The Default Risk Puzzle

Evidence from the Swedish market

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Abstract

Default risk is a major source of potential losses to equity investors and the effect of default risk on stock returns have therefore been widely examined by several papers. However, whether there exists an anomalous significant relationship between default risk and stock returns is a rather unexplored subject on the Swedish market. This paper is therefore analyzing 436 firms on the Swedish market between 1993-2016. A multifactor model including size and book-to-market factors derived from Fama and French (1993) and a constructed factor based on default risk is analyzed against excess stock returns. For statistical testing of whether default risk is systematic or not, Fama and MacBeth (1973) two-step regression is performed. The results indicate that default risk is systematic and that there is a negative relationship between default risk and stock return, implying that less risk generates higher returns. The default risk puzzle is thereby present at the Swedish market.

Keywords: Default risk, Altman's Z"-score, Systematic risk, Fama-MacBeth two-step regression, Stockholm Exchange

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Definitions

BM – Book-to-market

E/P - Earnings/Price

HML (High minus Low) - refers to a factor, based on book-to-market, describing asset return presented by Fama and French (1993)

SMB (Small minus Big) - refers to a factor, based on size, describing asset return presented by Fama and French (1993)

Value stocks - firms with high book-to-market ratio

Growth stocks - firms with low book-to-market ratio

Systematic risk - risk that is related to the whole market and could therefore not be diversified away

Idiosyncratic risk - risk that is related to an individual asset, in this paper is risk related to a company's stock

1. Introduction

This part introduces the subject and the purpose of the study. Followed by the outline of the thesis.

Success has been the goal of mankind since the dawn of humans. Evolution, fighting and succeeding for millions of years, have brought us to where we are today, and the losers are nothing but a fleeting memory. Humans have developed ways to understand the world better, aiding oneself to achieve victory. Thus, in the financial market theories have been tested and advanced. These theories simplify for the investors to be on the winning side. However, some investors get avid and are prepared to extend beyond their comfort zone - all to beat the market. Consequently, they start to seek opportunities where others do not.

In asset pricing theory the fundamental tenet is that higher risk should be associated with higher expected returns, implying that all investors are risk averse (Fama and Macbeth, 1973). If default risk is seen to be systematic, investors should be compensated with a positive risk-premium for bearing systematic risk. Based on this, the relationship between default risk and stock returns is influenced on the financial market through risk-reward (Chava and Purnanandam, 2010). If the risk is non-systematic, there should be no differential within returns due to credit risk (Avramov et al., 2009).

The traditional Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965) and Black (1972) was one of the first models to explain asset returns and states that expected stock excess returns is adequately explained by the stock price's covariation with the overall market portfolio. However, this has been challenged by papers which have found large unexplained anomalies and presented evidence of additional parameters capturing the assets returns. Fama and French (1992;93) find that risk affecting stocks are multidimensional and show that variables such as size, E/P, leverage and book-to-market equity may all explain the returns of a firm's stock. They document that smaller firms and value stocks are rewarded with higher returns, arguing that these parameters may affect price and therefore equitable factors to explain the average returns. Also, several other studies have documented a significant relation between average stock return and book-to-market equity on the U.S stock market (Basu, 1983; Stattman, 1980 and Rosenberg, Reid and Lanstein, 1985). Hence, the original CAPM is not giving a complete picture and may consequently not be the best choice to explain the pricing of assets. Further, there is no consensus among researchers regarding which factors can fully explain the evolution of stock returns.

Later studies on asset pricing theory have invoked the concept of financial distress and some have found that there is a significant anomalous relationship between default risk and asset returns. However, the findings are inconsistent. Opler and Titman (1994) finds that the default risk is only linked to idiosyncratic parameters. Meanwhile, Dichev (1998) and Vassalou and Xing (2004), among others, find that default risk is systematic, but the effect on stock return differs. Some find a positive default risk premia and others find a negative, hence it remains an unsolved puzzle. Looking at the Swedish market, research regarding default risk premium is almost non-existing. In a study by Dahlbom and Wahledow (2017) Ohlson's O-score is analyzed together excess stock returns, but they do not obtain any significant results. One implication might be the chosen length of the sample period. Lundblad (2007) investigates companies between 1836 to 2003 and finds that a long sample period is necessary to define a positive relationship between risk and return.

Consequently, the market lack of consistency regarding if default risk is systematic and how it affects stock returns. Besides, evidence from the Swedish market are poorly. The purpose of this study is therefore to investigate whether the default risk is reflected in equity returns on the Swedish Stock Exchange between 1993 and 2016. This paper has taken inspiration from the Fama and French (1993) three-factor model including the size and book-to-market factor, and introduced an additional factor capturing the effect of default risk on stock returns. The statistical test of the impact of default risk is performed by the Fama-MacBeth (1973) two step regression. The measure of default risk is derived from the updated model of Altman Z-score (1968), namely Altman Z''-score model from 1995 (Altman, Hartzell and Peck, 1995). The authors aim to present comprehensive evidence about the relation between default risk and stock performance and strengthen the research on financial distress on the Swedish market.

This study aims to answer to the following question:

- *Is default risk priced in the cross-section of stock returns on the Swedish market?*

1.2 Outline of Thesis

The thesis is divided into six sections, where each part begins with a short description of the coming section. To guide the reader throughout the thesis, this paper has been organized in the following way:

The first part introduces the subject and the purpose. It presents why the chosen subject is relevant to today's current market situation. The second part consists of the theoretical framework of the thesis. The third part presents the method that has been used for this study. Also, the data is presented and what criteria that have been used to sort the data. Thereafter, a section of the data structure and portfolio construction follow. Lastly, a discussion about the risk of using the chosen method and what it implies for the study. The fourth part presents the result and the analysis from the main study. This section is divided into three parts. First, descriptive results will be presented. Secondly, the portfolio results and lastly; the output from Fama-MacBeth regression. The fifth part discusses the results presented in the fourth part from an economics perspective. Here is the defined problem area, purpose, result and previously theories combined throughout a discussion. Thereupon follows the conclusions of the thesis in part sixth. Lastly, will the bibliography be presented. This part includes the sources that have been used, but also the appendix.

2. Previous Literature

This section will initially present previous and underlying studies on risk factors and stock return, followed by a selection relevant studies examining the relationship of default risk and stock performance.

2.1 Stock performance and risk

The CAPM model provides a method of quantifying risk and how it is priced into equity returns. The standard formula is presented in equation 1, whereas the expected return of asset 'i' is explained by the risk-free return (Rf), the beta of the security (β) and the market risk premium ($E(R_{mt}) - Rf$).

$$E(R_{it}) = Rf + \beta(E(R_{mt}) - Rf) \quad (1)$$

The model has been shown to be insufficient in explaining the development of stock returns. Several studies have investigated the efficiency of CAPM and developed the model by adding other factors that may explain the stock returns. One of the leading studies is Fama and French (1993) which are adding factors such as size and book-to-market to CAPM. Using their so called three factor model, they found a significant result for size and book-to-market affecting stock returns. Since then, other papers such as Dichev (1998) and Vassalou and Xing (2004), have tried to add alternative factors to the model in hope to find additional explanatory variables that could capture stock returns. These will be further discussed in section 2.2.1.

2.1.1 Fama and Macbeth (1973) Two-step Regression

Eugene F. Fama and James D. Macbeth (1973) investigates the relationship between average return and risk of the New York Stock Exchange common stocks. The statistical tests are performed by a two-step regression model which is used to determine the betas and risk premia for any risk factors that are assumed to influence asset prices. The theoretical basis of the tests is the two-parameter portfolio model which has the underlying assumption of a perfect capital market, in that sense that there are no transactions costs nor information costs. Also, the investors are price takers and assumed to be risk averse. Thus, the investors are assumed to behave rational and tend to hold a portfolio which has minimum variance per unit of expected return. Consequently, in a perfect market these factors together imply the *efficient set theorem*.

Presenting the expected return in the CAPM model comes with three implications, which form the three hypotheses of Fama and Macbeth (1973) study: (1) The relationship between the expected return on a security and its risk in any efficient portfolio *m* is linear, (2) beta is the measure of all risk of a security I, (3) in a market equilibrium with risk averse investors, higher risk should be associated with higher expected returns.

The Two-step Regression Model

As the name reveals, the two-step regression model approach is divided into two steps. Firstly, five years observations are used to estimate the CAPM betas and the other risk measures, the standard deviation and squared beta for each portfolio of assets. Equation 2 is regressed on data for each period, as the average across the assets of a portfolio. These time series values of the regression coefficients are then used as explanatory variables in a set of cross-sectional regressions each month for the following four years. The four years period is a window rolled forward and repeated until the end of the sample. The result will reveal how much each factor influence the return of the portfolio, for each risk factor over time. The final estimate of the factor risk premium is going to be the average of the individual factor risk premium found in each period. A problem with the two-parameter model is that when running the tests, it will create an unavoidable 'errors-in-the-variables' problem. To avoid this, Fama and MacBeth (1973) formed portfolios of the studied equities.

To be able to test the hypothesis about expected returns the data is analyzed one period at a time using the following generalized cross-sectional regression (2).

$$R_{pt} = \gamma_{ot} + \gamma_{1t}\beta_p + \gamma_{2t}\beta_p^2 + \gamma_{3t}s_p + \epsilon_{pt} \quad (2)$$

Whereas t refers to period t, so that R is the period percentage return on securities included in portfolio p from t-1 to t. γ_{0t} and γ_{1t} varies stochastically from period to period. However, the first hypothesis implies expected γ_{2t} =0, although it could vary over time. For the second hypothesis expected γ_{3t}=0, but this parameter could change over time. For the third hypothesis, the emphasis of the condition is quite obvious; as long as the risk premium is positive, the slope will be as well.

Given that the market portfolio is efficient, in the sense that it provides the highest expected return on a given level of risk, Fama and MacBeth (1973) suggests a positive tradeoff between risk and return. Further, they could not reject the relationship that the asset's portfolio risk and the expected return is linear. In other words, the systematic risk measured by the beta is not statistically indistinguishable from zero.

2.1.2 Fama and French factor models (1992;1993)

Another prominent research investigating the explanation of stock return is a study performed by Fama and French (1992) in which the statistical tests are derived from the cross-sectional regression approach of Fama and Macbeth (1973). They cover companies in the U.S. listed on NYSE, AMX and Nasdaq which are analyzed during the period 1963-1990. In contradiction to the earlier study performed by Fama and Macbeth (1973), Fama and French (1992) start their study with presenting criticism of CAPM. They suggest that other factors that may explain the stock return and the purpose of the study is therefore to investigate the relation of size, E/P, leverage and book-to-market equity in average returns.

Their study does not support the basic assumption that market betas have a positive relation to average return which is predicted in Fama and MacBeth (1973). Additionally, the average premium for beta is zero. Hence, they did not find a significant relationship between average stock returns and beta. Instead, their study documents that size and book-to-market have a strong cross-sectional relation to average stock returns. Looking at the Fama-Macbeth slopes they show that size has a negative premium in the cross-section of stock returns while book-to-market shows on a positive premium. This implies that smaller companies and value stocks generates higher returns. Fama and French (1992) discuss two possible explanations to why firms assigned a high book-to-market earns higher returns. One could be its relation to the distress risk factor. Companies with poor earnings prospects tend to signal lower prices and have high book-to-market ratios and will therefore be rewarded with a higher risk premium. Another suggestion is that companies with low book-to-market value might have performed well previous period and may seem as an attractive investment for an irrational investor. Consequently, the prices will increase and hence, lower stock returns.

To sum up, Fama and French, documents that book-to-market and size are two variables that could be used as proxies for risk and should therefore be included in an extended version of CAPM. From these findings Fama and French developed their study in 1993 and constructed a three-factor model to explain the risk related to returns. The factors are constructed to mimic the multidimensional risk in returns related to size and book to market.

The SMB factor is meant to mimic the risk related to size of stocks, calculated as the difference between the returns on small and big-stock portfolios with about the same weighted average book-to-market equity. The HML factor mimics the risk in returns related to book-to-market and is calculated as the monthly difference between the average of returns on the two high book-to-market portfolios and the average of the two low book-to-market portfolios (Fama and French, 1993). These factors are then used in time series regressions against market excess return, presented in equation 3 below, to investigate the relationship between average portfolio returns and the risk factors.

$$R_{it} - Rf_t = \alpha_i + \beta_i\,(R_{mt} - Rf_t) + s_i SMB_t + h_i HML_t + e_{it} \quad (3)$$

R_{it} is the return of a portfolio for period t. Rf_t represents the risk-free returns, Rm_t, SMB_t and HML_t are the factor portfolios and e_{it} is a zero mean residual (Fama and French, 1993). The results showed that the factors constructed based on size and book-to-market, could strongly explain the variation in stock returns. This presents additional evidence for book-to-market and size to be proxies for sensitivity to common risk factors affecting stock returns.

2.2 Is Default Risk Systematic or not?

Several researchers have tried to explain the development of stock returns. One potential factor that has been widely discussed since Fama and French (1992;93) is the effect of default risk on stock returns. Later studies such as Dichev (1998) and Vassalou Xing (2004) have looked at the relation between financial distress and equity returns, finding that distress risk could be embedded in stock returns.

2.2.1 Evidence of Systematic Default Risk and its Effect on Stock Returns

Default risk is only systematic if it is undiversifiable, meaning that default risk is systematic if the returns of distressed companies reacts more to unexpected changes in relevant market factors. Previous studies, such as Chan and Chen (1991) and Fama and French (1992;93), have suggested that size and book-to-market can be seen as proxies for distress risk. Dichev includes these two variables, and a distress risk factor, measured by Altman's Z-score and Ohlson's O-score in a Fama-MacBeth two step regression. In contradiction to CAPM, Dichev (1998) finds a negative relationship between default risk and realized stock returns. In fact, firms with higher distress risk earn lower than the average return since 1980. This could be explained by that the book value of distressed companies, dissimilar to market value, often is entirely erased or even sometimes negative. These findings contradict the previous studies that have found a positive relationship between book-to-market and stock returns. The study also shows evidence of the size effect, which was strong during 1960s and 1970s, had disappeared after 1980 and there is no relationship between distress risk and size.

Dichev (1998) lifts two possible explanations to the negative relation between distress risk and returns after 1980. One of them assumes an efficient market whereas more distressed firms have lower systematic risk. The other one concludes that the market does not to its fullest impound the available information about financial distress and thereupon will be an endless bias in pricing equites. Wherefore, companies that are more distressed earn a lower subsequent return when disadvantaged information is embedded in the price.

Other studies that also document a negative cross-sectional correlation between credit risk and equity returns are Griffin and Lemmon (2002), Campbell et al. (2008) and Chen et al. (2010). Griffin and Lemmon (2002) uses Ohlson (1980) O-score as a proxy of the possibility if default risk. They investigate the relationship between book-to-market, distress risk and equity returns. The most interesting finding is that firms with high level of distress risk, are associated with extremely low returns and low book-to-market firms. These findings can explain the earlier results presented by Dichev (1998), that high distress risk firms earning low average returns is mainly driven by underperformance of low book-to-market stocks.

The later, Campbell et al. (2008) also shows that stocks with high risk to default tend to underperform the market. They investigate portfolio returns and find that distressed portfolios have anomalously low average returns post 1980. Further, distressed stocks tend to do poorly when volatility in the market increases. Thus, their study shows significant values, therefore indicating that size and value are proxies for financial distress premium. Chen et al. (2010) are looking at the relation between distress and idiosyncratic volatility and what impact it has on required return. They document that stocks with high idiosyncratic volatility make significantly low returns looking at the lowest and highest distress risk quantile. Using a corrected CAPM model they find that stocks with high distress risk earns lowest returns. Consequently, default risk seems to be negatively priced into U.S equity returns.

Vassalou and Xing (2004) used default likelihood indicators derived from the Merton model (1974) for individual firms to examine whether default risk is systematic. The findings are in line of their hypothesis; default risk is systematic and positively priced in the cross section of equity returns. However, they found that only if small firms have high default risk, they will earn higher returns compared to big firms. Similarly, companies with high book-to-market earn higher returns than firms with low book-to-market as long as their risk to default is high. Further, higher default risk stocks earn higher returns only if they are small. This does not hold, there is no significant difference in the returns between high or low default risk stocks.

Also, Chava and Purnanandam (2010) find that the relationship between default risk and realized stock returns is systematic. In contrast to Campbell et al. (2008), Dichev (1998), Griffin and Lemmon (2002), Chava and Purnanandam (2010) documents a strong positive relationship between default risk and equity returns in the post 1980-period. Unlike other studies that often use realized returns (ex post) to study the relation between stock returns and a firm's risk of default, Chava and Purnanandam (2010) used implied cost of capital to estimate expected stock returns (ex-ante). The market is to be inefficient when a negative relationship between default risk and realized stock returns is discovered. Thus, the question remains why rational investors do not exploit this inefficiency. Chava and Purnanandam (2010) argues that this event is an outcome of using ex post realized return by previous researchers to estimate ex ante expected return. Hence, they conclude that the risk-return trade-off depends on chosen measurement of expected returns.

The study of Friewald, Wagner and Zechner (2014) find that credit risk premia is priced in size, book-to-market and probability of default. Hence, default risk is systematic and have a positive impact on returns. Excess returns are highest for value stocks, small firms and companies with high default risk. Godfrey and Brooks (2015) shows on a negative relationship between credit risk and equity returns. The negative pricing of high credit risk stocks seems to be driven by a previous period of relatively poor stock performance. The contemporary underperformance can be explained by firm characteristics, such as idiosyncratic risk, turnover, illiquidity and bid ask spread.

2.2.3 Evidence of Non-Systematic Default Risk

Studies such as Opler and Titman (1994) and Asquith, Gertner and Scharfstein (1994) establish that default risk is linked to idiosyncratic parameters and does not represent systematic risk. Further, Anginer and Yildizhan (2010) investigated the relationship between credit risk and stock performance, using corporate bond spreads as a proxy for distress risk. They could not find any proof of default risk being significantly priced into the equity returns, nor do companies with higher distress earn abnormal low returns. Avramov et al. (2009) also finds that distress risk is unsystematic. They state that low credit risk stocks make a return of 1,09% higher per month compared to high credit risk stocks.

Ang et al. (2006) documents that stocks with higher idiosyncratic volatility have extremely lower average returns. The stocks that have the highest idiosyncratic volatility generates a total return of -0,02% per month. They conclude that the low average returns could not be explained by size nor book-to-market. These results persist in bull and bear markets.

Summing up, there is a non-consensus among researchers whether default risk is systematic or not. However, most studies that find default risk to be systematic show a negative relationship between default risk and stock returns.

Some papers are applying accounting models for measuring default risk, such as Dichev (1998) and Griffin and Lemmon (2002). Even though accounting data is a backward-looking measurement, it has been shown from previous studies, such as Altman (1968), that accounting data could give good estimations for a company's risk to default. It is also Altman (1968) that Dichev (1998) have used as method for his studies. The different measurement of default risk and evidence of systematic default risk will be presented in table 1 below.

Table 1. Previous research on Default Risk and Stock Returns

Previous research	Conclusion	Default risk premium	Measure of Default Risk
Campbell et al. (2008)	Post 1980 distressed stocks have delivered low returns	Negative	Dynamic logit model using accounting and market variables
Chen et al. (2010)	Stocks with high idiosyncratic volatility have much lower returns, and high distress risk implies lower returns	Negative	A corrected Single beta CAPM model
Dichev (1998)	Bankruptcy risk is not rewarded by higher returns post 1980	Negative	Multifactor accounting models, Altman's Z-score (1968) & Ohlson's O-score (1980)
Godfrey and Brooks (2015)	The negative pricing in stocks is driven by four limits-to-arbitrage factors	Negative	Model incorporating limits-to-arbitrage factors
Griffin & Lemmon (2002)	Specific firm characteristics make them more likely to be mispriced	Negative	Fama French Three Factor model, using Ohlson's O-score (1980) as a proxy for default risk
Chava & Purnanandam (2010)	Investors were rewarded with higher returns for bearing risk, but the returns have lowered since 1980.	Positive	Implied Cost of Capital
Friewald, Wagner and Zecher (2014)	Stock returns increase with higher credit risk	Positive	Merton (1974) model and CDS spreads
Vassalou & Xing (2004)	Default risk is systematic and priced into equity returns	Positive	Merton (1974) model based "default risk indicators"

3. Methodology

This section will initially describe the data collection process, the chosen measurement of default risk and construction of studied factors and portfolios. Then the statistical test of this study will be lined out and necessary precision of the model described. Lastly, a discussion of potential drawbacks of the methodology will be held.

3.1 Data

3.1.1 Sample selection

The sample in this thesis consisted of all public firms listed on Stockholm Exchange including Small Cap, Mid Cap and Large Cap between the period of 1993 to 2016, regardless of delisting or re-listing. Both A and B-shares have been included in the sample. When a company had two or more stock series listed the least traded one, measured as stock turnover, was excluded. Since this study is investigating default risk on firms both active and inactive firms have been included in the sample. The main reason for this is avoiding survival ship bias, which could lead to an overestimation of the historical market performance. All industries except banks were included in the sample. The main reason for this is the use of an accounting model to calculate the default risk, high leverage is seen as normal in these companies and is therefore not interpretable the same way as for the other firms. The companies had to be listed and have accounting and market data available in Thomson Reuters DataStream for at least five years in a row. The disclosure of company industry and activity could be found in appendix A2.

The period of 23 years was chosen for mainly two reasons; firstly, it enables access to a desirable amount of data for statistical significance and secondly, it captures different business cycles. The original thought was to observe a much longer period, but due to limitations in the data this was not possible. Lundblad (2007) investigates companies between 1837 to 2003 of realized returns and established that a long sample is needed to obtain significant results. On the other hand, choosing a long period may cause instability in the outputs. Due to fluctuations in the economy, data may not be comparable over time. Thus, the authors had to assume that all cross sections are comparable over time.

Table 2. Sample selection criteria

√ Firms listed on the Stockholm Exchange
√ Minimum of 5 years observable data during the period
√ Both Active and Inactive firms
√ Large Cap, Mid Cap, Small Cap
√ All industries, except the banking industry

3.1.2 Collection of Accounting and Market Data

The key data in this study is financial accounting data used for calculating the default risk measure, Altman's Z''-score. Accounting variables collected were working capital, EBIT, total assets, total liabilities, retained earnings, current liabilities and common equity. Additionally, market value was collected for calculating book-to-market. The default risk scores were computed from the retrieved data as of the fiscal year-end of a given year t-1 starting at 31-12-1992 and ending at 31-12-2014. In accordance with Dichev (1998), all accounting parameters have been taken from annual report and the market data, such as stock price are obtained six months after the year end. Measuring the stock price six month ahead ensures that the accounting data is incorporated into stock prices, the authors therefore assume the annual reports to be published by then. For example, if a Z"-score is observable at 31-12-1992, the study uses one-year-ahead monthly returns (in percent), starting six months after fiscal-year end, at 30-06-1993-30-06-1994. Hence, the total studied period of returns was 30-06-1993-30-06-2016. The monthly stock prices were also retrieved from DataStream.

The Fama-French factors Rm, SMB and HML, generated on the Swedish stock market, were collected from Swedish House of Finance (SHoF), which is a financial database provided by Stockholm School of Economics. This database was primarily chosen because it could provide the Fama-French factors calculated on historical data for the studied market and period, covering 1993 to 2016. The Rm factor is the Six Return Index (SIXRX) which shows the average development of stocks listed at the Stockholm Exchange. In order to calculate the portfolio excess returns and the market excess return, a Swedish treasury-bill (SSVX 1M) with monthly maturity was used as the risk-free rate. It was retrieved at Riskbanken's website.

3.1.3 Excluded data

The starting point of this study was to do an assessment of all the data retrieved from DataStream. First task was to assess how many years the study could cover to pursue the purpose of the study. The selection process was initially based on the accounting data available for the companies. Due to limitations of DataStream the decision came down to 23 years, covering the period 31-12-1992 to 31-12-2014. Further, the selected companies which did not pass the sample requirements were excluded in the study. Originally, the data set contained 3008 listed and delisted equities from the Stockholm Exchange. After assessing all data available the final amount of unique companies are 436 ranging from 68 to 334 observed companies per year. The disclosure of the data loss is presented in appendix A1. The table in appendix A1 shows observed Altman's Z"-scores for each year, and the loss of companies per year after sorting them on market capitalization, book-to-market value and stock price.

3.2 Default Risk

The study has determined whether default risk has significant explanatory power in the variation of stock returns. For this matter excess return was used as a dependent variable and was analyzed together with the different constructed factors as independent variables, which will be further discussed in part 3.4.

3.2.1 Altman's Z"-score

Altman's Z-score (1968) measures the credit strength of a company using different financial ratios based on accounting data (Altman, 1968). Due to the limitations of the Altman Z-score model (1968), Altman developed a new model in 1995, called the Z"-score model. The revised model is not only looking at manufacturing industrials, but also non-manufacturing industrials covering both developed and emerging markets (Altman and Hotchkiss, 2018). Hence, it was found to be an appropriate proxy for default risk in this study.

The first step was to calculate the Z"-scores for all companies during the observed period. This resulted in 5324 observations during 31-12-1992 to 31-12-2014. The scores were calculated for all companies at the year-end using equation 8. In table 3 the variables from the Z"-score model will be further elucidated.

$$X1 = Current\ Assets - Current\ Liabilities\ /\ Total\ assets, weighing\ factor\ 6{,}56\ (4)$$

$$X2 = Retained\ Earnings/\ Total\ Assets, weighing\ factor\ 3{,}26\ (5)$$

$$X3 = Earnings\ Before\ Interest\ and\ Taxes/\ Total\ Assets, weighing\ factor, 6{,}72\ (6)$$

$$X4 = Book\ Value\ Equity\ /\ Total\ Liabilities, weighing\ factor\ 1{,}05\ \ (7)$$

$$Implying\ that, Z'' = 3{,}25 + 6{,}56X1 + 3.26X2 + 6.72X3 + 1{,}05X4\ (8)$$

Table 3. Explanations of the Z''-score variables

X1	shows a firm's profitability by measuring the working capital relative to the total capitalization.
X2	gives a measure of the leverage of the firm. Implying that companies with higher retained earnings relative to total assets have less debt. Meaning that they have financed their assets through reinvesting profits.
X3	shows the productivity if a company's assets, independent of leverage and tax factors. This ratio has been appropriated with studies that dealing with credit risk since it gives a fair picture of a company earning power of its assets. Something that could be seen as essential for the survival of a firm.
X4	measures the solvency of a company by illustrating the level of the assets of a company can decline in value before liabilities exceeds the assets value. X4, is the specific ratio that previous studies have not covered, which therefore gives Altman Z-score another dimension. In the Z"-model, the market value has been replaced by the book value of equity.

Source: Altman and Hotchkiss, 2006 p. 242-243

In order to interpret the scores, Altman and Hotchkiss (2006) showed how they could be translated to Standard and Poor's rating system, this is presented in table 4. A score below 1,75 corresponds to a rating grade of D and companies assigned a D are in default with little chance of recovery (S&P, 2009). A score higher or equal to 8,15 corresponds to a AAA S&P rating. Hence, the higher score a company have the less likely it is to default.

Table 4. Correspondence between Z" Score and Standard and Poor Rating

Safe Zone	**Rating**	**Z" Score Threshold**	**Rating**	**Z" Score Threshold**	**Grey area**
	AAA	**>8,15**	**BB+**	**5,65**	
	AA+	**8,15**	**BB**	**5,25**	
	AA	**7,60**	**BB-**	**4,95**	
	AA-	**7,30**	**B+**	**4,75**	
	A+	**7,00**	**B**	**4,50**	
	A	**6,85**	**B-**	**4,15**	**Distress**
	A-	**6,65**	**CCC+**	**3,75**	
	BBB+	**6,40**	**CCC**	**3,20**	
	BBB+	**6,25**	**CCC-**	**2,50**	
	BBB-	**5,83**	**D**	**<1,75**	

Source: Altman and Hotchkiss, 2006

3.3 Portfolio construction

Fama and French (1992) documents that firm specific characteristics such as size and book-to-market can be seen as proxies for risk and explain the cross-sections of equity returns. However, since the purpose is to investigate the impact of default risk on stock returns this study have constructed a factor based on the magnitude of each companies Z"-score. Additionally, the Fama and French (1993) factors SMB and HML have been used in the regression together with the constructed Default Risk factor (DHML). Including additional variables such as market value and book-to-market in the analyze is motivated by earlier studies (Dichev, 1998; Fama and French (1992;93)). The aim was to separate the effect of different variables on the portfolio returns. Similarly, to the methodology in studies of Dichev (1998) and Fama and French (1992;93) the companies were divided into different portfolios based on their yearly individual default risk score, size and book to market.

The portfolios consist of stocks with monthly observable realized stock returns as a proxy for expected return. Equation 9 was used when calculating the returns.

$$R = \frac{P_1 - P_0}{P_0} \quad (9)$$

P1 refers to the last day observed stock price of one month ahead and P0 refers to the last observed stock price of the month before. The frequency of monthly prices was chosen accordingly to previous studies (Dichev, 1998; Griffin and Lemmon, 2002; Vassalou and Xing, 2004). Using higher frequency might lead to systematic biases (Koller et al., 2015).

In accordance to the convention of Fama and French (1992;1993), the market capitalization is used as a proxy for size. The market capitalization was calculated using data as of the fiscal year end of year t-1. See equation 10.

$$MCAP = [31^{st}\ of\ December\ price\ per\ share *\ number\ of\ shares\ outstanding] \ (10)$$

Book-to-market is defined as common equity divided by market capitalization. The book-to-market was calculated as equation 11, using a firm's the book value of equity and the market equity as of the fiscal year end of year t-1.

$$BM = \ [book\ value\ of\ equity\ /\ (fiscal\ year\ end\ price\ per\ share\ * \\ number\ of\ shares\ outstanding)] \ (11)$$

3.3.1 Formation of Explaining factors

As mentioned in section 3.1.2, the Fama-French factors RM, SMB and HML were retrieved from Swedish House of Finance. The Rm factor represents the overall performance of the Swedish market. Below follows a description on how the factors, SMB and HML, that have been calculated at SHoF.

SMB is the equal-weight average of the returns on the three small stock portfolios for a period minus the average of the returns on the three big stock portfolios,

$$SMB \ = \frac{1}{3} * (Small\ Value\ +\ Small\ Neutral\ +\ Small\ Growth) \\ - \tfrac{1}{3} * (Big\ Value\ +\ Big\ Neutral\ +\ Big\ Growth) \ (12)$$

HML is the equal-weight average of the returns for the two high B/M portfolios for a period minus the average of the returns for the two low B/M portfolios,

$$HML = \frac{1}{2} * (Small\,Value + Big\,Value) - \frac{1}{2}(Small\,Growth + Big\,Growth) \quad (13)$$

The introduced variable in this thesis, the DHML factor, was created by constructing equally weighted portfolios, following the framework of Fama and French (1993). The first step was to divide the sample into two groups based on company size, then ranking the stocks according to their default risk at the fiscal year end at the 30th and 70th percentile. Since the study is using monthly returns, the firms are monthly assigned to a portfolio and then the average of the monthly returns were taken for each portfolio. Since the parameters used for constructing the portfolios are only observed yearly, the portfolios are updated on annually. 6 portfolios, with 2x3 sorting, were created each year, which gives a total number of 138 portfolios for the sample period. After this, the following formula 14 was used to calculate the factor.

DHML is the equal-weight average of the returns for two high Default Risk portfolios for the period minus the average of the returns for two low Default Risk portfolios,

$$DHML = \frac{1}{2} * (Small\,High + Big\,High) - \frac{1}{2} * (Small\,Low + Big\,Low) \quad (14)$$

3.3.2 Formation of Test portfolios

To construct the test portfolios the same approach as above was applied and extended a bit. The portfolios were formed using 2x3x3 sorting on size, book-to-market and default risk which resulted a total of 18 aggregated portfolios. With regards to sample size and to obtain sufficiently amount of observation in every portfolio, 18 portfolios were assumed to be a reasonable tradeoff. Totally 414 portfolios were constructed. Monthly observable returns during the period 30-06-1993 to 30-06-2016 was assigned each stock included in the portfolios.

The first step was to divide the sample of stocks at the 50th percentile based on their size, this resulted in two different sub-groups. Second step was to split each sub-group again by assigning the stocks high, neutral or low book-to-market values. From this sorting six portfolios were created where the 30th highest percentile consisted of ‘value stocks’, and the 40 percentiles consisted of ‘neutral stocks’, and the 70th percentile consisted of ‘growth stocks’. Lastly, the sorting was repeated using high, neutral and low default risk scores.

Table 5. Construction of the dependent portfolios

2	x3	x3
Small	High BM *30th percentile*	High DR *30th percentile*
	Neutral BM	Neutral DR
	Low BM *70th percentile*	Low DR *70th percentile*
Big	High BM 30th percentile	High DR *30th percentile*
	Neutral BM	Neutral DR
	Low BM *70th percentile*	Low DR *70th percentile*

3.4 Fama-MacBeth Regression

To examine the explanatory power of the dependent variables, specifically the effect of default risk, on asset returns this study have conducted the Fama-MacBeth two-step regression derived from Fama and MacBeth (1973). The Fama-MacBeth (1973) two-step regression is a practical way to test how different risk factors influence portfolio or individual stock returns.

3.4.1 Two-step regression

The first step was to estimate factor loadings by running a set of single $F_{k,t}$. The factors in this study are, as described in part 3.3; RM-Rf, SMB, HML and DHML. For each portfolio i=1,…N the following time series regressions was estimated using ordinary least squares (OLS) and equation 15.

$$R_{1t} - Rf_t = \alpha_1 + \beta_{1F1}(RM_t - Rf_t) + \beta_{1F2}SMB_t + \beta_{1F3}HML_t + \beta_{1F4}DHML_t + \epsilon_{1t}$$
$$R_{2t} - Rf_t = \alpha_2 + \beta_{2F1}(RM_t - Rf_t) + \beta_{2F2}SMB_t + \beta_{2F3}HML_t + \beta_{2F4}DHML_t + \epsilon_{2t}$$
$$\cdots$$
$$R_{nt} - Rf_t = \alpha_n + \beta_{nF1}(RM_t - Rf_t) + \beta_{nF2}SMB_t + \beta_{nF3}HML_t + \beta_{nF4}DHML_t + \epsilon_{nt} \quad (15)$$

Where β_{iF1}, β_{iF2}... β_{iFk} are regression coefficients obtained when estimating the equation 15, these will then be defined as $\hat{\beta}_{iF1}$, $\hat{\beta}_{iF2}$... $\hat{\beta}_{iFk}$. K is the number of studied factors (RM-Rf, SMB, HML, DHML), α_n is the intercept term and ϵ_{nt} is the error term, N is the number of portfolios and T is the number of time series observations.

In step two, cross-sectional regressions were estimated on factor loadings obtained from the first stage to determine each factor's premium. The equation 16 are estimated using OLS.

$$R_{i,1} - Rf_t = \gamma_{1,0} + \gamma_{1,1}\hat{\beta}_{iF1} + \gamma_{1,2}\hat{\beta}_{i,F2} + \gamma_{1,3}\hat{\beta}_{i,F3} \cdots \gamma_{1,m}\hat{\beta}_{i,Fm} + \epsilon_{i,1}$$
$$R_{i,2} - Rf_t = \gamma_{2,0} + \gamma_{2,1}\hat{\beta}_{iF1} + \gamma_{2,2}\hat{\beta}_{i,F2} + \gamma_{2,3}\hat{\beta}_{i,F3} \cdots \gamma_{2,m}\hat{\beta}_{i,Fm} + \epsilon_{i,2}$$
$$\cdots$$
$$R_{i,T} - Rf_t = \gamma_{T,0} + \gamma_{n,1}\hat{\beta}_{1F1} + \gamma_{n,2}\hat{\beta}_{i,F2} + \gamma_{n,3}\hat{\beta}_{i,F3} \cdots \gamma_{n,m}\hat{\beta}_{i,Fm} + \epsilon_{i,T} \quad (16)$$

R_{it} are the monthly returns of a portfolio at time t. The portfolio returns were regressed on factor loadings constructed by default risk (DHML), size (SMB) and book-to-market (HML). The γ_{0t} is the intercept term and γ_{1t}, γ_{2t} and γ_{kt} are the regression coefficients on the K factors. The average risk premium for each factor k=1,...K was then calculated as the time series average of γ_{kt}, as equation 17. The standard error for each coefficient was calculated as equation 18.

$$\widehat{\gamma_k} = \frac{1}{T} \sum_{t=1}^{T} \widehat{\gamma_k} \quad (17)$$

$$\widehat{\sigma_{\gamma k}} = \sqrt{\frac{1}{(T-1)} \sum_{t=1}^{T} (\hat{\gamma} - \overline{\hat{\gamma}_k})^2} \quad (18)$$

The estimation was done using Eviews were regression coefficients values, p-values and the t-statistic were received. The regression coefficient is the average of the coefficients in the monthly cross-sections, the t-statistic is equal to the coefficients divided by its time series standard errors. The t-statistic in the multivariate regressions, equation 19, provided the formal tests of statistical significance.

$$t\left(\overline{\hat{\gamma}_k}\right) = \frac{\overline{\hat{\gamma}_k}}{\widehat{\sigma_{\gamma k}}/\sqrt{T}} \quad (19)$$

Two multivariate Fama-MachBeth regressions have been run, the first containing of all factors; RM-Rf, SMB, HML and DHML and a second with only containing RM-Rf, SMB and HML.

3.5 Regression precision

3.5.1 OLS assumptions

The chosen method for this study is a classical linear regression model (CLRM). According to Brooks (2014) there are four especially important properties which need to hold for the estimates to be validly conducted.

1. The errors have zero mean: $E(u_t) = 0$
2. The error variance is constant and finite over all values of x_t: $var(u_t) = \sigma^2 < infinity$
3. The errors are linearly independent of each other: $cov(u_i, u_j) = 0$
4. There is no relationship between the error and corresponding x variable: $cov(u_t, x_t) = 0$

If the second assumption is violated the variance of the error term is not constant throughout the sample and it is said to be heteroscedastic. Even though it is violated the OLS estimators will still be unbiased. The main problem with presence of heteroscedasticity is incorrect standard errors and hence the interpretations made on the estimates might lead to misleading conclusions. This study applies HAC, Newey-West variance-covariance estimator, to adjust for heteroscedasticity and autocorrelation in the estimated Fama-MacBeth regressions.

Further, the explanatory variables might be correlated with each other which implies there is a linear relationship existing between the variables, this phenomenon is called multicollinearity. For uncorrelated variables the correlation should lie below 0,8 in absolute terms (Westerlund, 2005). Looking at the correlation matrix in appendix B1 all values lies below 0,8.

Another underlying assumption using OLS regressions is that the relationship between the independent variables and the dependent variable is linear (Brooks, 2014). To test if this holds, Ramsey RESET was applied on the manually run cross-sectional regression. It is presented in appendix B2 and as one can see the test cannot be rejected, indicating there is no evidence for non-linearity in the regression equation.

3.5.2 Errors-in-Variables

The main econometric problem when estimating the cross-sectional model in accordance to the Fama and Macbeth (1973) methodology is that it will generate an 'errors-in-variables problem'. This refers to the situation where either the independent variable is measured with some error and it occurs when the 'true' betas are replaced by the estimated betas (Brooks, 2014). The procedure of the two-step regression relies on the fact that betas are not known and must be estimated by a time-series regression on a single index. When using the estimated betas instead of 'true' betas in the cross-section regression, it will cause bias in estimated OLS coefficient of the cross-section regressions. In other words, the standard errors estimated in equation 20 are underestimated, which leads to an overestimation of the t-statistic in equation (Shanken, 1992).

Fama and MacBeth (1973) argue that using portfolios instead of individual assets as dependent variables could minimize the estimation errors. Another solution provided by Shanken (1992), is to perform direct adjustments of the standard errors using the formula 20. However, this will have a minimal impact on the test results since the observations are made on monthly basis (Shanken, 1992).

$$\hat{\sigma}_{\gamma k}^2 * = \hat{\sigma}_{\gamma k}^2 (1 + \frac{(\hat{\mu}_m - \gamma_0)^2}{\hat{\sigma}_m^2}) \quad (20)$$

This thesis has applied both Shanken's (1992) solution and formed portfolios in order to avoid errors-in-variables problem. The portfolio construction is further described in 3.3 and the Shanken correction results will be presented in part 4.3.1.

3.6 Method discussion

3.6.1 General criticism and weaknesses of the study

There are some general concerns regarding the use of accounting models when measuring the default risk of equities which have to be discussed. The default risk score is calculated using accounting values directly taken from the financial statements and these values are therefore backward looking and are not mirroring the future prospects of the company. The model could also be seen as outdated since it was first developed during 1968 and the financial market is way more complicated nowadays. However, the balance sheet and income statement will always have great importance and play a crucial role in explaining the wealth of a company which motivates the continued use of the score. An additional argument for using Altman's Z"-score in this particular study regards the length of the chosen time period. The model was easily implemented, and the values were found in annual reports which availability facilitates a long time period. The Z"-score it is only provided as a tool for ranking companies according to their default risk, the main focus of this study is not to evaluate Altman's Z"-score nor predicting default risk. Using Altman's Z"-score instead of credit ratings enabled the authors to investigate a much longer time period, since the availability of accounting data was substantially larger compared to the credit rating data during the period.

The study is updating the portfolios annually, which could be seen as a weakness since a lot of events could affect a company during a year. However, comparing the measurement to credit scores these are neither updated frequently. Another argument is that several earlier studies are using the same measurement have calculated it using accounting values at each fiscal year-end (Dichev, 1998; Griffin and Lemmon, 2002).

The chosen approach to this study implies some limitations which may impact the results. To start with, it is essential to point out that this study is made on the Swedish market. Implying that there could be some market factors affecting the result that would not occur if the data was gathered from another market. Consequently, one need to be aware of that the result from this study may not be applicable within other countries and one need to be cautious referring to this study within other markets. The conceptual framework used in the study could also be seen as a limitation. This because the investigated factors that have been chosen due to previous interesting studies, implying that other angles of incidence than the looked ones, are overlooked. Wherefore, other factors may also impact the result but have not been captured through this study.

3.6.2 Selection limitations

The data in this study have primarily been collected using Thomson Reuters DataStream and it is seen to be highly reliable. The authors have chosen to limit the data selection to only one source, which can be seen as weakness since other sources might be able to complement the data sample. However, the choice was considered reasonably since it ensures good quality and consequent format of the data throughout the whole sample.

However, one of the major limitations is the sample size. Since the study have been conducted on the Swedish market the observations were limited. A small sample size resulted in fewer possible portfolios with less firms within each. Thus, relatively fewer cross-sectional regressions could be performed.

3.6.3 Criticism of Sources

There are some criticisms to the used sources of the data. One major critique is that the gathered data is secondary data. Using secondary sources requires that one to be critical to the received data. This, since the data could be misleading, wrong or that it could easily be misinterpreted (Bryman and Bell, 2013).

Other sources that have been used are previous literature and research paper done within or nearby this subject. Consequently, a discussion about the reliability of these papers needs to be done (Bryman and Bell, 2013). Thus, the authors of this thesis have chosen sources with care to minimize misleading information. Besides, the used papers are presented throughout the study, which increase the transparency. The study is primarily conducted using the sources mentioned in section 3.1.

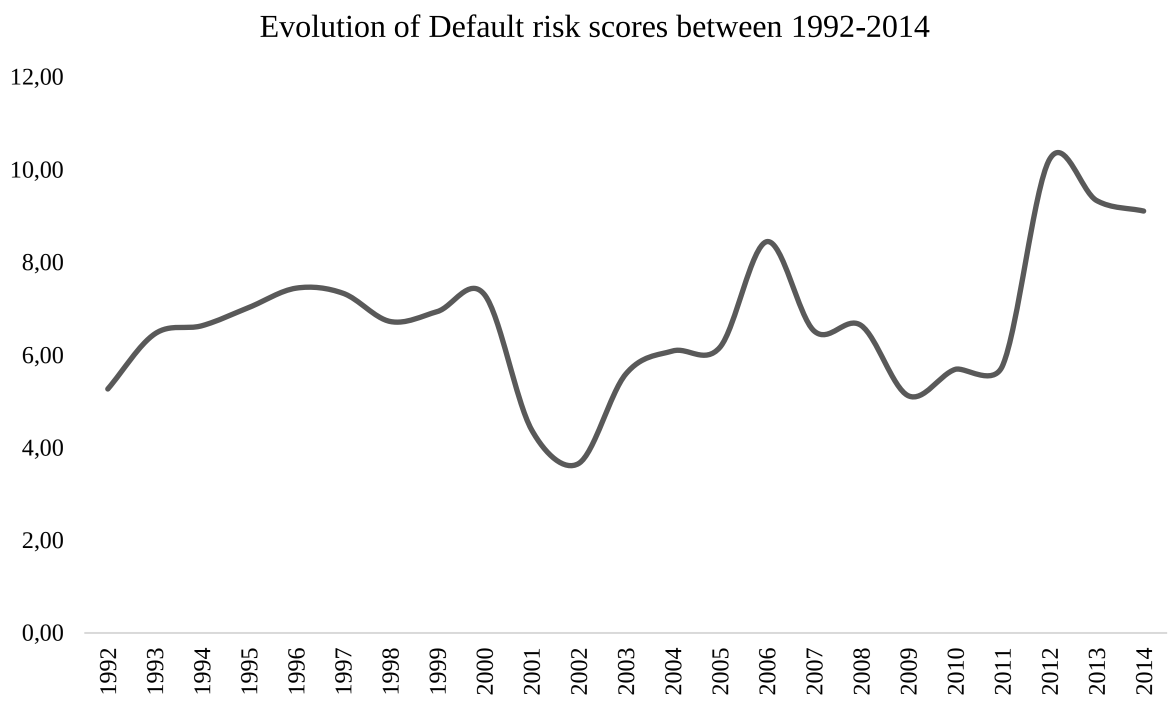
A complementary source has been used; Stattman (1980). This paper has not been controlled and could therefore be biased. Therefore, the authors have discussed its truthfulness and checked with other published research papers if the content perceives valid.

4. Results

This section will initially present descriptive statistics of the observed data. The following sections will present and shortly describe obtained portfolio results, results from the conducted statistical tests and regressions.

4.1 Descriptive statistics

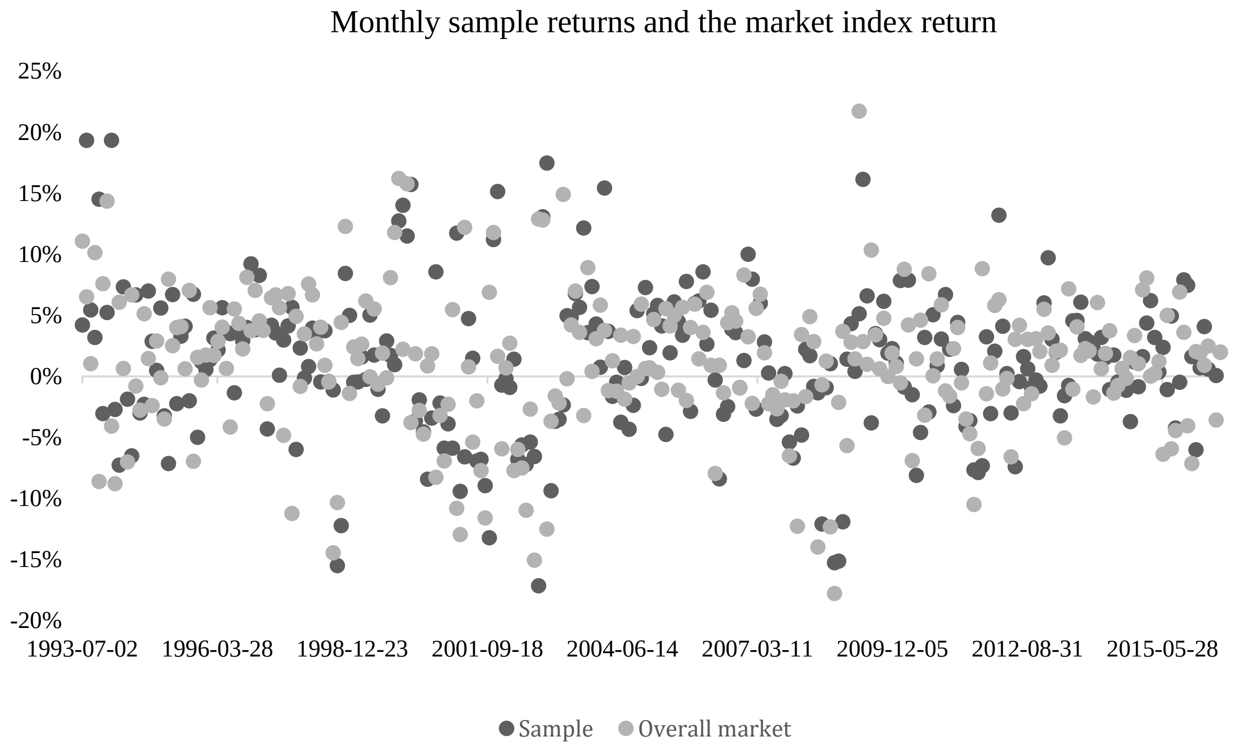
Diagram 1. Evolution of Default Risk scores between 1992-2014



The graph shows the average Altman's Z"-score for the period 31-12-1992 to 31-12-2014.

During 2012 the average Z"-score reaches its highest value for the observed period. The curve drops significantly during 2000-2002 when the dot-com bubble took place and between the economic crisis 2007-2009, during the outbreak of the great recession.

Diagram 2. Monthly sample return and the market index return



The graph plots the monthly sample returns and the monthly market index during the observed period of 30-06-1993 to 30-06-2016.

The market index (SIXRX) represents the overall market performance of companies listed on Stockholm Exchange. The sample consists of the stocks which was chosen due to the criteria presented in section 3.1. As one can see, the sample consists of some extreme values. However, the sample behavior does not deviate too much from the overall behavior of the market index. Looking at the graph presented in appendix A3 it is clear that their development is similar. The observed sample is therefore assumed to be a representative sample for the Swedish market.

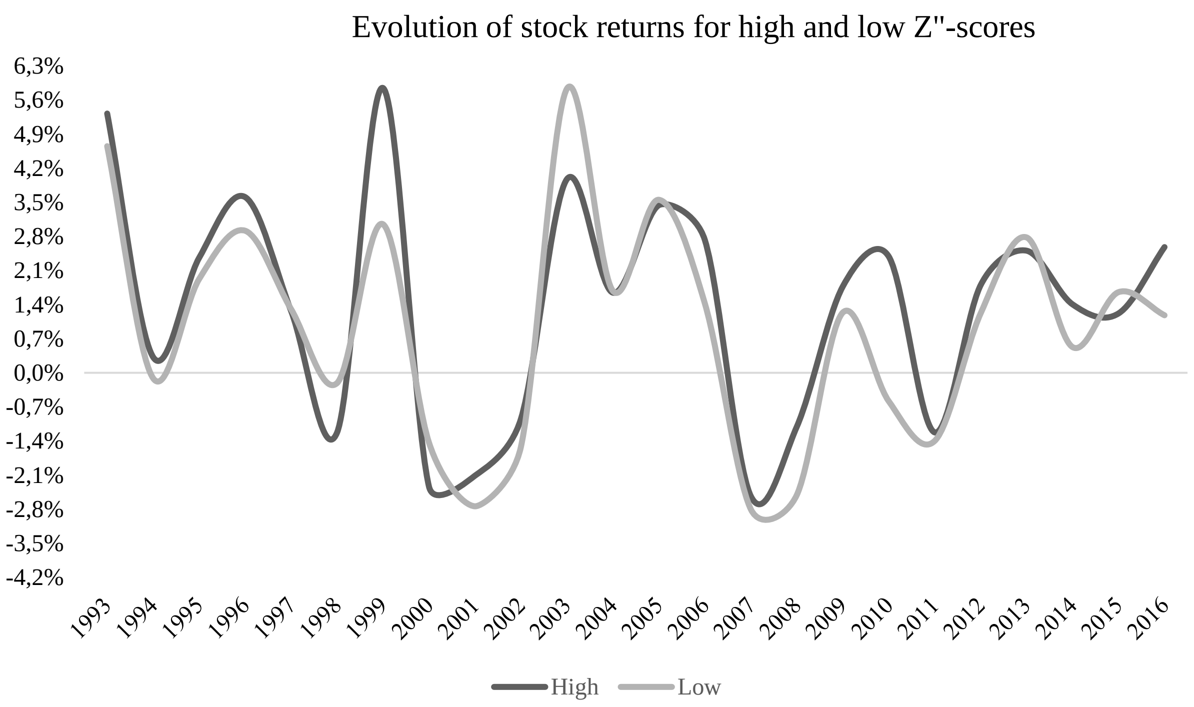
4.2 Portfolio Results

Table 6. Average returns for the sub-portfolios of DHML

	Small MCAP	Big MCAP	*Total Average*
High Z"-score	1,64%	1,24%	*1,44%*
Neutral Z"-score	1,54%	1,25%	*1,40%*
Low Z"-score	1,10%	0,97%	*1,04%*

The table shows that companies assigned a high default risk score, implying less risk of default, earns marginally 0,40% higher average returns compared to companies assigned a low default risk score, with higher risk of defaulting. It also shows that small companies tend to earn higher returns than big companies.

Diagram 3. Evolution of stock returns for high and low Z"-scores



The graph shows the evolution of stock returns for portfolios sorted on high and low Z"-scores. The observed period of returns was 30-06-1993 to 30-06-2016.

Low scores imply higher risk of defaulting and high scores implies the opposite. Looking at the graph one can see that during the market downturns the companies with low scores have slightly lower returns than the companies with high scores. However, the curves are very similar and only marginal differences are visible.

Table 7. Average returns for the factor portfolios

	RM-Rf	SMB	HML	DHML
1993-06-30	0,01790	0,01596	-0,00413	0,00670
1994-06-30	0,01106	-0,00822	-0,00417	0,00434
1995-06-30	0,01216	-0,00205	-0,00745	0,00436
1996-06-30	0,03466	-0,00005	0,00744	0,00691
1997-06-30	0,01795	0,00776	-0,01719	-0,00037
1998-06-30	0,00391	-0,00220	0,00908	-0,01016
1999-06-30	0,03537	0,03689	-0,06910	0,02797
2000-06-30	-0,02715	-0,01012	0,05016	-0,00903
2001-06-30	-0,02391	-0,02299	0,01734	0,00629
2002-06-30	0,07728	0,03020	0,04118	0,03313
2003-06-30	0,02435	0,01405	0,01378	-0,01856
2004-06-30	0,01653	-0,00646	0,01384	-0,00036
2005-06-30	0,01804	-0,00055	-0,00036	-0,00111
2006-06-30	0,02536	-0,00079	0,00420	0,01303
2007-06-30	-0,02964	-0,03891	0,00671	-0,00504
2008-06-30	-0,00524	-0,00839	0,01889	0,01401
2009-06-30	0,02390	-0,02509	-0,00069	0,00534
2010-06-30	0,01293	-0,02048	0,00845	0,02971
2011-06-30	-0,00576	-0,00916	0,00356	0,00175
2012-06-30	0,01391	0,01908	-0,02316	0,00579
2013-06-30	0,02062	0,02189	0,00412	-0,00272
2014-06-30	0,01320	-0,00479	-0,00326	0,00877
2015-06-30	-0,00180	0,00976	-0,00030	-0,00437
Average	*1,242%*	*-0,020%*	*0,300%*	*0,506%*

Table 7 presents the average returns from the studied factors RM-Rf, SMB and HML, and the thesis own constructed factor DHML all included in the FM regressions. The SMB factor has had an average return of -0,02% implying that bigger firms outperform smaller firms. The HML factor has had an average return of 0,3% which reveals that firms with high book-to-market generates higher returns compared to firms with low book-to-market. The DHML factor is in line with above results in table 6, only slightly different, that firms with high rating scores performs better than firms with low rating scores.

Table 8. Average returns of the test portfolios

	BH	BN	BL	SH	SN	SL	Average
High Z"-score	1,62%	1,63%	0,83%	2,45%	3,71%	1,66%	*1,98%*
Neutral Z"-score	1,54%	1,36%	3,31%	2,42%	1,89%	1,59%	*2,02%*
Low Z"-score	1,95%	2,52%	2,09%	1,71%	1,65%	3,06%	*2,16%*
Average	*1,70%*	*1,84%*	*2,08%*	*2,19%*	*2,41%*	*2,10%*	

Average return of the market *2,05%*

Table 8 shows the average returns of the constructed test portfolios during the observed time period 1993-2016. The results indicate that high Z"-scores are associated with marginally lower returns, implying a positive relationship between stock returns and default risk. The average return of the market, which is calculated as the average of the total sample, is 2,05%.

4.3 Fama-MacBeth Regression output

The time series has 23x12; 276 observations monthly observations of stock returns for each portfolio which results in 276x18; 4806 data points.

Table 9. Estimated time series betas for each portfolio

Test portfolio	RM-Rf	SMB	HML	DHML
BHH	0,1450	0,1343	0,0860	0,0436
BHL	0,0546	0,0021	-0,0378	0,4750
BHN	-0,0176	-0,0229	0,0405	-1,1425
BLH	-0,0617	0,0161	-0,0283	0,6616
BLL	-0,0106	-0,0206	-0,2881	0,1662
BLN	0,1888	-0,0712	-0,6108	-0,7415
BNH	-0,1383	0,3828	0,5247	0,5438
BNL	0,0506	-0,2682	0,1210	0,2988
BNN	-0,0376	-0,0432	-0,1688	-1,4649
SHH	-0,0381	0,1445	0,3944	1,2065
SHL	0,0087	0,0571	-0,0101	-0,6377
SHN	-0,0609	-0,0312	-0,0010	0,2462
SLH	0,0451	-0,0454	-0,3188	0,4907
SLL	0,1167	0,0340	-0,0045	-0,6355
SLN	-0,0918	0,0048	-0,0944	0,3774
SNH	-0,0564	-0,0217	0,2788	0,3659
SNL	0,0721	0,0255	0,0020	-0,8152
SNN	-0,0211	-0,0675	0,0884	0,4014
Average	*0,0082*	*0,0116*	*-0,0015*	*-0,0089*

Table 9 shows the estimated betas, factor loadings, obtained from the time series regressions run on each test portfolio. There were in total 72 (18x4), factor loadings estimated. They are then used in the next step, when running the cross-sectional regressions. 18 individual portfolios are run against the market risk factor, size factor, book-to-market factor and the default risk factor and the results are presented in table 10.

Table 10. Regression output including all factors

Regression Results

	Coefficients	StdD	t-Statistic	Probability
α	0,000707	0,00133	0,530	(0,6047)
RM_Rf	0,059765	0,03426	1,744	(0,1047)
SMB	-0,015954**	0,00689	-2,317	(0,0374)
HML	0,009570	0,00720	1,329	(0,2065)
DHML	0,005174**	0,00175	2,103	(0,0113)
R^2	0,4494			
Adjusted R^2	0,2800			

*The "**" denotes significance at the 5%-level.*

Table 10 shows the average intercepts (alpha) and slopes from the monthly cross-sectional regressions of the constructed portfolios on market risk (RM_Rf), size (SMB), book-to-market (HML) and default risk (DHML). The regression is run with HAC standard errors and covariance matrix, which corrects for heteroscedasticity and autocorrelation. Two out of four factors are significant. The RM_Rf and HML factor is positive but not significant, with rounded coefficient values of 0,060 and 0,0096 respectively. The SMB factor is significant negative and the DHML factor is significant positive, with rounded coefficient values of -0,016 and 0,0052 respectively. These results indicate that the size factor and the default risk factor is significant at the 5% level. The Eviews regression output is presented in appendix C1.

Table 11. Regression output excluding DHML factor

Regression Results

	Coefficients	StdD	t-Statistic	Probability
α	0,000846	0,001352	0,626	(0,5415)
RM_Rf	0,045935	0,036530	1,257	(0,2292)
SMB	-0,021778**	0,008265	-2,635	(0,0196)
HML	0,010151	0,007255	1,399	(0,1835)
R^2	0,3776			
Adjusted R^2	0,1228			

*The "**" denotes significance at the 5%-level.*

The table above shows the output of the regression containing of all factors except the DHML factor. As one can determine from the decreased R^2, the DHML contributed with some explanatory power. There are only small changes to the variables, this implies stability in the data which enables comparison of the results and previous studies. The Eviews regression output is presented in appendix C2.

4.3.1 Shanken corrections

For the errors-in-variable problem the study has applied Shanken (1992) corrections on the regression results presented in table 10. The Shanken correction was implemented using equation 21, and the t-statistic was calculated using equation 20, presented in the method chapter.

Table 12. Shanken corrections

	RM-Rf	SMB	HML	DHML
Shanken correction $\hat{\sigma}^{2*}_{\gamma k}$	0,001293	0,000052	0,000057	0,000003
Shanken Std error $\hat{\sigma}^{*}_{\gamma k}$	0,035964	0,007227	0,007555	0,001842
t-Stat	1,661816	-2,207570	1,266627	2,808653
p-value	0,109900	0,039258	0,216756	0,011861
Difference $(\hat{\sigma}^{*}_{\gamma k} - \hat{\sigma}_{\gamma k})$	*0,001702*	*0,000342*	*0,000357*	*0,000087*

As one can determine from table 12, the t-statistics and the p-values with corrected standard errors have become slightly worse. However, the differences between the Shanken corrected standard errors and the estimated standard errors in table 10 are negligible and have therefore marginal impact on the factor premiums. Thus, it would not change any of the originally obtained results or conclusions.

5. Discussion

This section will analyze and discuss the presented results in chapter four, with reference to relevant previous studies presented in chapter two.

Looking at the results from the default risk factor portfolios presented in table 6, it is obvious that portfolios assigned higher default risk scores, implying less risk of defaulting, are rewarded with marginally 0,40% higher returns on average. This relationship contradicts with the fundamental view of risk and return tradeoff, saying that higher risk should be associated with larger returns. The result deviates from what previous studies (Chava and Purnanandam, 2019; Vassalou and Xing, 2004) have found, that higher risk tends to be rewarded with a higher risk premium, indicating larger returns for companies closer to default. According to table 6, small companies seem to earn higher returns than big firms, which is in line with other studies such as Fama and French (1993;1992). However, the results are not consistent. Table 7 shows the opposite relationship for the SMB factor, indicating that large companies generates on average 0,02% higher returns compared to small companies. The factor was retrieved at SHoF and is therefore calculated using a slightly different sample, which could explain the difference.

The statistical test was performed by the Fama-MacBeth two-step regression and is presented in table 10. The DHLM factor has a p-value 0,0113 indicating that the factor is significant on a 5%-level. This shows evidence of default risk being systematic and hence is priced into equity returns. However, the finding contradicts with Opler and Titman (1994) and Asquith, Gertner and Sharfstein (1994) which states that the default risk is rather linked to idiosyncratic parameters. Also, Anginer and Yildizhan (2010) find that default risk is not priced into stocks. Looking at the construction of the factor in this thesis (good scores minus bad scores) the results in table 10 implies that firms with lower risk are rewarded with approximately 0,52% higher average returns. In other words, a negative relationship between risk and excess stock return is found. This result is, as mentioned, not in line with the fundamental asset pricing theory stating that higher risk should be rewarded with a higher risk premium, which is explained by that investors being risk averse and behaving rational. However, negative relationship is consistent with several other studies such as Campbell (2008); Chen et al. (2010); Dichev (1998); Godfrey and Brooks (2015); Griffin and Lemmon (2002) and Friewald, Wagner and Zechner (2014) which also find that default risk is negatively priced into stick stock returns.

Dichev (1998) found that higher risk was not associated with a higher risk premium post 1980 and this thesis strengthen that this relationship is also applicable to the Swedish market. A potential explanation could be that firms with lower risk to default have better potential to meet market expectations and therefore generates higher returns. Also, companies with lower risk of default have a better liquidity and have therefore better possibility to pay the debtholders. A better liquidity to pay the debt holders will preferable increase the possibility to pay the equity holders, implying higher returns. Chen et. Al (2010) and Godfrey and Brooks (2015) also document a negative relationship between default risk and stock returns and find that mispricing is the cause of underperformance in distressed stocks. Hence, a possible explanation why stocks with higher risk earn lower returns could be due to an error in investors valuation of the distressed stocks, overpricing them because it is not obvious that they have poor earnings prospects. Looking at the graph presented in diagram 2, one can see that companies with high default risk has performed worse during periods with higher volatility. It is consistent with Campbell (2008) who argues it could be an explanation for the slightly higher returns of the less risky stocks.

The R^2 in the regression presented in table 10, shows that the factors can explain approximately 45% of the variation in the of the dependent portfolios and that the model is a good fit for the data. However, the results also reveal that there could be other potential factors explaining asset returns which have not been included in this study. Comparing the R^2 from the regressions including, table 10, and excluding DHLM factor, table 11, one can see that the R^2 increases from 0,33 to 0,45 when adding the DHLM factor to the model. On one hand, this could imply that the DHML factor contributes to describe the excess returns. But on the other hand, one need to take in account the fact that R^2 will never fall if more variables are added to the regression (Brooks, 2015). But, since the adjusted R^2 more than doubles in size when adding the DHML factor, this justifies its presence and implies that the DHML factor contributes to the prediction of excess returns. There is almost no change in the coefficients nor to the variable standard errors or t-statistics when adding or removing the DHML factor, this implies that the data is stable and strengthen the evidence presented regarding the DHML factor.

Vassalou and Xing (2004) find that default risk is systematic and positively priced in the cross-section of equity returns. However, they find that smaller companies earn higher returns compared to big firms, only if the firms have higher risk to default and vice versa. Judging from the portfolio results in table 6, this study does not support their findings since small companies seem to earn higher returns regardless of their default risk scores. Also, it is shown to have an opposite relationship in the Fama-MacBeth regressions in table 10. Besides, their study shows that the SMB and HML factors seems to contain other significant information about price which is unrelated to default risk. Looking on the HML factor in table 10 one can see that the positive relation is not significant. If one disregard the fact that the result is not significant, the positive relation is consistent with previous research that have been done. Likewise, Basu (1993), Stattman (1980) and Rosenberg, Reid and Lanstein (1985) find a positive relation between average stock return and book-to-market equity on the U.S stock market, this study documents a positive relationship. Implying that value stocks outperform growth stocks. Also, Fama and French (1992) documents this relation.

Further, Fama and French (1992) find that size can explain stock returns, whereas they state that smaller companies seem to earn higher returns compared to larger firms. In other words, a positive relation between the SMB factor and excess returns. In spite of their findings, looking at the results in table 10, this study finds a negative significant relationship, suggesting that larger companies will earn higher returns compared to smaller firms. One possible explanation to this difference is that the studies have been made on two different market. Indicating there may be any market circumstance for the Swedish market that gives the opposite relationship. Another explanation could be that post 1980, Sweden has several large companies, such as ABB, Assa Abloy, Sandvik etc. that has had an extensive growth after 1980, and which are all included in the sample. Implying that larger companies have higher returns than smaller ones. Further, larger firms might also be more dependent on changes in the macroeconomic environment and will therefore have a relatively higher risk premium compared to smaller firms. Also, Fama and French (1992) found that size has the biggest impact on stock returns. Among the factors in table 10, the SMB coefficient has the largest coefficient number and hence this thesis strengthen those evidence. Additionally, the results show an opposite relationship between the size factor and the default risk factor, implying that larger companies and companies with less risk of defaulting earn higher returns. One may assume these characteristics go together; large companies usually are more established and generates stable cashflows, which indicates that they have less risk of defaulting. However, important to keep in mind is that the HML and SMB factors were not originally constructed using the exact same sample as in this study and therefore makes it difficult to draw any conclusions upon their behaviors.

Since various studies have gotten different result, one may assume it could depend on what kind of data and methods one is using. This study has followed the convention of Fama and MacBeth (1973) and Fama and French (1993) and no substantial deviations have been made except from the choice of observed market. One could therefore not exclude the fact that the result will perhaps be differently using another method than Fama and MacBeth regression or another market. Hence, it would be interesting to use different methods on the same dataset and see if the result will still be significant. Depending on what kind of result these tests will give, one could strengthen or weaken the result. Another possible explanation, similar to what Denis and Denis (1995) finds, is that macroeconomic factors have different impact on companies and regions, giving differently result.

6. Conclusion

This section will conclude the findings that have been made throughout the work of the thesis.

This thesis has examined whether default risk is priced into equity returns on the Swedish market using a model derived from Fama and French (1993) framework and Fama and MacBeth (1973) regressions for statistical testing. Portfolios of stocks on the Swedish market have been constructed and analyzed together with four different factors capturing the effect of market risk, size, book-to-market and default risk on stock returns. The introduced default risk factor was constructed using Altman's Z"-score (1995).

The creative part of this study is the introduction of the default risk factor, DHML, to the Fama French three factor model. It has shown to have a significant positive sign in the regression, implying that higher risk will have a negative impact on excess returns. However, this study does not show on any significant results for the market risk factor, Rm-Rf, or the book-to-market factor, HML. The size factor, SMB, turned out to have a negative sign in the regression, implying a positive relationship between size and return. In other words, returns are increasing with size and large firms will generate higher returns compared to small firms.

To conclude, this thesis finds that higher Z"-scores which signs less risk of defaulting, generate higher returns. The more exposure against the default risk factor, the higher return will a firm earn. These findings contradict with several previous studies within the area. It does not support studies of Chava and Purnanandam (2010) and Vassalou and Xing (2004) which documents a positive relation between default risk and return, neither the fundamental conjecture of a positive risk premium when bearing higher risk. However, this study seems to be in line with what most of the reviewed articles find (Campbell et al. 2008; Chen et al. 2010; Dichev, 1998; Griffin and Lemmon, 2015; Friewald, Wagner and Zechner, 2014 and Godfrey and Brooks, 2015).

The conducted investigation has contributed with additional evidence to the ambiguous discussion on whether default risk affects stock return or not. The presented information may be valuable from an investment perspective, where one wish to control the exposure of default risk. The Swedish market lacked on research within this area, and therefore the aim and motivation of this study was to present comprehensive documentation of the Swedish market. Consequently, default risk is negatively priced into stock returns and the default risk puzzle is thereby also applicable to the Swedish market.

What further could be investigated is if similar results would be found when applying other methods and models of measuring default risk. Besides, it would be interesting to investigate other markets that usually not are looked at and perhaps one could find patterns within these markets that could be used to predict future outcome of stock returns. Lastly, it would be interesting to divide the data into sub periods and see what patterns that would perhaps occur during and after economic downturns.

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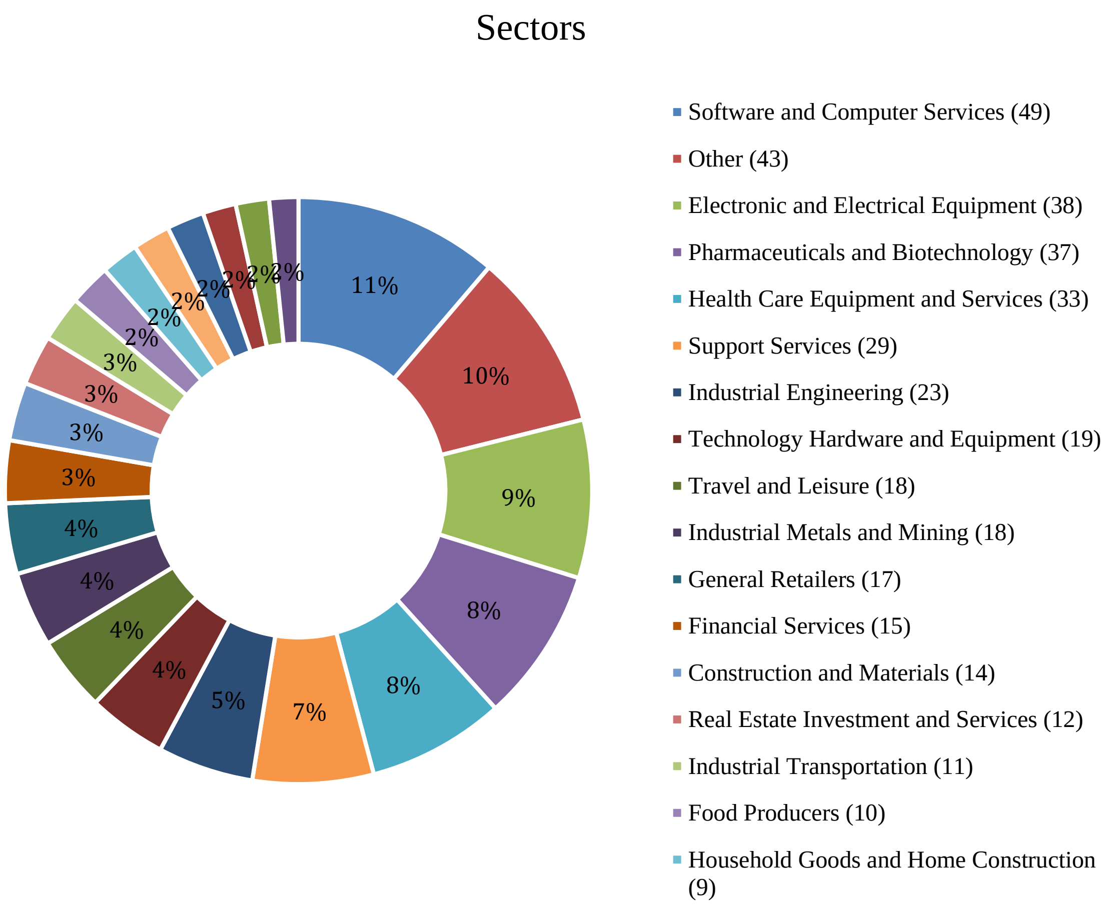
Appendix A. Sample

Appendix A1. Disclosure of Data Loss

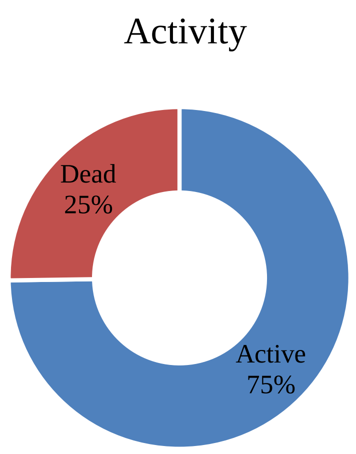
Loss in data due to market capitalization, book-to-market and stock prices

	Observed Altman's Z"-scores/Firms	*Loss*	*Firms recovered*
1992	74	6	**68**
1993	78	7	**71**
1994	83	5	**78**
1995	89	8	**81**
1996	117	9	**108**
1997	136	28	**108**
1998	158	41	**117**
1999	187	40	**147**
2000	196	25	**171**
2001	202	20	**182**
2002	208	23	**185**
2003	217	34	**183**
2004	243	50	**193**
2005	293	72	**221**
2006	307	62	**245**
2007	330	49	**281**
2008	331	40	**291**
2009	336	41	**295**
2010	342	49	**293**
2011	348	50	**298**
2012	349	47	**302**
2013	353	53	**300**
2014	347	13	**334**
Average	231	34	**198**

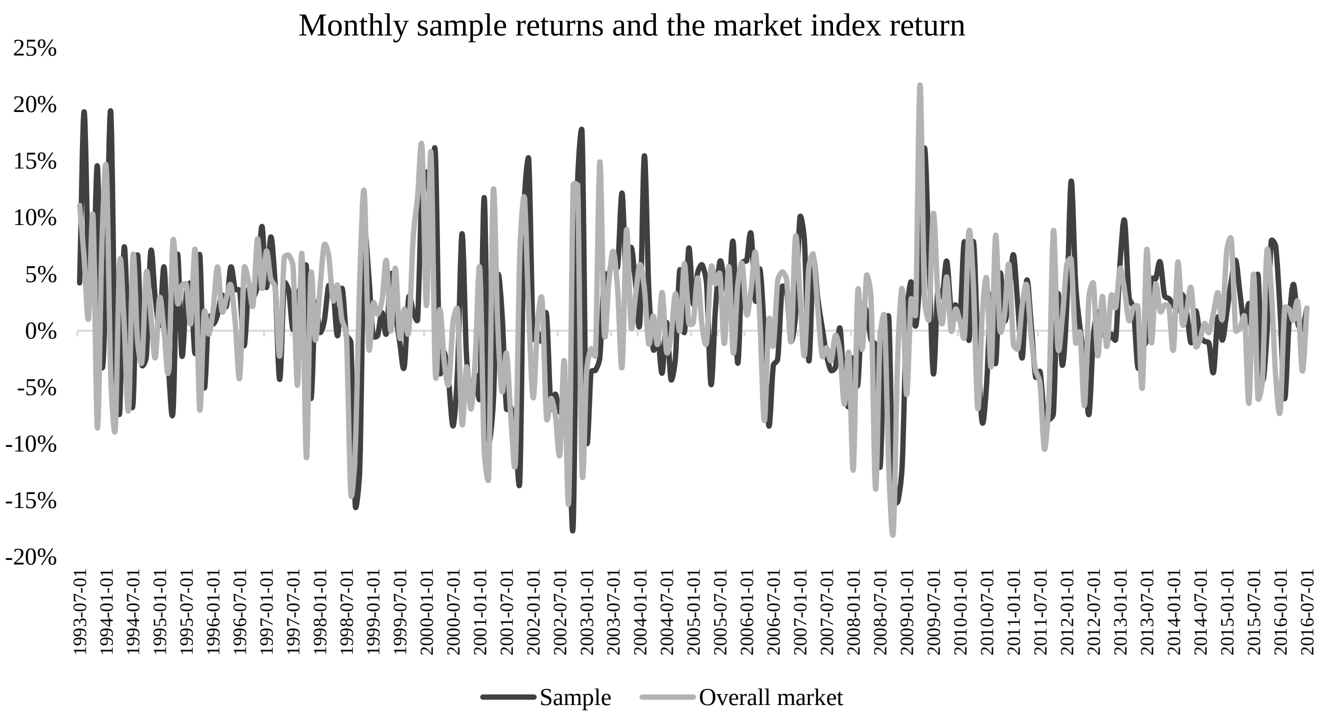
Appendix A2. Sectors and Activity



The (xx) shows the number of companies within each sector.



Appendix A3. Monthly sample return and market index return



The graph sows the monthly sample return and the monthly market index (SIXRX) during the observed period of 30-06-1993 to 30-06-2016.

Appendix B. OLS assumptions

Appendix B1. Correlation and Covariance Matrix

Correlation Matrix

	RM_Rf	SMB	HML	DHML
RM_Rf	1.000000	0.016249	-0.193592	0.038116
SMB	0.016469	1.000000	-0.388536	-0.014700
HML	-0.193592	-0.388536	1.000000	-0.121812
DHML	0.038116	-0.014700	-0.121812	1.000000

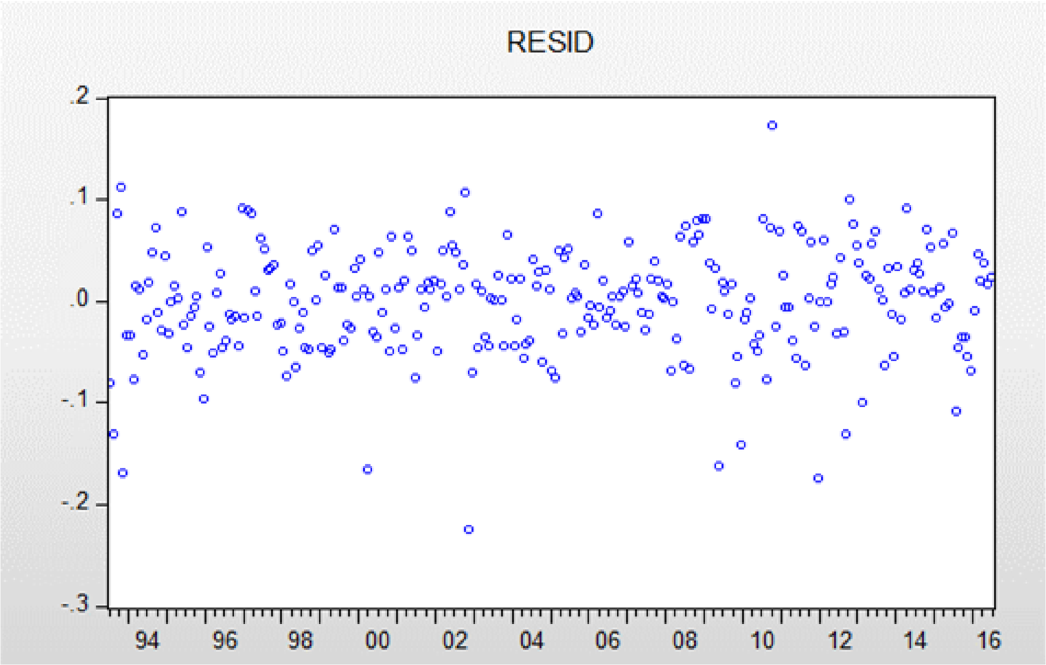
Covariance Matrix

	RM_Rf	SMB	HML	DHML
RM_Rf	0.003265	-	-	-
SMB	5.12E-05	0.003040	-	-
HML	-0.000582	-0.001126	0.002764	-0.000279
DHML	9.49E-05	-3.53E-05	-0.000279	0.001900

Appendix B2. Ramsey RESET

	Value	df	Probability
t-statistics	1,1532194	12	0,2712
F-statistics	1,330084	(1, 12)	0,2712
Likelihood ratio	1,892102	1	0,169

Appendix B3. Residual distribution



Appendix C. Regression output

Appendix C1. Fama-MacBeth Regression including the DHML factor

Gamma Summary 1
Returns: pr*
Factors: rm_rf smb hml dhml

Date: 05/10/19 Time: 09:31
Sample: 1993M07 2016M06

	gamma_0	gamma_1	gamma_2	gamma_3	gamma_4
Mean	0.000707	0.059765	-0.015954	0.009570	0.005174
Median	0.000289	0.022768	-0.020224	0.008444	0.004994
Maximum	0.029453	1.928086	1.696644	0.356862	0.217595
Minimum	-0.011575	-1.586964	-1.815543	-0.878185	-0.425041
Std. Dev.	0.005206	0.357950	0.278548	0.135565	0.052330
Skewness	1.445693	0.637046	0.073177	-1.605866	-1.471108
Kurtosis	8.379741	7.298862	13.48952	12.55785	20.73442
Jarque-Bera	428.9700	231.1905	1265.592	1169.178	3716.411
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	0.195114	16.49526	-4.403325	2.641305	1.428150
Sum Sq. Dev.	0.007452	35.23524	21.33705	5.053892	0.753067
Observations	276	276	276	276	276
t-stat	2.256159	2.773825	-0.951534	1.172786	1.642594

CS Average Regression 1
Returns: pr*
Factors: rm_rf smb hml dhml

Dependent Variable: AVGRETS
Method: Least Squares
Date: 05/10/19 Time: 09:31
Sample: 1 18
Included observations: 18
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000707	0.001333	0.530472	0.6047
BETA01	0.059765	0.034262	1.744363	0.1047
BETA02	-0.015954	0.006885	-2.317272	0.0374
BETA03	0.009570	0.007198	1.329498	0.2065
BETA04	0.005174	0.001755	2.947860	0.0113

R-squared	0.449382	Mean dependent var	0.000950
Adjusted R-squared	0.279961	S.D. dependent var	0.008012
S.E. of regression	0.006799	Akaike info criterion	-6.913997
Sum squared resid	0.000601	Schwarz criterion	-6.666672
Log likelihood	67.22598	Hannan-Quinn criter.	-6.879894
F-statistic	2.652455	Durbin-Watson stat	2.138058
Prob(F-statistic)	0.081082	Wald F-statistic	22.77450
Prob(Wald F-statistic)	0.000009		

Appendix C2. Fama-MacBeth Regression excluding DHML factor

Gamma Summary 1
Returns: pr*
Factors: rm_rf smb hml

Date: 05/10/19 Time: 14:12
Sample: 1993M07 2016M06

	gamma_0	gamma_1	gamma_2	gamma_3
Mean	0.000846	0.045935	-0.021778	0.010151
Median	0.000588	0.015356	-0.034275	0.009729
Maximum	0.029412	2.007165	1.732441	0.362624
Minimum	-0.010579	-0.761532	-1.782240	-0.881508
Std. Dev.	0.005142	0.350238	0.273514	0.136248
Skewness	1.358571	1.295978	0.187507	-1.612959
Kurtosis	8.873408	7.416972	14.37664	12.61438
Jarque-Bera	481.6175	301.6205	1490.038	1182.692
Probability	0.000000	0.000000	0.000000	0.000000
Sum	0.233490	12.67816	-6.010829	2.801709
Sum Sq. Dev.	0.007272	33.73326	20.57269	5.104978
Observations	276	276	276	276
t-stat	2.733335	2.178888	-1.322796	1.237751

CS Average Regression 1
Returns: pr*
Factors: rm_rf smb hml

Dependent Variable: AVGRETS
Method: Least Squares
Date: 05/10/19 Time: 14:12
Sample: 1 18
Included observations: 18
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000846	0.001352	0.625806	0.5415
BETA01	0.045935	0.036530	1.257470	0.2292
BETA02	-0.021778	0.008265	-2.634945	0.0196
BETA03	0.010151	0.007255	1.399161	0.1835

R-squared	0.277589	Mean dependent var	0.000950
Adjusted R-squared	0.122787	S.D. dependent var	0.008012
S.E. of regression	0.007504	Akaike info criterion	-6.753556
Sum squared resid	0.000788	Schwarz criterion	-6.555696
Log likelihood	64.78201	Hannan-Quinn criter.	-6.726274
F-statistic	1.793185	Durbin-Watson stat	2.330299
Prob(F-statistic)	0.194653	Wald F-statistic	8.942954
Prob(Wald F-statistic)	0.001465		