The Fama and French Three-Factor Model

- Evidence from the Swedish Stock Market

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Abstract

The present study adds to the sparse published Swedish literature on the performance of the Fama and French Three-Factor model on the Swedish stock market. The ability of the model to measure the cost of equity is compared with that of the CAPM. The tests are conducted in time periods with and without financial turmoil. The Fama and French Three-Factor Model is found to provide improved explanatory power over the CAPM in both stable and unstable market conditions. Another finding is that the performance of the Fama and French Three-Factor model does not perform well during a period of financial turmoil on the Swedish market.

Keywords: Fama and French Three-Factor Model, CAPM, Asset pricing, Cost of Equity

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We thank our supervisor Göran Andersson for his words of advice in the writing process.

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Chapter 1

Introduction

This first chapter introduces the background of the dissertation. Furthermore, it discusses the problem and the purpose. Additionally, the chapter describes our limitations, the outline of the dissertation and the definition of terms.

1.1 Background

Every day decisions about investing or not investing in a company, to undertake a project or not is made by investors and company management. One of the variables at the heart of these decisions as well as on decisions regarding capital budgeting, capital structure and performance evaluation is the cost of equity[1]. Therefore the correct estimation of cost of equity is crucial.

The decision whether to invest in a project or not is an important decision, and sometimes a complex task for a company, since making the right choice will have a positive effect on the future value of the company. Furthermore, a correct way of estimating the rate of return investors demand and the risk of an investment is constantly a relevant question in financial analysis. Today several models exist that either estimates the cost of equity or include it as a variable, for instance the Weighted Average Cost of Capital model (WACC).

One of the earlier models to estimate the cost of equity was developed in the 1960s, individually by William Sharpe[2], John Lintner[3], Jan Mossin[4] and Jack Treynor[5] and is called the Capital Asset Pricing Model (CAPM). The attraction of the CAPM is that it offers powerful and intuitively pleasing predictions about how to measure risk and the relation

[1] Bartholdy & Peare (2003)
[2] Sharpe (1964)
[3] Lintner (1965)
[4] Mossin (1966)
[5] Treynor (1961) (1962)

between expected return and risk[6]. The model has, however, since then received a great deal of criticism arguing that for instance a large part of the required rate of return that investors have on a company cannot be explained by the model[7]. Furthermore, it is not possible to estimate the CAPM since the world market portfolio is not observable.[8] In addition to this, the empirical record of the model is poor[9]. The CAPM´s empirical problems may reflect theoretical failings, the result of many simplifying assumptions[10]. The CAPM says that the risk of a stock ought to be measured relatively to a comprehensive *market portfolio* that, in principle, may include not just traded financial assets, but also consumer durables, real estate, and human capital[11]. Should the market include bonds and other financial assets, perhaps around the world?[12] Empirical work tells that the relation between beta and average return is flatter than predicted by the Sharpe-Lintner version of the CAPM. As a result, CAPM overestimates the cost of equity for high-beta stocks and underestimates the cost of equity for low-beta stocks[13].

Despite the criticism, the CAPM is, according to a study conducted by Graham and Harvey in 2001[14], still widely used amongst practitioners. The study showed that 73.5% of the 392 U.S. chief financial officers (CFOs) that were asked always or almost always used the CAPM to estimate cost of equity. In addition, another study on 313 European firms made in 2004 by Brounen, De Jong and Koedijk, showed that about 45% of them rely on the CAPM[15].

In 1993 Eugene Fama and Kenneth French present their model, the Fama French Three-Factor Model (hereafter called FF3FM). This model adds, besides the explanatory variable of the overall market factor, two more explanatory variables to the CAPM, factors related to firm

[6] Fama & French (2004)
[7] Jagannathan & McGrattan (1995)
[8] Bartholdy & Peare (2005)
[9] Fama & French (2004)
[9] Jagannathan & McGrattan (1995)
[10] Fama & French (2004)
[10] Jagannathan & McGrattan (1995)
[11] Fama & French (2004)
[11] Jagannathan & McGrattan (1995)
[12] Fama & French (2004)
[13] Friend & Blume (1970)
[14] Graham & Harvey (2001)
[15] Brounen, De Jong & Koedijk (2004)

size and book-to-market equity[16]. Fama and French manage to considerably increase the models level of explanation by expanding the CAPM with these two factors[17].

1.2 Problem discussion

The problem that we are examining in this dissertation is whether or not the conclusions from previous research, conducted in the U.S., Europe and other markets, applies for the Swedish market as well. Does the FF3FM outperform the CAPM in the Swedish market? Studies conducted in the U.S. and in Europe show that a large percentage of firms use the CAPM as their main model, when evaluating the cost of equity. This is done in spite of research that highly criticise the accuracy of the CAPM, and that presents evidence that the FF3FM has a higher accuracy. The fact that the cost of equity is a variable included in several of the decisions made by company managers and investors makes it crucial to obtain an accurate estimate of the cost of equity in order to be able to make the correct decisions.

1.3 Purpose

This thesis has two purposes, the first is to evaluate whether the Fama and French Three-Factor model works well or not for Swedish stocks, and the second is if the model works well or not during times of crisis. We want to perform this study on Swedish stocks because there is little previous research done on Swedish data, the majority of the research has been made on US data. More specifically we want to test whether the Fama and French Three-Factor model explains the investors´ required return on equity better than the CAPM for Swedish stocks. The questions we seek to answer in this thesis are:

"Does the Fama and French Three-Factor model outperform the CAPM in Sweden?"

"Does the Fama and French Three-Factor model work well during times of high financial turmoil?

With our research we hope to prove that FF3FM also provides more accurate estimates on the Swedish market, and thereby highlighting the importance of managers switching from the CAPM to the FF3FM as a foundation for their estimates of the cost of equity. In addition, we hope that our research will shed some light on whether or not the FF3FM remains effective during times of highly unstable market conditions, thereby analysing if the model can be relied upon during times of crises or not.

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[16] Fama & French (1993)
[17] Fama & French (1992)

1.4 Limitations

We choose to limit our research to only including the companies listed on the Stockholm stock exchange, Nasdaq OMX, more specifically companies listed on the segments Large- and Mid Cap. The reason for this limitation is that companies listed on the other lists tend to have smaller trading volume, which may lead to mispricing caused by non-trading. Non-trading occurs when we obtain the return of an asset that trades less frequently than other assets, if we for instance take the return of the last end day of the month, while the last quoted asset price of the less frequently traded asset is from another date, this give an inaccurate monthly return for this asset since news may have arrived that would have had an impact of the stock price of the asset if it had been traded after the arrival of the news.[18]

Furthermore, we also choose to limit our time period to five years since, according to Bartholdy and Peare[19], the longer the estimation period for beta is, the greater the risk that the estimate for beta will be biased since the true value of the beta is more likely to change over the time period.

In addition, we assume that the market is semi efficient, which means that all new available information about a company is reflected in their share price without any significant delay[20].

1.5 Outline

The dissertation has the following outline.

Chapter 2

This chapter explains the models that are used in the study. Furthermore, the chapter briefly reviews some previous research that is similar to our study.

Chapter 3

The method of how the study is conducted is presented in this chapter, from data collection to construction of the different portfolios and variables to the regression analysis.

Chapter 4

[18] Campbell, Lo & MacKinlay (1997)
[19] Bartholdy & Peare (2005)
[20] Berk & DeMarzo (2006)

In this chapter the results of the study are presented and analysed.

Chapter 5

Our conclusion of the study and suggestions for future research are presented in this chapter.

1.6 Definitions

Book value of equity is the book value of equity minus minority interest.

Treasury bill – statsskuldväxel issued by Riksgälden.[21]

[21] Riksgälden´s homepage

Chapter 2

Theoretical Background

This chapter presents the theories of the models that are used in the study and how their dependent- and explanatory variables are estimated and created. Furthermore, some previous research similar to this study is presented briefly.

2.1 Cost of Equity

The value of an investment is measured by deducting the return of the investment with the cost of capital for financing the investment[22]. Since the cost of equity is an important component of the cost of capital, it is essential that it is estimated accurately. The cost of equity is the expected return that investors demand on a firm's stock[23]. The required return is a premium for holding a risky asset and the return is required to be higher than investing in the risk free asset[24]. The investors' demanded return of a stock cannot be observed and in order to be obtained asset-pricing models are used; the most common one is the capital asset pricing model (CAPM)[25].

2.2 The Capital Asset Pricing Model (CAPM)

The CAPM was created in the mid 1960s by William Sharpe[26], John Lintner[27], Jan Mossin[28] and Jack Treynor[29] who all contributed individually to develop the model. The CAPM is based on the assumption that the only risk factor that a company is affected by; is the systematic risk. The idea behind the model is that the idiosyncratic risk can be diversified away and therefore the only risk that remains is the non-diversifiable risk[30]. This risk is

[22] Dangerfield, Merk & Narayanaswamy (1999)
[23] Ogden, Jen & O´Connor (2003)
[24] Ogden, Jen & O´Connor (2003)
[25] Koller, Goedhart, Wessels (2005)
[26] Sharpe (1964)
[27] Lintner (1965)
[28] Mossin (1966)
[29] Treynor (1961) (1962)
[30] Perold (2004)

measured by the beta value which is the covariance between a stocks return and the return of the market, and the variance of the market return as follows:

$$\frac{Cov(R_i, R_m)}{Var(R_m)}$$

The expected return (or in our case the cost of equity) is according to the CAPM a function of the risk-free interest rate Rf, the beta value βi and the expected market return $E(Rm)$:[31]

$$E(Ri) = Rf + \beta i[E(Rm) - Rf]$$

where

$E(Ri)$ = The expected return on asset *i*

Rf = The risk-free interest rate

βi = Beta value for asset *i*

$E(Rm)$ = The expected return of the market

As previously mentioned the CAPM is still widely used even though it has received a large deal of criticism over the years. This criticism has been regarding the fact that the market beta alone is not enough to explain expected returns[32], and research by Banz shows that there is a size effect to returns because low market-value stocks earned a higher return than was predicted by the CAPM[33]. Then in 1992 Fama and French argues that stocks with high book-to-market equity ratios (BE/ME) have high average returns that are not being captured by their market betas[34]. In addition, the results from a study conducted by Fama and French showed that on average the CAPM suffers from large absolute pricing errors, sometimes as high as three to five times those of the FF3FM[35]. In order to increase the CAPM level of explanation, Eugene Fama and Kenneth French expanded the model by including, in addition to the variable of the overall market factor, two additional explanatory variables, factors that related to the size of the firm and the book-to-market equity ratio[36]. They called the model *the*

[31] Grinblatt och Titman (2002)
[32] Fama & French (1992)
[33] Banz (1981)
[34] Fama & French (1992)
[35] Fama & French (1996)
[36] Fama & French (1993)

Three-Factor Model[37], today it is widely known as The Fama and French Three Factor Model.

2.3 The Fama French Three-Factor Model (FF3FM)

Fama and French found that two variables, size (ME) and book-to-market equity (BE/ME), explains much of the average stock returns[38]. Size is defined as the market equity (ME) which is the price of the stock times the number of stocks and is measured at the end of June of year t[39]. BE/ME is calculated by dividing book value of equity (BE), at the end of December year t-1, with the market value of equity (ME), at the end of December year t-1[40]. It is suggested that the variables size and BE/ME explains the variance of stock returns because these variables account for underlying risk of stocks[41]. As for the BE/ME variable Fama and French writes that "low BE/ME firms are persistently strong performers, while the economic performance of high BE/ME firms is persistently weak"[42]. The two variables are represented by two portfolios called small minus big (SMB) and high minus low (HML) which in addition to the market return compose the foundation of the model. The three explanatory variables of the FF3FM are Rm-Rf, SMB and HML and they are risk factors that catch the non-diversifiable variance of stocks[43].

The model looks as follows:

$$\mathrm{E}(Ri) - Rf = a + bi[\mathrm{E}(\mathrm{Rm})-\mathrm{Rf}] + si\mathrm{E}(\mathrm{SMB}) + hi\mathrm{E}(\mathrm{HML})$$

where

E*(Ri)* = The expected return on asset *i*

Rf = The risk-free interest rate

E*(Rm)* = The expected return of the market

E(*SMB)* = The expected return of the size factor

E(*HML)* = The expected return on the BE/ME factor

b, s and h = The coefficients or the betas of the three independent variables Rm-Rf, SMB and HML

[37] Fama & French (1993)

[38] Fama & French (1992)

[39] Fama & French (1993)

[40] Fama & French (1993)

[41] Fama & French (1992)

[42] Fama & French (1992)

[43] Fama & French (1993)

The three different betas are estimated by running time series regressions.

The actual return is calculated by omitting the expectation symbol E() from the equation and including a white noise error term ε:

$$Rit - Rft = a + bi[\text{Rmt-Rft}] + si\text{SMBt}) + hi\text{HMLt} + \varepsilon it$$

2.3.1 Explanatory variables, SMB and HML

The stocks are parted by the median into two size groups, small and big (S and B).

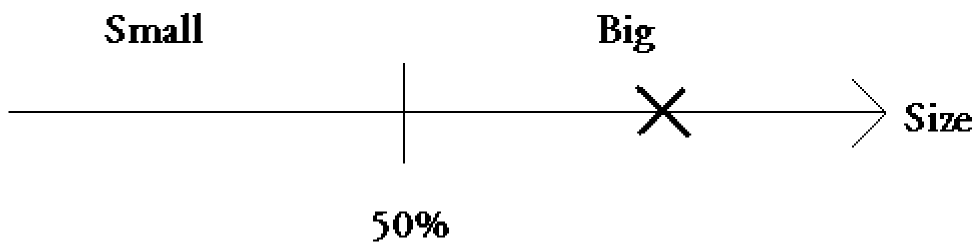

Figure 1. Sorting by size, where x is a company in the big group.

They are also divided into three book-to-market groups; low, medium and high (L, M and H), where the lowest 30% is the low group, the middle 40% is the medium group and the highest 30% is the high group[44].

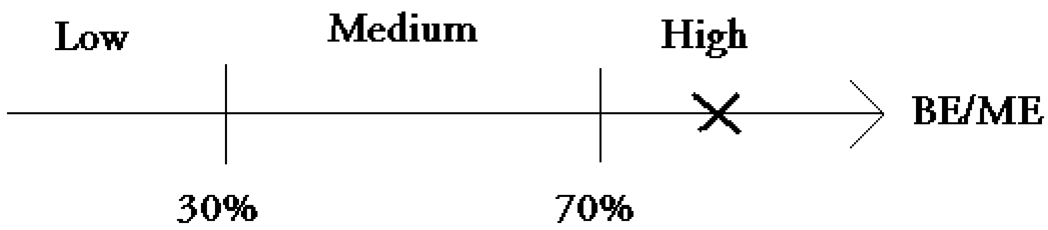

Figure 2. Sorting by BE/ME, where x is a company in the high group.

There are three BE/ME groups and only two size groups because of previous results indicating that BE/ME has a higher level of explanatory power for the average return of stocks than size has[45]. Any given stock will be present in one size group and in one book-to-market group.

[44] Fama & French (1993)

[45] Fama & French (1992)

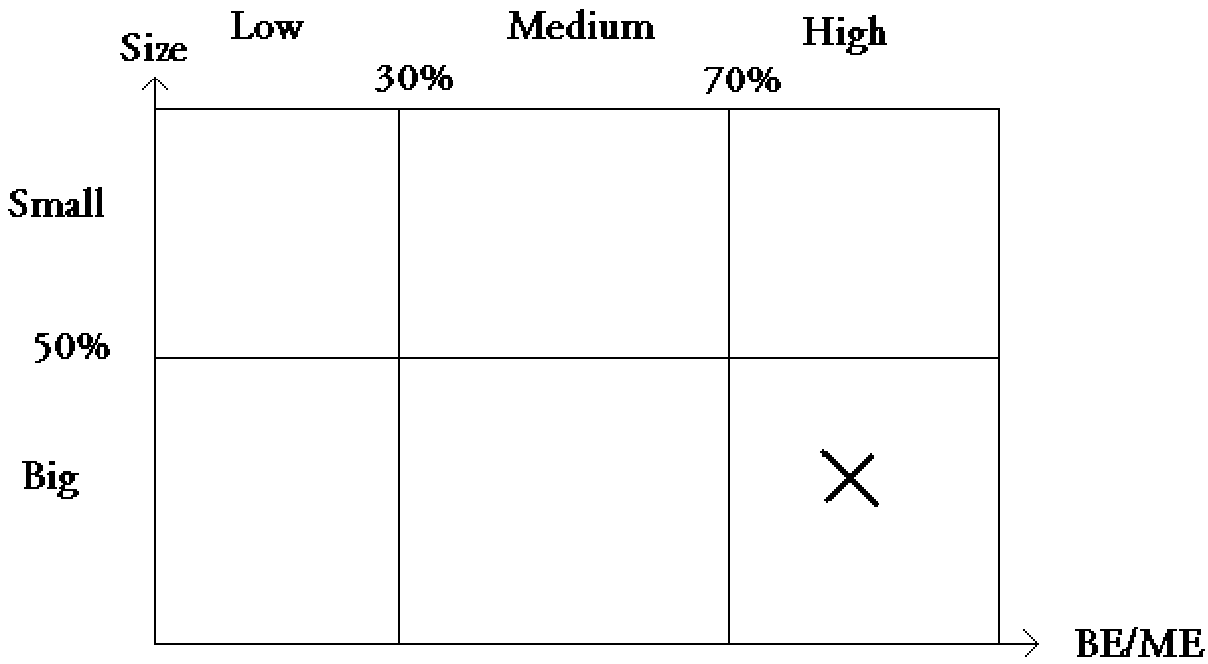

Figure 3. Sorting on size and BE/ME, where x is the same company as in figure 1 and 2, and it is here shown how company x is present in one size portfolio and in one BE/ME portfolio.

Monthly excess returns are calculated from July year t to June year t+1. The returns are calculated from July year t to ascertain that the book value of equity for year t-1 is available to the market[46]. The portfolios are renewed in June each year[47].

Six portfolios are constructed S/L, S/M, S/H, B/L, B/M and B/H, that is Small/Low, Small/Medium, Small/High, Big/Low, Big/Medium and Big/High[48]. From these six portfolios the explanatory variables, small minus big (SMB) and high minus low (HML), are derived[49].

The market return is represented by the excess return, which is return minus the risk free rate, of the above mentioned six size-BE/ME portfolios[50]. One-month Treasury bills are used as the risk free rate[51]. The risk of size is represented by the portfolio small minus big (SMB) and is

[46] Fama & French (1993)
[47] Fama & French (1993)
[48] Fama & French (1993)
[49] Fama & French (1993)
[50] Fama & French (1993)
[51] Fama & French (1993)

the difference each month between the average return for the three small portfolios (S/L, S/M, S/H) and the average return for the three big portfolios (B/L, B/M, B/H)[52].

$$SMB = \frac{(R_{SmallLow} + R_{SmallMedium} + R_{SmallHigh})}{3} - \frac{(R_{BigLow} + R_{BigMedium} + R_{BigHigh})}{3}$$

The risk of BE/ME is represented by the portfolio high minus low (HML) and is the difference each month between the average return for the two high BE/ME portfolios (S/H, B/H) and the average return of the two low BE/ME portfolios (S/L, B/L)[53]. Note that the two medium portfolios S/M and B/M are not included in the HML portfolio.

$$HML = \frac{(R_{SmallHigh} + R_{BigHigh})}{2} - \frac{(R_{SmallLow} + R_{BigLow})}{2}$$

2.3.2 Dependent variables

The excess return on 25 portfolios, created from the factors size and BE/ME, are used as dependent variables in the time-series regressions[54]. The 25 portfolios are constructed in the same manner as the six size-BE/ME portfolios;[55] the portfolios are formed in June each year t by size and BE/ME, where size is measured in the end of June year t and BE/ME is measured in December year t-1[56]. Five size groups and five BE/ME groups are created and the 25 portfolios are formed by a 5x5 matrix of these two categories[57]. The dependent variables are then the excess returns of the 25 portfolios from July of year t to June year t+1[58]. Regressions are run for each one of the 25 portfolios. As for the explanatory variables, any given stock of the portfolios of the explained variables will be present in one size group and one BE/ME group.

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52 Fama & French (1993)
53 Fama & French (1993)
54 Fama & French (1993)
55 Fama & French (1993)
56 Fama & French (1993)
57 Fama & French (1993)
58 Fama & French (1993)

The 25 portfolios are designed as follows:

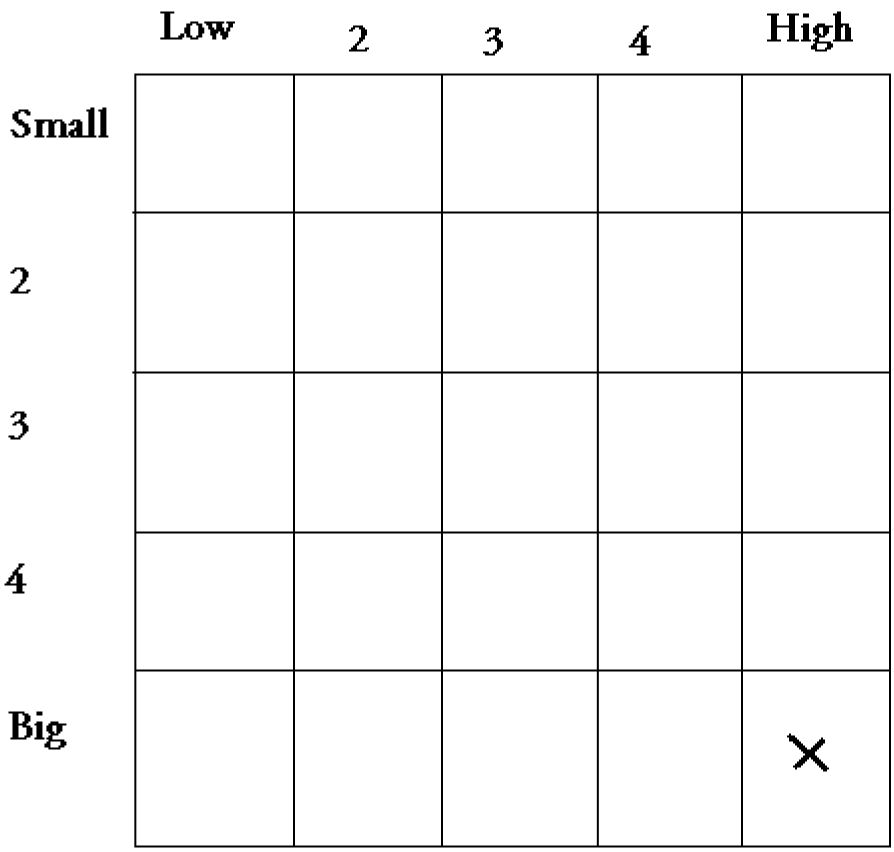

Figure 4. The 25 dependent portfolios, each square represents a portfolio. The x is a stock in the portfolio with the biggest size and highest BE/ME.

2.4 Previous research

There is a substantial amount of research conducted on U.S. data available from Kenneth French's homepage[59].

The bulk of the research on the Fama French model has been made on the U.S. market but there is also research from other countries. In an article by da Silva[60] the model is applied on the Brazilian market, where it is found that the market beta has high explanatory power. However, the explanatory power is increased further with the size and BE/ME factors.

59 French (2010)

60 da Silva (2006)

In an article by Mısırlı and Alper[61] the impact of coskewness is tested on the Turkish market and it is found that coskewness does not have any significant incremental power over the explanatory power of the Fama and French model. In an article by Gregory and Michou[62] the model is applied on the UK market, where the factors SMB and HML are found to have large variability through time, and it is considered difficult to judge whether the FF3FM is better than the CAPM. In a study conducted on the Greek market the FF3FM is compared to the Arbitrage Pricing Theory and it is found that FF3FM is better at capturing the returns, though it is found that large firms appear to earn higher returns than small firms[63]. In an article written by Faff the model is applied to the Australian market, where the risk premia for the market and the book-to-market factors are found to be significantly positive; however the risk premia for the size factor is found to be negative[64]. In a study by Kassimatis it is concluded that FF3FM does not work well for the Australian market[65]. In a study, by Allen, Singh and Powell conducted on the US market using quantile regressions, found that there are differences between the returns and the three factors of the FF3FM across quantiles and through time. They also found that the ordinary least squares (OLS) is less efficient when analyzing extremes within a distribution[66]. A study performed by Chen and Fang[67] on the Pacific Basin markets concludes that the FF3FM outperforms the CAPM in the Pacific Basin markets, and in addition their results do not support the momentum effect of the Carhart four factor model. Their results showed that FF3FM performed as well or even slightly better than the four factor model. In an article by Trimech, Kortas and Benammou[68] the model is tested using wavelets as a relatively new tool for statistical analysis that gives new understanding of pricing models. Their study is conducted on the French market and they conclude that the relationship between portfolio returns and the FF3FM risk factors is largely dependent on the time-horizon.

[61] Mısırlı and Alper (2009)
[62] Gregory and Michou (2009)
[63] Iatridis, Messis, Blanas (2006)
[64] Faff (2001)
[65] Kassimatis (2008)
[66] Allen, Singh and Powell (2010)
[67] Chen, Fang (2009)
[68] Trimech, Kortas, Benammou (2009)

Chapter 3

Method

This chapter, firstly, explains the time period of our study as well as how the data for the study has been retrieved. Secondly, it presents the sample on which the study is conducted and how the sample has been composed. Finally, the creation of the variables needed for the regression analysis is explained.

3.1 Selection

3.1.1 Time period

For this study we choose a time period of five years, 2005-2010. The reason for this choice is because the longer the time period is the higher the probability is that the value of the true beta changes over the period, and the beta estimate might therefore be biased[69]. Another reason to choose a five year period is that we obtain data before, during and after the recent financial crisis, and thereby the models will be tested on both stable and unstable market conditions. This way we can analyse if the FF3FM outperforms the CAPM on the Swedish market during different market conditions. The returns are taken from the end of July year t to the end of June year t+1. In 2010 we cannot take the returns all the way till the end of June because at the time of writing this those returns are still in the future. Instead we take the returns until the end of April 2010.

3.1.2 Data

The data we use for book value of equity is originally from firms´ annual reports. To obtain the book-to-market value of equity factor we collect data from the bank Nordnet[70]. The book value of equity from Nordnet is defined as the book value of equity minus minority interest (when available) hence this is the definition of book value of equity that we use. Furthermore, we use the University of Lund's database called ELIN[71] to search for articles that are relevant

[69] Bartholdy & Peare (2005)
[70] Nordnet´s homepage
[71] ELIN

for our thesis. We search for books in the University of Lund's database called LIBRIS[72]. The number of stocks is necessary for the calculation of market value of equity and this data is collected from companies´ annual reports that are gathered from the database Affärsdata[73] and the companies´ homepages.

To calculate the monthly return for each stock we use the database DATASTREAM[74] to obtain a return that is adjusted for dividends, repurchases and splits. The stock prices, used to calculate book-to-market value of equity and market value of equity, are acquired from Nasdaq OMX[75]. The latter stock prices are the nominal prices and are not adjusted for dividends, repurchases and splits. The reason for this is that the adjusted stock prices give incorrect estimations of the market value of equity, when multiplying the adjusted price with the number of shares of a company before a split, reversed split or repurchasing of shares. If the company has made a split then today's adjusted price multiplied with yesterday's number of stocks will give an underestimation of the marker value of equity and vice versa in the case of a reversed split.

The return of the one month Treasury bill (statsskuldväxel) has been gathered from Riksbanken[76]. This is our proxy for the risk-free interest rate.

3.1.3 Sample

Our sample consists of all companies listed on the market segments Large Cap and Mid Cap of the NASDAQ OMX Nordic Stockholm stock exchange for the years 2005-2010. To be included in the sample, a company must have been traded on the exchange in December year t-1, this to be able to measure the book value of equity. Companies that have gone bankrupt, or have been delisted from the NASDAQ OMX Stockholm stock exchange for some other reason, are not included in the study since we could obtain neither the return nor the book values of equity of these companies. Since we use the stock prices from NASDAQ OMX to form the portfolios, a company can be included no earlier than its first recorded price on NASDAQ OMX. In some cases we were able to find return data of stock from DATASTREAM for the full sample period, but we were not able to find the return data for the full sample period from NASDAQ OMX. In those cases the company could not be part of

[72] LIBRIS
[73] Affärsdata
[74] DATASTREAM
[75] Nasdaq OMX Nordic´s homepage
[76] Riksbanken's homepage

the sample until its return data could be obtained from NASDAQ OMX. Furthermore, companies with negative book value of equity cannot be part of the sample since it is necessary to obtain the book-to-market ratio, and this is not feasible when the numerator has a negative value. In our five year sample there was one company that had a negative book value of equity in one year. This company was excluded from the sample in that year but was part of the sample in the other years.

3.2 Construction of the portfolios

Each year, t, in June the companies in our sample are sorted on size and BE/ME. The size is measured as the market value of equity in June, t, and BE/ME is the book value of equity divided by the market value of equity in December, t-1. For example the portfolios of the year 2005 are created by taking the market value of equity in June 2005 and the end of the year book value of equity of 2004 divided by the market value of equity of December 2004. The returns are then taken from the end of July 2005 to the end of June 2006, consequently the returns of the portfolios of the year 2005 stretches from July 2005 to June 2006. We measured the market value of equity and formed the portfolios during the same time period as Fama and French, the end of June. This is to ascertain that the accounting data is known to the market before the returns are measured. In the example above the market does not yet have access to the accounting data for the first few months of 2005. We regard that by the end of June the information from the companies´ annual reports should be available to the market. The Swedish accounting law states that the annual report should be completed no later than six months after the financial year[77]. Consequently companies, of which the financial year follows the calendar year, have to complete their reports before the end of June. Six portfolios are created each year that are used for the construction of the three explanatory variables RM-RF, SMB and HML. Sixteen additional portfolios are created each year that are used as the dependent variables.

3.2.1 Explanatory variables

The market return is represented by the excess return, that is return minus the risk free rate, of a portfolio consisting of the stocks in the previous mentioned six "size-BE/ME" portfolios, including the return of the company with negative BE/ME that was excluded earlier. The

[77] SFS 1999:1078. *Bokföringslag.* (Swedish accounting law)

returns are taken from the beginning of July of year, t, to the end of June of year, t+1, from 2005-2010.

3.2.1.2 SMB

In order to create the explanatory variable SMB, all the companies that are included in our study are ranked on the basis of their size.

In accordance with Fama and French's definition of size, we measure the size of the companies included in our study/analysis as the market value of equity. The limit whether a company should be considered large or small is decided by the median value of the market value of equity. The median companies are not included in any of the groups. Thereby two categories, *Small* and *Big*, are created. SMB is the difference each month between the average return for the three small portfolios (S/L, S/M, S/H) and the average return for the three big portfolios (B/L, B/M, B/H).

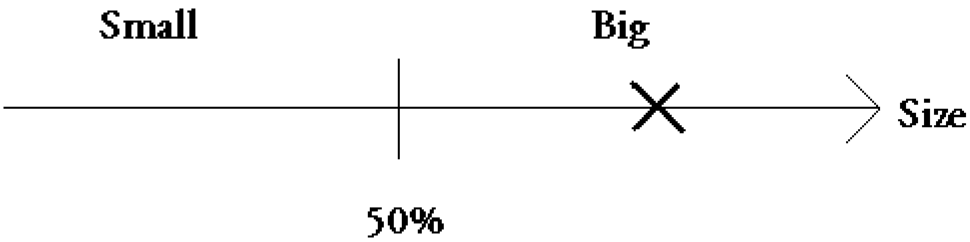

Figure 5. Sorting by size, where x is a company in the big group.

3.2.1.3 HML

In order to be able to rank the companies based on BE/ME ratio, information regarding both book value of equity and market value of equity is required. Both the book value of equity and the market value of equity have been collected in the end of December for each year, t-1, and for each company. In order to have the same point of observation for both BE and ME in the calculation of BE/ME, the same specific date is chosen.

We then divide the companies into the three different categories; Low, Medium and High. The 30 % of the companies with the lowest BE/ME ratio are included in the category *Low*, the 30% of the companies with the highest BE/ME ratio are part of the category *High*, and the remaining 40% are included in the category *Medium*. HML is the difference each month between the average return for the two high BE/ME portfolios (S/H, B/H) and the average return of the two low BE/ME portfolios (S/L, B/L). Note that the two medium portfolios S/M and B/M are not included in the HML portfolio.

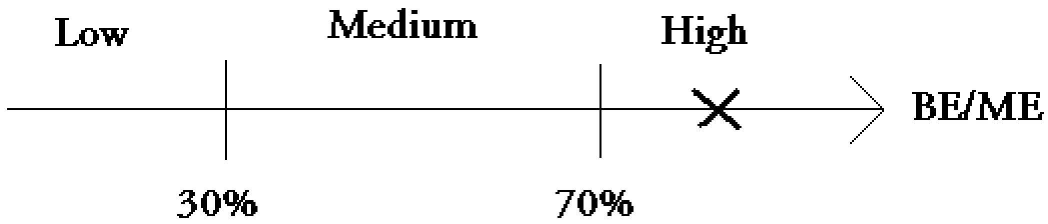

Figure 6. Sorting by BE/ME, where x is a company in the high group.

One should note, since the size ranking and BE/ME-ratio ranking is done independently of each other, that each company will be included in one of the two size categories, as well as in one of the three BE/ME ratio categories.

Six portfolios are then created, based on the two size categories and the three BE/ME-ratio categories, one for each combination of size and BE/ME-ratio.

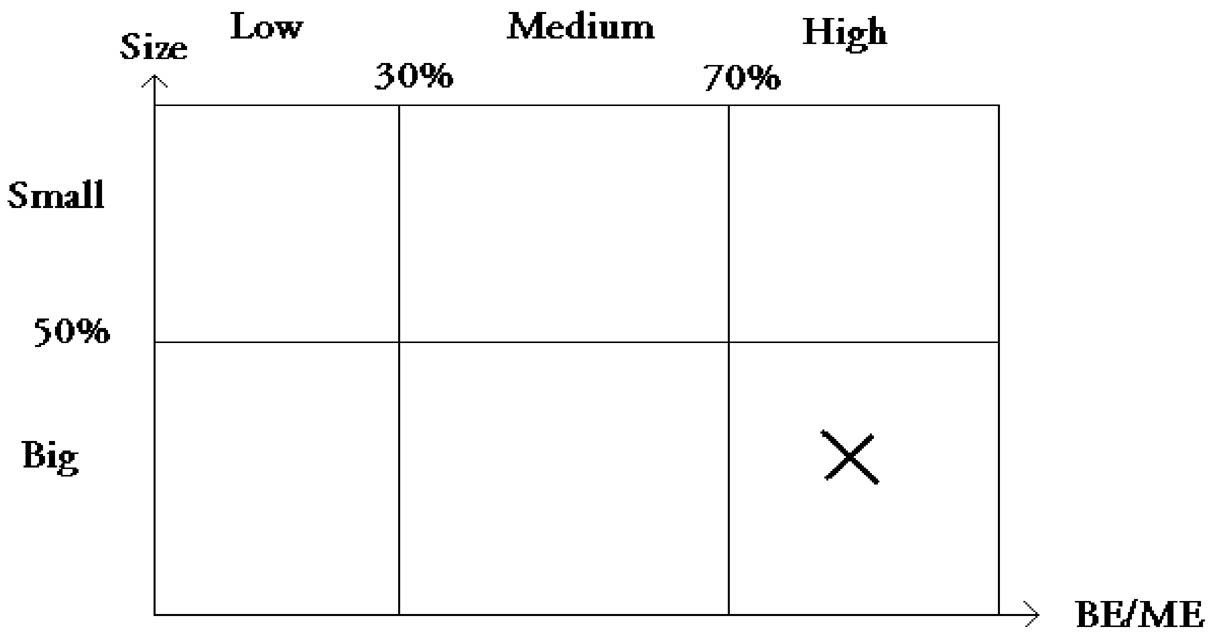

Figure 7. Sorting on size and BE/ME, where x is the same company as in figure 1, 2, 5 and 6. Here it is shown how company x is present in one size portfolio and in one BE/ME portfolio.

The return for each of the six portfolios is measured on a monthly basis. The SMB variable is created by subtracting the average return for the three portfolios with big companies, by the average return for the three portfolios containing small companies according to the following model:

$$SMB = \frac{(R_{SmallLow} + R_{SmallMedium} + R_{SmallHigh})}{3} - \frac{(R_{BigLow} + R_{BigMedium} + R_{BigHigh})}{3}$$

The HML variable is created in a similar way, with the exception of excluding the two medium portfolios as noted before. The reason for excluding these portfolios is, that Fama and French concludes that the HML variable works best when defined in this way[78]. Thereby, in order to obtain the HML variable, the average return of the portfolios containing companies with a low B/M ratio is subtracted from the average return of the portfolios containing companies with high B/M ratio using the following model:

$$HML = \frac{(R_{SmallHigh} + R_{BigHigh})}{2} - \frac{(R_{SmallLow} + R_{BigLow})}{2}$$

3.2.2 Dependent variables

The excess returns on the 16 portfolios are used as dependent variables in the time-series regressions. Fama and French use 25 portfolios as dependent variables, but since our sample consists of fewer companies we use fewer portfolios. The risk of obtaining portfolios with only one or even zero companies is avoided by using fewer portfolios. The 16 portfolios are constructed in the same manner as the six size-BE/ME portfolios; the portfolios are formed in June each year, t, by size and BE/ME, where size is measured in the end of June year, t, and BE/ME is measured in the end of December year, t-1. The monthly returns are measured each year from the end of July year, t, to June year, t+1, and in June, t+1, the portfolios are transformed. When we talk about the portfolios of year 2005, the returns are taken from July 2005 to June 2006. Four size groups and four BE/ME groups are created and the 16 portfolios are formed by a 4x4 matrix of these two categories, see figure 8.

The size groups are Small, 2, 3 and Big and the BE/ME groups are Low, 2, 3 and High. The stocks are distributed into four groups where each group is of equal size and contains 25% of the stocks. In this way 25% of the stocks will be in the size group Small, 25% will be in the size group 2 etc. As for the explanatory variables any given stock of the portfolios of the

[78] Fama & French (1993)

explained variables will be present in one size group and one BE/ME group. The dependent variables are then the excess returns of the 16 portfolios from the beginning of July of year, t, to the end of June year, t+1, for the years 2005-2010.

The betas of the three factors are estimated by running OLS time series regressions. Sixteen regressions are run per year, one regression for each one of the portfolios. This gives a total of 80 one-year regressions. In addition, 16 regressions are run for the whole time period and 16 regressions are run for the whole time period, excluding the returns of July 2007 to June 2008. Furthermore, 16 regressions are run for the whole time period using only the market return as explanatory variable, that is using the CAPM, and 16 regressions are run using CAPM for the whole time period, excluding the returns of July 2007 to June 2008.

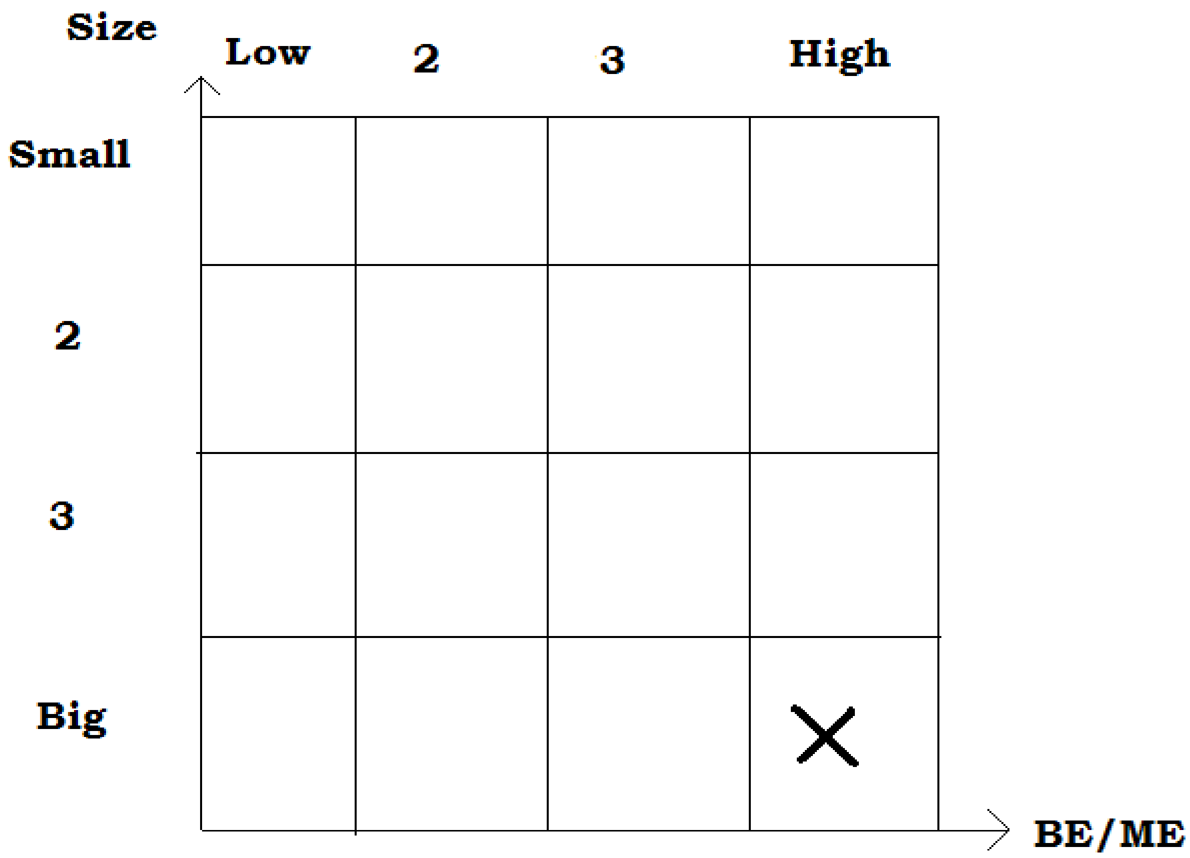

Figure 8. 4x4 matrix of the 16 dependent portfolios, where the x is a company in the Big/High portfolio.

3.2.3 The risk-free interest rate

The risk-free interest rate is approximated using the interest rate of a one-month Treasury bill[79]. We regard this interest rate as roughly risk-free, due to its short time to maturity. However, since the rate of interest of the Treasury bill is expressed on a yearly basis, we used the following model to obtain the monthly rate of interest:

$$r_f = \left(1 + r_f'\right)^{\left(\frac{1}{12}\right)} - 1$$

where r_f equals the monthly rate of interest and r_f' is the yearly rate of interest.

[79]Riksbanken´s homepage

Chapter 4

Analysis and Results

In this chapter the results of the study are analysed and discussed as well as the validity of the results. Instead of presenting the analysis part and results part separately we have chosen to integrate them in order to make it easier to comprehend.

4.1 Explanatory variables

The two Fama French variables, SMB and HML, as well as the market risk premium that are the explanatory variables in our regressions, have been calculated on a monthly basis. A total of 58 values for each variable have been derived. In table 1 the average of the explanatory variables are presented. It is worth noticing that when estimating the average of the variables and including the 2007 portfolios, the HML variable obtains a negative value. This means that on average during the period companies with a high BE/ME ratio tend to achieve a lower return than companies with a low BE/ME ratio. This result contradicts the Fama and French theory that value stocks, stocks with a high BE/ME ratio, should outperform growth stocks, stocks with a low BE/ME ratio. However, when the 2007 portfolios are excluded from the HML estimation, the variable achieves a positive value. Positive values for the explanatory variables indicates that during the period small companies, and companies with high BE/ME ratio, will on average yield a higher return than large companies and companies with low BE/ME ratio.

%	Rm - Rf	SMB	HML
Average	0,01198	0,01135	-0,0029
Average excluding 2007	0,02371	0,00804	0,0012
Number of observations	58	58	58

Table 1. Number of observations and average values for the explanatory variables in the regression

E(Rit) - Rft = a + b[E(Rmt) - Rft] + stSMBt + htHMLt

4.2 Results of the regressions for the FF3FM

For each of the sixteen dependent portfolios a regression analysis has been conducted in compliance with the model: Rit - $Rft = a + bi$[Rmt-Rft] + siSMBt)+ hiHMLt + εit

In table 2 the intercept and its related p-values, the coefficients for the explanatory variables as well as the value of the adjusted r-squared are presented for the period of 2005 - 2009.

	α	P-value	Rm-Rf β	SMB β	HML β	Adjusted R^2
S_L	-0,0011	0,8691	1,2328	0,5455	-0,6905	0,7653
S_2	0,0048	0,3638	1,0002	0,3996	-0,5813	0,7606
S_3	-0,0052	0,7145	0,7368	1,9239	0,2137	0,4141
S_H	-0,0005	0,9084	0,9920	0,2728	0,6117	0,8446
2_L	-0,0344	0,0058	1,2213	0,0711	-0,2106	0,4490
2_2	-0,0012	0,7729	1,0778	0,2186	-0,2024	0,8580
2_3	-0,0099	0,1927	1,3356	0,4869	0,2402	0,7595
2_H	-0,0017	0,7800	0,7883	-0,0448	0,7299	0,6952
3_L	0,0014	0,7969	1,0353	-0,3707	-0,3915	0,7167
3_2	-0,0014	0,8018	1,1092	-0,3366	-0,1850	0,7573
3_3	0,0094	0,0960	1,0505	-0,2389	0,1151	0,7641
3_H	0,0014	0,7487	0,9437	-0,4266	0,4049	0,8352
B_L	0,0092	0,0395	0,8072	-0,7401	-0,3823	0,7338
B_2	0,0070	0,0601	1,0479	-0,7813	-0,0397	0,8843
B_3	0,0033	0,4464	0,8962	-0,5708	0,1989	0,8103
B_H	0,0015	0,6976	0,9418	-0,4627	0,2020	0,8535

Table 2. Intercept & p-values, coefficients, adjusted R^2 according to the model

Rit - Rft = a + bi[Rmt-Rft] + siSMBt)+ hiHMLt + εit

The fact that α is positively significant at the 5 % level for two of the portfolios means, that the model underestimates the returns for those portfolios, 2_L and B_L. If the intercept had been negatively significant, the model would have overestimated the return of the portfolio in question.

To measure the level of explanation we use the adjusted R^2. The reason for doing this is because we are comparing the level of explanation for two models with different number of explanatory variables. The value of the unadjusted R^2 will always increase as the number of variables increase, while the adjusted R^2 takes the loss of degrees of freedom related to adding extra variables into consideration[80]. The value of the adjusted R^2 in the regressions above lies between 41 % and 88 %.

[80] Brooks (2008)

In addition to the regression analysis for the period 2005 – 2009 we also conducted a regression analysis for each independent year. The results of these regressions are presented in table 3 to 7.

	α	P-value	Rm-Rf β	SMB β	HML β	Adjusted R^2
S_L	-0,0296	0,1636	1,7890	-0,3237	-0,9929	0,6671
S_2	-0,0001	0,9969	1,1935	1,1837	-0,4352	0,7423
S_3	0,0060	0,8008	1,1408	0,2669	-0,5244	0,9261
S_H	-0,0299	0,0431	1,2035	0,0999	0,5600	0,7899
2_L	-0,0127	0,5750	0,8698	1,0239	-0,8800	0,4264
2_2	0,0030	0,7497	0,7489	0,4804	0,0320	0,7403
2_3	0,0059	0,3254	0,7065	0,2681	0,5088	0,9261
2_H	-0,0233	0,1611	0,7111	0,2599	1,1908	0,7899
3_L	0,0190	0,3153	0,9975	-1,6199	-0,0970	0,5373
3_2	0,0059	0,4051	0,8534	-0,7842	-0,7556	0,8040
3_3	0,0533	0,0119	1,2165	-1,5221	-0,1261	0,6486
3_H	-0,0090	0,3462	1,1590	-0,3370	0,4879	0,9027
B_L	0,0029	0,7305	0,7959	-0,6396	0,0240	0,7790
B_2	-0,0012	0,8819	1,0307	-0,2201	0,1348	0,8756
B_3	-0,0193	0,0286	0,8595	0,2929	0,0252	0,8486
B_H	-0,0199	0,0362	1,1538	-0,2886	-0,0748	0,7899

Table 3. Intercept & p-values, coefficients, adjusted R^2 for 2005 portfolios according to the model
$R_{it} - R_{ft} = a + b_i[R_{mt}-R_{ft}] + s_iSMB_t) + h_iHML_t + \varepsilon_{it}$

At the 5% level the model underestimates the returns for portfolios S_H, 3_3, B_3 and B_H. The value of the adjusted R^2 lies between 43 % and 93 %.

	α	P-value	Rm-Rf β	SMB β	HML β	Adjusted R²
S_L	0,0135	0,2543	1,2096	1,6965	-0,2228	0,8785
S_2	0,0103	0,5316	1,5024	-0,4546	-0,0987	0,6050
S_3	-0,0031	0,7845	0,7738	0,2774	-0,6690	0,6466
S_H	-0,0046	0,6998	1,3870	-0,1921	0,3448	0,7411
2_L	-0,0041	0,7218	0,9928	0,4628	-0,1619	0,6938
2_2	-0,0053	0,6219	1,0904	-0,1466	-0,5733	0,7148
2_3	-0,0018	0,9044	0,5799	0,5846	-0,0073	0,3199
2_H	-0,0049	0,4961	0,8980	1,0543	0,9057	0,8921
3_L	-0,0029	0,8406	0,8145	0,2606	-0,4004	0,4502
3_2	-0,0087	0,3862	1,0837	0,4046	1,1018	0,8080
3_3	0,0035	0,7834	1,0494	-0,8452	0,0969	0,5049
3_H	-0,0007	0,8177	0,9241	0,0327	0,3403	0,9542
B_L	0,0162	0,0430	0,6537	-0,6366	-0,5284	0,6302
B_2	0,0066	0,5260	1,2964	-1,2300	-0,5570	0,7337
B_3	0,0024	0,6206	0,9611	-0,5503	0,1124	0,8786
B_H	0,0016	0,7352	0,7763	-0,0934	0,2549	0,8608

Table 4. Intercept & p-values, coefficients, adjusted R² for 2006 portfolios according to the model

Rit - Rft = a + bi[Rmt-Rft] + siSMBt)+ hiHMLt + εit

For the 2006 portfolios only one α is positively significant at the 5 % level, B_L, and is therefore underestimated. The adjusted R² lies between 31 % and 95 %.

	α	P-value	Rm-Rf β	SMB β	HML β	Adjusted R²
S_L	-0,0028	0,8978	1,2383	-0,1388	-0,5946	0,6944
S_2	0,0157	0,2288	0,9290	-0,5266	-0,4180	0,8295
S_3	-0,0616	0,3613	0,1272	6,6836	0,6110	0,7351
S_H	0,0027	0,7673	0,6734	0,1859	0,1170	0,7592
2_L	-0,1777	0,0000	0,9073	-0,3027	-0,5766	0,8408
2_2	0,0108	0,6258	1,1252	-0,0043	-0,4210	0,6212
2_3	0,0180	0,4164	1,4195	-0,1749	0,9970	0,7137
2_H	0,0139	0,4390	1,2065	0,0010	0,6146	0,7243
3_L	0,0265	0,2338	0,8830	-0,3338	-0,2393	0,5283
3_2	0,0281	0,2349	1,6889	-0,2548	0,6658	0,7734
3_3	0,0329	0,1578	1,1285	-0,1467	1,2547	0,6005
3_H	0,0084	0,6130	1,1096	-0,2049	0,4867	0,7318
B_L	-0,0108	0,6800	0,4429	-0,8276	-1,6367	0,4211
B_2	0,0099	0,4510	1,0687	-0,7268	0,0473	0,8561
B_3	0,0153	0,0942	1,1728	-0,4551	0,5020	0,9350
B_H	0,0049	0,7480	0,6068	-1,1554	-0,3568	0,7569

Table 5. Intercept & p-values, coefficients, adjusted R² for 2007 portfolios according to the model

Rit - Rft = a + bi[Rmt-Rft] + siSMBt)+ hiHMLt + εit

For the 2007 portfolios, which covers the financial crisis, only two α is positively significant at the 5 % level, 2_L and B_3. The adjusted R² value lies between 42 % and 93 %.

	α	P-value	Rm-Rf β	SMB β	HML β	Adjusted R^2
S_L	0,0172	0,2248	1,0596	0,9125	-0,5992	0,9061
S_2	-0,0113	0,1171	0,8498	0,6670	-0,4830	0,9616
S_3	-0,0061	0,4294	1,3663	0,8043	-0,2647	0,9789
S_H	-0,0040	0,7741	1,1379	0,0793	0,3743	0,8997
2_L	-0,0043	0,7585	0,6154	0,5330	0,4099	0,7725
2_2	-0,0071	0,2756	1,0014	0,5119	0,5147	0,9763
2_3	0,0043	0,8889	1,4911	0,8728	0,3920	0,7766
2_H	0,0093	0,6875	0,7508	-0,3702	0,4108	0,5589
3_L	-0,0055	0,5219	1,2966	-0,6558	-0,6937	0,9567
3_2	-0,0087	0,5742	0,9239	0,0017	0,5038	0,8332
3_3	0,0005	0,9716	1,0291	-0,0042	0,3002	0,8703
3_H	-0,0053	0,5089	0,7717	-0,2540	0,6511	0,9373
B_L	0,0033	0,7394	1,0180	-1,0008	-1,0513	0,8976
B_2	0,0108	0,4297	1,0080	-0,7921	0,1101	0,8732
B_3	0,0022	0,8907	0,8511	-0,6376	0,0285	0,7633
B_H	-0,0009	0,9430	1,0201	-0,4318	0,1807	0,8875

Table 6. Intercept & p-values, coefficients, adjusted R^2 for 2008 portfolios according to the model

$$R_{it} - R_{ft} = a + b_i[R_{mt}-R_{ft}] + s_iSMB_t) + h_iHML_t + \varepsilon_{it}$$

It is worth noticing that α is not positively significant at the 5 % level for any of the 2008 portfolios. Hence, the model neither overestimates nor underestimates the portfolio returns for the period following the financial crisis of 2007. The value of the adjusted R^2 lies between 56 % and 98 %.

	α	P-value	Rm-Rf β	SMB β	HML β	Adjusted R²
S_L	-0,0228	0,2379	1,6320	-0,0694	-1,1602	0,5901
S_2	-0,0007	0,9456	0,7940	0,6370	-0,8738	0,8427
S_3	0,0030	0,8835	0,4000	0,4913	0,3767	0,2922
S_H	0,0218	0,0604	0,5116	0,8597	0,9385	0,9203
2_L	0,0347	0,2513	0,6163	0,5039	-0,0787	-0,0689
2_2	-0,0024	0,9000	1,4204	0,1681	-0,5361	0,4782
2_3	0,0021	0,9075	1,1820	0,2558	0,2167	0,6711
2_H	-0,0224	0,1792	1,4811	0,2547	0,2074	0,8079
3_L	0,0041	0,7808	0,7970	0,2612	-0,5008	0,3390
3_2	-0,0026	0,9063	1,4104	-0,3853	-0,4782	0,3685
3_3	-0,0133	0,2878	1,2302	-0,2731	0,0141	0,7919
3_H	-0,0326	0,3010	2,2591	-1,3812	-0,4300	0,6333
B_L	0,0103	0,3797	0,6695	-0,8116	-0,2100	0,6645
B_2	0,0044	0,7644	1,0131	-0,8797	-0,0220	0,7194
B_3	0,0139	0,5999	0,8120	-0,7411	0,6567	0,5734
B_H	0,0061	0,5946	0,6773	-0,3769	0,6990	0,8716

Table 7. Intercept & p-values, coefficients, adjusted R² for 2009 portfolios according to the model

Rit - Rft = a + bi[Rmt-Rft] + siSMBt)+ hiHMLt + εit

Just as for the 2008 portfolios neither one of the α:s are positively significant at the 5 % level for the 2009 portfolios. The adjusted R² value lies between 29 % and 92 %. Here we actually get an anomaly in the form of a single negative R² value -7% for one of the portfolios.

Since the value of the adjusted R² were as low as 41 % for the period 2005 – 2009, we redid the regression but this time we excluded the 2007 portfolios.

	α	P-value	Rm-Rf β	SMB β	HML β	Adjusted R^2
S_L	0,0029	0,6961	1,1446	0,7324	-0,6459	0,7626
S_2	0,0050	0,4040	0,9481	0,6059	-0,5280	0,7713
S_3	-0,0123	0,0604	1,2539	0,6437	-0,3652	0,8316
S_H	-0,0081	0,1350	1,1036	0,1998	0,6088	0,8704
2_L	0,0071	0,3263	0,7970	0,3822	-0,3265	0,5966
2_2	-0,0047	0,2749	1,0860	0,2601	-0,1444	0,8839
2_3	-0,0108	0,2371	1,3058	0,6385	0,2588	0,7467
2_H	-0,0022	0,7700	0,7260	0,0132	0,8301	0,6686
3_L	-1,0087	0,0000	1,1680	-0,4689	-0,4179	0,7786
3_2	0,0010	0,8780	1,0192	-0,2583	-0,1389	0,7304
3_3	0,0088	0,1796	1,0812	-0,2710	0,0323	0,7575
3_H	0,0008	0,8733	0,9408	-0,4564	0,4169	0,8223
B_L	0,0043	0,2714	0,8781	-0,7906	-0,3400	0,8384
B_2	0,0065	0,1455	1,0552	-0,7950	-0,0459	0,8656
B_3	0,0043	0,4390	0,8581	-0,5512	0,2230	0,7622
B_H	-0,0042	0,2914	0,9922	-0,3820	0,2502	0,8909

Table 8. Intercept & p-values, coefficients, adjusted R^2 for 2005-2009 portfolios (excluding the 2007 portfolios) according to the model Rit - Rft = a + bi[Rmt-Rft] + siSMBt)+ hiHMLt + εit

There are still two portfolios where α is positively significant at the 5 % level, S_3 and 3_L. Furthermore, the adjusted R^2 has increased to lie between 60 % and 89 %. The result shows that when excluding the portfolios covering the financial crisis, the Fama French traditional three factor model succeeds to a large extent in explaining the variation of the return for the sixteen portfolios. Without the crisis portfolio, the FF3FM seems to work relatively well for the Swedish market.

4.3 Results of the regressions for the CAPM

Since part of our research is to test whether or not the FF3FM outperforms the CAPM on the Swedish market, we conducted a regression analysis for each of the sixteen dependent portfolios in compliance with the model: *Rit* - *Rft* = *a* + *bi*[Rmt-Rft]

The intercept and its related p-values, the coefficient for the explanatory variable as well as the value of the adjusted r-squared are presented for the period of 2005 – 2009 in table 9.

	α	P-value	Rm-Rf β	Adjusted R^2
S_L	0,0084	0,2728	1,1273	0,6374
S_2	0,0121	0,0532	0,9079	0,6367
S_3	0,0141	0,3851	0,8935	0,1873
S_H	-0,0009	0,8633	1,1303	0,8005
2_L	-0,0325	0,0056	1,1835	0,4637
2_2	0,0022	0,5915	1,0504	0,8390
2_3	-0,0060	0,4210	1,4124	0,7460
2_H	-0,0061	0,3646	0,9314	0,6107
3_L	-1,0014	0,0000	0,9385	0,6907
3_2	-0,0040	0,4668	1,0523	0,7466
3_3	0,0062	0,2528	1,0593	0,7559
3_H	-0,0053	0,3136	0,9993	0,7482
B_L	0,0033	0,5292	0,6870	0,5748
B_2	-0,0011	0,8207	0,9937	0,7590
B_3	-0,0038	0,4669	0,9020	0,7090
B_H	-0,0045	0,3233	0,9547	0,7828

Table 9. Intercept & p-values, coefficients, adjusted R^2 for 2005-2009 CAPM portfolios according to the model Rit - Rft = a + bi[Rmt-Rft]

For the CAPM portfolios there are three portfolios where α is positively significant at the 5 % level, S_2, 2_L and 3_L. The adjusted R^2 lies between 18 % and 83 %, which is well below the FF3FM values (41 % - 88 %). Just as we did for the FF3FM regression, we excluded the 2007 portfolios and redid the regression; the results are presented in table 9.

	α	P-value	Rm-Rf β	Adjusted R^2
S_L	0,0110	0,2607	1,0848	0,5805
S_2	0,0117	0,1437	0,9001	0,5892
S_3	-0,0060	0,4486	1,2444	0,7363
S_H	-0,0089	0,1413	1,2542	0,8313
2_L	0,0113	0,1468	0,7681	0,5228
2_2	-0,0022	0,6337	1,0829	0,8635
2_3	-0,0070	0,4572	1,4285	0,7223
2_H	-0,0053	0,5365	0,9039	0,5549
3_L	-1,0107	0,0000	1,0294	0,7413
3_2	-0,0005	0,9387	0,8575	0,7294
3_3	0,0066	0,3070	1,0593	0,7522
3_H	-0,0042	0,5170	0,9811	0,7148
B_L	-0,0005	0,9345	0,7221	0,6510
B_2	-0,0005	0,9345	0,9612	0,7287
B_3	-0,0008	0,9033	0,8471	0,6511
B_H	-0,0080	0,1017	1,0049	0,8276

Table 10. Intercept & p-values, coefficients, adjusted R^2 for 2005-2009 CAPM portfolios (excluding the 2007 portfolios) according to the model Rit - Rft = a + bi[Rmt-Rft]

There still remains one portfolio where α is positively significant at the 5 % level. Furthermore, the level of explanation has increased to a minimum of 52 % and a maximum of 86 %. However, it is still below the values obtained by the FF3FM (60 % - 89 %).

When we analyse the results they reveal that the FF3FM do have some difficulties achieving optimal outcomes for the Swedish market. This is shown by the lowest adjusted R^2 value being only 41 %, and by the wide spread between the lowest and highest value, for both the individual years and for the period as a whole. In addition, the results reveal that several α:s are positively significant at the 5 % level, leading to underestimations of the portfolio returns.

However, when removing the portfolios that stretch over the period of the 2007 financial crisis, the adjusted R^2 values largely improves. This reveals that the FF3FM does in fact, to a great extent, work for the Swedish market given certain conditions. The increase also reveals that the FF3FM performs less effective when the market conditions are unstable. This is further supported by the HML variable, assuming a negative value when the 2007 portfolios are included in the regression and assuming a positive value when they are excluded.

Despite this, the FF3FM still outperforms the CAPM on the Swedish market regardless if the market conditions are stable or not.

4.4 Validity of the results

4.4.1 Multicollinearity

Multicollinearity is another factor that might affect our results, because if our variables are highly correlated, small changes in the data might lead to erratic changes in the coefficient estimates. The results of the test for multicollinearity are presented in tables 10 and 11, and since none of the correlations exceed 0.5 we can conclude that multicollinearity does not cause a problem in our study.

Including 2007	*Rm-Rf*	*SMB*	*HML*
Rm-Rf	1		
SMB	-0,0131	1,0000	
HML	-0,3676	0,0264	1

Table 11. Correlation between the explanatory variables (including the 2007 portfolios) in the regression
Rit - Rft = a + bi[Rmt-Rft] + siSMBt)+ hiHMLt + εit

Excluding 2007	*Rm-Rf*	*SMB*	*HML*
Rm-Rf	1		
SMB	0,3610	1,0000	
HML	-0,2684	-0,2326	1

Table 12. Correlation between the explanatory variables (excluding the 2007 portfolios) in the regression
Rit - Rft = a + bi[Rmt-Rft] + siSMBt)+ hiHMLt + εit

Chapter 5

Conclusion

This chapter presents the conclusions of our study and gives suggestions of future research possibilities.

5.1 Conclusions

The Fama and French Three-Factor Model is found to outperform the CAPM on the Swedish market. FF3FM gives higher explanatory power of the returns than the CAPM in two market conditions; for the whole sample period of 2005-2010 and for the whole time period of 2005-2010, with the period of July 2007 to June 2008 excluded. In the latter setting a time period characterized by economic downturn and financial turmoil is excluded and the explanatory power increases substantially for both models. With the 2007-2008 period included the risk premium of the book-to-market factor, HML, is negative. This means that low BE/ME companies outperform high BE/ME companies in our full sample period, in contrast to what is expected by the FF3FM. Furthermore, the R^2 values contain a wide spread from the lowest to the highest value when the downturn period is included. With the 2007-2008 period excluded the HML risk premium is positive and the spread of the R^2 values decreases. Consequently the FF3FM did not work well in a time of crisis in the Swedish market. The FF3FM is found to be a good estimator of the cost of equity on the Swedish market during our time period. We would recommend using the FF3FM over the CAPM for estimation of the cost of equity on the Swedish market.

5.2 Future research

For future studies it might be interesting to incorporate the companies on the Swedish Small Cap list, in order to analyse how the FF3FM performs for the entire Swedish market. Furthermore, future studies can be performed on single industries in Sweden in order to evaluate if the FF3FM performs well for all industries or if there are some industries, where it might struggle. It can also be interesting to add the momentum factor from the Carhart Four Factor Model and analyse how it affects the level of explanation.

In addition, for future studies it may be tested if changing the different parameters of the HML variable, for instance set the parameters to 20-60-20, and examine if this might improve the level of explanation of the model.

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- Active Biotech AB
- Addtech AB
- Alfa Laval AB
- ASSA ABLOY AB
- AstraZeneca PLC
- Atlas Copco AB
- Atrium Ljungberg
- Autoliv Inc. SDB
- Avanza Bank Holding AB
- Axfood AB
- Axis AB
- B&B TOOLS AB
- Beijer AB, G&L
- Beijer Alma AB
- Betsson AB
- Billerud AB
- BioInvent International
- Boliden AB
- Brinova Fastigheter
- Bure Equity AB
- Cardo AB
- Castellum AB
- Clas Ohlson AB
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- Eniro AB
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- Fast Partner AB
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- Hexagon AB
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- Holmen AB
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- Kungsleden AB
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- Lundin Mining Corporation SDB
- Lundin Petroleum AB
- Meda AB
- Mekonomen AB
- Millicom Int. Cellular SDB
- Modern Times Group
- Munters AB
- NCC AB
- Neonet AB
- Net Insight AB
- New Wave Group AB
- NIBE Industrier
- Nobia AB
- Nordea Bank AB
- Nordnet AB
- Orc Software AB
- Oriflame, SDB
- Peab AB
- Q-Med AB
- Ratos AB
- SAAB AB
- Sandvik AB
- SAS AB
- SCA
- SCANIA AB
- SEB
- Seco Tools AB
- SECTRA AB
- Securitas AB
- Skanska AB
- SKF, AB
- SkiStar AB
- SSAB AB
- Stora Enso Oyj
- Sv. Handelsbanken
- SWECO AB
- Swedbank AB
- Swedish Match AB
- Säkl AB
- Tele2 AB
- TeliaSonera AB
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- Modern Times Group
- Munters AB
- NCC AB
- Neonet AB
- Net Insight AB
- New Wave Group AB
- NIBE Industrier
- Nobia AB
- Nordea Bank AB
- Nordnet AB
- Orc Software AB
- Oriflame, SDB
- PA Resources
- Peab AB
- Q-Med AB
- Ratos AB
- SAAB AB
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- SCA
- SCANIA AB
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- Seco Tools AB
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- Sv. Handelsbanken
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- Swedish Match AB
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- TeliaSonera AB
- Tieto Corporation
- TradeDoubler AB
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- Trelleborg AB
- Unibet Group plc
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- VBG Group AB
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2007

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- SAS AB
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- SCANIA AB
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