ISTANBUL BILGI UNIVERSITY

INSTITUTE OF GRADUATE PROGRAMS

BANKING AND FINANCE MASTER'S DEGREE PROGRAM

TESTING THE VALIDITY OF FACTOR INVESTING STRATEGIES IN BORSA ISTANBUL

HAKAN NAZLI

117673007

PROF. DR. CENKTAN ÖZYILDIRIM

ISTANBUL

2021

Testing the Validity of Factor Investing Strategies in Borsa Istanbul

Faktöre Dayalı Yatırım Stratejilerinin Borsa Istanbul Üzerinde Geçerliliği

HAKAN NAZLI

117673007

Prof. Dr. Cenktan ÖZYILDIRIM (Bilgi Üniversitesi): .....

Prof. Dr. Ömür SÜER (Galatasaray Üniversitesi): .....

Assist. Prof. Dr. Ebru REİS (Bilgi Üniversitesi): .....

Tezin Onaylandığı Tarih: 02/02/2021

Toplam Sayfa Sayısı: 60

Anahtar Kelimeler (Türkçe):

1) Fama-French Üç Faktör Modeli
2) Varlık Fiyatlama
3) Hisse Getirisi
4) Borsa İstanbul
5) Ek Getiri

Anahtar Kelimeler(İngilizce)

1) Fama-French Three Factor Model
2) Asset Pricing
3) Returns
4) Borsa Istanbul
5) Excess Return

Acknowledgments

This master thesis is written with Prof. Dr. Cenktan Özyıldırım as supervisor. He has been very accessible throughout the whole process. I would like to thank him for his effort, support and understanding.

Özet

Bu çalışmanın amacı faktör yatırım stratejilerinin Borsa Istanbul üzerinde geçerli olup olmadığını araştırmaktır. Öncelikle Fama-French üç faktör modelinin esasları olan piyasa faktörü, değer faktörü ve büyüklük faktörü ele alınmıştır. Geleneksel çalışmaların aksine bu çalışmada finans dünyasına yeni kazandırılan momentum, büyüme, likidite ve karlılık faktörleri de test edilmiştir. Bu çalışmada faktörlere dayalı oluşturulan portföylerin performansları ile piyasa performansı karşılaştırılmış ve faktöre dayalı portföylerin piyasa getirisi üzerine yarattıkları ek getiri izlenmiştir. Finansal sektörlerde faaliyet gösteren şirketler çalışmada yer almamıştır. 2010 ve 2020 yılları arasındaki 10 yıllık süre zarfındaki veriler ile çalışma gerçekleştirilmiştir.

Abstract

The study tests the validity and availability of factor based investment strategies in Borsa Istanbul. In addition to the traditional factors, i.e. market factor, size factor and value factor explained in Fama-French three factor model, this study widens the scope of factor investing with momentum factor, growth factor, liquidity factor and profitability factor, which are commonly used in today's world. The study focuses on the excess return generation and tests if it is possible to generate sustainable excess return over market with a single factor based portfolio in Borsa Istanbul. In this study, only non-financial stocks are included in the research universe. The research horizon captures the ten year long period between 2010 and 2020.

Table of Contents

Acknowledgments iii

Özet iv

Abstract v

Table of Contents vi

List of Tables viii

List of Figures viii

1.Introduction **1**

2.Literature Review **3**

2.1 Historical Background 3

2.2 Studies on Developed Markets 9

2.3 Studies on Emerging Markets 11

2.4 Studies on Turkish Market 12

3.Data & Analysis **15**

3.1 Research Universe 15

3.2 Data Source 18

3.3 Methodology 18

3.4 Factor Analysis 21

3.4.1 Beta (market factor) 21

3.4.2 Size factor 27

3.4.3 Value factor 31

3.4.4 Growth factor 38

3.4.5 Liquidity factor 43

3.4.6 Momentum factor 45

3.4.7 Profitability factor 48

4.Conclusion **53**

5.References **55**

6.Appendices **59**

6.1 Stock frequencies in factor based portfolios 59

List of Tables

3.1.1: Top 50 Stocks in Borsa Istanbul

3.1.2: Financial Stocks in Top 50 Stocks

3.1.3: Stocks, whose don't have 10 year history in Borsa Istanbul

List of Figures

Figure 2.1.1: Markowitz Modern Portfolio Theory

Figure 2.1.2: Beta (β) factor of CAPM

Figure 3.4.1.1: Return performance of high beta portfolio

Figure 3.4.1.2: Excess return generation of high beta portfolio

Figure 3.4.1.3: Correlation between high beta portfolio and benchmark portfolio

Figure 3.4.1.4: The performance btw. 2010-2012

Figure 3.4.1.5: The performance btw. 2012-2014

Figure 3.4.1.6: The performance btw. 2014-2016

Figure 3.4.1.7: The performance btw. 2016-2018

Figure 3.4.1.8: The performance btw. 2018-2020

Figure 3.4.1.9: Return performance of low beta portfolio

Figure 3.4.1.10: Excess return generation of low beta portfolio

Figure 3.4.1.11: Correlation between low beta portfolio and benchmark portfolio

Figure 3.4.2.1: Return performance of small stocks portfolio

Figure 3.4.2.2: Excess return generation of small stocks portfolio

Figure 3.4.2.3: Correlation between small stocks portfolio and benchmark portfolio

Figure 3.4.2.4: Return performance of large stocks portfolio

Figure 3.4.2.5: Excess return generation of large stocks portfolio

Figure 3.4.2.6: Correlation between large stocks portfolio and benchmark portfolio

Figure 3.4.3.1: Return performance of value BMR portfolio

Figure 3.4.3.2: Excess return generation of value BMR portfolio

Figure 3.4.3.3: Correlation between value BMR portfolio and benchmark portfolio

Figure 3.4.3.4: The performance btw. 2010-2012

Figure 3.4.3.5: The performance btw. 2012-2014

Figure 3.4.3.6: The performance btw. 2014-2016

Figure 3.4.3.7: The performance btw. 2016-2018

Figure 3.4.3.8: The performance btw. 2018-2020

Figure 3.4.3.9: Return performance of value SMR portfolio

Figure 3.4.3.10: Excess return generation of value SMR portfolio

Figure 3.4.3.11: Correlation between value SMR portfolio and benchmark portfolio

Figure 3.4.4.1: Return performance of sales growth portfolio

Figure 3.4.4.2: Excess return generation of sales growth portfolio

Figure 3.4.4.3: Correlation between sales growth portfolio and benchmark portfolio

Figure 3.4.4.4: Return performance of EBIT growth portfolio

Figure 3.4.4.5: Excess return generation of EBIT growth portfolio

Figure 3.4.4.6: Correlation between EBIT growth portfolio and benchmark portfolio

Figure 3.4.4.7: Return performance of book value growth portfolio

Figure 3.4.4.8: Excess return generation of book value growth portfolio

Figure 3.4.4.9: Correlation between book value growth and benchmark portfolio

Figure 3.4.5.1: Return performance of liquid stock portfolio

Figure 3.4.5.2: Excess return generation of liquid stocks portfolio

Figure 3.4.2.3: Correlation between liquid stocks portfolio and benchmark portfolio

Figure 3.4.6.1: Return performance of long momentum portfolio

Figure 3.4.6.2: Excess return generation of long momentum portfolio

Figure 3.4.6.3: Correlation between long momentum portfolio and benchmark portfolio

Figure 3.4.6.4: Return performance of short momentum portfolio

Figure 3.4.6.5: Excess return generation of short momentum portfolio

Figure 3.4.6.6: Correlation between short momentum portfolio and benchmark portfolio

Figure 3.4.7.1: Return performance of EBIT profitability portfolio

Figure 3.4.7.2: Excess return generation of EBIT profitability portfolio

Figure 3.4.7.3: Correlation between EBIT profitability portfolio and benchmark portfolio

Figure 3.4.7.4: Return performance of earnings profitability portfolio

Figure 3.4.7.5: Excess return generation of earnings profitability portfolio

Figure 3.4.7.6: Correlation between earnings profitability portfolio and benchmark portfolio

Figure 3.4.8: Return performances of all factor based portfolios

1.Introduction

Different asset pricing models have been evaluated in order to be able to explain the variation in stock returns, so far. Modern portfolio theory was introduced by Markowitz (1952), which focusing on the relationship between the risk and return. Treynor (1961), Sharpe (1964), Lintner (1965) and Mossin (1966) evaluated the capital asset pricing model and emphasized the importance of market risk. The capital asset pricing model was perceived as revolutionary. Since the capital asset pricing model is a single factor model, it was getting insufficient in explaining the variation in stock returns. Following the capital asset pricing model as being a single factor model, multifactor models have been evaluated. The first multifactor model was introduced by Ross (1976) and this multifactor model was called as arbitrage pricing theory. The arbitrage pricing theory uses macroeconomic factors such as inflation and GDP to explain stock returns. However, in parallel to the developments in capital markets, multifactor models which focuses on only macroeconomic factors have struggled in explaining the returns of individual stocks. Fame and French (1992) introduced the three factor model to explain the stock returns. In addition to market factor by the capital asset pricing model, they introduced size and value factors.

This study will focus on the effectiveness of factor models in Turkish stocks. The aim of this study is to determine if it is possible to create sustainable excess return over market by using factor models. In addition to the traditional factors explained in Fama-French three factor model, this study will extend the scope of factor investing with more recent factors. Accordingly, in this study the factors, i.e. market factor, size factor, value factor, growth factor, momentum factor, volatility factor and liquidity factor will be studied, respectively. The analysis will contain only non-financial stocks listed in Borsa Istanbul. The reason behind the exclusion of financial stocks is their high leverage ratios as the nature of business. The research horizon will capture the ten year long period between 2010 and 2020.

This study is comprised of four parts. First part is a brief introduction. In the second part, modern portfolio theory, the capital asset pricing model, multifactor models, Fama-French three factor model and other factor models including momentum factor, volatility factor and liquidity factor are explained briefly. Second part also lists previous studies published in literature. In this part, studies on developed markets, emerging markets and Turkish market are summarized respectively. In third part, factor analysis with Turkish stocks are presented and explained. Lastly, the results are concluded.

2. Literature Review

2.1 Historical Background

All investors want to maximize their expected return by taking minimum risk as possible. The relationship between risk and return was the starting point of the finance researches on stock investing. Various theories and asset valuation methods have been developed so far defining the relationship between the risk and return in order to be used in investment decision making process. Firstly the relationship between risk and return was introduced by Harry Markowitz back in 1952. His article named portfolio selection was published in journal of finance, which focuses on the relationship between risk and return. and also which pioneered modern portfolio theory. Modern portfolio theory was anticipated as revolutionary after previous traditional theories. Modern portfolio theory tries to maximize the expected return of investors by evaluating their risk levels. According to modern portfolio theory, it is possible whether to maximize expected return by adding financial instruments with higher return profile at the same risk level or to minimize risk by adding less risky financial instruments at the same return profile. Markowitz defines efficient frontier, which allows investors to construct optimal portfolios with different individual financial instruments for a given risk level.

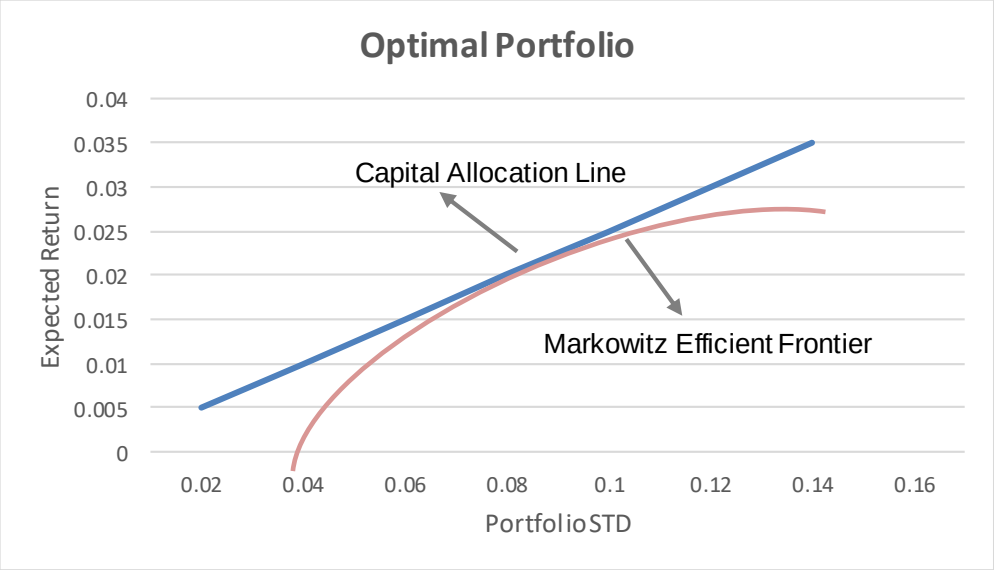

Figure 2.1.1: Markowitz Modern Portfolio Theory

According to modern portfolio theory, the return of the portfolio equals to sum of the individual assets returns by multiplying with their portfolio weights. Modern portfolio theory aims to diversify portfolio with individual assets and to decrease the variance of the portfolio return. Another important point that modern portfolio theory emphasizes is to correlation of the returns of individual assets. Modern portfolio theory suggests that investor should select individual assets which are negatively correlated, as individual assets have their own risks, which is called as idiosyncratic risk. Note that in addition to the idiosyncratic risk, there is also systematic risk for asset returns which affects all the financial system and all the financial instruments in the system according to modern portfolio theory.

After defining the principle of portfolio diversification and mean-variance model by Markowitz in 1952, Treynor (1961), Sharpe (1964), Lintner (1965) and Mossin (1966) evaluated the Capital Asset Pricing Model. The capital asset pricing model argues that the only risk is the systematic risk and suggests that the investors should hold market portfolio rather than individual assets. According to the capital asset pricing model, individual assets are only exposed to systematic risk (market risk), so idiosyncratic risk does not add extra risk premium to the expected returns of the investors. However, investors can manage their risks relative to the market portfolio by using individual assets. Some individual assets are categorized as more riskier and these riskier assets can perform better than market portfolio in bull market and they also can perform worse than market portfolio in bear market. In order to assess the risk level of an individual asset relative to market portfolio, the capital asset pricing model introduced beta factor. Beta factor shows the level of risk that the investors want to add in portfolios.

CAPM formula:

$E(r_i)=r_f+\beta_i E(r_m-r_f)$

where:

$E(r_i)$=expected return

r_f=risk-free rate

β_i=beta of the individual stock

$E(r_m - r_f)$=market risk premium

As shown in formula, if investors want to add extra risk, they should prefer individual stocks with beta factors above 1. If investors wants to avoid risk, they should hold individual stocks with beta factors less than 1. The formula of Beta (β), as a measurement factor for systematic risk, is as follows:

$\beta_i = Cov(R_i, R_m)/Var(R_m)$

where;

$Cov(R_i, R_m)$= the covariance of an individual asset or a portfolio relative to the market

$Var(R_m)$= the variance of the market

β_i = β of an individual asset or a portfolio *i*.

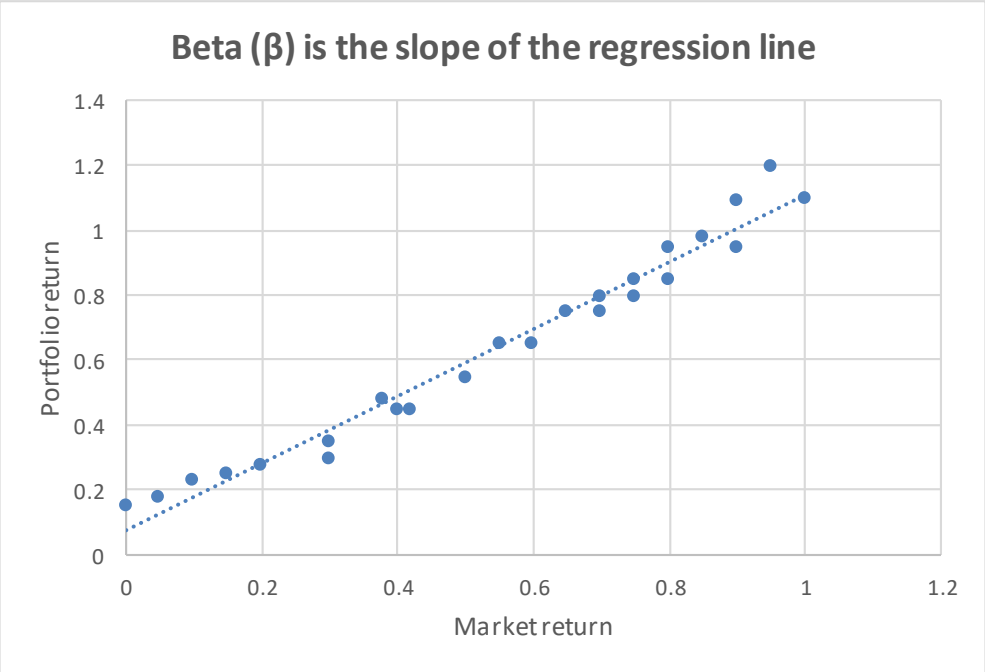

Figure 2.1.2: Beta (β) factor of CAPM

The capital asset pricing model is based on one factor, which is the market factor. The market factor as a sole factor to identify the returns was becoming insufficient. The anomalies of the capital asset pricing model were pushed the investors to

develop new factor models for asset pricing. Following the one-factor model, multiple factor models were introduced. The first multifactor model was introduced by Ross (1976) and this multifactor model was called as arbitrage pricing theory. The arbitrage pricing theory claims that there is a linear relationship between individual asset returns and the macroeconomic factors, such as GDP growth, inflation rate, the rate of Treasury Bill, Gold prices. The Arbitrage pricing theory measures the correlations of individual assets with those macroeconomic factors and determines a different beta factor for each macroeconomic factor. Expected return is a function of all those multi factors.

APT formula:

$E(r_i)=r_f+\beta_{i1}RP_1+\beta_{i2}RP_2+\ldots+\beta_{in}RP_n$

where:

$E(r_i)$=expected return

r_f=risk-free rate

β_{in}=individual asset's price sensitivity to factor

RP_n=risk premium associated with the factor

As shown above, the arbitrage pricing model provides more options for investors. Investors are able to construct their portfolio with the factors that they believe affect the return on the asset.

In parallel to the developments in capital markets, multifactor models which focuses on only macroeconomic factors, have struggled explaining the returns of individual stocks. Accordingly, Fame and French introduced the three factor model in order to be able to explain the stock returns. The Fama-French model explains the stock returns with three factors. In addition to market factor by the capital asset pricing model, there are also size factor and value factor in Fama-French three factor model.

Size factor is related to the market capitalization of the stock. Market capitalization equals to number of stocks multiplied by stock price.

Market Capitalization = Share Price x Number of outstanding shares

Fama and French claims that the average returns of small cap stocks are greater than the average return of large cap stocks.

Value factor is related to book value yield of the stock. Book value yield, which is noted as book-to-market ratio by Fama-French three factor model, equals to book value of the stock divided by market capitalization of the stock.

Book-to-market ratio=(Book value of the stock)/(Market capitalization)

According to Fama-French three factor model, the average returns of the stocks with high book-to-market ratio are larger than the average returns of the stocks with low book-to-market ratio. As formulated below, in Fama-French three factor model, investors are exposed to market factor, size factor and value factor and they are able to adjust their risk level according to these three factor.

Fama-French three factor model formula:

$E(ri)=rf+\beta_{i,MKT}E(r_m-r_f)+ \beta_{i,SMB}E(SMB)+ \beta_{i,HML}E(HML)$

where:

$E(r_i)$=expected return

r_f=risk-free rate

$\beta_{i,MKT}$=market factor

$E(r_m-r_f)$=risk premium associated with the market factor

$\beta_{i,SMB}$=size factor, which refers to the differential returns of small cap stocks minus large cap stocks

E(SMB)=risk premium associated with the size factor

$\beta_{i,HML}$=value factor, which refers to the differential returns of high book-to-market stocks minus low book-to-market stocks

E(HML)=risk premium associated with the value factor

In 2015, Fama and French have published a new paper on factor model. The paper 'A five-factor asset pricing model' was published in the Journal of Financial Economics in April 2015. With the new paper, Fama and French introduced two additional new factors on top of their classic three-factor model. One of the two new factors is profitability factor, which argues that the return of the stocks with high operating profitability are better. Second new factor is investment factor, which claims that the stocks with high asset growth (high capital expenditure) have poorer returns. The two new factors are also called as quality factors. Although Fama and French expanded their three factor model to five factor model, their model still ignores other factors such as momentum, volatility and liquidity factors.

Momentum factor was firstly introduced by Levy back in 1967. In his dissertation, Levy stated that if investors buy the stocks, whose current stock prices are higher than the average prices over past 27 weeks of them, their portfolios perform better than the market average. Following Levy's momentum study, there were introduced other studies/strategies on momentum factor in the literature while using different time horizons. One of them belongs to Jensen and Bennington (1970). They constructed Levy's trading rule using a longer time period and found that the trading rule does not outperform a buy and hold strategy.

Another factor investment strategy to create higher portfolio returns than market average is volatility factor, which was criticized in minimum-variance portfolio by Clarke, de Silva, and Thorley in 2006. This paper focused on minimum-variance portfolios containing the 1,000 largest US stocks over the 1968-2005 period and successfully reached higher portfolio returns than market average while reducing the volatility.

Amihud and Mendelson (1986) studied on the relationship between the liquidity and return. They argued that the capital asset pricing model is not sufficient to explain the differences between stock returns and the differences can be explained by liquidity factor. Liquidity means how easy is to buy or sell a stock. Latest studies on liquidity factor states that less liquid stocks perform better than more liquid stocks.

2.2 Studies on Developed Markets

Basu (1983) studied the relationship between the factors and the returns using the stocks listed in New York Stock Exchange. This paper focuses on the relationship the earnings yield (which equals to net income divided by the market capitalization, i.e the reciprocal of P/E ratio), the size and the return of stocks, which are tradable in New York Stock Exchange. The study was conducted with the NYSE data from 1962 to 1978. According to empirical findings reported in the paper, NYSE stocks confirms the relationship between the earnings yield, the size and the return. This paper concludes that 1) NYSE stocks with high earnings yield appear to have performed better than NYSE stocks with low earnings yield ,2) Small NYSE stocks seem to have performed remarkably higher returns than large NYSE stocks.

Chan, Hamao and Lakonishok (1991) published their article on factor analysis. This study examines the Japanese stock returns from 1971 to 1988. In this study, four factors are tested, which are size, earnings yield, book-to-market ratio and cash flow yield. The results show that four factors are satisfactory in explaining the stock returns, but more importantly, earnings yield and cash flow yield are more significant impact on stock returns rather than size and book-to-market ratio.

Barber and Lyon (1997) tried to explain the variation in stock returns in their study. This study analyzes the stocks listed in NASDAQ for the period between 1973 – 1994. According to this paper, size and book-to-market ratio have more significant impact on explaining the abnormal stock returns rather than beta (market factor).

Lam (2002) published his article focusing on the relationship between the factors and the stock returns. This paper is based on Fama-French three factor model and studies with stocks which are tradable in Hong Kong Stock Market. In this paper, the factors used in Fama-French three factor model are extended. This study adds earnings yield and leverage ratio on top of beta (market factor), book-to-market ratio and size factor. This study covers the period between 1984 and 1997. The study claims that Beta (market factor) is insufficient to explain the returns of the stocks continuously listed in Hong Kong Stock Market. However, the study concludes that the combination of three factors, earnings yield, size and book-to-market ratio seem to be more helpful to explain the stock returns rather than beta and leverage ratio.

Liang (2003) studied on asset pricing models as well. This study compares the capital asset pricing model and Fama-French Three factor model for four different time periods, which are 1933-1963, 1963-1993, 1994-2003 and 1933-2003. In this study, stocks listed in American Stock Market are used. Results of this study show us that CAPM fits better for the periods of 1933 – 1963 and 1994-2003, while Fama-French three factor model is better in explaining the stock returns for the period of 1963-1993.

Malin ve Veeraraghavan (2004) studied on Fama-French multifactor model. This paper tests the validity of Fama-French three factor model in three different European countries, which are France, Germany and United Kingdom. Only non-financial stocks are used in this study. The common result for the three different analysis is that beta (market factor) seems to be inadequate in explaining the divergence of the stock returns. In terms of size factor, the results are contradictory, as this study results show that small stocks perform better in Germany and France, while large stocks outperform small stocks in United Kingdom. Lastly, in this study, the stock with low book-to-market ratio have larger returns in opposite to the Fama-French three factor model. Recall that Fama-French three factor model claims that the stocks with high book-to-market ratio should perform better than the stocks with low one.

Kassimatis (2008) published his article on factor models. In his study, the validity of size, book-to-market and momentum factors are tested for the stocks listed in Australian Stock Market. The study concludes that size, book-to-market and momentum factor are useful additional factors to market factor by CAPM in explaining stock returns.

2.3 Studies on Emerging Markets

Lunden (2007) studied factor models in Brazil. This paper focuses on the Fama-French three-factor model and an international six-factor model yield and checks if models are a good proxy for the divergence in stock returns. Stocks are selected from Bovespa Index and the stocks data between 1995 and 2006 are used. In the study, the comparison between the performance of model on US stocks and the performance of model on Bovespa stocks are also made. The findings present that the three-factor model is less convincing for Bovespa stocks when compared to US stocks.

Pasaribu (2009) worked with Indonesian stock market. This study investigates the effectiveness of Fama-French three factor model in Indonesian stock market by using the Indonesian stock returns over 2003 and 2006 period. The main motivation of this study is to show that the Fama-French three factor model is also a good proxy in emerging markets, as well, in explaining the stock returns. The results of this study confirms the validity of Fama-French three factor model in Indonesian stock market. Another output is that the model fits well on non-financial stocks rather than financial stocks.

Shaker and Abdeldayem (2018) tested factors with Egyptian stocks. In this article, different asset pricing models are tested with the stock listed in Egyptian Stock Exchange (EGX) for a five year period. The study is conducted with the stocks in EGX 100 index, however, 45 stocks out of 100 stocks is eliminated due to lack of available data. According to the findings of the study, Fama-French three factor model is a better proxy compared to CAPM and latest models developed after Fama-French three factor model, i.e. Carhart model, four factor model and five

factor model, do not add any significant improvement on top of Fama-French three factor model.

One of the latest research was the article published by Cox and Britten (2019). This paper examines the ability of Fama-French five factor models in Johannesburg Stock Exchange and comparing it with the traditional Fama-French three factor model. The results shows us that the application of Fama-French three factor and also five-factor model is valid in Johannesburg Stock Exchange. Additional factors, i.e. profitability and investment factors, explained in Fama-French five factor model in 2015 seem to bring additional explanation, however this study claims that profitability factor is more consistent than investment factor.

2.4 Studies on Turkish Market

One of the pioneer articles focusing on factor models in Turkey published by Aksu and Onder (2003). In this study, the relationship between the factors and stock returns as well as the impact of stock-specific issues and macro-economic fundamentals on stock returns are investigated with stocks listed in the Istanbul Stock Exchange. Research is built with stock data from 1993-2001 and financial stocks are excluded from the study. The paper concludes that both size and book-to-market ratio have remarkable impact on stock returns in Turkish stocks. However, size factor is more significant. This study also argues that the significance of factor models varies with the macro-economic fundamentals and stock specific factors.

The paper by Doganay (2006) focused on Fama-French three factor model in Istanbul Stock Exchange. This paper constructs Fama-French three factor model with both financial and non-financial stocks listed in Istanbul Stock Exchange for the period between July 1995 – June 2005. In this study, the stocks, which reported negative equity value in their balance sheets, are excluded from the research universe. The study confirms the validity of Fama-French three factor model in Turkish stocks.

Gokgoz (2008) studied on asset pricing model in Turkey. This study tests the validity of both the CAPM and Fama-French three factor model with Turkish stocks. The analysis is made with five different indices, that are ISE Industrials, Services, Real Estate, Securities, and Technology indices. Stock data from 2001 to 2005 are used. The result of the study shows that the both model are valid for all indices.

Guzeldere and Sarioglu (2012) studied on Fama-French three factor model in Turkey as well. This study tests the effectiveness of Fama-French three factor model in Istanbul Stock Exchange (ISE). The chosen data includes only the non-financial members of ISE-100 index. The research is conducted for the period 1999-2011. Monthly data are used. The results of the study confirms that the Fama-French three factor is valid in Turkish stocks. All the three factors have positive correlation with the stock returns, however, size factor has less impact than beta and book-to-market ratio.

Kara (2016) published a more recent study on factor models. This study examines the validity of Fama-French three factor model in Borsa Istanbul (Istanbul Stock Exchange) using stock data from 2006 to 2014. However, this study differs from previous studies as it focuses on the sectoral breakdown. Fama-French three factor model are tested for the stocks listed in Borsa Istanbul Services Index, Borsa Istanbul Industrials Index and Borsa Istanbul Financials Index, separately. The findings of the study gives us that factors, i.e. beta, size and book-to-market ratio are valid in explaining the variation in stock returns for all the indices tested in this study. Another important point is that beta is the main explanatory factor for services and financials sectors.

Another factor analysis was published by Kaya and Gungor (2017) in Turkey. This study investigates the effectiveness of Fama-French three factor model for the non-financial stocks traded in Borsa Istanbul (Istanbul Stock Exchange). The methodology used in analyzing the relationship between the factors and the stock returns is based on panel data analysis. According to the findings, size factor has

negative direction with stock returns, while other two factors, value factor and market factor have positive directions. The results of this study are in-line with the findings of Fama-French three factor model.

Ozkan (2018) extended the previous factor studies with alternative factors. This paper examines not only the ability of Fama-French five factor model in Borsa Istanbul (Istanbul Stock Exchange), but also seeks for the requirement of value factor in explaining stock returns. Two different data analysis are constructed. First one is the Fama-French five factor model with no change. Second one is the Fama-French five factor model without value factor. Borsa Istanbul data from July 2009 to June 2015 (72 months period) are used in the research. The results of this paper gives us that 1) Fama-French five factor model is applicable for Turkish stocks, 2) Size factor is relatively less impact on divergence of stock returns, and 3) value factor has significant impact on predicting stock returns and value factor is irrevocable for the asset pricing model.

Aras, Cam, Zavalsiz, Keskin (2018) published their study on asset pricing models in Turkey. The paper investigates the ability of Fama-French five factor model in Borsa Istanbul (Istanbul Stock Exchange) and also compares the effectiveness of it with the previous traditional models such as Fama-French three factor model and CAPM. Research includes data from January 2006 to June 2017 (150 months period). The results of the study claims that the best fit asset pricing model is the Fama-French five factor model when compared to other alternative models.

3. Data and Analysis

This analysis aims to determine if factor models is applicable to Turkish stocks. Firstly, the study will focus on the traditional Fama-French factor model and will try to identify which factor explains best the variation in stock returns in Borsa Istanbul (Istanbul Stock Exchange). After analyzing the basic factors stated in Fama French three factor model, i.e. market risk premium (beta), size and book-to-market ratio, this study will also examine the momentum factor, profitability factor, growth factor and liquidity factor as well. Moreover, in this study, the scope of value factor will be extended and in addition to the book-to-market ratio, other ratios will be subjected to value factor analysis.

3.1 Research Universe

In this section, the research universe will be introduced and the selection criteria of the research universe will be explained in detail. As stated before, this study constitutes of only the Turkish stocks listed in Borsa Istanbul. As the first step, top 50 stocks are sorted according to their market capitalizations as of November 11th, 2020. The list are shown on the table below.

Stocks	Company Name	Sector Name	Market Capitalization*	IPO Date
KCHOL	Koc Holding	Conglomerates	50,464	04.01.1988
FROTO	Ford Otosan	Automotive	43,127	04.01.1988
BIMAS	Bim Birlesik Magazalar	Retail	44,447	06.07.2005
ASELS	Aselsan	Communication Equipment	41,040	01.08.1990
ENKAI	Enka Insaat	Construction	41,048	22.07.2002
EREGL	Eregli Demir Celik	Steel & Iron	49,700	04.01.1988
GARAN	Garanti Bankasi	Banking	41,370	06.06.1990
TCELL	Turkcell	Communication	35,266	03.07.2000
AKBNK	Akbank	Banking	33,852	26.07.1990
ISCTR	Is Bankasi (C)	Banking	30,375	04.01.1988
TTKOM	Turk Telekom	Communication	29,330	09.05.2008
YKBNK	Yapi Ve Kredi Bankasi	Banking	25,510	08.01.1988
ISDMR	Iskenderun Demir Ve Celik	Steel & Iron	28,942	28.03.2016
TUPRS	Tupras	Oil & Gas	26,544	30.05.1991
SAHOL	Sabanci Holding	Conglomerates	21,485	02.07.1997
SISE	Sise Cam	Glass	22,025	04.01.1988
ARCLK	Arcelik	Durable Goods	20,272	04.01.1988

VAKBN	T. Vakiflar Bankasi	Banking	18,044	09.11.2005
THYAO	Turk Hava Yollari	Aviation	17,581	20.12.1990
CCOLA	Coca Cola Icecek	Beverages	15,720	03.05.2006
SASA	Sasa	Industrial Textile	16,185	23.10.1996
TOASO	Tofas Otomobil Fab.	Automotive	15,980	01.07.1991
HALKB	Halk Bankasi	Banking	13,482	04.05.2007
AEFES	Anadolu Efes Biracilik	Beverages	13,950	24.07.2000
GUBRF	Gubre Fabrikalari	Agricultiral Chemicals	21,376	04.01.1988
ENJSA	Enerjisa Enerji	Utilities	13,736	01.02.2018
KOZAL	Koza Altin Isletmeleri	Mining	14,442	05.02.2010
PETKM	Petkim	Oil & Gas	12,672	09.07.1990
OYAKC	Oyak Cimento Fabrikalari	Cement	10,067	07.01.1988
ULKER	Ulker	Food	7,757	23.02.2004
TTRAK	Turk Traktor	Automotive	8,496	03.06.2004
SOKM	Sok Marketler Ticaret	Retail	7,894	08.05.2018
EKGYO	Emlak G.M.Y.O.	Real Estate	8,132	24.11.2010
MGROS	Migros	Retail	7,550	28.02.1991
DOAS	Dogus Otomotiv	Automotive	5,971	10.06.2004
DOHOL	Dogan Holding	Conglomerates	7,982	14.06.1993
KARTN	Kartonsan	Paper & Paper Products	7,054	04.01.1988
VESTL	Vestel	Durable Goods	7,045	27.06.1990
TURSG	Turkiye Sigorta	Insurance	7,434	14.11.1994
TAVHL	Tav Havalimanlari	Aviation	7,578	16.02.2007
TSKB	T.S.K.B.	Banking	5,124	05.05.1988
PGSUS	Pegasus Hava Tasimaciligi	Aviation	7,355	18.04.2013
SELEC	Selcuk Ecza Deposu	Healthcare	9,588	19.04.2006
BRISA	Brisa	Automotive Tires	6,069	04.01.1988
ZOREN	Zorlu Enerji	Energy	5,300	17.05.2000
TKFEN	Tekfen Holding	Conglomerates	6,175	16.11.2007
AGHOL	Ag Anadolu Grubu Holding	Conglomerates	6,697	10.02.2000
KOZAA	Koza Anadolu Metal	Mining	6,128	05.02.2003
ECILC	Eczacibasi Ilac	Healthcare	5,139	25.06.1990
OTKAR	Otokar	Automotive	6,696	13.04.1995

**in TRY million & as of 17/11/2020*
Source: Borsa Istanbul

Table 3.1.1: Top 50 Stocks in Borsa Istanbul

Secondly, financials stocks are excluded from the research universe, as previous studies suggest. The reason behind the exclusion of financial stocks is their high leverage ratios as the nature of business. However, high financial ratio is sign of financially distressed situation for non-financial stocks. That's why financial stocks

are excluded due to the health of study. Financial sectors as mentioned are banking sector, insurance sector and real estate sector.

The exclusions from the list due to sector criteria are as follows:

Stocks	Company Name	Sector Name	Market Capitalization*	IPO Date
GARAN	Garanti Bankasi	Banking	41,370	06.06.1990
AKBNK	Akbank	Banking	33,852	26.07.1990
ISCTR	Is Bankasi (C)	Banking	30,375	04.01.1988
YKBNK	Yapi Ve Kredi Bankasi	Banking	25,510	08.01.1988
VAKBN	T. Vakiflar Bankasi	Banking	18,044	09.11.2005
HALKB	Halk Bankasi	Banking	13,482	04.05.2007
EKGYO	Emlak G.M.Y.O.	Real Estate	8,132	24.11.2010
TURSG	Turkiye Sigorta	Insurance	7,434	14.11.1994
TSKB	T.S.K.B.	Banking	5,124	05.05.1988

**in TRY million & as of 17/11/2020*
Source: Borsa Istanbul

Table 3.1.2: Financial Stocks in Top 50 Stocks

Nine financial stocks are excluded from the research universe, seven of them operates in banking sector, one of them is an insurance company and one of them is a REIT company.

Since this study aims to capture different states of economy in order to observe the reaction of factor models in different economic situations, the research horizon is set for 10 years long. So, 10 year history of the financial statements and stock returns should be available prior to third quarter results of 2020, as the latest available financial statements of stocks are as of third quarter of 2020. The following stocks are excluded due to lack of necessary data history, as their Initial Public Offering (IPO) dates are late than 2010.

Stocks	Company Name	Sector Name	Market Capitalization*	IPO Date
ISDMR	Iskenderun Demir Ve Celik	Steel & Iron	28,942	28.03.2016
ENJSA	Enerjisa Enerji	Utilities	13,736	01.02.2018
SOKM	Sok Marketler Ticaret	Retail	7,894	08.05.2018
PGSUS	Pegasus Hava Tasimaciligi	Aviation	7,355	18.04.2013

**in TRY million & as of 17/11/2020*
Source: Borsa Istanbul

Table 3.1.3: Stocks, whose don't have 10 year history in Borsa Istanbul

Briefly, the financial stocks (9 stocks) and the recent publicly traded stocks (4 stocks) are excluded from the top 50 largest stocks in Borsa Istanbul. After the adjustments, the research universe includes 37 stocks.

3.2 Data Source

This study is conducted with 37 stocks with the period covers 2010-2020. Financial statements are available on Public Disclosure Platform (www.kap.gov.tr). Stock returns are downloaded from Borsa Istanbul (www.borsaistanbul.com). All data used in this study are public data.

3.3 Methodology

This study will focus on the factors i.e. beta, size, value, growth, liquidity, momentum and profitability, respectively. For each factor at least one criteria will be tested. In order to be able to see if the factor investing is valid in explaining stock returns, there will be constructed two portfolios. First portfolio will be selected according to factor criteria. Second portfolio will contain all the stocks in the research universe and will be called as benchmark portfolio. In both portfolios stocks will have equal weights. The portfolios will be run monthly. The performance of these portfolios will be compared. To make a more visible comparison, indexing will be used. First data point is set at 100 for indexing methodology. For each factor, different selection criteria are set, which are summarized as follows:

Beta (market factor): High beta portfolio will hold five stocks, which have highest beta coefficients in the research universe. Low beta portfolio will hold five stocks, which have lowest beta coefficients. Benchmark portfolio will contain all the stocks in the research universe. The performance of these three will be compared.

Size factor: Top 5 largest stocks will be included in large size portfolio. Small size portfolio will continuously hold 5 stocks which have the smallest market

capitalization values. Benchmark portfolio will contain all the stocks in the research universe. The performance of these three will be compared.

Value factor: Firstly, the traditional criteria will be subjected to analysis. The stocks will be listed in regards to their book-to-market ratio. High book-to-market portfolio will hold the 5 stocks, which have highest book-to-market ratio. Benchmark portfolio will contain all the stocks in the research universe. The performance of these two will be compared. Secondly, an alternative criteria for value factor, sales-to-market ratio will be tested. High sales-to-market portfolio will be compared with benchmark portfolio.

Growth factor: Three growth factor portfolios will be constructed with sales growth, operational profit growth and book-value growth, respectively. Each growth factor based portfolio will hold 5 stocks which reported the highest year-on-year growth within the list rated in regards to the mentioned growth factor criteria such as sales growth in the underlying period. These three portfolio returns will be compared with the benchmark return.

Liquidity factor: The stocks in the research universe will be listed according to their daily trading volume amounts. The stocks which have the highest average daily trading volume within the month will be categorized as liquid stocks and the liquidity factor based portfolio will hold continuously top 5 liquid stocks. The return of liquid stocks portfolio will be compared with the return of benchmark portfolio.

Momentum factor: Momentum means winners will be winners. As the meaning of momentum suggests Long momentum portfolio will always contain the best performer stocks of the previous month and short momentum portfolio will hold the worst performer stocks of the previous month. Momentum portfolios will hold five stocks as previous factors do. The returns of long and short momentum portfolios will be compared with the return of benchmark portfolio.

Profitability factor: Profitability factor will be based on operating profit yield (EBIT - to-market ratio) as described in Fama-French five factor model. The stocks

will be ranked according to their operating profit yield. Profitability portfolio will always hold the five most profitable stocks and its performance will be compared with benchmark portfolio.

The performance of all portfolios will be tracked cumulative. The results will be shown in line chart and the excess return generated through factor investing will be presented in area charts. For each portfolio, the return correlation with benchmark portfolio will be plotted as well with the R-squared coefficient on it.

3.4 Factor Analysis

3.4.1 Beta (market factor)

High beta portfolio performance and benchmark portfolio performance are compared below in the figure 3.4.1.1 and the excess return of high beta portfolio is shown below in the figure 3.4.1.2. The correlation between the return profiles of two portfolios is presented in the figure 3.4.1.3.

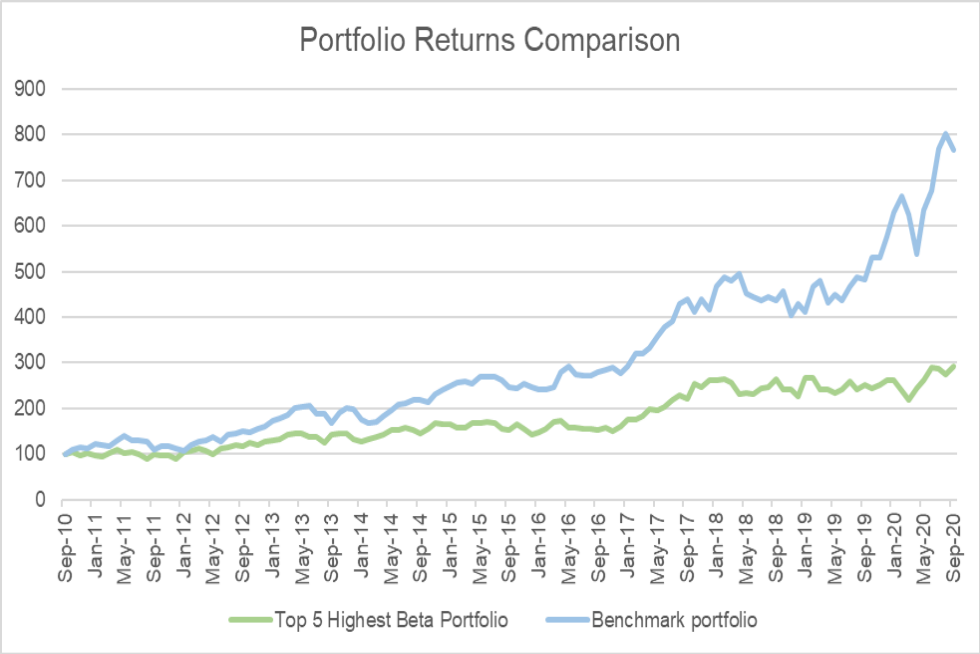

Figure 3.4.1.1: Return performance of high beta portfolio

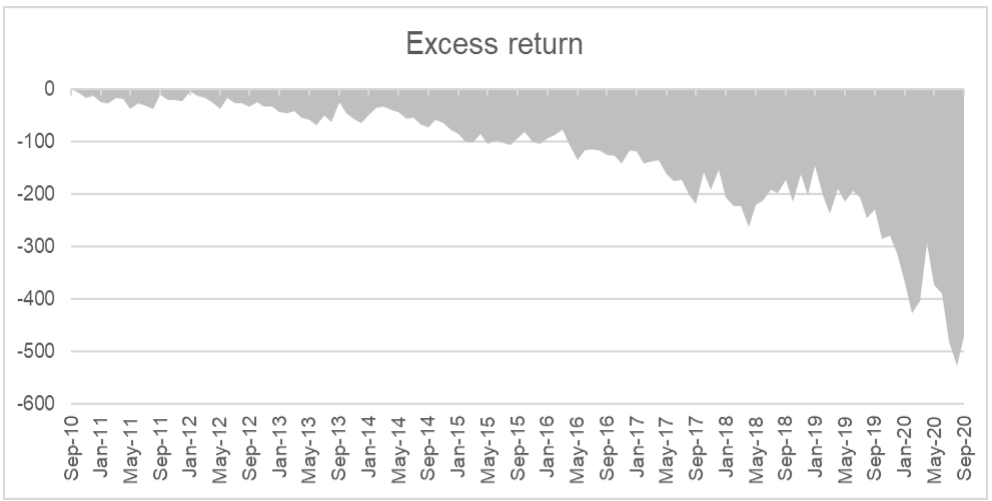

Figure 3.4.1.2: Excess return generation of high beta portfolio

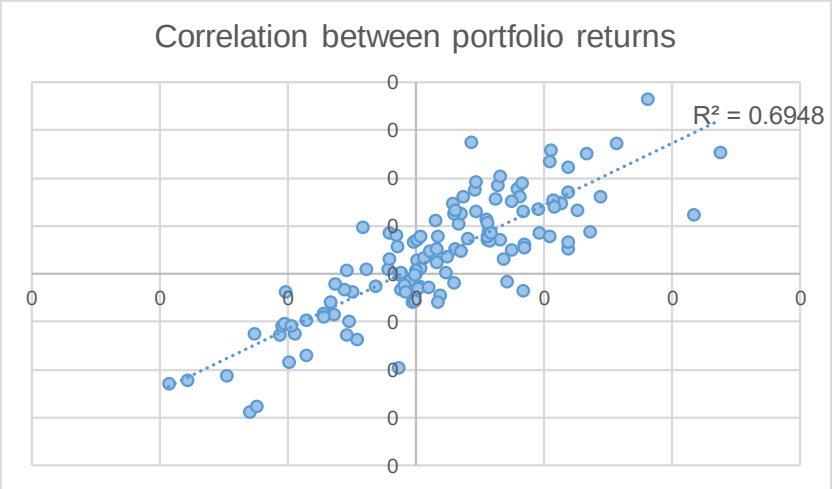

Figure 3.4.1.3: Correlation between high beta portfolio and benchmark portfolio

As seen in the figures above, high beta portfolio couldnt generate an excess return over benchmark portfolio sustainably. Cumulatively, high beta portfolio posted negative excess return. The correlation between the return profiiles of two portfolios is very weak with a R-squared coefficient of around 0.7.

To observe the excess return performance in detail, it would be better to compare the return of portfolios in shorter periods. If the ten-year-long research period is divided into five two-years-long periods, we see that high beta portfolio outperforms benchmark portfolio in only 2016-2018 period out of 5 different periods. It seems that high beta factor investing is not helpful to create excess return for long-only investing strategy.

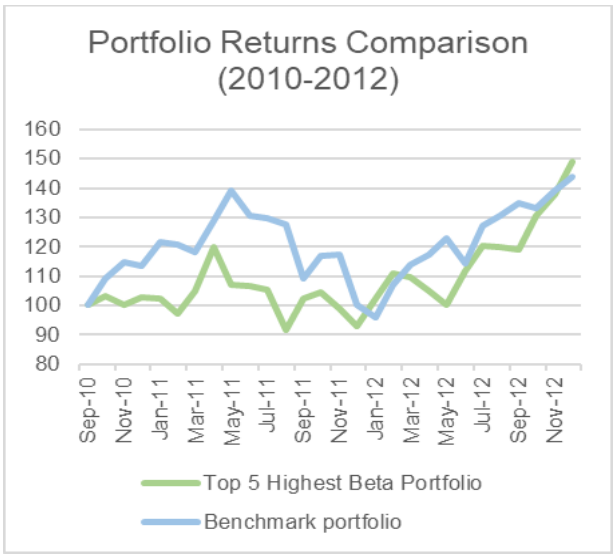

Figure 3.4.1.4: The performance btw. 2010-2012

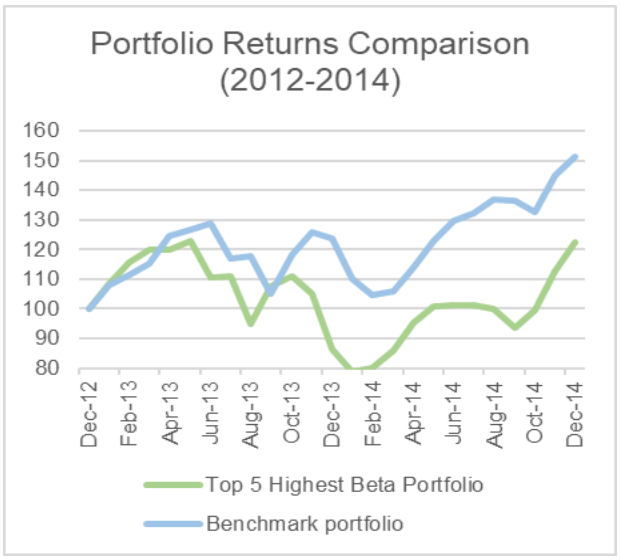

Figure 3.4.1.5: The performance btw. 2012-2014

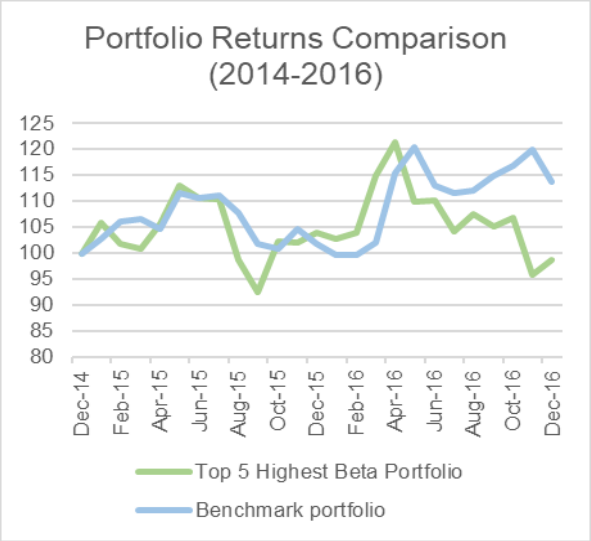

Figure 3.4.1.6: The performance btw. 2014-2016

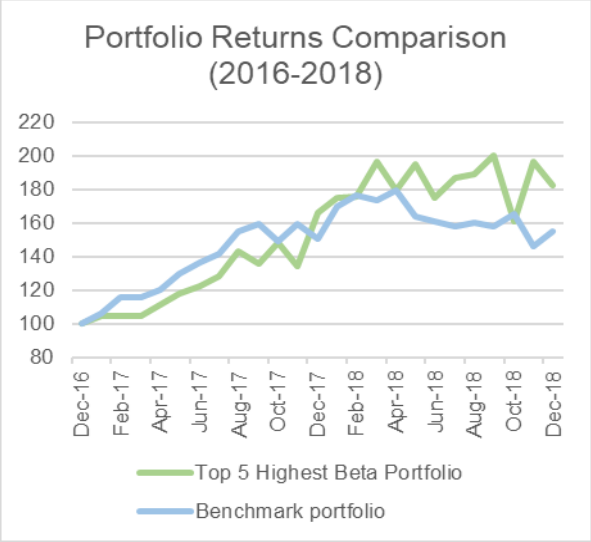

Figure 3.4.1.7: The performance btw. 2016-2018

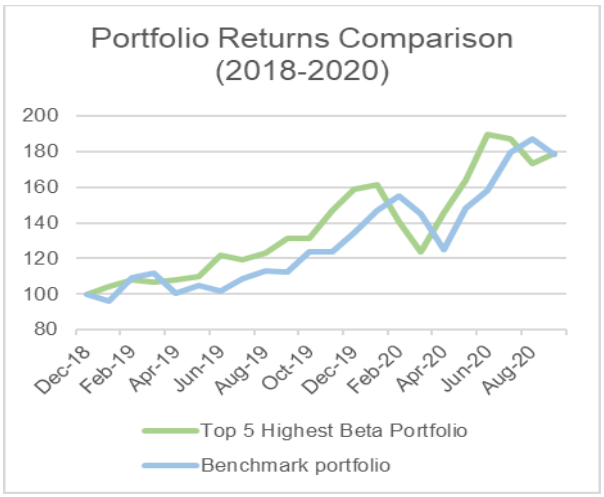

Figure 3.4.1.8: The performance btw. 2018-2020

After testing the performance of high beta portfolio as a long-only beta factor investment strategy, now the study will examine short investment strategy using beta factors of stocks in research universe. Low beta portfolio, which contains continuously five stocks with lowest beta coefficient, will be run over the research period. This time of the beta investing study, the study aims to see that the low beta portfolio underperforms the benchmark portfolio. The results are presented below in the figures.

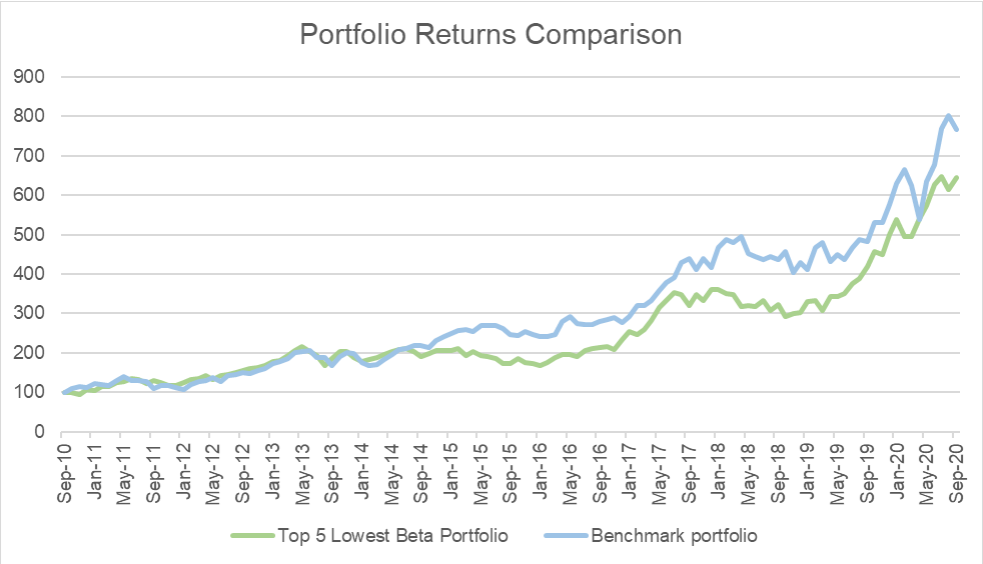

Figure 3.4.1.9: Return performance of low beta portfolio

Figure 3.4.1.10: Excess return generation of low beta portfolio

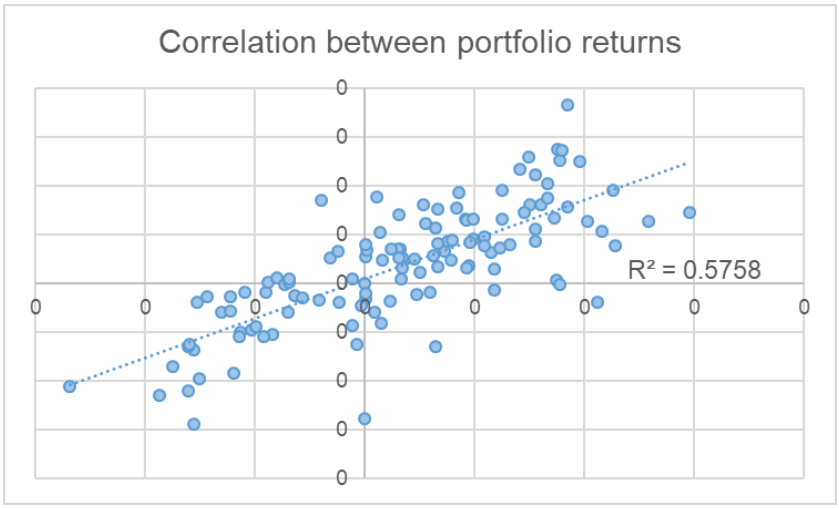

Figure 3.4.1.11: Correlation between low beta portfolio and benchmark portfolio

Correlation figure presents a weak correlation between the returns of low beta portfolio and benchmark portfolio. However, according to output of low beta factor investment strategy as shown in figures above, it seems that shorting the low beta stocks have better and more meaningful impact on generating excess return over benchmark portfolio rather than buying high beta stocks.

3.4.2 Size factor

The research universe is ranked in regards to their market capitalization. Since Fama-French claims that small stocks perform better, small size stocks portfolio is constructed with the five smallest stocks in the universe. The return performance of both small size stocks portfolio and benchmark portfolio are compared below.

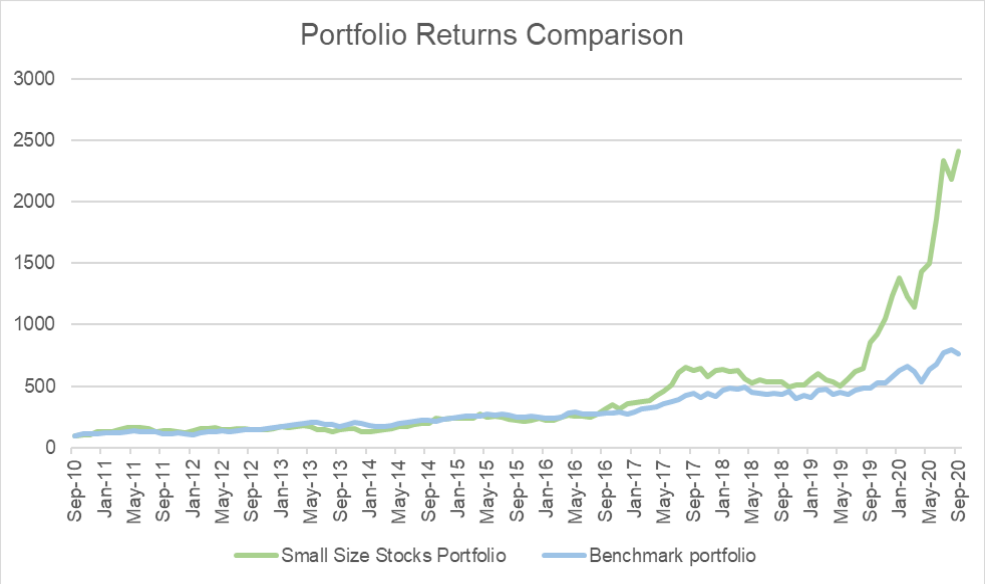

Figure 3.4.2.1: Return performance of small stocks portfolio

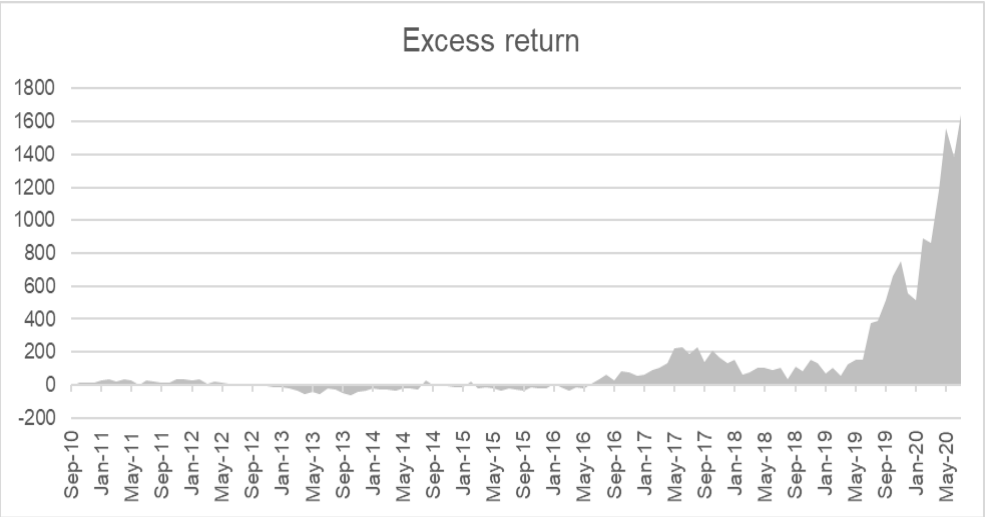

Figure 3.4.2.2: Excess return generation of small stocks portfolio

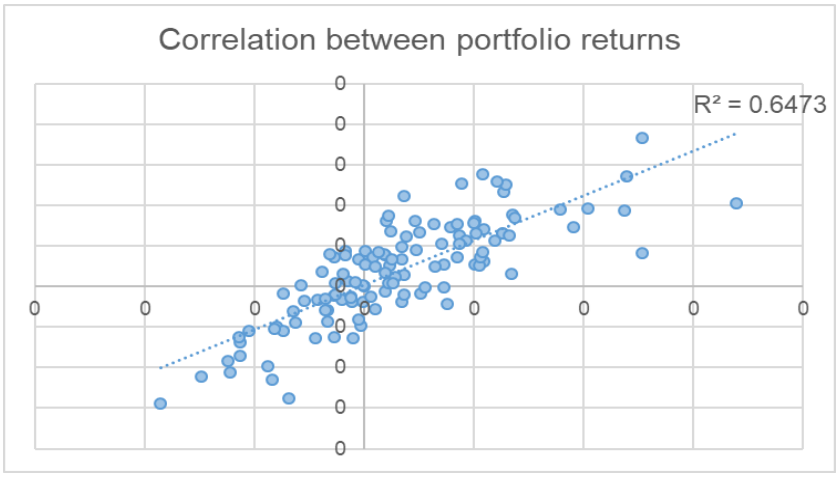

Figure 3.4.2.3: Correlation between small stocks portfolio and benchmark portfolio

As seen in above figures, small size stocks portfolio performs better than the benchmark portfolio. More importantly, small size stocks portfolio shows more significant performance as of second half of 2019. It seems that investing in small size stocks to create excess return pays off. The return profiles of small stocks portfolio and benchmark portfolio differ from each other as presented in correlation figure.

After testing the performance of long position in small stocks in generating excess return, the study now will test to short large stocks in order to generate excess return over benchmark portfolio. Top 5 largest stocks are included in a portfolio. The returns of large stocks portfolio and benchmark portfolio are drawn below.

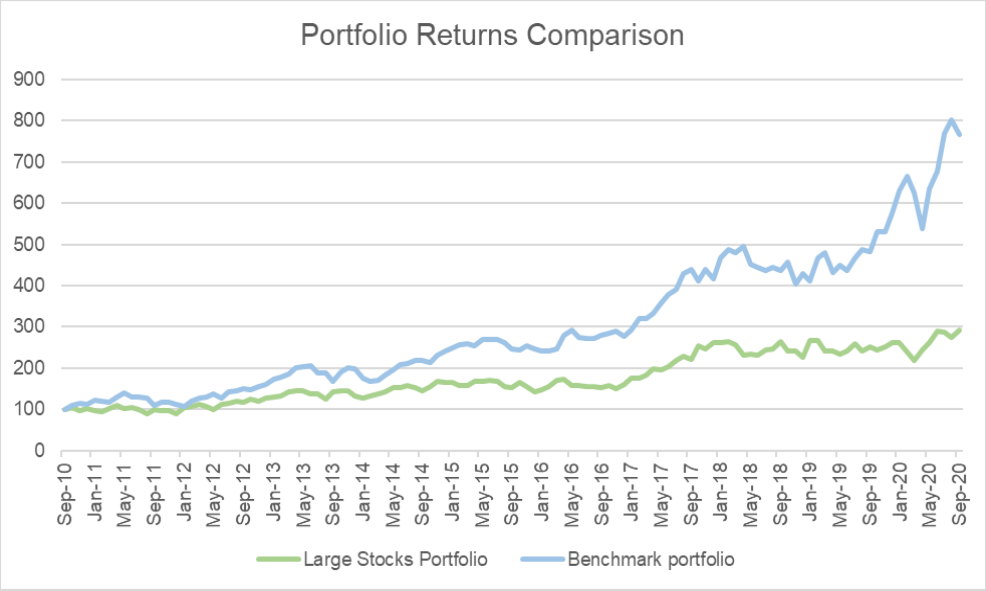

Figure 3.4.2.4: Return performance of large stocks portfolio

Figure 3.4.2.5: Excess return generation of large stocks portfolio

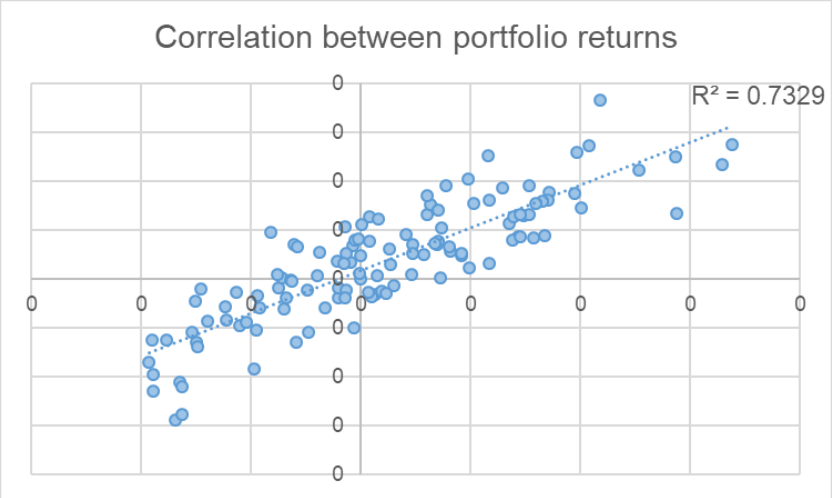

Figure 3.4.2.6: Correlation between large stocks portfolio and benchmark portfolio

The returns of large stocks are more correlated with the benchmark portfolio when compared with the return of small stocks. The return performances of two portfolios present that the investment strategy including shorting largest stocks seems to fit on Turkish equity market more significantly and sustainably rather than long strategy with small stocks.

3.4.3 Value factor

Firstly, in this study, the traditional value factor is tested. According to Fama-French three factor model, value factor is captured with book-to-market-ratio. Recall that the Fama-French three factor model claims that the stocks with high book-to-market ratio perform better than the stocks with low book-to-market ratio. In parallel to Fama-French three factor model, the research universe is ranked in regards to their book-to-market ratio. Value factor based portfolio contains top 5 stocks within the list. Below, the performance of value portfolio, the excess return generated through value portfolio and the correlation between the return profiles of value portfolio and benchmark portfolio are presented, respectively.

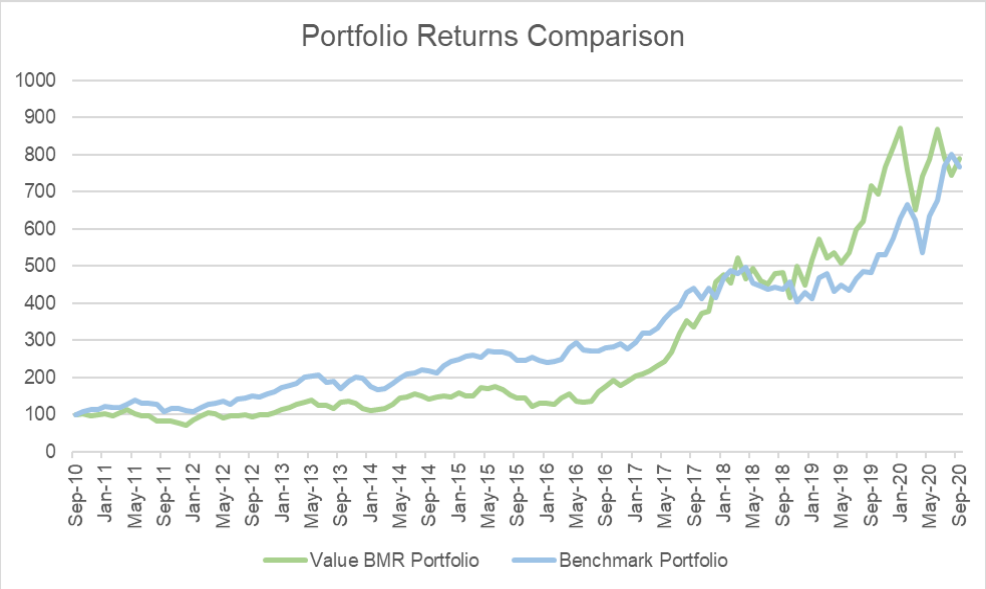

Figure 3.4.3.1: Return performance of value BMR portfolio

Figure 3.4.3.2: Excess return generation of value BMR portfolio

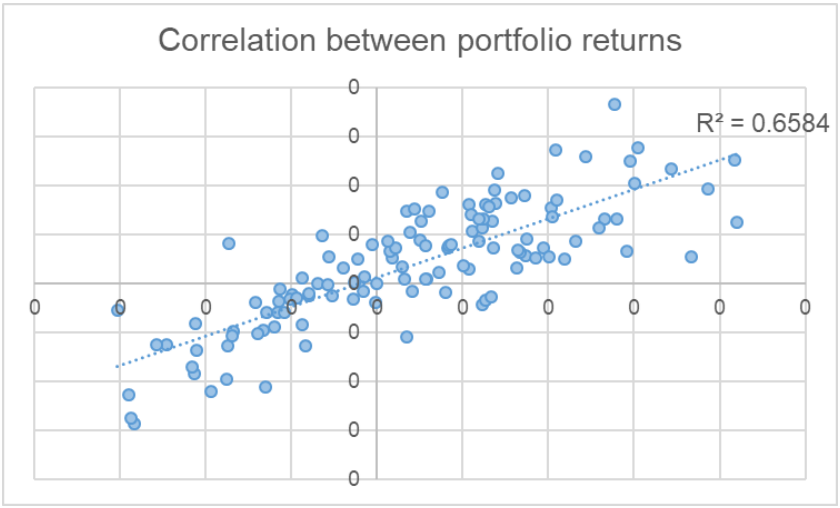

Figure 3.4.3.3: Correlation between value BMR portfolio and benchmark portfolio

The correlation coefficient of book-to-market ratio based portfolio with respect to benchmark portfolio is below 70%. So, the book-to-market ratio based portfolio does not follow the movements of benchmark portfolio.

As shown in the performance figures above, value factor investing couldn't create excess return sustainably. So the analysis is divided into time brackets whether to be able to see the value factor is valid in which time periods. The periods cover 2010-2012, 2012-2014, 2014-2016,2016-2018 and 2018-2020.

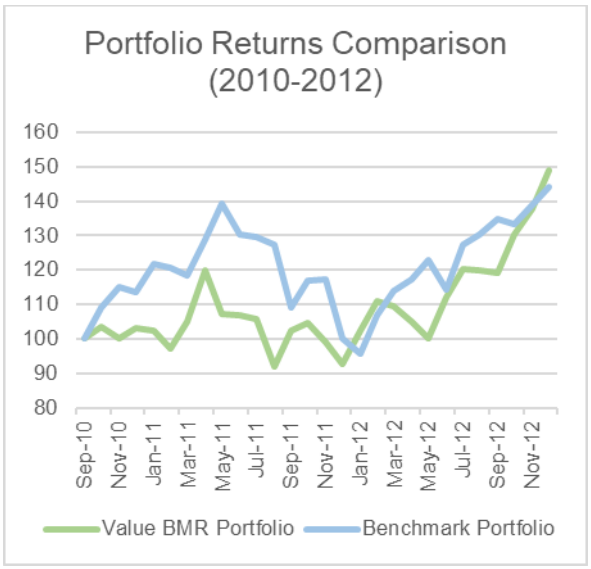

Figure 3.4.3.4: The performance btw. 2010-2012

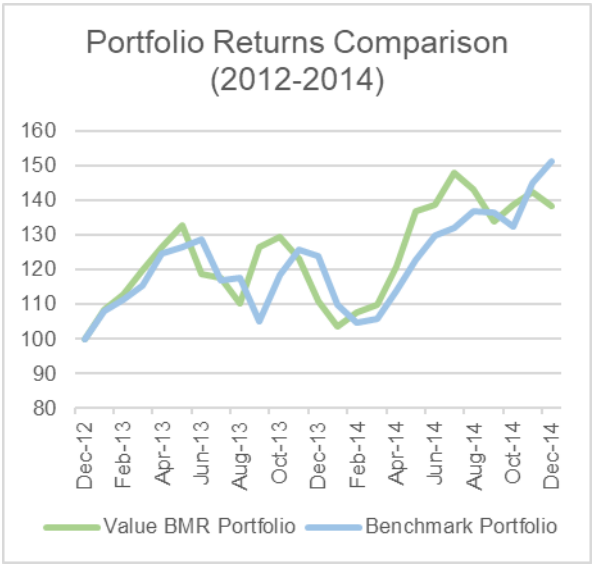

Figure 3.4.3.5: The performance btw. 2012-2014

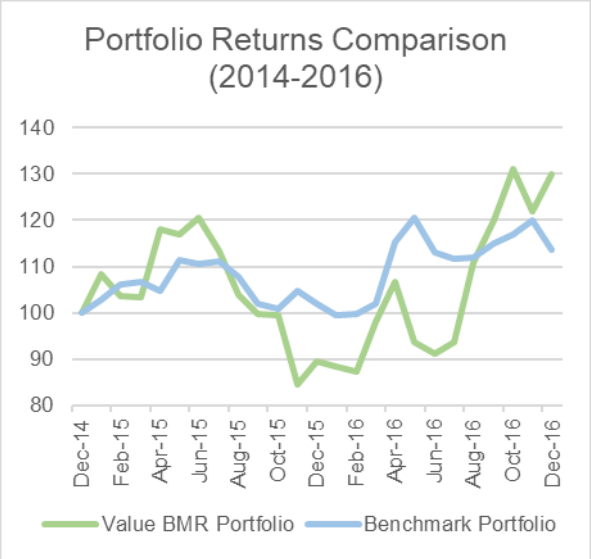

Figure 3.4.3.6: The performance btw. 2014-2016

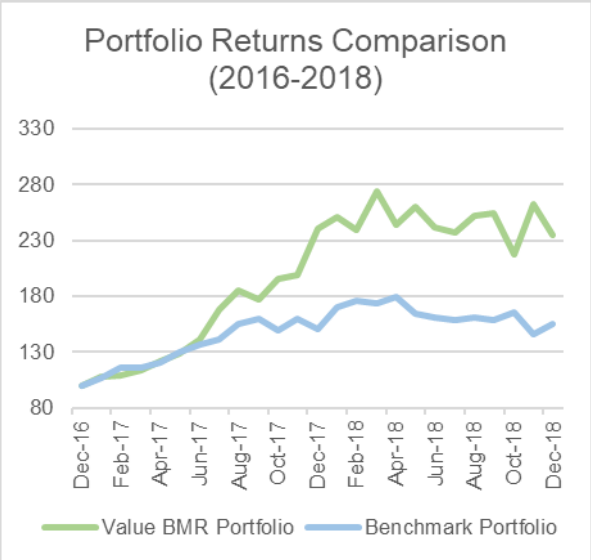

Figure 3.4.3.7: The performance btw. 2016-2018

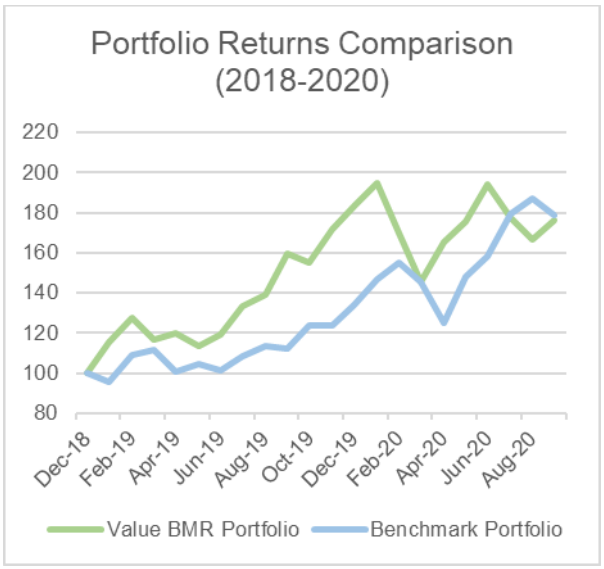

Figure 3.4.3.8: The performance btw. 2018-2020

The detailed period analysis reveals that value factor investing based on picking always stocks with highest book-to-market ratio is not sustainably sufficient in order to generate excess returns. Book-to-market ratio based value factor did not work between 2010 and 2017. However, the analysis shows us that the book-to-market ratio based value factor, i.e. traditional value factor has been generating excess return since 2017.

In addition to the traditional value factor investing approach, this study tests another alternative ratio for value factor investing, which is sales-to-market ratio. The research universe is ranked according to stocks' sales-to-market ratios.

The formula for sales-to-market ratio (SMR) is as follows:

SMR = LTM Sales / Market Capitalization

where;

LTM Sales = Last twelve months sales

Market Capitalization = Number of shares x Stock price

The performance of value factor portfolio based on sales-to-market ratio is compared with benchmark portfolio below.

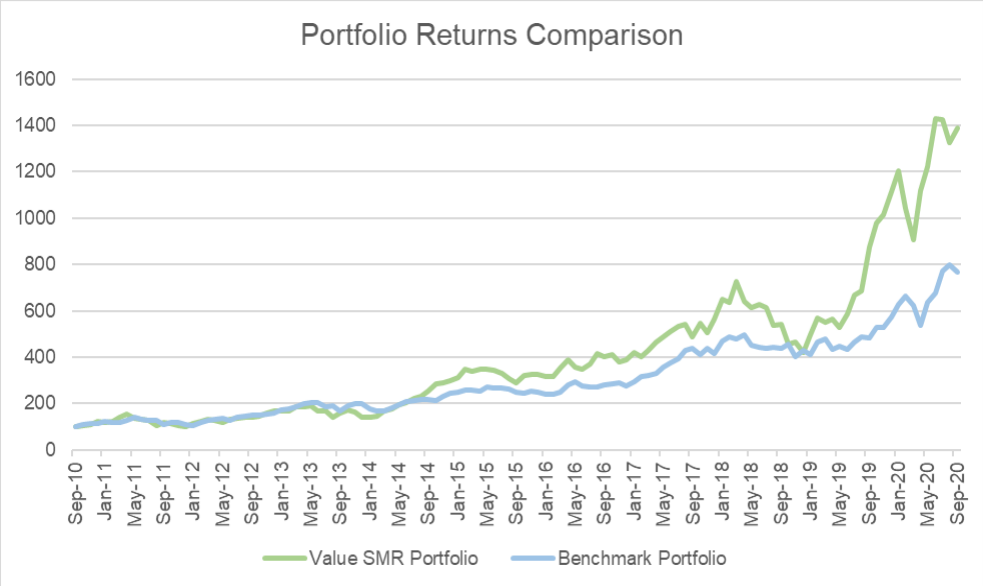

Figure 3.4.3.9: Return performance of value SMR portfolio

Figure 3.4.3.10: Excess return generation of value SMR portfolio

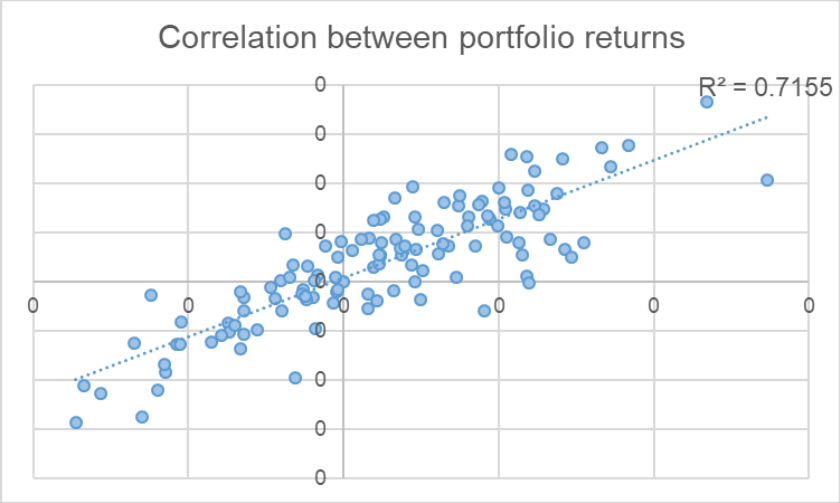

Figure 3.4.3.11: Correlation between value SMR portfolio and benchmark portfolio

This alternative approach for value factor analysis seems to have more impact on generating excess return in Turkish equity market. Sales yield has a strong explanatory power since the beginning of 2019. Another output is that the correlation coefficient is above 70%. Volatility of sales yield based portfolio with respect to benchmark portfolio is low compared to book-to-market based portfolio.

3.4.4 Growth factor

Following to the Fama-French three factor model, this research will test the relatively new developed factors as well. Growth factor will be put under the scope in this section. Sales growth, operational profit growth and book value growth are selected to analyze the impact of growth factor on Turkish equities. Growth figures will be based on year over year growth. Since quarterly financials are used in this study, sales growth and operational profit growth calculations takes the sum of last four quarters in order to annualize the figures. As book value being a balance sheet item, quarterly figures are taken into consideration in calculations. For operating profit, EBIT (earnings before interest and tax) is chosen in this study. Most common figure for operational profit is actually EBITDA (earnings before interest, tax, depreciation and amortization). However, depreciation calculations vary between sectors according to IFRS rules. That's why EBITDA figures from different sectors are not comparable. EBITDA is more useful for comparison in the same sector. Firstly sales growth analysis are presented below.

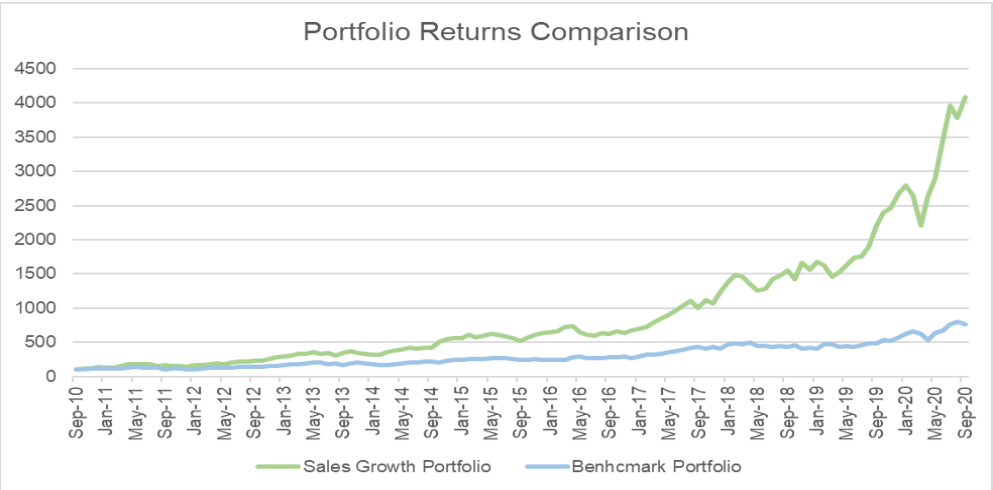

Figure 3.4.4.1: Return performance of sales growth portfolio

Figure 3.4.4.2: Excess return generation of sales growth portfolio

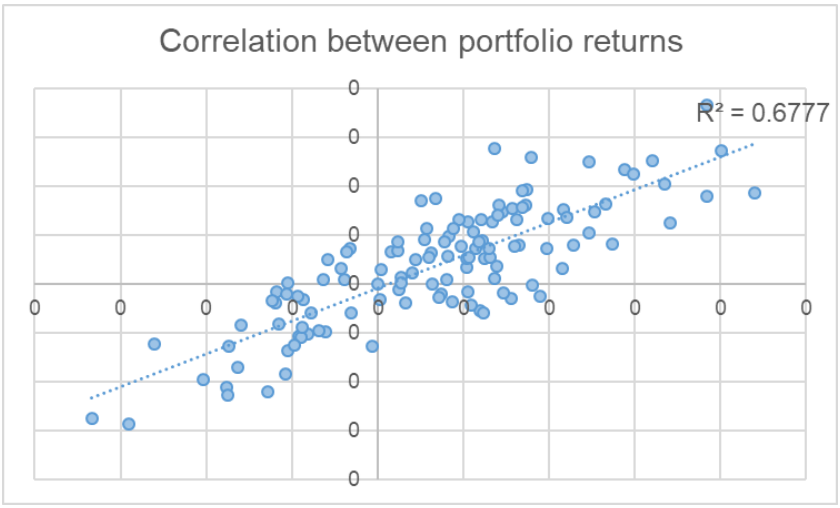

Figure 3.4.4.3: Correlation between sales growth portfolio and benchmark portfolio

Although the volatility of sales growth based portfolio with respect to benchmark portfolio is high as seen in correlation figure, the performance figures above show us that the results of sales factor based investment strategy is magnificent in creating excess return. Sales growth portfolio has generated continuously and sustainably excess return over benchmark portfolio and the amount of generated excess return through sales factor investing is notably huge.

Secondly, operating profit growth will be tested. As mentioned previously, EBIT (earnings before interest and tax) is selected for this analysis.

EBIT = Revenue - (COGS + Opex)

where;

Revenue: Sales recognized within the period

COGS: Cost of goods sold

Opex: Operating expenses (Sum of Sales & Marketing expenses, General & Administration expenses, and R&D expenses)

The performance of EBIT growth portfolio is presented below.

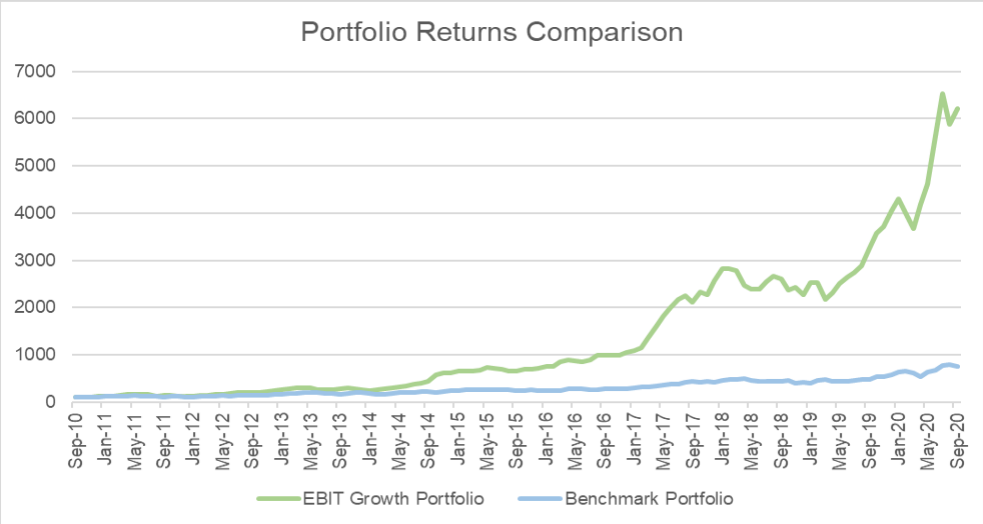

Figure 3.4.4.4: Return performance of EBIT growth portfolio

Figure 3.4.4.5: Excess return generation of EBIT growth portfolio

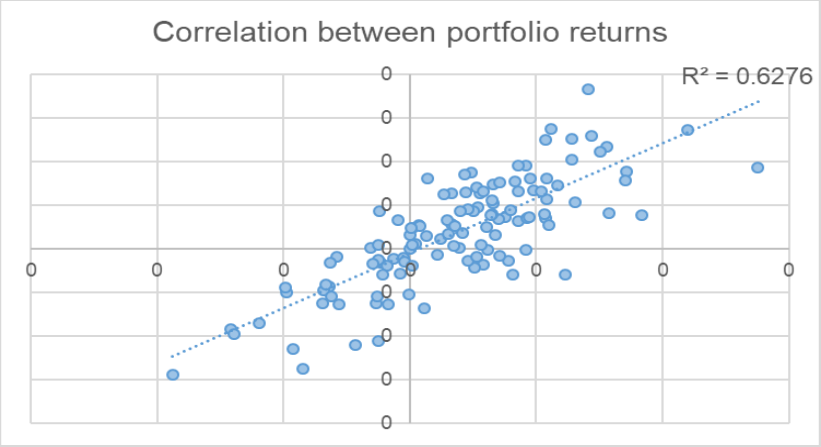

Figure 3.4.4.6: Correlation between EBIT growth portfolio and benchmark portfolio

EBIT factor performance is also very good as it was in sales growth factor. EBIT growth portfolio has outperformed the benchmark portfolio continuously over the research period. The investment strategy based on EBIT growth has generated sizable excess return with Turkish stocks. The correlation between two series is very weak.

Lastly, book value growth will be examined under growth factor section. The comparison of book value growth portfolio and benchmark portfolio is shown below on the charts.

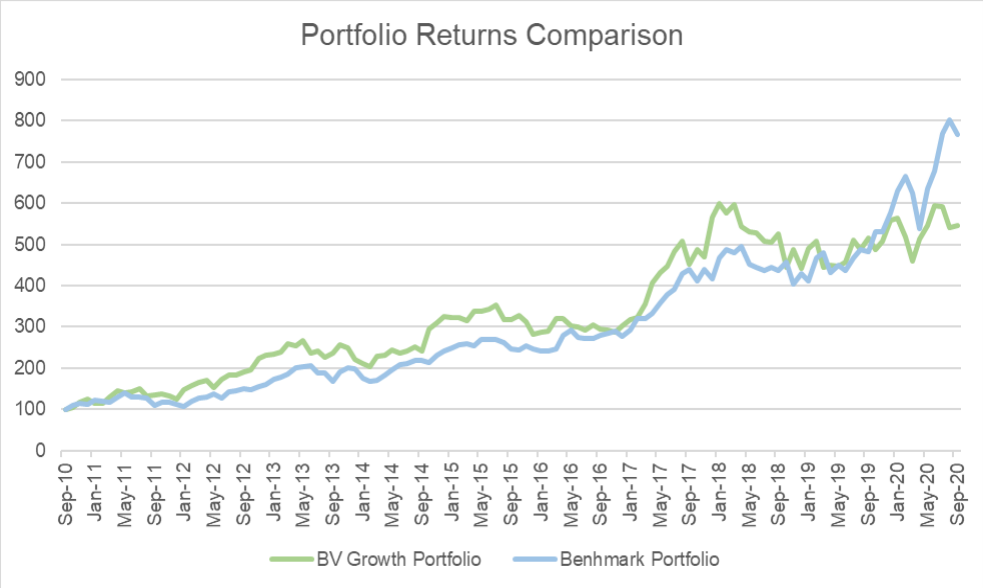

Figure 3.4.4.7: Return performance of book value growth portfolio

Figure 3.4.4.8: Excess return generation of book value growth portfolio

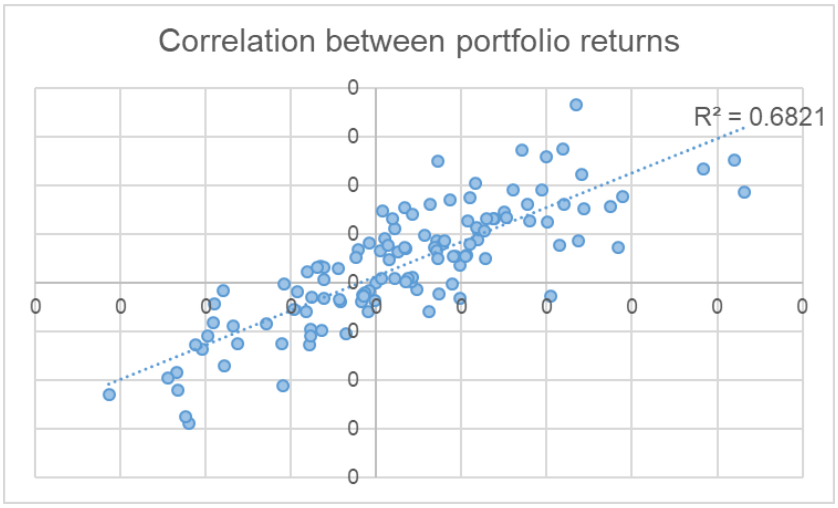

Figure 3.4.4.9: Correlation between book value growth portfolio and benchmark portfolio

Performance comparison of two portfolios above proves that book value growth portfolio is not good at generating excess return over benchmark portfolio as much as previous growth portfolios, sales growth portfolio and operating profit (EBIT) growth portfolio. The correlation between the returns of two portfolios is also weak.

The performances of growth factor portfolios prove that sales growth and operating profit growth portfolios generated high amount of excess return in Turkish equity market over the last ten years. On the other hand, book value growth posted poor set of results in this study conducted with Turkish stocks capturing last ten years.

3.4.5 Liquidity factor

Liquidity factor will be examined in this section. Liquidity refers to average daily volume of stocks. Stocks, whose average trading volume are high, are called liquid stocks. In order to measure the impact of liquidity on generating excess return, liquid stocks portfolio will be conducted and this portfolio hold always top five liquid stocks in the research universe. The performance of liquid stocks portfolio is compared with the performance of benchmark portfolio below.

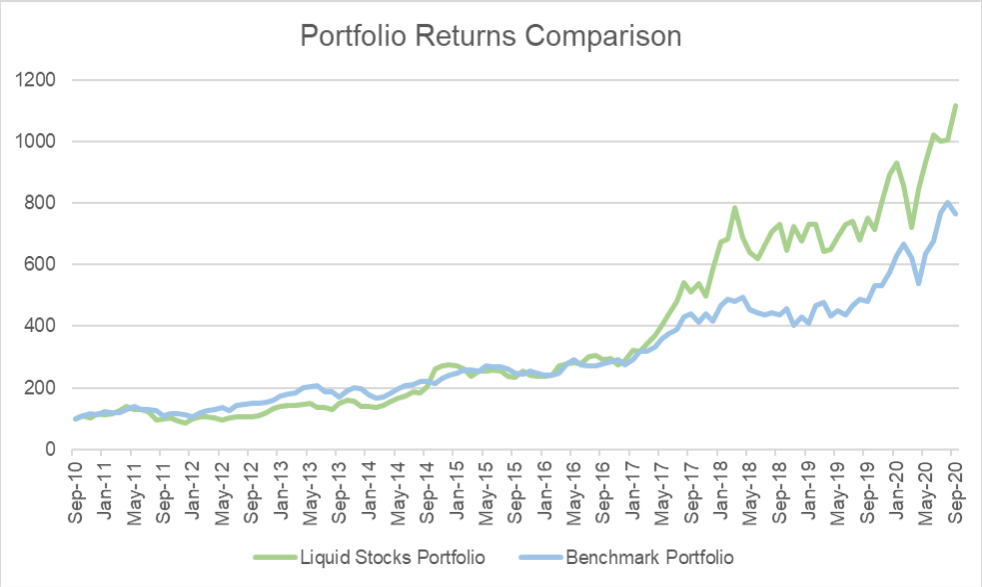

Figure 3.4.5.1: Return performance of liquid stock portfolio

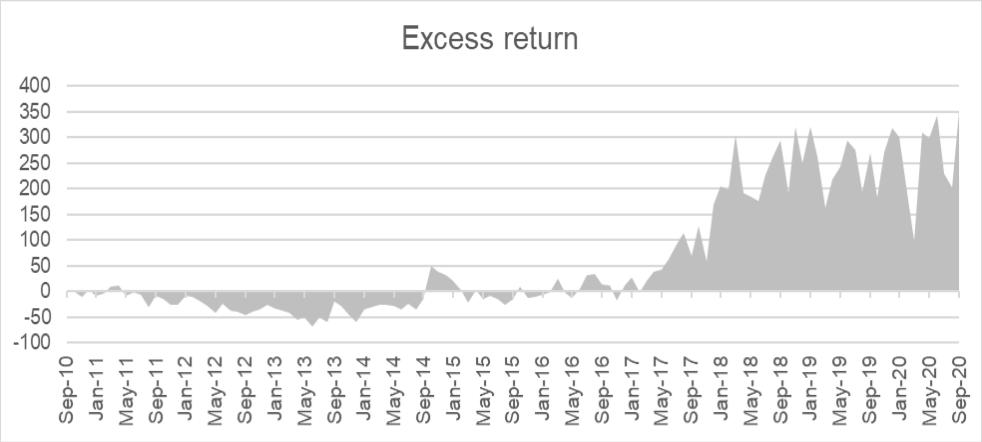

Figure 3.4.5.2: Excess return generation of liquid stocks portfolio

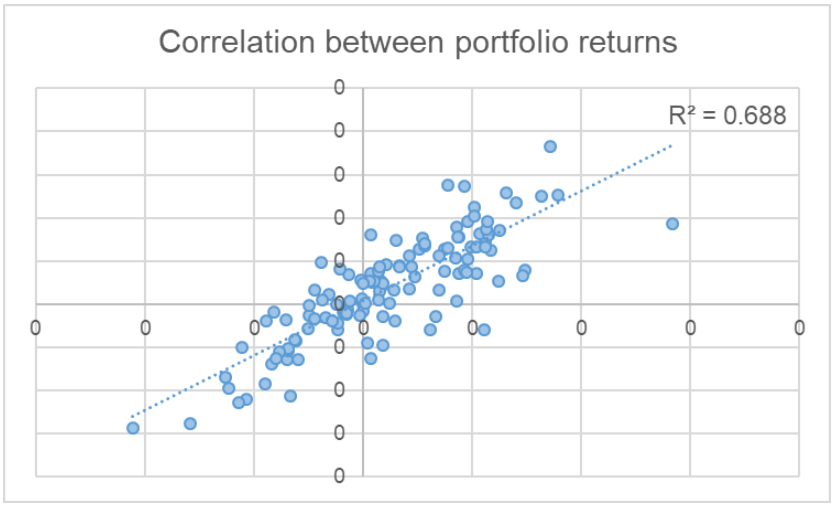

Figure 3.4.2.3: Correlation between liquid stocks portfolio and benchmark portfolio

As shown in the performance charts above, liquid stocks portfolio has not been generating sustainable excess return over benchmark portfolio over the last ten years. However, it seems that since the beginning of 2017, liquid stocks portfolio has started to generate excess return over the benchmark portfolio. The volatility of liquid stocks based portfolio with respect to benchmark portfolio is high.

3.4.6 Momentum factor

Momentum factor will be analyzed two-sided in this section. The meaning of momentum suggests that winners will win and loser will continue to lose. So, long momentum portfolio and short momentum portfolio will be created. Long momentum portfolio contains top winners, while short momentum portfolio holds top losers. Each portfolio holds five stocks.

The performance of long momentum portfolio is presented below.

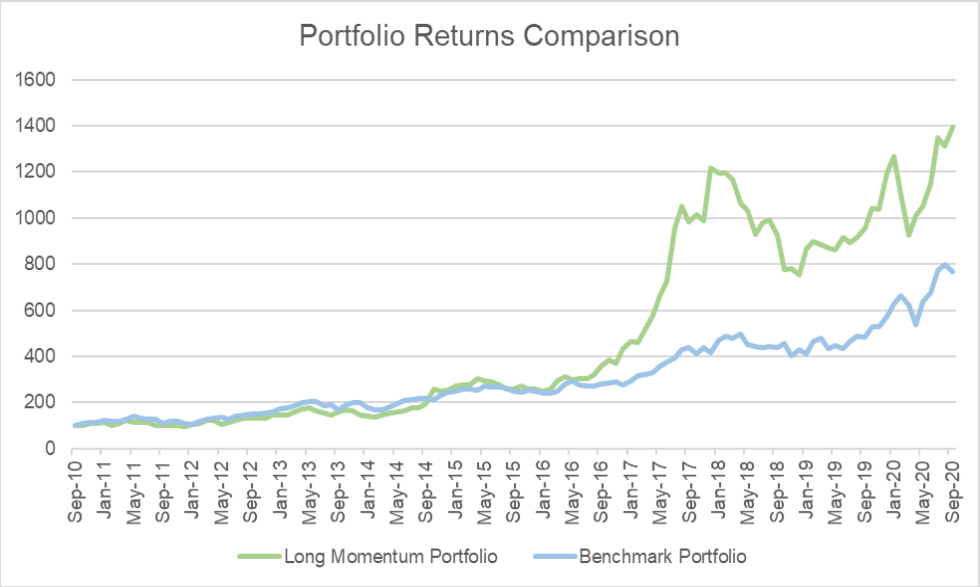

Figure 3.4.6.1: Return performance of long momentum portfolio

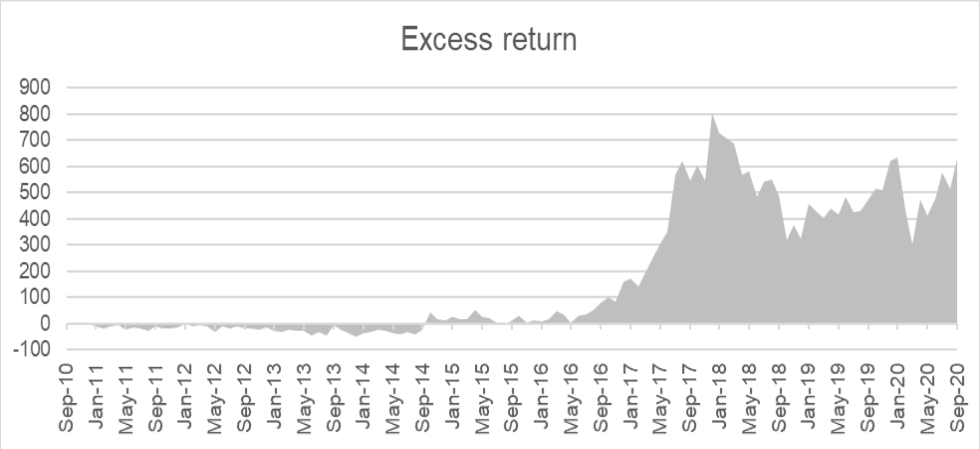

Figure 3.4.6.2: Excess return generation of long momentum portfolio

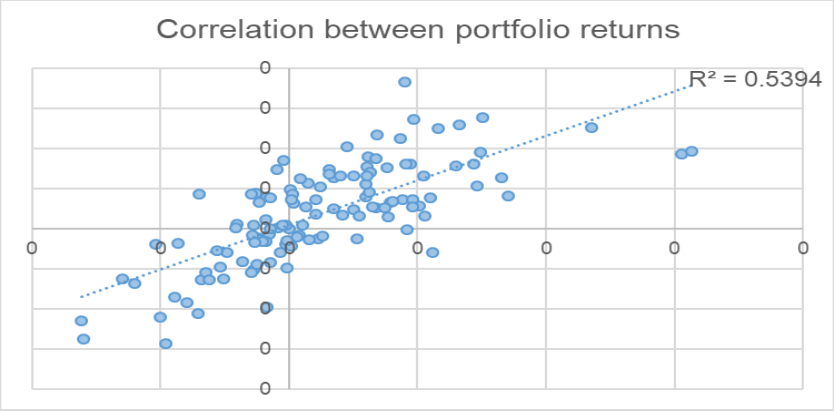

Figure 3.4.6.3: Correlation between long momentum portfolio and benchmark portfolio

The movement of momentum portfolio is not correlated with the movement of benchmark portfolio. As shown in the figures, long momentum portfolio performance is mixed. Until mid-2016, long momentum portfolio hasn't generated excess return over benchmark portfolio. Two portfolios' returns are almost the same in the underlying period. However, it seems that since second half of 2016 long momentum portfolio has started to generate excess return over benchmark portfolio. All-in-all, the excess return generation with holding long momentum portfolio is not sustainable.

The return profiles of both short momentum portfolio and benchmark portfolio are drawn below.

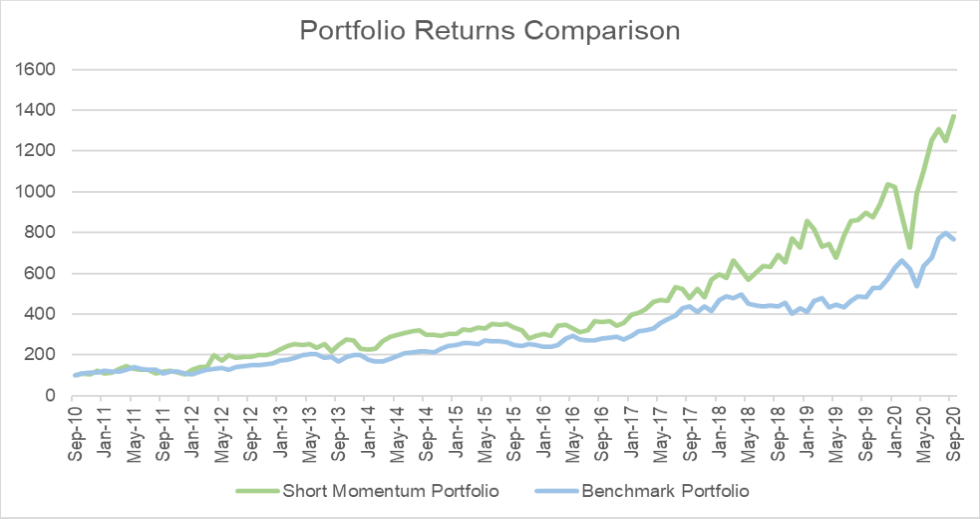

Figure 3.4.6.4: Return performance of short momentum portfolio

Figure 3.4.6.5: Excess return generation of short momentum portfolio

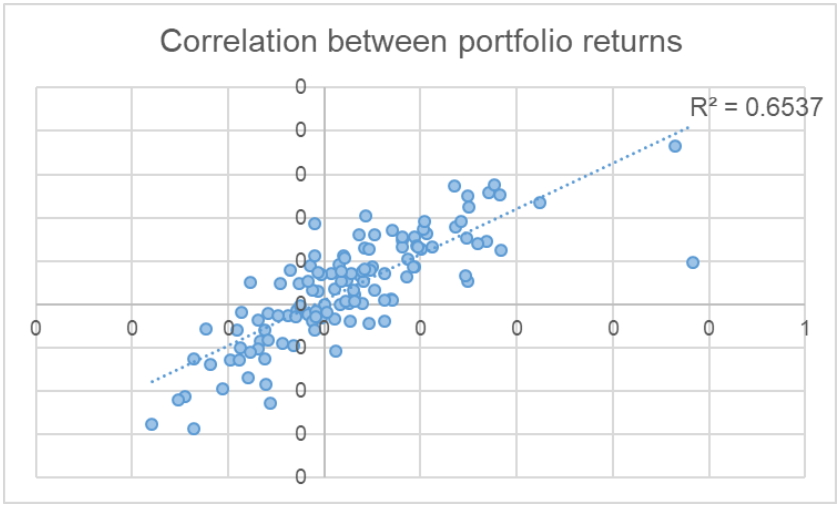

Figure 3.4.6.6: Correlation between short momentum portfolio and benchmark portfolio

As seen in the short momentum portfolio charts above, short momentum does not work in Turkish equity market. It is expected that the short momentum portfolio should underperform the benchmark portfolio. On the contrary, short momentum portfolio in this study has been outperforming the benchmark portfolio since the beginning of the research period.

Considering the performances of both long and short momentum portfolio, momentum factor is not applicable to Turkish equity market.

3.4.7 Profitability factor

In this section, profitability factor is tested with two different methods. First method is using EBIT yield as stated in the Fama-French five factor model. Second one is using Earnings yield.

EBIT yield = EBIT / Market Capitalization

Earnings yield = Net Income / Market Capitalization

where;

EBIT = Earnings before interest and tax

Market Capitalization = Number of stocks x Stock price

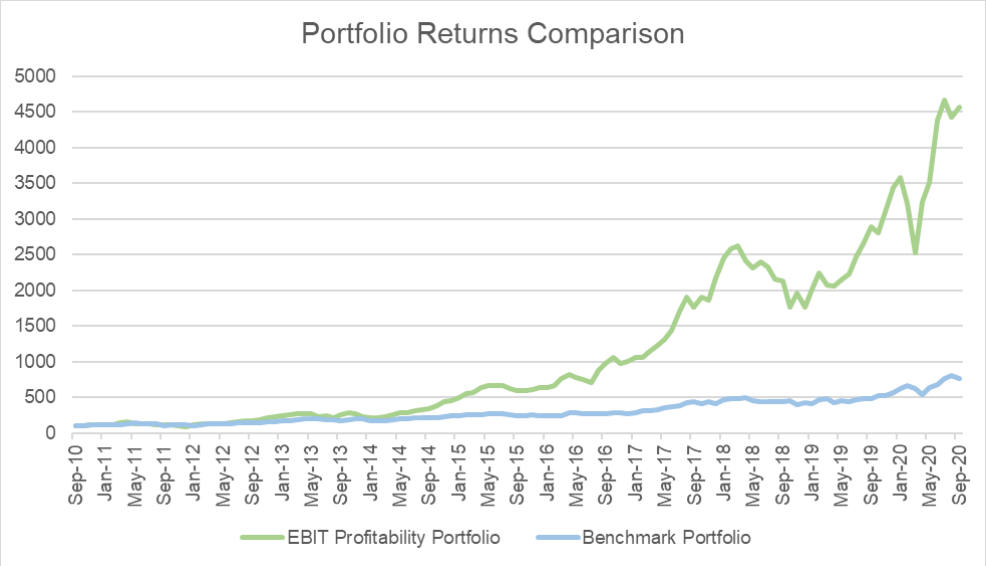

Figure 3.4.7.1: Return performance of EBIT profitability portfolio

Figure 3.4.7.2: Excess return generation of EBIT profitability portfolio

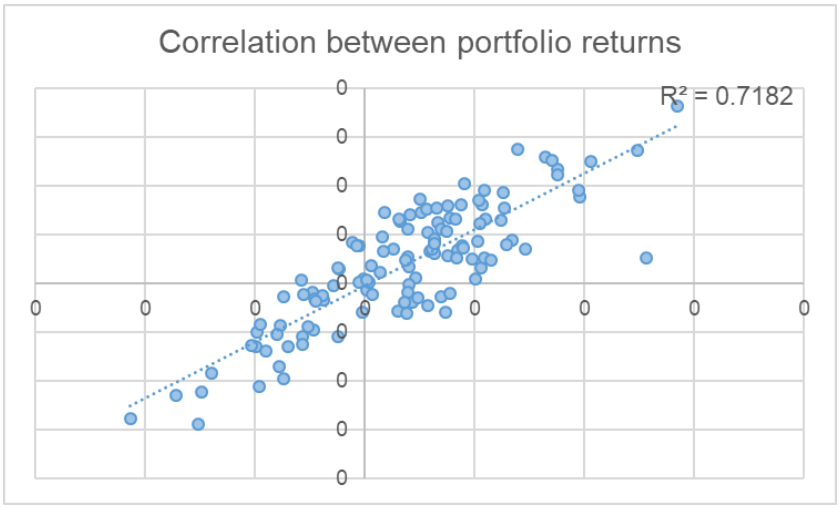

Figure 3.4.7.3: Correlation between EBIT profitability portfolio and benchmark portfolio

The results of profitability analysis reveals that the profitability portfolio, which holds continuously five largest EBIT yielding stocks in the research universe, has generated significant and sustainable excess return over the last ten years. Moreover, EBIT profitability based portfolio has been generating excess return with low volatility with respect to benchmark portfolio (see figure 3.4.7.3).

Second profitability factor analysis is based on earnings yield. This time, profitability portfolio is constructed in regards to earnings yield of stocks. The profitability portfolio always holds the highest earnings yielding stocks. The below graphs show the performance of earnings profitability portfolio.

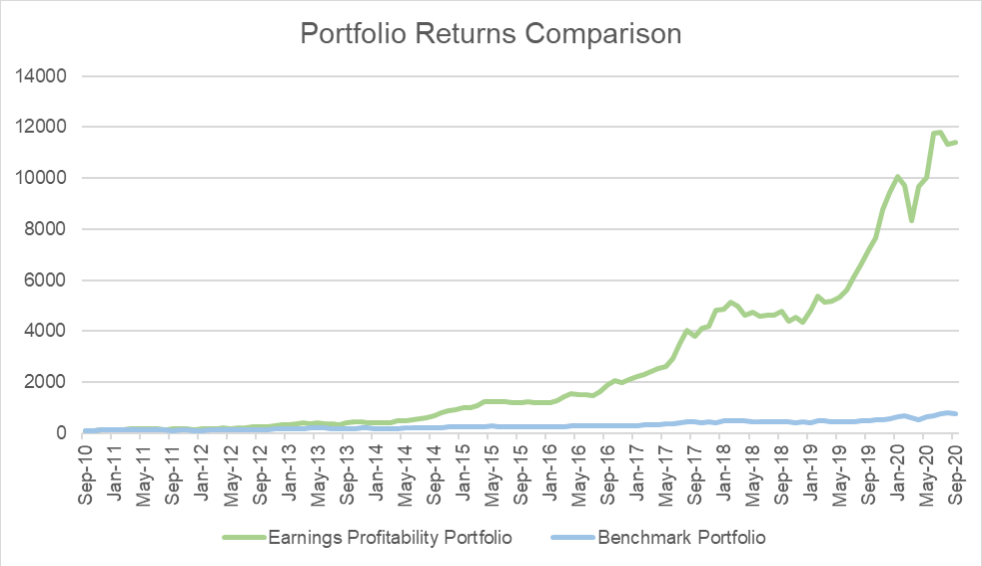

Figure 3.4.7.4: Return performance of earnings profitability portfolio

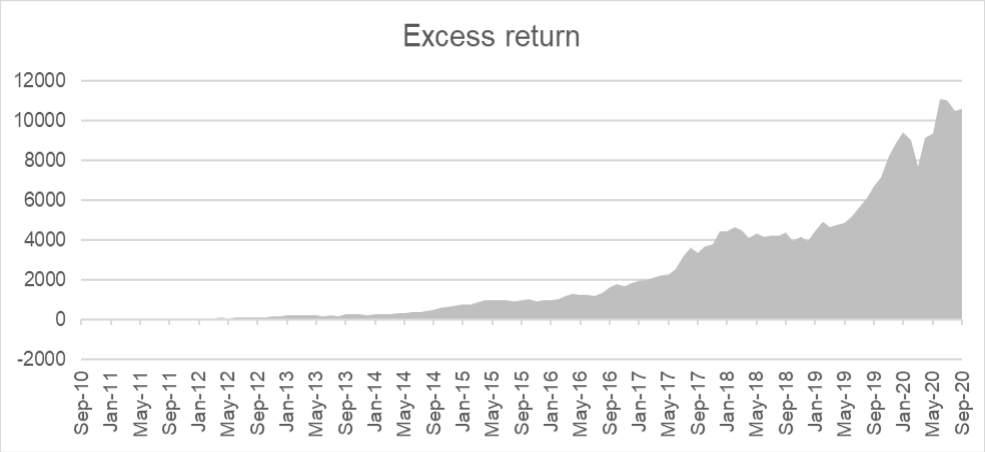

Figure 3.4.7.5: Excess return generation of earnings profitability portfolio

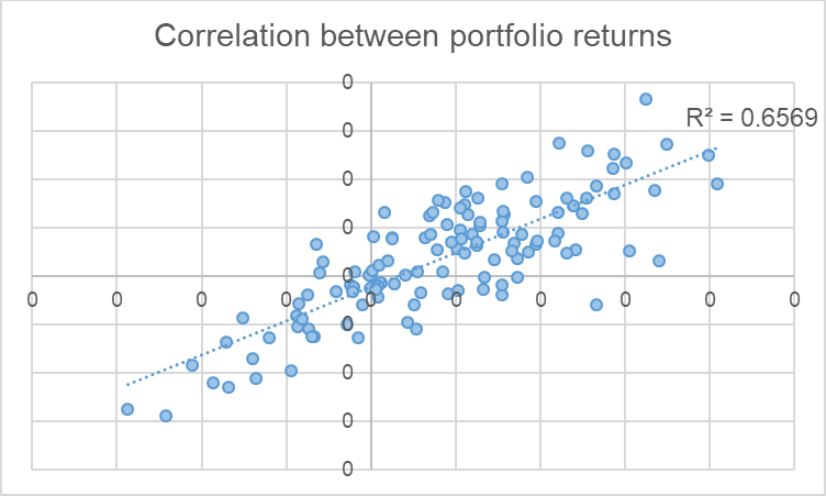

Figure 3.4.7.6: Correlation between earnings profitability portfolio and benchmark portfolio

As presented in the performance figures above, profitability factor based on earnings yield is also valid in the Turkish stocks. The profitability portfolio constructed in regards to the earnings yields of the stocks have generated significant and sustainable excess return over the benchmark portfolio. However, earnings yield based portfolio has been creating more volatility when compared to EBIT yield based portfolio.

The results of both methods (EBIT yield & Earning yield) proves that profitability factor based investing strategy pays off in the Turkish equity market.

To sum up, the performances of factor (market factor, size factor, value factor, momentum factor, growth factor, liquidity factor and profitability factor) based portfolios were compared with the performance of benchmark portfolio. Also value, growth and profitability factors are constructed with different methods. For some factors, both long and short strategies are examined. In order to be able to see the big picture, all long portfolio performances are presented in the same chart below.

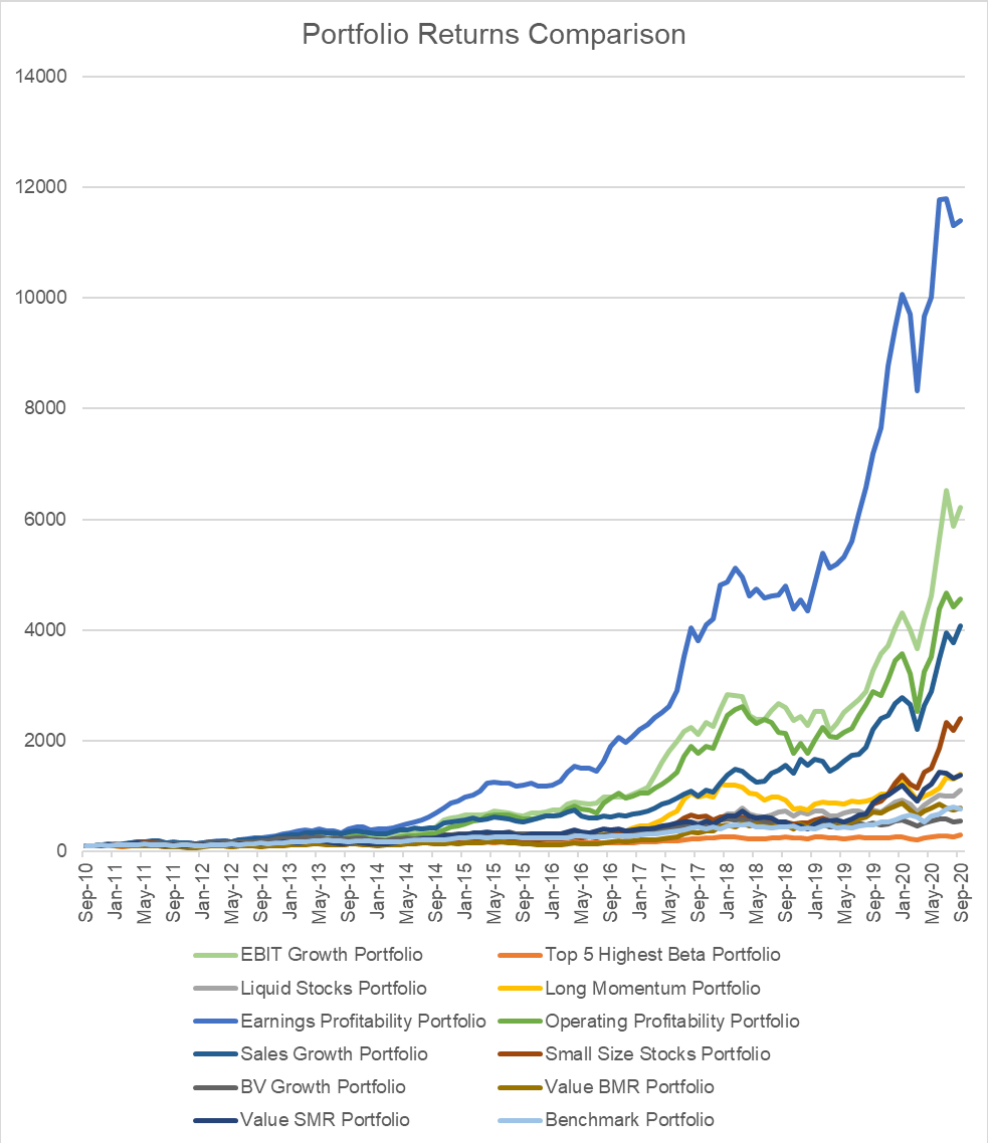

Figure 3.4.8: Return performances of all factor based portfolios

The above chart show us that growth factor (except book value growth) and profitability factor have significant impact on generating excess return in Turkish equity market.

4. Conclusion

The goal of this study has been to test the validity and availability of factor investing strategies in Borsa Istanbul with chosen non-financials stocks. The chosen period was 2010 – 2020. On top of the factors explained in traditional Fama-French three factor model, more recent developed factors such as growth, liquidity, momentum and profitability have been added to this study in order to be able to explain the variation in stock returns and to find the most suitable factors for Borsa Istanbul.

In order to measure the effectiveness of each factor, different portfolios were constructed with top five stocks which met the selection criteria for the mentioned factor. The performance of each factor portfolio was compared with the performance of benchmark portfolio. The method used in this study to measure the effect of each factor was grounded on the return profile of the above mentioned factor portfolios. Accordingly, if factor portfolio has generated sustainably excess return over benchmark portfolio in this study, it is concluded that the factor is applicable to Borsa Istanbul.

The results of the study does not confirm the validity of Fama-French three-factor model in Borsa Istanbul. Fama-French three factor model suggests that stocks having high beta coefficient should perform better than market. However, the results of this study reveal that the portfolio holding high beta stocks haven't outperformed the benchmark portfolio, hence the market. Another conflicting point with Fama-French three factor model's results is the book-to-market ratio. Fama-French three factor model claims that the stock with high book-to-market ratio should outperform the market. On the contrary, in this study, the portfolio holding the stocks having highest book-to-market ratio within the universe, have underperformed the market. The only factor whose results are in-line with the Fama-French factor model is the size factor. Small stocks portfolio have posted better returns than the market in this study, as Fama-French three factor model suggests. If all the three factors are taking into consideration, the results of this study concludes that the Fama-French three factor model is a week asset pricing

model in explaining the variation of stock returns listed in Borsa Istanbul. In other words, Fama-French three factor model is not applicable to Borsa Istanbul. It should be noted that there are some limitations in this study. As explained in the methodology section, top 50 stocks are used in this study. It is possible that size factor would perform better if top 100 stocks were used in the study as the gap between the market capitalizations widens with more stocks. Another limitation would be the time lag between the financials release dates. In this study it is assumed that all the companies have reported their financials at the same day, but in reality release dates can differ from each other. It is possible that this mentioned time lag may affect the book-to-market ratio, hence the performance of value factor analysis.

In addition to the measure the availability of Fama-French three factor model in Borsa Istanbul, another object of this study has been to apply the other recently developed factors to stocks listed in Borsa Istanbul and to identify the factors which can help investors to generate sustainable excess return over the market. When the performances of all factors tested in this study were compared, it has been seen that the best performing factors are profitability and growth factors. Size factor and liquidity factor are also posted sizable and sustainable excess return over benchmark portfolio. According to the readings from the results of the study, the best investment strategy in Borsa Istanbul in order to generate sustainable excess return would be creating a composite portfolio, which holds the stocks from profitability, growth, size and liquidity factors.

5.References

Aksu, M. H., & Önder, T. (2003). The Size and Book-to-Market Effects and Their Role as Risk Proxies in The Istanbul Stock Exchange. Koc University, Graduate School of Business, Working Paper No. 2000-04.

Amihud, Y., & Mendelson, H. (1986). Asset pricing and the bid-ask spread. Journal of Financial Economics, 17(2), 223-249.

Aras, G., Çam, İ., Zavalsız, B., & Keskin, S. (2018). Fama-French Çok Faktör Varlık Fiyatlama Modellerinin Performanslarının Karşılaştırılması: Borsa İstanbul Üzerine Bir Uygulama. Istanbul Business Research, 47(2), 183-207.

Barber, B. M., & Lyon, J. D. (1997). Detecting Long-Run Abnormal Stock Returns: The Empirical Power and Specification of Test Statistics. Journal of Financial Economics,43(3), 341-372.

Basu, S. (1983). The Relationship Between Earnings' Yield, Market Value and Return for NYSE Common Stocks. Journal of Financial Economics, 12(1), 129-156.

Chan, L. K. C., Hamao, Y., & Lakonishok, J., (1991). Fundamentals and Stock Returns in Japan. The Journal of Finance, 46(5), 1739-1764.

Clarke, R.G., Silva, H., & Thorley, S. (2006). Minimum-Variance Portfolios in the U.S. Equity Market. The Journal of Portfolio Management, 33(1), 10-24.

Cox, S., & Britten, J. (2019). The Fama-French five-factor model: Evidence from the Johannesburg Stock Exchange. Investment Analysts Journal, 48(2), 1-22.

Doğanay, M. M. (2006). Fama-French Üç Faktör Varlık Fiyatlama Modelinin İMKB'de Uygulanması. İktisat İşletme ve Finans Dergisi. 21(249), 61-72.

Fama, E. F., & French, K. R. (1992). The Cross-Section of Expected Stock Returns. Journal of Finance, 47(2), 427-465.

Fama, E. F., & French, K. R. (1993). Common Risk Factors in the Returns on Stocks and Bonds. Journal of Financial Economics, 33(1), 3-56.

Fama, E. F., & French, K. R. (1995). Size and Book-to-Market Factors in Earnings and Returns. Journal of Finance, 50(1), 131-155.

Fama, E. F., & French, K. R. (1996). Multifactor Explanations of Asset Pricing Anomalies. The Journal of Finance, 51(1), 55-84.

Fama, E. F., & French, K. R. (2015). A Five-Factor Asset Pricing Model. Journal of Financial Economics, 116(1), 1-22.

Fama, E. F., & French, K. R. (2017). International Tests of a Five-Factor Asset Pricing Model. Journal of Financial Economics, 123(3), 441-463.

Gökgöz, F. (2008). Üç faktörlü varlık fiyatlandırma modelinin İstanbul menkul kıymetler borsasında uygulanabilirliği. Ankara Üniversitesi SBF Dergisi. 63(2), 44-64.

Güzeldere, H., & Sarıoğlu, S. E. (2012). Varlik fiyatlamada Fama-French üç faktörlü model'in geçerliliği: İMKB üzerine bir araştirma. Business and Economics Research Journal, 3(2), 1-19.

Jensen, M., & Bennington, G.A. (1970). Random Walks and Technical Theories: Some Additional Evidence. Journal of Finance, 25(2), 469-482.

Kara, E. (2016). Testing Fama and French's Three-Factor Asset Pricing Model: Evidence from Borsa Istanbul. Çankırı Karatekin University Journal of the Faculty Economics and Administrative Sciences, 6(1), 257-272.

Kassimatis, K. (2008). Size, Book to Market and Momentum Effects in the Australian Stock Market. Australian Journal of Management, 33(1), 145-168.

Kaya, E., & Güngör, B. (2017). The Validity of the Fama and French Three Factor Model: Panel Data Analysis on Borsa Istanbul. Akademik Araştırmalar ve Çalışmalar Dergisi, 9(17), 222-236.

Lam, K. (2002). The Relationship between Size, Book-to-market Equity Ratio, Earnings–price Ratio, and Return for the Hong Kong Stock Market. Global Finance Journal, 13(2), 163-179.

Levy, R.A. (1967). The Theory of Random Walks: A Survey of Findings. The American Economist, 11(2), 34-48.

Liang, Y. (2004). Cross-sectional and Multivariate Tests of the CAPM and Fama-French Three Factor Model. Project Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Arts, Simon Fraser University.

Lintner, J. (1965a). The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. The Review of Economics and Statistics, 47, 13-37.

Lintner, J. (1965b). Securities Prices, Risk, and Maximal Gains from Diversification. The Journal of Finance, 20(4), 587-615.

Lunden, L. (2007). The Brazilian stock market : extending the three-factor model of Fama and French to capture the variation of Brazilian stock returns. Master Thesis for the Master of Economics degree, University of Oslo.

Malin, M., & Veeraraghavan, M. (2004). On the robustness of the Fama and French multifactor model: Evidence from France, Germany and United Kingdom. International Journal of Business and Economics, 3(2), 155-176.

Markowitz, H. (1952). Portfolio Selection. The Journal of Finance, 7(1), 77-91.

Mossin, J. (1966). Equilibrium in a Capital Asset Market. Econometrica, 34(4), 768-783.

Özkan, N. (2018). Fama-French Five Factor Model and the Necessity of Value Factor: Evidence from Istanbul Stock Exchange. Pressacadamia, 8(1), 14-17.

Pasaribu, R. (2009). Stock Portfolio with Fama-French Model in Indonesian Stock Exchange. Journal of Accounting and Business, 9(1), 1-12.

Ross, S. A. (1976). The Arbitrage Theory of Capital Asset Pricing. The Journal of Economic Theory, 13(3), 341-360.

Shaker, M. A., & Abdeldayem, M. M. (2018). Examining Asset Pricing Models in Emerging Markets: Evidence from Egypt. Corporate Ownership and Control, 16(1), 50-57.

Sharpe, W. F. (1965). Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk. The Journal of Finance, 19(3), 425-442.

Treynor, J. L. (1961). Market Value, Time, and Risk. Unpublished manuscript, Rough Draft dated 8/8/61, 95-209.

6.APPENDICES

6.1 Stock frequencies in factor based portfolios

	1	2	3	4	5	6	7	8	9	10	11
AEFES	9	-	-	14	12	3	12	-	30	26	-
AGHOL	33	-	-	16	25	27	45	1	33	86	40
ARCLK	3	10	-	18	-	-	-	-	3	-	-
ASELS	18	2	28	18	4	-	28	-	54	-	-
BIMAS	3	-	-	11	-	-	9	-	21	-	-
BRISA	9	-	1	18	-	3	3	15	3	-	-
CCOLA	3	-	-	17	8	-	9	-	12	-	-
DOAS	18	50	-	21	29	62	36	38	12	-	109
DOHOL	33	6	83	15	15	2	24	4	12	99	29
ECILC	33	7	12	12	7	-	3	8	-	85	-
ENKAI	3	-	3	9	1	-	12	-	15	-	-
EREGL	22	5	88	21	38	26	12	-	9	-	-
FROTO	3	-	-	14	1	1	12	-	9	-	-
GUBRF	28	21	-	20	71	62	19	35	19	-	7
KARTN	33	8	-	16	3	-	15	120	-	-	-
KCHOL	6	38	1	7	26	6	3	-	6	10	27
KOZAA	27	48	20	30	35	101	42	41	37	65	-
KOZAL	18	23	-	31	27	21	45	-	46	-	-
MGROS	3	18	-	8	6	11	-	-	15	-	47
OTKAR	27	18	-	22	4	-	33	26	18	-	-
OYAKC	18	-	-	9	8	3	12	109	6	3	7
PETKM	25	-	119	13	7	4	18	-	12	-	-
SAHOL	3	91	3	5	-	-	15	-	-	117	-
SASA	40	21	47	31	31	22	16	81	27	-	37
SELEC	12	-	-	11	17	13	-	3	-	-	118
SISE	3	2	19	18	22	1	-	-	6	26	-
TAVHL	-	4	-	14	10	15	12	-	30	-	-
TCELL	3	-	6	8	-	-	3	-	-	-	-
THYAO	27	96	115	21	46	42	21	-	39	31	27
TKFEN	34	7	1	19	25	12	27	-	3	-	4
TOASO	-	27	-	17	-	-	12	-	-	-	-
TTKOM	-	16	13	9	41	11	3	-	12	-	-
TTRAK	9	-	-	22	10	13	22	6	18	-	-
TUPRS	24	2	-	13	31	18	12	-	18	-	46
ULKER	12	-	-	16	9	-	15	-	22	-	-
VESTL	27	52	6	24	22	83	3	39	6	39	107
ZOREN	36	33	40	17	14	43	52	79	52	18	-

*Portfolio 1 – EBIT growth portfolio
Portfolio 2 – High beta portfolio
Portfolio 3 – Liquid stocks portfolio

Portfolio 4 – Long momentum portfolio
Portfolio 5 – Earnings yield portfolio
Portfolio 6 – EBIT yield portfolio
Portfolio 7 – Sales growth portfolio
Portfolio 8 – Small stocks portfolio
Portfolio 9 – Book value growth portfolio
Portfolio 10 – Value BMR portfolio
Portfolio 11 – Value SMR portfolio