Estimation of Expected Return: The Fama and French Three-Factor Model Vs. The Chen, Novy-Marx and Zhang Three-Factor Model

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Abstract

The study examines the adequacy of the measurement of the cross-section of expected stock returns on the London Stock Exchange of the recent three-factor model introduced by Chen, Novy-Marx and Zhang against that of the Fama and French three-factor model. The former model use factors in addition to the market factor based on profitability and investment while the latter model use factors based on size and book-to-market equity. The models are tested together with the CAPM on a number of anomalies based trading strategies. It is found that the three-factor models consistently outperforms the CAPM and that the model by Chen, Novy-Marx and Zhang in general is not able to outperform the Fama and French three-factor model during the time period tested on the London Stock Exchange.

Keywords: Fama and French Three-Factor Model, CAPM, Asset pricing, Anomalies, Cost of Equity, Chen, Novy-Marx and Zhang.

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Chapter 1
Introduction

This first chapter introduces the background of the dissertation. In addition, the chapter contains the problem discussion and purpose of the thesis. Furthermore, it describes the limitations of the study, the outline of the thesis as well as the definitions of specific terms.

1.1 Background

Estimating expected stock returns and calculating the cost of equity lies at the heart of several financial and economic decisions, ranging from estimating expected returns for asset allocation and evaluate mutual fund performance to decisions regarding capital budgeting and stock valuation.[1] Making the correct decisions will greatly impact the future value of a company or the future performance of a portfolio of assets. Therefore, over the years several different models have been created to estimate, as accurately as possible, these variables in order to facilitate the complex decision making process for managers and investors alike.

One of the earlier models called the Capital Asset Pricing Model (hereafter CAPM) was developed in the 1960s, individually by Jack Treynor[2], William Sharpe[3], John Lintner[4] and Jan Mossin[5].

$$E(R_i) = R_f + \beta_i E\left(R_m - R_f\right)$$

The equation is explained in the theory section

However, the model has since then been the focus of a great deal of criticism, among the earliest were Roll in 1977[6], Ross in 1976[7] and Roll and Ross in 1980[8]. In 1977 Roll[9] stated, which has come to be known as Roll's critique, that it is not possible to test the CAPM; a statement based on two main points regarding the market portfolio. The first point is that the

[1] Chen, Novy-Marx & Zhang (2011)
[2] Treynor (1961) (1962)
[3] Sharpe (1964)
[4] Lintner (1965)
[5] Mossin (1966)
[6] Roll (1977)
[7] Ross (1976)
[8] Roll & Ross (1980)
[9] Roll (1977)

CAPM's validity is comparable to the market, with respect to all investment opportunities, being mean-variance efficient, or in other words the assumption that the CAPM equation holds is equal to the market portfolio being mean-variance efficient. The second point is that the true market portfolio is unknown since the true market portfolio would need to include all available traded and non-traded assets e.g. commodities, human capital, real estate, basically everything with any sort of value. Hence, the model is not testable unless the market portfolio's true composition is known, in other words all investment opportunities (assets) are observable and included in the market portfolio.

A year earlier Ross[10] published a solution to Roll's critique, called the arbitrage pricing theory (APT). The benefits of the APT are that it holds in disequilibrium and not only in equilibrium situations and it allows for more than one explanatory factor. Furthermore, there is no obligation, unlike in CAPM, for the market portfolio to be mean-variance efficient and therefore the market portfolio is of little consequence for the APT.[11] In 1980 Roll and Ross[12] published a research paper in which they empirically tested the APT. Based on the result of past empirical work, which had concluded that there might exists several factors in the processes of generating asset returns, they investigated whether those factors exist and if they are associated with a risk premium. With their basic test on expected returns on equities traded on the New York and American Exchanges, the authors identified that definitely three, possibly four, factors are present and carry a risk premium or a price as the authors refer to it[13]. The presence of more than just one factor casts doubt on the CAPM's ability to explain asset returns, being a one factor model, as well as the validity of its results.

Furthermore in 1995, Jagannathan and McGrattan argued that a large portion of the required rate of return that the investors have on a company cannot be explained by the CAPM[14]. In addition to Roll, Bartholdy and Peare also argue that since the world market portfolio is not observable it is not even possible to estimate the CAPM[15]. In addition, Friend and Blume argued that the CAPM estimates the cost of equity for low-beta stocks too low, and the estimates for high-beta stocks are too high; a result from empirical work which states that the

[10] Ross (1976)
[11] Ross (1976)
[12] Roll & Ross (1980)
[13] Roll & Ross (1980)
[14] Jagannathan & McGrattan (1995)
[15] Bartholdy & Peare (2005)

relation between average return and beta is flatter than predicted by the model[16]. According to Jagannathan and McGrattan the poor empirical record of the model[17] might be the result of too many simplifying assumptions, hence theoretical failings of the model[18]. Further, Banz stated that there is a size effect on returns because low market-value stocks earned a higher return than was predicted by the CAPM[19]. In the early part of the 90's Eugene Fama and Kenneth French, who are among the loudest critics of the CAPM, argued that the market beta alone is not enough to explain expected returns[20] Fama and French found that small stocks and value stocks, stocks with high book-to-market equity ratios (BE/ME), have high average returns compared to big stocks and growth stocks, stocks with low book-to-market equity ratios, that are not being captured by their market beta's[21].

In a response to the limitations of the CAPM, Fama and French presented their model in 1993 called the Fama French Three Factor-Model (hereafter called FF3). The model included two additional explanatory variables, beside the explanatory variable of the overall market factor of the CAPM, the two factors relate to firm size and book-to-market value of equity[22].

$$E(R_i) - R_f = \beta_m^i E(R_m - R_f) + \beta_{SMB}^i E(SMB) + \beta_{HML}^i E(HML)$$

The equation is explained in the theory section

By expanding the CAPM with these two additional factors the model´s level of explanation increased considerably[23].

However, as with the CAPM the FF3 has been the target of criticism from for instance Lakonishok, Shleifer and Vishny and Haugen who argue that due to systematic overreaction by investors to corporate news; the subsequent unrealistic predictions of possible future high or low growth, and the size and book to-market equity effects are due to the overreaction rather than compensation for risk bearing. The overreaction will lead to underpricing of value stocks and overpricing of growth stocks.[24] Furthermore, Berk states that companies with small market capitalization will due to mispricing or economic risk by construction earn higher

16 Friend & Blume (1970)
17 Fama & French (2004)
18 Jagannathan & McGrattan (1995)
19 Banz (1981)
20 Fama & French (1992)
21 Fama & French (1992)
22 Fama & French (1993)
23 Fama & French (1992)
24 Lakonishok, Shleifer & Vishny (1994) Haugen (1995)

mean returns.[25] In addition, in a study by Ferson and Harvey the authors find that the FF3 fails to explain conditional expected returns[26] and Griffin and Lemmon find that the explanatory power of BE/ME is more consistent with mispricing explanations and is inconsistent with a distress risk interpretation[27].

In 2011 Chen, Novy-Marx and Zhang published an alternative three-factor model (hereafter CNMZ) in a response to past research showing that the FF3 cannot explain several capital market anomalies[28]. The model has two variables in addition to the CAPM market variable; one variable based on investment and one variable based on profitability. The authors argue that this model adds explanatory power superior to that of the FF3[29].

$$E(R_i) - R_f = \beta^i_{MKT}E(MKT) + \beta^i_{INV}E(INV) + \beta^i_{ROE}E(ROE)$$

The equation is explained in the theory section

1.2 Problem discussion

The CAPM have been found unable to explain asset pricing anomalies. As has been described previously there has been much literature written on the limitations of the CAPM, further examples of this include DeBondt and Thaler, Rosenberg, Reid and Lanstein, Fama and French, Lakonishok, Shleifer and Vishny, and Jegadeesh and Titman. DeBondt and Thaler[30] state that returns show covariance with P/E and prior returns; recent losers outperform winners, and the authors notice abnormal returns in January each year, the well-known phenomenon “January effects”. Rosenberg, Reid and Lanstein[31] detected abnormal returns using two strategies based on book-to-market and investing in prior losers. Fama and French[32] [33] show that stocks with low book-to-market, value stocks, outperforms stocks with high book-to-market, growth stocks, and that the returns of smaller companies outperform the returns of larger companies. Lakonishok, Shleifer and Vishny[34] have found that average returns show covariance with earnings-to-price and cash flow-to-price. Jegadeesh and Titman[35] demonstrate that recent winners, on average, keep earning higher returns.

25 Berk (1995)
26 Ferson & Harvey (1999)
27 Griffin & Lemmon (2001)
28 Chen, Novy-Marx & Zhang (2011)
29 Chen, Novy-Marx & Zhang (2011)
30 DeBondt, & Thaler (1985)
31 Rosenberg, Reid & Lanstein (1985)
32 Fama & French (1993)
33 Fama & French (1992)
34 Lakonishok, Shleifer & Vishny (1994)
35 Jegadeesh, Narasin & Titman (1993)

Considering the findings of this literature it is clear that there exists a wide range of anomalies on the market which makes it desirable to find a model that is able to explain as much as possible of the mentioned asset pricing anomalies, in order to get a correct estimation of the cost of equity. Given the arguments of superiority over the FF3 and the positive empirical results supporting these arguments in Chen, Novy-Marx and Zhang[36] may the CNMZ be the answer?

1.3 Purpose

The purpose of this thesis is to find out if the Chen, Novy-Marx and Zhang Three-Factor Model is valid and if it manages to outperform the Fama and French Three-Factor Model.

1.4 Limitations

We limit our research to a market outside the US stock markets since we want to test the adequacy of the measurement of the cross-section of expected stock returns on a market different than the one researched in Chen, Novy-Marx and Zhang. This is done in order to see if the CNMZ model is valid on and outperforms the FF3 on other markets as well. The market we study is the London Stock Exchange and more specifically the FTSE All Share Index, since it represents 98-99% of the UK's market capitalization and is "considered to be the best performance measure of the overall London equity market" and "regular index reviews are conducted to ensure that a continuous and accurate representation of the market is maintained"[37]. It will therefore reduce the risk of data errors. In order to conform to the FF3 and CNMZ, financial companies and companies with negative book value of equity are excluded from the sample. Financial companies include insurance and real estate companies and are the companies with SIC-codes 6000-6799. In addition our time period is limited to approximately 9 years, July 2002 to March 2011. The reason for this limitation is the accessibility to accurate and reliable quarterly data from Datastream.

[36] Chen, Novy-Marx & Zhang (2011)
[37] FTSE All-Share Index Fact Sheet p.1

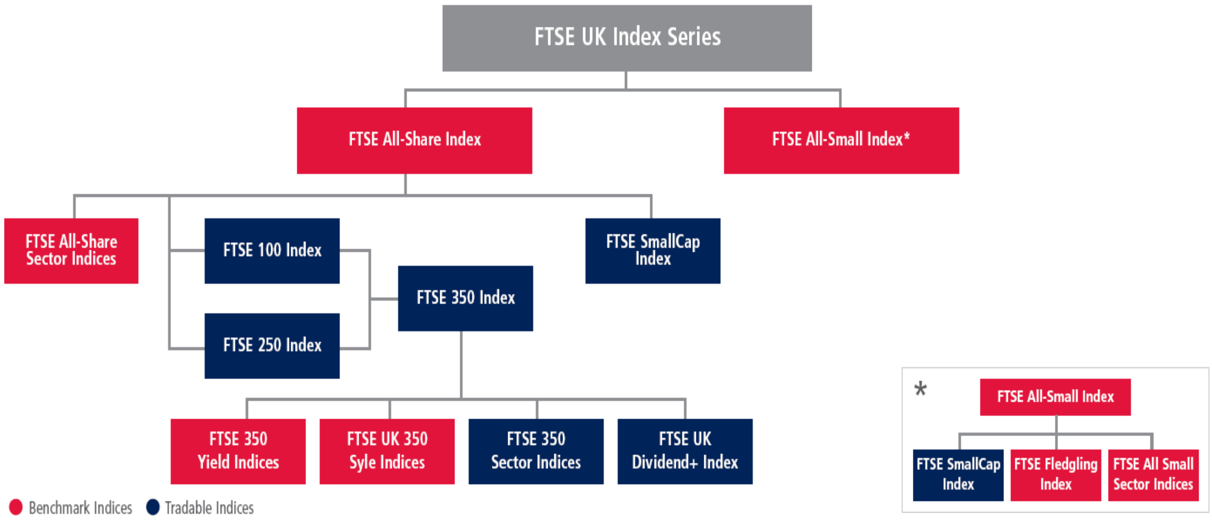

Figure 1: FTSE UK Index Series Family Tree. Source: FTSE All-Share Index Fact Sheet

1.5 Outline

The dissertation has the following outline.

Chapter 2

This chapter explains the theory of the different models used in the study. The procedure of obtaining the variables and constructing and testing the models in the original articles are presented. Furthermore, it also briefly reviews some previous research in asset pricing.

Chapter 3

The method of how the study is conducted is presented in this chapter, from the selection and data collection to the obtainment of the models´ variables, the construction of the different portfolios and finally description of the different tests conducted in the study.

Chapter 4

In this chapter the results of the study are presented and analysed as well as the validity and reliability of the study.

Chapter 5

The 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.

Financial companies are companies with the SIC-codes 6000-6799.

Growth stocks are stocks with low book-to-market equity.

Value stocks are stocks with high book-to-market equity.

Chapter 2

Theoretical Background

In this chapter the theories of the different models used in the study are presented as well as how both their dependent- and explanatory variables are created and estimated. In addition, the chapter also briefly presents some of the previous researches that are similar to this study.

2.1 Cost of Equity

The cost of equity is the expected return that shareholders of a firm demand[38]. The required return is a premium for holding a risky asset and the return is demanded to be superior to the return obtained by investing in the risk free asset[39].

2.2 The Capital Asset Pricing Model (CAPM)

Since the models of main interest in this study are the FF3 and the CNMZ only a brief description of the CAPM will be given below, for more detailed description see for instance Copeland, Weston, and Shastri[40]. Markowitz showed that an investor optimally should hold a portfolio with the highest expected return given a certain level of variance, a mean-variance efficient portfolio[41]. The CAPM builds on to this and showed that the market portfolio, which is the value-weighted portfolio of all existing assets in the world, can be a mean-variance efficient portfolio[42]. Some assumptions are necessary for this to be the case[43]:

- Investors are risk averse
- Investors have homogenous expectations
- There is a risk-free asset in which investors can borrow or lend without any limit
- There exists a fixed quantity of assets and all assets are marketable
- All investors share the same information and markets are frictionless
- Market imperfections such as taxes are absent

[38] Ogden, Jen & O'Connor (2003)
[39] Ogden, Jen & O'Connor (2003)
[40] Copeland, Weston, & Shastri (2005)
[41] Markowitz (1959)
[42] Copeland, Weston, & Shastri (2005)
[43] Copeland, Weston, & Shastri (2005)

With the CAPM came a measure to quantify and price risk where an asset´s quantity of risk is measured by its covariance with the market divided by the variance of the market, its beta, and the market price of risk is measured by the risk premium[44], see equations below:

Quantity of risk, beta

$$\beta = \frac{COV(R_i, R_m)}{\sigma_m} \text{ (Eq. 1)}$$

where

$COV(R_i, R_m)$ = The covariance of the independent variables R_i and R_m

R_i = Return on asset *i*

R_m = Return on the market

σ_m = The standard deviation of the market

Market price of risk, risk premium

$$[E(R_m) - R_f] \text{ (Eq. 2)}$$

where,

$E(R_m)$ = The expected return on the market

R_f = The risk-free interest rate

To measure the expected excess return of an asset the risk-free rate is added and the whole CAPM equation looks as seen below

$$E(R_i) = R_f + \beta_i[E(R_m - R_f)] \text{ (Eq. 3)}$$

where,

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

R_f = The risk-free interest rate

$E(R_m - R_f)$ = The expected excess return of the market

β_m^i = The coefficient or the beta of the independent variable $R_m - R_f$

Actual returns are obtained by excluding the expectation symbol $E(\,)$ from the equation and including the intercept, time subscripts, and a white noise error term ε:

$$R_{it} - R_{ft} = \alpha + \beta_m^i(R_{mt} - R_{ft}) + \varepsilon_{it} \text{ (Eq. 4)}$$

[44] Copeland, Weston, & Shastri (2005)

2.3 The Fama French Three-Factor Model (FF3)

By expanding the traditional CAPM with two more variables, size (ME) and book-to-market equity (BE/ME), Fama and French discovered that the two variables significantly increased the model's level of explanation and help explain much of the average stock returns[45]. The authors state that this is because those variables account for the underlying risk of stocks[46], the two variables are represented by two portfolios named *small minus big* (SMB) and *high minus low* (HML). The size factor is the market equity (ME) of the company and is defined as the price of the company's stock multiplied with the number of outstanding shares at the end of June of year t[47]. The book-to-market equity (BE/ME) factor is derived by dividing the company's book value of equity (BE) at the end of December year t-1, with its market value of equity (ME) at the end of December year t-1[48]. The three explanatory variables of the FF3; Rm-Rf, SMB and HML, are risk factors that according to the authors catch the non-diversifiable variance of stocks[49]. Fama and French use a sample including all stocks on the New York Stock Exchange (NYSE), and the American Stock Exchange (AMEX) from July 1963-December 1991 and also from 1972 and forward all NASDAQ stocks, financial companies and companies with negative book equity are excluded from the sample[50]. The FF3 equation is expressed like the following:

$$E(R_i) - R_f = \beta_m^i E(R_m - R_f) + \beta_{SMB}^i E(SMB) + \beta_{HML}^i E(HML) \text{ (Eq. 5)}$$

where,

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

R_f = The risk-free interest rate

$E(R_m - R_f) =$ The expected excess return of the market

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

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

β_m^i, β_{SMB}^i and β_{HML}^i = The coefficients or the betas of the three independent variables $R_m - R_f$, SMB and HML. The three different betas are estimated by running time series regressions.

[45] Fama & French (1992)
[46] Fama & French (1992)
[47] Fama & French (1993)
[48] Fama & French (1993)
[49] Fama & French (1993)
[50] Fama & French (1993)

Actual returns are obtained by excluding the expectation symbol $E(\,)$ from the equation and including the intercept, time subscripts, and a white noise error term ε:

$$R_{it} - R_{ft} = \alpha + \beta_m^i(R_{mt} - R_{ft}) + \beta_{SMB}^i R_{SMB_t} + \beta_{HML}^i R_{HML_t} + \varepsilon_{it} \text{ (Eq. 6)}$$

2.4 The Chen, Novy-Marx and Zhang Three-Factor Model (CNMZ)

The CNMZ model expands the CAPM with two additional factors based on investment and profitability[51]. The first additional factor is called INV and builds on the returns of a portfolio including companies with low investments less the returns of a portfolio including companies with high investment, low-minus-high INV. The second additional factor is called ROE and builds on the returns of a portfolio including companies with high return-on-equity less the returns of a portfolio including companies with low return-on-equity, high-minus-low ROE. The authors argue that the INV variable has a similar role as the Fama and French value factor HML[52] in the way that firms with low book-to-market equity, that is a high stock price compared to the book equity, have more growth opportunities than their high book-to-market counterparts and thereby invests more and due to this earn lower expected returns[53]. The INV variable do a good job in explaining the variance of returns with origin in the net stock issues anomaly found by Fama and French[54] and the asset growth anomaly found by Cooper Gulen, and Schill[55], the explanation to this is that firms with high net stock issues and high asset growth invest more and due to this earn lower expected returns than their low net stock issues and low asset growth counterparts[56]. The authors write that the profitability variable, the ROE, explain the variance of returns since shocks to profitability are positively related to contemporary shocks to returns, this finding the authors argue adds explanatory power that is not present in the FF3[57]. The ROE variable is found to do good job in explaining the variance of the returns with portfolios formed on the earnings surprises anomaly found by Foster, Olsen, and Shevlin[58], the idiosyncratic volatility anomaly found by Ang, Hodrick, Xing, and

[51] Chen, Novy-Marx, & Zhang (2011)
[52] Fama & French (1993)
[53] Chen, Novy-Marx, & Zhang (2011)
[54] Fama & French (2008)
[55] Cooper, Gulen, & Schill (2008)
[56] Chen, Novy-Marx, & Zhang (2011)
[57] Chen, Novy-Marx, & Zhang (2011)
[58] Foster, Olsen & Shevlin (1984)

Zhang[59], on failure probability found by Campbell, Hilscher, and Szilagyi[60], and on Ohlson´s O-score found by Ohlson[61].

Chen, Novy-Marx and Zhang[62] follow Fama and French[63] and use the same indices for their sample; all stocks from the NYSE, the AMEX, and the NASDAQ. Chen, Novy-Marx and Zhang[64] collect the data for these indices, the Fama and French factors SMB and HML, and the risk-free rate from Kenneth French´s homepage[65].The sample has a time period of January 1972-December 2010 and financial companies and companies with negative book value of equity are excluded[66]. AMEX changed name to NYSE AMEX after NYSE Euronext acquired AMEX in 2008[67].

$$E(R_i) - R_f = \beta^i_{MKT}E(MKT) + \beta^i_{INV}E(INV) + \beta^i_{ROE}E(ROE) \text{ (Eq. 7)}$$

where

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

R_f = The risk-free interest rate

$E(MKT)$ = The expected excess return of the market

$E(INV)$ = The expected return of the investment factor

$E(ROE)$ = The expected return on the productivity factor

β^i_{MKT}, β^i_{INV}, and β^i_{ROE} are the coefficients or the betas of the three independent variables MKT, INV and ROE. The three different betas are estimated by running time series regressions.

Actual returns are obtained by excluding the expectation symbol $E(\,)$ from the equation and including the intercept, time subscripts, and a white noise error term ε:

$$R_{it} - R_{ft} = \alpha + \beta^i_{MKT}MKT_t + \beta^i_{INV}INV_t + \beta^i_{ROE}ROE_t + \varepsilon_{it} \text{ (Eq. 8)}$$

59 Ang, Hodrick, Xing, & Zhang (2006)
60 Campbell, Hilscher, & Szilagyi(2008)
61 Ohlson (1980)
62 Chen, Novy-Marx, & Zhang (2011)
63 Fama & French (1993)
64 Chen, Novy-Marx, & Zhang (2011)
65 http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html
66 Chen, Novy-Marx, & Zhang (2011)
67 http://corporate.nyx.com/en/who-we-are/history/new-york

2.5 Explanatory variables (FF3)

Firstly, in order to derive the SMB variable and HML variable the NYSE stocks of the sample are ranked on size. The NYSE median size is used to divide all stocks of the NYSE, AMEX, and NASDAQ into two size groups, small and big (S and B), as illustrated in figure 2.

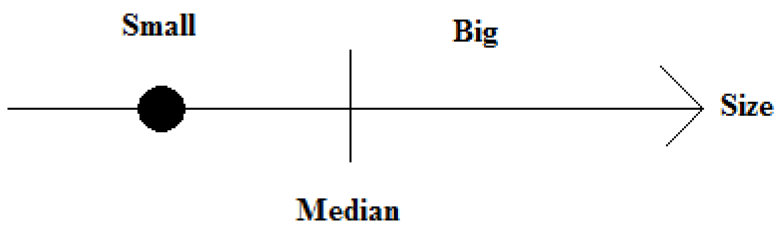

Figure 2: Sorting by size, where ● is a company in the small group.

Secondly, the companies are further divided into three book-to-market groups; low (L), medium (M) and high (H), where the lowest 30% of the shares are part of the low group, the middle 40% are part of the medium group and the highest 30% are part of the high group[68], as can be seen in figure 3.

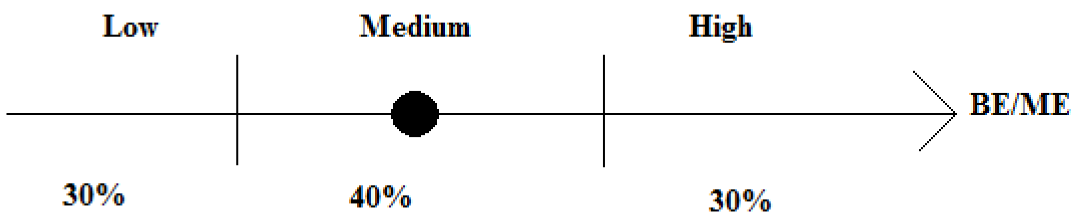

Figure 3: Sorting by BE/ME, where ● is a company in the medium group.

Because of previous results, indicating that BE/ME has a higher level of explanatory power for the average return of stocks than size has[69], there are three BE/ME groups and only two size groups. All stocks will be present in one book-to-market group and in one size group, as illustrated in figure 4.

[68] Fama & French (1993)
[69] Fama & French (1992)

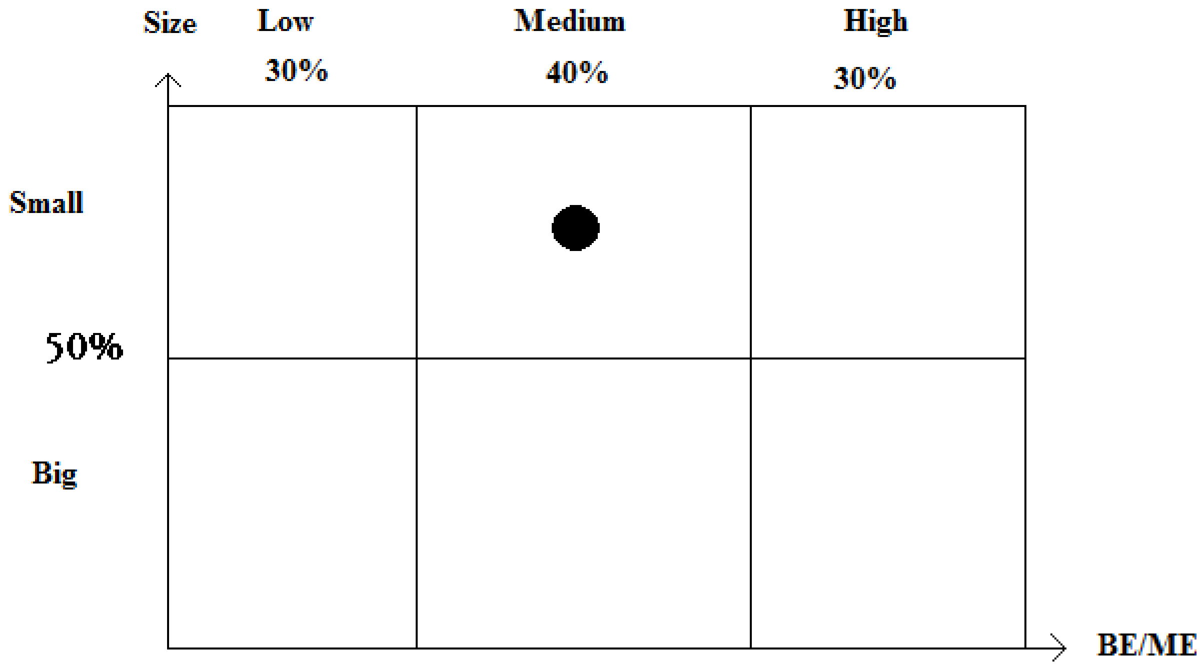

Figure 4: Sorting on size and BE/ME into six portfolios, where ● is the same company as in figure 2 and 3, and is here shown to be present in one size portfolio and in one BE/ME portfolio.

The monthly excess returns are calculated from July year t to June year t+1. The returns are calculated from July year t in order to ascertain that the information regarding the book value of equity for year t-1 is available to the market[70].

Thirdly, as can be seen in figure 4, six portfolios are constructed; Small/Low (S/L), Small/Medium (S/M), Small/High (S/H), Big/Low (B/L), Big/Medium (B/M) and Big/High (B/H)[71]. The explanatory variables SMB and HML are derived from these six portfolios[72].

2.5.1 SMB

The size risk is represented by the SMB portfolio, which 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)[73].

$$SMB = \frac{(R_{SmallLow} + R_{SmallMedium} + R_{SmallHigh})}{3} - \frac{(R_{BigLow} + R_{BigMedium} + R_{BigHigh})}{3} \quad \text{(Eq. 9)}$$

2.5.2 HML

The BE/ME risk is represented by the HML portfolio which is the difference each month between the average return for the two high BE/ME portfolios (S/H, B/H) and the average

[70] Fama & French (1993)
[71] Fama & French (1993)
[72] Fama & French (1993)
[73] Fama & French (1993)

return of the two low BE/ME portfolios (S/L, B/L)[74]. Notice that the two medium portfolios S/M and B/M are not included in the HML portfolio since Fama and French concludes that the HML variable operates best when defined this way[75].

$$HML = \frac{\left(R_{SmallHigh} + R_{BigHigh}\right)}{2} - \frac{\left(R_{SmallLow} + R_{BigLow}\right)}{2} \text{ (Eq. 10)}$$

2.5.3 Rm-Rf

Fama and French use all companies on the NYSE, and the AMEX from 1963-1991 and also all NASDAQ stocks from 1972-1991 as a proxy for the market portfolio, financial companies are excluded and companies with negative book-to-market equity that were excluded from the sample are here included[76]. The market factor is the value-weighted excess return of these stocks which is obtained by taking the value-weighted return less the return of the risk-free rate[77].

2.6 Explanatory variables (CNMZ)

Firstly, in order to construct the INV variable and ROE variable, the investment-to-asset factor (I/A) has to be derived. The I/A factor is defined as the annual change in gross property, plant, and equipment (PP&E) plus the annual change in inventories (INVT) divided by the lagged book value of assets (TA).[78]

$$\frac{I}{A} = \frac{\Delta PP\&E_t + \Delta INVT_t}{TA_{t-1}} \text{ (Eq. 11)}$$

The changes in PP&E capture the capital investments in fixed assets, for instance machines and buildings and the changes in inventories capture investments in current assets such as raw materials and finished goods. Secondly, the ROE factor is derived by dividing the quarterly net profit (NP) with one-quarter-lagged book equity (BE). The book-equity is defined as the shareholders equity plus balance sheet deferred taxes and investment tax credit less the book value of the preferred stock.[79]

$$ROE_{factor} = \frac{NP_t}{BE_{t-1}} \text{ (Eq. 12)}$$

[74] Fama & French (1993)
[75] Fama & French (1993)
[76] Fama & French (1993)
[77] Fama & French (1993)
[78] Chen, Novy-Marx & Zhang (2011)
[79] Chen, Novy-Marx & Zhang (2011)

Thirdly, a third factor is obtained which is the size factor. Size is measured by multiplying the number of outstanding shares with the stock price.

Fourthly, the stocks are independently ranked and triple sorted on the I/A factor, the ROE factor, and on size. The companies are in June each year sorted on their I/A factor into three groups, low 30%, medium 40% and high 30%, as illustrated in figure 5.

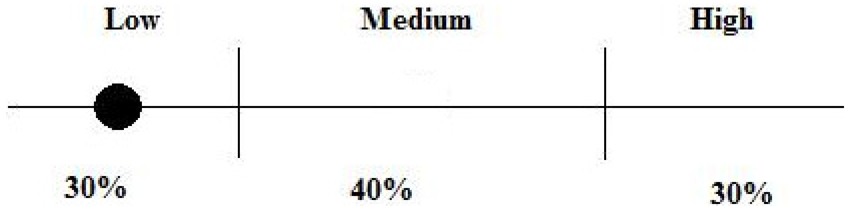

Figure 5 Sorting on I/A where ● is a company in the low group

Independently the ROE factor is obtained monthly where the firms are sorted each month according to their latest announced quarterly earnings. The companies are sorted on their ROE factor into terciles, see figure 6, with the same division as in the I/A.

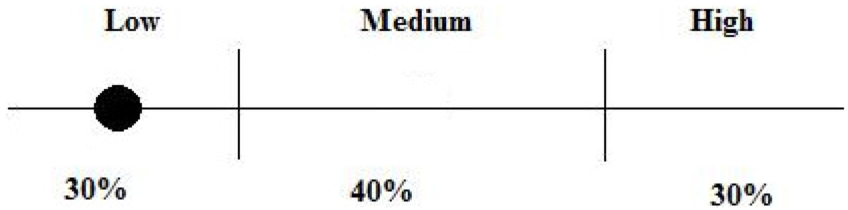

Figure 6: Sorting by ROE, where ● is a company in the low group.

The firms are independently ranked each month on size following Fama and French by taking the NYSE median to sort the stocks from NYSE, AMEX and NASDAQ into terciles, illustrated in figure 7, again using the same weights as the I/A factor.

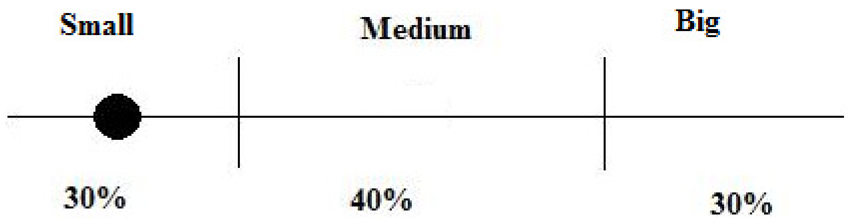

Figure 7: Sorting by size, where ● is a company in the small group.

Fifthly by taking intersections of the three I/A groups, the three ROE groups and the three size groups 27 portfolios are created each month, see figure 8. Lastly, the explanatory variables INV and ROE are derived from these 27 portfolios.[80]

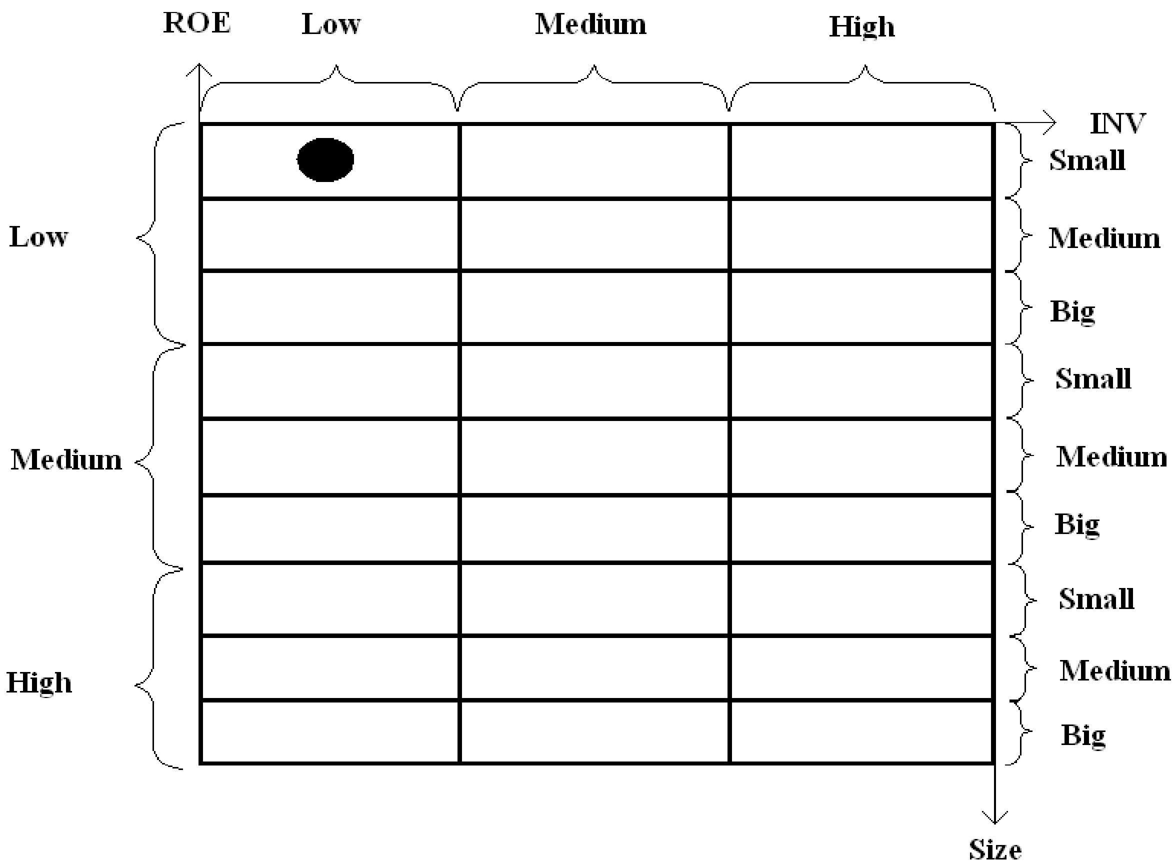

Figure 8: Sorting on I/A, ROE, and Size into 27 portfolios, where ● represents a company in with low ROE, low I/A and small size. This company is thereby placed in the Linv, Lroe, Ssize portfolio.

2.6.1 INV

The INV variable, low- minus-high INV, is derived by the difference each month between the average return of the nine low I/A portfolios and the average return of the nine high I/A portfolios.[81]

$$INV = (R_{Linv\,Lroe\,Ssize} + R_{Linv\,Lroe\,Msize} + R_{Linv\,Lroe\,Bsize} + R_{Linv\,Mroe\,Ssize} + R_{Linv\,Mroe\,Msize} + R_{Linv\,Mroe\,Bsize} + R_{Linv\,Hroe\,Ssize} + R_{Linv\,Hroe\,Msize} + R_{Linv\,Hroe\,Bsize})/9$$
$$- (R_{Hinv\,Lroe\,Ssize} + R_{Hinv\,Lroe\,Msize} + R_{Hinv\,Lroe\,Bsize} + R_{Hinv\,Mroe\,Ssize} + R_{Hinv\,Mroe\,Msize} + R_{Hinv\,Mroe\,Bsize} + R_{Hinv\,Hroe\,Ssize} + R_{Hinv\,Hroe\,Msize} + R_{Hinv\,Hroe\,Bsize})/9 \quad \text{(Eq. 13)}$$

[80] Chen, Novy-Marx & Zhang (2011)
[81] Chen, Novy-Marx & Zhang (2011)

2.6.2 ROE

The ROE variable, high-minus-low ROE, is derived by taking the difference each month between the average return of the nine high ROE portfolios and the nine low ROE portfolios[82].

$$ROE = (R_{Hroe\ Linv\ Ssize} + R_{Hroe\ Linv\ Msize} + R_{Hroe\ Linv\ Bsize} + R_{Hroe\ Minv\ Ssize} + R_{Hroe\ Minv\ Msize} + R_{Hroe\ Minv\ Bsize} + R_{Hroe\ Hinv\ Ssize} + R_{Hroe\ Hinv\ Msize} + R_{Hroe\ Hinv\ Bsize})/9$$

$$- (R_{Lroe\ Linv\ Ssize} + R_{Lroe\ Linv\ Msize} + R_{Lroe\ Linv\ Bsize} + R_{Lroe\ Minv\ Ssize} + R_{Lroe\ Minv\ Msize} + R_{Lroe\ Minv\ Bsize} + R_{Lroe\ Hinv\ Ssize} + R_{Lroe\ Hinv\ Msize} + R_{Lroe\ Hinv\ Bsize})/9 \quad \text{(Eq. 14)}$$

2.6.3 MKT

Chen, Novy-Marx, and Zhang[83] collect the data for the MKT variable from Kenneth French´s homepage[84] where the MKT variable is built up of all the stocks on the NYSE, AMEX and NASDAQ, excluding financial companies and including companies with negative book value of equity. The value-weighted return of these stocks is taken and the return on the risk-free rate is subtracted to obtain the value-weighted excess return.

2.7 Dependent variables

2.7.1 Dependent variables (FF3)

In the same manner as the six size-BE/ME portfolios were constructed, 25 portfolios are formed in June each year t by size and BE/ME and their excess return is used as dependent variables in the time-series regressions[85], see figure 7. Size is measured at the end of June year t and BE/ME is measured in December year t-1[86]. The 25 portfolios are formed by a 5 by 5 matrix of five size groups and five BE/ME groups, see figure 6, the excess returns of the 25 portfolios from July of year t to June year t+1 acts as the dependent variables[87]. Regressions are run for each one of the 25 portfolios and like 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.

[82] Chen, Novy-Marx & Zhang (2011)
[83] Chen, Novy-Marx & Zhang (2011)
[84] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/
[85] Fama & French (1993)
[86] Fama & French (1993)
[87] Fama & French (1993)

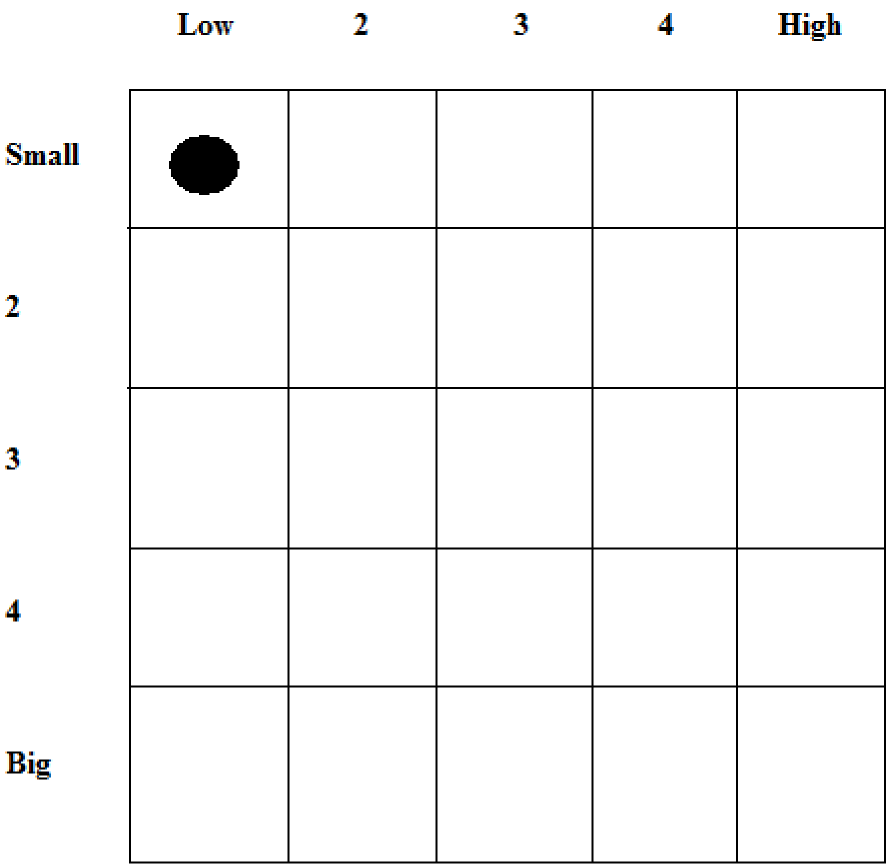

Figure 7: The 25 dependent portfolios, each square represent a portfolio.

The ● is a stock in the portfolio with the smallest size and lowest BE/ME.

2.7.2 The risk-free interest rate

Fama and French use the one-month US Treasury bill as the risk-free rate[88].

2.7.3 Dependent variables (CNMZ)

The dependent variables used in the article by Chen, Novy-Marx and Zhang to test the CNMZ consist of nine different portfolio sorts[89]. Portfolios are sorted on:

- Short-Term Prior Returns
- Earnings Surprises
- Idiosyncratic Volatility
- Distress
- Net Stock Issues
- Asset Growth
- Book-to-Market Equity

[88] Fama & French (1993)
[89] Chen, Novy-Marx & Zhang (2011)

- Industries, CAPM Betas, and Market Equity
- Hansen-Jagannathan Distance

For a description of the background of these test portfolios see the previous research section below.

2.7.4 The risk-free interest rate

Chen, Novy-Marx and Zhang[90] follow Fama and French[91] and use the one-month US Treasury bill as the risk-free rate which is collected from Kenneth French´s homepage[92].

2.8 Previous research

Short-Term Prior Returns builds on the so called momentum effect from an article by Jegadeesh and Titman[93]. In the momentum effect it can be seen that past winners on the stock market from last year continue to outperform last year´s losers one year ahead. Earnings Surprises builds on Standardized Unexpected Earnings from an article by Foster, Olsen and Shevlin[94]. The so called post-announcement earnings drift is researched and it is found that the more positive the unexpected announced are earnings the more positive are the abnormal returns following the earnings announcement, this goes the opposite way for negative unexpected announced earnings. Idiosyncratic Volatility is based on an article by Ang, Hodrick, Xing, and Zhang[95]. It is found that stock with high idiosyncratic volatility relative to the FF3 have abnormally low average returns. Distress builds on failure probability and Ohlson´s O-score[96] from an article by Campbell, Hilscher, and Szilagyi[97]. The article presents a measure to predict company defaults. Net Stock Issues builds on an article by Fama and French[98]. The results show that high net stock issues is associated with lower average returns while low net stock issues is associated with higher average returns. Asset Growth builds on an article by Cooper, Gulen, and Schill[99]. It is found that firms with low asset growth have higher average returns than their counterparts with high asset growth which obtains significant negative returns in the empirical test performed. Book-to-Market Equity is based

[90] Chen, Novy-Marx & Zhang (2011)
[91] Fama & French (1993)
[92] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/
[93] Jegadeesh & Titman (1993)
[94] Foster, Olsen & Shevlin (1984)
[95] Ang, Hodrick, Xing, & Zhang (2006)
[96] Ohlson (1980)
[97] Campbell, Hilscher, & Szilagyi(2008)
[98] Fama & French (2008)
[99] Cooper, Gulen, & Schill (2008)

on the FF3 by Fama and French[100]. In Fama and French it is found that small stocks and value stocks tend to outperform big stocks and growth stocks. The creation of the dependent variables in the FF3 can be seen just above in section 2.5. Industries, CAPM Betas, and Market Equity are based on an article by Lewellen, Nagel, and Shanken[101]. Tests are performed on the FF3 factors size and book-to-market on portfolios based on these factors and on industries. It is concluded that asset pricing models should not be evaluated on their performance in explaining average returns with the origin in these FF3 factors. Hansen-Jagannathan Distance is based on an article by Hansen and Jagannathan[102]. In this article a method is developed in which one can compare different asset pricing models against each other.

[100] Fama & French (1993)
[101] Lewellen, Nagel, & Shanken (2008)
[102] Hansen & Jagannathan (1997)

Chapter 3

Method

Firstly, this chapter explains the selection process of determining which companies are to be included in the study. Secondly, it explains the time period of our study and how the data for the study has been gathered. Thirdly it presents the number of companies included in our sample as well as how the variables needed for the regression analysis have been created.

3.1 Selection

We conduct our study outside the US stock markets since we want to test the adequacy of the measurement of the cross-section of expected stock returns on a market different than the one researched in Chen, Novy-Marx and Zhang. This limitation is made in order to see if the CNMZ model is valid on and outperforms the FF3 on other markets as well. The study is therefore conducted on The London Stock Exchange on the FTSE All Share Index. Our choice of this particular stock market outside of the US stock market is made because we deemed it to be interesting to test the model on one of the world´s major financial centres. The choice of the FTSE All Share Index as can be seen in section 1.4 is made since that the index is seen as the best measure of the general performance of the London Stock Exchange[103]. Furthermore since London is one of the world´s major financial centres the FTSE All Share Index is a highly liquid index which allows us to avoid the risk of 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.[104] Companies with negative book equity are not included in the tests. Financial firms with SIC-codes 6000-6799 are excluded from the sample in accordance with the Fama and French[105] and Chen, Novy-Marx, and Zhang[106] articles. Financial companies are excluded since "the high leverage that is normal for these firms probably does not have the same meaning as for

[103] FTSE All-Share Index Fact Sheet
[104] Campbell, Lo & MacKinlay (1997)
[105] Fama & French (1993)
[106] Chen, Novy-Marx & Zhang (2011)

nonfinancial firms, where high leverage more likely indicates distress".[107] From our sample on the London Stock Exchange we are excluding the following sectors: 'Banks', 'Equity Investment Instruments', 'Financial Services', 'Life Insurance', 'Non-equity Investment Instruments', 'Nonlife Insurance', 'Real Estate Investment & Services', and 'Real Estate Investment Trusts'. The reason for these exclusions is to make sure that our study complies with the studies of Fama and French and Chen, Novy-Marx and Zhang.

3.1.1 Time period

The time period in which the models are tested is July 2002 – March 2011, this gives a total of 105 months. The time period is limited to the accessibility of quarterly data from the database Datastream.

3.1.2 Data

Data is collected from the database Datastream. The FTSE All Share index includes as of March 2011 a total of 626 companies. Excluding financial companies reduces the number of companies with 257 and gives a sample of 369 companies. Applying this sample to the time period of 105 months gives a total of 38745 company months. Further exclusion of companies with negative book equity excludes 1722 company months. The final sample thereby consists of 37023 observed company months. Annual data with the following data types in Datastream is collected;

- WC02999 which stands for Total Assets,
- WC03501 which stands for Common Equity (Key Item),
- WC02501 which stands for Property, Plant and Equipment – Net (Key Item),
- WC02101 which stands for Inventories – Total (Key Item),
- NOSH which stands for Number of Shares,
- MV which stands for Market Value.

Quarterly data is collected using the following data types;

- DWNP which stands for Net Profit (Income),
- DWSE which stands for Common / Shareholder´s Equity,
- NOSH which stands for Number of Shares.

[107] Fama & French p.429 (1992)

Monthly data with the following data types is collected;

- MV which stands for Market Value,
- P which stands for Price (Adjusted - Default).

We are aware of the risks of using secondary data from a database in the data collection; there may be errors in the data. However we have conducted an evaluation of the accounting data from Datastream, see section 4.5.3. Fama and French and Chen, Novy-Marx and Zhang use The Center for Research in Security Prices (CRSP) to collect prices and Compustat to collect accounting information. We understand that there may be differences in the data reported in CRSP, Compustat and Datastream. Calculations are made in Excel.

3.1.3 Sample

The sample consists of 369 companies on the FTSE All Share Index. The full sample applied on the time period July 2002 – March 2011, 105 months, consists of 37023 company months.

3.2 Portfolios' construction FF3

In June each year, t, the companies in our sample are sorted on both size and BE/ME. Size is measured as the market value of equity in June, t, and BE/ME is book value of equity divided by the market value of equity in December, t-1. For instance, the portfolios of 2009 are formed by taking the market value of equity, ME, in June 2009 and the end of year book value of equity, BE, of 2008 which is divided by the market value of equity of December 2008. Next, the returns are taken from the end of July 2009 to the end of June 2010 hence the returns of the portfolios of 2009 extend from July 2009 to June 2010. Following Fama and French[108] we use the same time period, the end of July year t to the end of June year t+1, to measure the portfolio returns and the end of June each year to measure the market value of equity and to construct the portfolios. This specific time period also ensures that the market has access to the accounting data before the returns are measured. As for the example above in the first few months of 2009 it cannot be expected that the market have access to the specific accounting data due to the fact that it might not yet have been published. However, by the end of June the information should be available to the market through for instance company's annual reports. We regard that the UK Company Act 2006 states that the annual report for public companies should be completed no later than six months after the financial year[109]. Consequently companies, of which the financial year follows the calendar year, have

[108] Fama & French (1993)
[109] Companies Act 2006

to complete their reports before the end of June. Each year six portfolios are created and used for the construction of the FF3 three explanatory variables RM-RF, SMB and HML. In addition sixteen portfolios are created to be used as the dependent variables.

3.3 Portfolios' construction CNMZ

Each year in June the stocks of our sample from the FTSE All Share Index are ranked on their I/A and sorted into terciles with the weights 30/40/30. The same argument goes here as above that the market does not have access to the information of the annual accounting data before it has been published; therefore the portfolio formation on investment is done in June six months after the end of the financial year for companies following the calendar year. Independently each month the stocks of our sample are ranked on their ROE and sorted into terciles with the same weights as the I/A terciles. The stocks are sorted on their ROE as the quarterly accounting data is available to the market, see further description in 3.4.5. Independently of the other sorts the companies of our sample are ranked at the end of every month on their size and sorted into terciles with the same weights as the I/A and ROE terciles. Size is measured as the number of outstanding stocks multiplied with the stock price at the end of the month. The stocks are then triple sorted every month on I/A, ROE, and size into 27 portfolios, see figure 8. The 27 portfolios are then used to create the explanatory variables INV and ROE, see further explanation below in of the creation of these variables in sections 3.4.4, and 3.4.5, respectively. The creation of the dependent variables of the CNMZ can be seen in section 3.8.

Linv	Lroe	Ssize	Minv	Lroe	Ssize	Hinv	Lroe	Ssize
Linv	Lroe	Msize	Minv	Lroe	Msize	Hinv	Lroe	Msize
Linv	Lroe	Bsize	Minv	Lroe	Bsize	Hinv	Lroe	Bsize
Linv	Mroe	Ssize	Minv	Mroe	Ssize	Hinv	Mroe	Ssize
Linv	Mroe	Msize	Minv	Mroe	Msize	Hinv	Mroe	Msize
Linv	Mroe	Bsize	Minv	Mroe	Bsize	Hinv	Mroe	Bsize
Linv	Hroe	Ssize	Minv	Hroe	Ssize	Hinv	Hroe	Ssize
Linv	Hroe	Msize	Minv	Hroe	Msize	Hinv	Hroe	Msize
Linv	Hroe	Bsize	Minv	Hroe	Bsize	Hinv	Hroe	Bsize

Figure 8: Portfolios triple sorted on INV, ROE and size. Each rectangle and every color shade is a portfolio.

3.4 Explanatory variables

3.4.1 MKT

The market factor of all models equals the value-weighted portfolio of all existing individual assets in the world[110]. Our proxy for the market portfolio is the value-weighted MSCI World-index. We have chosen this index in order to obtain a proxy as close as possible to the true market portfolio. We have further chosen to measure the betas of our sample of the UK stocks against this world index rather than a UK index to avoid measuring the betas against an index with industry weights different to that of the market portfolio. [111] Because, doing that would lead to an incorrect measurement of the market-wide systematic risk[112]. Monthly value-weighted returns from July 2002 to March 2011 have been collected from Datastream using the data type P, which is an adjusted price. The Datastream adjusted price includes adjustments for capital actions, for example stock splits. The returns are taken at the last trading day of each month. The returns are exchanged from US Dollars to British Pounds using Datastream. The risk-free rate is subtracted from the MSCI-World index value-weighted return in order to obtain the value-weighted excess return from the index in accordance with Fama and French[113] and Chen, Novy-Marx and Zhang articles[114], respectively.

3.4.2 SMB

In accordance with Fama and French each company included in our sample is ranked based on the size of their market value of equity (ME) in order to create the explanatory variable SMB. The companies are divided by the median into two groups; Small and Big.

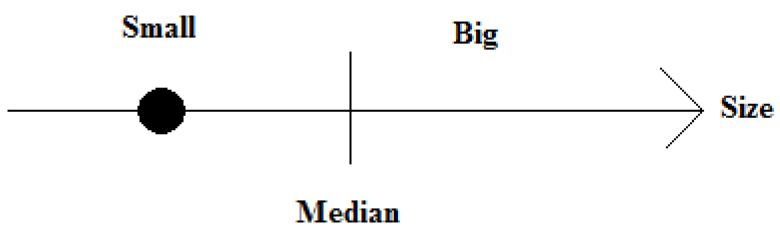

Figure 9: Sorting by size, where ● is a company in the small group.

[110]Copeland, Weston, & Shastri (2005)
[111]Koller, Goedhart, & Wessels (2005)
[112]Koller, Goedhart, & Wessels (2005)
[113]Fama & French (1993) Chen, Novy-Marx, & Zhang (2011)
[114] Chen, Novy-Marx, & Zhang (2011)

The SMB variable is derived by subtracting the average return each month for the three big portfolios from the average return each month for the three small portfolios, see equation 9 on page 13.

3.4.3 HML

In order to create the HML variable, as with the SMB variable, the companies in our sample are ranked according to size. However, they are not ranked according to the size of their market value of equity (ME) but rather on the size of their book-to-market equity ratio (BE/ME ratio). The companies are divided into the three different categories; Low, Medium and High, see figure 10.

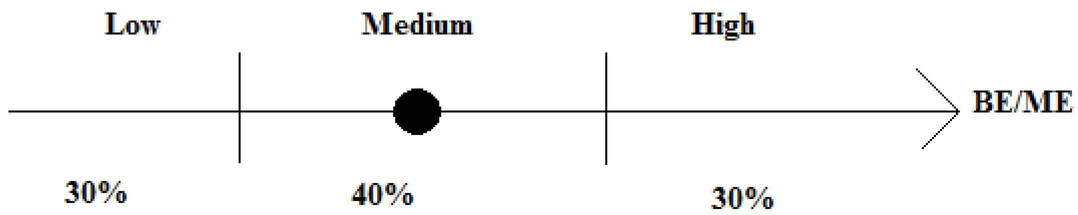

Figure 10: Sorting by BE/ME, where ● is a company in the medium group.

In order to derive the HML variable the difference between the average return for the two high BE/ME portfolios and the average return of the two low BE/ME portfolios is taken each month, see equation 10 on page 14.

Each company in the sample will be included in either one of the two size categories, as well as in one of the three BE/ME ratio categories because the size ranking and BE/ME-ratio ranking is done independently of each other. Based on the two size categories and the three BE/ME-ratio categories six portfolios are created one for each combination of size and BE/ME-ratio as seen in figure 11.

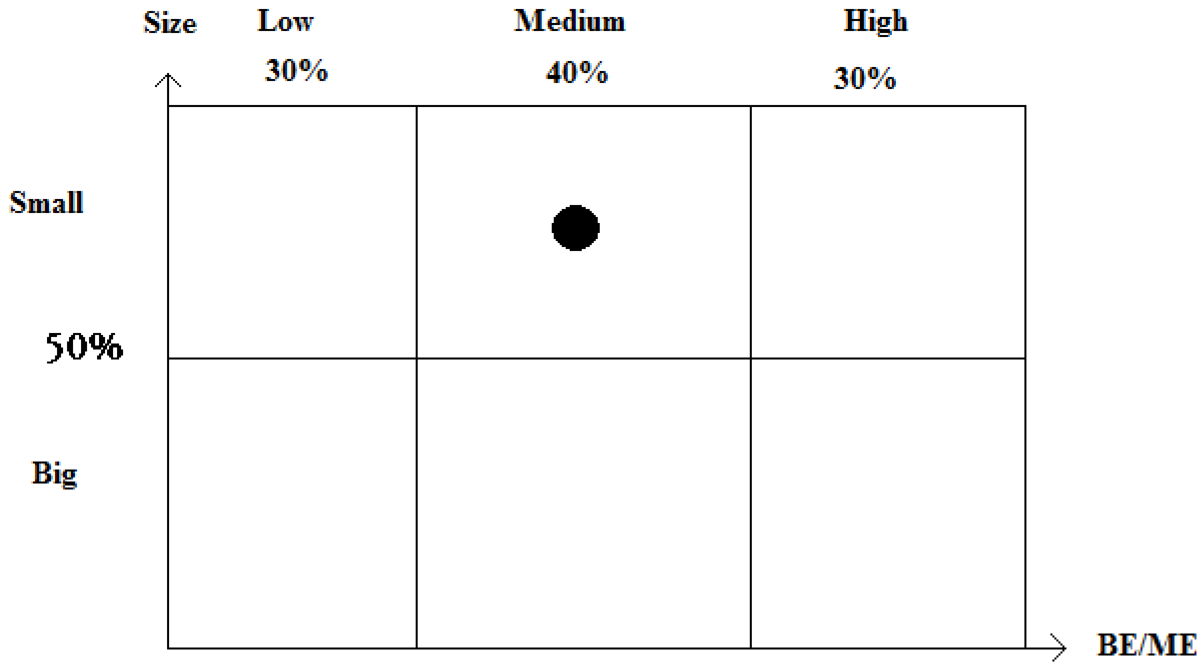

Figure 11: Sorting on size and BE/ME, where ● is the same company as in figure 2 and 3, and is here shown to be present in one size portfolio and in one BE/ME portfolio.

3.4.4 INV

In order to derive the INV variable, low-minus-high INV, the I/A factor firstly has to be estimated for each of the companies in our sample. This is accomplished by dividing the property, plant, and equipment (PP&E) and the annual change in inventories (INVT) with the lagged book value of assets (TA)[115], see equation 11 on page 14.

Each month, in June, the stocks in our sample from the FTSE All Share Index are based on their value of the I/A factor sorted into three groups, low, medium and high, on a yearly basis, as illustrated in figure 12.

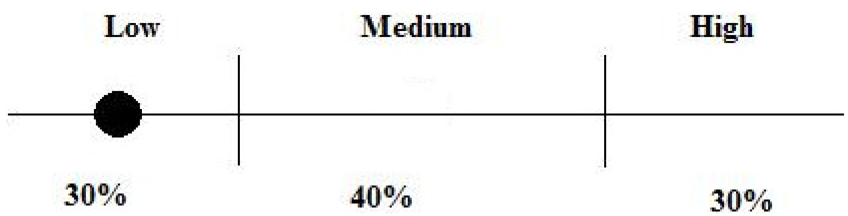

Figure 12: Sorting on I/A, where ● is a company in the low I/A group.

[115] Chen, Novy-Marx & Zhang (2011)

In order to estimate the INV variable the difference between the average return of the nine low I/A portfolios and the average return of the nine high I/A portfolios is taken each month, see equation 13 on page 16.

3.4.5 ROE

Return on equity, high-minus-low ROE, is measured following Chen, Novy-Marx and Zhang as quarterly earnings divided by one quarter lagged book equity[116]. This gives the ROE factor that is used to rank and sort the companies which in turn will give the ROE variable used in the regressions. Datastream data types DWNP and DWSE are used to obtain quarterly earnings and book equity, respectively. Independently of the I/A sort the companies of our sample from the FTSE All Share Index are ranked each month on ROE according to their latest announced quarterly earnings, as illustrated in figure 13. For example if the fourth quarter year t-1 quarterly earnings are announced in March year t then these earnings are divided by the third quarter year t-1 book equity to rank companies according to ROE in April. The same companies will then stay in the same groups until the next quarterly earnings are announced.

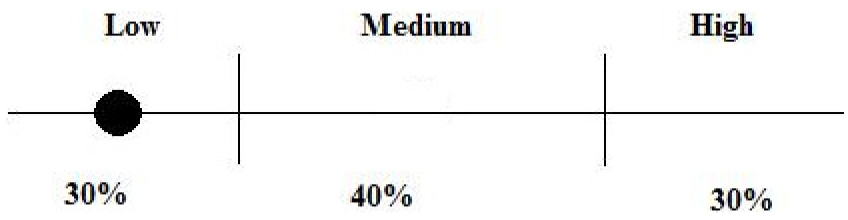

Figure 13: Sorting on ROE, where ● is a company in the low ROE group.

Each month the nine high ROE portfolios minus the nine low ROE portfolios create the ROE variable, see equation 14 on page 17, which is used in the regressions with the CNMZ.

3.5 Dependent variables (FF3)

Since our sample consists of fewer companies than in Fama and French's study we only use the excess returns of 16 portfolios, instead of 25 portfolios used by Fama and French, as dependent variables in the time-series regressions. By using fewer portfolios the risk of obtaining portfolios that only contain one or even zero companies is avoided. These 16 portfolios are constructed with the same method used to construct the six size-BE/ME portfolios. The portfolios are formed in June each year, t, by size, which is measured in the

[116] Chen, Novy-Marx & Zhang (2011)

end of June year, t, and BE/ME, which is measured in the end of December year, t-1. Each year the monthly returns are measured from the end of July year, t, to June year, t+1, and in June, t+1, the portfolios are rebalanced. Four size groups and four BE/ME groups are created and the 16 portfolios are formed by a 4x4 matrix consisting of these two categories, as can be seen in figure 14.

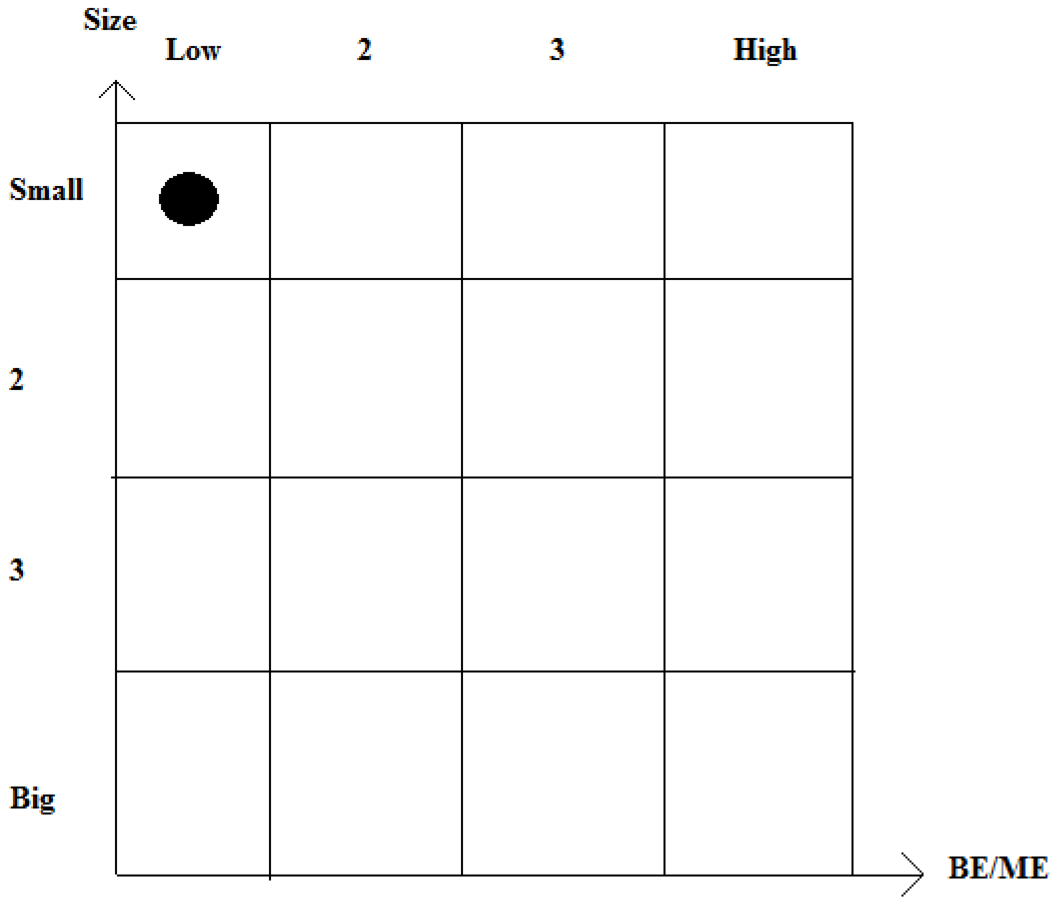

Figure 14: 4x4 matrix of the 16 dependent portfolios, where the ● is a company in the Small/Low portfolio.

The four size groups are Small, 2, 3 and Big and the four BE/ME groups are Low, 2, 3 and High. The stocks are distributed into four groups of equal size hence each group contain 25% of the stocks. For example 25% of the stocks will be in the size group Small, 25% will be in the size group 2 and so forth. Regarding the explanatory variables any given stock of the portfolios of the explained variables will be present in both one size group and one BE/ME group. From the beginning of July of year, t, to the end of June year, t+1, for the years 2002-2010, the excess returns of the 16 portfolios are the dependent variables.

By running Ordinary Least Squares (OLS) time series regressions the betas of the three explanatory variables is estimated. 16 regressions are run for the whole time period of 2002-2010.

3.6 Dependent variables (CNMZ)

The dependent variables in the CNMZ are the portfolios that can be seen in section 3.8. As seen in section 2.7.3 the article by Chen, Novy-Marx and Zhang[117] use nine portfolios to test the CNMZ. We are performing five of these tests as well as one that is not conducted by Chen, Novy-Marx and Zhang[118].

3.7 The risk-free interest rate

Our proxy for the risk-free interest rate is the UK Treasury bill with a one month term to maturity obtained from Datastream. The Datastream name of the interest rate is UK Treasury Bill Tender - Middle Rate. We have chosen this rate since treasuries issued by the UK government are as close to a risk-free rate as one can come. These treasuries would be one of the first choices for the risk-free rate of the investor in UK stocks due to the fact that it is in the same currency as the stocks and the investor thereby avoids any risk of losing money on currency fluctuations of the British Pound. The choice of using one-month term to maturity is in order to comply with the Fama and French[119] and Chen, Novy-Marx, and Zhang[120] articles. Since the interest rate is expressed on a yearly basis we used the following model to obtain the monthly rate of interest:

$$r_f = \left(1 + r_f'\right)^{\left(\frac{1}{12}\right)} - 1 \text{ (Eq. 15)}$$

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

3.8 Test Portfolios

3.8.1 Calendar-time Factor Regressions

Following Chen, Novy-Marx and Zhang[121] as well as Fama and French[122] we use factor regressions to test the CNMZ:

$$R_{it} - R_{ft} = \alpha + \beta^i_{MKT} MKT_t + \beta^i_{INV} INV_t + \beta^i_{ROE} ROE_t + \varepsilon_{it} \text{ (Eq. 8)}$$

where if the model performs sufficient enough the α should be statistically insignificant from zero. Furthermore, due to the simplistic nature of the portfolio approach and following Chen,

117 Chen, Novy-Marx & Zhang (2011)
118 Chen, Novy-Marx & Zhang (2011)
119 Fama & French (1993)
120 Chen, Novy-Marx & Zhang (2011)
121 Chen, Novy-Marx & Zhang (2011)
122 Fama & French (1993,1996)

Novy-Marx and Zhang[123], we test the CNMZ by using several different test portfolios that have been constructed on a wide range of variables.

The first test is time-series regressions where there has been no change to the construction of the portfolios. The 27 portfolios are formed by taking the intersections of the I/A factor, the ROE factor and the size factor. The monthly excess returns from each of the 27 portfolios are used as dependent variables in the regressions.

3.8.2 Earnings Surprises

Earnings surprises are measured as Standardized Unexpected Earnings (SUE) following an article by Foster, Olsen, and Shevlin[124]. SUE is calculated by taking the change in a company's most recent quarterly earnings per share from its earnings per share four quarters ago divided by the standard deviation of this change in quarterly earnings over the antecedent eight quarters. Since quarterly data is necessary from eight months prior to the measurement of SUE the time period of our SUE observations is measured from January 2005-March 2011, a period of 75 months. The quarterly earnings are collected by using the Datastream data type DWNP and the number of shares outstanding in the quarter antecedent to the earnings quarter are collected with the data type NOSH. The earnings are then divided by the number of shares to get the earnings per share. The stocks from our sample from the FTSE All Share Index are ranked and sorted into deciles at the beginning of each month according their latest past SUE. The stocks are sorted into deciles with decile one containing the stocks with the lowest SUE and decile ten containing the stocks with the highest SUE. Following the CNMZ article we only report the results of deciles one (Low), five, ten (High) and High minus Low (H-L) to save space.[125] For each portfolio monthly value-weighted returns are taken at the end of each month and each portfolio is rebalanced in the beginning of every month according to its latest past SUE. In this way the February and March portfolios include the same companies as the January portfolio since these months are all part of quarter one and share the same latest past SUE. For this quarter one portfolio the monthly returns are taken from January to March and afterwards in April the quarter two portfolio is formed. The value weighted returns of each portfolio month are regressed on the returns from the CAPM, FF3, and CNMZ portfolios.

[123] Chen, Novy-Marx & Zhang (2011)
[124] Foster, Olsen & Shevlin (1984)
[125] Chen, Novy-Marx & Zhang (2011)

3.8.3 Net Stock Issues

Net stock issues are measured following a Fama and French[126] article. Net stock issues are calculated as the change in the natural log of outstanding shares as of yearend t-1 and outstanding shares as of yearend t-2. The Datastream data type NOSH is used to collect the yearend outstanding shares. Each year t in June the sample from the FTSE All Share Index is sorted into deciles based on net stock issues for the yearend of t-1. Following Chen, Novy-Marx, and Zhang[127] the firms with negative net stock issues are sorted into decile one and the firms with zero net stock issues are sorted into decile two. The firms with positive net stock issues are then sorted into the rest of the eight deciles. Following the CNMZ article we only report the results of deciles one (Low), five, ten (High) and High minus Low (H-L) to save space[128]. Monthly value weighted returns are taken at the end of each month for all deciles from July year t to June year t+1. The portfolios are then rebalanced in June year t+1. In this way the deciles contains the same companies from July to June and are then rebalanced. The value weighted returns of each portfolio month are regressed on the returns from the CAPM, FF3, and CNMZ portfolios.

3.8.4 Asset Growth

Following an article by Cooper, Gulen, and Schill[129] asset growth is measured as total assets at the end of the year t-1 less total assets at the end of the year t-2 divided by total assets at the end of the year t-2. The Datastream data type WC02999 is used to obtain the total assets of each company in the sample. In each June year t the shares of the sample from the FTSE All Share Index are ranked and sorted into deciles according to their asset growth. Decile one contain the stocks with the lowest asset growth and decile ten contain the stocks with the highest asset growth. Following the CNMZ article we only report the results of deciles one (Low), five, ten (High) and High minus Low (H-L) to save space[130].Monthly value weighted are taken at the end of each month for all deciles from July year t to June year t+1 and the portfolios are then rebalanced in June year t+1. In this way the deciles contains the same companies from July to June and are then rebalanced. The value weighted returns of each portfolio month are regressed on the returns from the CAPM, FF3, and CNMZ portfolios.

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[126] Fama & French (2008)
[127] Chen, Novy-Marx & Zhang (2011)
[128] Chen, Novy-Marx & Zhang (2011)
[129] Cooper, Gulen & Schill (2008)
[130] Chen, Novy-Marx & Zhang (2011)

3.8.5 Book-to-Market Equity

The test is conducted by instead of taking the monthly excess returns from each of the 27 portfolios, the excess returns from the 16 size and book-to-market portfolios, the FF3 portfolios, are instead used as dependent variables in the factor regressions. The results of the CNMZ are then compared against the results of the FF3 and CAPM as in accordance with Chen, Novy-Marx, and Zhang[131].

3.8.6 Industries

We follow Chen, Novy-Marx, and Zhang[132] and divide companies into ten industry portfolios where the division of different industries into the ten portfolios can be found on Kenneth French´s homepage[133]. For the different industry sectors of the FTSE All Share Index included in the ten industry portfolios, see table 15. Tests are performed on ten industry portfolios from our sample from the FTSE All Share Index with the returns of every portfolio regressed on the CAPM, FF3, and CNMZ.

[131] Chen, Novy-Marx & Zhang (2011)
[132] Chen, Novy-Marx & Zhang (2011)
[133] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html

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. In order to make it easier to comprehend, we have chosen to integrate the analysis part and the results part as opposed to presenting each part separately.

4.1 Explanatory variables

4.1.1 Descriptive statistics

In tables 8, and 9, respectively descriptive statistics of the explanatory variables can be seen. Our INV variable obtains a positive average monthly return of 0.02% while the ROE variable obtains a negative average monthly return of -0.15%. These results are different from Chen, Novy-Marx, and Zhang where both variables obtain large positive monthly returns. Our SMB variable obtains a negative average monthly return of -0.70%. The only variable with a large positive average monthly return is the value stock variable HML which obtains a positive average monthly return of 1.73%. The market factor is not good at explaining the average returns of any of the other independent variables measured by adjusted R^2 values. SMB and HML are better at explaining the average returns of the ROE variable with an adjusted R^2 of 52%. INV and ROE can explain 32% of the variance of the returns of the SMB variable.

4.1.2 SMB and HML

The explanatory variables in the FF3 regression, SMB, HML and MKT, have been estimated on a monthly basis. A total of 105 values for each variable have been derived. In table 1 below, the average of the explanatory variables are presented. It is worth noticing that the SMB variable obtains a negative value, which means that on average during the period small size companies, small-cap, tend to achieve a lower return than large size companies, large-cap. This result contradicts the Fama and French theory which states that small-cap stocks tend to outperform large-cap stocks[134], or in other words small companies will on average yield a higher return than large companies. When examining the data for the SMB variable, see table 7, it is evident that during 2009 and 2010 small-caps performed worse than large-

[134] Fama & French (1992)

caps. Because, in the 2009 portfolio all SMB values are negative and in the 2010 portfolio two thirds of the values are negative.

One possible explanation for this could be that following a period where the market has experienced a sharp decline, as it did in 2008, investors will prefer to invest in larger companies. The reason being that they are, as will be discussed later in this chapter, less risky than smaller companies

However, the HML variable obtains a positive value which means that stocks with a high BE/ME ratio, called value stocks, outperforms stocks with a low BE/ME ratio, known as growth stocks. This result is perfectly in-line with the Fama and French theory that value stocks should outperform growth stocks[135].

%	Rm - Rf	SMB	HML
Average	0,1439 %	– 0,7008 %	1,7314 %
Number of observations	105	105	105

Table 1: FF3 explanatory variables data, Number of observations and average values for the explanatory variables in the regression

$$R_{it} - R_{ft} = \alpha + \beta_m^i(R_{mt} - R_{ft}) + \beta_{SMB}^i SMB_t + \beta_{HML}^i HML_T + \varepsilon_{it} \text{ (Eq. 6)}$$

4.1.3 INV and ROE

The explanatory variables in the CNMZ regression, INV, ROE and MKT, have just like the explanatory variables in the FF3 been estimated on a monthly basis, giving a total of 105 observations. The average value of the explanatory variables is presented in table 2. The INV variable obtains a positive value, which means that in our sample companies in the low investment ratio portfolios have achieved higher average returns that the companies in the high investment ratio portfolios. According to Liu, Whited, and Zhang[136] when companies are faced with high cost of capital they are more likely to reduce their investments, because they have less projects with a positive net present value (NPV) to invest in. Low investments, in relation to the asset base, should therefore indicate a potential for high future average returns.

However, the ROE variable has obtained a negative value, which means that during our time period companies have been less profitable, especially the companies in the high profitability

[135] Fama & French (1992)
[136] Liu, Whited & Zhang (2009)

ratio portfolios. This indicates a potential for lower returns because, quite intuitively, companies that are expected to be relatively less profitable will most likely deliver lower returns and vice versa.

These results differ from those of the Chen, Novy-Marx and Zhang study which obtained positive values for both variables. One possible explanation for this could be the fact that our time period is significantly shorter than that of the Chen, Novy-Marx and Zhang study. Furthermore, much of our time period have experienced several highly negative economic events, such as the aftermath of the dot-com bubble, the financial crisis of 2008/2009 which lead to a global economic downturn, the collapse of Iceland's financial system and the sovereign debt crisis of several European countries. These events have, for instance, had the effect of reducing companies' sales which leads to lower profitability levels.

%	**Rm - Rf**	**INV**	**ROE**
Average	0,1439 %	0,0246 %	– 0,1549 %
Number of observations	105	105	105

Table 2: CNMZ explanatory variables data, Number of observations and average values for the explanatory variables in the regression

$$R_{it} - R_{ft} = \alpha + \beta^i_{MKT} MKT_t + \beta^i_{INV} INV_t + \beta^i_{ROE} ROE_t + \varepsilon_{it} \text{ (Eq. 8)}$$

4.2 Results of the regressions for the FF3

4.2.1 Calendar-time Factor Regressions

A regression analysis for the FF3 has been conducted for each of the sixteen dependent portfolios in compliance with the model:

$$R_{it} - R_{ft} = \alpha + \beta_m^i(R_{mt} - R_{ft}) + \beta_{SMB}^i SMB_t + \beta_{HML}^i HML_T + \varepsilon_{it} \text{ (Eq. 6)}$$

In table 3 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 2002 - 2011.

	α	P-value	Rm-Rf β	SMB β	HML β	Adjusted R²
S_L	0,008	0,277	0,808	1,587	0,492	0,554
S_2	0	1	0,65	1,159	0,595	0,636
S_3	0,008	0,057	0,686	1,107	0,657	0,702
S_H	0,003	0,464	0,87	1,614	1,127	0,82
2_L	0,008	0,042	0,714	0,729	0,259	0,578
2_2	0,008	0,018	0,804	0,675	0,384	0,726
2_3	0,006	0,143	0,959	0,865	0,497	0,693
2_H	0,009	0,037	1,028	1,255	0,751	0,794
3_L	0,007	0,051	0,909	0,373	0,157	0,627
3_2	0,005	0,163	0,866	0,314	0,192	0,649
3_3	0,007	0,119	1,046	0,457	0,289	0,624
3_H	0,002	0,622	1,104	0,587	0,558	0,637
B_L	0,003	0,319	0,85	0,058	0,049	0,626
B_2	0,006	0,038	0,936	0,093	0,04	0,685
B_3	0,003	0,277	1,036	0,111	0,073	0,744
B_H	0,006	0,08	1,014	0,078	0,18	0,704

Table 3: FF3 16 portfolios regression data, Intercept and p-values, coefficients, adjusted R² according to the model

$$R_{it} - R_{ft} = \alpha + \beta_m^i(R_{mt} - R_{ft}) + \beta_{SMB}^i SMB_t + \beta_{HML}^i HML_T + \varepsilon_{it} \text{ (Eq. 6)}$$

The results of table 3, shows that for four of the portfolios, 2_L, 2_2, 2_H and B_2, the α is positively significant at the 5 % level. This means that the model underestimates the returns for those four portfolios, had the intercept instead been negatively significant, the model would then have overestimated the return of the portfolios. When the α value is not significantly different from zero the model neither overestimates or underestimates the return of the portfolio. What is worth noticing is that three out of those four portfolios are in the second lowest size group, which might indicate that the FF3 have problem correctly estimating companies of that size, at least in our study.

We use the adjusted R^2 to measure the level of explanation, because adjusted R^2 takes the loss of degrees of freedom related to adding extra variables into consideration[137]. It is therefore a more accurate measure of the goodness of fit than the unadjusted R^2. The value of the adjusted R^2 for the FF3 regressions ranges between 55% and 82%.

Furthermore, the results of table 3 show that the beta values for portfolios that contain larger sized companies are smaller than the beta values for portfolios containing smaller sized companies. This illustrates that larger size firms are less risky than smaller sized firms and will therefore on average yield a lower return than small companies, since the higher the risk the higher the return must be for people to be willing to invest; this is in consistence with the mean-variance theory of Markowitz[138]. This result coincides with the Fama and French theory that states that small-cap stocks tend to outperform large-cap stocks[139].

[137] Brooks (2008)
[138] Markowitz (1959)
[139] Fama & French (1992)

4.3 Results of the regressions for the CNMZ

4.3.1 Calendar-time Factor Regressions

Regression analyses for the CNMZ have been conducted for each of the 27 dependent portfolios in compliance with the model:

$$R_{it} - R_{ft} = \alpha + \beta^{i}_{MKT} MKT_t + \beta^{i}_{INV} INV_t + \beta^{i}_{ROE} ROE_t + \varepsilon_{it} \text{ (Eq. 8)}$$

The intercept and its related p-values, the coefficients for the explanatory variables as well as the value of the adjusted r-squared for the period of 2002 - 2011 is presented in table 4.

	α	P-value	Rm-Rf β	INV β	ROE β	Adjusted R²
Linv Lroe Ssize	0,009	0,093	0,53	-0,179	-1,921	0,621
Linv Lroe Msize	0,012	0,023	0,992	0,097	-1,423	0,661
Linv Lroe Bsize	0,006	0,353	0,475	0,175	-0,699	0,237
Linv Mroe Ssize	0,002	0,681	0,721	-0,2	-1,014	0,46
Linv Mroe Msize	0,006	0,274	0,858	0,408	-0,567	0,437
Linv Mroe Bsize	0,008	0,032	0,849	0,073	-0,137	0,52
Linv Hroe Ssize	0,022	0,032	1,139	0,877	0,472	0,206
Linv Hroe Msize	0,01	0,034	0,785	0,205	-0,557	0,472
Linv Hroe Bsize	0,009	0,062	0,876	-0,074	-0,177	0,44
Minv Lroe Ssize	-0,005	0,575	0,575	-0,728	-1,769	0,346
Minv Lroe Msize	0,004	0,441	0,963	-0,103	-1,278	0,678
Minv Lroe Bsize	0,006	0,044	0,993	0,009	-0,543	0,769
Minv Mroe Ssize	-0,003	0,76	0,858	-0,135	-0,813	0,23
Minv Mroe Msize	0,003	0,414	0,91	-0,174	-0,612	0,644
Minv Mroe Bsize	0,004	0,146	0,955	-0,252	-0,276	0,703
Minv Hroe Ssize	-0,002	0,792	0,718	-0,681	-0,59	0,134
Minv Hroe Msize	0,007	0,069	0,998	-0,294	-0,425	0,592
Minv Hroe Bsize	0,007	0,015	0,758	-0,329	-0,042	0,582
Hinv Lroe Ssize	0,002	0,732	0,709	-0,887	-1,617	0,647
Hinv Lroe Msize	0,024	0	0,877	-1,16	-1,544	0,553
Hinv Lroe Bsize	0,013	0,069	0,157	-0,571	-0,274	0,013
Hinv Mroe Ssize	0,003	0,482	0,657	-0,782	-1,107	0,532
Hinv Mroe Msize	0,01	0,01	0,679	-1,072	-0,726	0,514
Hinv Mroe Bsize	0,01	0,032	0,389	-0,167	-0,239	0,132
Hinv Hroe Ssize	-0,004	0,416	0,54	-0,697	-1,051	0,39
Hinv Hroe Msize	0,012	0,011	0,874	-0,781	-0,65	0,488
Hinv Hroe Bsize	0,893	0	1,208	1,356	-0,287	0,021

Table 4: CNMZ 27 portfolios regression data, Intercept and p-values, coefficients, adjusted R² according to the model

$$R_{it} - R_{ft} = \alpha + \beta^{i}_{MKT} MKT_t + \beta^{i}_{INV} INV_t + \beta^{i}_{ROE} ROE_t + \varepsilon_{it} \text{ (Eq. 8)}$$

Table 4 shows that the CNMZ underestimates the returns of 11 portfolios since the α is positively significant at the 5 % level for these portfolios. Surprisingly of these 11 portfolios, 4 are in the low investment group, which is about 44% of the total portfolios in that group. In addition, 5 of the 11 portfolios are in the high investment category, about 56% of the total amount of portfolios in that category. This indicates that in our study the CNMZ seems to have difficulties correctly estimating the returns of portfolios containing either companies with a low investment ratio or companies with a high investment ratio.

The value of the adjusted R^2 for the CNMZ regressions range from between as low as 1.3% to 77%. An explanation to why the adjusted R^2 values for the CNMZ, compared to the FF3, gets as low as 1.3% could be that the CNMZ regressions contain more dependent portfolios than the FF3 regressions, 27 compared to 16. Therefore, each CNMZ portfolio contains on average fewer companies than the FF3 portfolios, which might have a negative impact on its adjusted R^2 values. Especially for the portfolios that might contain fewer companies, due to our limited sample and time period, than the other portfolios, for instance the Hinv/Lroe/Bsize portfolio which only obtains a adjusted R^2 value of 1.3%.

4.4 Results for the regressions including all three models

4.4.1 Earnings Surprises

Table 10 shows that the high SUE decile earns an average monthly return of 0.013% while the low SUE decile earns an average monthly return of 0.07%. This means that firms with high earnings surprises earn higher average returns than firms with low earnings surprises. Our high-minus low SUE decile earns obtains a CAPM alpha of 0.007, (t=1.20), a Fama and French alpha of 0.011, (t=2.11), and a CNMZ alpha of 0.005 (t=1.08). The CNMZ thereby has the lowest alpha of the three models and can thereby do a good job in comparison with the other models in explaining the post-earnings announcement drift of the high-minus-low portfolio. However the difference of the alphas is small; 0.06. The high-minus-low decile has a ROE beta of 0.71, where a positive beta means that a portfolio has higher return on equity. This gives the intuitive result that firms that have experienced positive earnings surprises have higher average returns than their counterparts that have experienced negative earnings surprises. The high-minus-low decile CNMZ market beta equals -0.21 and the INV beta equals -0.67, where a negative INV beta means that a portfolio invest more. The negative INV beta thereby implies that firms with positive earnings surprises invest more than their counterparts with negative earnings surprises. Furthermore since the positive earnings surprises firms earn higher average returns this finding implies that the market may have looked positively on the investments of these firms resulting in higher average returns of these stocks. The CNMZ model obtains the highest mean absolute error of its alphas; 0.08 compared to 0.07 for the CAPM and the FF3. This means that the CNMZ is doing slightly worse in explaining the post-announcement earnings drift when looking at all portfolios. Again the difference is small; 0.01. All models are rejected by the Gibbons, Ross, and Shanken test - the GRS test.[140] This finding means that the null hypothesis that all alpha values are equal to zero is rejected and therefore none of the models perfectly explains the anomaly. Looking at the adjusted R^2 values the results shows a pattern that the FF3 consistently obtains the highest adjusted R^2 for every portfolio, the CNMZ consistently come in the middle and the CAPM consistently obtains the lowest adjusted R^2. The finding is most obvious in the low decile, where the FF3 obtains an adjusted R^2 of 73% while the second best model in this decile, the CNMZ reaches 55%. Thus this result implies that the FF3 is good at explaining the variance of the returns of this decile. Looking at all deciles the CAPM obtains adjusted R^2 of 11% to 39%, the CNMZ 35% to 55%, and the FF3 41% to 73%. The adjusted R^2 measure suggests that the FF3 overall is the most adequate model in explaining the variance of the returns of the post-announcement earnings drift.

In Chen, Novy-Marx, and Zhang the high decile earns a return of 0.77% and the low decile earns an average return of 0.41%. This is in line with our results and the findings of Foster, Olsen and Shevlin[141] where companies with high earnings surprises earn higher average returns than their counterparts with low earnings surprises. The high-minus low SUE decile obtains a CAPM alpha of 0.40, (t=3.27), a Fama and French alpha of 0.46, (t=3.55), and a CNMZ alpha of 0.12 (t=0.91). The CNMZ obtains the lowest alpha which is the same result we reach, though the difference of the alphas of Chen, Novy-Marx and Zhang are much larger. The ROE beta is 0.35 while the CAPM beta and the FF3 beta are -0.03, and -0.01, respectively. The positive ROE beta is in line with our results while the CAPM and FF3 betas of Chen, Novy-Marx, and Zhang are much smaller than our CAPM and FF3 betas. The negative INV beta we obtain means that the firms with positive earnings surprises, which were found to earn higher average returns, are investing more than their counterparts. This result is contrary to the finding of Chen, Novy-Marx, and Zhang that firms that earn higher average returns invest less than their counterparts. In Chen, Novy-Marz, and Zhang the mean

[140] Gibbons, Ross, & Shanken (1989)
[141] Foster, Olsen & Shevlin (1984)

absolute error is found to be 0.16% of the CAPM, 0.17% of the FF3, and 0.10% of the CNMZ; that is the CNMZ obtains the smallest mean absolute error of the models. We obtain the opposite result since the CNMZ mean absolute error is the largest in our results. In Chen, Novy-Marx, and Zhang the CAPM and the FF3 are rejected by the GRS test but the CNMZ is not rejected.

The difference in the results can be because a number of reasons. The time period in Chen, Novy-Marx, and Zhang is longer with 468 months of data while we have 105 months of data. The Chen, Novy-Marx, and Zhang sample using data from Kenneth French´s homepage[142] contains 1837 firms as of December 2010 while our sample contains 369 firms as of the same date. The Chen, Novy-Marx, and Zhang sample and our sample are also from different markets; the USA and the UK, respectively. As discussed earlier there are also many financial downturns during our time period.

4.4.2 Net Stock Issues

In table 11 panel A it can be seen that firms with high net stock issues earn higher average returns than firms with low net stock issues; 1.02% versus 0.62% per month. The high-minus-low portfolio obtains a CAPM alpha of 0.003 (t=0.93), a FF3 alpha of 0.003 (t=0.83), and a CNMZ alpha of 0.003 (t=0.82); all models have the same alpha of this decile. The mean absolute errors of the alphas are 0.06 for the CAPM, 0.05 of the FF3, and 0.06 of the CNMZ. The FF3 thereby has slightly lower errors of its alphas, however the difference is only 0.01. Since all models obtain the same alpha and roughly the same mean average error they do an equally good job in explaining the variance of the returns controlling for net stock issues. The high-minus-low decile has a factor loading on the INV of -0.27 (t=-1.72). The high decile has an INV beta of -0.42 while the low decile has a beta of -0.15. This implies that companies with high net stock issues invest more than companies with low net stock issues. Furthermore since the companies with higher net stock issues on average obtains 0.4% higher average returns per month than their low net stock issues counterparts this could mean that the investments of the high net stock issues firms have had a positive impact on the stock price and the average returns. The high-minus-low decile has a factor loading on the ROE of -0.41 (t=-3.41), the high decile -1.08 and the low decile -0.61. This would suggest that the high decile earn lower average returns since a lower ROE beta implies lower profitability. However the high decile earns higher average returns during our time period. One reason for this could be that the firms with high net stock issues in our sample have managed to create

[142] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html

value with the funds obtained from the stock issues. The investments made with the funds seem to have been made in projects with net present value exceeding zero which has had a positive impact on the stock price. The lower profitability measured by return on equity would be a direct effect of the increase in the number of stocks which leads to lower earnings in pounds per stock.

An evaluation of the adjusted R^2 values gives the same result as in section 4.4.1 where the FF3 obtains the highest adjusted R^2 values, the CNMZ takes the second place and the CAPM obtains the lowest adjusted R^2 values. The CAPM obtains adjusted R^2 of 15% to 59%, the CNMZ 23% to 68%, and the CNMZ 25% to 79%. The CNMZ adjusted R^2 comes close to the FF3 corresponding value of portfolio five, implying that both of the models are good at explaining the variance of the returns of the middle portfolio. The CNMZ is also close to the adjusted R^2 of FF3 on the high-minus-low decile, however the explanatory power of this decile judged by the adjusted R^2 measure is not impressive for any of them.

In Chen, Novy-Marx and Zhang and in Fama and French[143] firms with high net stock issues earn lower average returns than firms with low net stock issues, contrary to our results. In Chen, Novy-Marx and Zhang the corresponding results are obtained; a high-minus low portfolio CAPM alpha of -0.64 (t=-4.40), a FF3 alpha of -0.63 (t=-4.42), and a CNMZ alpha of -0.26 (t=-1.79). Consequently the CNMZ alpha is the lowest with some margin while our high-minus-low alphas all are equal. In both, the Chen, Novy-Marx and Zhang study and in our study all models are rejected by the GRS test, which implies that the alphas are not equal to zero. The results from the CNMZ article are: high-minus-low decile has a factor loading on the INV of -0.24 (t=-3.65). Here our results and the results from Chen, Novy-Marx and Zhang article are quite similar; it is found that high net stock issues firms invest more than low net stock issues firms. In Chen, Novy-Marx and Zhang the high decile has a ROE factor loading of -0.24 and the low decile has a ROE factor loading of 0.12, consequently the high decile has a lower factor loading on ROE than the low decile.

4.4.3 Asset Growth

As can be seen in table 11 panel B high asset growth firms earns higher average returns than low asset growth firms; 1.02% versus 0.96% per month. This is the opposite of the results from the CNMZ article where high asset growth firms earns lower average returns than low asset growth firms; 0.20% versus 0.99% per month. Our high-minus-low decile obtains a

[143] Fama & French (1998)

CAPM alpha of 0.000 (t=0.11), a FF3 alpha of 0.002 (t=0.39), and a CNMZ alpha of -0.002 (t=-0.54). The CNMZ article has the corresponding alphas: CAPM alpha of -0.87 (t=-4.26), a FF3 alpha of -0.45 (t=-2.53), and a CNMZ alpha of -0.52 (t=-2.80). The FF3 outperforms the CNMZ in explaining the variance of the returns controlling for asset growth in the Chen, Novy-Marx and Zhang. In Chen, Novy-Marx and Zhang the CAPM alpha mean absolute error is 0.22%, FF3 alpha of 0.14%, and a CNMZ alpha of 0.15%, thus not large differences between the models. Our corresponding results are a CAPM mean absolute error of its alpha of 0.007, and FF3 and CNMZ obtains slightly lower mean absolute errors of their alphas of 0.005, this implies that the FF3 and the CNMZ explains the variance of the returns due to the asset growth anomaly slightly better than the CAPM. The high-minus-low decile in Chen, Novy-Marx and Zhang has a factor loading on the INV of -1.17 and a ROE factor loading of 0.23 (t=2.37). We have corresponding results of the high-minus-low decile: a factor loading on the INV of -0.72 (t=4.16) which means that companies with high asset growth invest more than companies with low asset growth, and a ROE factor loading of 0.23 (t=1.59), these are quite similar results. The result of a positive factor loading on the ROE for the high-minus-low decile means that companies with high asset growth is more profitable than companies with low asset growth. The negative high-minus-low INV beta implies for both our study and the Chen, Novy-Marx and Zhang study that firms with high asset growth invest more heavily than their counterparts with low asset growth. In both studies all models get rejected by the GRS test. The adjusted R^2 values of the asset growth deciles gives similar results as in 4.4.1, and 4.4.2, respectively, with one exception; the CNMZ obtains the highest adjusted R^2 explanatory power for the high-minus-low decile. In the high-minus-low decile the CAPM, and the FF3 have adjusted R^2 value close to zero which means that they cannot be trusted to explain the variance of the returns of this portfolio, judging by the adjusted R^2 measure. The CNMZ obtains an adjusted R^2 of 22% for this portfolio which is not much either, but better than zero. In the low decile the FF3 and the CNMZ obtain the same adjusted R^2 which means that they are equally good at explaining the variance of the returns of this decile. Overall the CAPM obtains adjusted R^2 of -0.03% to 44%, the CNMZ 22% to 69%, and the FF3 -1% to 72%.

Our results show that companies with high asset growth have higher average returns than companies with low asset growth, which is the opposite of Chen, Novy-Marx and Zhang and also of Cooper, Gulen, and Schill[144] who find that high asset growth firms have lower average

[144] Cooper, Gulen, & Schill (2008)

returns than low asset growth firms. Companies with high asset growth are more profitable and thus invest more[145] and since they invest more they should have lower average returns[146]. However, since our results show them to actually have higher average returns, a possible explanation is that they have made sound investments for instance, investments with a positive net present value (NPV), investments that have had value creating synergies like economies of scale and scope and so forth, such investments would be well received by the market and result in higher returns.

4.4.4 Book-to-Market Equity

Table 12 shows factor regression on the FF3 16 size and book-to-market portfolios. The results in table 6, panel A, show that value stocks earn higher average returns compared to growth stocks. Because, the average high-minus-low returns is approximately 0.6% per month (t = 0.62) in the smallest size quintile and about 0.5% (t = 0.65) in the largest size quintile. The small-stock value-minus-growth quintile has a CAPM alpha of 0.006% (t = 0.85) although low it is still larger than the FF3 alpha of – 0.005% (t = – 0.36). The big-stock value-minus-growth quintile has a CAPM alpha of 0.005% (t = 1.42) and the FF3 obtains an alpha of only 0.003% (t = 0.77).

The results from panel A coincides very well with those of Chen, Novy-Marx and Zhang, their results also show that value stocks on average earn higher returns than growth stocks, this also corresponds with the Fama and French theory that small-cap stocks tend to outperform large-cap stocks.[147] Furthermore, Chen, Novy-Marx and Zhang's results also achieve a consistently higher alpha value for the CAPM compared to the FF3, which shows that the FF3, as expected, outperforms the CAPM.

Panel B shows that the small-stock value-minus-growth alpha for the CNMZ has a positive value of 0.005% (t = 1.08) which is the opposite of the negative alpha value obtained by the FF3 of – 0.005% (t = – 0.36). However, it is only a difference of 0.01 between the two results. In addition, the CNMZ does a good job in capturing the small-growth anomaly since its alpha value is only 0.003% compared to the FF3 alpha value of 0.008%. Furthermore, for the big-stock value-minus-growth quintile the CNMZ obtains only a slightly higher alpha of 0.005% compared to the FF3 alpha of 0.003%. In addition, the CNMZ also obtains a slightly higher

[145] Fama & French (1996)
[146] Chen, Novy-Marx & Zhang (2011)
[147] Fama & French (1992)

alpha of 0.009% compared to the FF3 alpha of 0.003% for the small-value portfolio, but it perfectly match the FF3 alpha of 0.003% for the big-growth portfolio. The FF3 does however outperform the CNMZ when it comes to the mean absolute error (m.a.e) metric, 0.0034% compared to 0.0057% for the CNMZ and 0.0065% for the CAPM.

Our results from panel B match Chen, Novy-Marx and Zhang's results very well and even surpass them on some points. For instance, regarding the small-value portfolio where they experienced a large difference between their model and the FF3 but our results show only a slight difference.

Panel B also shows that value stocks have higher INV factor loadings compared to growth stocks, since the value stocks have less negative loadings than growth stocks. The loading spread range from approximately 0.12 to 0.55. This result is equivalent to that of Chen, Novy-Marx and Zhang's. Growth firms that have high valuation ratios have more growth opportunities and thus invest more compared to companies that have low valuation ratios.

Regarding the ROE factor loadings, panel B shows that both value stocks and growth stocks obtain negative values and the loading spreads range from approximately – 0.14 to – 0.07. This result differs from the Chen, Novy-Marx and Zhang study since they only obtain a negative value for the high-minus-low portfolio in the largest size quintile. The negative ROE factor loadings are because the value stocks obtain higher negative loadings than growth stocks. The reason that all the portfolios have negative factor loadings is because, as explained in 4.1.3, our time period have experienced several economic crisis which have lead to lower profitability for both value stocks and growth stocks. However, the crises have had a larger negative effect on the profitability of value stocks than growth stocks. All three models are rejected by the GRS test, which is the same result as in the Chen, Novy-Marx and Zhang study.

In table 13, the adjusted R^2 values for each portfolio for the three different models are presented. The results show that the CAPM obtains the lowest R^2 values of 15% to 74% however; its R^2 values do match those of the FF3 for the portfolios containing the biggest sized companies. Overall the FF3 obtains the highest R^2 values ranging from 55% in the small-stock growth quintile to 82 % in the small-stock value quintile. Hence, the FF3 does a good job estimating small sized value stocks. In addition, the CNMZ obtains values ranging from 32% for the small-stock growth quintile to 76% for the portfolio with the biggest size and average book-to-market equity companies. The CNMZ match the FF3 well when it comes to the portfolios containing the average sized companies. Furthermore, the CNMZ outperforms both the CAPM and the FF3 when it comes to the portfolios that consist of the biggest sized companies, by obtaining higher R^2 values for each of the portfolios in the biggest size quintile. Hence, the CNMZ does a better job estimating big sized stocks than the FF3.

4.4.5 Industries

In table 14 it can be seen that all of the models are rejected by the GRS test. In Chen, Novy-Marx and Zhang the only model that is not rejected by the GRS test is the CAPM. In our study the CAPM obtains the highest mean absolute error of its alphas, followed by the CNMZ, and the FF3 obtains the lowest mean absolute error of its alphas. However the differences are not large. In Chen, Novy-Marx and Zhang the corresponding results are CAPM mean absolute error 0.15%, FF3 and CNMZ 0.19%, not large differences either. One more time the FF3 consequently obtains the highest adjusted R^2. The CNMZ obtains slightly lower R^2 values while the CAPM obtain the lowest R^2 values. The CAPM obtains adjusted R^2 of 29% to 61%, the CNMZ 28% to 72%, and the FF3 26% to 78%. The CNMZ is good at explaining the variance of the returns of the Manuf and HiTec sectors, with adjusted R^2 high and close to those of the FF3.

4.5 Validity and reliability

4.5.1 Multicollinearity

A factor that might affect our results is multicollinearity, 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 5 and 6. Although there seem to be some small level of negative correlation between SMB and HML in the FF3 and between INV and ROE in the CNMZ, but since none of the correlations exceed neither 0.5 nor – 0.5 we conclude that multicollinearity should not cause a problem in our study.

FF3	*Rm-Rf*	*SMB*	*HML*
Rm-Rf	1,000		
SMB	– 0,060	1,000	
HML	0,354	– 0,471	1,000

Table 5: FF3 explanatory variables correlation data, Correlation between the explanatory variables in the regression

$$R_{it} - R_{ft} = \alpha + \beta_m^i(R_{mt} - R_{ft}) + \beta_{SMB}^i SMB_t + \beta_{HML}^i HML_T + \varepsilon_{it} \text{ (Eq. 6)}$$

CNMZ	*Rm-Rf*	*INV*	*ROE*
Rm-Rf	1,000		
INV	0,240	1,000	
ROE	– 0,348	– 0,466	1,000

Table 6: CNMZ explanatory variables correlation data, Correlation between the explanatory variables in the regression

$$R_{it} - R_{ft} = \alpha + \beta_{MKT}^i MKT_t + \beta_{INV}^i INV_t + \beta_{ROE}^i ROE_t + \varepsilon_{it} \text{ (Eq. 8)}$$

4.5.2 Homoscedasticity and heteroscedasticity

An underlying assumption for regression analysis is that the variance of the error is constant across observations, in other words there exist homoscedasticity[148]. Assuming a distribution of data is homoscedastic when in actuality it is heteroscedastic will result in an overestimation of the goodness of fit, in our case the adjusted R² values. If we have heteroskedasticity instead of homoscedasticity it will not affect the coefficients of the variables, but instead it will have an effect on the standard errors of the coefficients. Therefore, in order for us to comment on the significance of the variables, we need to test for occurrence of homoscedasticity or

[148] Brooks (2008)

heteroscedasticity. In order to test for presence of heteroscedasticity we have conducted a Goldfeld-Quandt test, see tables 16 and 17, respectively. The null hypothesis of the test is that there is homoscedasticity and consequently a rejection by the GQ test implies that heteroscedasticity is present. The results show that heteroscedasticity is generally present in the same deciles across models. The FF3 could not be rejected on slightly fewer occasions than the CAPM and the CNMZ.

4.5.3 Database reliability

In order to see if the data we collected from the database Datastream is accurate we have conducted an evaluation of the accounting data by looking at the annual reports from the homepages of 33 companies, one company randomly selected from each industry sector seen in table 15. This evaluation sample of 33 companies equals 9% of the total number of companies in our sample. The evaluation gave satisfactory results as it was found that the accounting data obtained from Datastream coincided with the data of the annual reports from the companies´ homepages.

Chapter 5

Conclusion

In this chapter the conclusions of our study are presented as well as suggestions of future research topics.

5.1 Conclusions

The CMNZ is found to produce inferior results, compared to the FF3, when regressions are made using the monthly excess returns from its own 27 portfolios as the dependent variables. This is evident since the model produces several α values that are positively significant at the 5 % level, which means that the model underestimates the returns for several portfolios, especially those containing either companies with a low investment ratio or companies with a high investment ratio. Although the FF3 also obtains α values that are positively significant at the 5 % level, the percentage of portfolios are far less than for the CNMZ and a measure of whether or not it performed sufficiently enough was that the α values should be statistically insignificant from zero.

Furthermore, the CNMZ obtains lower adjusted R^2 values, ranging from 1.3% to 77%, compared to the FF3 which obtains adjusted R^2 values between 55% and 82%. As previously stated one explanation to why the adjusted R^2 values for the CNMZ are much lower than the FF3 values could be that the CNMZ regressions contain more dependent portfolios than the FF3 regressions. Hence each CNMZ portfolio will on average contain fewer companies than the FF3 portfolios which might have a negative impact on its adjusted R^2 values. Therefore, further studies containing more companies, thereby increasing both the number of companies in each CNMZ portfolio and the total number of FF3 portfolios, need to be conducted.

However, in the book-to-market equity test instead of taking the monthly excess returns from the 27 CNMZ portfolios, the excess returns from the 16 FF3 portfolios are used as dependent variables in the regressions. This improves the CNMZ results. The findings from this test show that the CNMZ performance is, on average, nearly equivalent to the performance of the FF3, since the α values of the CNMZ are close to those of the FF3. The α values are at times higher than those of the FF3, but only slightly, and at times the CNMZ obtains α values that are lower than the FF3, for example in the small-growth quintile. Which means that the CNMZ does a better job in capturing the small-growth anomaly than the FF3, and since it obtains the same α value as the FF3 for, for instance, the big-growth portfolio it does an equal job in capturing the big-growth anomaly. The results from the book-to-market equity test even at some points surpass those of Chen, Novy-Marx and Zhang for instance regarding the small-value portfolio. Where their results show a large difference between the models our results only show a slight difference.

In addition, the adjusted R^2 values for the CNMZ significantly improve when both models are regressed on the same dependent variables, ranging from 32% to 76%. Although, on average the FF3 obtains higher adjusted R^2 values the CNMZ outperforms it regarding portfolios that consist of the biggest sized companies obtaining higher R^2 values for each of the portfolios in the biggest size quintile. Hence, the CNMZ better explains the excess returns for big sized stocks than the FF3.

With the earnings surprises test it is found that all three models do a good job in explaining both the average return and the variance of the returns when controlling for earnings surprises. Hence, all three models explain the post-earnings announcement drift. In the Chen, Novy-Marx and Zhang study the authors judge the CNMZ to be the better model to explain the post-earnings announcement drift. However, with our results such a judgment is not possible since none of the models is clearly superior to the other models. Although, the FF3 seems to be the better model, though not superior, since it obtains the lowest α values for most portfolios as well as the highest adjusted R^2 values for each portfolio. It is also found that companies with higher average returns invest more than firms with lower average returns.

One possible explanation for why the CNMZ is not deemed the best model to explain post-earnings announcement drift could be that the time period is shorter for our study and it contains fewer companies compared to the Chen, Novy-Marx and Zhang study.

In the net stock issues test it is found that our results are the opposite of those in the Chen, Novy-Marx and Zhang study since in our study firms with high net stock issues earn higher average returns than firms with low net stock issues. Chen, Novy-Marx and Zhang find that firms with high net stock issues earn lower average returns than firms with low net stock issues. Since all models obtain the same alpha and roughly the same mean average error all three models do an equally good job in explaining the variance of the returns when controlling for net stock issues. However, regarding the high-minus-low decile the factor loading on the

INV obtains a negative value, as did the Chen, Novy-Marx and Zhang study. This suggests that high net issues firms invest more than low net issues firms, and that high net issues firms are somewhat less profitable than low net issues firms. Putting together the findings that the high net stock issues firms investment more and also earn higher average returns would imply that there is a tendency that the market reacts positively to investments which gives higher average returns of the stocks that invest more. The findings of the earnings surprises portfolios go in the same direction. These findings are contrary to the results of Chen, Novy-Marx, and Zhang where higher investments are found to lead to lower average returns.

In addition, our results for the asset growth test are also found to be the opposite of those in the Chen, Novy-Marx and Zhang study, since in our study high asset growth firms earn higher average returns than low asset growth firms. In Chen, Novy-Marx and Zhang's study the CNMZ underperforms the FF3 in explaining the variance of the returns when controlling for asset growth, this is also the case in our study but not by as much as in their study. In our study the CNMZ obtains more equivalent values compared to those of the FF3, the only difference is for the high-minus-low decile. Again it is found that the portfolios that invest more earn higher average returns. These findings may be solely present in our sample and in our time period, i.e. the same sample on another time period may give another result and the other way around.

The results of the industries test also finds that the FF3 on average outperforms the CNMZ since the FF3 obtains, on average, both the lowest α values and the highest adjusted R^2 values. However, the CNMZ does obtain the highest adjusted R^2 value and lowest α value for the Energy industry, the highest adjusted R^2 value and equal α value for both the Telecom industry and Utilities industry.

Chen, Novy-Marx and Zhang's final conclusion is that their model at a minimum "seems a parsimonious description of the cross-section of expected stock returns. As such it might be useful in many applications that require expected return estimates, such as evaluating mutual fund performance, measuring abnormal returns in event studies, estimating expected returns for asset allocation, and calculating costs of equity for capital budgeting and stock valuation".[149]

[149] Chen, Novy-Marx & Zhang p.18 (2011)

Based on our study, our final conclusion is that the CNMZ model might be used as a complement to the FF3 but not as a substitute since the FF3, on average, delivers superior results compared to those of the CNMZ. However, the INV variable and ROE variable deliver useful information about companies performance, regarding their investment ratios and profitability ratios, and thereby their expected future returns. Together with the information provided by the FF3; the CNMZ can prove to be, for instance, a useful complementary tool for investors when evaluating possible investments.

5.2 Future research

For future studies it might be interesting to conduct the different tests that were not conducted in our study, Idiosyncratic Volatility, Distress and Hansen-Jagannathan Distance. Furthermore, for future studies a longer time period can be used to see how it will affect the outcomes of the CNMZ compared to the FF3; will the results of the CNMZ improve or diminish? In addition, future studies can be performed on different markets, for instance the Japanese market, the German market, the French market or the Russian market. It can also be interesting to conduct studies on two or more markets simultaneously to for instance see how the CNMZ performs on developing markets compared to more mature markets. It might also be interesting to add a fourth variable to the CNMZ in order to see whether or not it improves the performance of the model.

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Appendix

Table 7: SMB values

SMB values for each early portfolio (July 2002-March 2011, 105 months)

2002-07-31	-0,012	2004-07-30	0,021	2006-07-31	0,008	2008-07-31	-0,041	2010-07-30	-0,008
2002-08-30	-0,077	2004-08-31	0,000	2006-08-31	0,002	2008-08-29	-0,017	2010-08-31	0,004
2002-09-30	-0,053	2004-09-30	0,004	2006-09-29	-0,016	2008-09-30	-0,037	2010-09-30	-0,006
2002-10-31	-0,060	2004-10-29	0,015	2006-10-31	-0,034	2008-10-31	-0,068	2010-10-29	0,006
2002-11-29	0,016	2004-11-30	-0,011	2006-11-30	-0,005	2008-11-28	-0,099	2010-11-30	-0,013
2002-12-31	0,011	2004-12-31	-0,027	2006-12-29	0,034	2008-12-31	-0,080	2010-12-31	-0,002
2003-01-31	0,060	2005-01-31	0,038	2007-01-31	0,020	2009-01-30	0,043	2011-01-31	0,019
2003-02-28	-0,003	2005-02-28	0,020	2007-02-28	0,012	2009-02-27	0,039	2011-02-28	-0,012
2003-03-31	-0,001	2005-03-31	0,010	2007-03-30	-0,033	2009-03-31	0,026	2011-03-31	-0,002
2003-04-30	0,052	2005-04-29	0,027	2007-04-30	0,018	2009-04-30	0,183		
2003-05-30	0,100	2005-05-31	-0,034	2007-05-31	0,010	2009-05-29	0,031		
2003-06-30	0,053	2005-06-30	0,024	2007-06-29	0,003	2009-06-30	0,058		
2003-07-31	0,008	2005-07-29	0,001	2007-07-31	0,003	2009-07-31	-0,105		
2003-08-29	0,018	2005-08-31	0,016	2007-08-31	-0,023	2009-08-31	-0,017		
2003-09-30	0,029	2005-09-30	-0,002	2007-09-28	-0,027	2009-09-30	-0,043		
2003-10-31	-0,016	2005-10-31	-0,012	2007-10-31	-0,010	2009-10-30	-0,074		
2003-11-28	0,004	2005-11-30	-0,014	2007-11-30	-0,043	2009-11-30	-0,137		
2003-12-31	0,003	2005-12-30	-0,018	2007-12-31	-0,005	2009-12-31	-0,105		
2004-01-30	0,064	2006-01-31	0,031	2008-01-31	-0,008	2010-01-29	-0,023		
2004-02-27	-0,002	2006-02-28	0,007	2008-02-29	0,069	2010-02-26	-0,114		
2004-03-31	-0,022	2006-03-31	-0,010	2008-03-31	-0,030	2010-03-31	-0,152		
2004-04-30	-0,004	2006-04-28	0,009	2008-04-30	0,018	2010-04-30	-0,071		
2004-05-31	-0,015	2006-05-31	0,004	2008-05-30	-0,004	2010-05-31	-0,089		
2004-06-30	0,015	2006-06-30	-0,009	2008-06-30	0,028	2010-06-30	-0,076		

Table 8: Descripitive statistics of INV and ROE

Descriptive statistics of the INV factor and the ROE factor (July 2002-March 2011, 105 months)

Panel A: Descriptive statistics of r_{INV} and r_{ROE}

	Mean	α	$β_{MKT}$	$β_{SMB}$	$β_{HML}$	R^2
r_{INV}	0,02	0,000	0,13			0,05
	(-0,23)	(0,024)	(2,50)			
		-0,002	0,072	0,11	0,18	0,11
		(-0,88)	(1,32)	(1,89)	(3,00)	
r_{ROE}	-0,15	-0,0012	-0,24			0,11
	(-0,55)	(-0,41)	(-3,76)			
		0,001	-0,15	-0,49	-0,31	0,52
		(0,25)	(-3,07)	(-9,37)	(-5,67)	

Panel B: Correlation matrix (p-values)

	r_{ROE}	MKT	SMB	HML
r_{INV}	-0,47	0,24	0,03	0,29
	(0,00)	(0,01)	(0,75)	(0,00)
r_{ROE}		-0,35	-0,49	-0,21
		(0,00)	(0,00)	(0,03)
MKT			-0,06	0,35
			(0,55)	(0,00)
SMB				-0,47
				(0,00)

Table 9: Descripitive statistics of SMB and HML

Descriptive statistics of the SMB factor and the INV factor (July 2002-March 2011, 105 months)

	Panel A: Descriptive statistics of r_{SMB} and r_{HML}					
	Mean	α	β_{MKT}	β_{INV}	β_{ROE}	R^2
r_{SMB}	-0,70	-0,007	-0,06			-0,01
	(-0,23)	(0,024)	(-1,51)			
		-0,008	-0,25	-0,42	-1,01	0,32
		(-2,16)	(-2,81)	(-2,50)	(-7,22)	
r_{HML}	1,73	0,017	0,37			0,12
	(-0,55)	(3,80)	(3,84)			
		0,017	0,31	0,42	0,00	0,15
		(3,86)	(3,11)	(2,13)	(0,00)	

	Panel B: Correlation matrix (p-values)			
	r_{HML}	MKT	INV	ROE
r_{SMB}	-0,47	-0,06	0,03	-0,49
	(0,00)	(0,55)	(0,75)	(0,00)
r_{HML}		0,35	0,29	-0,21
		(0,00)	(0,00)	(0,03)
MKT			0,24	-0,35
			(0,01)	(0,00)
INV				-0,47
				(0,00)

Table 10: Earnings Surprises

Calendar times factor regressions for monthly percent excess returns of the SUE deciles (January 2005-March 2011, 75 months)

	Low	5	High	H-L	m.a.e. (pgrs)
	The SUE Deciles				
Mean	0,007	0,009	0,013	0,006	
t	0,45	0,78	1,43	0,42	
α	0,005	0,007	0,012	0,007	0,007
β	1,12	0,94	0,71	-0,41	(0,00)
$t\alpha$	0,63	1,56	2,88	1,20	
R^2	0,39	0,57	0,46	0,11	
α FF	0,000	0,006	0,011	0,011	0,007
β MKT FF	0,88	0,85	0,64	-0,24	(0,00)
β SMB	1,19	0,56	0,45	-0,74	
β HML	0,87	0,36	0,28	-0,59	
t αFF	-0,04	1,47	2,83	2,11	
R^2FF	0,73	0,72	0,59	0,41	
α CNMZ	0,006	0,008	0,012	0,005	0,008
β MKT CNMZ	0,85	0,78	0,65	-0,21	(0,00)
β INV	0,28	-0,02	-0,39	-0,67	
β ROE	-1,27	-0,82	-0,54	0,73	
t αCNMZ	1,00	2,05	3,12	1,08	
t βMKT CNMZ	5,82	9,16	7,41	-1,74	
t βINV	1,04	-0,12	-2,43	-3,10	
t βROE	-4,74	-5,28	-3,38	3,40	
R^2CNMZ	0,55	0,69	0,54	0,35	

Table 11: Net Stock Issues and Asset Growth

Calendar time factor regressions for monthly percent excess returns of the Net Stock Issues deciles and the Asset Growth deciles (July 2002-March 2011, 105 months)

	Low	5	High	H-L	m.a.e. (pgrs)	Low	5	High	H-L	m.a.e. (pgrs)
	Panel A: Net Stock Issues Deciles					Panel B: Asset Growth Deciles				
Mean	0,62	1,01	1,02	0,39		0,96	1,08	1,02	0,06	
t	0,7	1,21	0,97	0,42		1,04	1,39	1,11	-0,14	
α	0,005	0,009	0,008	0,003	0,006	0,008	0,010	0,009	0,000	0,007
β	0,90	0,99	1,25	0,35	(0,00)	0,96	0,82	1,04	0,08	(0,00)
$t\alpha$	1,47	2,56	1,51	0,93		1,70	2,81	1,90	0,11	
R^2	0,59	0,63	0,50	0,15		0,44	0,54	0,51	-0,003	
α FF	0,003	0,006	0,006	0,003	0,005	0,005	0,008	0,007	0,002	0,005
β MKT FF	0,80	0,89	1,11	0,31	(0,00)	0,82	0,73	0,93	0,11	(0,00)
β SMB	0,59	0,43	0,93	0,34		0,81	0,47	0,76	-0,05	
β HML	0,35	0,34	0,52	0,16		0,52	0,32	0,42	-0,10	
t αFF	1,21	1,92	1,39	0,83		1,33	2,49	1,88	0,39	
R^2FF	0,79	0,73	0,72	0,25		0,69	0,68	0,72	-0,01	
α CNMZ	0,004	0,008	0,007	0,003	0,006	0,007	0,009	0,008	-0,002	0,005
β MKT CNMZ	0,77	0,85	1,05	0,28	(0,00)	0,69	0,71	0,92	0,23	(0,00)
β INV	-0,15	0,05	-0,42	-0,27		-0,07	-0,15	-0,79	-0,72	
β ROE	-0,61	-0,54	-1,08	-0,47		-1,15	-0,52	-0,92	0,23	
t αCNMZ	1,42	2,66	1,48	0,82		1,90	2,85	1,99	-0,54	
t βMKT CNMZ	11,10	12,02	9,30	3,37		8,21	9,71	10,27	2,61	
t βINV	-1,11	0,33	-1,94	-1,72		-0,40	-1,05	-4,54	-4,16	
t βROE	-5,51	-4,77	-5,99	-3,56		-8,50	-4,41	-6,37	1,59	
R^2CNMZ	0,68	0,71	0,63	0,23		0,69	0,61	0,65	0,22	

Table 12: Book-to-market equity

Calendar time factor regressions for monthly percent excess returns of 16 size and book-to-market equity portfolios (July 2002-March 2011, 105 months)

	L	3	H	H-L	L	3	H	H-L
	Panel A: Means, CAPM alphas, and Fama-French alphas							
	Mean				t			
S	0,65	1,24	1,26	0,61	0,45	1,32	1,07	0,62
3	0,87	1,03	0,96	0,09	1,01	1,09	0,91	-0,10
B	0,49	0,52	1,00	0,51	0,52	0,53	1,17	0,65
	α (m.a.e. = 0,0065)				tα (pGRS = 0,00)			
S	0,005	0,011	0,011	0,006	0,55	1,92	1,41	0,86
3	0,007	0,009	0,008	0,000	1,97	1,92	1,45	-0,51
B	0,004	0,004	0,008	0,005	1,22	1,33	2,64	1,42
	αFF (m.a.e. = 0,0034)				tαFF (pGRS = 0,00)			
S	0,008	0,008	0,003	-0,005	1,09	1,92	0,73	-0,36
3	0,007	0,007	0,002	-0,005	1,98	1,57	0,49	-1,48
B	0,003	0,003	0,006	0,003	1,00	1,09	1,77	0,77

	L	3	H	H-L	L	3	H	H-L
	Panel B: The CNMZ regressions							
	αCNMZ (m.a.e. = 0,0057)				tαCNMZ (pGRS = 0,00)			
S	0,003	0,010	0,009	0,005	0,39	1,99	1,46	1,08
3	0,007	0,008	0,007	0,000	1,93	1,87	1,39	-0,54
B	0,003	0,003	0,008	0,005	1,15	1,26	2,59	1,44
	βINV				tβINV			
S	-0,86	-0,72	-0,31	0,55	-2,29	-3,24	-1,15	1,14
3	-0,28	0,02	0,08	0,36	-1,81	0,09	0,33	2,14
B	-0,18	-0,31	-0,06	0,12	-1,32	-2,55	-0,42	0,90
	βROE				tβROE			
S	-1,66	-1,24	-1,80	-0,14	-5,34	-6,79	-8,08	-2,74
3	-0,57	-0,49	-0,63	-0,07	-4,42	-3,03	-3,36	1,06
B	-0,20	-0,28	-0,31	-0,12	-1,78	-2,78	-2,68	-0,90

Table 13: Book-to-market equity R^2 values

R^2 values for CAPM, FF3 and CNMZ based on calendar time factor regressions for monthly percent excess returns of 16 size and book-to-market equity portfolios (July 2002-March 2011, 105 months)

	L	3	H	L	3	H	L	3	H
	R^2 CAPM			R^2 FF			R^2 CNMZ		
S	0,15	0,30	0,32	0,55	0,70	0,82	0,32	0,51	0,59
3	0,56	0,56	0,53	0,63	0,62	0,64	0,63	0,59	0,58
B	0,63	0,74	0,70	0,63	0,74	0,70	0,64	0,76	0,71

Table 14: Ten Industry Portfolios

Calendar time factor regressions for monthly percent excess returns of Ten Industry Portfolios (July 2002-March 2011, 105 months)

	NoDur	Durbl	Manuf	Enrgy	HiTec	Telcm	Shops	Hlth	Utils	Other	m.a.e. (pgrs)
Mean	0,80	0,80	1,24	2,10	1,46	0,58	0,76	0,84	0,51	0,95	
t	2,28	1,43	2,14	3,22	2,18	1,30	1,52	1,86	1,58	1,82	
α	0,007	0,007	0,011	0,020	0,013	0,005	0,006	0,007	0,004	0,008	0,0088
β	0,58	1,00	1,14	0,83	1,20	0,87	1,00	0,68	0,49	1,00	(0,00)
$t\alpha$	2,50	1,21	2,62	3,42	2,46	0,98	1,40	1,66	1,22	1,89	
R^2	0,45	0,40	0,61	0,29	0,51	0,41	0,51	0,31	0,27	0,52	
α_{FF}	0,006	0,003	0,008	0,023	0,009	0,004	0,003	0,008	0,005	0,006	0,0075
$\beta_{MKT\ FF}$	0,53	0,87	1,02	0,85	1,04	0,82	0,87	0,63	0,49	0,90	(0,00)
β_{SMB}	0,14	0,51	0,68	0,48	0,94	0,40	0,79	0,55	0,05	0,67	
β_{HML}	0,14	0,43	0,44	0,02	0,59	0,18	0,49	0,22	0,01	0,37	
$t_{\alpha FF}$	1,91	0,55	2,48	3,90	2,45	0,91	1,03	1,80	1,19	1,82	
R^2_{FF}	0,46	0,49	0,78	0,37	0,77	0,47	0,76	0,47	0,26	0,71	
α_{CNMZ}	0,007	0,006	0,010	0,019	0,011	0,004	0,005	0,006	0,005	0,007	0,0080
$\beta_{MKT\ CNMZ}$	0,56	0,84	0,99	0,80	0,94	0,70	0,81	0,51	0,54	0,88	(0,00)
β_{INV}	-0,10	0,15	-0,36	-0,98	-0,19	-0,30	-0,19	-0,17	-0,17	-0,48	
β_{ROE}	-0,13	-0,58	-0,83	-0,65	-1,21	-0,84	-0,91	-0,79	0,13	-0,75	
$t_{\alpha CNMZ}$	2,44	1,13	2,79	3,55	2,81	0,87	1,38	1,64	1,28	1,89	
$t_{\beta MKT\ CNMZ}$	8,32	7,01	12,17	6,37	9,93	7,39	9,42	5,53	6,50	9,93	
$t_{\beta INV}$	-0,74	0,63	-2,27	-4,02	-1,01	-1,61	-1,16	-0,98	-1,03	-2,79	
$t_{\beta ROE}$	-1,18	-3,04	-6,38	-3,21	-8,01	-5,52	-6,57	-5,36	0,99	-5,30	
R^2_{CNMZ}	0,44	0,46	0,72	0,39	0,71	0,54	0,66	0,46	0,28	0,62	

Table 15: Industry sectors of the Ten Industry Portfolios

The different industry sectors of the FTSE All Share Index included in the Ten Industry Portfolios. Financial companies with SIC-codes 6000-6799 are excluded from the sample. The division of industries included in the Ten Industry Portfolios can be found on Kenneth French´s homepage[150].

NoDur	BEVERAGES	FOOD & DRUG RETAILERS	FOOD PRODUCERS	TOBACCO			
Durbl	AUTOMOBILE&PARTS	HOUSEHOLD GOODS & HOME CONSTRUCTION	LEISURE GOODS	PERSONAL GOODS			
Manuf	AEROSPACE&DEFENSE	CHEMICALS	INDUSTRIAL ENGINEERING	FORESTRY & PAPER	GENERAL INDUSTRIALS	TECHNOLOGY HARDWARE & EQUIPMENT	
Enrgy	OIL & GAS PRODUCERS	OIL EQUIPMENT & SERVICES					
HiTec	ELECTRONIC & ELECTRICAL EQUIPMENT	SOFTWARE & COMPUTER SERVICES					
Telcm	FIXED LINE TELECOMMUNICATIONS	MOBILE TELECOMMUNICATIONS					
Shops	GENERAL RETAILERS	SUPPORT SERVICES					
Hlth	HEALTH CARE EQUIPMENT & SERVICES	PHARMACEUTICALS & BIOTECHNOLOGY					
Utils	ELECTRICITY	GAS, WATER & MULTIUTILITIES					
Other	ALTERNATIVE ENERGY	CONSTRUCTION & MATERIALS	INDUSTRIAL METALS & MINING	INDUSTRIAL TRANSPORTATION	MEDIA	MINING	TRAVEL & LEISURE

[150] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html

Table 16: GQ tests on Earnings Surprises, Net Stock Issues and Asset Growth

Goldfeld-Quandt test for detection of heteroscedasticity. The null hypothesis of the test is that there is homoscedasticity.

	Earnings Surprises											
	CAPM				FF3				CNMZ			
	L	5	H	H-L	L	5	H	H-L	L	5	H	H-L
GQ	12,78	3,29	1,66	10,26	4,36	2,17	1,50	4,56	9,33	1,97	1,46	9,08
Critical value	2,03	2,03	2,03	2,03	2,03	2,03	2,03	2,03	2,03	2,03	2,03	2,03
Rejected?	YES	YES	NO	YES	YES	YES	NO	YES	YES	NO	NO	YES

	Net Stock Issues											
	CAPM				FF3				CNMZ			
	L	5	H	H-L	L	5	H	H-L	L	5	H	H-L
GQ	2,78	1,51	2,42	1,87	1,56	1,03	1,25	1,58	3,25	1,73	3,14	2,01
Critical value	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
Rejected?	YES	NO	YES	YES	NO	NO	NO	NO	YES	NO	YES	YES

	Asset Growth											
	CAPM				FF3				CNMZ			
	L	5	H	H-L	L	5	H	H-L	L	5	H	H-L
GQ	1,05	3,54	2,53	1,09	1,27	2,55	2,96	1,12	1,10	2,90	4,26	1,05
Critical value	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
Rejected?	NO	YES	YES	NO	NO	YES	YES	NO	NO	YES	YES	NO

Table 17: GQ tests on Ten Industry Portfolios and Book-to-Market Equity

Goldfeld-Quandt test for detection of heteroscedasticity. The null hypothesis of the test is that there is homoscedasticity.

	NoDur	Durbl	Manuf	Enrgy	HiTec	Telcm	Shops	Hlth	Utils	Other
CAPM										
GQ	0,98	5,54	1,08	1,87	1,60	0,53	3,81	1,05	1,34	3,97
Critical value	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
Rejected?	NO	YES	NO	YES	NO	NO	YES	NO	NO	YES
FF3										
GQ	1,06	3,69	1,28	1,52	1,77	0,54	3,43	1,21	1,41	3,49
Critical value	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
Rejected?	NO	YES	NO	NO	NO	NO	YES	NO	NO	YES
CNMZ										
GQ	1,01	3,64	2,35	1,47	3,46	0,83	5,73	1,70	1,68	5,03
Critical value	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
Rejected?	NO	YES	YES	NO	YES	NO	YES	NO	NO	YES

		CAPM				FF3				CNMZ			
		L	3	H	H-L	L	3	H	H-L	L	3	H	H-L
GQ	S	7,78	1,97	1,47	1,37	7,36	1,68	1,07	3,81	10,06	3,17	1,18	1,36
Critical value		1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
Rejected?		YES	YES	NO	NO	YES	NO	NO	YES	YES	YES	NO	NO
GQ	3	1,70	2,07	3,43	2,29	1,36	1,58	2,16	2,23	1,89	1,94	2,28	1,78
Critical value		1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
Rejected?		NO	YES	YES	YES	NO	NO	YES	NO	YES	YES	YES	NO
GQ	B	2,61	1,43	2,40	1,28	2,54	1,33	3,20	1,28	2,67	1,59	2,53	1,13
Critical value		1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84	1,84
Rejected?		YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO

Table 18: Companies included in the sample

Companies included in the sample from the London Stock Exchange FTSE All Share Index.
Financial companies with SIC-codes 6000-6799 are excluded from the sample.

A-L

888 HOLDINGS	BRITISH SKY BCAST.GROUP	DOMINO'S PIZZA	HERITAGE OIL
AEGIS GROUP	BRITVIC	DRAX GROUP	HIKMA PHARMACEUTICALS
AFREN	BROWN (N) GROUP	DUNELM GROUP	HILL & SMITH
AFRICAN BARRICK GOLD	BT GROUP	E2V TECHNOLOGIES	HILTON FOOD GROUP
AGA RANGEMASTER GROUP	BTG	EAGA	HMV GROUP
AGGREKO	BUNZL	EASYJET	HOCHSCHILD MINING
ALTERIAN	BURBERRY GROUP	ELECTROCOMP.	HOGG ROBINSON GROUP
AMEC	BWIN PARTY DIGITAL ENTM.	ELEMENTIS	HOLIDAYBREAK
ANGLESEY MINING	CABLE & WIRELESS COMMS.	EMBLAZE	HOME RETAIL GROUP
ANGLO AMERICAN	CABLE & WIRELESS WWD.	ENQUEST	HOMESERVE
ANGLO PACIFIC GROUP	CADOGAN PETROLEUM	ENTERPRISE INNS	HORNBY
ANGLO-EASTERN PLTNS.	CAIRN ENERGY	ESSAR ENERGY	HOWDEN JOINERY GP.
ANITE	CAPITA GROUP	EURASIAN NATRES.CORP.	HUNTING
ANTOFAGASTA	CARCLO	EUROMONEY INSTL.INVESTOR	HUNTSWORTH
AQUARIUS PLATINUM (LON)	CARILLION	EXILLON ENERGY	HYDER CONSULTING
ARENA LEISURE	CARNIVAL	EXPERIAN	ICTL.HTLS.GP.
ARM HOLDINGS	CARPETRIGHT	FENNER	IMAGINATION TECHNOLOGIES
ASHLEY(LAURA) HOLDINGS	CENTAMIN EGYPT NPV (LON)	FERREXPO	IMI
ASHTEAD GROUP	CENTAUR MEDIA	FIBERWEB	IMPERIAL TOBACCO GP.
ASSOCIATED BRIT.FOODS	CENTRICA	FIDESSA GROUP	INCHCAPE
ASSURA GROUP	CHARTER INTL.	FILTRONA	INFORMA
ASTRAZENECA	CHEMRING GROUP	FINDEL	INMARSAT
ATKINS (WS)	CHIME COMMS.	FIRST GROUP	INNOVATION GROUP
AUTONOMY CORP.	CINEWORLD GROUP	FISHER(JAMES)& SONS	INTERNATIONAL PBPART.
AVEVA GROUP	CLARKE (T)	FLYBE GROUP	INTERNATIONAL POWER
AVIS EUROPE	CLARKSON	FORTH PORTS	INTERSERVE
AXIS-SHIELD	CLINTON CARDS	FORTUNE OIL	INTERTEK GROUP
AZ ELECTRONIC MATS.(DI)	COBHAM	FRENCH CONNECTN.GROUP	INTL.CONS.AIRL.GP.(CDI)
BABCOCK INTL.	COLT GROUP	FRESNILLO	INTL.FERRO METALS
BAE SYSTEMS	COMPASS GROUP	FULLER SMITH 'A'	INVENSYS
BALFOUR BEATTY	COMPUTACENTER	G4S	INVISTA FNDTN.PR.TRUST
BARR (AG)	CONSORT MEDICAL	GALLIFORD TRY	ITE GROUP
BARRATT DEVELOPMENTS	COOKSON GROUP	GAME GROUP	ITV
BATM ADVANCED COMMS.	COSTAIN GROUP	GEM DIAMONDS (DI)	JD SPORTS FASHION
BBA AVIATION	CPPGROUP	GENUS	JKX OIL & GAS
BELLWAY	CRANSWICK	GKN	JOHNSON MATTHEY
BERENDSEN	CRODA INTERNATIONAL	GLAXOSMITHKLINE	JOHNSTON PRESS
BERKELEY GROUP HDG.(THE)	CSR	GLEESON (MJ) GROUP	KAZAKHMYS
BETFAIR GROUP	DAILY MAIL 'A'	GO-AHEAD GROUP	KCOM GROUP
BG GROUP	DAIRY CREST	GOLDENPORT HOLDINGS	KELLER
BHP BILLITON	DE LA RUE	GOODWIN	KENMARE RES. (LON)
BLOOMSBURY PBL.	DEBENHAMS	GREENE KING	KESA ELECTRICALS
BODYCOTE	DECHRA PHARMACEUTICALS	GREGGS	KEWILL
BOOKER GROUP	DEVRO	HALFORDS GROUP	KIER GROUP
BOVIS HOMES GROUP	DIAGEO	HALMA	KINGFISHER
BP	DIALIGHT	HAMPSON INDS.	KOFAX
BRAEMAR SHIPPING SVS.	DIGNITY	HANSEN TNSMS.INTL.(DI)	LADBROKES
BRAMMER	DIPLOMA	HARDY OIL & GAS	LAIRD
BRITISH AMERICAN TOBACCO	DIXONS RETAIL	HAYS	LAMPRELL
BRITISH POLYTHENE INDS.	DOMINO PRINTING SCIENCES	HEADLAM GROUP	LAVENDON GROUP

LOGICA
LONMIN
LOOKERS
LOW & BONAR
MANAGEMENT CNSL.GP.
MARKS & SPENCER GROUP
MARSHALLS
MARSTON'S
MCBRIDE
MEARS GROUP
MECOM GROUP
MEGGITT
MELROSE
MELROSE RESOURCES
MENZIES (JOHN)
MICHAEL PAGE INTL.
MICRO FOCUS INTL.
MILLENNIUM & CPTH.HTLS.
MISYS
MITCHELLS & BUTLERS
MITIE GROUP
MONDI
MONEYSUPERMARKET COM GP.
MORGAN CRUCIBLE
MORGAN SINDALL GROUP
MORRISON(WM)SPMKTS.
MOTHERCARE
MOUCHEL GROUP
NAMAKWA DIAMONDS (DI)
NATIONAL EXPRESS
NATIONAL GRID
NCC GROUP
NEXT
NORTHERN FOODS
NORTHGATE
NORTHUMBRIAN WATER GP.
OCADO GROUP
OPTOS
OXFORD BIOMEDICA
OXFORD INSTRUMENTS
PACE
PAYPOINT
PEARSON
PENDRAGON
PENNON GROUP
PERSIMMON
PETROFAC
PETROPAVLOVSK
PHOENIX IT GROUP
PHOTO-ME INTL.
PREMIER FARNELL
PREMIER FOODS
PREMIER OIL
PROMETHEAN WORLD
PROSTRAKAN GROUP
PSION
PUNCH TAVERNS
PV CRYSTALOX SOLAR
PZ CUSSONS
QINETIQ GROUP
RANDGOLD RESOURCES
RANK GROUP
REA HOLDINGS
RECKITT BENCKISER GROUP
REDROW
REED ELSEVIER
REGUS
RENISHAW
RENOLD
RENOVO GROUP
RENTOKIL INITIAL
RESTAURANT GROUP
REXAM
RICARDO
RIGHTMOVE
RIO TINTO
RM
ROBERT WALTERS
ROBERT WISEMAN DAIRIES
ROLLS-ROYCE GROUP
ROTORK
ROYAL DUTCH SHELL A(LON)
ROYAL DUTCH SHELL B
RPC GROUP
RPS GROUP
SABMILLER
SAGE GROUP
SAINSBURY (J)
SALAMANDER ENERGY
SCOT.& SOUTHERN ENERGY
SDL
SENIOR
SEPURA
SERCO GROUP
SEVERFIELD-ROWEN
SEVERN TRENT
SHANKS GROUP
SHIRE
SIG
SINCLAIR PHARMA
SMITH & NEPHEW
SMITH (DS)
SMITHS GROUP
SMITHS NEWS
SOCO INTERNATIONAL
SOUTHERN CROSS HLTHCR. GP.
SPECTRIS
SPEEDY HIRE
SPIRAX-SARCO
SPIRENT COMMUNICATIONS
SPORTECH
SPORTINGBET
SPORTS DIRECT INTL.
ST.IVES
STAGECOACH GROUP
STHREE
STOBART GROUP ORD.
SUPERGROUP
SYNERGY HEALTH
TALKTALK TELECOM GROUP
TALVIVAARA MNG.CO.(CDI)
TARSUS GROUP
TATE & LYLE
TAYLOR WIMPEY
TED BAKER
TELECITY GROUP
TELECOM PLUS
TESCO
THOMAS COOK GROUP
THORNTONS
TOPPS TILES
TRAVIS PERKINS
TRIBAL GROUP
TRINITY MIRROR
TT ELECTRONICS
TUI TRAVEL
TULLOW OIL
UK COAL
UK MAIL GROUP
ULTRA ELECTRONICS HDG.
UMECO
UNILEVER (UK)
UNITED BUSINESS MEDIA
UNITED UTILITIES GROUP
UTV MEDIA
VECTURA GROUP
VEDANTA RESOURCES
VICTREX
VITEC GROUP
VODAFONE GROUP
VOLEX GROUP
VP
WEIR GROUP
WETHERSPOON (JD)
WH SMITH
WHITBREAD
WILLIAM HILL
WILMINGTON GROUP
WINCANTON
WOLFSON MICROELECTRONICS
WOLSELEY
WOOD GROUP (JOHN)
WPP
WSP GROUP
XCHANGING
XP POWER (DI)
XSTRATA
YELL GROUP
YULE CATTO