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INTEREST RATE SPREADS AND STOCK MARKET RETURNS

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<p>Abstract</p> <p>This thesis studies systematic risk factors and return predictability in the Finnish stock market. The purpose is to test whether global Fama French factors and three interest rate spreads are risk factors that explain the cross sectional variation of excess returns in the Finnish stock market. The thesis also studies whether these factors are variables that forecast excess stock returns in the Finnish market. Research method is a linear factor pricing model, where excess returns are explained with these six risk factors.</p> <p>Main result of this study is that global Fama French factors, term spread and treasury spread are variables that can be used as systematic risk factors for explaining returns in the Finnish stock market. These variables explain about half of the cross sectional variation of excess returns in the Finnish market. Results regarding excess market return are unambiguous whereas results regarding SMB, HML, term spread and treasury spread vary along the estimated indices. Results of return predictability show that term spread and treasury spread are variables that forecast returns in the Finnish stock market.</p> <p>Limitation of this study is that these results are not supported with out of sample tests. Therefore these results cannot be generalized. Results of this study inspires to further research which would help to evaluate whether these variables can be used as systematic risk factors in other regional markets in addition to Finnish stock market.</p>			
Keywords asset pricing, systematic risk factors, return predictability.			
Additional information			

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1 INTRODUCTION

Asset returns vary across time and across assets. Asset pricing research tries to explain this phenomenon. According to Cochrane (2011) the variation in asset returns is mainly caused by changes in discount rates or in the risk premium. Risk premiums vary along with changes in business conditions. Risk premiums tend to be high during financial distress and low during the business cycle peaks.

Asset pricing models explain asset returns with their sensitivity to systematic risk. An essential part of financial research is evaluating proper risk factors that are sufficient measures for systematic risk. These are variables that vary along with business cycles and tell something about macroeconomic conditions. Most well-known systematic risk measure for stocks is the CAPM beta, which measures the sensitivity of stock return to the excess return of the market. However, empirical evidence has shown that CAPM beta is unable to explain the entire cross sectional variation of excess stock returns. This means that other risk factors are needed in addition to CAPM beta for explaining why certain assets pay higher returns than the others.

The purpose of this thesis is to study systematic risk factors and return predictability in the Finnish stock market. The aim is to find out whether three stock market- and three interest rate variables are risk factors that explain the cross sectional variation of excess returns in the Finnish stock market. Another interest is to study whether these factors are variables that forecast returns in the Finnish market. Stock market variables are global versions of factors from the Fama French three factor model. These factors are chosen since the three factor model has been successful explaining stock returns in the U.S market (Fama & French 1993). According to Cochrane (2011) returns are functions of characteristics which mean same as risk factors. These characteristics should be congruent globally. Therefore I use global versions of the Fama French factors. Interest rate variables are term spread, default spread and treasury spread. These are financial variables that vary along with macroeconomic conditions. Therefore they are good proxies for systematic risk and potential risk factors explaining stock returns. As a research method I use a linear factor pricing model explaining excess stock returns in the Finnish stock market.

There are three questions under interest of this study:

- Do these three interest rate spreads along with global Fama French factors explain excess returns in the Finnish stock market?
- Do the results differ between different indices in the OMX Helsinki stock exchange?
- Can excess returns in the Finnish stock market be predicted with these factors?

Hypothesis of this study is based on the earlier empirical studies of Chen Roll and Ross (1986), Fama and French (1989) and Fama and French (1993). I assume global Fama French factors and three interest rate spreads to be risk factors that explain cross sectional variation of excess returns in the Finnish stock market. Another assumption is that these factors predict stock returns in the Finnish market.

The thesis proceeds as follows. Chapter 2 introduces asset pricing theory. I start with stochastic discount factor analysis and with basic consumption based model which is considered as the basis of all other asset pricing models. Chapter 2 continues presenting briefly commonly used practical asset pricing models. Chapter 3 provides empirical evidence related to risk factors that have shown to be proxies for systematic risk. Chapter 4 gives brief introduction of stock return predictability. Chapter 5 provides the empirical study including data and method description, results and analysis. Chapter 6 concludes.

2 ASSET PRICING THEORY

Asset pricing is an area of finance that tries to explain the prices of claims to uncertain payments (Cochrane 2005:13). Payments or cashflows that investor receives for the investment are uncertain because of the risk that is included to them. Besides of the risk, investor needs to account for the delay of the cashflow. Investor requires compensation both for the delay and for the risk. Compensation for the delay is called the risk free rate. Risk free rate is usually a rate of return of a non-risky investment such as government bond yield. Compensation for the risk is called the risk premium.

The general rule for pricing any asset is fairly simple. Price equals expected future cashflows. This can be expressed with a simple formula

$$P_t = E(m_{t+1}x_{t+1}), \quad (1)$$

where P_t equals the price of an asset at time t , m_{t+1} is the stochastic discount factor, and x_{t+1} is the asset payoff for the following period (Cochrane 2005: 15). The stochastic discount factor is a random variable which prices all assets in the economy (Campbell 2000). It can be seen as a factor that converts future cash flows in to present. It is directly related to discount rate which is the same as the risk premium or the expected return (Cochrane 2011:1047). Consequently, the basic equation of asset pricing states that two variables that affect asset prices are expected future cash flows and discount rates. The cash flows are quite simple to understand. The discount rates are more complicated.

The basic pricing principle points out that variation in asset prices come either from changes in expected future cash flows or from changes in discount rates. Another essential part of asset pricing research explains why asset prices vary across times and across assets. Asset pricing research states that most of the price variation is caused by changes in discount rates instead of changes in expected future cash flows. (Cochrane 2011.) This is explained by the fact that asset prices vary too much compared to changes in expected future cash flows (Shiller 1981). Therefore most of the price variation must come from the discount rate variation. That is also the central question in current asset

pricing research (Cochrane 2011). Since asset prices and returns are closely connected, asset pricing research studies why some assets pay higher average returns than others (Cochrane 2005:13).

2.1 Stochastic discount factor

The stochastic discount factor (SDF) approach provides a general framework for asset pricing (Smith & Wickens 2002). As equation 1 states, a SDF has the following property: the price of an asset equals the expected value of the product of the asset payoff and the SDF. Hence, SDF converts the payoff received in the future to the present. (Jagannathan & Wang 2002.) Therefore the SDF is also called intertemporal marginal rate of substitution (Ferson 1995:146).

Asset pricing in practice is finding values for future cash flows. Further examination of SDF tells how investor values these payoffs. SDF framework helps also understanding why certain assets have higher prices than the others. In this further analysis, the pricing principle in equation 1 is expressed as a basic consumption-based model. This is done by solving the investor's first order condition from the optimization problem where investor maximizes a lifetime utility function of consumption. This means finding an optimal allocation of resources to consumption and to investment assets. If this allocation is optimal, it is not possible to obtain higher utility by changing the allocation. (Ferson 1995:147.)

Investor must thus decide how much to consume today and how much to invest in an asset to receive consumption in the future. Investor makes this decision in order to maximize her utility. Consumption today increases current utility and lowers future utility whereas investment in an asset does the opposite. The utility is maximized when the marginal utility loss of consuming little less today and investing a little more in an asset equals the marginal utility gain of consuming a little more of the asset's payoff in the future. (Cochrane 2005:3.)

The investor's utility can be expressed in mathematical formation,

$$U(c_t, c_{t+1}) = u(c_t) + \beta E_t[u(c_{t+1})], \quad (2)$$

where $u(c_t)$ and $u(c_{t+1})$ are utilities given consumptions at time t and $t+1$ and β is the subjective discount factor. Investor allocates her wealth between consumption and investment in order to maximize the objective function,

$$\max u(c_t) + E_t[\beta u(c_{t+1})]. \quad (3)$$

Consumption streams are constrains for the objective function. The choice of how much to consume and how much to invest determines the consumption streams for each period,

$$c_t = e_t - p_t \xi, \quad (4)$$

$$c_{t+1} = e_{t+1} + x_{t+1} \xi. \quad (5)$$

Equation 4 states that consumption at period t equals the original consumption level e_t subtracted with the price of the asset p_t times the amount of the asset purchased ξ . Investor thus consumes everything that she does not invest. Equation 5 states that consumption at period $t+1$ equals the original consumption level e_{t+1} added with the payoff of the asset x_{t+1} times the amount of the asset purchased ξ . (Cochrane 2005:5.)

Constrains in equations 4 and 5 are substituted into the objective function (Appendix 1). The objective function is derived with respect to ξ and set to zero. The first order condition for an optimal allocation between consumption and investment becomes,

$$p_t u'(c_t) = E_t[\beta u'(c_{t+1}) x_{t+1}]. \quad (6)$$

In the above equation the allocation between consumption and investment is at the optimum. The marginal loss equals the marginal gain. (Cochrane 2005:5.)

If the above relation is solved in respect to the asset price p_t the equation can be written as

$$p_t = E_t \left[\beta \frac{u'(c_{t+1})}{u'(c_t)} x_{t+1} \right]. \quad (7)$$

This is the basic pricing principle written in another form. It is called the basic consumption based model. The model was first developed by Lucas (1978) and it works as a foundation to all other asset pricing models (Jones 2008:107). It is in principle a complete answer to all asset pricing questions (Cochrane 2005: 5 - 6). The model can be interpreted by analysing features of the SDF and the utility functions. This is done by breaking up the equation and defining the SDF m_{t+1} ,

$$m_{t+1} \equiv \beta \frac{u'(c_{t+1})}{u'(c_t)}. \quad (8)$$

(Cochrane 2005: 5 – 6.)

The definition of the SDF states that three variables affect how investor values expected future cash flows. If the subjective discount factor β is assumed to be constant, expected future cash flows are determined by marginal utility of consumption $u'(c)$ at current and future periods.

Utility function determines investor's utility at given level of consumption. Utility function is often assumed to be a power utility form which means that marginal utility is positive (Appendix 2). It tells the change in investor's utility when consumption changes by one unit. Positive marginal utility means that investor prefers more consumption. Investor is better off for each additional unit she is able to consume. Another important property of the utility function is the negative second derivative. It means declining marginal utility. An additional unit of consumption increases utility more when consumption is low. (Cochrane & Culp 2003: 59 – 60, Cochrane 2005: 4 – 5.)

The form of the SDF and above mentioned properties of the utility function have important economic meaning. Marginal utility is high when consumption is low and vice versa. People value additional consumption most during bad times such as in recession when aggregate consumption is low. In such state they are not willing to give up any consumption in order to invest. Instead, people are willing to hold assets that provide payoffs during these bad states of nature when marginal utility is high. These assets work as insurances providing smoother consumption stream to investors. Therefore these assets sell at higher price and their returns are lower. The implication to be made of this analysis is that asset returns are driven by their covariance with aggregate consumption. Assets, whose payoffs co-vary positively with consumption, provide higher returns whereas assets with negative covariance provide lower returns. (Cochrane & Culp 2003: 59 – 60, Cochrane 2005: 4 – 5.)

The basic consumption based model and SDF analysis provides a general theoretical framework that helps to understand why discount rates vary and why certain assets pay higher returns than the others. It also works as a foundation of understanding other asset pricing models which are all specializations of the basic consumption based model shown in equation 7 (Jones 2008: 107). The purpose of these models is to explain the nature of the SDF. The models differ in a way how the SDF is defined. (Cochrane 2005: 44.) For example, a linear factor pricing model identifies a particular linear function of the factors as a SDF (Jagannathan & Wang 2002). Regardless of what types of techniques are used to define the SDF, the idea for all applications is the same, asset returns are driven by their covariance with the discount factor. Cochrane (2001: 13) expresses this mathematically as,

$$E(R^i) - R^f = -R^f \text{cov}(m, R^i), \quad (9)$$

where $E(R^i)$ refers to the expected return of asset i , R^f to the risk free rate and m to the SDF. Equation states that assets whose payoffs have negative covariance with the discount factor produce higher excess returns. Equation 9 explains also another basic principle in finance, the relation between risk and return. An individual asset's risk is measured by its variance. However, only covariance between asset return and the discount factor generates excess return. Hence, investor does not get compensated for

the variance of the individual asset. The part of the risk that is perfectly correlated with the discount factor is called systematic risk. The part that is uncorrelated with the discount factor is called idiosyncratic risk. Only systematic risk generates premium. (Cochrane and Culp 2003: 64 – 68.)

In empirical work instead of using stochastic discount factors and utility functions, it is convenient to use more practical applications. Finance theorists use discount factor models which are generally expressed in expected return-beta representation form. Commonly used asset pricing models expressed in this form are Capital asset pricing model (CAPM), Arbitrage pricing theory (APT), Intertemporal capital asset pricing model (ICAPM) and Consumption based capital asset pricing model (CCAPM) (Cochrane 2005:77, Jones 2008:107.)

2.2 Consumption based capital asset pricing model

The characteristic in the earlier derived fundamental asset pricing equation is that it links asset prices and returns in general equilibrium context to investor's decision about consumption and savings (Carmichael 1998). A practical application of this fundamental idea is CCAPM and it was first developed by Breeden (1978). CCAPM uses real consumption data to estimate asset returns. In the Breeden's model asset return is linearly related to the growth rate in aggregate consumption (Elton & Gruber 1991:322 – 323).

Breeden (1978) define the model under several assumptions. He assumes that a) all risky assets are tradable, b) investors have homogenous beliefs, (c) other assets can be traded without costs and d) all assets have returns which follow Ito process (Grossman & Shiller 1982). The model is expressed in a functional form as,

$$R_{it} = \alpha_i + \beta_i C_t + e_{it}, \quad (10)$$

where R_{it} refers to the return of the asset i at time t , C_t is the growth rate of aggregate consumption per capita at time t , α_i is the constant term and e_{it} is the residual parameter. The parameter beta is defined as,

$$\beta_{it} = \frac{Cov(R_{it}, C_t)}{Var(C_t)} \quad (11)$$

(Elton & Gruber 1991: 323).

The model in this form is simple and appealing. It is a concrete way to estimate expected returns while still capturing the intuition behind the theory. Unfortunately, CCAPM does not work in practice. Empirical studies have not found support for the model. Studies have been done to test the Breeden's (1979) model as well as the original consumption based model produced by Lucas (1978). Neither of the models have been supported empirically. (Elton & Gruber 1991: 354 – 356, Chen 2003.)

Mehra and Prescott (1985) state that consumption based models are unable to explain the equity premium puzzle. Equity premium puzzle means that the risk premium of stocks over risk free bonds is too large given the risk related to them (Kocherlakota 1996). The risk of equities should be measured with their covariance with consumption growth. Over the ninety-year period, US equity risk premium has been over six percent with standard deviation over sixteen percent. The same time the average growth rate of per capita real consumption has been under two percent with standard deviation of four percent. The finding here is that consumption growth covaries too little with the return of equities to justify the large risk premium of stocks (Mankiw & Zeldes 1991). Mehra and Prescott (1985) state that the consumption based model presented by Lucas (1978) would work only with extremely high risk aversion parameters. In practice this means that the model does not work properly or investors are significantly more risk averse than thought.

Empirical testing of consumption based models has also challenges which are related to measuring the growth rate of per capita consumption. Breeden, Gibbons & Litzenberger (1989) study empirical implications of the Breeden's (1978) CCAPM. They report four

econometric problems associated with measured consumption: a) statistics are reported on expenditures not on consumption, b) consumption data is reported infrequently relative to stock returns, c) statistics report total expenditures instead of expenditures at a point in time and d) data contains sampling errors. These can bias the estimation results. Due to these problems, Breeden et al. (1989) test the CCAPM using betas based on both consumption and the portfolio having the maximum correlation with consumption. This means that the growth rate of aggregate consumption is replaced with returns of the portfolio that has the maximum correlation with consumption. Breeden et al. (1989) reject the linear equality between the reward and the risk implied by CCAPM at the 0.05 level. The relation is rejected also for the portfolio with maximum correlation with consumption. However, Breeden et al. (1989) state that the relation is reasonably linear given the poor quality of the consumption data.

Cumby (1990) test the consumption model in international stock market. He studies whether stock returns in four countries are consistent with consumption based models. Countries under observation in his study are United States, United Kingdom, Germany and Japan. He show that real stock returns cannot be explained fully by consumption based models.

Another weakness of CCAPM is that it does not measure an asset's risk in the way investors presumably do, using covariances with variables that are exogenous to investors. Exogenous here mean variables that are independent and are not affected by investors decisions. However, investors choose consumption and that is endogenous from their perspective. Therefore the CCAPM cannot give a good account of the way investors perceive risk. (Campbell 1996: 301.)

Even though empirical evidence does not support the functionality of consumption based models, they have important role in financial economics. Cochrane and Campbell (2000) state that empirical evidence that has rejected the models should be interpreted against specific functional forms and parameterizations than against the consumption based models in general. This because all other asset pricing models are specializations of the consumption based model instead of alternatives to it.

2.3 Capital asset pricing model

The most well-known asset pricing model is the capital asset pricing model (CAPM) originally developed by Sharpe (1964) and Lintner (1965). Due to its mathematical simplicity CAPM is widely used practical application in financial industry to estimate expected returns and risk premiums of capital assets. CAPM is a special case of the consumption based model even though it was originally developed earlier than the consumption based model (Cochrane & Culp 2003: 71). It measures the risk of a security by the security's covariance with market return. The model can be expressed as,

$$E(R^i) = R^f + \beta [E(R^m) - R^f]. \quad (12)$$

The formula says that expected return of the asset $E(R^i)$ equals the risk free rate R^f added the asset beta β times the market risk premium $E(R^m) - R^f$ (Chen 2003). The market risk premium is the return of the market portfolio minus the risk free rate. The beta is calculated as,

$$\beta = \frac{Cov(R^i, R^m)}{Var(R^m)}. \quad (13)$$

The beta is thus the covariance between asset and market returns divided by the variance of the market return. (Cochrane & Culp 2003: 70).

CAPM model states that asset's return is driven by its systematic risk which is measured by its beta. Beta tells the asset return's sensitivity to the market return. Assets that are more sensitive to the movements of the market as a whole have higher betas than assets that react slowly to changes in the market. In other words, the higher the asset's beta, the higher is the expected return. The idea is the same as in the consumption based model. Models differ in ways they define the systematic risk measure, and what data is used in that definition. Consumption based model uses consumption data whereas CAPM uses data of market returns. (Cochrane & Culp 2003: 68 - 71).

CAPM is based on set of quite strong assumptions. Some of the assumptions are sensible, but most of them are too strong to describe financial markets as they are. Assumptions state that there are no transaction costs or personal taxes. Assets are infinitely divisible and individuals cannot affect prices with their transactions. Short selling is unlimited and investors are able to lend freely with the risk free rate. All assets are marketable even human capital and labor. Investors make decisions solely in terms of expected returns and standard deviations of their portfolios. Finally, investors have homogeneous expectations of the future. (Elton & Gruber 1991: 284 – 285).

The model cannot be judged solely based on its unrealistic assumptions. All models are based on simplifications that enable the description of complicated reality. Instead, the model should be judged based on the robustness of its predictions. CAPM is based on two predictions: a) the market portfolio is mean variance efficient and b) the security market line (SML) accurately describes the risk-return trade-off. Mean variance efficiency implies that differences in expected returns across securities and portfolios are fully explained by differences in market beta (Fama & French 2004). The SML is the graphical representation of the expected return – beta relationship defined by the CAPM. The problem of testing the CAPM is the fact that the market portfolio is unobservable. The hypothetical market portfolio should include all assets in the economy which makes it infeasible. To overcome this problem, tests for CAPM use proxies such as equity indices to stand for the true market portfolio. Roll (1977) criticized these tests stating that only true test of CAPM is whether the market portfolio is ex ante mean-variance efficient. His claim that CAPM is not testable is called the Roll's critique. (Bodie, Kane and Marcus 2009: 288 – 297, Jones 2008: 144.)

Empirical record of the CAPM is not encouraging. For example Black, Jensen and Scholes (1972) and Blume and Friend (1973) test CAPM with cross sectional regressions. These studies show that the CAPM beta is unable to explain completely the relation between market beta and expected returns of assets. Time-series tests such as Friend and Blume (1970) and Stambaugh (1982) also show that CAPM does not work empirically. If CAPM would hold and market portfolio would be mean-variance efficient, variation in asset returns would be explained solely by variation in asset betas. However, empirical research has found evidence of the variation in asset returns that are

unrelated to beta. This states that there are other measures for systematic risk in addition to market risk premium. (Fama & French 2004.)

2.4 Arbitrage pricing theory

The arbitrage pricing theory (APT) developed by Ross (1976) is one of the primary alternatives to the CAPM. It is an asset pricing model that explains the cross sectional variation in asset returns (Chen 1983). APT relies on three key propositions: i) asset returns can be described by a factor model ii) there are sufficiently securities to diversify away idiosyncratic risk and iii) well-functioning security markets do not allow for the persistence of arbitrage opportunities. Factor pricing model is an asset pricing model that determines asset's expected return as a linear function of set of factors. Second proposition implies that firm specific risk does not generate excess return since it can be diversified away. Arbitrage opportunity means a chance to earn riskless profits without making a net investment. APT states that security markets are efficient enough to prevent arbitrage opportunities or if they exist they will disappear immediately. (Bodie et al. 2009: 324 – 325.)

As stated earlier, each asset pricing model has a certain way to define the stochastic discount factor. Cochrane (2005: 44 - 45) show how a factor pricing model specifies the SDF as a linear function of a set of proxies,

$$m_{t+1} = a + b_A f_{t+1}^A + b_B f_{t+1}^B + \dots, \quad (13)$$

where f^i are factors and a, b_i are parameters. The SDF does the same as earlier; it converts future cash flows to present. In the pure consumption based model the SDF was defined by investor's marginal utility. In the factor pricing model, the factors are proxies for marginal utility; events that describe whether typical investors feel good or not. Thus, factor pricing model is an alternative way to describe the SDF. This can be demonstrated by breaking the SDF as it was determined earlier,

$$\beta \frac{u'(c_{t+1})}{u'(c_t)} = a + b_A f_{t+1}^A + b_B f_{t+1}^B + \dots \quad (14)$$

(Cochrane 2005:44-45.)

Factor pricing model is expressed in a form explaining returns as,

$$R^i = E(R^i) + \sum_{j=1}^M \beta_{ij} f_j + \varepsilon^i. \quad (15)$$

In the equation $E(R^i)$ is the expected return of the asset i , β_{ij} are betas or factor loadings, f_j are factors and ε^i are residuals. Beta measures the asset's sensitivity to the risk and factor measures the price of the risk. According to the model, asset return is the expected return plus sum of random returns; factor returns plus idiosyncratic return. Factor returns are measures of the systematic risk. In this equation they mean deviation of factors from their expected values. If factors get value of zero, the asset return becomes the expected return added with firm specific random return. Idiosyncratic returns have zero mean and they are uncorrelated with factors and with each other. This means that investor is able to get rid of the idiosyncratic risk by holding a well-diversified portfolio. Instead, factor risks cannot be diversified away. Since the random risk is diversifiable, it is not rewarded. Factor pricing model therefore states that asset returns are driven by their sensitivities to the systematic risk factors. (Connor & Korajczyk: 1995: 87 – 88, Cochrane 2005: 78, 173 – 175, Bodie et al. 2009: 319 – 333.)

APT does not identify factors. Instead, factors are identified empirically by using data to find the best fit for the linear factor model. Factors can be classified in three ways to macroeconomic factors, fundamental factors and statistical factors. Macroeconomic factors are the simplest and most intuitive since they are good proxies for marginal utility. They are observable macroeconomic time series such as interest rates, inflation or change in industrial production. Fundamental factors are associated with company attributes such as firm size, dividend yield or book-to-market ratio. Statistical factors are found with statistical analysis of the panel data of set of security returns. (Jones 2008:

131, Connor 1995.) Factors can be also returns of factor mimicking portfolios. They are portfolios whose returns are proxies of factors (Huberman, Kandel & Stambaugh 1987).

In empirical finance, factor models are estimated either by running a time-series regression or a cross-sectional regression. Typical way to estimate asset returns is to run a cross sectional regression and express it in an expected return-beta relationship form as,

$$E(R^i) = \gamma + \beta_{i,a}\lambda_a + \beta_{i,b}\lambda_b + \dots + \alpha_i, \quad i = 1, 2, \dots, N, \quad (16)$$

where γ is the intercept and α_i are pricing errors. If there is a risk free rate with zero beta, the intercept equals the risk free rate. Pricing errors should be statistically insignificant and economically small in test. It is common to estimate only excess returns where the risk free rate is subtracted from the original asset return. The model then becomes,

$$E(R^{ei}) = \beta_{i,a}\lambda_a + \beta_{i,b}\lambda_b + \dots, \quad i = 1, 2, \dots, N \quad (17)$$

(Cochrane 2005: 78 – 80).

CCAPM, CAPM and APT are all asset pricing models that try to explain the relation between risk and return. CCAPM and CAPM have failed empirically to explain this relation (Lettau & Ludvigson 2001). APT is therefore a good alternative for these two models. Its empirical usefulness is based on its ability to permit cross-sectional tests where there may be more than just one risk factor (Roll & Ross 1980).

3 EMPIRICAL EVIDENCE OF RISK FACTORS

Poor empirical evidence of CAPM has influenced search for alternative asset pricing models (Vassalou 2003). Studies of Black, Jensen and Scholes (1972), and Blume and Friend (1973) state that low beta stocks have had higher returns and high beta stocks have had lower returns than their CAPM beta would imply. This means that CAPM beta is unable to explain completely the systematic risk that drives stock returns. Empirical finance has thus found other systematic risk factors than the beta. Banz (1981) show that smaller firms have had higher risk adjusted returns. Basu (1983) have similar observation of firms with higher earnings in relation to their price. Neither of these higher returns can be explained with CAPM beta. Financial research has also found macroeconomic factors that explain stock returns. Chen, Roll and Ross (1986) find several macroeconomic variables significant explaining expected stock returns, most notably industrial production, changes in interest rates spreads and inflation. Fama and French (1989) show that interest rate variables such as term- and default spreads explain the business cycle pattern of stock and bond returns.

3.1 Size and value factors

Empirical findings first noted by Banz (1981) and Basu (1983) led to a notable new course in financial research. This culminated to the famous three factor model developed by Fama and French (1993). The model explains stock returns with their sensitivities to three risk factors. In addition to market return the model includes size and value factors.

3.1.1 Empirical evidence of size and value factors

Banz (1981) studies the empirical relationship between the return and the market value of NYSE common stocks. He has 40 year observation period between 1926 - 1975. As a method he uses a general asset pricing model which defines the expected return of a common stock as a function of market return and an additional factor; market value of the equity. As a result he states that CAPM is misspecified. On average, small NYSE

firms have had significantly larger risk adjusted returns than large NYSE firms over the estimation period. The effect has been stronger for very small firms while there has been just a little difference in return between average sized and large firms. Banz (1981) does not provide explanation for the effect. He does not state whether the factor is the size itself or some other factor correlated with it.

Basu (1983) examines the empirical relationship between earnings yield, firm size and returns on the common stock of NYSE firms. His results confirm that stocks with high earnings to price (E/P) ratio earn on average higher risk adjusted returns than the stocks with low E/P ratio. High E/P ratio implies that the stock is valued lowly in relation to its earnings. The effect is significant even if the size effect is taken into account. However, Basu (1983) state that the size effect practically disappears when returns are controlled for differences in risk and E/P ratios. Basu (1983) believes that neither size nor E/P ratio can be considered to cause expected returns but both variables are proxies for more fundamental determinants of expected returns for common stocks.

Rosenberg, Reid and Lanstein (1985) study the relation between book-to-price ratio and stock return. Book-to-price ratio describes the relation between the book value of equity and the market value of equity. Stocks with high book-to-market equity are called value stocks and stocks with low book-to-market equity are called growth stocks. Rosenberg et al. (1985) study returns of stocks listed in the NYSE, ASE and NASDAQ exchanges for the time period of 1973 - 1984. They report a positive relation between high book-to-price ratio and stock returns. Firms that are valued lowly in relation to their book value of equity have higher returns on average.

Fama and French (1992) test the cross sectional variation of average stock returns in the U.S market with five factors. Along with market beta they explain average stock returns with size, E/P, book-to-market equity and leverage factors. They find that market beta is not a significant factor. Instead, all other factors have significant explanatory power. However, their results show that leverage and E/P factors are useless if the combination of size and book-to-market equity is used. This indicates that these two variables used together explain well the cross-section of average returns on NYSE, Amex and NASDAQ stocks for the 1963 – 1990 period.

Fama and French (1993) study the cross section of average returns stock returns expanding the analysis of Fama and French (1992). Along with stock returns they explain also bond returns. In addition to size and book-to-market factors, they test two interest rate variables; term- and default spreads. Most importantly, Fama and French (1993) use the time series regression approach of Black, Jensen and Scholes (1972). In their study Fama and French (1993) produce a three factor model with three stock market variables. Risk factors in the model are the excess market return and the mimicking returns for size and book-to-market equity factors. Size factor means the spread between returns of two portfolios; portfolio consisting small stocks and portfolio consisting big stocks. Value factor means the spread between returns of portfolios consisting value- and growth stocks. Other names for these two factors are small minus big (SMB) and high minus low (HML). The three factor model can be expressed as

$$R_t^M - R_t^f = a + b[R_t^M - R_t^f] + sSMB_t + hHML_t + e_t, \quad (18)$$

where $R_t^M - R_t^f$ is the excess market return, a is the intercept and e_t is firm specific residual. In their analysis, Fama and French (1993) sort stocks to five quintiles according to their size and similarly according to their book-to-market equity values. With this division they form 25 sub portfolios whose excess returns are estimated. These portfolios are used in order to determine whether the mimicking portfolios SMB and HML capture common factors in stock returns related to size and book-to-market equity.

The main result of the regressions by Fama and French (1993) confirms that the three-factor model explains well the cross-section of average stock returns. Intercepts for the three-factor regressions are close to zero. Also R-squared values for all 25 sub portfolios are between 0.83 – 0.97. This implies that the model captures most of the cross sectional variation in returns of these 25 portfolios. SMB and HML capture a strong common variation in returns regardless of what other variables are in the regression. These two factors alone can explain the differences in average returns across stocks. The market factor is needed to explain the large difference between the average returns on stocks and one-month bills.

Enormous research of the validity of the three factor model followed. A question under this research has been whether size and value factors can explain cross section of returns outside the U.S market (Drew & Veeraraghavan 2002). Fama and French (1998) provide international evidence of the value premium. They study average returns of global portfolios of high and low book-to-market stocks for the period of 1975 - 1995. Value stocks outperform growth stocks in twelve of thirteen major markets. Barry, Goldreyer, Lockwood and Rodriquez (2002) study the robustness of size and value effects in emerging equity markets during 1985 - 2000. As a method they define measures of size and book-to-market equity relative to each firm's local market average. Barry et al. (2002) show that mean returns for value stocks are significantly higher than returns of growth stocks. Returns of small stocks exceed the returns of large stocks but results are not robust due to the removal of extreme returns. Evidence of Drew and Veeraraghavan (2002) support also the view that size and value premiums exist outside the U.S market. They study the cross section of average stock returns in Malaysian stock market during 1992 – 1999. Their findings suggest that Fama French three factor model explains returns in Malaysian market in an economically meaningful way.

There are also studies that reject the validity of three factor model outside the U.S market. Griffin (2002) studies whether country-specific or global versions of SMB and HML better explain the time series variation in stock returns. His results do not give support to the extension of the model to a global context. He states that country specific three factor models are more useful for explaining returns than global versions. Similar conclusions are provided by Mirza and Afzal (2011). They evaluate the performance of Fama French model in European markets. They include stocks from 15 European countries to their tests. As a difference to other studies they use daily returns and relatively short estimation period from 2002 to 2006. Results are not encouraging for the three factor model. The model fails to explain five of the six portfolios under investigation. Mirza and Afzal (2011) make a similar conclusion as Griffin (2002) that the three factor model performs poorly for global portfolios.

3.1.2 Explanation for size and value factors

Impressive performance of the Fama French three factor model has led to a debate in the financial research about the economic interpretation of size and value factors (Petkova 2006). There exists a controversy for the explanation of this phenomenon. Fama and French (1992) state that with rational markets, higher returns gained by small and value stocks come due to the higher risk. They expect size and value factors to proxy for common systematic risk factors in returns. For the explanation Fama and French (1992) say that these factors are related to economic fundamentals. Firms that have poor prospects according to the market have higher discount rate and their prices are lower. This is signalled with high book-to-market value and with higher expected returns. Fama and French (1992) show that firms with high book-to-market equity tend to have consistently poor earnings compared to firms with low values of book-to-market equity. Similarly, small firms are thought to be more sensitive to financial distress than large firms and therefore contain higher systematic risk. Liew and Vassalou (2000) give support to this risk based explanation. Using data from ten countries they show that size and value factors contain significant information about future GDP growth. They prove a positive relation between future economic growth and returns of mimicking portfolios of size and value factors. Their findings clearly state that size and value factors are proxies of fundamental risk measures.

There are also other explanations for this phenomenon. In contrast to the risk based explanation, Lakonishok, Shleifer and Vishny (1994) suggest that high returns of value stocks are caused by market inefficiency instead of the higher risk. They state that higher returns of the stocks with high book-to-market equity are caused by irrational investors who fail to evaluate past earnings growth rates of firms. They are too optimistic about firms which have done well in the past and too pessimistic of those who have performed poorly. Another view they propose is that growth stocks are more glamorous than value stocks and therefore more attractive to naïve investors who drive up their prices and lower the expected return. Daniel and Titman (1998) also deny the view that size and value factors are proxies for nondiversifiable factor risks. Instead they explain the higher risk premium of small and value stocks with characteristics instead of with the covariance structure of returns. This means that there are other

explanations for higher returns than the higher risk. High book-to-market firms might be for example in related lines of businesses, in the same industries or from the same regions. It is these characteristics that explain their higher returns, not the covariances with the systematic risk factor.

3.2 Macroeconomic risk factors

Many asset pricing models use macroeconomic factors as measures of the systematic risk. A model with macroeconomic factors connects returns to economic fundamentals. This is appealing since economic conditions are related to aggregate consumption and therefore they should tell something about how a typical investor feels. Macroeconomic factors give good expression of the business cycle patterns of the economy and expected business conditions should be linked to expected excess returns. Some factors are direct measures of the current state of the economy. Rates of inflation, industrial production and changes in GDP are examples these (Flannery & Protopapadakis 2002, Vassalou 2000). Other factors are financial variables which are proxies for expected business conditions and therefore usable factors measuring the systematic risk (Campbell & Diebold 2009).

Two financial variables that have been commonly used for explaining risk premium of equities are term (TERM) and default (DEF) spreads. Term spread is the difference between long- and short term government bond yields. Default spread is long term corporate bond yield subtracted with long term government bond yield. Term spread is a measure of the term structure of interest rates. It expresses the maturity premium for holding long term bonds over short term bonds. Graphic representation of this relationship is called the yield curve. In addition of telling how investors are compensated for holding risk related to bonds with longer maturity, term spread is commonly used predictor of real economic activity. Positive term spread and upward sloping yield curve indicate future increase in real economic activity; higher consumption, consumer durables and investment. It predicts also higher interest rates in the future. On the contrary a downward sloping yield curve is a clear indicator of a forthcoming recession. Estrella and Trubin (2006) show in their study that negative term

spread has predicted every recession in the U.S during the period of 1968 – 2006. (Fama & French 1989, Estrella & Hardouvelis 1991.)

An individual firm's default risk is measured by the spread between the rate of interest paid to its borrowers and the risk free rate. Several studies have examined the effect of default risk on equity returns. These studies have focused on the ability of the default spread to explain or predict returns. However, many of these studies show that much of the information in the default spread is unrelated to default risk. Denis and Denis (1995) explain that default risk is related to macroeconomic factors and it varies with the business cycle. Elton, Gruber, Agrawal and Mann (2001) state that large part of the risk premium in corporate bonds comes as reward of holding systematic risk. Vassalou and Xing (2004) show similarly that default risk is systematic and therefore priced in the cross section of equity returns.

Term and default spreads are thus commonly used systematic risk measures. Empirical evidence supports their use in asset pricing models for explaining stock returns. Chen, Roll and Ross (1986) study whether some macroeconomic variables are risks that are rewarded in the stock market. They estimate monthly excess stock returns with an asset pricing model that have several macroeconomic risk factors. They assume these factors to be variables that systematically affect stock market returns. The estimation period is from 1953 to 1983. Risk factors that they use are annual and monthly growth rates in industrial production, change in expected inflation, unexpected inflation, and term and defaults spreads. They also estimate an additional model where they add an equity factor which is the return of either the value- or equally weighted NYSE index.

As a result they show that their model with macroeconomic factors is capable for explaining the cross section of excess stock returns for the estimation period. Most of the variables are statistically significant excluding annual growth rate of industrial production. Default spread is statistically significant throughout the estimation period whereas the term spread is only marginally. Most striking result of their study is the effect of the equity factor in the model. Neither value- nor equally weighted returns have statistically significant effect on pricing in any subperiod. The market return factor does not either impair the statistical significance of the original macroeconomic factors.

As conclusion Chen, Roll and Ross (1986) state that stock returns are exposed to economic news and that returns are priced in accordance with their exposures to systematic risk.

Fama and French (1989) complement the cross sectional evidence of Chen, Roll and Ross (1989). They study return predictability of stocks and bonds with three forecasting variables. Variables are dividend yield, default spread and term spread. They also study whether the variation in expected returns are related to business conditions. Stock returns under estimation are returns of NYSE equal- and value weighted portfolios and the estimation period is between 1927 – 1987. Main result of this study is that returns on common stocks and long term bonds contain a maturity premium that has clear business cycle pattern. Expected returns are lower when economic conditions are strong and higher when conditions are weak.

Fama and French (1989) show that default and term spreads are business condition variables. Their results support and enrich the default spread argument of Chen et al. (1986) who state that stock returns are driven by their covariance with shocks to the default spread. Fama and French (1989) also show that variation in returns tracked by the default spread is higher for stocks compared to bonds and higher for small stocks compared to large stocks. Also, default spread is highly correlated with the dividend yield. These two variables are measures of long term business conditions. During the period of 1927 – 1987 default spread as well as dividend yield have taken highest values when economy have been persistently poor and lowest when economy have been persistently strong.

Instead, Fama and French (1989) show that the term spread is related to shorter-term measured business cycles. It is low near business-cycle peaks and high near troughs. This property is caused by its characteristic. Long term bond yield rises less than the yield of a short term bond during expansions and it falls less during contractions. As a result the term spread which is the difference in yields of the long- and short term bonds has a clear business cycle pattern. Term spread is largely a function of maturity so it tracks similarly the returns of all long term securities.

Fama and French (1989) provide two explanations for the finding that expected returns vary along with business cycles. First one is consumption smoothing and another is changes in risk premium. Consumption smoothing means that when income is high in relation to wealth, investors are willing to smooth consumption into future by saving more. Conversely, investors are less willing to save when income is temporarily low. If there is no offsetting reduction in capital-investment opportunities, lower desired savings lead to lower asset prices which increase expected returns. This observation of variation in expected returns opposite to business conditions is consistent with the stochastic discount factor analysis in chapter 2 and with the original consumption based model by Lucas (1978). Another explanation for the variation in expected returns is that investors change their perspective toward risk according to business conditions. Hypothesis is that risks are higher when times are poor and lower when times are good. Term and default spreads are thus proxies for these fundamental sources of systematic risk.

Fama and French (1993) test also term- and default spreads as risk factors in the study where they implement their famous three factor model. They explore whether same factors that explain stock returns explain also bond returns and vice versa. Term- and default spreads capture most of the variation in bond returns. Interestingly, used alone in the time-series regression these two factors capture strong variation in stock returns as well. Fama and French thus estimate a model where they explain excess returns of 25 portfolios formed by their size and book-to-market equity values with these two factors. In these regressions term- and default spreads are both statistically significant for all estimated 25 sub portfolios. Fama and French note that these 25 stock portfolios have slopes or parameter estimates for term spread that are similar as those for long term bonds. This implies that the risk captured by terms spread affects similarly to long term bonds and stocks. Also, t-values of default spread are higher for small stocks than for large stocks. According to this Fama and French (1993) state that small stocks are more sensitive to the risk captured by default spread than the returns of big stocks. However, R-square values for estimated 25 stock portfolios are significantly lower than those for bond portfolios. R-square values are only between 0.06 – 0.21 for estimated stock portfolios compared to bond portfolios which have R-squared values between 0.49 – 0.97. This means that even though term and default spread are both statistically

significant factors they explain only small part of the cross section of average stock returns in these regressions. The regression results where these two factors are used along with SMB and HML provide similar results. Term and default spreads do not improve the model if SMB and HML factors are used. These results are opposite to those of Chen, Roll, and Ross (1986) and state that average risk premiums for term and default spreads are too small to explain much of the cross sectional variation in stock returns.

Zhou (1996) study how the term structure of interest rates is related to stock market fluctuations. He shows that interest rates have an important impact on stock returns, especially at long horizons. He also shows that long-term real interest rates explain a significant part of the variation in dividend-price ratios. This finding supports the view that the high volatility of the stock market is related to the high volatility of long-term bond yields.

Hahn and Lee (2006) study whether SMB and HML are proxies for business cycle fluctuations. They specify an alternative three factor model to estimate the returns of 25 Fama French portfolios where they replace SMB and HML factors with two interest rate variables. They use change in term spread and change in default spread as proxies for systematic risk. They show that these factors along with market return capture the cross section of average return as well as Fama French three factor model. They also show that SMB and change in default spread share similar systematic pattern along with size dimension and HML and change in term spread share similar systematic pattern along with book-to-market dimension. Their study thus gives support for the risk based interpretation of the Fama-French factors.

4 RETURN PREDICTABILITY

The early empirical work in finance established few pillars that were believed to hold. In particular these pillars stated that asset returns are unpredictable. Prices follow random walks and expected returns do not vary greatly through time. Also, CAPM is a good measure of risk and explains well why some assets earn higher average returns than others. The new generation of financial research has challenged these views. CAPM beta is not a sufficient measure of the systematic risk anymore. There are assets and strategies whose average returns cannot be explained by their market betas. Instead, multifactor models dominate the empirical research and explanation of average returns. Returns are also considered to be predictable. Recent studies provide forecasting strategies that provide statistically and economically significant results advocating return predictability (Rapach & Zhou 2012). Especially variables including dividend-price ratio and term spread can predict substantial amount of stock return variation. This phenomenon occurs over business cycles and for the longer period. Short term stock return prediction is still considered to be useless. (Cochrane 2005: 389 – 390.)

4.1 Theoretical background behind return predictability

Stock return predictability is a fascinating area of finance. Understanding of return predictability allows practitioners to enhance yield and helps researchers to produce more realistic asset pricing models that better explain the data. A common misconception related to return predictability is that it violates the market efficiency. This belief comes from the random walk model which implies that future stock returns are unpredictable with currently available information. However, predictable return process is not against market efficiency, insofar as predictability is consistent with exposure to time-varying aggregate risk. This means that returns can be predicted in efficient markets when variation of predictive variables is caused by the changes in systematic risk. (Rapach & Zhou 2012.)

Dividend-price ratio or the dividend yield is the most prominent variable that can be used to predict stock returns. Returns can be predicted since the dividend-price ratio varies through time. The starting point of most of the empirical analysis of the relation

between the dividend-price ratio and returns is the work of Campbell and Shiller (1988). They state that when the log dividend-price ratio is relatively high; dividends are expected to grow more slowly, future returns are expected to be high or some combination of the two. Thus, if dividend-price ratio varies it must forecast either dividend growth or growth in expected returns. Widely reported result is that dividend-price ratios forecast returns not future dividend growth. (Cochrane 2008, Cochrane 2011). High dividend-price ratio forecast high returns and vice versa. (Cornell 2012.)

Return predictability is thus based on the business cycle patterns of the economy. Dividend-price ratio and other variables that forecast stock returns are correlated with the business cycles. This is consistent with the study of Fama and French (1989) who state that expected returns vary over business cycles. Higher risk premium or discount rate is required at the bottom of the recession when aggregate consumption and income levels are low. Thus, when expected returns rise prices go down and vice versa. This variation in discount rate and prices leads to the variation in dividend price ratio as well. (Cochrane 2005: 391 – 392, Rapach & Zhou 2012.)

4.2 Methods for return predictability

With its simplest form, return predictability is often examined with a predictive regression model that can be expressed as,

$$r_{t+1} = \alpha + \beta x_t + \varepsilon_{t+1}, \quad (19)$$

where r_{t+1} is the excess stock return over the risk free rate from the end of the period t to the end of the period $t+1$, x_t is the value of the predictive variable at the end of the period t and ε_{t+1} is the zero mean disturbance term. The parameter β is unknown coefficient and it is estimated from the data. The predictive ability of the variable x_t is typically assessed by examining the t -statistic of the β , the ordinary least square estimate (OLS) of β or the R^2 value. Equation 19 says that variable x_t predicts excess returns if $\beta \neq 0$. Thus, a predictive model as in equation 19 uses data available at time t

to predict the excess returns for the following period. A potential problem with this kind of predictive regression model is serially correlated disturbance term. This biases the t -statistics of the β . A common procedure to correct this is to use Newey and West (1987) standard errors which take serial correlation and heteroskedasticity of the disturbance term in to account. (Campbell & Motohiro 2006, Rapach & Wohar 2005, Rapach & Zhou 2012.)

Stock return predictability is challenging task since stock returns contain a large unpredictable component. Even best forecasting models that seem to work explain only a relatively small part of returns. However, monthly R^2 values even below 1 % can be economically relevant. Forecasting models that seem to explain a large portion of stock return fluctuations imply prominent risk-adjusted abnormal returns and are simply too good to be true. It is also difficult to create a persistence model in a competitive stock market. Once a successful model is found it is quickly implemented to trading decisions of other traders. This causes stock prices to move in a way that eliminates the model's predictive ability. However, if a models predictive ability is caused by the exposure to time-varying aggregate risk and the model consistently captures the time-varying aggregate risk premium, then it will likely remain over time. (Rapach & Zhou 2012.)

Large part of empirical research relies on in-sample tests of stock return predictability. However, in sample evidence of return predictability does not guarantee out-of-sample predictability. This raises question of data mining or data snooping. It is generally believed that out-of-sample tests provide a good measure of protection against data mining. It is therefore important to understand what causes differences in results between these two methods. However, strong in-sample evidence and weak out-of-sample evidence does not necessary indicate that in-sample tests are not reliable. (Inoue & Kilian 2002 & Rapach & Wohar 2005.)

4.3 Empirical evidence of return predictability

Enormous amount of financial literature has studied the predictive power of the dividend yield. Ang and Bekaert (2008) study whether dividend yield predicts excess stock returns, cash flows and dividends. In their study they question the long run

predictive power of dividend yield. In contrast to the general view, they find that dividend yield does not have any long run predictive power. Instead it predicts returns only in short run in a bivariate regression with short interest rate. They also report that the strongest predictability comes from the short interest rate rather than the dividend yield.

Cochrane (2008) provides evidence of return predictability with dividend yield. He regresses annual excess returns of the CRSP value weighted index for the period of 1926 – 2004. He shows that dividend yield is statistically as well as economically significant predictor of excess returns. Statistical significance is only marginal, with t - statistic slightly above two. However, Cochrane (2008) give strong weight to the economic significance of the results. The R^2 value rises with the horizon. Also, regression results show that dividend yield predicts none of the future dividend growth. Cochrane (2008) concludes that the fact that dividend yield does not predict future dividend growth is the strongest evidence for return predictability.

Cochrane (2011) shows return forecasting regressions for 1-year and five year time horizons. He regresses annual excess returns of the CRSP value weighted index against the dividend yield. Estimation period is between 1947 – 2009. Statistical significance of regressions are sufficient but not impressive. Slope coefficient for dividend yield is 3.8 for one year regression and 20.6 for five year regression. R^2 value also rises with the horizon from 0.09 for the one year regression to 0.28 for the five year horizon. These results imply high economic significance of dividend yields predictive power.

Cornell (2012) provides also strong evidence for dividend yields predictive power. He runs predictive regressions for annual returns and dividend growth rates. His results are consistent with the studies of Cochrane (2008) and Cochrane (2011). Dividend yield is statistically and economically significant predictor of returns but it has not any predictive power for dividend growth prediction.

Empirical research has found several other variables in addition with dividend-price ratio that forecast stock returns. Many of these financial variables such as term and default spreads are correlated with macroeconomic variables and thus proxies for

expected business conditions. (Campbell & Diebold 2005.) Other predictive variables are for example book-to-market ratio (Kothari & Shanken 1997), nominal interest rates (Ang and Bekaert 2007), dividend payout ratio (Lamont 1998), consumption-wealth ratio (Lettau and Ludvigson 2001), aggregate output (Rangvid 2006) and stock market volatility (Guo 2006).

Chen (1991) show that future stock returns can be predicted with the default spread, dividend yield, term spread, one month T-bill rate and with lagged industrial production. Explanation for their predictive power comes from their correlation with changes in the macroeconomic environment. Chen (1991) state that default spread and dividend yield are related to current economic conditions measured with recent growth rate of the GDP and consumption whereas term spread, short interest rate, and lagged industrial production growth rate forecast changes in future economic conditions.

Jensen, Mercer and Johnson (1996) study whether expected stock and bond returns can be predicted with the term spread, default spread and dividend yield. They also study whether monetary conditions affect how these three business-condition proxies capture the variation in expected stock and bond returns. They show that dividend yield and default spread explain variation in expected stock returns only during the expansive monetary policy periods. During restrictive periods, none of the three proxies have significant explanation power. Thus, in their study term spread does not have predictive power at all.

Hjalmarsson (2010) study stock return predictability in a large international data set. His sample contains stock return data from 40 different markets including 24 developed and 16 emerging markets. As predictive variables he use the dividend-price and earnings-price ratios, the short interest rate and the term spread. Hjalmarsson (2010) reports that dividend-price and earning-price ratio have very limited predictive ability in international data. Instead, term spread and short interest rate are robust predictors of stock returns. Their predictive power is strongest in developed markets.

5 EMPIRICAL ANALYSIS OF THE FINNISH STOCK MARKET RETURNS

This chapter provides an empirical study of the Finnish stock market returns. The purpose is to find risk factors that explain the cross sectional variation of excess returns in the Finnish stock market. This is done by testing variables that are commonly used measures for systematic risk in the empirical research. There are three stock market- and three interest rate variables under interest. Stock market variables are global factors from the Fama French three factor model; excess return of the global stock market index, SMB and HML. Interest rate variables are term spread (TERM) default spread (DEFAULT) and treasury spread (TREASURY). The aim is to create a linear factor pricing model using these six factors. Another interest is to study return predictability in the Finnish market with these factors.

5.2 Data and methods

I estimate monthly excess returns of several indices of the OMX Helsinki stock exchange. I use data from total return indices which takes dividends in to account. There are two general indices and five industry indices whose returns are estimated. OMXH general index includes all shares listed on the Helsinki Stock Exchange. OMX Helsinki Cap index is weight capped version of all-share index where the maximum weight of one share is limited to 10 % of total market value of the index (Nasdaq OMX). Estimated industry indices are Consumer Services, Industrials, Basic Materials, Financials and Technology indices. The estimation period is close to 18 years from February 1995 to November 2012. The data is from three sources. Time series for Moody's Baa corporate bond yield is from the Federal Reserve's web page. Data for three global Fama French factors is from FTSE database. Data for OMX Helsinki stock exchange indices and for other interest rates is from Thomson Datastream.

Empirical tests are divided in two parts. In the first part, I study whether the chosen risk factors explain excess returns in the Finnish stock market. Regressions are run for each index's excess returns and results are compared between indices. In the second part, I study return predictability. Methodology for studying return predictability is the same as in the first part with exception that lagged explanatory variables are used for explaining

returns. As a research method I have a linear factor pricing model with six risk factors. The model is expressed as

$$E(R_t^i) = \alpha + \beta_1 F_t^1 + \beta_2 F_t^2 + \beta_3 F_t^3 + \beta_4 F_t^4 + \beta_5 F_t^5 + \beta_6 F_t^6 + \varepsilon_t^i, \quad (20)$$

where $E(R_t^i)$ is the excess return of the index for the period t , α is the constant term, β_j is the sensitivity to the risk factor j , F_t are risk factors at the period t and ε_t^i is the error term. I use Newey-West corrected standard errors. Excess returns of each index are estimated with four different regressions. First, I estimate returns with all six risk factors. Secondly, returns are estimated with three stock market variables and with a model consisting only three interest rate variables. Lastly a stepwise regression is run in order to find the best model using these risk factors. The best model is chosen by the Akaike information criteria (AIC). The model that has the lowest AIC value is chosen.

Return predictability is studied with lagged values of risk factors. The model is expressed as

$$E(R_t^i) = \alpha + \beta_1 F_{t-k}^1 + \beta_2 F_{t-k}^2 + \beta_3 F_{t-k}^3 + \beta_4 F_{t-k}^4 + \beta_5 F_{t-k}^5 + \beta_6 F_{t-k}^6 + \varepsilon_t^i, \quad (21)$$

where k refers to the amount of lags of the risk factor. We estimate returns using lagged values of 1,2,3,6, and 12 months. Stepwise regressions are run for each lag in order to find the best predictive model. Predictive regressions are limited to two general indices.

Excess returns for each index are calculated subtracting the risk free rate from the logarithmic (log) return of the index. Risk free rate in this study is the 3-month German government bond yield. Risk factors are formed as follows;

Excess market return (MARKET): Log return of the MSCI world index subtracted with the risk free rate.

Small minus Big (SMB): Log return of the MSCI world small cap index subtracted with log return of the MSCI world large cap index.

High minus Low (HML): Log return of the MSCI world value index subtracted with log return of the MSCI world growth index.

Term Spread (TERM): 10 year German government bond yield subtracted with 3-month German government bond yield.

Default Spread (DEFAULT): 10 year Moody's Baa corporate bond yield subtracted with 10 year German government bond yield.

Treasury Spread (TREASURY): 3-month Euribor subtracted with 3-month Libor. For the period of February 1995 to December 1998, 3-month Euribor is replaced with 3-month Bundesbank rate since Euribor has not existed.

5.3 Descriptive statistics

Average returns and standard deviations of each index during the estimation period are presented in table 1. Average annual return of the OMXH general index has been 7.3 % with standard deviation of 28.5 %. Financials index has had highest average return of 16.9 % and Basic Materials index has had lowest with -0.14%. Technology index has been most volatile during the period with annual volatility of 46.1%.

Appendix 3 provides graphs of OMXH general index linked with several explanatory variables. Figure 1 shows that OMXH and MSCI world indices are strongly correlated. OMXH index has been more volatile and risen more than MSCI world, but the trend of these two indices have been very similar. Intuitively this gives support to the hypothesis that global stock returns explain OMXH index returns. Figure 2 shows the inverse relation between term spread and OMXH index. Even though not fully explicit, term spread seems to be high when index value is low and vice versa. This relation supports the view that term spread is a proxy for systematic risk and hypothesis that it explains OMXH returns. In contrast, default and treasury spreads shown in figures 3 and 4 do not have clear relation with OMXH index.

Table 1. Descriptive statistics of indices

Index	Mean excess Return	Standard deviation
OMXH	0.0059 (0.073)	0.0823 (0.2851)
OMXH Cap	0.0051 (0.0633)	0.0622 (0.2155)
Consumer Services	0.0031 (0.0382)	0.0862 (0.2985)
Industrials	0.0074 (0.0928)	0.0922 (0.3195)
Basic Materials	-0.0001 (-0.0014)	0.0897 (0.3107)
Financials	0.0131 (0.1692)	0.0810 (0.2805)
Technology	0.0014 (0.0173)	0.1331 (0.461087)

Annual values are in parenthesis.

Another important issue to be noted is the multicollinearity which occurs if two or more explanatory variables are highly correlated with each other. Multicollinearity weakens the model's robustness. (Brooks 2002: 190 -192.) Correlations between risk factors are presented in table 2. Risk factors are not highly correlated with each other. The highest correlation 0.52 is between default and treasury spreads. Other variables are not significantly correlated. Multicollinearity is thus not a problem with these variables.

Table 2. Correlation between risk factors

	Market	SMB	HML	TERM	DEFAULT	TREASURY
Market	1	0.0480	-0.0686	0.2001	-0.1410	-0.0979
SMB	0.0480	1	0.0830	0.0323	0.1000	0.2112
HML	-0.0686	0.0830	1	-0.0938	0.0308	0.0410
TERM	0.2001	0.0323	-0.0938	1	-0.1702	0.0020
DEFAULT	-0.1410	0.1000	0.0308	-0.1702	1	0.5210
TREASURY	-0.0979	0.2112	0.0410	0.0020	0.5210	1

5.3 Results of cross section of stock returns

Regression results for OMXH general index are presented in the table 3. Excess returns are estimated with four different models, each model having different amount of explanatory variables. Model 1 contains all six risk factors. Model 2 is the Fama French three factor model with global factors. Model 3 contains three interest rate factors. Model 4 is the model where risk factors have been chosen with step-wise regression according to AIC. Results for OMX Helsinki Cap index are presented in table 4. Results for five industry indices are presented in Appendix 4 in tables 7 – 11.

Regression results in table 3 show that the model with all six risk factors is unable to explain completely the cross sectional variation of excess returns of the OMXH general index. The constant term is statistically significant meaning that there are other risk factors in addition to these six factors that explain returns. However, results show that

Table 3. Regression results for excess returns of OMXH general index

Explanatory variable	Model 1	Model 2	Model 3	Model 4
Estimation Period 2/1995 - 11/2012				
Intercept	-0.0557 (-2.0963)	0.0026 (0.5812)	-0.0622 (-1.3562)	-0.0463 (-1.8450)
Market	1.1700 (12.6386)	1.1901 (12.7307)		1.1810 (12.8664)
SMB	-0.0799 (-0.3413)	-0.1760 (-0.7344)		
HML	-0.5866 (-2.4821)	-0.6051 (-2.4733)		-0.6053 (-2.5667)
TERM	0.4096 (0.7875)		1.7125 (2.9074)	
DEFAULT	1.1943 (1.6384)		0.6284 (0.4709)	1.0934 (1.4742)
TREASURY	-1.1334 (-2.9192)		-1.4560 (-2.4278)	-1.1248 (-2.9472)
Multiple R^2	0.5189	0.4971	0.0693	0.5168

The t - statistics are based on Newey-West heteroskedasticity and autocorrelation corrected covariance matrices. t -statistics are presented in parenthesis, bolded t -statistics mean statistical significance at 95 % level.

three risk factors are statistically significant; Excess market return, HML and Treasury spread. From these three variables excess market return is highly statistically significant with t-value of 12.64. The R^2 value 51.89 % is remarkable but not impressive. It means that the model explains slightly above half of the cross sectional variation of excess returns of the index. Regression results of models 2 and 3 show that two stock market variables, excess market return and HML explain large part of returns and the explanatory power of interest rate variables are marginal. Term and treasury spreads are both statistically significant in model 3, but the R^2 value of the model, 6.9 % is low compared to model 2 which has R^2 value of 49.7 %. Last column shows the result of step-wise regression providing the best model according to AIC. With the model, excess returns of the index are expressed as,

$$E(R_t^i) = -0.0463 + 1.181 * MARKET - 0.6053 * HML + 1.093 * DEFAULT - 1.125 * TREASURY$$

Excess market return, HML and treasury spread are statistically significant factors in the model. Default spread and constant term are not significant. R^2 value of the model is 51.7%.

Regression results for OMX Helsinki Cap index in table 4 are somewhat different than for the OMXH general index. However, two things are common. Excess market return is highly statistically significant in every regression that it is included in. Also, R^2 values of models 2 and 3 show that the explanatory power of interest rate factors is marginal. In contrast with the results of OMXH general index, SMB and term spread are statistically significant factors whereas HML and treasury spread are not. Also, R^2 values are higher for OMX Helsinki Cap index. R^2 values are over 60 % for all regressions excluding the model which contains only interest rate factors.

Regressions for five industry indices show that results vary between different indices (Appendix 4). There is nevertheless one common feature for all indices. Excess market return is highly statistically significant risk factor for all indices. Statistical significance of other factors vary. In addition to excess market return, HML and treasury spread are statistically significant risk factors for Technology index as well as SMB depending of what other factors are in regression.

Table 4. Regression results for excess returns of OMX Helsinki Cap index

Explanatory variable	Model 1	Model 2	Model 3	Model 4
Estimation Period 2/1995 - 11/2012				
Intercept	-0.0287 (-1.5603)	0.0016 (0.555)	-0.0290 (-0.7358)	-0.0149 (-2.3920)
Market	0.9900 (14.8445)	1.0190 (15.5590)		0.9902 (14.3165)
SMB	0.4174 (3.2581)	0.3698 (2.8162)		0.4032 (2.9905)
HML	-0.1556 (-1.0528)	-0.1790 (-1.1760)		
TERM	0.6258 (2.0732)		1.6802 (3.6700)	0.6044 (1.9144)
DEFAULT	0.4123 (0.7833)		-0.0854 (-0.0748)	
TREASURY	-0.5505 (-1.6425)		-0.6213 -1.1601	-0.4305 (-1.7888)
Multiple R^2	0.6316	0.6170	0.0737	0.6267

The t - statistics are based on Newey-West heteroskedasticity and autocorrelation corrected covariance matrices.
 t -statistics are presented in parenthesis, bolded t -statistics mean statistical significance at 95 % level.

HML is also significant for Basic materials and Financials indices. SMB is significant for Industrials and Consumer Services indices. Term spread is also significant for Consumer Services index. R^2 values are lower for industry indices than for general indices. For industry indices R^2 values vary between 32 % - 42 % with exception of Consumer Services index which has R^2 value of 11.1 % for its best model according to AIC. Regression results of five industry indices confirm that the explanatory power of interest rate variables are marginal compared to stock market variables.

5.4 Results of return predictability

Table 5 contains results of predictive regressions of excess returns of OMXH index and table 6 for OMX Helsinki Cap index. Excess returns are estimated with all six risk factors using lagged values of explanatory variables. Results for each lag are expressed

in separate columns. For each lag, the best predictive model is chosen according to AIC. These results are shown in appendix 5.

Results in table 5 show that two interest rate variables; term and treasury spreads predict excess returns of the OMXH index. These variables are statistically significant for predicting returns 1, 2, 3 and 6 months ahead. The coefficient is positive for the term spread and negative for treasury spread. This means that increase in term spread forecast higher returns and increase in treasury spread forecast lower returns for the following months. Stock market variables are not significant with these lags. Default spread is neither significant with exception of predictions of 6 months ahead. Results are opposite for the prediction with 12 lags when interest rate spreads are not significant. In contrast three stock market variables are all significant when interest rate variables are left out. Results in table 11 show R^2 values of best forecasting models for each lag. R^2 values vary from 7.8 % to 12.5 %.

Table 5. Predictive regressions for excess returns of OMXH index

Explanatory variable	k=1	k=2	k=3	k=6	k=12
Estimation Period 2/1995 - 11/2012					
Intercept	-0.0925 (-2.2111)	-0.0892 (-2.0764)	-0.0934 (-2.2094)	-0.1233 (-3.1168)	-0.0443 (-1.1013)
Market	0.0900 (0.5934)	-0.1314 (-0.9161)	0.1403 (1.2444)	-0.1416 (-0.9956)	0.2232 (1.6355)
SMB	-0.2250 (-0.8637)	0.0378 (0.1141)	-0.0699 (-0.2666)	0.3740 (-1.0944)	-1.1282 (-2.9292)
HML	-0.2996 (-0.9480)	-0.5107 (-1.5091)	-0.4799 (-1.8268)	0.1435 (0.4275)	0.5783 (1.8593)
TERM	1.5779 (2.4496)	1.8143 (2.5675)	1.5339 (2.0676)	2.0612 (2.7008)	0.7808 (0.8706)
DEFAULT	1.6860 (1.4647)	1.4299 (1.2507)	1.7770 (1.7388)	2.4179 (2.6153)	0.9225 (0.9421)
TREASURY	-1.6402 (-3.0440)	-1.7066 (-2.9535)	-1.5455 (-2.6588)	-1.7653 (-2.8276)	-0.7828 (-1.2047)
Multiple R^2	0.0906	0.1014	0.0980	0.1072	0.1399

The t - statistics are based on Newey-West heteroskedasticity and autocorrelation corrected covariance matrices.

t -statistics are presented in parenthesis, bolded t -statistics mean statistical significance at 95 % level.

Predictive regressions in table 6 show that term spread forecasts also excess returns of the OMX Helsinki Cap index. Term spread is significant predicting returns 1, 2, 3 and 6 months ahead. In contrast, treasury spread is not significant predictor of the index. Excess market return is significant for lag 1 and default spread for lag 6. Term spread does not have predicting power predicting returns 12 month ahead. Instead, SMB is statistically significant. R^2 values are at similar levels as in regressions for the OMXH index.

Table 6. Predictive regressions for excess returns of OMX Helsinki Cap index

Explanatory variable	k=1	k=2	k=3	k=6	k=12
Estimation Period 2/1995 - 11/2012					
Intercept	-0.0627 (-1.9401)	-0.0632 (-1.9249)	-0.0707 (-2.2368)	-0.0890 (-2.9725)	-0.0163 (-0.4472)
Market	0.2205 (2.1694)	-0.0841 (-0.7108)	0.0683 (0.7511)	-0.1518 (-1.2119)	0.1450 (1.5028)
SMB	0.04218 (0.1883)	0.0685 (0.2616)	-0.0122 (-0.0566)	-0.2044 (-0.8697)	-0.5186 (-2.0904)
HML	-0.0883 (-0.4512)	-0.1249 (-0.5740)	-0.2612 (-1.1983)	-0.0055 (-0.0269)	0.2946 (1.4249)
TERM	1.4083 (2.9724)	1.7696 (3.3298)	1.5356 (2.8805)	1.7929 (3.1365)	0.6093 (0.7970)
DEFAULT	1.1060 (1.2675)	0.9401 (1.0900)	1.3411 (1.7699)	1.7922 (2.6106)	0.3433 (0.4305)
TREASURY	-0.8679 (-1.9510)	-0.9220 (-1.8793)	-0.8567 (-1.7367)	-0.9758 (-1.8455)	-0.1699 (-0.2982)
Multiple R^2	0.0974	0.0795	0.0845	0.100	0.0587

The t - statistics are based on Newey-West heteroskedasticity and autocorrelation corrected covariance matrices. t -statistics are presented in parenthesis, bolded t -statistics mean statistical significance at 95 % level.

5.5 Analysis

According to results of cross section of stock returns, I confirm the hypothesis that excess market return, SMB, HML, term spread and treasury spread are risk factors that explain cross sectional variation of excess returns in the Finnish stock market. I reject the hypothesis regarding default spread. However, these factors explain only about half of the cross sectional variation which means that there are also other risk factors that

explain returns in the Finnish stock market. Results regarding excess market return are unambiguous. It is highly statistically significant risk factor for every estimated index. Results regarding SMB, HML, term spread and treasury spread are more controversial. Statistical significance of these risk factors vary between different indices. HML and treasury spread are significant risk factors for OMXH general index whereas SMB and term spread are significant for OMX Helsinki Cap index. Possible explanation for this is that larger firms which have greater weight in general index are more sensitive to changes in HML and treasury spread. Also, smaller firms which have greater weight in OMX Helsinki Cap index relative to general index may be more sensitive to changes in SMB and term spread. The statistical significance of these factors varies also between different industry indices. Another important result of this study is that explanation power of interest rates spreads is marginal. Even though statistically significant, term and treasury spreads do not improve remarkably the model when stock market variables are used.

According to results of predictive regressions, I confirm the hypothesis that term and treasury spreads forecast excess returns in the Finnish stock market. I reject the hypothesis regarding default spread, and three stock market variables since the statistical significance of these factors seem to be random. The predictive power of term spread is clear. It is statistically significant predictor of excess returns for both general indices for predicting returns 1, 2, 3 and 6 months ahead. Treasury spread is significant predictor only for OMXH general index. R^2 values of these regressions are high considering that stock returns have large unpredictable component.

6 CONCLUSIONS

The purpose of this thesis was to study systematic risk factors and return predictability in the Finnish stock market. The aim was to find out whether global Fama French factors and three interest rate spreads are systematic risk factors that explain the cross sectional variation of excess returns in the Finnish stock market. Another interest was to study whether the results vary between different indices in the OMX Helsinki stock Exchange. This study also investigated whether these factors forecast excess returns in the Finnish stock market.

This study shows that three global Fama French factors; Excess market return of the global stock market index, SMB and HML as well as term and treasury spreads are factors that explain cross sectional variation of excess returns in the Finnish stock market. Excess market return is however the only factor that is unambiguous measure of systematic risk for all estimated indices. Statistical significance of other factors vary between indices. Results show that explanation power of term and treasury spread are marginal when stock market factors are included in the model. This study also shows that a model constructed with these variables, captures only about half of the cross sectional variation of excess returns in the Finnish stock market. This implies that there are other systematic risk factors in addition to these six factors that explain cross sectional variation of excess returns in the Finnish stock market. Most striking result of this study is that term and treasury spreads are variables that forecast returns in the Finnish stock market. Results regarding term spread are strong whereas results regarding to treasury spread vary between estimated indices.

The results of this study differ from studies of Chen, Roll and Ross (1986) and Fama and French (1989) in terms of the statistical significance regarding the default spread. Chen et al. (1986) show that default spread is statistically significant factor explaining stock returns in the U.S market. Fama and French (1989) show that default spread is business condition variable that forecast stock returns in U.S market. This study shows that default spread does not explain nor predict excess returns in the Finnish stock market. The finding that explanatory power of interest rate spreads is marginal when stock market variables are used is consistent with the study of Fama and French (1993).

However, results of this study differ from their study regarding the explanatory power of the three factor model. Their study show that three factor model explains most of the cross sectional variation of returns in the U.S stock market. In contrast, results of this study show that global Fama French factors capture less than a half of the cross sectional variation of excess returns in the Finnish stock market. Results regarding return predictability are reasonable according to the theory and consistent with studies of Fama and French (1989) and Rapach and Zhou (2012).

Estimation period of this study was close to 18 years. Longer estimation period would have improved the robustness of the study, but it was not possible due to the lack of availability of the stock market data. Another way to improve the robustness of these results would be by doing out-of-sample tests within different time periods.

This study raises several questions and topics for further research in this area. It could be enlarged by sorting stocks to portfolios by their size and testing whether smaller stocks are more sensitive to SMB and term spread as our results suggest. Treasury spread appeared to be statistically significant factor explaining as well as forecasting return for the OMXH general index. This raises a question of the theoretical background of this observation since the variable is a spread between two interbank rates. An interesting study would also be evaluating other systematic risk factors in addition to factors found in this study. Also, risk factors of this study could be used for estimating returns of other regional stock markets. This would expose whether the features of these factors can be generalized to other markets or whether the results of this study are caused by the special characteristics of the Finnish stock market.

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APPENDICES

Appendix 1. First order condition for investor's utility maximization.

$$\max u(c_t) + E_t [\beta u(c_{t+1})],$$

where

$$\begin{aligned} c_t &= e_t - p_t \xi, \\ c_{t+1} &= e_{t+1} + x_{t+1} \xi. \end{aligned}$$

Constrains in equations 4 and 5 are substituted in to the objective function in equation 3,

$$\max u(e_t - p_t \xi) + E_t [\beta u(e_{t+1} + x_{t+1} \xi)]$$

The objective function is now derived with respect to ξ and set to zero,

$$u'(e_t - p_t \xi)(-p_t) + E_t [\beta u'(e_{t+1} + x_{t+1} \xi)(x_{t+1})] = 0,$$

$$u'(e_t - p_t \xi)(-p_t) = -E_t [\beta u'(e_{t+1} + x_{t+1} \xi)(x_{t+1})] \quad \parallel \cdot (-1)$$

$$p_t u'(e_t - p_t \xi) = E_t [\beta u'(e_{t+1} + x_{t+1} \xi)(x_{t+1})]$$

substitute terms $e_t - p_t \xi$ and $e_{t+1} + x_{t+1} \xi$ back to c_t and c_{t+1} ,

$$p_t u'(c_t) = E_t [\beta u'(c_{t+1})(x_{t+1})].$$

(Cochrane 2005: 4 – 5).

Appendix 2. Derivation of utility function.

$$u(c_t) = \frac{1}{1-\gamma} c_t^{1-\gamma}$$

The limit as $\gamma \rightarrow 1$ is

$$u(c) = \ln(c)$$

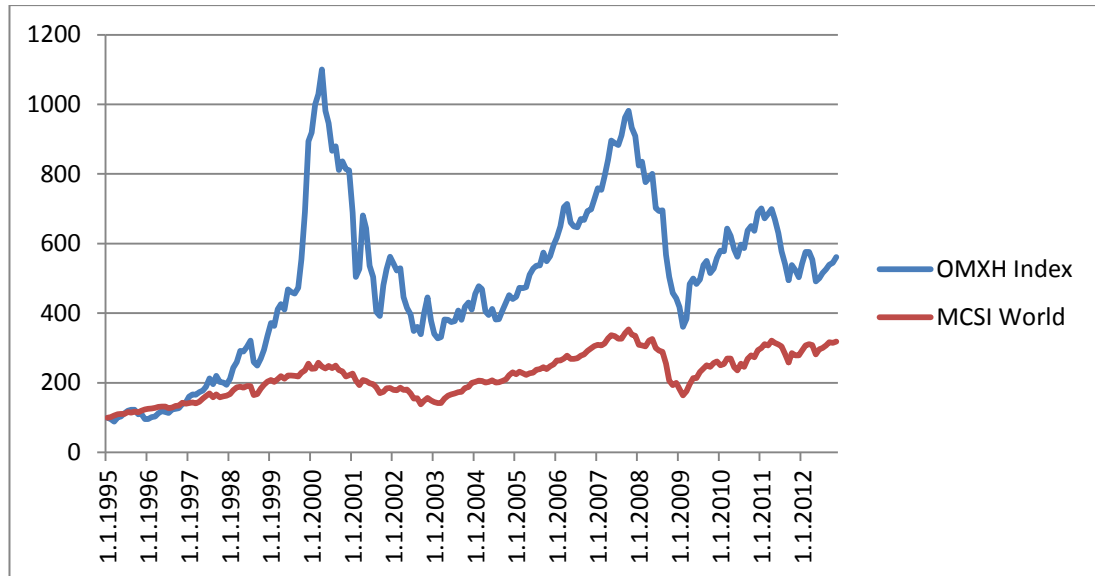
$$u'(c) > 0$$

$$u''(c) < 0$$

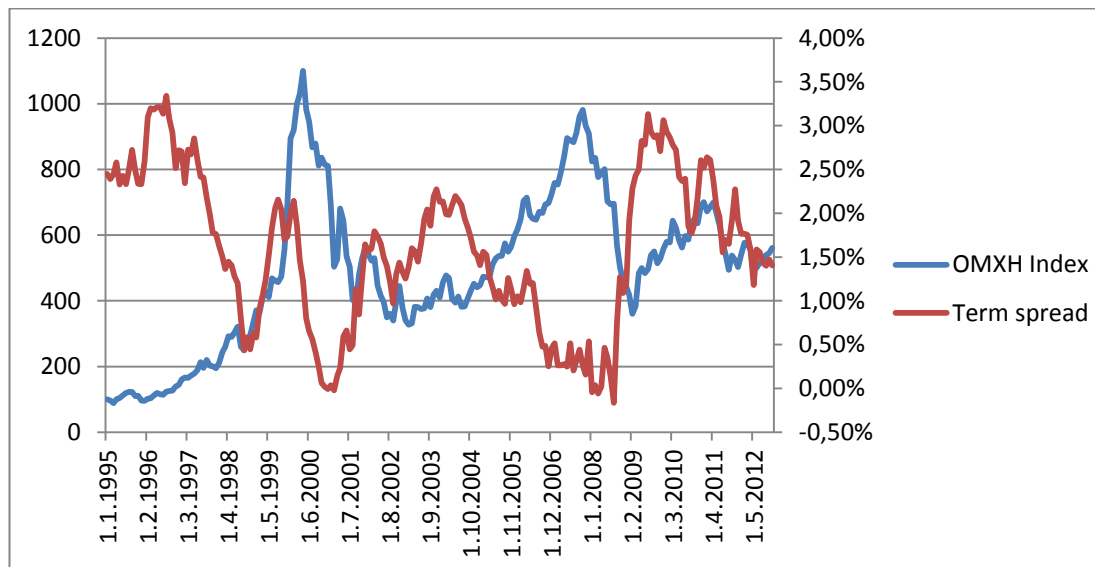
(Cochrane 2005: 4 - 5).

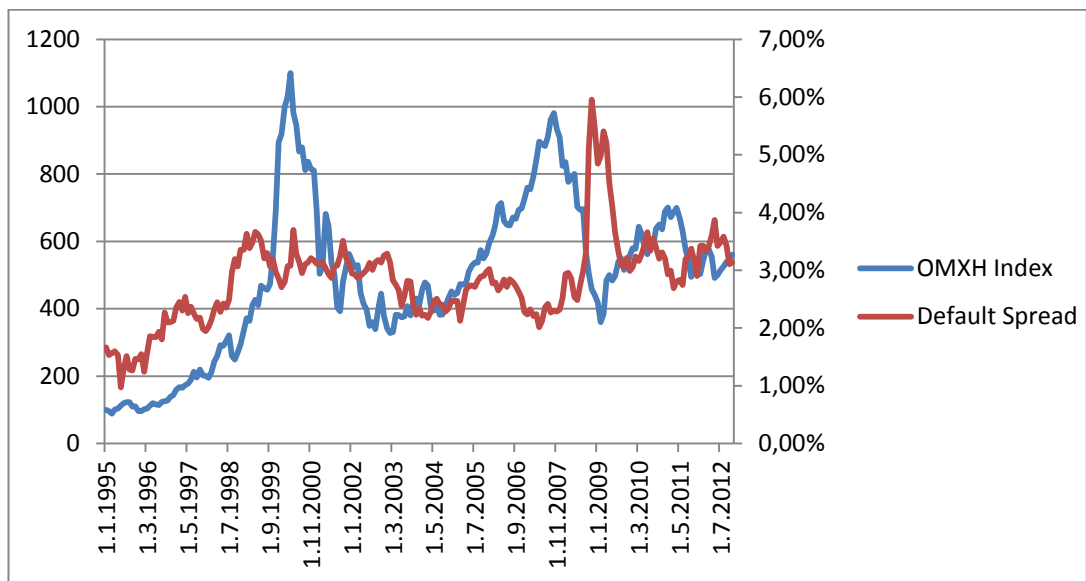
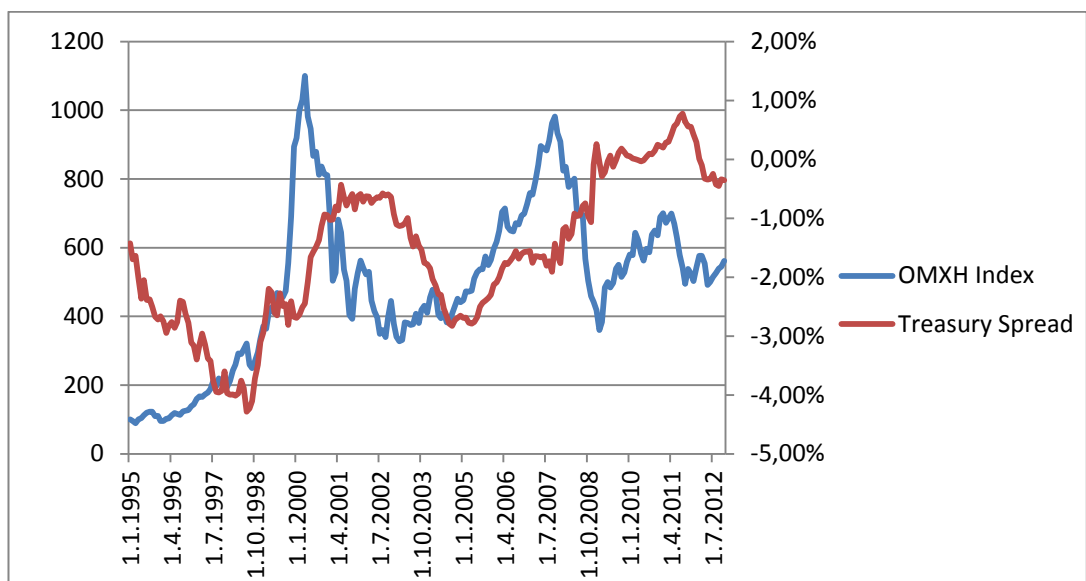
Appendix 3. Graphs of OMXH general index against risk factors

Graph 1. OMXH and MSCI World indices



Graph 2. OMXH index and term spread



Graph 3. OMXH index and default spread**Graph 4. OMXH index and treasury spread**

Appendix 4. Regression results for industry indices.

Table 7. Regression results for excess returns of Finland Consumer Services index

Explanatory variable	Model 1	Model 2	Model 3	Model 4
Estimation Period 2/1995 - 11/2012				
Intercept	-0.0399 (-1.4266)	0.0009 (0.1704)	-0.0357 (-1.0858)	-0.0282 (-2.6260)
Market	0.4150 (4.3031)	0.4752 (4.6998)		0.4080 (4.0561)
SMB	0.6421 (2.2816)	0.5667 (2.2926)		0.6560 (2.3081)
HML	0.1556 (0.7827)	0.1103 (0.5350)		
TERM	1.2275 (2.7401)		1.6498 (3.0618)	1.1508 (2.3619)
DEFAULT	0.3118 (0.4195)		0.0880 (0.1006)	
TREASURY	-0.7953 (-1.4311)		-0.6390 (-1.1374)	-0.6956 (-1.3426)
Multiple R^2	0.1130	0.0892	0.0356	0.1109

The t - statistics are based on Newey-West heteroskedasticity and autocorrelation corrected covariance matrices.
 t -statistics are presented in parenthesis, bolded t -statistics mean statistical significance at 95 % level.

Table 8. Regression results for excess returns of Finland Industrials index

Explanatory variable	Model 1	Model 2	Model 3	Model 4
Estimation Period 2/1995 - 11/2012				
Intercept	-0.0095 (-0.3488)	0.0025 (0.5323)	-0.0039 (-0.0759)	0.0026 (0.5334)
Market	1.1147 (9.4773)	1.1368 (9.9947)		1.1332 (10.1060)
SMB	1.1002 (4.3413)	1.1392 (4.4723)		1.14851 (4.4911)
HML	0.1252 (0.4270)	0.1008 (0.3420)		
TERM	0.8227 (1.4979)		1.9828 (2.9222)	
DEFAULT	0.0809 (0.1095)		-0.5001 (-0.3370)	
TREASURY	0.2004 (0.3529)		0.3718 (0.4933)	
Multiple R^2	0.4186	0.4120	0.0400	0.4114

The t - statistics are based on Newey-West heteroskedasticity and autocorrelation corrected covariance matrices.
 t -statistics are presented in parenthesis, bolded t -statistics mean statistical significance at 95 % level.

Table 9. Regression results for excess returns of Finland Basic Materials index

Explanatory variable	Model 1	Model 2	Model 3	Model 4
Estimation Period 2/1995 - 11/2012				
Intercept	-0.0305 (-0.9765)	-0.0044 (-0.9577)	-0.0260 (-0.4937)	-0.0044 (-0.9535)
Market	1.1308 (8.8321)	1.1346 (8.6277)		1.1350 (8.5473)
SMB	0.0310 (0.0915)	0.0192 (0.0595)		
HML	0.9484 (3.2155)	0.9399 (3.1519)		0.94141 (3.2538)
TERM	0.2592 (0.5414)		1.1530 (1.5571)	
DEFAULT	0.6126 (0.6864)		0.0199 (0.0136)	
TREASURY	-0.2945 (-0.6504)		-0.4424 (-0.6860)	
Multiple R^2	0.3870	0.3847	0.0163	0.3847

The t - statistics are based on Newey-West heteroskedasticity and autocorrelation corrected covariance matrices.
 t -statistics are presented in parenthesis, bolded t -statistics mean statistical significance at 95 % level.

Table 10. Regression results for excess returns of Finland Financials index

Explanatory variable	Model 1	Model 2	Model 3	Model 4
Estimation Period 2/1995 - 11/2012				
Intercept	-0.0270 (-0.9957)	0.0094 (2.2964)	-0.0228 (-0.4933)	0.0095 (2.3865)
Market	0.9587 (7.5154)	0.9558 (7.5629)		0.9593 (7.7121)
SMB	0.1923 (0.7892)	0.1418 (0.5649)		
HML	0.6981 (3.4331)	0.6964 (3.4408)		0.7079 (3.4398)
TERM	-0.0161 (-0.0360)		0.7800 (1.1710)	
DEFAULT	0.9230 (1.1317)		0.4205 (0.3200)	
TREASURY	-0.6592 (-1.4007)		-0.7337 (-1.1703)	
Multiple R^2	0.3386	0.3301	0.0159	0.3287

The t - statistics are based on Newey-West heteroskedasticity and autocorrelation corrected covariance matrices.
 t -statistics are presented in parenthesis, bolded t -statistics mean statistical significance at 95 % level.

Table 11. Regression results for excess returns of Finland Technology index

Explanatory variable	Model 1	Model 2	Model 3	Model 4
Estimation Period 2/1995 - 11/2012				
Intercept	-0.0833 (-1.6927)	-0.0015 (-0.1811)	-0.0955 (-1.5508)	-0.0965 (-2.0410)
Market	1.3881 (8.3190)	1.3934 (8.5124)		1.3701 (8.5311)
SMB	-0.5922 (-1.4728)	-0.8317 (-2.0346)		-0.5979 (-1.5041)
HML	-0.9046 (-2.7077)	-0.9004 (-2.4957)		-0.8871 (-2.6328)
TERM	-0.5456 -0.5821		1.0150 (0.9982)	
DEFAULT	1.8672 (1.3595)		1.2111 (0.6968)	2.0033 (1.4378)
TREASURY	-2.3508 (-3.6152)		-2.9293 (-3.7555)	-2.3991 (-3.7392)
Multiple R^2	0.3235	0.286	0.0650	0.3223

The t - statistics are based on Newey-West heteroskedasticity and autocorrelation corrected covariance matrices.
 t -statistics are presented in parenthesis, bolded t -statistics mean statistical significance at 95 % level.

Appendix 5. Regression results of best predictive models according to AIC.

Table 12. Best predictive model according to AIC for excess returns of OMXH general index

Explanatory variable	k=1	k=2	k=3	k=6	k=12
Estimation Period 2/1995 - 11/2012					
Intercept	-0.0962 (-2.3040)	-0.0888 (-2.1354)	-0.0940 (-2.2392)	-0.1220 (-2.9821)	0.0069 (1.1557)
Market					0.2557 (2.1990)
SMB				-0.3837 (-1.0623)	-1.1863 (-3.7138)
HML		-0.4956 (-1.4304)	-0.4984 (-1.9492)		0.5502 (1.9989)
TERM	1.7257 (2.8127)	1.6898 (2.5128)	1.6644 (2.3202)	1.8851 (2.5983)	
DEFAULT	1.6549 (1.3916)	1.4950 (1.3787)	1.7067 (1.6752)	2.4900 (2.5554)	
TREASURY	-1.7679 (-3.0187)	-1.6659 (-2.8447)	-1.6007 (-2.7200)	-1.7147 (-2.6537)	
Multiple R^2	0.0775	0.0962	0.0918	0.0992	0.1247

The t - statistics are based on Newey-West heteroskedasticity and autocorrelation corrected covariance matrices. t -statistics are presented in parenthesis, bolded t -statistics mean statistical significance at 95 % level.

Table 13. Best predictive model according to AIC for excess returns of OMX Helsinki Cap index

Explanatory variable	k=1	k=2	k=3	k=6	k=12
Estimation Period 2/1995 - 11/2012					
Intercept	-0.0631 (-1.9257)	-0.0635 (-2.0776)	-0.0709 (-2.3020)	-0.0903 (-3.0300)	0.0058 (1.1751)
Market	0.2238 (2.2005)			-0.1584 (-1.2109)	0.1646 (1.9590)
SMB					-0.5199 (-2.4362)
HML			-0.2686 (-1.2703)		0.2745 (1.4486)
TERM	1.4300 (2.9681)	1.7217 (3.4300)	1.6012 (3.0786)	1.7856 (3.1166)	
DEFAULT	1.1095 (1.2719)	0.9842 (1.2335)	1.3065 (1.7664)	1.7910 (2.6032)	
TREASURY	-0.8599 (-1.8416)	-0.8894 (-1.7674)	-0.8758 (-1.7591)	-1.0548 (-2.0990)	
Multiple R^2	0.0963	0.0737	0.0819	0.0954	0.0510

The t - statistics are based on Newey-West heteroskedasticity and autocorrelation corrected covariance matrices. t -statistics are presented in parenthesis, bolded t -statistics mean statistical significance at 95 % level.