Fama and French Three Factor Asset Pricing Model with Two New Factors:

A Case from Istanbul Stock Exchange

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ÖZET

İKİ YENİ FAKTÖRLE FAMA VE FRENCH ÜÇ FAKTÖRLÜ VARLIK FİYATLANDIRMA MODELİ: BORSA İSTANBUL'DAN BİR UYGULAMA

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Bu araştırmanın temel amacı, finans yöneticilerinin ve yatırımcıların, yatırım stratejilerini oluştururken risk ve getiri ilişkisini kurmalarında, getirilerini maksimize etmelerinde ve rasyonel karar vermelerinde destek niteliğinde bilgi üretmektir. Fama ve French (1993) üç faktörlü varlık fiyatlandırma modeli 30 yıl sonra, ABD Borsasında risk-getiri arasındaki korelasyonu saptamada geleneksel Sermaye Varlık Fiyatlandırma Modeli'ne (CAPM) göre daha iyi performansı nedeniyle önemli ölçüde dikkat çekmiştir. Bu çalışmanın iki temel hedefi, Fama French (F&F) üç faktörlü varlık fiyatlandırma modelinin (FF3F) BIST (Borsa İstanbul) üzerindeki geçerliliğini test etmek ve getiriyi açıklama gücünü belirlemektir. Bir diğer hedef ise, FF3F varlık fiyatlandırma modelinde kullanılan geleneksel faktörlere (piyasa riski, büyüklüğü ve değeri) ek olarak, işlem hacmi ve döviz kuru faktörlerini modele eklemektir. Araştırmanın verileri, BIST-100'de işlem gören 70 firmaya ilişkin, Ocak 2010 ile Aralık 2019 tarihleri arasında günlük frekanslı olarak elde edilmiştir. Ana veri kaynağı Thomson Reuters Veri tabanı ve TCMB veri portalıdır. Araştırmada yöntem olarak doğrusal regresyon model tahmini kullanılmıştır. Fama ve French'in (1993) modelinin geçerliliğini test etmek ve üç faktörlü modele işlem hacmi ve döviz kuru olmak üzere iki yeni faktör eklenerek modelin geçerliliği tekrar test edilmiştir. Tahmin edilen modellerden elde edilen bulgulara göre FF3F modelinin Borsa İstanbul'da geçerli olduğu ve BIST-100'deki portföy getirilerini etkin bir şekilde açıkladığı sonucuna varılmıştır. Bu geçerliliğe dayanılarak, araştırmada FF3F modeline dahil edilmesi önerilen işlem hacmi ve döviz kuru faktörlerinin, portföy getirilerini açıklamada önemli bir etkiye sahip oldukları ampirik olarak bulunmuştur.

Anahtar Sözcükler: Fama ve French üç faktörlü varlık fiyatlandırma modeli, Yükselen ve gelişmekte olan piyasalar, Borsa İstanbul, İşlem hacmi, Döviz kuru

ABSTRACT

FAMA AND FRENCH THREE FACTOR ASSET PRICING MODEL WİTH TWO NEW FACTORS: A CASE STUDY FROM BORSA ISTANBUL

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Main objective of this research is facilitating financial managers and investors to make appropriate analysis of the risk and return relationship of their investment strategies and enabling them to make rational decisions to maximize their returns. After 30 years, the Fama and French (1993) three-factor model attracted significant attention for its better performance over the conventional Capital Asset Pricing Model (CAPM) in capturing the correlation between risk-return in a sample of U.S. stock market. Based on this, two primary objectives of this study are to determine its validity and to test the Fama French (F&F) three-factor (FF3F) model's performance on the BIST (Istanbul Stock Exchange). Furthermore, another objective is to add trading volume and exchange rate along with the conventional factors used in the FF3F asset pricing model (market risk, size, and value). The data is obtained from 70 listed firms in BIST-100 between January 2010 and December 2019, and the frequency of the data is daily. The main data source is the Thomson Reuters Database and TCMB data portal. The method in this research is linear regression. According to findings we can conclude that the FF3F model is valid in the Istanbul Stock Exchange. Besides, based on empirical evidence, the proposed model with two additional factors (trading volume and exchange rate) is also valid and have substantial impact on portfolio returns.

Keywords: Fama and French three factor asset pricing model, Emerging and developing markets, Istanbul stock exchange, Trading volume, Exchange rate

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ETİK İLKE VE KURALLARA UYGUNLUK BEYANNAMESİ

Bu tezin bana ait, özgün bir çalışma olduğunu; çalışmamın hazırlık, veri toplama, analiz ve bilgilerin sunumu olmak üzere tüm aşamalarında bilimsel etik ilke ve kurallara uygun davrandığımı; bu çalışma kapsamında elde edilen tüm veri ve bilgiler için kaynak gösterdiğimi ve bu kaynaklara kaynakçada yer verdiğimi; bu çalışmanın Anadolu Üniversitesi tarafından kullanılan "bilimsel intihal tespit Programı'yla tarandığını ve hiçbir şekilde "intihal içermediğini" beyan ederim. Herhangi bir zamanda, çalışmamla ilgili yaptığım bu beyana aykırı bir durumun saptanması durumunda, ortaya çıkacak tüm ahlaki ve hukuki sonuçları kabul ettiğimi bildiririm.

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TABLE OF CONTENTS

LIST OF TABLES:

ABBREVIATIONS:

B/M: Book to Market

BIST: Borsa Istanbul

BIST-100: Borsa Istanbul 100 Index

CAPM: Capital Asset Pricing Model

F&F: Fama & French

FF3F: Fama & French three factor Model

FF4F: Fama & French Four factor Model

FF5F: Fama & French Five factor Model

FX-Rate: Foreign Exchange rate

HML: High Minus Low (Value)

HVMLV: High Volume minus Low volume (Trade Volume)

IPOs: Initial Public Offering

ISE: Istanbul Stock Exchange

MPT: Mean Portfolio Theory

OTC: Over the Counter

SMB: Small minus Big (Size)

TCMB: Central Bank of Turkey

TV: Trade Volume

CHAPTER ONE

1. INTRODUCTION

The development of an asset pricing model was a crucial study subject during the modern finance revolution. In the traditional asset pricing theory, markets are expected to be efficient if there is no friction, such as taxes, the market is completely liquid, and there are no transaction costs (Urhayati and Endri, 2020). Liquid markets can help with this because they allow for swift transaction execution. Because of this, a number of asset-pricing models have been created in response to various works that questioned the precision of the Sharpe and Lintner (1964) and Sharpe (1965) Capital Asset Pricing Model (CAPM). In addition to attempting to explain the distribution of average stock returns, these models also attempt to explain the relationship between risk and return. However, since anomalies are frequently found in empirical tests, most models are not flawless. These variables are known as anomalies when a novel risk-return relationship is discovered that cannot be explained by the CAPM (Fama and French, 2008).

It has already been successfully proven (Fama and French, 2015) that the FF3F model augments the market, size, and B/M variables with profitability and investment factors. The model looks at statistically significant variables like operating profitability, B/M, investment, and market capitalization (size). According to the size effect, the small firm impact theory contends that smaller enterprises should often provide higher returns (Banz, 1981). The value impact was originally recognized by Fama and French (1992), who used the book-to-market indicator to demonstrate the relationship between this variable and expected returns. The future risk-adjusted returns for businesses that raise capital are negative (Titman et al. 2004). The last connection is made by Novy-Marx (2013) between profitable businesses and expected returns.

The forecasting potential of these variables risk-adjusted (abnormal) returns must be evaluated in order to determine whether they point to any baffling relationships. Comparing the outcomes of these, two asset pricing model tests require using either the CAPM or the FF3F.

The Fama and French (1993) FF3F model gained significant attention after 30 years due to its superior performance to the traditional CAPM in capturing the correlation between risk-return in a sample of U. S. from 1963 to 1990, stock. The intercept of regressions incorporating a market variable (beta) and substitutes for risk variables, size, and B/M was statistically equal to zero, and the authors used this to show this association. So, it appeared that the three-factor model proposed by F&F (1993) explained the distribution of average returns on stocks.

Accordingly, complex new models with significant new variables have appeared for a variety of sample sets and time periods. This is demonstrated by the Carhart (1997) four-factor model, which gave the FF3F more weight. Additionally, recent research has shown that The FF3F model is insufficient and fails to account for some of the variation in market returns, specifically variation in investment and profitability.

Based on this, our two main goals for this study are to evaluate the FF3F model's performance on the BIST (Istanbul Stock Exchange) and ascertain its validity. The second objective is to combine the traditional elements of market risk, size, and value in the FF3F asset pricing model with trading volume and exchange rate. Less market liquidity, less seasoned market participants, a shorter history, institutional investor dominance, particularly from commercial banks, and a concentration of trading in a small number of companies are unusual characteristics of an emerging market. Market liquidity must therefore be considered in the asset pricing model that is used to value excess return.

The trade volume is one of the primary indicators of market liquidity, which is a crucial component of an effective market. Trade volume is an indicator of how well the exchange system can distribute assets among investors. Calculating the value of an increase or fall in stock price requires knowledge of trading volume, which refers to the cumulative no. of shares traded each day and a key technical analysis indicator (Abbondante, 2010).

After adding these factors, we have a model with 5 factors, and we want to check the performance of the model and its effect on the price and stock returns. For that reason, we are going to study the expected portfolio returns of BIST through the "***Fama and French Three Factor Model***". The portfolios are classified by size (calculated through market

equity) and value (calculated through book-to-market equity). However, in this project, we will also use trading volume and Exchange rate to construct portfolios along with other factors. The general purpose of our project is to check the association of expected returns with factors used in the three-factor model with trading volume and Exchange rate on portfolio return. Trading volume may be a helpful tool, especially for the measurement of risk. A lower trading volume indicates lesser interest of investors or a lower amount of effectively free float share in the market of a particular stock. These issues may increase the return volatility or risk of the portfolio.

Since a few years ago, one of the most important aspects in emerging markets is the exchange rate. Exchange rates have an influence on investment. For this study, we will collect data from Thomson Reuters, State Bank of Turkey (TCMB) and financial statements of companies listed at BIST. Data will be collected and estimated in a daily time period. Further, panel regression analysis will be undertaken to compute the parameters of the risk, size, and value premiums. This research will help us to learn how to construct portfolios, calculate returns, and estimate parameters with more than one explanatory or independent variables.

Turkey has been classified as an emerging market and its equity market is of special interest for domestic as well as foreign investors. FF3F model provides a measure for estimating the expected return on the portfolio. Further consideration of trading volume in the construction of portfolios may provide a better understanding of returns as well as the risk on holding portfolio. From the last 5 years, the Turkish economy has had a devastating effect due to exchange rate fluctuations.

1.1. Significance of the Study

Turkey has been classified as an emerging market and its equity market is of special interest for domestic as well as foreign investors. Fama and French three factor model provide a meaningful measure for estimating the expected return on portfolio. Further consideration of trading volume in the construction of portfolios provides a better understanding of returns as well as risk on holding portfolio. Comparison of expected return

on portfolio of ISE stock using the portfolio formation strategy used in Fama and French Three Factor with the portfolio classified by trading volume and exchange rate will benefit financial managers, investors, researchers etc. Turkish currency Lira which is highly volatile and vulnerable against dollar. It estimates three factor asset pricing model for ISE shares. This research work provides guideline for an investor to compare predicted return with actual return on portfolio and make effective investment decision. This research study exposed that the size, value premium, trading volume and exchange rate increases the explaining power of the model. We have also designed a template which can calculate the risk and return of a portfolio, which is selected by the investors in which they want to invest in. This will become a very help full tool for investment managers, investors, and researchers if we update our database on a regular basis.

1.2. Limitations of the Study

There are several limitations and recommendations regarding the FF3F Model with new factor which are trading volume and exchange rate:

Mixed empirical evidence: As mentioned earlier, the empirical evidence on the impact of trading volume and exchange rates on stock returns is mixed. Some studies have found a significant relationship while others have not. This suggests that the impact of these factors may be context-dependent and may vary across different markets and time periods.

Complex and noisy data: Trading volume and exchange rate data can be complex and noisy, which can make it difficult to accurately measure their impact on stock returns. This can make it challenging to incorporate these factors into investment models and can lead to unreliable results.

Overfitting: The inclusion of additional factors in the FF3F Model can increase the risk of overfitting the model, which can lead to false positive results and reduce the model's predictive power.

1.3. Recommendations of the Study

There are several recommendations regarding the FF3F Model with new factor which are trading volume and exchange rate:

Robustness checks: When adding trading volume and exchange rate factors to the FF3F Model, it is important to conduct robustness checks to ensure that the results are robust to changes in the methodology and data used.

Careful consideration of data quality: It is important to carefully consider the quality of the trading volume and exchange rate data used in the analysis, and to account for any potential errors or biases in the data.

Use of alternative models: Rather than simply adding new factors to the FF3F Model, it may be useful to consider alternative models that are specifically designed to incorporate trading volume and exchange rate data, such as the Liquidity-Augmented Capital Asset Pricing Model (LCAPM) or the International Asset Pricing Model (IAPM).

Overall, while the addition of trading volume and exchange rate factors to the FF3F Model may offer some benefits, it is important to carefully consider the limitations and conduct robust analysis to ensure reliable results.

1.4. Agenda for Future Research

Future research will use the FF5F model with additional variables in economies around the world, not just Turkey. where we might think about incorporating a factor relating to volatility or liquidity. The influence of trading expenses on profits could be accounted for by including a liquidity element. The degree of change in a financial instrument's price over time is known as volatility. By including a volatility element, one might better take into consideration the risk involved in investing in assets with significant price swings.

Furthermore, environmental, social, and governance (ESG) factors are also a potential extra influence. Investors use ESG variables to assess businesses based on their sustainability initiatives and moral standards. ESG criteria could be incorporated into the FF5F Model to provide insight into how these variables impact stock returns. We wish to

determine whether adding a new factor to the FF5F Model increases the model's explanatory power and is supported by empirical data.

CHAPTER TWO

2. CONCEPTUAL FRAMEWORK/ HISTORICAL BACKGROUND

In this section, the main topic of discussion in this part is developing a framework for understanding markets and the factors that influence price changes. Moreover, how these pressures lead to market equilibrium. In addition, we talked about the many kinds of financial markets and how to analyze them.

2.1. The Forces of Demand and Supply and Equilibrium Point

Samuelson and Nordhaus (2009), the term *demand* literally means desire or want for something. Demand is the inclination and willingness of customers to buy a specific commodity or service at a specific cost and at a moment in time. The demand curve is usually downward sloping since the consumer will want to buy more if the value of a particular good or service decreases. As the law of demand expresses the functional relationship between two variables, that is price and quantity of goods, and it simply states that the demand varies inversely to change in price. Demand has an impact on people, businesses, and the financial markets as a whole.

The quantity of goods purchased for the market's sale at a specific price is known as the supply. It is, in other words, the quantity of goods that producers are able and willing to offer for sale at a given price for a given length of time. The supply curve usually positively slopes. It shows the relationship between two variables, that are price and quantity supplied. The quantity supplied depends on the price. As the law of supply explains that price is directly proportional to the quantity supplied, as the quantity increases the price will also increase. The supply curve is not positive all the time, it may be downward, upward, horizontal, and vertical depending on the situation (Samuelson and Nordhaus, 2009).

Market equilibrium refers to the point at which quantity supplied and quantity demanded are equal. It can also be defined as the prices at which the buyer and seller of the good or service have come to an agreement. According to Dobson and Palfreman (1999), The amount of the good or service that is purchased and sold at the equilibrium price is

known as the equilibrium quantity, The price at which buyers and sellers are both supplying the same amount of a good or service is known as the equilibrium price.

The financial market, where people trade commodities, financial securities, and other tradable goods of value at reasonable prices that take demand and supply into account, is a significant contributor to the economy. Prices have a push-pull dynamic due to demand for goods, currencies, and other investments. The stock market is impacted by the law of demand because it controls individual's prices. Investors will purchase more shares of a stock if the price is low or the supply is high, which increases demand for that stock. Similar to this, as investors have shown they are willing to pay more for successful stocks, the price increases (supply decreases). However, when the price is too high, demand declines and investors change course.

Additionally, demand for the stock market may be impacted by the interest rate. As the risk-free rate of return1 rises, it tends to cause a decline in stock demand. As a result, changes in interest rates have an effect on company shares. If everything else remains the same and interest rates fall, share value should increase, and vice versa.[1]

The stock market is reliant on the quantity of shares that will be purchased or offered in the market, the law of supply also has an impact on it. Initial public offerings (IPOs) increase the supply in the stock market, and the no. of shares automatically rises when a new firm is listed on the stock exchange. These two economic forces of supply and demand interact in this way, and the market equilibrium point is where the quantities of goods demanded and supplied meet.

2.1.1. How demand force affects market

Prices in a market economy are primarily determined by the forces of supply and demand. Supply and demand are terms used to describe the readiness of producers to sell a

[1] the interest rate that a potential investor would expect to earn on a risk-free investment over a specific period of time.

product at a specific price and the desire of customers to purchase a product at a specific price. The way these factors interact affects a product's market price.

The market price of a product rises when demand for that thing rises but supply remains constant. On the other hand, the market price of a product decreases when demand for it declines but supply stays the same. The market price of a good declines when the supply of that good rises but the demand stays the same. On the other hand, the market price of a commodity rises when the supply of a good falls, but the demand stays the same.

Price elasticity of a product refers to how well variations in price correspond to shifts in demand and supply. The responsiveness of customers to changes in a product's price is referred to as demand's elasticity.

In conclusion, demand and supply forces are critical to comprehending market economies and how pricing of products and services are established. The result of the interplay between these factors determines a product's market price, and the degree of price elasticity determines how responsive consumers are to changes in a product's price.

2.1.2. How supply force affects market

In a market economy, the supply force, which is a fundamental market factor, controls how much products and services cost. The price of a good and the quantity delivered are directly correlated, according to the law of supply. When a product's price rises, more of it is produced; the opposite is also true.

The market price of a thing is determined by the combination of supply and demand. When a product's supply outpaces its demand, the market price of that product declines. On the other hand, when a thing is in higher demand than is available, its market price rises.

The responsiveness of suppliers to changes in a product's price is referred to as the elasticity of supply. If a product's supply is elastic, a little change in price causes a significant shift in the amount delivered.

In conclusion, the supply force is a key market factor that affects how much products and services cost in a market economy. According to the law of supply, there is a direct correlation between a product's price and the amount delivered. A product's supply elasticity dictates how responsive producers are to changes in price, and an increase or decrease in supply has an impact on the equilibrium product's price and quantity.

2.1.3. Why market equilibrium is important?

When a product is being desired and supplied in equal amounts at a certain price, the market is said to be in equilibrium. The point where the supply and demand curves connect in a market where there is competition is where the equilibrium price is found. The quantity exchanged at the equilibrium price, commonly referred to as the market clearing price, is the equilibrium quantity.

Market equilibrium is crucial because it guarantees that the quantity of a product that consumers want and the quantity that producers supply at a given price are equal. This optimizes the advantages for both consumers and producers and results in the optimal allocation of resources. There will either be scarcity or excess if the market is not in equilibrium, which causes inefficiencies and less-than-ideal results.

In conclusion, market equilibrium happens when the quantity of a product sought and supplied at a given price are equal. Demand and supply curves intersect to form the equilibrium price, which optimizes benefits to both consumers and producers while ensuring effective resource allocation.

2.2. Financial Market and its Types

Financial markets, according to Melicher and Norton (2020), are an exchange where financial assets are bought and sold between buyers and sellers.

Overall, financial markets play an important role in the global economy by facilitating the flow of capital and providing a mechanism for investors to allocate their savings to

different assets. Financial infrastructure is used to accomplish this, allowing entities with money to distribute it to people who might be able to invest it more profitably.

According to Ayadi's (1994) definition, the price discovery function refers to the process by which the market arrives at a consensus price for a financial asset based on the information available to market participants.

The liquidity function is an important aspect of financial markets because it helps to ensure that investors are able to buy and sell assets quickly and easily, and that prices accurately reflect supply and demand. This in turn helps to promote efficiency in financial markets and facilitates the flow of capital (Amihud, 2012).

Because it affects transaction costs and investor returns, the liquidity function plays a crucial role in the market. The degree to which an asset may be swiftly and at stable prices acquired and sold is referred to as its liquidity. It is a gauge of the quantity of buyers and sellers present and the ease with which transactions may be completed.

In order for financial markets to function, liquidity is essential. It guarantees that investors can purchase and sell assets when necessary, maintaining market stability and averting financial catastrophes as a result. The significance of market liquidity has increased as a result of structural changes in the financial system. Securities markets, where money is raised for market investments, are becoming more and more important in the distribution of capital.

Additionally, funding liquidity—the capacity of market participants to secure funding to support their trading positions—is directly tied to liquidity. When there is a surplus of funding liquidity, traders have the means to finance trading positions that reduce price shocks and maintain market liquidity.

In conclusion, the liquidity function plays a crucial role in the market since it affects trading fees and investor profits. By ensuring that investors can buy and sell assets, when necessary, liquidity contributes to market stability and helps to avert financial catastrophes. A liquid market typically carries lower risk, draws more investors, boosts trading activity, and improves pricing efficiency.

In the financial market, a wide range of financial securities are traded. Based on the financial instrument's long- and short-term maturities, it is categorized. We have long-term products including bonds, convertibles, preferred stocks, and more. Whereas bills, commercial paper, certificates of deposit, etc. are examples of short-term instruments. Financial instruments referred to as debt instruments or fixed income instruments are those in which the issuer promises to return the investor's principal plus interest.

Financial markets come in a variety of forms where companies can raise capital to expand, manage risks, and profit from investors.

The commodity market is a real-world or online marketplace for buying, selling, and trading raw or basic goods (Clayton, 2016). The two categories of commodities that are traded in this market are hard and soft commodities. Agribusiness produces soft commodities like wheat, coffee, and sugar while hard commodities like gold and oil are mined.

Price discovery and price risk management are significantly influenced by the commodity futures market. Farmers can trade with correct product prices thanks to commodity trading, and they will be protected by the existence of well-regulated commodity markets. Understanding the variables that influence the evolution of the commodity markets is essential to designing policy frameworks that support the economic goals of sustainable growth, poverty reduction, inflation control, food security, and the decrease of income inequality.

Prices for commodities can affect the economy and inflation. Commodity prices were a significant factor in both the inflation spike that started in 2021 and the subsequent decline from high inflation levels.

In conclusion, the commodities market is a setting for the purchase, sale, and exchange of raw materials or basic goods. It enables access to commodity goods in a controlled and liquid market for both producers and consumers. Price discovery and price risk management are significantly influenced by the commodity futures market. Farmers can trade with correct product prices thanks to commodity trading, and they will be protected by the existence of well-regulated commodity markets. The design of policy frameworks that support the economic goals of long-term growth, inflation stability, reducing hunger, and the

mitigation of income inequality depends on an understanding of the factors that shape the development of the commodity markets.

According to Stigum (1990), **the money market** facilitates the economy by providing a mechanism for businesses, governments, and other organizations to borrow and lend funds on a short-term basis. It also provides investors with a low-risk, low-return investment option that can be used to park excess cash holdings.

The money market is significant because it supports the market's equilibrium between supply and demand for short-term financial activities. It fosters corporate expansion, which is advantageous for economic growth. It aids in the analysis of particular monetary policies.

The government can raise short-term funding by issuing treasury notes on the open market with the aid of a developed money market. The government would be obliged to begin printing and releasing more money or borrowing from the central bank, the two of which would cause inflation, in the absence of a functioning money market.

Money markets act as trading platforms for the shortest-term instruments and as channels for the implementation and transmission of monetary policy, stabilizing the entire term structure of interest rates. One of the biggest financial markets in the world, money markets are an essential part of the financial architecture of industrialized nations.

In conclusion, the money market serves to meet the requirement for short-term borrowing and lending by individuals, businesses, or the government. It is a market where short-term financial securities are traded. It aids in evaluating specific monetary policies, strengthens the market's equilibrium between supply and demand for short-term monetary transactions, and makes it easier for central banks to operate efficiently. A well-developed money market reduces inflation while assisting the government in raising short-term financing.

The short-term maturity of the money market, which normally ranges from a few days to a year, is one of its fundamental characteristics. Money market instruments are regarded as relatively low-risk investments due to their short-term nature. Additionally, they frequently provide lesser returns than longer-term assets like bonds or stocks.

According to Afonso (2013), **the interbank market** is a financial market where banks and other financial institutions trade financial instruments with each other. It is a wholesale market, meaning that transactions take place between large financial institutions and not between individual investors.

The interbank market plays an important role in the financial system, providing a mechanism for banks to manage their liquidity needs and adjust their balance sheets. Banks use the interbank market to borrow and lend funds to other banks on a short-term basis, typically overnight or for a few days. This allows banks to manage their daily cash flow needs, meet regulatory requirements, and provide funding for loans and other investments.

The interdealer market, a subset of which financial organizations can trade a range of asset classes with each other and on behalf of their clients over the counter (OTC), is where these transactions take place. Interdealer brokers frequently act as intermediaries in these transactions.

Because it enables banks to control their own exposure to interest rate and currency rate risk, the interbank market is crucial. By giving financial institutions liquidity, it also aids in the smooth operation of the global financial system. A crucial avenue for the implementation and dissemination of monetary policy is the interbank market. Additionally, it is crucial for capital allocation, effective liquidity distribution between financial institutions, and the hedging of near-term risks.

The interbank market also has a significant impact on the foreign currency market. It controls the exchange rates for all currencies because it is the main market where they are traded. The interbank market is crucial for managing foreign exchange risk for businesses and for facilitating currency exchange in international trade and investment.

2.2.1. Capital market

According to the New York Stock Exchange (1987), Capital market refers to the markets in which long-term securities are traded or issued. Long-term securities are debt and

equity. In other words, we can say that the Capital market is a place where buyer and seller exchange their views and transacted their securities.

The advancement of the capital market has created two major sets in the economy, first it has improved capital allocation and second the development of the capital market has played an important role to adjust risk more efficiently.

A primary market or a secondary market are both possible in the capital market. New stock or bond issues are offered to investors in a main market, frequently via a process called underwriting. Governments, businesses, and investment trusts are the key organizations looking to raise long-term capital on the primary capital markets.

The capital market is crucial because it gives governments and corporations access to long-term finance. It enables companies to raise money for growth and investment, which can result in the creation of jobs and economic expansion. Governments can also finance public works and infrastructure, such as roads, bridges, and schools, through the capital market.

The capital market is crucial for the effective distribution of liquidity among financial institutions, the allocation of capital, and the hedging of long-term risks. Additionally, it enables investors to share in long-term capital gains.

In conclusion, it offers a source of long-term funding for companies and governments, enabling them to fund infrastructure and public projects as well as raise money for growth and investment. The allocation of capital, the effective distribution of liquidity between financial institutions, and the mitigation of long-term risks are all significant functions of the capital market, which is made up of primary and secondary markets like the stock market and the bond market.

It can be classified into the following:

According to Hafer and Hein (2007), you can buy, sell, and trade stocks on any given weekday on **the stock market**. It is also referred to as a stock exchange, and it is a network of exchanges where prosperous businesses go to raise significant sums of money for growth. Investors invest in the stock market because it offers a good opportunity to generate returns

that outperform inflation over the long term. When the businesses increase their profits, the investors benefit. Companies may sell stock to raise money for their operations or, eventually, when they need to advance to a new stage of development.

The stock market is significant because it has a significant impact on a nation's economy and helps that nation's economy expand. Businesses can use it to raise money for operations and expansion, and it offers chances for the securities to be liquidated. The stock market measures the state of the nation's economy and acts as a barometer for it. With every big shift in the nations and economy, share prices fluctuate, signaling boom or bust cycles.

Additionally, the stock market encourages better capital allocation because it is simpler to find information about companies listed on the stock market and because media sources are more inclined to cover them. By bringing buyers and sellers together in one location and accounting for the impact of all variables that can affect enterprises, it also aids price discovery. The stock market can help an economy flourish by encouraging savings investments and stimulating economic activity.

In trading activities, it guarantees price openness, liquidity, discovery of prices, and fair deals. By assisting firms in raising cash, offering chances for liquidity of the securities, and acting as an economic barometer, the stock market is essential to a nation's economy. Additionally, it encourages better capital allocation and can contribute significantly to the growth and economic growth of a country.

The bond market, sometimes referred to as the debt market, is a place for investors to trade in and out of debt securities, most frequently in the form of bonds. The bond market is significant because it gives businesses and governments access to long-term finance. It enables them to raise money for long-term projects that could result in the development of jobs and economic expansion. Bonds, which pay interest to investors over time, offer investors a means to profit from their investment in the bond market.

By affecting interest rates, the bond market has an impact on the economy. Investors will purchase bonds during a recession and be willing to accept lower rates in order to protect their capital. Bond issuers have the financial means to pay lower interest rates while still selling all the bonds they require. Bonds appear alluring when the economy and stock market

are in decline because they provide a set interest payout. Bonds are more appealing during a contraction or recession of the business cycle.

The bond market also has a significant impact on how well financial markets operate. The efficient operation of critical market segments, such as the bond market, is crucial to the process by which policy changes are implemented in the larger economy. Economic efficiency and welfare depend heavily on the efficient operation of financial markets. The ability to acquire capital may be restricted or become more expensive, which could have a detrimental effect on economic growth.

In conclusion, the bond market is a place for people to buy and sell debt instruments as well as issue new debt. It gives governments and businesses a source of long-term financing, enables investors to get a return on their investment, and influences interest rates, which in turn has an impact on the economy. The bond market also has a significant impact on how financial markets operate and how policy changes are implemented in the larger economy.

In the bond market, investors can buy bonds issued by corporations, governments, or other organizations. These bonds typically have a fixed maturity date and pay interest to the investor at a specified rate until the bond matures. Bonds can be traded on secondary markets, where their value can fluctuate based on factors such as changes in interest rates, credit ratings, and market conditions (Fabozzi and Fabozzi, 2021).

2.2.2. Financial & capital market analysis

According to Blake (1990), book value is determined by the balance in its financial statement. Asset values are determined by deducting any depreciation, amortization, or impairment expenses from the asset's initial cost. Book value provides a snapshot of an asset's worth as recorded in the company's accounting records, but it may not reflect the true market value of the asset. In contrast, market value on the other hand, refers to the current price that an asset would fetch if it were sold on the open market.

Intrinsic value refers to the inherent or fundamental value of an asset, independent of its market price. It is the value that an asset is deemed to have based on its underlying characteristics, such as its earnings potential, cash flow, assets, and liabilities (Reddy, 2012). The intrinsic value gave the concept of mispriced assets. Mispriced assets are those assets whose price and intrinsic value are not equal, which is responsible for providing an arbitrage opportunity in the market and at this point these assets become undervalued or overvalued. When price and intrinsic value are equal this is the equilibrium point.

Undervalued stocks are those stocks whose price is less than their intrinsic value (Hauser and Huber, 2012). It can also be explained as this stock will provide a greater rate of return as compared to the expected return. When the price of any security is lower, the investors seek this opportunity and rush to buy the stocks and this action drives the price of the stock up and expected return down.

Overvalued stocks are the stocks which offer less rate of return as compared to the expected rate of return (Hauser and Huber, 2012). Investors usually tap this opportunity and sell their stocks at higher prices and earn higher profit.

The situation of disequilibrium in stock prices does not prevail long in the market and these prices adjust rapidly and come to market security line. But disequilibrium condition provides chances for arbitragers to earn higher profit and maximize their returns.

An essential component of financial market analysis is the evaluation and analysis of traded securities. It comprises developing and managing portfolios using securities, as well as using securities to improve portfolio performance. Fundamental analysis, technical analysis, and quantitative analysis are all used in the analysis and value of stocks. To assess a company's financial standing and future prospects, fundamental analysis examines its financial statements. In quantitative analysis, financial data is analyzed using mathematical models to forecast future market trends.

For the formulation and diagnosis of monetary policy, financial market analysis is also crucial. It is a useful tool for policymakers and is used to set benchmark rates for the markets' pricing of assets. Financial market analysis can assist policymakers in developing

efficient policies to accomplish their objectives and in comprehending how monetary policy influences the economy.

In conclusion, financial market evaluation is the process of comprehending a specific financial market's past, present, and future. Analyzing the make-up of financial markets, trading, transactions, securities, stocks, and other financial contracts are all part of the process. Because it offers information on the functioning of financial markets and aids in making wise investment decisions, financial market analysis is significant for both investors and policymakers. It is critical to the creation and diagnosis of monetary policy as well as the study and value of traded securities.

2.2.3. Financial markets in Turkey

The main stock exchange in Turkey is called Borsa Istanbul (BIST). Equities, debt securities, derivatives, and precious metals and diamond markets are the four primary markets run by BIST. The main market for trading stocks, exchange-traded funds, and real estate investment trusts is the equity market. Treasury bills, corporate bonds, and government bonds can all be traded on the debt securities market. Trading in futures and options contracts on stocks, indices, and commodities is available in the derivatives market. Gold, silver, platinum, palladium, and diamonds can all be traded on the Precious Metals and Diamond Markets. The BIST 100 Index, BIST 30 Index, BIST Banking Index, BIST Industry Index, BIST Services Index, BIST Technology Index, and BIST Financial Index are just a few of the indexes that BIST maintains to monitor the performance of various market segments. BIST is a self-regulatory organization without a monopoly.

2.2.4. Istanbul stock exchange

The previous Istanbul Stock Exchange (ISE), the Istanbul Gold Exchange, and the Turkish Derivatives Exchange have all been combined into the one exchange company known as Borsa Istanbul (BIST). BIST provides a number of indices that monitor the performance of various market sectors. The BIST 100 Index, which excludes investment trusts, is a capitalization-weighted index made up of National Market firms. It serves as a

benchmark for evaluating the effectiveness of the national market of the Istanbul Stock Exchange. The 30 most liquid and highest market value equities traded on the National Market make up the free float market capitalization-weighted BIST 30 Index. The most liquid and valuable banks trading on the National Market makes up the free-float market capitalization-weighted BIST Banking Index. The most liquid and expensive companies traded on the National Market make up the free-float market capitalization-weighted BIST Industry Index. The most liquid and greatest market value equities traded on the National Market make up the free float market capitalization-weighted BIST Services Index. The most liquid and expensive technology equities traded on the National Market make up the BIST Technology Index, a free float market capitalization-weighted index. The most liquid and valuable financial equities traded on the National Market make up the BIST Financial Index, a free float market capitalization-weighted index.

2.2.5. BIST 100

The BIST 100 Index, which excludes investment trusts, is a capitalization-weighted index made up of National Market firms. It serves as a benchmark for evaluating the effectiveness of the national market of the Istanbul Stock Exchange. The main stock exchange in Turkey, Borsa Istanbul, is referred to by the term BIST 100 Index. It controls exchange operations and is a commonly used gauge of the Turkish stock market. During trading hours, the BIST 100 Index is updated every 15 seconds and is based on the free-floating market capitalization of the companies that make up the index. Investors monitor the development of the Turkish stock market and make investment decisions using the BIST 100 Index.

2.2.6. Tools in financial market analysis

In order to evaluate the performance of the financial markets and make wise investment decisions, financial market analysis uses a variety of instruments. The following are a few frequently used financial analysis tools:

2.2.6.1. Ratio analysis

Ratios analysis provides a more granular view of a company's financial standing, which can help investors and creditors make more informed decisions. By comparing ratios between different companies, analysts can spot trends and potential opportunities. By tracking ratios over time, they can also identify any potential risks that a business may be facing.

Fundamental equity research is built on ratio analysis, which aids in the examination of financial elements like profitability, liquidity, and efficiency. It can provide information on a company's performance as well as profitability, liquidity, earnings, and other financial characteristics like risk, reward (profitability), solvency, and how well the business is run.

There are other ratios available, but analysts and investors like to utilize the price-to-earnings ratio and net profit margin the most. Ratio analysis is a tool that allows you to compare the financial performance of companies in the same industry or sector to benchmark performance and identify trends over time. It also helps identify potential opportunities and risks that may arise in the future, enabling investors and financial professionals to make more informed decisions.

2.2.6.2. Comparative financial statements

Financial statements that compare one financial statement to those from earlier periods are referred to as comparative financial statements. The full set of financial statements that a company releases, which include information from many reporting periods, can be included in comparative financial statements. The balance sheet, profit and loss accounts, and cash flow statements for the last two years are the financial statements that could be included in this package.

For the following reasons, comparative financial statements are quite helpful: they make it simpler to see a company's performance over a number of time periods by only looking at one document; they summarize the company's accomplishments over two

accounting periods; they enable investors to determine trends and make wise investment choices; and they report the company's achievements over two accounting periods.

In conclusion, the full set of financial statements that a company releases, which include information from many reporting periods, can be included in comparative financial statements. They are very helpful for making it simpler to view a company's performance over a number of time periods, reviewing a company's financial growth, and spotting trends so that investment decisions may be made with knowledge.

2.2.6.3. Common size statements

A financial statement that shows line items as a percentage of one chosen or common amount, like total sales revenue, is called a "common size financial statement." Analysts have the chance to evaluate organizations based on several factors thanks to common-sized financial statements.

All numbers are rounded to the nearest equivalent in common size financial statements, such as a percentage of sales or assets. The standardization of figures varies slightly between financial statements. Using the following formula, common size analysis of financial statements is calculated:

Common size analysis = (specific line item / base item) x 100%

We can evaluate the ratio of inventory to total assets, for instance, using the balance sheet. The term "horizontal analysis" describes the examination of certain line items throughout time. For instance, we may evaluate the evolution of net income over the last five years. By comparing particular line items to a base item, investors might see significant changes in a company's financials and draw key conclusions.

In conclusion, a financial statement that shows line items as a percentage of a chosen or standard figure, like total sales revenue, is called a common size financial statement. It makes it simple to compare firms or time periods for the same company. All numbers are rounded to the nearest equivalent in common size financial statements, such as a percentage of sales or assets.

2.2.6.4. Trend analysis

Trend analysis is a method for analyzing data to find patterns or trends that can be used to guide investment choices, forecast future outcomes, and assess rivals' performance. To uncover useful patterns from the provided information, it entails gathering data from various time periods and plotting that data on a horizontal line.

Every line element on the profit or loss statement and balance sheet is frequently evaluated using trend analysis. The organization's profit and loss statement's cost and sales data are arranged on a horizontal line for various time periods, and this analysis looks for trends and discrepancies in the data. The market trend of the entity over a period of time, for which historical data and chart patterns are employed for interpretation, can also be explained using trend analysis.

In conclusion, trend analysis is a method employed in technical analysis that tries to forecast future stock price changes based on trend data that has previously been observed. By examining the financial data of an organization over time, it is used to assess its financial health. By concentrating on the change in particular line items within the balance sheets and income statements, trend analysis offers a way to assess corporate data over a period of time. It can also be used to explain the market trend of the business over time. It is frequently used to examine each line item on the balance sheet and income statement.

2.2.6.5. Cash flow analysis

Analyzing a company's cash inflows and outflows and the quantities involved in each is called cash flow analysis. Because it emphasizes the cash that is accessible to pay bills and make purchases, generally speaking, money that is needed to run and expand the business, it is a crucial component of a company's financial management. Cash flow analysis looks at how much money gets into and leaves an organization, where it comes from, where it goes, and where it goes to. Current assets less Current Liabilities is the Net Cash Flow for any Period.

A corporation must first create a cash flow statement that details all of the cash it receives from ongoing operations and outside sources of investment, as well as all of the cash it expends to fund operations and make investments over the course of a specific period. It includes the cash that the company generates through operations, investments, and financing; this number is known as net cash flow. Accounts payable, amortization, depreciation, and various deferred items recorded as revenue or expenses but without corresponding cash flow are also included in the cash flow statement.

Analyzing cash flow statements involves looking at how money enters and leaves a business. It aids in monitoring business expansion and can be used to assess a company's capacity for cash flow and bill payment. The identification of possible cash flow issues, such as a decline in operating cash flow or an increase in financing activities cash flow, can also be done using cash flow analysis.

In conclusion, cash flow analysis is a method of looking at the amounts of cash that come into and go out of a business. It is a crucial component of financial management since it highlights the cash that is available to cover expenses and make purchases. Cash flow analysis looks at how much money gets into and leaves an organization, where it comes from, where it goes, and where it goes to. A corporation must create a cash flow statement that details all cash inflows and outflows before conducting a cash flow analysis. Analyzing cash flow statements can be used to monitor business progress by looking at how money enters and leaves a company. It can also be used to spot possible issues with cash flow.

2.2.6.6. Fund flow analysis

A monthly or quarterly measurement of a company's input and outflow of assets is known as a "fund flow analysis." When comparing two balance sheets and the inflow and outflow of funds, it is used to examine changes in a company's financial condition.

In order to verify the transfer of money from the prior fiscal year to the current year, a funds flow statement analyzes a company's balance sheets for the past two years. It illustrates the movement of money among various sources and how it was used by comparing the sources of inflow and outflow of money throughout the relevant accounting period. It is

also known as the Statement of Sources and Application of the Funds. An study of the funds flow statement compares different elements of a balance sheet. It acts as a financial indicator that aids a business in maintaining control over its finances and creating a more effective plan for allocating resources. The identification of possible cash flow issues, such as a decline in operating cash flow or an increase in financing activities cash flow, can also be done using fund flow analysis.

In conclusion, fund flow analysis describes the input and outflow of money or other assets for a business and is frequently measured on a quarterly or monthly schedule. When examining two balance sheets and the inflows and outflows of funds, it is used to examine changes in a company's financial condition. In order to verify the transfer of money from the prior fiscal year to the current year, a funds flow statement analyzes a company's balance sheets for the past two years. Potential cash flow issues can also be found via fund flow analysis.

2.2.6.7. Technical analysis

In order to produce insightful consumer data, trend lines are made using statistical data and records of recent market behavior. This is employed in the technical analysis of stocks. Charts are used by traders to discover probable trade entry and exit positions using technical analysis tools. Any security with a trading history can benefit from technical analysis.

Technical analysis makes use of findings from behavioral economics, market psychology, and quantitative analysis to extrapolate previous performance into predictions of future market behavior. Technical analysis makes the assumption that the market has taken into account all information that is currently accessible and that this is reflected in the price chart. Technical analysis, commonly referred to as "charting," has long been used in the financial industry. However, compared to more conventional methods like basic analysis, this discipline has not been subjected to the same amount of scholarly examination and approval.

In conclusion, technical analysis makes use of findings from behavioral economics, market psychology, and quantitative analysis to extrapolate previous performance into predictions of future market behavior. Technical analysis makes the assumption that the market has taken into account all information that is currently accessible and that this is reflected in the price chart. In contrast to technical analysis, which concentrates on recent price patterns and stock trends, fundamental analysis concentrates on the financials of a company.

2.2.6.8. Bloomberg tools

For financial professionals who want real-time data, information, analytics, and trading tools, Bloomberg Professional Services offers a variety of software and hardware products known as "Bloomberg tools." The most potent and adaptable tool for financial professionals that want real-time data, news, analytics, and trading tools is the Bloomberg Terminal. Leading decision-makers may quickly access news, statistics, specialized expertise, and trade tools through this service. Your desktop and mobile devices can access content that The Terminal can't through The Terminal. It features powerful alerting capabilities, sophisticated graphing, and news that drives markets in addition to dynamic multi-asset class security monitors.

With the help of Bloomberg APIs, customers may combine their current technology with the breadth and depth of Bloomberg's resources to create custom trading and investment models. How to use and manage your Terminal subscription, along with other associated goods and services, is covered in the API Library's user manuals.

Users of Bloomberg can access the most frequently asked questions concerning their software, hardware, mobile apps, and connection as well as other customer support services. In order to access their Bloomberg Terminal subscription remotely from a computer, laptop, or mobile device, users can also utilize remote access and mobile services.

In conclusion, the term "Bloomberg tools" refers to the collection of hardware and software solutions offered by Bloomberg Professional Services. These products are created for financial professionals. The most potent and adaptable tool for financial professionals

that want real-time data, news, analytics, and trading tools is the Bloomberg Terminal. With the help of Bloomberg APIs, customers may combine their current technology with the breadth and depth of Bloomberg's resources to create custom trading and investment models. Users of Bloomberg can access the most frequently asked questions concerning their software, hardware, mobile applications, and connection as well as other customer support services.

Lastly, financial market analysis uses a variety of instruments to assess the performance of financial markets and help investors make wise choices.

2.3. Risk and its Types

Risk is the level of irrationality and/or the potential for monetary loss that comes with choosing an investing strategy. All investments carry some level of risk, and when the risk of an investment increases, investors look for bigger returns to make up for the increased risk. Market risk, credit risk, liquidity risk, operational risk, strategic risk, and event risk are just a few of the categories that risks in finance are broken down into.

Understanding financial risk is crucial because it enables investors to manage their portfolios and make wise investment decisions. Investors can evaluate a company's future using a variety of financial risk ratios. Financial risk for businesses can lead to capital loss, debt default, or loss of influence over monetary policy.

In conclusion, risk is the degree of ambiguity and possible financial damage that is present in a decision to make an investment. Market risk, credit risk, liquidity risk, operational risk, strategic risk, and event risk are just a few of the categories into which risks can be divided. Understanding financial risk is crucial because it enables investors to manage their portfolios and make wise investment decisions.

There are several types of risk in finance, including financial risk, market risk, credit risk, liquidity risk, operational risk, strategic risk, event risk, speculative risk, longevity risk, currency risk, legal risk, and asset-backed risk. In this study we are going to talk about systematic and unsystematic risk.

2.3.1. Systematic risk

Systemic risk refers to the risk associated with the entire market or market sector. Undiversifiable risks are also called market risks, volatility risks, and undiversifiable risks. Economic, geopolitical, and financial factors, among others, are the causes of systematic risk because they are outside the control of a particular business or person. Natural disasters, weather-related occurrences, inflation, interest rate changes, war, and terrorism are a few examples of systemic risk. Systematic risk, as opposed to focusing on a particular stock or industry, impacts the entire market or a significant portion of it.

Significantly unpredictable and challenging to avoid systematic risk. Which affects a particular industry or security, is distinguished from systematic risk. Diversification can help to lower unsystematic risk. Systematic risk is highly unpredictable and challenging to eliminate, although investors can minimize its effects by diversifying their holdings. The goal of the diversification strategy is to lower the total risk of the portfolio by investing in a variety of assets. Investors can limit their exposure to any one specific asset or market segment by diversifying their portfolio.

Using hedging techniques like buying put options or short selling is another strategy to control systematic risk. By using these tactics, losses in the investor's portfolio are compensated by taking positions that will make money if the market collapses. These tactics, however, can be complicated and might not be appropriate for many investors.

In conclusion, systematic risk refers to the risk that is intrinsic to the entire market or market segment and is associated with stock market investing. It impacts the entire market or a significant portion of the market, not just a single stock or industry, and is brought on by causes outside the control of a particular business or person. Although systemic risk is mostly unpredictable and challenging to eliminate, investors can partially lessen its effects by diversifying their holdings. Although systemic risk is mainly unpredictable and challenging to eliminate, investors can lessen its effects by diversifying their holdings and utilizing hedging techniques like buying put options or short selling. Hedging methods entail holding positions that will profit if the market collapses, offsetting losses in the investor's

portfolio, whereas diversification strategies involve investing in a variety of assets to lower the total risk of the portfolio.

2.3.2. Unsystematic risk

The terms specific risk, diversifiable risk, residual risk, and company-specific risk are also used to describe it. Systematic risk is the type of risk that is built into the market and cannot be eliminated through diversification, whereas unsystematic risk can be decreased through diversification.

Internal factors including management changes, product recalls, legislative changes, and strikes can lead to unsystematic risk. Through diversification in the sense of an investment portfolio, it can be prevented and managed. Unsystematic risk is the inherent unpredictability of an investment in a company or sector. Strikes, natural disasters, and legal processes are a few examples of unsystematic risk.

Through diversification, which entails distributing investments over a number of asset classes and/or geographic areas, unsystematic risk can be reduced. Investors can lessen their exposure to any one specific asset or market area and so lessen the impact of unsystematic risk by diversifying their portfolios.

By investing in a variety of assets, including cash, equities, bonds, mutual funds, ETFs, and other funds, one can attain diversification. By making investments in many businesses operating in the same sector or industry, investors can diversify their portfolios across asset classes. Investing in various asset categories, such as real estate, commodities, or alternative investments, allows investors to diversify beyond asset classes.

In conclusion, unsystematic risk is the kind of risk that is distinctive to a given business or sector and can be decreased through diversification. Internal issues like changes in leadership, product recalls, modifications to regulations, and strikes are the main culprits. Strikes, natural disasters, and legal processes are a few examples of unsystematic risk. Through diversification, which entails distributing investments over a number of asset classes and/or geographic areas, unsystematic risk can be reduced. Investors can lessen their exposure to any one specific asset or market area and so lessen the impact of unsystematic

risk by diversifying their portfolios. Investments in a variety of assets, including cash, equities, mutual funds, bonds, ETFs, and other funds, as well as diversification both within and between asset classes, can help accomplish diversification.

2.4. Asset Pricing and Portfolio Theories

The portfolio theories facilitate the investors to find out the relationship between risk and expected returns. These portfolio theories are based on certain assumptions which include the concept of optimum portfolio. The term portfolio is the collection of financial assets like stocks, bond, etc. and the optimal portfolio is that portfolio which maximizes the utility of the investor (Kim, 2013). Systematic risk cannot be diversified, and the investor has to face it at any cost. The other one is an unsystematic risk, which can be diversified. These models help individual investors to diversify their systematic risk by using different techniques.

One of the most significant and enduring economic theories that addresses finance and investment is MPT. Harry Markowitz created it, and in 1952 he published "Portfolio Selection" as a paper in the Journal of Finance. Investors, financial analysts, and portfolio managers frequently utilize MPT to build diversified portfolios that maximize returns while lowering risk.

In conclusion, Modern Portfolio Theory (MPT) provides a mathematical framework for creating investment portfolios that optimize expected return for the total amount of assumed risk. MPT is significant because it aids in building diversified portfolios for investors that optimize returns while minimizing unacceptably high levels of risk. The theory makes use of the fundamental principle of diversification, which states that maintaining a portfolio of assets from various classes is less hazardous than doing the same with a portfolio of similar assets. Investors, financial analysts, and portfolio managers frequently utilize MPT to build diversified portfolios that maximize returns while lowering risk.

2.4.1. Mean-variance theory

Mean-variance theory is developed by Markowitz in 1952 and is constructed on the concept of how a risk-averse investor can construct a portfolio to maximize his/her returns at a given level of risk so there arises a concept of efficient portfolio. An efficient portfolio can be defined as that an investor can construct through which he can maximize his returns at a certain or minimum level of risk and vice versa (Markowitz, 2000). The main objective of this theory is to derive the expected rate of return of the portfolio and measure the risk factors which affect the rate of return.

Because it offers a mathematical foundation for creating ideal portfolios that optimize expected returns for a specific degree of risk, the mean-variance theory is significant. The theory further implies that investors can accurately estimate the expected return and risk of each asset and that they have access to all pertinent information about the assets in the portfolio.

The assumption of reason and the availability of all pertinent information are two of the mean-variance theory's many drawbacks. The theory also makes another assumption that is not necessarily true in actual financial markets: that the expected return and risk of any asset remain constant throughout time. Despite these drawbacks, the mean-variance theory is nevertheless a crucial tool for managing portfolios and making investment decisions.

Markowitz derived the formula for the variance of the portfolio and highlighted that the risk factor can be measured by calculating the variance of the portfolio. But variance only indicates the risk of an individual risky asset. However, the risk factor of multiple assets portfolio can be diversified by creating different combinations of assets and computing their correlation. Positively correlated assets have systemic risk, which implies they are in direct relationship and are risky by nature. In contrast, negatively correlated assets are regarded to contain unsystematic hazards because their prices will not move in the same direction (Levy, 1970). Therefore, by avoiding the correlated assets, an investor can diversify their risk and maximize their return. The formula for calculating risk and return is as follows:

$$\sigma 2 = \Sigma(Ri - R)\ (\mathrm{Pi})$$

$$R = \Sigma\ (\mathrm{Ri})\ (\mathrm{Pi})$$

Where,

$\sigma 2$ = variance

R = expected return

Ri = return of $_n$th possibility

Pi= probability of return

2.4.2. *The Capital asset pricing model (CAPM)*

Investors often desire a market equilibrium price for a security since they are risk averse by nature, which is determined by the linear trade-off between systematic risk and the necessary rate of return. The CAPM explains that the return increases as risk increases. The William Sharpe one-period model, which is employed to estimate the portfolio's required rate of return. In reality, it demonstrates the connection between expected return and systematic risk, or non-diversifiable risk. A statistic called beta is used to evaluate the systematic risk of a securities or portfolio to the market's overall risk. The risk and return relationship are measured by the following equation which is also known as market line security (Levy, 2012).

$$R_i=R_f + (R_m-R_f)\,\beta_i \qquad (1)$$

It is an equation which takes in three pieces of information regarding an asset and market index, the risk-free rate (Rf), the expected return of stock, and the risk premium (E {Rm} – Rf), (Rm is market return). The CAPM is a extensively used model in asset pricing, and it provides a better understanding of systematic risk, diversification and allocating capital for investment.

2.4.3. *Arbitrage pricing theory (APT)*

The APT was first presented by Stephen Ross in 1976. This theory's central idea is that there is room for arbitrage in the market because the price of an asset is influenced by a variety of variables. The investor can estimate the price of an asset in which he wants to

invest and can easily earn profit by tapping the arbitrage opportunity. The term “arbitrage opportunity” can be defined as buying an asset at a low price and selling it out immediately at a higher cost in the financial market, this price difference is known as arbitrage profit (Wilhelm, 1988).

It is difficult to highlight those factors that influence the price of stocks and required a lot of research but the five key variables that have the greatest impact on stock prices:

Expected inflation: If investors expect inflation to increase, it can lead to higher interest rates and reduced demand for stocks, as investors may shift their money to other investments such as bonds or cash.

Unexpected changes in inflation: Sudden changes in inflation rates can cause uncertainty and volatility in the stock market. Inflation can affect consumer spending, business investment, and interest rates, which can all impact the stock market.

Unexpected changes in industrial production: Changes in industrial production can affect the economy as a whole and specific industries, which can impact the stock market. For example, a decrease in industrial production can lead to reduced corporate earnings and lower stock prices.

These variables reflect changes in the economy and market conditions that can impact investor sentiment and decision-making, which can in turn affect stock prices. The first three factors have an impact on cash flows, dividends, and dividend growth, while the final two have an impact on market capitalization and discount rate, respectively. The following is the equation for the theory of arbitrage pricing.

$$R = \alpha + \beta_1 F_1 + \beta_2 F_2 + \varepsilon \qquad (2)$$

Where F_1 and F_2 are the values of the factors, and a is the return when both factors are zero. β_1 and β_2 review are the slopes and ε is the error term. It is the foundation of equilibrium price and highlights relevant risk factor that affect the price of securities. It helps investors to decide whether the stocks or assets are overvalued or undervalued.

2.4.4. *Three factor Fama and French model (FF3F)*

The FF3F model, an expansion of the CAPM, was put forth by F&F in 1992. A single factor served as the foundation for the CAPM model. In order to create a three-factor model, they added the additional factors of size (market capitalization) and value (book to market equity). By adding these factors, the model becomes more efficient to estimate the excess expected rate of returns of portfolios. They consider the period from 1963-1992 and found that the stock with smaller market capitalization performs better than the higher market capitalization and High BE/ME tends to outperform Low BE/ME.

The 3-factor explains that beta is a risk measure, but it is not a true measure of realized returns. F&F claimed that the realized returns are better explained by the size and value factors. They are weighing indicators for average stock returns as compared to beta and they are appropriate proxies for risk.

2.5. Fama and French Three-Factor model in detail

In 1992, The FF3F Model was developed by F&F based on three risk factors. The size, value premium, and market beta form the basis of the FF3F model.

Generally speaking, the FF3F model is an expansion of the CAPM, which is a single period model based on market beta i. e. risk that is systematic. The average expected return's association with market beta is explained by the CAPM. It makes the supposition that beta is the only risk factor that can be used to calculate the expected return on common stocks.

They extend the CAPM by adding market equity (size), price time outstanding shares, and the ratio of book equity to market equity in addition to market beta.

By including these factors, they conclude that beta in combination with these variables and alone has little information about the average market return. However, the true measure of risk and expected return is not affected by beta, which increases the explanatory power of the regression equation. According to F&F, the inclusion of size and value premium increases the accuracy of the prediction of expected stock returns because they serve as the proper risk substitutes.

The market equity, price time outstanding shares is generally called size factor and shows the related profitability of the firm. It concludes that the firm with a small size will have a high average expected return given their beta estimator whereas the firms with a big size will have a low average expected return given their beta estimator.

The B/M equity ratio is called value premium. The value factor shows that the firms with high B/M equity are fundamentally rich, and these companies pay a rich and consistent dividend. These stocks are usually undervalued and generally known as value stocks. Firms with low book-to-market equity are overvalued and they do not care about paying dividends, they just focus on their growth. These stocks are known as growth stocks. So, growth stocks outperform value stocks and generate higher returns.

They explain FF3F model with size, value premium, and market beta and determine size and value premium are better proxies for risk of average expected stock return.

The FF3F model equation is as follows:

$$r_p = R_F + \beta_1 SMB + \beta_2 HML + \beta_3 (R_M - R_F) \quad (3)$$

Were,

r_p Shows average market return on portfolio.

R_F Shows risk-free rate of return.

R_M Shows market return.

SMB Shows proxy for size factor.

HML shows proxy for value premium.

Where SMB considers the risk element connected to business size. HML is an acronym for a risk element connected to value premium. The average portfolio returns consisting of high B/M value stocks, often known as value stocks, is subtracted from the portfolio's average return of low B/M value stocks to create the value stock index (Cochrane et al., 2017).

2.5.1. *Ratio analysis*

In this section, we briefly discussed the formulas we use to determine the leverage, debt-to-equity, debt-to-total-assets, and book-to-market ratios in our model.

2.5.1.1. Leverage ratio

Palmer (1983) defined leverage as the use of different financial instruments to generate profits greater than the amount of the investment. The decision to raise capital through debt and equity must be made by the company. The balance of debt and equity in the company is indicated by the leverage ratio. It essentially defines a company's capital structure in order to make the necessary payments. Financial leverage ratios quantify the total amount of debt held by the business. Debt-to-equity ratios are another name for financial leverage ratios.

FORMULA:

$$\text{Debt Ratio} = \frac{\text{Total Debt}}{\text{Total Asset}}$$

2.5.1.2. Debt to equity ratio

A financial indicator called the debt-to-equity ratio reveals the amount of equity and debt that were used to finance a company's assets. The ratio reveals how much debt you have for every dollar of equity. Other names for the ratio include risk, gearing, and leverage.

The debt-to-equity ratio is a crucial metric in corporate finance that is used to evaluate a company's level of financial leverage. It measures the proportion of debt that a company is employing to finance its operations as opposed to cash on hand. The ratio, a particular form of gearing ratio, can be used to assess how heavily a business depends on debt.

Divide shareholder equity by the company's total debt yields to get this number. This ratio shows how much borrowed money the business is consuming.

$$\text{Debt to Equity Ratio} = \frac{Total\ Debt}{Total\ shareholder's\ equity} \text{ OR } \frac{Total\ Debt}{Total\ Equity}$$

When a company has a low debt-to-equity ratio, it means that a larger portion of its financing comes from shareholder equity, which reduces the amount of risk an investor has to take on. The riskier the company's finances are, the higher the debt-to-total asset ratio.

2.5.1.3. Debt to total asset ratio

A financial indicator called the debt to total asset ratio calculates the proportion of a company's assets that are financed by debt. The debt ratio is another name for it. By dividing the total amount of debt by the total value of assets, the ratio is calculated. Depending on the analyst's judgment, total assets could include both current and non-current assets or only specific assets.

Lenders and creditors pay close attention to a company's debt to total asset ratio as it is a key indicator of its financial health. Companies with a larger debt to asset ratio might be less stable, whilst those with more assets than debts make better investment candidates.

This ratio of a company is calculated by dividing its total debt by its total assets.

$$\text{Debt to Total Asset Ratio} = \frac{Total\ Debt}{Total\ asset}$$

By displaying the portion of the firm's assets that are financed by debt financing, it emphasizes the relative significance of debt financing to the company.

2.5.1.4. Book to market size

A financial ratio called book-to-market size is used to compare the book value to market value of a corporation. In determining a company's market value, the share price is multiplied by the number of outstanding shares; in determining its book value, liabilities are subtracted from assets. Divide the market value of equity by the book value of stock to calculate the book-to-market ratio.

According to Anschütz (2016), book to market size compares a company's book value to its market value in order to determine the value of the company. As determined by stock market investors who buy and sell the stock, book value is a reliable indicator of a company's worth. Regardless of what the book's value is, market value has a more significant implication because it represents the cost of acquiring a stake in the company.

For investors who need to determine a company's value, the book-to-market ratio is one measure of a company's worth. An undervalued stock is one with a high book-to-market ratio, whereas an overpriced stock is one with a low book-to-market ratio.

FORMULA:

$$\text{Book to Market} = \frac{Book\ Value\ of\ Firm}{Market\ Value\ of\ Firm}$$

2.5.2. Why does F&F use these ratios?

By utilizing the book-to-market ratio and leverage ratio in their Three-Factor Model, Fama and French account for the outperformance of value and small-cap stocks.

2.5.2.1. Book to market equity

F&F use two valuable risk factors, size (i.e., Market equity) and value (i.e., book-to-market equity ratio) to check the relation with the behavior of stock prices, that reflect the behavior of earnings. It also captures how average return changes across different portfolios and stock. F&F find out that small stock with High BE/ME gives low earnings, less profitable and riskier stock for the investor because stock with high BE/ME was termed as value stock these stock trade at a lower price and are called undervalued stock. The large stock with low book-to-market equity was termed as growth stock which gives high earnings more profitable and less risky than high BE/ME because they trade at a high price due to the market value of firm is high means investor get more additional return on growth stock than value stock.

2.5.2.2. Leverage ratio

F&F uses the leverage ratio to define the behavior of stock return. Since it represents the discrepancy between book value and total assets. Leverage is also a risk factor which affects the stock return. If we have a lower leverage ratio, its stock performs better than the stock which has a higher leverage ratio.

2.5.2.3. Earning price ratio

To explain the return on the portfolio, F&F uses this ratio. The E/P portfolio's typical return is U-shaped. The portfolio with a low E/P ratio and a negative return has a higher average return. The average return in the portfolio with positive returns, on the other hand, rises from the lowest to highest E/P ratio. Low E/P has a low average return with a low BE/ME, whereas high E/P has a high return with a high BE/ME.

2.6. Trading Volume as a New Factor

For a specific security, such as stocks, bonds, options contracts, futures contracts, and all varieties of commodities, trading volume refers to the overall quantity or the overall number of shares or contracts that are exchanged during a given period of time. It is a gauge of market activity and liquidity over a predetermined time frame. Trade volume is a sign of the market's activity and liquidity for a particular security. High market activity signifies that buyers and sellers can easily communicate and complete transactions.

Because they signify more liquidity and improved order execution, higher trading volumes are seen favorably compared to lower trading volumes. A stock or commodity with a larger trade volume is more popular generally on the market, and it is traded more frequently and quickly than a stock with a lower volume. Therefore, a high transaction volume typically indicates a high amount of market liquidity for a given investment or commodity. Securities with a smaller trade volume, on the other hand, show a low level of interest from the market as a whole in that specific asset or commodity.

In conclusion, trading volume refers to the entire amount or total number of shares or contracts traded for a specific security within a specific time period. This includes trading volume for stocks, bonds, options contracts, futures contracts, and other kinds of commodities. It is a gauge of market activity and liquidity over a predetermined time frame. A stock or commodity with a larger trade volume is more popular generally on the market, and it is traded more frequently and quickly than a stock with a lower volume. Therefore, a high transaction volume typically indicates a high amount of market liquidity for a given investment or commodity.

2.6.1. Incorporating trading volume in Fama & French three factor model

Based on Ochere et al. (2018), trading volume is the sum of all securities traded in a given time period. It is a helpful tool for the measurement of risk that influences the price and return of stocks. Lower trading volume indicates lesser interest of investor or a lower amount of effectively free float share in the market of particular stock and a gap is exist between trading periods and there will be increment in stock prices so there is a weak relationship between trading volume and stock returns. If the trading volume is high, indicate more interest of the investor and show that stocks are effectively traded in a market and no gap exists between the stock prices, then there will not be incrementally changed in stock prices so there is a strong correlation between trading volume and average stock returns. The portfolio of high trading volume has a positive average return, and they outperform the average return of low trading volume. The price momentum (rate of acceleration of security price or volume) is higher in high trading volume due to which supply of stock increases and demand decreases then it is impossible to achieve an equilibrium price. The stock which has low trading volume has many characteristics commonly linked with value investing. Low-volume stock experiences significantly better future operating performance than large-volume stock due to its high price but it is illiquid in nature. An investor uses it as a technical indicator to validate a trend or trend reversal. A security volume can also help a trader decide whether to buy or sell a security by letting him know how the security's price is performing. Investors can use it to recognize stock momentum and confirm a trend.

2.7. Exchange Rate as a New Factor

The cost of exchanging one currency for another between countries or economic zones is known as an exchange rate. It is crucial in determining the dynamics of trade and capital flow since it is used to calculate the amount that various currencies are worth in respect to one another. Two currencies' exchange rates are given, for instance, how many Turkish Lira (TRY) are needed to buy one U.S. dollar (USD).

Currency exchange rates can change for a variety of reasons and are a good predictor of many economic factors and causes. Currency exchange rates can be floating or fixed; the majority of exchange rates are regarded as floating and change in response to supply and demand in the market.

In conclusion, an exchange rate is the cost associated with converting one currency into another within a country or economic zone. Both the domestic and foreign currency values have an impact on exchange rates, this is subject to change depending on a number of variables which we discussed above.

2.7.1. Incorporating exchange rate in Fama & French three factor model

To incorporate exchange rate risk into the FF3F model, a fourth factor, such as a currency risk factor, can be added. This fourth factor would reflect the effect of exchange rate fluctuations on an asset's returns. One approach to including a currency risk factor in the model is to use the excess returns of a currency index as a proxy for currency risk. The return above the risk-free rate is known as the excess return, which reflects the additional return an investor expects for taking on the risk of holding a particular currency. Exchange rates also impact on foreign investment. Investors may be attracted to invest in countries with a strong currency and favorable exchange rates, as their investments will yield higher returns when converted back to their home currency. However, exchange rate fluctuations can also lead to increased risk and volatility in investments. According to Huffman et al., (2010), this affects the balance of payments, inflation, and overall economic activity. Foreign exchange risk is a

problem for emerging markets nowadays. It can be helpful to incorporate asset pricing models for a better forecast.

2.8. Comparison of CAMP and Fama & French three factor model

Since they are both asset pricing models and Fama & French's models are based on capital asset models, we compared them. According to Tao (2022), determining the asset's equilibrium price is the main goal of both the CAPM and the Three Factor Model. In contrast to the FF3F model, which is based on the arbitrage portfolio theory and asserts that risk is multidimensional, the CAPM is primarily based on a single factor, namely market beta, which measures systematic risk and illustrates the volatility of stock prices. So, the FF3F model is the extension of CAPM by including size and value premium which measure the risk and expected return in a better way as compared to CAPM. It is observed that CAPM does not perform better in emerging market due to the fact that the market index does not reflect overall market dynamics whereas the FF3F model performs better as compared to CAPM because it incorporates the company's size and value characteristics. CAPM assumes that investor makes decisions of investments for a single time period but daily movement in stock prices could not be explained by a single factor. F&F claimed that size and value premium are influential indicators of average stock return and better proxies for risk. Market beta presents information about the underlying minimum return that a risk-averse investor should expect to earn. CAPM is an appropriate theory from the point of view of corporate finance for allocating capital to investment projects. However, Three Factor Model is very useful tool for understanding portfolio management.

CHAPTER THREE

3. EMPERICAL ANALYSIS

This section's key debate points include the reliability of the Fama and French three-factor model, as well as earlier studies, research methodology, data types, and creating models.

3.1. Literature Review

The main topic of discussion in this part is the validity of the Fama and French 3 factor model as well as earlier research that were related to the capital asset pricing model and the extra factors that were added to the Fama and French 3 factor model or Fama and French 5 factor model.

Table 1 *Literature Review*

Authors (Year published)	**Sample Data**	**Method of Analysis**	**INDEX**	**Tested Model**	**Results**
Emine Kaya (2020)	(2005 -2017)	Regression Analysis & spanning Test	BIST 100 index	CAPM FF3F Model FF5F Model	The results indicate that FF5F is the model that performs the best overall, followed by FF3F and CAPM, in that order. Despite the fact that all three models are valid.
Karaomer et al. (2017)	(2005- 2016)	Regression Analysis & GRS-F test	Istanbul Stock Exchange	FF5F Model	The research concludes that FF5F is valid in ISE in accordance with its findings.
	(2000- 2017)			CAPM	

Table 1 *Literature Review* (Continue)

Yaşar Edrinç (2018)		Regression Analysis & GRS-F test	Istanbul Stock Exchange	FF3F Model FF5F Model	The FF5F Model performs the best, according to the results, followed by the FF3F Model, and finally, CAPM has no ability to explain excess return.
Esen Kara (2016)	(2006- 2014)	Panel Data Analysis	BIST Financials indexes, BIST Services, and BIST Industrials,	FF3F Model	The analysis's findings showed that market portfolio risk premiums, business size, and the M/B value ratio all contributed to the explanation of the industrial sector's overall equity risk premium.
Zeren et al. (2019)	(1995- 2017)	Unit root test, Variance Inflation Factor (VIF) and Correlation Matrix	ISE Sustainability Index	FF5F Model	According to the results, there is no evidence supporting the validity of the FF5F Model for Turkish companies. It is vital to keep in mind that this research only focuses on a specific set of companies in Turkey and may not be generalizable to other countries or regions.
Veysel Eraslan (2013)	(2003- 2010)	Regression Analysis	Istanbul Stock Exchange	FF3F Model	The FF3F model can explain changes in excess portfolio returns, but its ability to do so has not been consistently strong over the course of the ISE test period.
Ebubekir Mollaahmetoğlu (2020)	(2009- 2018)	Static panel data analysis	BIST30 index	FF5F Model	In contrast to the FF5F model, they find out sufficient empirical evidence for BIST30 to suggest that the four-factor model is valid.
Gökgöz (2007)	(2001- 2006)	Time series and cross-sectional Regressions, GRS-F test	Istanbul Stock Exchange	CAPM FF3F Model	On the ISE, CAPM and the FF3F Model are found to be viable and applicable. Pricing errors are handled better by the FF3F Model than by the CAPM.

Table 1 *Literature Review* (Continue)

Roy and Shijin (2018)	(1986- 2016)	OLS & Instrumental variable generalized method of moments. (IVGMM)	NYSE, AMEX, and NASDAQ	Fama-French Six-Factor Model (Human capital)	The human capital component of the framework has the same ability to anticipate fluctuations in return on portfolios as the other framework elements.
Maeda (2016)	Empirical review	Empirical review	Japanese Stock Market (JPX)	CAPM Carhart Four-factor Model FF3F Model FF5F Model	He finds out that CAPM is an inappropriate model for the JPX. For the Japanese stock market, he contends, the FF3F model is suitable. He came to the conclusion that in order to apply the asset pricing model to the JPX, the book to market factor should be incorporated because the results will be better and the correlation between B/M and share return is significant.
Michou & Zhou (2016)	(1900- 2013)	GRS Test and Spanning test	London Stock Exchange	FF5F Model	This study's primary goal is to provide comprehensive data on the new factor model's performance in the U.S. K. They came to the conclusion that size and value are independent of US stock market returns. For better results, they recommended substituting investment and profitability variables.

Table 1 *Literature Review* (Continue)

Hou et al. (2015)	(2000- 2010)	OLS regressions	Japanese stock market (JPX)	Carhart Four-factor Model	In order to evaluate how well the q-factor model explained share performance on the JPX, they examined four different components. They asserted that the FF3F model cannot explain the majority of abnormalities. The Japanese stock market's share returns are not fully explained by the q-factor model, according to the regression results on the portfolio that were classified based on factor size, investment, and profitability. Nonetheless, French and Fama deliver the intended outcomes.
				FF3F Model	
				FF5F Model	
Fama and French (2015)	(1963- 2013)	OLS regressions	NYSE, AMEX, and NASDAQ stocks	FF3F Model	On Chinese A-share stock, they employed the FF5F model and contrast it to the FF3F model. The findings demonstrate that the FF3F model best represents the volatility in estimated stock return than the profitability and investment variables.
				FF5F Model	
Khuu et al. (2017)	(2003-2014)	Regression and GRS test	Japanese Stock market	FF3F Model	Their objective was to determine whether stock returns on the Japanese equity market could be explained by market sentiments. They discovered a link between news sentiment and the risk factors for F&F. Additionally, it was discovered that, in contrast to middle stocks, where sentiments have little impact

Table 1 *Literature Review* (Continue)

					on risk factors related to value, small and large stocks tend to be most affected by news sentiments.
Srivastava and Aggarwal (2014)	(2012-2013)	Regression and t-statistics	Bombay Stock market	FF3F Model	They set out to determine how closely the FF3F Model's forecasted returns corresponded to actual returns. Additionally, it was discovered that there was a sizable discrepancy between expected return and actual return, leading researchers to draw the conclusion that the FF3F Model's high volatility between actual and expected return makes it impossible for investors to rely on it.
Zhang et al. (2015)	(2007- 2015)	Multivariate Regression	Vietnam Stock Exchange	CAPM FF3F Model FF5F Model	Their goals were to determine the relationship between the value factor and stock return, to explain the behavior of stocks using a FF5F model on Vietnam, and to see if state ownership of listed companies had any bearing on stock return. According to their findings, compared to the FF3F model and CAPM, the FF5F model explains more anomalies in asset pricing. Additionally, they discovered that state ownership and stock return are correlated with the value factor, with state ownership providing higher average returns than private firms.

Table 1 *Literature Review* (Continue)

Bereket (2014)	(2004- 2013)	Regression Analysis	Istanbul Stock Exchange	FF4F Model	The study shows that FFFM is valid in ISE but does not provide a significant performance increase compared to the FF3F model. By investing in various assets with weak correlation coefficients, investors can take advantage of diversification.
Guzeldere and Sarioglu (2012)	(1999-2011)	Panel data analysis	Istanbul Stock Exchange	FF3F Model	The FF3F model is effective in explaining stock returns in ISE, they discovered. It was also determined that the conventional CAPM, which states that a financial asset's risk premium is positively correlated with its market risk, is valid.
Hasan et al, (2017)	(2005-2010)	Panel data analysis	Kuala Lumpur Stock Exchange Market (KLSE)	FF3F Model	According to the study, the CAPM and FF3F models can both be used to explain excess returns in the KLSE market. Nonetheless, the FF3F model outperforms the CAPM in terms of explanatory power.
Özkan (2018)	(2006-2016)	Panel data analysis	Istanbul Stock Exchange	FF5F Model	The study's findings demonstrate the applicability of the FF5F model to ISE. In ISE, it is discovered that Value is an essential factor in estimating stock market returns. Consequently, it may be said that the value element in the FF5F model is not unnecessary. This result confirms earlier research showing the value component has a significant role in determining stock returns.

Table 1 *Literature Review* (Continue)

Paliienko et al, (2020)	(2014-2019)	Panel data analysis	Ukrainian Stock Exchange	FF5F Model	According to the findings, the FF5F model fits Ukrainian stock returns better than the FF3F model.
Albakri (2023)	(2017-2021)	Panel data analysis	S&P 500 Index	FF4F Model	The CAPM is seen as desirable as compared to FF4F in the scope of the desirability of the S&P 500 stock markets because it provides compelling and conceptually appealing estimates on how to evaluate uncertainty and the relationship between expected earnings and dangers.
Sunarsih (2020)	(2014-2018)	Panel data analysis	Indonesia Sharia Stock Index (ISSI)	FF5F Model and Momentum factor	She sheds light on how the momentum factor and FF5F affect the excess returns on Islamic stock portfolios that are listed in ISSI. The study demonstrates that investors can examine Islamic stock portfolios listed in ISSI using the FF5F model.
Doğan et al. (2022)	(2014-2018)	Panel data analysis	Istanbul Stock exchange	FF6F Model with Momentum factor	According to the research study's conclusions, the FF6F is the model that best accounts for stock returns on the BIST. The suggestion that momentum be taken into account while making investment because it enables greater profits to be realized is one of the research study's practical recommendations.
Ali et al. (2021)	(2003–2016)	Panel data analysis	Pakistan Stock exchange (PSX)	FF3F Model Carhart Four-factor Model FF5F Model	Nonetheless, the depiction of average returns is much improved by the profitability component. The results are robust across sub-periods, test asset development, and various factor definitions.

Table 1 *Literature Review* (Continue)

				FF6F Model with Momentum factor	
Güler et al. (2018)	(2005–2017)	Regression Analysis and GRS-F test	Istanbul Stock exchange	CAPM FF3F Model FF5F Model	This model has undergone testing in a number of developed nations, most notably it is effective in explaining variances in stock market returns in the US. The study whether this paradigm is applicable to emerging nations with dynamics that are distinct from those of developed nations, however, has certain flaws. It has been found that FF5F outperforms the alternative models in the BIST.
Andrei et al. (2015)	(2006-2013)	Regression Analysis	Bucharest Stock Exchange	FF3F Model	The FF3F model captures more fluctuation in portfolio returns than the traditional model according to the authors, who also demonstrate that it passes standard diagnostic tests.

According to the literature review, there have been several studies on asset pricing models, which have been extensively examined in a variety of financial markets. It is significant in some markets while being meaningless in others. We can, however, generalize that FF3F is significant in developed markets. There is not enough evidence to support the viability of various asset pricing strategies in the Turkish financial sector. This study will close a research gap by supplying empirical evidence on two key topics: 1) whether the FF3F model is valid in the Turkish financial market; and 2) whether the ICAPM model is valid in the Turkish financial market (by incorporating foreign exchange risk and trading volume factors into the FF3F model and evaluating the significance). Additionally, this study contrasts two models to see which is providing more valid results.

3.2. Research Design

Empirical research-wise, we have two major objectives in this study. First, we are assessing the significance of the FF3F model. To achieve this objective, it is required to determine the relationship between excess return (E_R-R_f) with risk premium (R_m-R_f), size factor (SMB) and value premium (HML). Whether there is a positive or negative relationship between risk premium and excess return, this implies that the FF3F is significant in the stock index, which shows a bullish or bearish trend in the market. Second, we look at the notion of whether there exists a relationship between the excess return (E_R-R_f) with 2 new added factors which are the exchange rate and trading volume. In order to verify this, we need to test the significance of FF3F on the index and then add one 2 variable, the exchange rate and trading volume.

3.2.1. *Data*

Data is obtained from 70 listed firms in BIST-100 (the main indexes in Borsa Istanbul) for the 2010–2019 period. The Thomson Reuters Database is the primary data source, where we collected the data of stock prices and financial statements, implied returns, trading volume and market returns, as well as exchange rates. In addition, Turkish T-bills data is from the TCMB Data Portal. The frequency of the data is daily. The period of the data that has been used is between 2010 and 2019, i.e., 10 years of data.

After compiling information on the 100 companies that make up the BIST-100 index. We eliminate 30 companies that have missing data, most of which are recent additions to the Istanbul Stock Exchange, such as Alfa Solar Enerji Sanayi Ve Ticaret, Biotrend Çevre Ve Enerji Yatirimlari, Europen Endüstri İnşaat Sanayi Ve Ticaret and Galata Wind Enerji, among others. These companies are all expected to be incorporated after 2020. The remaining companies total 70 when the missing data is removed.

For the period between July of year k and June of year k+1, enterprises with negative BE/ME for December of year k1 were eliminated from the sample in accordance with Fama and French. The companies were once more included in the sample as BE/ME began to improve in the ensuing years (Fama and French, 1993).

3.3. Methodology

The analysis of this study is conducted for all stocks registered on Istanbul Stock Exchange (ISE) BIST-100 Index at daily frequency from the year 2010 to 2019. The affordability of the data throughout this time period was the deciding factor in picking this sample period. Companies from every industry listed on the Istanbul Stock Exchange (ISE) are represented in the sample firm. Thomson Reuters is the data's source, and it provides information on all firms' closing prices and trade volumes. Using the daily closing prices, intra-day returns are estimated.

In line with Canbaş and ARIOĞLU, (2008) ordinary least square (OLS) regression method analysis is used in this research. First aim, for testing the validity of FF3F, then add 2 new variable to check the efficiency of model. These are the 5 variables for FF3F: market prices (BIST index), risk-free return (R_f), BIST index registered companies' prices, HML and SMB. Furthermore, by adding two more variables—the exchange rate and trading volume—to the FF3F, we test the validity of the FF5F.

For risk-free return, after considering various options, we decided to use the implied risk-free interest rate as used by Bianconi et. al (2015) and also Black and Scholes (1973), which used the implied risk-free rate as a proxy in option pricing. The difference between future and spot interest rates for the future is known as the implied interest rate, which is used as a proxy for the risk-free rate. Other options for risk-free rates are as follows: As a proxy for risk-free interest rate, Çebi (2012) and Kaya (2021) prefer to use an overnight interest rate; Kara (2016) uses 365 days T-bill rate; Eraslan (2013) uses quarterly and bi-annually T-bill rate; Erdinç (2017) uses 3-month Turkish Lira Interbank Offer Rate (TRLIBOR); and Gökgöz (2007) uses Monthly Turkish Government Internal Loan Index (GIL).

The compensation needed for an investor to accept more risk than T-bills or other government bonds is determined by the other half of the FF3F formula. This is determined by assessing the historical returns of the asset with those of the market and the market premium ($R_m + R_f$) using a risk measure (beta). For estimating market capitalization (size factor) we use leverage ratio and for value premium we use book to market ratio.

The method used in this study is time series analysis with OLS regression. Using the analysis of a particular asset, security, or economic variable can be examined to understand how it evolves over time and how it relates to other variables using the analysis.

Pre-tests are frequently carried out in time series analysis to evaluate the features of the data and choose the best modelling strategy. These pre-tests give information on the underlying structure of the time series and check that the assumptions of the chosen model are true. Here are a few pre-tests that are frequently used in time series analysis:

3.3.1. Hypothesis

The hypothesis tested in multivariate regression analysis is as follows:

$\boldsymbol{HO}$: **μ1=μ2 =μ3=μ4=μ5=μ6= 0**

$\boldsymbol{H1}$: **μ1 =μ2 =μ3 =μ4=μ5=μ6≠0**

In Fama and French three factor model, $\beta 1$ should be insignificant and β2, β3, β4, β5 and β6 should be significant.

3.3.2. Stationarity test

A fundamental premise of many time series models is stationarity. Pre-tests are used to detect whether a time series exhibits trends and non-stationarity or is stationary, such as the Unit root test (Augmented Dickey-Fuller test).

Table 2 *Augmented Dickey-Fuller test statistic for FF3F Portfolio*

Portfolios	t stats	P-Value
SH	-3.15844	0.0227
SL	-2.69292	0.0753
SM	-3.02485	0.0328
BH	-3.16601	0.0222
BL	-2.70541	0.0732
BM	-2.96662	0.0383

Table 3 *Augmented Dickey-Fuller test statistic for FF4F Portfolio*

Portfolios	t stats	P-Value
BHHV	-3.41352	0.0106
BHLV	-3.64202	0.0051
BLHV	-3.15164	0.0231
BLLV	-2.75916	0.0644
BMHV	-2.57218	0.0989
BMLV	-2.8129	0.0566
SHHV	-3.30871	0.0146
SHLV	-3.57966	0.0063
SLHV	-3.05292	0.0304
SLLV	-2.66379	0.0806
SMHV	-3.39348	0.0113
SMLV	-3.01342	0.0338

Table 4 *Augmented Dickey-Fuller test statistic for Independent Variables*

Factors	t stats	P-Value
Rm-Rf	-3.63274	0.0052
SMB	-44.2116	0.0001
HML	-46.5861	0.0001
HVMLV	-47.69	0.0001
Fx-Rate	-2.89667	0.0995

A statistical test known as the Augmented Dickey-Fuller (ADF) test is used to detect whether or not a time series is stationary. The alternative hypothesis in the ADF test is typically stationarity or trend-stationarity, while the null hypothesis of the test is that a unit root exists in the time series sample. The test's ADF statistic is a negative number, and the more negative it is, the more strongly the unit root hypothesis is rejected, at least to some extent.

The p-value affects how the findings of the ADF test should be interpreted. The null hypothesis can be rejected, and the series is regarded as stationary if the p-value is less than the significance level. The null hypothesis cannot be ruled out if the p-value is higher than the significance level, and the series is deemed non-stationary. As you can see, all

independent variable p-values and portfolio p-values for FF3F and FF4F are less than 10%, demonstrating that we reject the null hypothesis and confirming that our data are stable.

3.3.2. Normality test

The assumption of normality is common in time series models. The Jarque-Bera test was used to determine whether the data had a normal distribution. Transformations or the use of non-parametric models may be necessary to account for deviations from normalcy.

Table 5 *Jarque-Bera test statistic for FF3F Portfolio*

Portfolio	Jarque-Bera	Probability
B_H	584.5432	0.269
B_L	887.325	0.387
B_M	796.6815	0.326
S_H	898.0076	0.353
S_L	852.5184	0.348
S_M	940.9334	0.334

Table 6 *Jarque-Bera test statistic for FF4F Portfolio*

Portfolio	Jarque-Bera	Probability
BHHV	501.3722	0.250
BHLV	593.1412	0.271
BLHV	586.9938	0.264
BLLV	1036.127	0.408
BMHV	524.4949	0.254
BMLV	832.6083	0.348
SHHV	754.4461	0.312
SHLV	915.695	0.378
SLHV	2198.958	0.893
SLLV	815.0853	0.398
SMHV	774.5212	0.290
SMLV	869.8234	0.323

Table 7 *Jarque-Bera test statistic for Independent Variables*

Variables	Jarque-Bera	Probability
RM_RF	1340.832	0.567
SMB	686.7923	0.332
HML	787.5464	0.278
HVMLV	235.251	0.132
FX_RATE	438.3485	0.194

The Jarque-Bera test evaluates whether the skewness and kurtosis of sample data are in accordance with a normal distribution. A goodness-of-fit test is used. The exam bears Carlos Jarque and Anil K. Bera's names. The test statistic is always positive, and if it deviates significantly from zero, it indicates that the distribution of the data is not normal.

JB has a two-degree-of-freedom chi-squared distribution under the null hypothesis of normality. The p-value affects how the Jarque-Bera test results should be interpreted. The null hypothesis can be disregarded, and the data are thought to be non-normal if the p-value is less than the significance level. The null hypothesis cannot be ruled out and the data are regarded as normal if the p-value is higher than the significance level. The normality assumption of the residuals is frequently tested in regression analysis using the Jarque-Bera test. As you can see, the p-values are higher than 10%, indicating that our data is normally distributed.

3.3.3. Homoscedasticity test

The assumption of homoscedasticity is that the variance of the residuals is stationary. If heteroscedasticity is present, tests like the Breusch-Pagan test or the White test can assist identify it; this may call for modifying the modelling strategy.

In regression models, heteroscedasticity is identified using the Breusch-Pagan test. The alternative theory holds that the residuals are heteroscedastic, in contrast to the null hypothesis that they are homoscedastic. The p-value affects how the Breusch-Pagan test results should be interpreted. The null hypothesis can be rejected if the p-value is less than the significance level, which is typically 0.05, and the data are deemed heteroscedastic. The

data are regarded as homoscedastic if the p-value exceeds the significance level, which prevents the null hypothesis from being disproved. The degrees of freedom for the test statistic, which has a chi-squared distribution, depend on how many independent variables are included in the model. The null hypothesis of homoscedasticity is rejected, and the data are deemed heteroscedastic if the test statistic's p-value is below the threshold of significance. When the p-value exceeds the threshold for significance, homoscedasticity is assumed to be the case and the null hypothesis cannot be ruled out.

Table 8 *Homoscedasticity test statistic for FF4F Portfolio with Fx-rate*

Portfolio	P-Value
B/H	0.169
B/L	0.282
B/M	0.322
S/H	0.153
S/L	0.408
S/M	0.342

Table 9 *Homoscedasticity test statistic for FF4F Portfolio with Fx-rate*

Portfolio	P-value
BHHV	0.450
BHLV	0.271
BLHV	0.262
BLLV	0.268
BMHV	0.494
BMLV	0.348
SHHV	0.212
SHLV	0.118
SLHV	0.193
SLLV	0.38
SMHV	0.290
SMLV	0.311

It is safe to utilize our data because it is homoscedastic for all models in FF3F and FF4F with exchange rates having P-values greater than 10%.

3.4. Portfolio Formation

Market risk and size premium are the two risk factors used in the Fama and French three factor model. premium value. The companies were first ranked and sorted into three groups, labeling the bottom 30% as Low (L), the middle 40% as Medium (M), and the top 30% as High (H), in order to build the book to market value portfolio. Stocks with low, medium, and high book-to-market ratios in time (t) are categorized into the bottom group, middle group, and top group, respectively, in time (t+1). Stocks were evaluated according to their market capitalization in order to create the size portfolio. The top 50% of the stocks are classified as Big (B), and the bottom 50% as Small (S). Stocks with a large market capitalization at time (t) are regarded as large stocks at time (t+1), whilst companies with a modest market capitalization at time (t) are regarded as tiny stocks at time (t+1).

The following results in the formation of six equally weighted size and book-to-market sorted portfolios: B/H, B/M, B/L, S/H, S/M, and S/L. B/H and other similar metrics include all stocks with high book to market values and market capitalizations.

There were six portfolio in each model, hence six regression tests were conducted for each model to assess the FF3F model's validity.

Table 10 *FF3F Table for portfolio construction*

SIZE	VALUE	PORTFOLIO
B	H	B/H (Big/High)
B	M	B/M (Big/Medium)
B	L	B/L (Big/Low)
S	H	S/H (Small/High)
S	M	S/M (Small/ Medium)
S	L	S/L (Small/Low)

Table 11 *FF3F Table of year wise sample composition of portfolio*

Year	Small/Low (S/L)	Small/Medium (S/M)	Small/High (S/H)	Big/Low (B/L)	Big/Medium (B/M)	Big/High (B/H)	Total
2010	11	16	8	9	14	12	70
2011	7	18	10	13	12	10	70
2012	7	18	11	13	12	9	70
2013	8	17	10	12	13	10	70
2014	8	16	11	12	14	9	70
2015	9	18	9	11	12	11	70
2016	10	16	9	10	14	11	70
2017	10	17	8	10	13	12	70
2018	10	16	9	10	14	11	70
2019	11	15	9	9	15	11	70

Then, we include trading volume, the fourth factor, in our portfolio. The equities were divided into two groups—the top 50% as High Trading Volume (HV) and the bottom 50% as Low Trading Volume (LV)—in order to create a trading volume-sorted portfolio. Stocks with high trading volumes at one point in time are referred to as high-volume stocks at that point in time (t+1), and stocks with low trading volumes at that point in time are referred to as low volume stocks at that point in time (t+1).

In this manner, twelve portfolios with equal weights for size, book-to-market ratio, and trading volume are created: BHHV, BHLV, BMHV, BMLV, BLHV, BLLV, SHHV, SHLV, SLHV, SLLV, SMLV and SMHV. BHHV and similar metrics cover all the equities with high book to market values, market capitalizations, and trading volumes.

Second, after confirming the FF3F model's validity, we introduced a new factor trading volume. Since each model contained 12 portfolios, regression tests for each model were conducted 12 times.

Table 12 *FF4F Table for portfolio construction*

SIZE	VALUE	TRADING VOLUME	PORTFOLIO
B	H	HV	BHHV (Big/High/High Volume)
B	M	HV	BMHV (Big/Medium/High Volume)
B	L	HV	BLHV (Big/Low/High Volume)
B	H	LV	BHLV (Big/High/Low Volume)
B	M	LV	BMLV (Big/Medium/Low Volume)
B	L	LV	BLLV (Big/Low /Low Volume)
S	H	HV	SHHV (Small/High/High Volume)
S	M	HV	SMHV (Small/Medium/High Volume)
S	L	HV	SLHV (Small/Low/High Volume)
S	H	LV	SHLV (Small/High/Low Volume)
S	M	LV	SMLV (Small/Medium/Low Volume)
S	L	LV	SLLV (Small/Low/Low Volume)

Table 13 *FF4F Table of year wise sample composition of portfolio*

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	AVG.
SLLV	9	6	6	7	6	7	8	6	7	8	7
SMLV	10	9	11	10	10	8	9	11	11	10	9.9
SHLV	1	3	4	3	3	3	5	2	3	1	2.8
BLLV	5	8	7	7	8	8	8	7	5	6	6.9
BMLV	9	8	7	7	7	7	4	8	8	9	7.4
BHLV	10	1	1	9	1	2	1	1	1	1	2.8

Table 13 *FF4F Table of year wise sample composition of portfolio* (Continue)

SLHV	2	1	1	1	2	2	2	4	3	3	2.1
SMHV	6	9	7	7	6	10	7	6	5	5	6.8
SHHV	7	7	7	7	8	6	4	6	6	8	6.6
BLHV	4	5	6	5	4	3	2	3	5	3	4
BMHV	5	4	5	6	7	5	10	5	6	6	5.9
BHHV	2	9	8	1	8	9	10	11	10	10	7.8
Total	70	70	70	70	70	70	70	70	70	70	70

3.5. Model Specification

The dependent and independent model variables are the topic of discussion under this category. The process of defining the variables and components that will be used in the model is referred to as model specification.

3.5.1. Dependent variable

The excess portfolio return, which is denoted by ERi, is the dependent variable in the Fama and French three component model. The portfolio return demonstrates the return on portfolio that is higher than the risk-free rate of return needed by investors to support the investors' exposure to risk. A portfolio's return is also weighted based on the performance of all the equities in the portfolio.

3.5.2. Independent variable

Market risk premium, value premium, and size premium are the independent variables in the three-factor model proposed by Fama and French.

Due to their lack of financial flexibility and lack of diversification, small-sized businesses are more vulnerable to the adverse effects of various risk factors related to their line of work, giving rise to the concept of size premium, which is necessary for investors to make investment decisions.

Another risk factor that investors must consider when making investment selections is size premium. Size premium is calculated using the book-to-market ratio; however, a high book-to-market ratio indicates that a stock's book value is higher than its market value, indicating that the market will not place a high value on the stock due to the market's distress and investors' expectations regarding the stock's ability to generate future profits predictably.

Trading volume is another risk factor for price and return in the FF4F model. When there is no price discrepancy between stocks, as shown by high trading volume, there won't be any increase in stock price; nevertheless, when there is, as shown by low trading volume, there will be an increase in stock price.

For FF5F model, Exchange rate is used as last independent variable and there we took the currency pair USD/TRY for 10 years.

3.5.3. Regression equation

The FF3F model equation with the addition of the two new factors is as follows.:

$$r_p - \text{Rf} = \beta_0 + \beta_1 SMB + \beta_2 HML + \beta_3(R_M - R_F) + \beta_4\,(\text{HVMLV}) + \beta_5(\text{Fx Rate}) + \mu \quad (6)$$

Where,

r_p Shows average market return on portfolio.
R_F Shows risk free rate of return.
R_M Shows market return.
SMB Shows proxy for size factor.
HML shows proxy for value premium.
HVMLV shows proxy for Trading volume.
FX rate shows Exchange rate.

According to FF3F, the beta coefficient is employed to quantify systematic risk. However, this account could not be a thorough account of what happened. A company's operations are influenced by the macroeconomic environment of the nation in which it is based. In the modern economic perspective of today, the majority of enterprises have also increased their international operations.

3.6. Model estimation

A modeless of figuring out the values of the variables or components employed in a model based on the information available is known as variable estimate. We outline the study's hypothesis and display all of the computations for the variables.

3.6.1. Daily portfolio returns and market return

The following formula is used to determine the daily historical returns on particular stocks i:

$$Rit = \left(\frac{Pt_1 - Pt_{-1}}{Pt_{-1}}\right) * 100 \qquad (4)$$

Where,

Rit is *i*th daily return on *i*th stock at time t.

Pt is the closing price of *i*th stock at time t.

$Pt{-}1$ is the closing price of stock at time t-1.

The value-weighted average return, which is the portfolio return, is calculated using the formula below.

$$R_{pt} = \sum_{i=1}^{N} W_t R_{it}$$

Similarly, the market return can be estimated as:

$$R_{mt} = \left(\frac{Mt_1 - Mt_{-1}}{Mt_{-1}}\right) * 100 \qquad (5)$$

Where,

Mt1 is closing index value at time t.

Mt−1 is closing index value at time t-1.

The estimated value of excess portfolio return (Rpt-RF) and market risk premium (Rmt-Rf) can be computed by using portfolio and market return.

3.6.2. SMB (Small Minus Big) for Fama & French three factor model

SMBs take into account the business size-related risk factor. It is calculated as the average portfolio return for small firm size minus the average portfolio return for large business size (book to market).

$$SMB = \frac{1}{3}(SH + SM + SL) - \frac{1}{3}(BH + BM + BL)$$

3.6.3. HML (High minus Low) for Fama & French three factor model

HML is a risk component associated with value premium. It is calculated by subtracting the average return of a portfolio of growth stocks with a low book-to-market value from the average return of a portfolio of high book-to-market value firms, or value stocks. It is made to be neutral in size.

$$HML = \frac{1}{2}(SH + BH) - \frac{1}{2}(SL + BL)$$

3.6.4. SMB (Small Minus Big) for Fama & French four factor model

SMBs take into account the business size-related risk factor. It is calculated using trading volume and neutral value (book to market) and is equal to the average return on portfolio of small firm size minus average return on portfolio of big firm size.

$$SMB = \frac{1}{6}(SHHV + SHLV + SLHV + SLLV + SMHV + SMLV) - \frac{1}{6}(BHHV + BHLV + BLHV + BLLV + BMHV + BMLV)$$

3.6.5. HML (High minus Low) for Fama & French Four factor model

HML is a risk component associated with value premium. It is calculated by subtracting the average return of a portfolio of growth stocks with a low book-to-market value from the average return of a portfolio of high book-to-market value firms, or value stocks. It is made to be neutral in size and trading volume.

$$HML = \frac{1}{4}(BHHV + BHLV + SHHV + SHLV4) - \frac{1}{4}(+BLHV + BLLV + SLHV + SLLV)$$

3.6.6. HVMLV (High Volume minus Low Volume)

HVMLV is the difference of the average return of portfolio of high trading volume and the average return of portfolio of low trading volume.

$$HVMLV = \frac{1}{6}(BHHV + BLHV + BMHV + SHHV + SLHV + SMHV) - \frac{1}{6}(BHLV + BLLV + BMLV + SHLV + SLLV + SMLV)$$

CHAPTER FOUR

4. RESULTS AND CONCLUSION

According to Canbaş and Ariolu (2008), one issue with performing any type of multiple regression analysis is the possibility of multicollinearity between the explanatory variables. The potential for multicollinearity was investigated by taking into account the correlation matrix for the variables that explain the results (Curuk, 2001). Table 14,15,16 and 17 display the correlation matrix.

Table 14 *Correlation Matrix of the independent Variables for FF3F*

	Rm-Rf	*SMB*	*HML*
Rm-Rf	1		
SMB	-0.04777	1	
HML	0.269115	-0.03229	1

According to the correlation matrix, there was no multicollinearity that would have been problematic for FF3F variables.

Table 15 *Correlation Matrix of the independent Variables for FF3F with FX-Rate*

	Rm-Rf	*SMB*	*HML*	*FX Rate*
Rm-Rf	1			
SMB	-0.04777	1		
HML	0.269115	-0.03229	1	
FX Rate	-0.47021	0.020687	-0.00333	1

The correlation matrix demonstrates that there is no such multicollinearity after adding FX-rate to the FF3F model.

Table 16 *Correlation Matrix of the independent Variables for FF4F*

	Rm-Rf	*SMB*	*HML*	*HVMLV*
Rm-Rf	1			
SMB	0.024334	1		
HML	0.166715	-0.23871	1	
HVMLV	0.137238	0.27557	-0.32754	1

The correlation matrix demonstrates that the FF3F variables were not adversely affected by this multicollinearity.

Table 17 *Correlation Matrix of the independent Variables for FF4F with FX-Rate*

	Rm-Rf	*SMB*	*HML*	*HVMLV*	*FX Rate*
Rm-Rf	1				
SMB	0.024334	1			
HML	0.166715	-0.23871	1		
HVMLV	0.137238	0.27557	-0.32754	1	
FX Rate	-0.47021	0.010627	-0.02505	0.050892	1

The correlation matrix demonstrates that there is no such multicollinearity after adding FX-rate to the FF4F model. Reddy et al. (2010) claim that a correlation coefficient of less than 0.5 may be applied in real-world situations. All variable values in Table 5-8 are less than 0.5, confirming that there is no collinearity in the data and allowing us to move on to the regression analysis.

Table 18 *Portfolio Results of FF3F Model in BIST-100*

$r_p - \text{rf} = \beta_0 + \beta_1(R_M - R_F) + \beta_2\, SMB + \beta_3\, HML + \mu$							
Portfolio	**B0**	**B1**	**B2**	**B3**	**R-square**	**Adjusted R-square**	**F-value**
SL (Small/Low)	-0.677*** 0.000	0.806*** 0.000	0.966*** 0.000	-0.766*** 0.000	0.861	0.861	5166.650
SM (Small/Medium)	-0.726*** 0.000	0.795*** 0.000	0.798*** 0.000	-0.277*** 0.000	0.823	0.823	3885.879
SH (Small/High)	-0.895*** 0.000	0.752*** 0.000	0.897*** 0.000	0.277*** 0.000	0.827	0.827	3990.650
BL (Big/Low)	-0.851*** 0.000	0.764*** 0.000	-0.162*** 0.000	-0.732*** 0.000	0.805	0.805	3451.497
BM (Big/Medium)	-0.814*** 0.000	0.771*** 0.000	-0.082*** 0.005	-0.258*** 0.000	0.811	0.811	3593.027
BH (Big/High)	-0.633*** 0.000	0.818*** 0.000	-0.094*** 0.000	0.224*** 0.000	0.875	0.875	5880.910

Note: '*','' and '***' represents significance at 10%, 5% and 1% respectively**

This table displays the empirical findings from six portfolios that have been categorized by size and book to market equity using individual Fama and French regressions. Market beta ($\beta 0$) and significance (at 1% threshold of significance) were found in this regression for all six portfolios. For all six portfolios with large and small companies, the risk factor ($\beta 1$) market risk premium has all positive and significant coefficients at the 1% level of significance. The risk factor ($\beta 2$) SMB (small minus big) is significant at the 1% level of significance for all six of the portfolios with large size companies, showing negative coefficients in contrast to the market, and positive coefficients for all of the portfolios with small size companies. This difference suggests the existence of a size premium.

For all six portfolios, which contain businesses with low, medium, and high book to market equity ratios, the risk factor (3) of HML (high minus low) is significant at the 1% level of significance. Even though the other portfolios with low coefficients indicate a negative trend in this case, all six of the portfolios are still significant. Which is blatant proof that the value premium's existence has a big impact on market portfolio.

The R-square for SL is 0.861, which means that the model explains 86.1% of the variation in portfolio returns and for SM, SH, BL, BM, BH the values are 0.823, 0.827, 0.805, 0.811 and 0.875 respectively. Which shows that six portfolios are more than 80% fitted which shows that Fama and French 3 factor model explains perfectly in BIST-100. The fact that the Adjusted R-square and the R-square in this instance are the same shows that the model is not overfitting the data. The average separation between the observed data and the regression line is measured by the standard error. The overall relevance of the model is gauged by the F-value. The F-value for the first portfolio SL is quite high (5166.650), indicating that the model is statistically significant. F-statistics for all models are greater than 3000, indicating that all models are extremely significant.

Table 19 *Portfolio Results of FF3F Model with FX-rate in BIST-100*

$r_p - \text{rf} = \beta_0 + \beta_1(R_M - R_F) + \beta_2\, SMB + \beta_3\, HML + \beta_4\, (\text{Fx Rate}) + \mu$								
Portfolio	**B0**	**B1**	**B2**	**B3**	**B4**	**R-square**	**Adjusted R-square**	**F-value**
SL (Small/Low)	-0.119*** 0.001	0.700*** 0.000	0.963*** 0.000	-0.678*** 0.000	-0.334*** 0.000	0.886	0.886	4896.975
SM (Small/Medium)	-0.136*** 0.001	0.683*** 0.000	0.796*** 0.000	-0.185*** 0.000	-0.353*** 0.000	0.851	0.851	3590.711
SH (Small/High)	-0.196*** 0.000	0.619*** 0.000	0.894*** 0.000	0.387*** 0.000	-0.418*** 0.000	0.866	0.866	4048.904
BL (Big/Low)	-0.199*** 0.000	0.640*** 0.000	-0.165*** 0.000	-0.631*** 0.000	-0.391*** 0.000	0.844	0.844	3392.162
BM (Big/Medium)	-0.131*** 0.001	0.641*** 0.000	-0.085*** 0.001	-0.151*** 0.000	-0.409*** 0.000	0.853	0.852	3626.200
BH (Big/High)	-0.121*** 0.001	0.721*** 0.000	-0.096*** 0.000	0.304*** 0.000	-0.306*** 0.000	0.896	0.895	5380.067

Note: '*','' and '***' represents significance at 10%, 5% and 1% respectively**

This table present the empirical result of the individual Fama and French 3 factor model with FX-rate as an additional factor regressions on six portfolios that are sorted on the basis of size and book to market equity. The results are the same as Table 10. that all 6 portfolios with all 3 factors have significant effects on the market. Additionally, SMB and HML confirm that there is an important role of size and value. Lastly the fourth factor we added is the FX-rate which is significant and negative at 1% level of significance for all six portfolios.

The R-square for SL is 0.886, which means that the model explains 88.6% of the variation in portfolio returns and for SM, SH, BL, BM, BH the values are 0.85, 0.866, 0.844, 0.853 and 0.896 respectively. Which shows that six portfolios are more than 80% fitted and we can see that after adding the exchange rate in FF3F model it increases the efficiency of model around 3%, which shows that Fama and French 3 factor model with exchange rate in case of Turkey explain, more than usual model in BIST-100. The fact that the Adjusted R-square and the R-square in this instance are the same shows that the model is not overfitting

the data. The average separation between the observed data and the regression line is measured by the standard error. The overall relevance of the model is gauged by the F-value. The F-value for the first portfolio SL is 4896.9, which is extremely high and shows that the model is statistically significant. F-statistics for all models are greater than 3500, indicating that all models are extremely significant.

Table 20 *Portfolio Results of FF4F Model in BIST-100*

$r_p - \text{rf} = \beta_0 + \beta_1(R_M - R_F) + \beta_2\, SMB + \beta_3\, HML + \beta_4\,(\text{HVMLV}) + \mu$								
Portfolio	**B0**	**B1**	**B2**	**B3**	**B4**	**R-square**	**Adjusted R-square**	**F-value**
SLLV (Small/Low/Low Volume)	-0.760*** 0.000	0.778*** 0.000	0.668*** 0.000	-0.442*** 0.000	-0.929*** 0.000	0.792	0.792	2389.741
SLHV (Small/Low/High Volume)	-0.773*** 0.000	0.783*** 0.000	1.164*** 0.000	-1.086*** 0.000	0.562*** 0.000	0.730	0.729	1693.564
SMLV (Small/Medium/Low Volume)	-0.757*** 0.000	0.781*** 0.000	0.560*** 0.000	-0.203*** 0.000	-0.649*** 0.000	0.790	0.789	2353.751
SMHV (Small/Medium/High Volume)	-0.790*** 0.000	0.769*** 0.000	0.732*** 0.000	0.094*** 0.002	-0.042 0.295	0.742	0.741	1800.806
SHLV ((Small/High/Low Volume)	-0.822*** 0.000	0.769*** 0.000	0.981*** 0.000	0.288*** 0.000	-0.799*** 0.000	0.772	0.772	2125.053
SHHV (Small/High/High Volume)	-0.926*** 0.000	0.741*** 0.000	0.654*** 0.000	0.367*** 0.000	0.161*** 0.000	0.781	0.780	2232.855
***BLLV* (Big/Low/Low Volume)**	-0.824*** 0.000	0.768*** 0.000	-0.119*** 0.000	-0.582*** 0.000	-0.799*** 0.000	0.781	0.781	2242.329
BLHV (Big/Low/High Volume)	-0.911*** 0.000	0.742*** 0.000	-0.455*** 0.000	-0.618*** 0.000	0.076* 0.079	0.683	0.682	1350.549
BMLV (Big/Medium/Low Volume)	-0.848*** 0.000	0.760*** 0.000	-0.084*** 0.008	-0.306*** 0.000	-0.591*** 0.000	0.765	0.764	2036.707
BMHV (Big/Medium/High Volume)	-0.726*** 0.000	0.790*** 0.000	-0.205*** 0.000	-0.091*** 0.000	0.070** 0.038	0.797	0.797	2468.347
BHLV (Big/High/Low Volume)	-0.817*** 0.000	0.764*** 0.000	-0.247*** 0.000	0.263*** 0.000	-0.930*** 0.000	0.655	0.654	1188.625
BHHV (Big/High/High Volume)	-0.702*** 0.000	0.796*** 0.000	-0.131*** 0.000	0.353*** 0.000	0.477*** 0.000	0.819	0.818	2830.444

Note: '*','' and '***' represents significance at 10%, 5% and 1% respectively**

This table present the empirical result of the individual Fama and French with trading volume regressions on twelve portfolios that are sorted on the basis of size, book to market equity and trading volume. In this regression market beta ($\beta 0$) the coefficients are significant (at 1% level of significance) for all twelve portfolios. The risk factor ($\beta 1$) has all positive and significant coefficients at 1% level of significance for all 12 portfolios with big and small size companies. The risk factor ($\beta 2$) SMB (small minus big) is significant at 1% level of significance for all twelve portfolios with big size companies show negative coefficient in contrast with market and there are positive coefficients for all portfolios with small size companies and this difference indicate an existence of size premium. The risk factor (β3) of HML (high minus low) is significant at 1% level of significance for all twelve portfolio that include companies with low, medium and high book to market equity. Here the portfolios with High shows a positive trend while the other portfolios with Low have negative coefficients but all six portfolios are significant. Which is a clearing indication that the existence of value premium has significant effects on market portfolio. The risk factor (β4) of HVMLV (high volume minus low volume) are significant and negative at 1% level of significance for each six (out of six) portfolios with low trading volume and 3 (out of six) that include companies with high trading volume, 2 portfolios with high trading volume show significance at 5% and the other at 10%, while there is a portfolio SMHV which is insignificant but all high volume trade portfolios are positive. Which basically creates a pattern where trading volume affects the market sentiments.

The R-square for SLLV is 0.792, which means that the model explains 79.2% of the variation in portfolio returns and for SLHV, SMLV, SMHV, SHLV, SHHV, BLLV, BLHV, BMLV, BMHV, BHLV and BHHV the values are 0.730, 0.790, 0.742, 0.772, 0.781, 0.781, 0.683, 0.765, 0.797, 0.655 and 0.819 respectively. Which shows that all twelve portfolios are more than 65% fitted which shows that Fama and French 3 factor model with trading volume explains in BIST-100. There is no evidence from previous literature in ISE related to Fama and French with trading volume, but our results prove that trading volume have significant effect in explaining portfolio returns. Similar to this, Opuodho et al. (2018) discovered that in the Nairobi stock market, trading volume does enhance the FF3F Model's value. The fact

that the Adjusted R-square and the R-square in this instance are the same shows that the model is not overfitting the data. The average separation between the observed data and the regression line is measured by the standard error. The overall relevance of the model is gauged by the F-value. The F-value for the first portfolio SLLV is quite high, 2389.741, indicating that the model is statistically significant. F-statistics for all models are greater than 1000, indicating that all models are extremely significant.

Table 21 *Portfolio Results of FF4F Model with FX-rate in BIST-100*

$r_p - \text{rf} = \beta_0 + \beta_1(R_M - R_F) + \beta_2\, SMB + \beta_3\, HML + \beta_4$ (HVMLV) + β_5 (Fx Rate) + μ									
Portfolio	**B0**	**B1**	**B2**	**B3**	**B4**	**B5**	**R-square**	**Adjusted R-square**	**F-value**
SLLV (Small/Low/Low Volume)	-0.170*** 0.000	0.663*** 0.000	0.674*** 0.000	-0.368*** 0.000	-0.801*** 0.000	-0.358*** 0.000	0.821	0.821	2302
SLHV (Small/Low/High Volume)	-0.088 0.210	0.651*** 0.000	1.172*** 0.000	-1.001*** 0.000	0.710*** 0.000	-0.416*** 0.000	0.753	0.752	1526
SMLV (Small/Medium/Low Volume)	-0.145*** 0.002	0.662*** 0.000	0.567*** 0.000	-0.126*** 0.000	-0.517*** 0.000	-0.372*** 0.000	0.821	0.820	2295
SMHV (Small/Medium/High Volume)	-0.195*** 0.000	0.653*** 0.000	0.738*** 0.000	0.169*** 0.000	0.087** 0.026	-0.362*** 0.000	0.768	0.767	1656
SHLV ((Small/High/Low Volume)	-0.150*** 0.004	0.639*** 0.000	0.988*** 0.000	0.372*** 0.000	-0.654*** 0.000	-0.408*** 0.000	0.805	0.804	2064
SHHV (Small/High/High Volume)	-0.240*** 0.000	0.608*** 0.000	0.661*** 0.000	0.453*** 0.000	0.310*** 0.000	-0.417*** 0.000	0.817	0.817	2244
***BLLV* (Big/Low/Low Volume)**	-0.181*** 0.000	0.643*** 0.000	-0.112*** 0.000	-0.502*** 0.000	-0.660*** 0.000	-0.390*** 0.000	0.819	0.818	2261
BLHV (Big/Low/High Volume)	-0.242*** 0.000	0.612*** 0.000	-0.448*** 0.000	-0.534*** 0.000	0.220*** 0.000	-0.406*** 0.000	0.718	0.718	1278
BMLV (Big/Medium/Low Volume)	-0.142*** 0.002	0.623*** 0.000	-0.076*** 0.008	-0.218*** 0.000	-0.438*** 0.000	-0.429*** 0.000	0.809	0.809	2124

Table 21 *Portfolio Results of FF4F Model with FX-rate in BIST-100* (Continue)

BMHV (Big/Medium/High Volume)	-0.134*** 0.004	0.675*** 0.000	-0.199*** 0.000	-0.017 0.457	0.198*** 0.000	-0.360*** 0.000	0.826	0.826	2378
BHLV (Big/High/Low Volume)	-0.201*** 0.004	0.645*** 0.000	-0.240*** 0.000	0.340*** 0.000	-0.796*** 0.000	-0.374*** 0.000	0.679	0.678	1059
BHHV (Big/High/High Volume)	-0.090* 0.051	0.678*** 0.000	-0.124*** 0.000	0.429*** 0.000	0.609*** 0.000	-0.372*** 0.000	0.846	0.846	2750

Note: '*','' and '***' represents significance at 10%, 5% and 1% respectively**

This table present the empirical result of the individual Fama and French with trading volume and exchange rate regressions on twelve portfolios that are sorted on the basis of size, book to market equity and trading volume. In this regression market beta ($\beta 0$) the coefficients are negative and significant (at 1% level of significance) for 10 portfolios while for one portfolio is significant at 10% and there is portfolio named SLHV which is insignificant. The risk factor ($\beta 1$) has all positive and significant coefficients at 1% level of significance for all 12 portfolios with big and small size companies. The risk factor ($\beta 2$) SMB (small minus big) is significant at 1% level of significance for all twelve portfolios with big size companies show negative coefficient in contrast with market and there are positive coefficients for all portfolios with small size companies and this difference indicate an existence of size premium. The risk factor (β3) of HML (high minus low) is significant at 1% level of significance for eleven portfolio that include companies with low, medium and high book to market equity except one which is BMHV. Here the portfolios with High values shows a positive trend while the other portfolios with Low have negative coefficients but all six portfolios are significant. Which is a clearing indication that the existence of value premium has significant effects on market portfolio. The risk factor (β4) of HVMLV (high volume minus low volume) are significant and negative at 1% level of significance for each six (out of six) portfolios with low trading volume and 5 (out of six) that include companies with high trading volume, except one portfolio which was insignificant in the previous model but this time it shows significance at 5% level. Furthermore, all high-volume trade portfolios are positive. Which basically creates a pattern where trading volume affects the market sentiments. Lastly the fifth factor we added is the FX-rate, which is significant and negative

at 1% level of significance for all six portfolios. It explains that real effective exchange rates such as USD/TRY and EUR/TRY, interest rates, and money supply are among the market drivers since they have a significant predictive capacity for stock market volatility at different frequencies. It claims that the exchange rate impacts the Turkish stock market negatively.

The R-square for SLLV is 0.821, which means that the model explains 82.1% of the variation in portfolio returns and for SLHV, SMLV, SMHV, SHLV, SHHV, BLLV, BLHV, BMLV, BMHV, BHLV and BHHV the values are 0.753, 0.821, 0.768, 0.805, 0.817, 0.819, 0.718, 0.809, 0.826, 0.679 and 0.846 respectively. Which shows that all twelve portfolios are more than 67% fitted which shows that Fama and French 3 factor model with trading volume and exchange rate explains in BIST-100. The fact that the Adjusted R-square and the R-square in this instance are the same shows that the model is not overfitting the data. The average separation between the observed data and the regression line is measured by the standard error. The overall relevance of the model is gauged by the F-value. The F-value for the first portfolio SLLV is 2302, which is quite high and shows that the model is statistically significant. F-statistics for all models are greater than 1000, indicating that all models are extremely significant.

The FF3F Model, a popular asset pricing theory in finance, attempts to explain stock market returns in terms of market risk, value, and size. Although the model was initially created using data from US markets, it has since been tested and used in other markets all over the world. There are two main objectives of this study, first one is two check the validity of Fama and French 3 factor (FF3F) model. On the other hand, we are trying to add 2 new factors, which are trading volume and exchange rate and check whether there is any translation in the market in terms of these factors or not.

According to the evidence, the FF3F Model can be used to analyze stock market returns in both emerging as well as developed markets. However, depending on the particular market and time period under study, the model's performance may change. In developed markets, the model has often been useful in translating the cross-sectional volatility in stock returns. Studies have discovered, for instance, that the model is helpful in explaining stock returns in nations like Canada, the UK, Japan, and several European nations. In emerging

markets, the evidence is mixed. Some studies have found that the F&F model is less effective in explaining stock returns in these markets, while others have found that the model performs reasonably well. In some cases, modifications to the original model have been proposed to better capture the specific characteristics of emerging markets.

The analysis of this study is conducted for BIST-100 index companies on Istanbul Stock Exchange (ISE) at daily frequency from the year 2010 to 2019. The source of data is Thomson Reuters that includes closing prices and trading volume data of all 100 companies. After removing the company which has missing data because of new registration in ISE. We have got 70 firms in total in which all sector companies are included. For calculating the risk-free rate, we used implied rate as a proxy, and for exchange rate we used the currency pair USD/TRY. After calculating the Book to Market ratio and market capitalization we developed portfolios for the FF3F model. In order to construct the book to market value portfolio, firstly the stocks were ranked and divided into three groups which are as follows, the bottom 30% as Low (L), middle 40% as Medium (M), and top 30% as High (H).The stocks with low book to market ratio, medium book to market ratio and high book to market ratio in time (t) are considered in the bottom group, medium group, and top group in time(t+1) respectively. To form the size portfolio the stocks were ranked on the basis of market capitalization. The stocks are divided into two subgroups which are top 50% as Big (B) and bottom 50% as Small (S). The stocks with high market capitalization at time (t) are considered as big stocks at time (t+1) and stocks with low market capitalization at time (t) value are considered as small stocks at time (t+1). In this way 6 equally weighted size and book to market sorted portfolios are formed, B/H, B/M, B/L, S/H, S/M, S/L. We use the OLS regression method to compute the results and our results are in line with the previous researches that confirms the validity of the FF3F model in Istanbul stock exchange. Furthermore, we can conclude that both factors size and value are significant and explaining portfolio returns in Bist-100 efficiently.

Two additional factors that have been proposed for inclusion in the F&F model are trading volume and exchange rate. These factors have been suggested based on empirical evidence that suggests that they may also have a significant impact on stock returns. For that we constructed the portfolio, which is to form trading volume sorted portfolio, the stocks

were categorized into two groups, top 50% as High trading volume (HV) and bottom 50% as low trading volume (LV). The stock with high trading volume at time t are considered as high-volume stocks at time (t+1) and the stock with low trading volume at time t are considered as low volume stocks at time (t+1).

In this way twelve equally weighted size, book to market and trading volume sorted portfolios are formed, BHHV, BHLV, BMHV, BMLV, BLHV, BLLV, SHHV, SHLV, SLHV, SLLV, SMLV, SMHV. After running the regression, we compute the results that trading volume shows significance in Istanbul stock exchange there were 12 portfolios in which 11 shows significance just 1 SMHV doesn't show significance otherwise almost all variable show significance at 1% level. We can conclude that companies trading on BIST 100 index with low trading volume explain more portfolio returns as compared to high trading volume. Trading volume is a measure of the number of shares that are traded in a given period of time. We can say that higher trading volume may be associated with higher expected returns, possibly due to increased liquidity or better market information. Furthermore, the other additional factor, which is the exchange rate shows significance in terms of adding in FF3F model with all six portfolios and also, the model with trading volume shows same consistency with all 12 portfolios. We can conclude that emerging countries such as Turkey exchange rate is one of the important factor which affect the market adversely. Exchange rate refers to the value of one currency relative to another. Changes in exchange rates can affect the returns of firms that trade in multiple countries, as they may face increased costs or benefits from changes in currency values. However, the impact of exchange rates on stock returns can be complex and may depend on a variety of factors, including the specific countries and currencies involved.

While the inclusion of trading volume and exchange rate as additional factors in the F&F model is a topic of ongoing research and debate, some studies have found evidence to support their inclusion. However, it is important to note that the performance of any model that includes these additional factors is likely to depend on the specific market and time period being examined, and further research is needed to fully understand their impact on stock returns. We reached the conclusion that FF3F is explaining the market portfolios in

Istanbul exchange efficiently and adding new factors like trading volume and exchange rate enhance the model's accuracy.

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APPENDICES:

Appendix-1:

Order	Code	Data Available Company Name
1	AGHOL	AG ANADOLU GRUBU HOLDİNG A.Ş.
2	AKBNK	AKBANK T.A.Ş.
3	AKSA	AKSA AKRİLİK KİMYA SANAYİİ A.Ş.
4	ALARK	ALARKO HOLDİNG A.Ş.
5	ALBRK	ALBARAKA TÜRK KATILIM BANKASI A.Ş.
6	ALKIM	ALKİM ALKALİ KİMYA A.Ş.
7	AEFES	ANADOLU EFES BİRACILIK VE MALT SANAYİİ A.Ş.
8	ASUZU	ANADOLU ISUZU OTOMOTİV SANAYİ VE TİCARET A.Ş.
9	ARCLK	ARÇELİK A.Ş.
10	ASELS	ASELSAN ELEKTRONİK SANAYİ VE TİCARET A.Ş.
11	BAGFS	BAGFAŞ BANDIRMA GÜBRE FABRİKALARI A.Ş.
12	BIMAS	BİM BİRLEŞİK MAĞAZALAR A.Ş.
13	BRYAT	BORUSAN YATIRIM VE PAZARLAMA A.Ş.
14	BUCIM	BURSA ÇİMENTO FABRİKASI A.Ş.
15	CCOLA	COCA-COLA İÇECEK A.Ş.
16	CEMTS	ÇEMTAŞ ÇELİK MAKİNA SANAYİ VE TİCARET A.Ş.
17	CIMSA	ÇİMSA ÇİMENTO SANAYİ VE TİCARET A.Ş.
18	DOHOL	DOĞAN ŞİRKETLER GRUBU HOLDİNG A.Ş.
19	DOAS	DOĞUŞ OTOMOTİV SERVİS VE TİCARET A.Ş.
20	EGEEN	EGE ENDÜSTRİ VE TİCARET A.Ş.
21	ECILC	EİS ECZACIBAŞI İLAÇ SINAİ VE FİNANSAL YATIRIMLAR SANAYİ VE TİCARET A.Ş.
22	ENKAI	ENKA İNŞAAT VE SANAYİ A.Ş.
23	ERBOS	ERBOSAN ERCİYAS BORU SANAYİİ VE TİCARET A.Ş.
24	EREGL	EREĞLİ DEMİR VE ÇELİK FABRİKALARI T.A.Ş.
25	FENER	FENERBAHÇE FUTBOL A.Ş.
26	FROTO	FORD OTOMOTİV SANAYİ A.Ş.
27	GARAN	TÜRKİYE GARANTİ BANKASI A.Ş.
28	GLYHO	GLOBAL YATIRIM HOLDİNG A.Ş.
29	GSDHO	GSD HOLDİNG A.Ş.
30	GUBRF	GÜBRE FABRİKALARI T.A.Ş.
31	HALKB	TÜRKİYE HALK BANKASI A.Ş.
32	HEKTS	HEKTAŞ TİCARET T.A.Ş.
33	IPEKE	İPEK DOĞAL ENERJİ KAYNAKLARI ARAŞTIRMA VE ÜRETİM A.Ş.
34	ISCTR	TÜRKİYE İŞ BANKASI A.Ş.
35	ISGYO	İŞ GAYRİMENKUL YATIRIM ORTAKLIĞI A.Ş.
36	IZMDC	İZMİR DEMİR ÇELİK SANAYİ A.Ş.

37	KARSN	KARSAN OTOMOTİV SANAYİİ VE TİCARET A.Ş.
38	KCHOL	KOÇ HOLDİNG A.Ş.
39	KERVT	KEREVİTAŞ GIDA SANAYİ VE TİCARET A.Ş.
40	KONYA	KONYA ÇİMENTO SANAYİİ A.Ş.
41	KORDS	KORDSA TEKNİK TEKSTİL A.Ş.
42	KOZAA	KOZA ANADOLU METAL MADENCİLİK İŞLETMELERİ A.Ş.
43	KRDMD	KARDEMİR KARABÜK DEMİR ÇELİK SANAYİ VE TİCARET A.Ş.
44	MGROS	MİGROS TİCARET A.Ş.
45	OTKAR	OTOKAR OTOMOTİV VE SAVUNMA SANAYİ A.Ş.
46	OYAKC	OYAK ÇİMENTO FABRİKALARI A.Ş.
47	PETKM	PETKİM PETROKİMYA HOLDİNG A.Ş.
48	SAHOL	HACI ÖMER SABANCI HOLDİNG A.Ş.
49	SASA	SASA POLYESTER SANAYİ A.Ş.
50	SELEC	SELÇUK ECZA DEPOSU TİCARET VE SANAYİ A.Ş.
51	SISE	TÜRKİYE ŞİŞE VE CAM FABRİKALARI A.Ş.
52	SKBNK	ŞEKERBANK T.A.Ş.
53	SNGYO	SİNPAŞ GAYRİMENKUL YATIRIM ORTAKLIĞI A.Ş.
54	TAVHL	TAV HAVALİMANLARI HOLDİNG A.Ş.
55	TCELL	TURKCELL İLETİŞİM HİZMETLERİ A.Ş.
56	THYAO	TÜRK HAVA YOLLARI A.O.
57	TKFEN	TEKFEN HOLDİNG A.Ş.
58	TOASO	TOFAŞ TÜRK OTOMOBİL FABRİKASI A.Ş.
59	TSKB	TÜRKİYE SINAİ KALKINMA BANKASI A.Ş.
60	TTKOM	TÜRK TELEKOMÜNİKASYON A.Ş.
61	TTRAK	TÜRK TRAKTÖR VE ZİRAAT MAKİNELERİ A.Ş.
62	TUKAS	TUKAŞ GIDA SANAYİ VE TİCARET A.Ş.
63	TUPRS	TÜPRAŞ-TÜRKİYE PETROL RAFİNERİLERİ A.Ş.
64	TURSG	TÜRKİYE SİGORTA A.Ş.
65	ULKER	ÜLKER BİSKÜVİ SANAYİ A.Ş.
66	VAKBN	TÜRKİYE VAKIFLAR BANKASI T.A.O.
67	VESBE	VESTEL BEYAZ EŞYA SANAYİ VE TİCARET A.Ş.
68	VESTL	VESTEL ELEKTRONİK SANAYİ VE TİCARET A.Ş.
69	YKBNK	YAPI VE KREDİ BANKASI A.Ş.
70	ZOREN	ZORLU ENERJİ ELEKTRİK ÜRETİM A.Ş.

Appendix-2:

Order	Code	Data Missing Company Name
1	AKFGY	AKFEN GAYRİMENKUL YATIRIM ORTAKLIĞI A.Ş.
2	AKSEN	AKSA ENERJİ ÜRETİM A.Ş.
3	ALFAS	ALFA SOLAR ENERJİ SANAYİ VE TİCARET A.Ş.
4	AYDEM	AYDEM YENİLENEBİLİR ENERJİ A.Ş.
5	BASGZ	BAŞKENT DOĞALGAZ DAĞITIM GAYRİMENKUL YATIRIM ORTAKLIĞI A.Ş.
6	BERA	BERA HOLDİNG A.Ş.
7	BIOEN	BİOTREND ÇEVRE VE ENERJİ YATIRIMLARI A.Ş.
8	EKGYO	EMLAK KONUT GAYRİMENKUL YATIRIM ORTAKLIĞI A.Ş.
9	ENJSA	ENERJİSA ENERJİ A.Ş.
10	EUREN	EUROPEN ENDÜSTRİ İNŞAAT SANAYİ VE TİCARET A.Ş.
11	GWIND	GALATA WIND ENERJİ A.Ş.
12	GENIL	GEN İLAÇ VE SAĞLIK ÜRÜNLERİ SANAYİ VE TİCARET A.Ş.
13	GESAN	GİRİŞİM ELEKTRİK SANAYİ TAAHHÜT VE TİCARET A.Ş.
14	ISDMR	İSKENDERUN DEMİR VE ÇELİK A.Ş.
15	KCAER	KOCAER ÇELİK SANAYİ VE TİCARET A.Ş.
16	KLRHO	KİLER HOLDİNG A.Ş.
17	KMPUR	KİMTEKS POLİÜRETAN SANAYİ VE TİCARET A.Ş.
18	KONTR	KONTROLMATİK TEKNOLOJİ ENERJİ VE MÜHENDİSLİK A.Ş.
19	KOZAL	KOZA ALTIN İŞLETMELERİ A.Ş.
20	KZBGY	KIZILBÜK GAYRİMENKUL YATIRIM ORTAKLIĞI A.Ş.
21	MAVI	MAVİ GİYİM SANAYİ VE TİCARET A.Ş.
22	ODAS	ODAŞ ELEKTRİK ÜRETİM SANAYİ TİCARET A.Ş.
23	PGSUS	PEGASUS HAVA TAŞIMACILIĞI A.Ş.
24	PSGYO	PASİFİK GAYRİMENKUL YATIRIM ORTAKLIĞI A.Ş.
25	SMRTG	SMART GÜNEŞ ENERJİSİ TEKNOLOJİLERİ ARAŞTIRMA GELİŞTİRME ÜRETİM SANAYİ A.Ş.
26	SOKM	ŞOK MARKETLER TİCARET A.Ş.
27	TKNSA	TEKNOSA İÇ VE DIŞ TİCARET A.Ş.
28	TMSN	TÜMOSAN MOTOR VE TRAKTÖR SANAYİ A.Ş.
29	ULUUN	ULUSOY UN SANAYİ VE TİCARET A.Ş.
30	YYLGD	YAYLA AGRO GIDA SANAYİ VE TİCARET A.Ş.