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The Effect of Stock Market Literacy on Individual Investor's Investment Decisions: Evidence from Borsa İstanbul

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Mine Berra Doğaner[*], İbrahim Halil Ekşi[**], Ahmet Şit[***], Berna Doğan Başar[****]

Abstract

In stock market investing, there are many factors that affect the decision-making process. Investors' financial literacy is one of these factors that affect investment decisions. In this study, financial literacy regarding the stock market was determined by a questionnaire applied to 1140 individual investors and the factors that affect decision-making were clustered according to the K-means technique. Then, the effect of stock market literacy levels on investment decisions was analyzed with random forest regression. As a result of the analysis, the demographic characteristics of the investors and their stock market literacy were also associated. From the findings, it was concluded that the factors of unbiased information in the group with low stock market literacy, and the factors of advice and unbiased information in the group with high stock market literacy are effective in investment decisions.

Keywords: Demographic Features, Stock Market Literacy, Investment Decisions, K-means.

JEL: J11, G53, G11

Introduction

Capital markets are the markets where companies ensure equity inflows and they have a big importance, lowering risk and financial cost in economies. Especially in underdeveloped countries, capital markets are effective in increasing the amount of savings and increasing the number of people who are saving (Bekaert and Hervey, 1998). On the other hand, situations such as the inadequacy of the number of people saving, the amount of savings and the lack of diversity in securities restrict the efficiency of the markets in underdeveloped and developing countries (Kyereboah et al.,2008).

It is accepted that the development of capital markets, which is an important pillar of financial markets, is directly proportional to the number of participants in the stock market. This situation is also expressed in the development plans of the countries (TC Presidency Strategy And Budget Department,

[*] Department of Management Information Systems, OSTIM Technical University, Ankara, Turkey
[**] Department of Business Administration, Gaziantep University, Gaziantep, Turkey
[***] Department of International Trade and Finance, Malatya Turgut Özal University, Malatya, Turkey
[****] Department of Business Administration, Gaziantep University, Gaziantep, Turkey

2019). In this study, based on the importance of subject, it is aimed to determine the stock market literacy of individual investors who invest in Borsa İstanbul (BIST) and how it affects investment behaviour. Understanding the literacy level and investment behaviours of investors, especially in developing countries where the number of investors is not at desired levels such as Turkey, which constitute the sample of this study, is very important for policy makers and regulatory institutions. When the general profile of stock market investors in Turkey is analyzed, it is observed that individual investors are dominant. As of the latest situation, the number of investors is 2.452.731 (Data Analysis Platform, May 2022). For this reason, research was conducted on individual investors in the study.

There are several reasons why Turkey is chosen as the sample of the study. The low number of individual participants in the stock market compared to the population, being a developing country, and the increasing importance of domestic investors the weight of foreign investors decrease in recent years is at the forefront of these reasons. BIST's strong developing opportunities compared to developed markets is another source of motivation. For example, market capitalization/GDP ratio is 126% for the New York Stock Exchange, 92% for the Nasdaq Stock Exchange, 136% for TMX Group, 131% for Euronext (Europe) Stock Exchange, while BIST is at the level of 33%. It is seen that Turkey comes in the 32nd place in country ranking. In addition to this potential development area of Turkey stands out with its geographical location, strong dynamics as being one of the largest twenty economies in the world, having wide domestic and regional markets, a liberal investment environment, foreign investor incentives, and the existence of institutions such as the Capital Markets Board of Turkey (CMBT) and BIST that protect investors (TC. Presidency Investment Office, 2021).

The key motivation of this study is to determine the stock market literacy levels of individual investors. Although there are many studies on financial literacy in the literature, no study has been found in particular on the stock market literacy level. Apart from Balloch et al. (2015) which measures the level of investors' knowledge of financial markets no other study was found. In that study, the authors used the Stock Market Literacy Questionnaire prepared by the American Life Panel (ALP). In this study, a new stock literacy score has been produced since there is no known standard scale for Turkish stock market investors.

The findings of the study will give an idea about the level of stock market literacy of individual investors. On the other hand, the findings will be able to give an idea about the factors that they consider when making investment decisions. According to this, it will be able to give ideas to the regulatory and enforcement institutions of developing countries in implementing policies to increase the number of individual investors. In this study, the survey was applied to a larger scale of investors compared to other studies evaluated in literature. The investors were chosen amongst clients of the brokerage houses with the highest trade volume in Turkey. These two facts highlight the importance of the sampling.

The study continues with theory, literature and practice sections after the introduction.

Theory and Literature

It is known that a country's development is directly proportional to the development of its financial markets, and the development of its financial markets depends on the development

of its stock market (Nowbutsing and Odit, 2009; Levine and Zervos, 1996). With the increase in financial market liberalization, individuals act on their own decisions and take on more responsibility for wealth management. Alongside this, especially because financial products become more and more complex, not every investor is knowledgeable enough to accurately predict the underlying risks (Gui et al., 2021).

Financial markets are affected by various economic and non-economic factors, both national and international. These events create different perceptions in the minds of stock market investors, and as a result, they cause the sensitivity of stock prices. As the stock market carries a higher risk due to these fluctuations, stock investment decisions become more difficult. When the breadth of the financial product range is added to these, the dominance of the investors on financial issues becomes even more important (Mandell and Klein, 2009).

In general, financial literacy is expressed as the ability to make conscious financial decisions based on adequate knowledge of financial concepts and instruments (Agarwal et al.,2010). In another definition, Financial literacy is defined as "Knowledge and understanding of financial concepts, and the skills, motivation and confidence to apply such knowledge and understanding in order to make effective decisions across a range of financial contexts, to improve the financial well-being of individuals and society and to enable participation in economic life" (OECD, 2013).

The major importance of financial literacy came to the forefront during the 2008 financial crisis (Klapper vd., 2013). Financial literacy is accepted globally as an important element of economic and financial stability and development after this crisis (Infe, 2009). Significant efforts and recourses have been developed by financial education providers to promote financial literacy through numerous financial education programs. In official reports, (for instance, the Organization for Economic Co-operatation and Development (OECD), 2009), the importance of low financial literacy among citizens was emphasized and the need for more financial education was expressed. When the steps taken by governments to improve financial literacy is also considered, investment awareness and financial literacy have become a vital and important approach to conscious financial decision making (Prasad et al., 2021; Herrador-Alcaide et al., 2021).

Financial literacy comes to the forefront especially in investing in risky instruments such as stocks. Financial literacy emerges in different ways in relation to investor behavior. Leveraging issues, paying more interest for loans, cost management of investments and decreasing probability of investing in stocks with low financial literacy are some of them (Hilgert et al., 2003). Research shows a positive link between financial knowledge and financial behavior, namely credit management, savings and investments (Phung, 2022). In the complex environment of financial market with dynamic political, economic and demographic factors, emergence of new and innovative financial products increase the importance of financial literacy.

A high level of financial literacy also helps reduce barriers for individuals to purchase complex derivatives (Prasad et al., 2021). Lusardi and Mitchell (2014) claim in their theoretical framework that financial literacy helps individuals get higher returns on their savings, which in turn significantly increases their financial well-being. According to Prasad

et al. (2021), people with high financial literacy are more active in the stock market. Jiang et al. (2020) defend that financial literacy improves individuals' returns on savings. These results show that a higher financial literacy motivates individual investors to increase their interest in the stock market.

In economies around the world, financial literacy is seen as a fundamental pillar of development and is receiving increasing attention. Today, investors having insufficient financial literacy is a problem not only for developing countries, but also for highly developed countries. Investors with insufficient financial literacy are incapable of making financial plans and face financial losses due to market uncertainties and the inability to anticipate risks (Rasool and Ullah, 2020).

Although it is known in the literature that there are many different factors that will affect the decisions of individual investors, it is accepted that the level of financial knowledge is an important determinant (Jariwala, 2015; Lodhi, 2014; Gutsche vd., 2020).

Therefore, understanding the individual investor's background and knowledge is an important indicator to understand regulatory concerns in terms of when and why regulatory interventions can be effective. The growing literature on financial literacy shows that investors' knowledge and skills of basic financial principles and products are far from the required level (OECD, 2005; Awais ET AL., 2016; Mouna and Anis, 2017).

In a literature review, it is seen that the relations between individual investors' demographic characteristics such as age, gender, marital status and their investments have been analyzed in many studies (Jariwala 2015; Öztopçu 2016; Tekin and Cengiz 2020; Maknickiene and Rapkeviciute, 2022).

Duqi and Al-Tamimi (2019), Öztopçu (2016), Şamandar and Çömlekçi (2019) examined individual investor behaviors through questionnaires. In general, the studies in which factor analysis and Chi-Square Test were applied have concluded that individuals cannot act rationally, and they are affected by their social environment and their demographic characteristics are determinative in investment decisions.

Chandra and Kumar (2011), Shafiee Sardasht, Moradi and Rahmani (2014), Lai (2019), Dervishaj and Xhaferi (2020), Adielyani and Mawardi (2020), Cherotich and Shiundu (2020) aimed to measure the behavioral factors that affect the participation of individuals in the stock market. In general, by making use of the T-Test, Correlation Test and Anova tests. It has been concluded that herd behavior, risk tolerance, confidence in the stock market and anchoring tendencies are effective in the participation of individuals in the stock market.

Al-Tamimi and Kalli (2009), Hossain and Nasrin (2012) in their individual studies tried to determine the behavioral and socioeconomic factors that affect investors' participation in the stock market. The questionnaires they applied were generally analyzed by regression analysis and T-Test. In general, they concluded that high levels of financial literacy, closeness of individuals to the field of finance, high income levels and being married are effective in trading in the stock market.

In the summary of the literature review, it is seen that many studies have been done on this subject (Van Rooij et al., 2011; Hastings et al., 2012; Sivaramakrishnan et al., 2017; Stolper et al., 2017; Gerth et al., 2021; Hermansson et al., 2022). However, in studies in the literature stock market literacy, which has not investigated apart from Balloch

et al.(2015) is the original part of this work. The difference between our study and the aforementioned study is the scoring and the methodology. In addition, the application of the survey to a large scale of investors who trade in brokerage houses with the highest trading volumes in Turkey creates originality in terms of the sample. With these aspects, this study is expected to contribute to the literature.

Methodology

This study aims to determine the stock market literacy level of individual investors in Turkey and the effect of this level on their investment decisions. In this context, an online survey was conducted with the random sampling technique among 1140 individual stock investors across Turkey. Individual stock investors were reached through intermediary institutions as Yapı Kredi Investment, İş Investment, Ak Investment, Info Investment, Gedik Investment, which are among the top ten brokerage houses in Turkey. The main research questions for the study are:

1. What is the stock market literacy level of individual investors in Turkey?
2. What is the impact of stock market literacy on investment decisions?

Method

In the survey, it was observed that the respondents gave incomplete answers to some questions. This problem can be solved by discovering the relation between known data and unknown data and approximating them to missing values. For this, methods such as Multiple Kernel Learning and KNN based on neural networks are used (Abas, 2011; Kumar et al., 2013). In this study, missing data in the data set were completed with the KNN (nearest neighbor) algorithm in order not to decrease the number of samples.

Multivariate statistical techniques are divided into two as dependency and non-dependency techniques in order to evaluate the relationship between variables. While the dependent variable or variables are estimated using independent variables in dependent models, it is aimed to determine the internal relations structure in the internal dependent models. Factor analysis, cluster analysis and cohesion analysis are considered as techniques that contain intrinsic dependency. In this study, the K-means method, which is a special clustering method that tries to measure the internal dependency in a two-dimensional plane based on distance measurements, is used. With the K-means method, it was investigated how the investments would be clustered in terms of the stock literacy score.

The K-means clustering technique has been used in the finance-investment field for many years (Ge et al., 2022). In the K-Means clustering technique, “K” refers to the number of clusters and “Means” refers to the weighted average of the elements that make up the cluster. Before starting the clustering process, the number of k clusters is given by the researcher (Liao et al., 2008; Baringo and Conejo, 2013; Zuhroh et al, 2021; Hu et al, 2020). Cluster analysis is a method that does not require statistical inference. The main purpose of cluster analysis is to create clusters in which high homogeneity of units within the same cluster and high heterogeneity between clusters are achieved. If the clustering process is successful, it is expected that the units in the cluster will be close to each other and the units in different clusters will be far from each other in the geometric representation (Garey, 1979). The K-means method, which is an important clustering analysis, was used in this study. The K-means clustering method is also known as Solid C-means in the literature.

In cluster analysis, as in other multivariate statistical analyses, the assumption of normality of data is not very important, and the normality of distance values is considered as sufficient. The relation between the variables used in the analysis do not have to be linear and the analysis can be applied to data measured by nominal, ordinal, interval, ratio or categorical scales according to the chosen clustering method (Çakmak, 1999).

The general purpose of cluster analysis is to gather individuals who are similar to each other in the same groups. The clustering process is done according to the similarity (closeness) or distance measures of the two observations in question. The main similarity measures frequently used in practice are: (1) correlation coefficients, (2) distance measures, (3) association coefficients and (4) probability-based similarity coefficients. The correlation coefficient and distance measures are widely used particularly in social sciences. The Euclidean distance function is used in this study (Aldenderfer and Blashfield, 1984).

Random Forest Regression

Random forest regression, one of the supervised machine learning methods, is a tree-based ensemble consisting of trees connected to a collection of random variables. The error rate for generalization approaches the limit as the number of trees increases (Breiman, 2001). It is used in many fields including economics because of its applicability in classification and regression problems (Medeiros et al., 2021; Akşehir & Kılıç, 2019). In the literature review, it has been seen that recent studies in the field of finance have focused on using random forest regression-based machine learning methods (Demirezen and Çetin, 2021). The random forest consists of many decision trees. Two features of the random forest method can be mentioned. Each tree consists of a subset of the observations, and each split within each tree consists of a random subset of the mtry candidate variables. Mtry refers to the number of randomly sampled variables as candidates in each compartment. The overall estimate is formed by averaging the estimates from each tree (Grömping, 2009). In the random forest regression method, the independent variables can be numeric, ordinal, or nominal. It requires no assumptions about the distribution of the data. The data is usually divided into training and test datasets. The mean square error (MSE) between the model based on the training data and the test data is a measure of the model's success. Variables are chosen to split the data based on the reduction in error obtained after a split. Unlike linear regression, interactions between different independent variables are automatically included in the regression tree model and irrelevant predictors are removed from the model. It extended the concept of regression trees by using the power of the computer to simultaneously generate hundreds of regression trees known as 'random forests' based on the random selection of a subset of data from the training set. The various regression tree solutions are averaged to estimate the target variable with the smallest MSE (Smith vd.,2013).

The "Target Shuffle - Target Shuffling" method proposed by Elder (2009) was used to determine the importance levels of the independent variables. The basic idea of Elder's target mixing is to treat the entire machine learning process as a function. It rearranges the output variable by mixing between samples and measures the strength of the resulting prediction. This process is repeated many times. Thus, target shuffling measures the sensitivity of the function to the outcome variable (Maymin, 2021).

The random forest method is a more applicable method since it does not adopt assumptions such as normality, linearity, and variable independence that classical methods require. At the same time, it gives more successful results as it focuses on the optimum solution like Artificial Neural Networks. For this reason, the RO method is preferred in studies in the field of finance. The RO method was used in the study, which consists of 35 questions and categorizes the factors affecting investment decisions, which is the dependent variable of the study, and a causal relationship between stock literacy and investment decisions (Kumar and Thenmozhi, 2014; Hastie, et al., 2009; Ciaburro, 2018). This method was also created in accordance with the methodological framework put forward by Breiman vd. (1984) - the classification tree that stock literacy represents by categorizing it as low and high.

Survey Scale

There are many studies in the literature that try to measure the investment knowledge of individual stock investors with exam type questions (Byrne 2007, Alexander et al. 1997, Al-Tamimi and Bin Kalli 2009). In this study, a questionnaire was prepared to evaluate the factors that determine stock literacy and investment decisions.

The questionnaire consists of three parts. In the first part, following Al-Tamimi and Bin Kalli (2009), 35 Likert-type questions that affect the investment decisions of individual stock investors in Turkey were asked. The factors in question were divided into 5 main categories as 9 items corresponding to the image of the company, 11 items corresponding to the financial information of the company, 5 items corresponding to the objective information, 4 items corresponding to the recommendations and 6 items corresponding to the personal financial needs.

In the second part, 20 exam type true-false questions were used to determine the stock literacy level. Stock literacy levels were generated by scoring the 20 questions with equal weights and deriving a unique score. The most important contribution of this study is this stock market literacy score. This aspect of the study reveals its originality.

In order to see the effects of investors' scores on investment decisions, they are divided into two (high - low) clusters with the clustering technique. In the literature, it is stated that studies conducted with the clustering technique on the subject can help market participants make inferences about financial markets (Cai vd., 2012).

How effective these 5 factors are in both clusters, in other words, ranking them according to their importance was made with the "Target Shuffle - Target Shuffling" method suggested by Al-Tamimi and Bin Kalli (2009). The method was used to ensure that the relationships identified by each modeling technique were not purely random. According to this method, a new MSE ratio was obtained by mixing the observations of the independent variable selected. This process was applied for all independent variables in turn. The variable that caused the most change in the MSE ratio was determined as the most important observation (Coşkuner and Rençber, 2021).

The third part includes demographic and socioeconomic variables such as age, gender, employment status, monthly income, total investment amount and education level.

Before the survey, a pilot survey was applied to 20 individual stock investors. Accordingly, some changes have been made and some questions have been rearranged.

Results

Profile of Research Participants

In the survey, each participant was asked to provide demographic data including age, gender, income, education, employment status and workplace activity. Table 1 provides descriptive statistics on the characteristics of individual stock investors.

Table 1. Sample Descriptive Statistics

Features	Number	Percentage
Age		
18-25	55	4.8
26- 35	293	25.7
36-45	487	42.7
46-55	231	20.3
56-65	67	5.9
66 and more	7	0.6
Gender		
Male	1060	93
Female	80	7
Employment Status		
Full Time	721	63.2
Part Time	23	2
Self Employed	183	16.1
Student	32	2.8
Unemployed(not working)	69	6.1
Retired (not working)	87	7.6
Retired (working)	25	2.2
Main Activity		
Finance / Banking / Investment	119	10.4
Other	1021	89.6
Monthly Income (TL)		
5,000 and less	152	13.4
5,000-10,000	501	43.9
10,000-20,000	318	27.9
20,000-30,000	88	7.7
30,000-40,000	22	1.9
40,000-50,000	18	1.6
50,000 and above	41	3.6

Features	Number	Percentage
Total Investment Amount (TL)		
Less than 1,000	14	1.2
1,000-5,000	54	4.7
5,000-10,000	162	14.2
10,000-50,000	220	19.3
50,000-100,000	433	38
More than 100,000	257	22.5
Education Level		
Primary Education	24	2.1
High School	124	10.9
Undergraduate- Associate Degree	743	65.2
Degree	223	19.6
Doctorate	26	2.3
Investment Experience		
Less than 2 years	268	23.5
2-5 years	414	36.3
5-10 years	188	16.5
10 years and above	270	23.7
Share of Stock in Investments		
Less than %10	64	5.6
Between %10-%25	100	8.8
Between %25-%50	180	15.8
Between %50-%75	282	24.7
%75 and above	514	45.1
Investment Maturity		
Less than 1 month	116	10.2
1month – 6 months	307	26.9
6 months -12 Months	213	18.7
12 months -24 months	174	15.3
Longer than 24 Months	330	28.9

When the above table is summarized, approximately 43% of respondents were 36-45, 25.7% 26-35, 20.3% 46-55, 5.9% 56-65, 4.8% 18-25, and the remaining 0.6% 66 and more age range. According to Table 1, 93% of the participants are men and 7% are women. About 63.2% of the respondents are full-time workers, 16.1% are self-employed, 2% are part-time workers, 2.8% are students, 6.1% are unemployed, 7.6% are retired (not working) and 2.2% are working retirees. In terms of the professional activity of the respondents, 10.4%

of the respondents have a finance, banking or investment background, while the employment activity of the remaining 89.6 percent is in other fields. In addition, approximately 85.2% of them have a monthly income of 20,000 TL or less, while 14.8% of them earn more than 20,000 TL. When looking at education, 2.1% of the respondents are primary school graduates, 10.9% are high school graduates, 65.2% are undergraduate-associate degrees, 19.6% are graduates, and the remaining 2.3% are doctoral graduates.

Stock Literacy Level

The percentage of correct answers given to the true-false questions created to determine the investors' stock literacy levels is given in Table 2.

As seen in Table 2, the Stock Literacy score average of all participants is 66,819%. This score indicates that the participants have high Stock Literacy in general.

In the second question that is about the benefit of diversification, participants have got the highest score and it implies that the investors know this concept very well. On the other hand, the respondents have the least

Table 2. Percentage of correct answer for each question.

Survey Rank	Question Subject	Correct Answer Percentage
1	General index knowledge	63.33
2	General diversification knowledge	95.61
3	Technical Analysis knowledge	40.79
4	Stock split knowledge	88.07
5	Dividend announcement date	53.68
6	Knowledge on the base price of the stock	83.42
7	Price/ Earnings Ratio	87.89
8	Electronic participation in the general assembly	48.60
9	High Return	62.37
10	Earnings per share	46.84
11	Beta Information	47.54
12	ROA and ROE	84.56
13	Accurate diversification knowledge	66.40
14	Closing Price in the Stock Market	81.40
15	Short selling	65.18
16	Paid capital increase	86.75
17	Publishing consolidated quarterly financial statements	21.84
18	Placing chain orders for stop profit / stop loss	80.88
19	Public Offering Prospectus	85.70
20	Public Offering Price	45.53
	Average	66.819

knowledge about the issuance of consolidated quarterly financial statements with only 21.8%. The question about technical analysis shows the second lowest score at 40.79%. The low number of correct answers to these two questions indicate that the technical knowledge level of the investors is low. The question about the public offering price received the third lowest score with a rate of 45.53%. The earnings per share question got the fourth lowest score with 46.84%, and the beta question got the fifth lowest score with 47.54%. The low number of correct answers given to these three questions indicate that their knowledge of stock price level is significantly low.

The investment decisions used in the research are divided into 5 factors, following Al-Tamimi and Bin Talli (2009). The variables used in the study and their abbreviations are given in the table below.

Table 3. Variables and Abbreviations

Dependent Variables (Investment Decisions)	
Company Image	CI
Accounting Information	AI
Objective Information	OI
Advices	A
Personal Financial Needs	PFN
Independent Variable	
Stock Literacy	SML

The factors affecting the investment decisions of the investors both separately on the basis of 35 questions and the frequency values of the sub-factors to which they belong are given in Table 4.

When Table 4 is analyzed on the basis of questions; it is seen that different answers were given to the five-point Likert scale regarding investment decisions. The question which shows most variation in the given answer is the 1st question about Financial Needs, while the least variable is the 6th question about Financial Needs. This situation is due to the fact that financial needs may differ according to personality traits. When analyzed on the basis of sub-factors, it is seen that the answers given to the financial needs factor vary more and the answers given to the objective information factor show less variability.

Stock literacy, which is the independent variable, was tried to be clustered with the K-means technique. The final cluster centers table gives the cluster center values of both groups. Accordingly, the geometric mean of the center values of the first group was 1.4; the second group was determined as 1.7. The technique assigns to the groups according to the mentioned average. From this point of view, the first group with relatively small values has low literacy; the second group with relatively high values was categorized as having high literacy. Therefore, from this stage onwards, investors were divided into two clusters as low and high clusters.

When we look at the classification of stock literacy according to the demographic variables of the participants, while 621 of 1140 participants participating in the survey, which is about 54%, have high stock literacy;

Table 4. Statistical Values Regarding Investment Decisions

Questions	Average	Standard Deviation	Questions	Average	Standard Deviation	Questions	Average	Standard Deviation
CI1	2.073	1.4871	PFN1	3.630	1.1344	AI1	2.449	1.3714
CI2	3.330	1.3106	PFN 2	4.136	1.0773	AI2	2.013	1.1793
CI3	4.130	1.0462	PFN 3	2.379	1.1807	AI3	4.411	0.8081
CI4	2.918	1.3186	PFN 4	3.375	1.1595	AI4	3.345	1.2971
CI5	4.475	0.8018	PFN 5	3.561	1.0869	AI5	3.824	1.1581
CI6	4.537	0.7678	PFN 6	3.590	1.1260	AI6	3.754	1.0246
CI7	3.014	1.2641	OI1	3.641	1.0881	AI7	4.458	0.8055
CI8	4.024	1.0463	OI2	2.685	1.1695	AI8	4.459	0.8259
CI9	4.067	1.0522	OI3	3.056	1.3489	AI9	4.282	0.9998
A1	2.740	1.2264	OI4	3.852	1.1360	AI10	4.123	1.0654
A2	1.768	1.0431	OI5	3.874	1.0229	AI11	3.354	1.2172
A3	2.168	1.1694						
A4	3.461	1.1864						

Sub-Factors	Average	Standard Deviation
Company Image (CI)	3.6186	1.3115
Accounting Information (AI)	3.6791	1.2521
Objective Information (OI)	3.4215	0.9582
Advice (A)	2.5342	1.0832
Personal Financial Needs (PFN)	3.4452	1.0394

519 of the participants, that is, 46%, have low stock literacy.

It is seen that the highest stock literacy age group is 36-45 years old. This can be explained by the increase in stock literacy as the investment experience increases, especially since the investment experience may increase as the age increases. It is seen that the full-time working men's stock literacy level is higher. Among the respondents, 15% of those with high stock literacy and 4.5% of those with low stock literacy work in a business operating in the field of finance. This situation can be associated with the financial information of the investor. It is seen that the monthly income range of the group with the highest stock literacy is 10.000 – 20.000 TL and the portfolio size of this group is higher than 100.000 TL. This situation shows that individual investors with higher incomes have a higher amount of savings in direct proportion, and as stock literacy increases, the amount allocated to stocks also increases. It has been observed that the group with the highest stock literacy is associate/undergraduate graduates and they have 5 to 10 years of experience in stock investments. The share of stocks in financial investments of those with the highest stock literacy is 75% or more. This situation shows that the amount allocated to stocks

increases as stock market literacy increases. On the other hand, it shows that investors need more financial knowledge (such as fundamental/technical analysis, financial concepts) in order to increase the amount of investment to be made in stocks. It is seen that those with the highest stock market literacy generally invest in the stock market in terms of 1-6 months and longer than 24 months. In other words, those with high stock market literacy make both short-term and long-term investments, taking into account the maturity-yield relations.

Reliability and Regression Findings

Before the survey results are analyzed, the reliability results of the results are given in Table 5.

Table 5. Reliability Results

	Variables	Cronbach's Alpha
Independent Variables	SML	0,659
Dependent Variables	Investment Decisions	0,846
	CI	0,568
	AI	0,622
	OI	0,730
	A	0,645
	PFN	0,689
General		0,770

When the reliability of the scale is evaluated in general, it is seen that it is 77% reliable.

The results obtained from the questionnaires applied in the study were analyzed with the Random Forest Method. A Random Forest is a method that consists of a large number of trees. The decision is made based on the average of the predictions from each tree. The error values determined as a result of the Random Forest Regression application are shown in the table below.

Table 6. Error Values Regarding RF Application

Evaluation Metrics	Value
R^2	0.967
Mean Absolute Error (MAE)	0.060
Mean Squared Error (MSE)	0.007
Root Mean Squared Error (RMSE)	0.088
Mean Signed Difference (MSD)	-0.00
Mean Absolute Percentage Error (MAPE)	0.020

It is seen in the table that the R^2 value is 0.967. This value shows that the dependent variable is explained strongly (about 97%) by the independent variables. The success of the model shows the MSE value. It is seen in the table that the MSE value is 0.007. The fact that this value is close to zero indicates that the predictive power of the model is

high (Coşkuner and Rençber, 2021). In the second part of the application, the changes in this ratio will be used in determining the importance of the independent variables.

The target Shuffling method was used to determine the importance levels of the variables. According to this method, a new MSE ratio is obtained by mixing the observations of the independent variable selected. This process is applied sequentially for all independent variables. The variable that causes the most change in the MSE ratio is determined as the most important observation. Clustering was calculated by the K-Means technique and divided into 2 clusters as 1: High and 2: Low.

The new MSE values after applying the Target Shuffling Method are shown in the table below.

Table 7. The Significance Levels of the Variables According to the Random Forest Method

		New MSE Value	Difference	Sequence
ALL	BEGINNING	0.6		
	CI	1.4	0.80	4
	AI	1.1	0.50	5
	A	2.8	2.20	1
	OI	2.2	1.60	2
	PFN	1.7	1.10	3
HİGH	BEGINNING	0.8		
	CI	1.6	0.80	4
	AI	1.3	0.50	5
	A	2.8	2.00	1
	OI	2.7	1.90	2
	PFN	2.0	1.20	3
LOW	BEGINNING	0.9		
	CI	1.8	0.90	4
	AI	1.4	0.50	5
	A	2.9	2.00	2
	OI	3.0	2.10	1
	PFN	1.9	1.00	3

According to the table above, the values of the variables at the initial stage, in other words, when we do not mix any factors, in the whole sample was found to be 0.6. When we mix the financial need factor with Target Shuffling, it is seen that the effect of this factor is 1.4. This process is applied sequentially for all independent variables.

On the other hand, considering the entire sample and investors with high stock literacy scores, it is seen that the variable that makes the most difference in MSE value is the recommendations factor. In other words, it is concluded that investors, experts or institutions with a high level of stock literacy shape their investment decisions in line with

different analyses and expert opinions. Their recommendations are followed by objective information, personal financial needs, firm image and firm financial information, respectively.

Again, according to the table above, when investors with low stock literacy scores are taken into account, it is seen that the variable that makes the most difference in the MSE value is the neutral information factor. It has been stated that the variable that affects the investment decisions of investors with low stock market literacy the most is the objective information criterion. While those with high stock literacy can direct their investments with their knowledge and expertise, investors with low stock literacy tend to reach their investment targets with unbiased information from written and visual sources. Impartial information is followed by recommendations, personal financial needs, company image and financial information, respectively.

Conclusion and recommendations

The aim of this study is to investigate the effect of stock market literacy on individual stock investors' investment decisions who invest in Borsa Istanbul. For this purpose, 20 questions were asked to determine the stock market literacy of 1140 individual investors who participated in the survey. In this way, investors' stock market literacy success score was established. The factors affecting the investment decisions of the investors are categorized as Firm Image, Financial Information, Impartial Information, Recommendations, Personal Financial Needs.

While measuring the stock literacy level, 20 exam type true-false questions were used. According to the analysis results, individual stock investors are more knowledgeable about the benefits of diversification, while they are least aware of the release of consolidated quarterly financial statements. In addition, low scores were observed in technical analysis, public offering price, earnings per share and beta questions.

As a method, individual stock investors were classified by the clustering method at first, and then the importance levels of the factors were determined by Target Shuffling and Random Forest Regression. As a result of the analysis, it is seen that the dependent variable is explained strongly (about 97%) by the independent variables. This data indicates that stock market literacy is very effective on the investment decisions of investors.

According to the Random Forest Regression results, it is seen that the recommendations sub-factor is the most effective on the investment decisions of investors with a high stock literacy level. In addition to the expert opinions of investors with high stock literacy, it has been concluded that the most influential variable on investment decisions is the advice of official institutions such as BIST, CMBT, financial institutions such as intermediary institutions, banks, and experts such as economists, analysts and academicians. These results show that individual investors consider technical/fundamental analyses performed and published by experts instead of analyzing with different techniques with their individual efforts. This result increases the importance of the responsibilities of institutions that publish analysis reports. Neutral information, personal financial needs, company image and financial information follow respectively the "recommendations" sub-factor that affects the investors' decisions the most. The fact that the image of the company is one of the decisions that affect the investment decisions the least shows that the investors are investing with a focus

on capital gain and dividend income rather than the value of the firm, and their priorities are based on earnings. Although it is quite unexpected that the financial information of the invested companies is in the last place, it is thought that the use of these data while preparing the analysis reports, which is the most determining sub-factor, reduces the singular importance of the data.

It is seen that the "unbiased information" sub-factor is the most effective on investment decisions of investors with a low stock literacy level. Investment decisions require deep financial knowledge and judgment. Therefore, investors with low financial literacy direct their investments with investment recommendations from other people or institutions since their own financial analysis skills are limited. It is extremely important whether these recommendations are prepared using the right methodologies, whether they act ethically, whether they contain manipulative information, and the importance of reliable information and advice in the stock markets for the investment decisions of investors with low stock literacy is demonstrated. Impartial information is followed by recommendations, personal financial needs, company image and financial information, respectively.

In line with these results, it has been observed that stock literacy has an impact on investment decisions. The fact that the financial information about the company to invest is the variable that influences investment decisions the least, creates the risk of being exposed to more manipulation since investors' perception about the company and the factual information are not aligned. This is also an important result for the policymakers of other developing countries similar to Turkey, which constitutes the sample of this study. In other words, countries that try to increase the number of individual stock investors who invest in capital markets should increase the stock market literacy level of individual investors. In doing so, the importance of policymaking that fits the financial literacy level they address has emerged once again. The results obtained from this study were reviewed in the literature by Baihaqqy (2020), Kristanto and Gusaptono (2020) and Kristanto (2021) give results in parallel with their studies; It gives opposite results to Arianti (2018).

An interesting observation that is derived from the study is the fact that stock market literacy is a determining factor in investment maturity. It is safe to say that investors with high stock market literacy make both short-term and long-term investments.

The most important limitation of the study is that it was applied only to individual stock investor trading within BİST, and therefore solely the market conditions in Turkey were taken into account. The study can be developed by studying with investors from different markets such as institutional investors, SMEs and by analyzing data with different techniques.

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