated values, and the sub-criterion of regret aversion bias, which is also the highest of the main criteria, is identified as the criterion C41: "I feel sorrow for the long-losing securities." Jain et al., (2019) mentioned the existence of overconfidence bias among the most important biases for investors.

Although it is thought that the number of samples to represent the population has been reached in this study, the inability to obtain higher sample numbers can be perceived as a limitation of the research. Nonetheless, excluding other factors other than the five factors selected among investor biases involves another limitation of the research study. This study, which is thought to make a serious contribution to the behavioral finance literature, especially on a national basis, has produced outputs that can make serious inferences for policymakers and interested parties. Upon considering that different outputs can be obtained once this study is conducted on individual or institutional investors trading in different countries' stock exchanges, especially developed stock markets, it is assumed that studies in this field can be put forward in the future.

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Extended Abstract

Bireysel yatırımcıların irrasyonel yatırım davranışları olarak da bilinen birçok yatırımcı eğilimi bulunmaktadır. Bu çalışmada aşırı güven, temsiliyet, çapalama, pişmanlıktan kaçınma ve sürü eğilimi olarak beş faktör dikkate alınmıştır. Bu çalışmanın amacı bireysel yatırımcıların yatırım kararını etkileyen bu beş faktörün yatırımcılar açısından göreceli önem derecelerini tespit etmektir.

Bireysel yatırımcıların yatırım kararını etkileyen davranışsal eğilimlerin göreceli ağırlık derecelerinin tespitinde AHS yöntemi kullanılmıştır. Çok kriterli karar verme yöntemi olan AHS için amaç, ana kriter ve alt kriterlerden oluşan hiyerarşik bir ağ modeli kurulmuştur. Modelin amacı, davranışsal eğilimler ve ana kriterleri, aşırı güven, temsiliyet, çapalama, pişmanlıktan kaçınma ve sürü eğiliminden oluşurken; her eğilim 4 alt kriterden oluşmaktadır. AHS yöntemi uygulanmaya başlandığında; önem derecelerini belirlemek için Saaty tarafından geliştirilen ölçek ile kriterler arasında ikili karşılaştırmanın olduğu bir anket hazırlanmıştır. BIST'te yatırım yapan finansal yatırım konusunda alanında uzman olan kişiler tarafından ağırlık dereceleri belirlenmiştir. Ağırlık derecelerinin ortalamaları alınan her bir ana kriter ve alt kriter için ikili matrisler oluşturulmuş daha sonra matrisler normalleştirilmiştir. Normalleştirilen matrisler üzerinde önem dereceleri belirlenmiş ve kriterler sıralanmıştır. Aynı zamanda anketin uzmanlar tarafından tutarlı çözülüp çözülmediğinin tespiti için tutarlılık oranı hesaplanmıştır. Tutarlılık oranı 0.10'nun altında çıkmıştır. Başka bir ifadeyle anket verilerinin tutarlı olduğu sonucuna varılmıştır.

AHS hesaplamaları sonucunda öncelik değerleri hesaplanan ana kriterlerin önem dereceleri tespit edilmiştir. BIST bireysel yatırımcıların yatırım davranışını en çok etkileyen pişmanlıktan kaçınma eğilimi ardından aşırı güven eğilimi; en az etkileyenin temsiliyet eğilimi olduğu tespit edilmiştir. Antony ve Joseph (2017), yaptıkları çalışmada yatırımcılar için yatırımcı eğilimleri arasında en önemli iki eğilimi aşırı güven ve pişmanlıktan kaçınma eğilimi olarak tespit etmiştir. Araştırmada elde edilen sonuç ile paralellik taşımaktadır. Her alt kriterin öncelik değerleri ile ana kriterlerin öncelik değerleri birbirleriyle çarpılıp entegre değer elde edilmiştir. Entegre değerleri belirlenen tüm alt kriterlerin, önem dereceleri arasında en yüksek önem derecesine sahip alt kriter, aynı zamanda ana kriterlerin de en yükseği olan pişmanlıktan kaçınma eğiliminin alt kriteri olan "C41: Elimde tuttuğum uzun süre kaybeden hisse senetleri için üzülürüm." kriteri olarak tespit edilmiştir. Jain vd., (2019), yaptığı çalışmada yatırımcılar için en önemli eğilimler arasında aşırı güven eğiliminin varlığına değinmiştir.