

## **The Effects of Investor Behavior on Market Predictability**

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### **Abstract**

This study aimed to test the effects of investor behavior on the predictability of the market by testing CAPM estimation errors in negative growth period and growth period of the market. This study also aims to draw attention to the existence of some factors that may affect the CAPM estimation errors. Negative growth period is the period in which irrational behavior is likely to occur. Growth period is the period when irrational behaviors are less common. CAPM estimation errors calculated by Jensen's alpha, Sharpe ratio, Sortino ratio and Treynor ratio were compared by T-Test and Mann-Whitney U Test during negative growth periods and growth periods. USA-S&P 500, Germany-DAX 100, England-FTSE 100, France-CAC All Tradable, Canada-S&P TSX, Japan-Nikkei 225 developed countries and their indices and India S&P BSE 200, China-SSE Composite, South Africa &-FTSE JSE African All Share, Turkey-BIST 100 developing countries and their indices included in the study. Between January 31,2005 and December 31,2018 monthly closing prices of the indices, monthly closing prices of stocks listed in consumer staples sectors and consumer discretionary sectors were used. As a result of the study, it has been observed that CAPM estimation errors calculated by Jensen's alpha and Treynor ratio in consumer staples and consumer discretionary sectors in developed and developing countries do not differ during negative growth periods and growth periods of the market. It cannot be said that CAPM is more reliable or unreliable in negative growth periods compared to growth periods. It has been determined that CAPM estimation errors calculated by Sharpe ratio and Sortino ratio differ during negative growth periods and growth periods. It can be said that CAPM is less reliable in negative growth periods compared to growth periods.

**Keywords:** Capital Asset Pricing Model, Investor Behavior, Negative Growth Period, Consumer Staples Sector, Consumer Discretionary Sector

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## **1.Introduction**

The concept of investment, which is defined as giving up the value of today and making sacrifices by taking the risk to obtain a value that is expected to be obtained in the future, appears in every field of daily life. Decision making is the most important stage of the investment process. Having an expected return at the end of the investment is important for the investment decision. Along with the expected return from the investment, the risk to be incurred is also an important factor in the investment decision.

In traditional finance theory, it has been assumed that investors are rational and will choose the most appropriate option that will maximize their utility. Emotional aspects of investors were not considered in the investment decision process. In economics and finance theories, human is described as rational, irrational, and limited rational. While it is assumed that investors are rational in traditional finance theory, the assumption that people in traditional finance theory are rational has been criticized in behavioral finance theory and it has been stated that people are irrational or limited rational. In behavioral finance theory, it is stated that investors may act irrationally and not rationally when making investment decisions.

CAPM assumes that investors are essentially rational. However, the facts do not support this view of the CAPM. CAPM assumptions are often criticized as being unrealistic. Despite all the criticisms, CAPM continues to be widely used by researchers and practitioners.

In CAPM, it is assumed that investors are risk-averse, rational, and trying to maximize their returns (Copeland and Weston, 1988, p. 194). CAPM assumes that investors try to maximize their utility and are rational. It is also assumed that there is no tax, the investor expectations are homogeneous, and that there are no transaction costs. Even if these assumptions do not match the facts, it is possible for these assumptions to be sound, but investors are irrational. In many experimental studies, it has been determined that investors move away from rationality and the prices of financial assets cause deviations from the theoretical models.

This study aims to explain that investor behaviors affect the predictability of the market by testing the difference in the measurements of the capital asset pricing model (CAPM) in negative growth and growth periods of the market.

## **2. Literature Review**

There are many academic studies that examine whether CAPM is a successful model for estimating asset prices, the effect of investor behavior on estimation errors of CAPM, how investors' rationality is affected in times of market turmoil, and whether investors' investment decisions are affected by adverse economic conditions and propose alternative models.

Shah, Dars, and Haroon (2015) tested CAPM on the Karachi Stock Exchange between July 2004 and December 2012. According to the results of the research, it has been seen that CAPM is not sufficient to predict stock returns in periods when emerging markets have negative returns and high volatility. It has been determined that CAPM accurately predicts stock returns in periods when the market is positive and upwards.

Guerrero, Stone and Sundali (2012) examined how investors distribute their investments among financial assets under difficult conditions and how the collapse in asset prices affects the rationality of individual investors. In this study, which is based on the years of the economic crisis in 1929, it was investigated how investors distributed their investments between risk-free assets and risky assets while making their choices. Investors are divided into two groups; those who experienced the returns of the market between 1925-1944 and those who experienced the returns of the market between 1929-1948. The risk-free asset returns, which are constantly 4%, and the returns of the Dow Jones Industrial Average (DJIA) index as a risky asset are discussed. With the results obtained in the study, it has been seen that investors tend to avoid risk due to fear and anxiety in negative market conditions and are risk sensitive. It has been observed that the investors acted with the fear that the market returns would decrease more than expected. It has been determined that investors do not act rationally in periods when the market is in significant negative growth.

García (2012) aimed to measure the emotional reaction of investors to financial news in his study. In order to determine to what extent investors are affected by the published financial news, the relationship between the financial news published in New York Times between 1905 and 2005 and the share returns was examined. As a result of the research, he said that news content can be used to predict share returns in general. It has been determined that the effect of financial news on investor behavior is more evident in the periods when the market is in negative growth, and investor behaviors differ in negative growth and growth periods of the market. In the research conducted using stocks in Dow Jones Industrial Average (DJIA) index,

it has been observed that the effect of news on investor behavior is greater in negative growth periods of the market than in the growth periods of the market.

In the study of Yu and Yuan (2011) examining the effect of investor sentiment on the relationship between mean and variance, it was found that the relationship between mean and variance was significantly positive in periods when investor sentiment was low. It has been observed that the relationship between the mean and the variance is close to zero in the periods when investor sensitivity is high. In times of low investor sentiment, irrational investors think that stocks are priced above their value, although stocks are priced below their value. For this reason, it has been determined that rational investors invest more in stocks than irrational investors in periods when investor sensitivity is low. In addition, it has been observed that the reaction of the market to volatility is not always homogeneous and varies according to periods when investor sentiment is high and low. It has been determined that the market considers volatility more in periods when investor sentiment is low than in periods with high investor sentiment.

Apergis and Rehman (2018) investigated the effect of investor sentiment on financial asset prices by using daily data of S&P 500 firms between 1995 and 2005. The predictability of investor sentiment with residuals of CAPM is examined. According to the research, it has been determined that the residuals of CAPM can be explained by investor sentiment and investor sentiment is a factor in pricing the financial asset.

Marsh (2018), in his study, examined the estimation errors of CAPM in negative growth and growth periods of the market. Sharpe ratio, Jensen's alpha and Treynor ratio were used to determine the estimation errors of CAPM. In US Russell 3000 index; 86 companies' data which are located in the consumer discretionary sector and 36 companies' data which are located in the consumer staples sector were used between 1994 and 2016. The estimation errors of the CAPM were determined for the companies in the consumer staples sector and consumer discretionary sector, with the Sharpe ratio, Jensen's alpha and Treynor ratio. Whether the determined estimation errors differ in negative growth and growth periods of the market has been examined with the Independent T-Test. In the results obtained, it was seen that the estimation errors determined by the Jensen's alpha and Sharpe ratio were different in negative growth and growth periods of the market. It was determined that there was no difference in the estimation errors determined by the Treynor ratio in negative growth and growth periods of market.

Barberies, Greenwood, Jin, and Shleifer (2015) conducted an empirical study using the US stock market data between 1947 and 2011 and the results of a survey with investors. They worked on a Consumption Based CAPM that included irrational investors who think that future prices in the stock market will follow past prices and investors who think completely rationally. It is examined how the irrational and rational investors react to the shocks caused by the positive and negative news in the stock market. It has been observed that the market generally reacted positively to positive cash flow news such as dividends and stock prices increased. The expectation of irrational investors is that past prices will affect future price formation. However, with the effect of the positive shock, it has been determined that the overreaction of irrational investors caused the price increase to be higher than normal. Rational investors, on the other hand, did not overreact to the abnormal increase in the stock price caused by irrational investors. The rational investor is aware of the fact that the price of the stock has increased more than usual due to the impact of positive news about cash flow and the overreaction of irrational investors to the positive shock. Irrational investors believe that future prices will follow past prices and are affected by recent price increases. They think that prices will continue to rise in the near future. Therefore, they continue to place excessive demands on the stock. It has been determined that rational investors do not overreact because they know that irrational investors will behave in this way. A rational investor, who is aware of irrational investor behavior, slowly reduces his demand for the stock. It does not stop its reaction to the share certificate suddenly and continues its demand for the share certificate for a while. Barberies, Greenwood, Jin and Shleifer (2015) suggested XCAPM (extrapolative CAPM) to price financial assets by including the behavior of irrational and rational investors in the model.

### **3.Capital Asset Pricing Model and Criticisms**

#### **3.1. Capital Asset Pricing Model**

The Capital Asset Pricing Model (CAPM) was developed from the portfolio selection model developed by Harry Markowitz (1959). In Markowitz's model, the investor creates a portfolio at t-1 and the related portfolio produces a return at t. The model assumes that the investor is risk-averse and will consider only the mean and variance of the single-period returns of the investments when choosing between investments. Investors choose the asset that minimizes the risk at a certain return level or aims the maximum return at a certain risk level (Fama and French, 2004, p. 26).

Sharpe (1964) states that there is no theory explaining that the price of risk arises from the fundamental effects of investor preferences and physical characteristics of financial assets. Noting that due to the absence of such a theory, it is difficult to understand the relationship between the price and risk of a single asset, he developed CAPM, which considers the relationship between the price of an asset and the various components of its total risk, with inferences consistent with the claims of traditional finance theory.

Introduced by Markowitz in the 1960s, Modern Portfolio Theory (MPT) was developed by Sharpe, Lintner, and Tobin, and the relationships between an asset's risk and its return were placed on a more comprehensive scientific basis (Karan, 2013, p. 199). CAPM is central to modern financial economics and estimates the relationship we must observe between an asset's risk and its expected return. This relationship between risk and return serves two especially important purposes. The first of these specifies the rate of return that we can use as a reference to evaluate possible investments. For example, with CAPM, we can observe whether the expected return for a stock is more or less than its "fair" return, given the risk we take. Second, it allows us to estimate the expected return on financial assets that have not yet been traded in the market. For example, it is used to determine the price of a stock to be offered to the public or to measure how a new and large investment project affects the return that investors expect from the company's stock. Although CAPM is not fully supported by empirical tests, it is widely used because its accuracy is considered acceptable for important applications (Bodie, Kane, & Marcus, 2014, p. 291).

### **3.2. Comparison of Investor Behaviors in Traditional and Behavioral Finance**

Homo Economicus is the first decision-making model formulated in the 19th century. According to this model, investors have full information about their investment options and the possible consequences of their investment decisions. According to Homo Economicus, investors are rational. The financial crisis in 2007-2008 provided an understanding of human behavior. Researchers have found that the root cause of the financial crisis is the psychological distortion in investor's judgments. Excessive optimism and confirmation bias observed in investors have been the driving force behind the crisis (Nair and Antony, 2015, p. 1055).

Homo economicus is a simple model of economic behavior that assumes the principles of perfect self-interest, perfect rationality, and perfect information are used by individuals in making economic decisions. Economists who support homos economicus postulate people as

rational maximizers who are concerned only with their own benefits and make perfectly rational decisions. Most economists critical of homo economicus have challenged the assumptions of perfect rationality, perfect personal utility, and perfect information. (Pompian, 2006, pp. 15-16)

Behavioral finance assumes that most people do not have all the information available and make choices using limited information. As a result, investor's choices are not compatible with the expectation that rational individuals will maximize their utility. In fact, the choices of individuals whose rationality is limited by limited information and limited perception are satisfying themselves. The response and behavior of individuals in the economy to changes are different from those expected from rational individuals (Estrada, 2001, p. 2).

Traditional finance is a source of information based on the arbitrage principles of Miller and Modigliani, the portfolio principles of Markowitz, the capital asset pricing theory of Sharpe, Lintner, and Black, and the option pricing theory of Black, Scholes, and Merton. Traditional finance is challenging because it uses minimal tools to construct a unified theory to explain financial questions (Statman, 1999, p. 19). Miller (1986) states in his study that market equilibrium models based on rationality are in good condition and not worse than other economic models (Miller, 1986, p. 466). However, today it makes sense to reconstruct the theory of finance by considering the investor behavior due to the anomalies experienced (Statman, 1999, p. 19).

Traditional finance tries to understand financial markets by developing models assuming that investors are rational. When rational investors reach new information, they update their beliefs according to the new information and make choices according to their beliefs updated with the new information. According to behavioral finance, investors cannot update their beliefs correctly with new information. The framework established by traditional finance is quite simple, and the predictions of traditional finance will be convincing when confirmed by the data. However, as a result of studies conducted over the years, it has been seen that the basic facts about the stock market, average return and individual investor behavior are not easily understood within the framework drawn by traditional finance. Behavioral finance is a new approach that tries to explain the situations that traditional finance has difficulty in explaining. Behavioral finance argues that financial markets can be better understood by developing models in which some investors in financial markets are not completely rational (Barberis and Thaler, 2003, p. 1053).

## **4. Research Method**

### **4.1. The Purpose and Scope of the Analysis**

In this study, Jensen's alpha, Sharpe ratio, Treynor ratio and Sortino ratio performance measurement methods were used to calculate the effect of irrational investor behavior on the estimation errors of CAPM. CAPM estimation errors calculated by performance measurement methods are analyzed separately in negative growth periods and growth periods of the market. Negative growth periods are determined as the months in which the market loses value for a minimum of two consecutive months (Diego García, 2013, p. 1270). Negative growth periods of the market are included in the study as periods in which irrational investor behaviors will be seen more.

The companies in the study were examined in two separate groups as "consumer staples sector" and "consumer discretionary sector". Since the companies in the consumer staples sector are less sensitive to economic cycles, the volatility of the stocks of the companies in this sector is lower than in other sectors. Since consumer discretionary sector companies are extremely sensitive to economic cycles, the volatility of the stocks of companies in this sector is high. For this reason, the stocks of the companies included in the study were examined separately as consumer staples sector and consumer discretionary sector. As of 31 December 2018, companies included in the selected indices for countries and listed in consumer staples sector and consumer discretionary sector according to GICS were included in the study.

### **4.2. The Data**

A total of 395 shares were included in the study, 76 of which are in the consumer staples sector in developed countries, 131 in the consumer discretionary sector in developed countries, 59 in the consumer staples sector in developing countries, and 129 in the consumer discretionary sector in developing countries. The month-end return rates of the stocks between December 31,2005 and December 31,2018 and the 1-year treasury bill rate were used as the risk-free interest rate and converted to monthly values. Developed countries; USA, Germany, England, Japan, France, Canada respectively; Firms in S&P 500, DAX 100, FTSE 100, Nikkei 225, CAC All Tradable, S&P/TSX indices are included. Developing countries; Companies in the S&P BSE 200, SSE Composite, FTSE&JSE African All Share and BIST 100 indices of India, China, South Africa, and Turkey, respectively, are included. For each stock, Jensen's alpha, Sharpe ratio, Treynor ratio, Sortino ratio and CAPM estimation error were calculated. Calculated



estimation errors were compared by applying the “Independent T-Test” and “Mann-Whitney U” test in negative growth and growth periods of the market. When estimating the beta, the monthly returns of the companies for 24 months or 48 months are considered. (Berk & DeMarzo, 2006, Damodaran, 2002, Ross, Westerfield & Jaffe, 2003). In this study, the monthly returns of the companies for 24 months were considered while estimating the beta.

**Table 1.** Number of Firms by Country Indices and Sectors

Country Group	Countries	Index Name	Number of Firms in Consumer Staples Sector	Number of Firms in Consumer Discretionary Sector
Developed Countries	USA	S&P 500	28	50
	Germany	DAX 100	2	8
	France	CAC All Tradable	13	27
	England	FTSE 100	9	10
	Japan	Nikkei 225	15	27
	Canada	S&P/TSX	9	9
Developing Countries	China	SSE Composite	33	90
	South Africa	FTSE&JSE Africa All Share	11	11
	India	S&P BSE 200	11	16
	Turkey	BIST 100	4	12

#### 4.3. Growth and Negative Growth Periods

Growth period: it refers to any month in which the market has not lost consecutively, the general value of the market is in negative growth or in growth. Investors feel happy and positive during the earnings periods of the market. A negative growth period refers to any month in which the market has lost value for two or more consecutive months. Investors feel fear and anxiety during the market negative growth periods. The negative mood that affects investors in negative periods of the market changes the decision-making abilities of investors (Diego García, 2013, p. 1270).

#### **4.4. Variables Used in Analysis**

The dependent variables are the CAPM estimation errors calculated by Jensen's alpha, Sharpe ratio, Treynor ratio and Sortino ratio. The market negative growth periods and the market growth periods are independent variables. In the analyzes, it is investigated whether the CAPM estimation errors differ in positive and negative periods.

#### **4.5. T-Test and Mann-Whitney Test Analysis**

The aim of this study is to investigate whether the CAPM estimation errors calculated by Jensen's alpha, Sharpe ratio, Sortino ratio and Treynor ratio differ in negative growth and growth periods of the market for each stock. "Independent T-test" was applied to investigate whether there is a statistically significant difference between the estimation errors determined for the growth and negative growth periods. One of the T-test assumptions is the normal distribution of data. "Shapiro-Wilks" normality test was applied for the "CAPM estimation error" time series calculated for each stock to investigate whether the normality assumption was met. According to the test results, CAPM estimation errors were determined that provided and did not provide the normality assumption. "Independent T-test" was applied for the CAPM estimation errors, which provided the assumption of normality. For the CAPM estimation errors that do not satisfy the assumption of normality, the Mann-Whitney U test, which is used when the data is not normally distributed and can be used instead of the non-parametric T-test, was applied. Before performing the T-test for the CAPM estimation errors found to be normally distributed, the homogeneity of the variances was examined with the Bartlett F test. The t-test was applied according to the acceptance of homogeneous or heterogeneous variance according to the results of the Bartlett F test. By applying the t-test for normally distributed data and Mann-Whitney U test for non-normally distributed data, it was examined whether there is a statistically significant difference between the CAPM estimation errors in the growth and negative growth periods.

Hypotheses:

**H<sub>0</sub>:** There is no significant difference between the CAPM estimation errors in negative growth and growth periods of the market calculated for the stocks of the companies.

**H<sub>A</sub>:** There is a significant difference between the CAPM estimation errors in negative growth and growth periods of the market calculated for the stocks of the companies.

## 5. Findings

According to the T-test and Mann-Whitney U tests results for countries and indices; the number of stocks which have significant difference between CAPM estimation errors in negative growth and growth periods calculated by Jensen's alpha, Sharpe ratio, Sortino ratio and Treynor ratio shown in "there is difference" column. The number of stocks which do not have significant difference shown in "no difference" column. Numbers of stocks which has CAPM estimation errors average greater in negative growth period than growth period are shown in the "negative growth" column. Numbers of stocks which has CAPM estimation errors average greater in growth period than negative growth period are shown in the "growth" column.

### 5.1. T-Test and Mann-Whitney U Test Analysis for Consumer Staples Sectors in Developed Countries

**Table 2.** T-Test and Mann-Whitney U Test Analysis Results for Consumer Staples Sectors in Developed Countries

Country Group	Measurement Method	Negative Growth	Growth	There is Difference	There is no Difference	Total
Developed Countries	Jensen's Alpha	55	21	5	71	76
	Sharpe Ratio	74	2	68	8	76
	Sortino Ratio	73	3	65	11	76
	Treynor Ratio	42	34	10	66	76

While there is no significant difference between the CAPM estimation errors calculated by Jensen's alpha and Treynor ratio for the stocks in consumer staples sector of developed countries during the growth and negative growth periods of the market, there is a significant difference between the CAPM estimation errors calculated by Sharpe ratio and Sortino ratio.

According to the results of the analysis of the CAPM estimation errors calculated by Jensen's alpha and Treynor ratio, it cannot be said that the CAPM is more reliable or unreliable in negative growth periods of the market compared to the growth periods. According to the results of the analysis of the CAPM estimation errors calculated by the Sharpe ratio and Sortino ratio,

it can be said that the CAPM is less reliable in negative growth periods of the market compared to the growth periods.

## 5.2. T-Test and Mann-Whitney U Test Analysis for Consumer Staples Sectors in Developing Countries

**Table 3.** T-Test and Mann-Whitney U Test Analysis Results for Consumer Staples Sectors in Developing Countries

Country Group	Measurement Method	Negative Growth	Growth	There is Difference	There is no Difference	Total
Developing Countries	Jensen's Alpha	38	21	14	45	59
	Sharpe Ratio	56	3	43	16	59
	Sortino Ratio	53	6	35	24	59
	Treynor Ratio	35	24	13	46	59

While there is no significant difference between CAPM estimation errors calculated by Jensen's alpha and Treynor ratio for the stocks in the consumer staples sectors of the developing countries during growth and negative growth periods of the market, it is seen that there is a significant difference between CAPM estimation errors calculated by Sharpe ratio and Sortino ratio.

According to the results of the analysis of the CAPM estimation errors calculated by Jensen's alpha and Treynor ratio, it cannot be said that the CAPM is more reliable or unreliable in negative growth periods of the market compared to the growth periods.

According to the results of the analysis of the CAPM estimation errors calculated by Sharpe ratio and Sortino ratio, it can be said that CAPM is less reliable in negative growth periods of the market compared to growth periods.

### 5.3. T-Test and Mann-Whitney U Test Analysis for Consumer Discretionary Sectors in Developed Countries

**Table 4.** T-Test and Mann-Whitney U Test Analysis Results for Consumer Discretionary Sectors in Developed Countries

Country Group	Measurement Method	Negative Growth	Growth	There is Difference	There is no Difference	Total
Developing Countries	Jensen's Alpha	96	35	6	12	131
	Sharpe Ratio	120	11	109	22	131
	Sortino Ratio	103	28	70	61	131
	Treynor Ratio	79	52	6	125	131

While there is no significant difference between CAPM estimation errors calculated by Jensen's alpha and Treynor ratio for the stocks in consumer discretionary sectors of developed countries during negative growth and growth periods of the market, there is a significant difference between the CAPM estimation errors calculated by Sharpe ratio and Sortino ratio.

According to the results of the analysis of CAPM estimation errors calculated by Jensen's alpha and Treynor ratio, it cannot be said that CAPM is more reliable or unreliable in negative growth periods of the market compared to the growth periods. According to the results of the analysis of CAPM estimation errors calculated by Sharpe ratio and Treynor ratio, it can be said that CAPM is less reliable in negative growth periods of the market compared to growth periods.

#### 5.4. T-Test and Mann-Whitney U Test Analysis for Consumer Discretionary Sectors in Developing Countries

**Table 5.** T-Test and Mann-Whitney U Test Analysis Results for Consumer Discretionary Sectors in Developing Countries

Country Group	Measurement Method	Negative Growth	Growth	There is Difference	There is no Difference	Total
Developing Countries	Jensen's Alpha	65	64	11	118	129
	Sharpe Ratio	123	6	101	28	129
	Sortino Ratio	120	9	70	59	129
	Treynor Ratio	67	62	12	117	129

While there is no significant difference between CAPM estimation errors calculated by Jensen's alpha and Treynor ratio for the stocks in consumer discretionary sectors of the developing countries during negative growth and growth periods of the market, there is a significant difference between CAPM estimation errors calculated by Sharpe ratio and Sortino ratio. According to the results of the analysis of CAPM estimation errors calculated by Jensen's alpha and Treynor ratio, it cannot be said that CAPM is more reliable or unreliable in negative growth periods of the market compared to growth periods. According to the results of the analysis of CAPM estimation errors calculated by Sharpe ratio and Treynor ratio, it can be said that CAPM is less reliable in negative growth periods of the market compared to growth periods.

#### 6. Conclusion

Although CAPM is the most widely used model for determining the prices of financial assets, it has also been subject to many criticisms. One of the most important of these criticisms is the assumption of CAPM that investors are rational. In this study, the estimation errors of CAPM are examined separately in developed countries and developing countries in negative growth and growth periods of the market.

The purpose of including developed and developing countries in the study is to examine separately the estimation errors of CAPM in markets in different country groups with different development levels. Thus, it is to investigate whether the estimation errors of CAPM in negative growth and growth periods of the market differ according to the development levels of the countries. According to the results obtained, similar results were obtained for both country groups. It has been observed that the estimation errors of CAPM calculated by Sharpe ratio and Sortino ratio in both country groups differ in negative growth and growth periods of the market. However, it has been observed that the estimation errors of CAPM calculated by Jensen's alpha and Treynor ratios do not differ in negative growth and growth periods of the market.

The estimation errors of CAPM were analyzed separately for the companies in consumer staples sector and consumer discretionary sector of the indices included in the study. By examining the estimation errors of CAPM in both sectors separately, it has been investigated whether the errors of CAPM differ in negative growth and growth periods of the market in companies with different sensitivities to economic cycles. According to the results of the research conducted on companies in consumer staples sector, it has been observed that the estimation errors of CAPM calculated by Sharpe ratio and Sortino ratio differ in negative growth and growth periods of the market. However, it has been observed that the estimation errors of CAPM calculated by Jensen's alpha and Treynor ratios do not differ in negative growth and growth periods of the market. Similarly, according to the results of the research conducted on companies in consumer discretionary sector, it has been observed that the estimation errors of CAPM calculated by Sharpe ratio and Sortino ratio differ in negative growth and growth periods of the market. However, it has been observed that the estimation errors of CAPM calculated by Jensen's alpha and Treynor ratios do not differ in negative growth and growth periods of the market.

There are many factors that can affect the rationality and predictability of investor behavior. These factors may affect the reliability of the estimation of CAPM. In this study, as factors affecting investor behavior, negative growth periods in which negativities occurred in the market and growth periods in which there were no negative effects in the market were examined. Negative growth periods are periods when investors tend to act irrationally. CAPM assumes that investors are rational. Irrational behavior of investors violates this assumption of CAPM. Therefore, the irrational behavior of investors will adversely affect the reliability of CAPM.

According to the studies conducted with the Jensen's alpha and Treynor ratio, which are used to measure CAPM estimation errors, there are no results supporting that investor behavior differs in negative growth and growth periods of the market. In the light of the research made with Jensen's alpha and Treynor ratio, there is no evidence that investors act rationally and exhibit irrational behaviors in negative growth periods of the market. It cannot be said that the CAPM is less reliable in negative growth periods of the market than in growth periods. According to the "Independent T-Test" and "Mann-Whitney U" test results, it was observed that CAPM estimation errors did not differ statistically from growth periods in negative growth periods which included in the study with a high probability of irrational behavior.

According to the research made by Sharpe ratio and Sortino ratio, which are used to measure CAPM estimation errors, it has been determined that investor behaviors differ in negative growth and growth periods of the market. The results obtained support that investor behaviors differ in negative growth and growth periods of the market. Investors are expected to exhibit irrational behaviors during negative growth periods of the market. Therefore, CAPM estimation errors are expected to be larger in the market negative growth periods than in the growth periods. It has been observed that the averages of the CAPM estimation errors calculated with Sharpe ratio and Sortino ratio are larger in negative growth periods of the market than in the growth periods. According to "Independent T-Test" and "Mann-Whitney U" test results, it has been determined that CAPM estimation errors differ statistically in negative growth and growth periods of the market. It is observed that the behavior of investors during negative growth and growth periods of the market affects the reliability of CAPM. It can be said that CAPM is less reliable in negative growth periods than in growth periods.

The same data set, including returns on stocks and risk-free interest rates, was used to calculate CAPM estimation errors calculated by Jensen's alpha, Sharpe ratio, traynor ratio and Sortino ratio. However, there are differences in the way of using the data between the measurement methods. Jensen's alpha and Treynor ratio use beta to measure CAPM estimation error, while Sharpe ratio and Sortino ratio do not use beta. This can be said to be the reason why the test results of CAPM estimation errors calculated by Jensen's alpha and Treynor ratios, and the test results of CAPM estimation errors calculated by Sharpe ratio and Sortino ratio differ.

In this study, it is aimed to draw attention to the fact that investor behavior in negative growth and growth periods of the market may affect the reliability of CAPM. It is seen that the CAPM



estimation errors calculated by Sharpe ratio and Sortino ratio are larger in negative growth periods of the market compared to the growth periods. One of the assumptions of behavioral finance theory that explains the change in investor behavior is that investors avoid negative growth. Investors' tendency to behave irrationally may be high in negative growth periods of the market, where there are negativities that will cause changes in investor behaviors and cause investors to behave emotionally. For this reason, it will be more difficult to predict investor behavior in negative growth periods than in growth periods. CAPM users are advised to pay attention to this situation.

The fact that CAPM estimation errors are small in growth periods of the market supports the assumption of CAPM that the investors are rational. It can be said that CAPM results are reliable when investors are rational.

Supporters of the efficient market hypothesis and CAPM state that price deviations caused by irrational investors will disappear with the intervention of rational investors. The results of tests with CAPM estimation errors calculated by Jensen's alpha and Treynor ratio support this view. According to the test results with the CAPM estimation errors calculated by Jensen's alpha and Treynor ratio, the  $H_0$  hypothesis cannot be rejected.

This study is not aimed at rejecting CAPM or general acceptance of behavioral finance. The factors that cause irrationality in investor behavior and CAPM estimation errors were investigated. According to the results obtained in the study, although there are no findings proving that CAPM is not a reliable model, it is aimed to draw attention to the factors that those who use CAPM should pay attention to when using the model. According to the results obtained in the research, it is seen that CAPM is a more reliable model in the growth periods of the market compared to negative growth periods of the market.

In future research, the effect of investor behavior on CAPM estimation errors can be investigated by increasing the number of companies covered in the research, by including all companies in the examined market, by including different countries and sectors in the research, by expanding the date range of the data used in the research.

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