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THE EFFECT OF FOREIGN TERM STRUCTURE OF INTEREST RATES ON FINNISH STOCK MARKET

Masters' Thesis in

Accounting and Finance

Programme of Financing

VAASA 2018

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Degree: Master's Degree in Finance
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Major Subject: Finance
Start of studies: 2013
Year of Graduation: 2018 **Pages: 72**

ABSTRACT

This thesis researches the effect of foreign term structure of interest rates' in predicting stock market index returns in Finland. A market timing "probit" model will be utilised to invest in stock index of Finland when the probability of a recession in the following month is low. When the model produces a high probability of a recession in the following month, the position will be switched to less risky assets which in this thesis is the 3-month Finnish government bond.

The previous literature suggests that the term structure is a viable tool to predict recessions from 1960s to present day. The approach has been transferred to account for possible stock market returns. It has been found that predicting stock market returns with the term structure interest rates is able to generate abnormal returns compared to the stock market index. To further investigate the impact of United States, the yield curve has been found to be able to generate abnormal returns when investing in foreign stock markets.

This thesis takes the Finnish perspective into consideration. The preceding literature studied the effect of United States' yield curve on other countries. This thesis studies the United States yield curve in tandem with Finland's close economic partners Sweden and Germany. The results produce robust results in the Finnish stock market in the sample period 1987-2017.

The following thesis studies the term structure of interest rates and the transmission and correlation of global stock markets. The results might prevent an investor generating losses in Finnish stock market declines and thus the contribution is strictly tied to an investor in the Finnish stock market.

KEY WORDS: Term Structure of Interest Rates, Recession, Market Timing

1. INTRODUCTION

The difference between long and short-term interest rates in a given country has been the focus of widespread research in recent history. This difference is called the *term structure of interest rates* (also yield curve, term spread, yield spread) and it has been producing signals before almost every major recession. In a growing economy the term structure is most likely upward-sloping, which means, that short-term loans generate lower interest than long-term loans. This is based on the idea that borrowing money for a longer period of time is riskier than doing multiple short-term obligations. (Liu, Resnick & Shoesmith 2004)

The real strength of the term spread is the alleged predicting power in predicting bear markets. Right before the markets start going down, the slope coefficient of the term structure tends to become zero or negative. In other words, the yield curve becomes flat or downward-sloping. This means that long-term credit has lower interest rates than short-term. There are several theories trying to explain this effect. These will be discussed in this thesis. The phenomenon could predict future recessions act as a predictor of future returns and thus is a topic that has been heavily studied in the past. (Liu, et al. 2004)

Many of the studies that are referred to in this thesis discuss the term structure of interest rates' slope coefficient and its properties. Possibly one of the first papers to test the leading indicators of a recession is Estrella & Mishkin (1996). This paper acts as a base for quite many future papers. One of these is Liu et al. (2004). They suggest that United States financial markets might be dominating the rest of the world. They form a "Probability unit (Probit)" market timing model where the probability of a market being in a recession in the following month is estimated. With this model Liu et al. (2004) are able to produce an investment strategy. In this strategy, the investor would invest in local market stock index if the probability produced by the term structure of either the local currency or US Dollar would predict bull markets and invest in the money market if the models predict downturn. (Liu, et al. 2004)

The results were particularly prominent from a Finnish perspective. All the sample countries correlate better with the US term spread than their own domestic term structure, *the only exception being Sweden*. The fact that Finland is closely related to Sweden both geographically and economically raises the question whether the financial markets of Finland are dominated by the United states yield curve or maybe something else (Statistics Finland 2017). Germany is one of the countries with correlation to United

States term spread. The question that this thesis seeks to answer is which of Finland's close economical partners' term spread has the most effective predictive power over Finnish stock market recessions. (Liu, et al. 2004)

1.1. Purpose of the study and motivation

The decision to focus on Finland for this thesis, is the lack of research done in the global scale of academic research. The connection between Finland and its close economic neighbours has not been well documented in the past. The purpose of this study is to widen the knowledge on the effect of larger economies' yield spread on the Finnish stock markets in the form of the predictive power of their term structure of interest to the Finnish stock market.

This thesis studies four distinct countries and the effect of their term spread on the Finnish market. The decision to include every particular country in the sample varies from one country to another. United States is included in the sample because of the major role it has in the global economy. This topic has been studied by at least Gotzmann & Jorion (1999), Liu et al. (2004) and Rapach, Strauss & Zhou (2013). Liu et al. (2004) show the previously mentioned ability to predict recessions in other countries only by looking at the term structure of interest rates of the United States. In the paper, Finland is not included which motivates the decision to repeat similar study with Finland in focus. United States also is ranks close to the top in the export figures from Finland (Statistics Finland 2016).

Sweden is selected to capture its relationship with Finland. In the base study by Liu et al. (2004), Sweden is the sole country that does not experience any profits from the use of either Swedish or United States term spread as a leading indicator for recessions. On the other hand, Sweden has a significant role as the second largest export partner of Finland. The largest export partner of Finland is Germany. Germany is included in the sample because of this and furthermore to capture its leading role in the European Union. According to Bernard & Gerlach (1998) the yield curve of Germany is useful in predicting recessions in other countries. Finland might be one of these countries. The complete set of countries is selected to reflect the Finnish economic environment and its closest and most influential partners. (Statistics Finland 2016, Eurostat 2017, Liu et al. 2004)

Intuitively, the results of the model estimation would be either, that Finland is separated from the United States influence in the same way as Sweden, that the market timing model would not generate excess returns. The other possibility is that Finland has strong enough

economic connections to the European Union through common currency which would separate Finland from Sweden. This could lead to Finnish business cycle being predictable by United States yield curve. As Liu et al. (2004) research shows, United States yield curve is often the best leading indicator, however, profitable alternatives in the Finnish stock market might be the interest rate levels of Germany and Sweden. Therefore, testing only United States influence might generate unsurprising and useless results and with the addition of the European candidates the academic contribution can be amplified.

1.2. Hypotheses

The empirical research of this thesis seeks to answer two distinct research questions. The fact that Sweden is so significantly different from the rest of the sample countries makes it slightly more difficult to formulate the hypotheses. As stated in the section 3.4. regarding the Finnish stock market, the connection between Finland and the rest of the sample countries gives important insight on the possible results of the probit model regressions. The first test in the following section is the predictive power of the Finnish term spread on its own stock market index. The logical assumption based on the preceding literature is that the term spread should generate statistically significant results with its own yield curve. Therefore, the hypothesis 1 is defined as follows:

> *Hypothesis 1: An investor can generate excess returns by using an investment strategy based on the market timing model specified by the Finnish yield curve compared to the buy-and-hold strategy. The estimates are calculated by both stock market recessions and OECD chronology (equation 16 and 20).*

In other words, it is more profitable to switch between Finnish government bonds and stocks based on the probability generated by the probit model than to use a conventional strategy of buying the index and staying with the index for the sample period. The differences between the stock market recessions and OECD chronology will be described in section 3.2.

The hypotheses 2, 3 and 4 are the assumptions between the foreign yield curves and the Finnish stock index. They are formulated as follows:

Hypothesis 2: An investor can generate excess returns Finnish stock market by using an investment strategy based on the market timing model generated by the United States yield curve compared to the buy-and-hold strategy. The estimates are calculated by both stock market recessions and OECD chronology (equation 17 and 21).

Hypothesis 3: An investor can generate excess returns Finnish stock market by using an investment strategy based on the market timing model generated by the German yield curve compared to buy-and-hold strategy. The estimates are calculated by both stock market recessions and OECD chronology (equation 18 and 22).

Hypothesis 4: An investor can generate excess returns in Finnish stock market by using an investment strategy based on the market timing model generated by the Swedish yield curve compared to buy-and-hold strategy. The estimates are calculated by both stock market recessions and OECD chronology (equation 19 and 23).

The United States term spread is backed by preceding literature to be able to generate excess returns in the Finnish stock market. Therefore, the hypothesis 2 is expected to hold. There is, of course, the discrepancy in Liu et al. (2004) that sees Sweden acting differently. This would result in United States yield spread generating no abnormal returns in the Finnish stock market when using the market timing model. Hypotheses 3 and 4, instead, have no such academic backing since they have not been researched together before. The assumption is, that it is possible the two yield curves have predicting power over Finnish stock market recessions. However, Germany is the leading economy in Europe by gross domestic product (2016) which could generate similar expectations as for United States in this paper. Sweden's close economic ties and close proximity to Finland might result in robust results with the Swedish yield spread as the independent variable. (Eurostat 2017)

1.3. Structure of the paper

The ideas presented above are foundation of this thesis work. The aim is to answer the research hypotheses in section 1.2 by replicating the Liu et al. (2004) empirical research with Finland in focus. The sample consists of countries closely related to Finnish markets, Sweden, Germany and United States. The thesis is divided into seven sections. The following section 2 discusses the theoretical foundation of financial markets, security pricing and term structure of interest rates. Sections 3 and 4 discuss the preceding literature of term structure of interest rates and global financial markets respectively. Section 5 describes the data and methodology used in section 6 where the empirical results will be discussed. Section 7 concludes.

2. THEORETICAL FOUNDATION

This section describes the fundamental theories and ideas in finance that are the foundation of the discussion regarding recessions, yield curves and interconnection of global economy. Theories such as efficient markets and the basic rules that apply when pricing securities are discussed. Thereafter, different forms of risk are discussed in the area of this thesis. Finally, the two ratios *Sharpe* and *Treynor* are introduced to prepare for the empirical results of this thesis.

2.1. Efficient markets

When researching an *anomaly* in pricing, the efficient market hypothesis is critical to include in the perspective. Anomaly is a pricing discrepancy, which is not explained by finance theory and wherein an investor can generate *excess returns.* Excess returns, also known as abnormal returns, is the portion of the profit that an investor makes that is above the return the investor *should* make according to financing theory. In the case of this thesis, the pricing discrepancy is generated by the investment strategy that relies on the output of the probit model, which in turn relies on the yield spread of government bonds.

Efficient Market Hypothesis was originally presented by Eugene Fama 1970 and it is a critical piece of modern finance. According to Fama (1970) an "ideal market" happens when asset prices correctly reflect the value of the asset and the information is "equally, fairly and immediately" transferred to security prices. Fama (1970) presents the famous three levels of market efficiency. (Fama 1970)

> *Weak form of market efficiency: The historical information regarding asset prices is reflected in the price.*
>
> *Semi-strong form of market efficiency: All the historical and current information is reflected in the price.*
>
> *Strong form of market efficiency: All information, including company insider information, is reflected in the price. No party in the market has "monopolistic access price relevant information."*

It can be argued whether even the weak form of efficiency holds in real markets. Fama (1970) analyses the question whether prices reflect perfectly the existing information. Weak form of market efficiency is supported by the empirical research conducted by

Fama (1970). The future price of a security can be estimated based on historical information only to some extent. The assumption of weak form of market efficiency is exploited by the branch of finance known as *technical analysis,* which uses the historical price movements to predict future price evolution. (Fama, 1970)

2.2. Security pricing

Interest rates play a massive role in finance and economics altogether. Interest rates' role in pricing securities and basically everything time dependent is a corner stone in finance. Time-value of money, discounted cash flow model and cost of capital – terms fundamental in finance today – are derived from the impact of interest. (Benninga & Wiener 1998)

The basis of interest is simple. Make an investment of $100 today. Annual interest rate of 5% will generate a $5 coupon payment after one year. Coupon is a term derived from the times when interest was paid by tearing coupons off the loan contract. Reinvesting the $5 from the original coupon generates compound interest which put together with long investment horizon is one of the most powerful combinations in finance. (Benninga et al. 1998)

Interest rates are the determining factor in pricing different securities. Consider an investment that generates a cash flow of $110 after a one year. After the investor has taken into consideration the riskiness of that cash flow, he demands a 10% yearly return on his money for postponing his own spending and taking a risk that the cash flow might not happen in the future. The price of the investment today is discounted from time t=1 with the 10% discount rate by the following equation 1 also known as *discounted cash flow model*:

$$P_0 = \frac{CF_t}{(1+r_t)^t} \quad (1)$$

where CF_t is the incoming cash flow at time t (coupon payments, dividends etc.). The interest rate at time t is r. In this case the price today, which is denoted by P_0 would be $100. The simple formula can be generalised in equation 2 for multiple cash flows discounted by different discount rate based on the maturity. The Discounted Cash Flow

model utilises the idea that the value of a security is the present value of its cash flows discounted from the future to today.

$$P_0 = \sum_{t=1}^{N} \frac{CF_t}{(1+r_t)^t} + \frac{Face\ Value}{(1+r_N)^N} \quad (2)$$

where N is the total number of periods. This the discounted cash flow model (DCF). As the term structure of interest rates is the most important theoretical focus point in this thesis, the distinction between r_t and r_{t+1} is important to be made. (Benninga et al. 1998)

Pricing securities or portfolios by the *beta factor,* William Sharpe and John Lintner developed the *Capital Asset Pricing Model (CAPM).* In this model, the price determining factor is the sensitivity compared to the market which is denoted by β. CAPM is visualised in Equation 3. (Puttonen & Knüpfer, 2009)

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f) \quad (3)$$

where $E(R_i)$ is the expected return of a single investment or a portfolio, R_f is the risk-free rate, normally the government 3-month bond interest rate. β_i is the beta factor and $E(R_m)$ is the expected return of the market index. (Puttonen & Knüpfer, 2009)

The main idea of Capital Asset Pricing Model is that the market risk premium is multiplied by the stock beta and then added to the risk-free rate. The resulting number is the expected rate of return on the stock or portfolio. The interest rate defined by the Capital Asset Pricing model is considered to be the riskiness of the asset. (Puttonen & Knüpfer, 2009) The component of risk is discussed in the following section.

2.3. Interest rates and risk

Interest rates act as a measure of *risk.* Risk is a fundamental component of finance theory. An investor demands a higher interest rate, a better *return,* for an investment with higher risk, ceteris paribus and it comes in many forms. (Eddy 1978, Pilotte & Sterbenz 2006) The forms of risk close to the topic of this thesis are *interest rate risk, inflation risk* and

liquidity risk. United States government bonds are considered *default-free*. This means that they do not contain *default risk,* which means that the United States government is considered to be able to pay the interest on their obligations. The risk associated with government bonds is mostly *interest rate risk.* Investor that engages in an obligation for a certain interest rate, takes the risk that the interest rate changes into an unfavourable direction for the investor during the duration of the obligation. (Eddy 1978)

United States government bonds have a specific role in the global finance spectrum. Already Childs (1920) states that "being an obligation of a nation, such a bond represents a form of credit of utmost superiority." That is why investors can remain confident that government bonds pay the interest and face value on the specified dates. The "default-free" aspect of government bonds is something that must hold. Otherwise, a nation's currency becomes worthless. (Childs 1920)

Liquidity is a term used to describe the ability that an asset can be transformed into "liquid form." Generally, this means the same as transforming the asset into cash. Cash is thus referred as being *liquid. Liquidity risk* is a component of risk that is attributed to the risk, that in case of unfavourable market movements, the security does not have a buyer in the markets. Normally with illiquid assets, the *bid-ask spread* is large and therefore the seller might have to settle for a lower price. According to Elton & Green (1998), liquidity risk is a major driver for the price of United States Treasury bonds. This observation attributed to "flight to liquidity" and flight to quality" phenomena which are discussed in later chapters. (Elton & Green 1998)

Inflation risk is the risk that arises from the changing value of money. An investor faces a risk of the returns being drained by the lowering value of money. For example, if investor makes 2% returns with a security, the *nominal* interest rate is 2%. However, inflation consumes the returns. If the inflation during the holding period was 2%, the *real* interest rate is 0%. The inflation target by the European Central Bank is 2%. Therefore, the inflation risk is not associated whether there is or is not inflation. Rather, it is how high the inflation is. The investor receives the returns in currency, however the value of the cash proceeds has diminished during the holding period to result in 0% real return. There is a number of ways to hedge inflation risk. One of these is presented by Evans (1998) in a form of "index-linked bonds." The interest is tied to an index which follows the inflation and thus generates profits regardless of the level of inflation. (Evans 1998)

2.4. Sharpe & Treynor

In finance, the investor demands compensation for the risk taken. There exists a risk-reward relationship in which for higher risks there ought to be a better return, *a reward.* Return is the profit in the future the investor makes for the investment. It is denoted by r previously in this section. To consider both risk and return, *Sharpe ratio* (S) *or reward-to-variability ratio* is often used. It is shown in equation 4. (Pilotte et al. 2006)

$$S_p = \frac{R_p - R_f}{\sigma_p} \quad (4)$$

where S_p is the portfolio Sharpe ratio, R_p is the return of the portfolio, R_f is the risk-free return often shown as 3-month government bond, σ_p is the portfolio standard deviation. The R_p-R_f is also known as "excess returns" or "risk premium" since the risk-free rate has been subtracted. Therefore, the Sharpe ratio is the ratio between the excess returns and the standard deviation of the return. (Pilotte et al. 2006)

Pilotte & Sterbenz (2006) test the connection between treasury note maturities and Sharpe ratio. They state that long term government bonds' Sharpe measures move against the business cycle. Treasury notes which have longer maturity are more profitable in economic downturns. The mean excess returns for treasury notes are high when the economy is in a trough and correspondingly low when the economy is at its peak. Treasury bills with shorter maturities do not experience changes in the mean excess returns over the business cycle. (Pilotte et al. 2006)

Pilotte & Sterbenz introduce the *Treynor ratio* as well. The idea behind the Treynor ratio is similar with Sharpe ratio. However, Sharpe ratio is a better measure of risk adjusted returns when screening a single security. Sharpe ratio performs better when money is invested mostly in one or very few assets. The denominator is modified for Treynor ratio. Excess returns are divided by the *systematic risk* factor, which is the *beta factor.* Systematic risk is also known as *market risk* and it is the component of risk which cannot be diversified away in a certain security (Eddy 1978). The Treynor ratio is visualized in equation 5.

(5) $$Treynor\ Ratio = \frac{R_p - R_f}{\beta_p}$$

where β_p is the beta of the portfolio. (Pilotte et al. 2006)

Pilotte & Sterbenz discuss the findings on both Sharpe and Treynor ratios in different maturities of treasury bills and notes. The discussion is shifted to the term structure theory as well. According to the paper, a time-varying characteristic of returns exists in treasury bills and notes. All of the models that are tested by Pilotte & Sterbentz (2006) generate Sharpe ratios which have the time-varying aspect. Sharpe ratios are high for treasury bills with short maturities. Risk adjusted returns become lower when the maturity increases. Sharpe ratio behaves differently for short-term and long-term bonds over the business cycle. The reason for this might be the origins of systematic risk. (Pilotte et al. 2006) The term structure of interest rates will be further discussed in section 3

2.5. Theory of the term structure of interest rates

Interest rates acting as the price for money have a massive impact in the global markets and real economic activity. Government bonds are a major asset class today and the term structure of interest rates is an important feature of this. Term structure of interest rates is the slope coefficient of long and short-term interest rates in an economy normally measured by a short-term government bond interest rate and its long-term counterpart. For example, United States term structure of interest rates is often measured by the differential between US government 3-month T-bill and the 10-year Treasury note. (Estrella et al. 1996, Estrella & Trubin 2006)

The behaviour of long-term and short-term interest rates is explained by three distinct theories. The theories seek to explain the following characteristics of interest rates:

1. Interest rates for different maturities tend to move together.
2. Short-term interest rates deviate more.
3. Short-term interest rate tends to be lower.

The theories explaining these features are called *expectations theory, segmented markets theory* and *liquidity premium theory.*

According to *expectations theory*, the investors have no preference over different maturities. In this case, they will hold the bond with the best return regardless of the maturity of the bond. As a classical example, the investor has two options:

1. Buy 100€ bond that matures in 1 year. After one year, the investor buys another 1-year bond.
2. Buy 100€ bond that matures in 2 years.

In the scope of expectations theory, these two options are *"perfect substitutes."* This means that there is no advantage of choosing one over the other. This theory assumes no inflation risk and no interest rate risk. If there were these risks, *ceteris paribus*, the first option would become riskier because the investor takes the risk of changed interest rate and inflation after the first year. (Cox et al. 1985)

The two options for bond selection is summed up in equation 6.

(6) $$100€ \times (1 + i_t) \times (1 + i_{t+1}) = 100€ \times (1 + i_{2t})^2$$

Here, i_t is the interest rate for one year for the 1-year bond, i_{t+1} is the interest rate after one year for the 1-year bond at time t+1 and i_{2t} is the interest rate for the 2-year bond at time t. The two sides are set equal. From equation 6 follows equations 7 and 8.

(7) $$i_t + i^e_{t+1} = 2i_{2t}$$

(8) $$\rightarrow i_{2t} = \frac{i_t + i^e_{t+1}}{2}$$

Equation 7 can be interpreted as the 2-year interest rate being the average of the 1-year bond contracts. The equation can be expanded to n years. This is illustrated in equation 9.

$$i_{nt} = \frac{i_t + i_{t+1}^e + i_{t+2}^e + \cdots + i_{t+(n-1)}^e}{n} \quad (9)$$

Expectations theory explains the co-movement of long-term and short-term interest rates and the volatility of the short-term interest rates. As can be stated based on equation 9, the long-term rates are all average values of the expected future short-term rate. Therefore, if i_t changes, so will the interest rate for longer maturities. The volatility of the short-term contracts is explained by the averaging of the long-term obligations. The shorter bond contracts have fewer terms in the equation and thus a single movement has a larger impact on the resulting interest rate. The theory assumes that there is no uncertainty in future interest rates thus resulting in a flat term structure (Cox et al. 1985). Therefore, a low future short rate means that the demand for money is going to be low in the future and thus the economy might not be prospering (Adrian, Estrella & Shin 2010). Expectations theory does not explain why the longer bond contracts tend to have higher interest rates. This tendency is better explained by the *segmented markets theory.* (Cox et al. 1985)

The segmented markets theory assumes that long-term and short-term bonds are completely different asset classes. This is because long-term contracts contain inflation risk and interest rate risk. These were assumed not to affect the preferences of investors in expectations theory. Short-term holding periods are less associated with inflation risk and interest rate risk which results in lower yields. The idea is the same as in section 2.1. Segmented markets theory explains the upward sloping nature of the term structure of interest rates, however, it does not explain the co-movement of different maturities nor the high volatility of short-term bond contracts. (Cox et al. 1985)

Liquidity premium theory makes an effort explaining the three features of the yield curve. The investors are interested in the real return of the bond after the contract has expired after all. Therefore, a larger emphasis is put on the "risk preferences of the market participants." (Cox et al. 1985) Thus, it can be argued that the inflation risk and interest rate risk cannot be neglected in the assumptions as the *expectations theory* does. Liquidity premium theory utilises the expectations theory, however the *perfect substitutes* idea is developed. Bonds with different maturities are not seen as substitutes but not *perfect substitutes.* Short-term bonds do not contain as much inflation and interest rate risk and thus for holding bonds with longer maturity the investor demands a premium. This is

called *liquidity premium.* Therefore, the equation 6 is given an additional term l_{nt}. The equation 10 presents the developed form. (Cox et al. 1985)

$$i_{nt} = \frac{i_t + i^e_{t+1} + i^e_{t+2} + \cdots + i^e_{t+(n-1)}}{n} + l_{nt} \quad (10)$$

Liquidity premium theory has the same advantages with expectations theory. Liquidity premium theory predicts the co-movement of short-term and long-term bonds and the higher volatility of the short-term bonds. The liquidity premium term in equation 10 is also in line with the observation that long-term obligations tend to have higher yields. This comes with the assumption that the liquidity premium is often greater than zero and grows as the maturity becomes longer. Therefore, the liquidity premium is what gives the yield curve the upward-sloping nature. (Cox et al. 1985)

A modification to the liquidity premium theory is the *preferred habitat theory*. This theory adds another component to the equation. According to the theory, investors are constrained to buy bonds that have exactly the correct maturity compared to the investor's "preferred" investment horizon. Thus, investors demand another premium and therefore price the bond accordingly. Investors add the premium not only to acclimatize for the longer period but for buying a bond outside of their own "preferred habitat." (Cox et al. 1985)

An additional theory explaining the term spread phenomenon is presented by Adrian et al. (2010). One of the reasons the inverted yield curve occurs in the onset of a recession might be the balance sheet management by financial intermediaries. The cash reserve requirements are set by the central bank and they have an impact on the supply of money. The effect arises from the nature of the balance sheets maintained by financial intermediaries, for example, banks. Banks need to borrow money to be able to issue loans. According to Adrian et al. (2010) the basic business model is to borrow money at a rate and then lend it at a rate that is higher. The loans that are issued by the bank have often longer maturities than the borrowed money. When the yield curve is normal, the situation is economically viable for the bank. When the inversion of the yield curve happens, the business becomes unprofitable for the financial intermediary as the liabilities start generating costs that are not fully covered by the profits from assets. This leads to a reduced supply of money which in turn leads to a decreased economic activity in

aggregate. The empirical section in Adrian et al. (2010) first tests the hypothesis that the term spread affects the real gross domestic product with a probit model. Thereafter, the hypothesis that financial intermediaries are affected by the yield curve is tested. The results are significant in a macroeconomic scale. According to Adrian et al. (2010) "whenever tighter policy leads to a term spread below a threshold level of 93 basis points, increases in unemployment tend to follow." (Adrian et al. 2010)

3. TERM STRUCTURE OF INTEREST RATES

3.1. History

According to Cox, Ingersoll & Ross (1985) the term structure of interest rates is the relationship between the yields of ”default-free securities” which differ only by their time to maturity. The term default-free is used for government issued loan agreements also known as *government bonds* (Cox, Ingersoll, Ross, 1985). The predictive power of future recession has been studied in the past by Estrella & Mishkin (1996) and Liu et al. (2004). The findings and applications will be discussed further in almost every following section. However, the theoretical foundation for the term structure is of interest at this point.

The term structure of interest rates is the relationship between short-term and long-term interest rates. (Datastream 2018) Figure 1 displays the relationship with Finnish Government bonds of different maturities in February 2018. (Estrella et al. 1996)

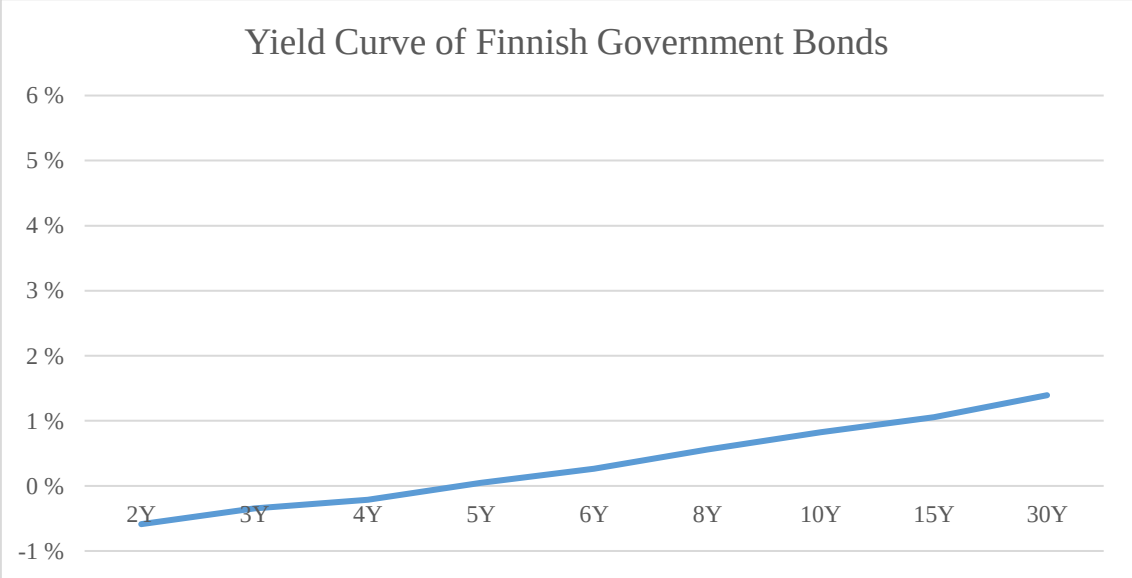

Figure 1 Interest rates of Finnish Government bonds of different maturities. 9th of February 2018.

According to preceding literature Estrella & Mishikin (1996) among others, the upward-sloping nature of the signals of an economy which is growing. When looking at a United States yield curve from March 2007, the curve looks quite different. This relationship is visualised in figure 2 Datastream, 2018).

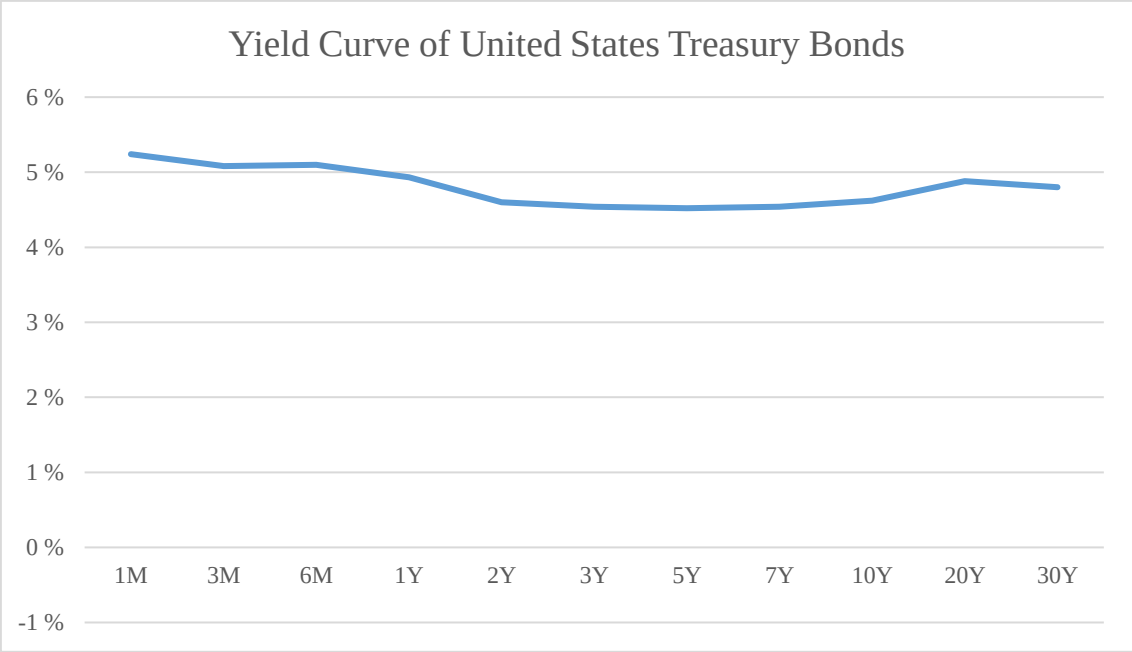

Figure 2 Interest rates United States Government Bonds of different maturities. 23rd of March 2007. United States Treasury.

Cheung, Fung & Tsai (2010) state that during this time, the financial crisis was about to start. As can be seen from the figure, the yield curve is sloping downwards, which, according to Estrella & Mishkin (1996) signals a recession in the real economy which begun in the form of the financial crisis later in 2007.

3.2. Recessions and business cycle

As stated in section 3.1, in a normal, steadily growing economy, the yield curve is most likely upward-sloping. This means, that the annual return for short term investments is lower than for long-term investments. When a recession is foreshadowed, this relationship is turned upside down and the yield curve becomes inverted. The suggestions for possible theories explaining this effect were presented in section 2.5. (Estrella et al. 2006)

The term ”recession” in itself is not very useful in empirical research unless it has a clear definition. The National Bureau of Economic Research (NBER) maintains a record of the United States’ business cycle. This record keeps track of ”peaks and troughs” that frame economic recession or expansion.” By definition, the time period between a through and a peak is called an ”expansion” and the period from peak to a through is called ”recession.” According to NBER (2008) the time period between 1991 and 2001 was a

record long expansion which ended in March 2001. However, every small decline in the economic activity cannot be defined as a recession. If there is an interim decline during a single trading day in a single stock exchange, it cannot be said that that particular day was a recession and the following day an expansion. As stated by the NBER (2008), the definition for a recession is given below. (National Bureau of Economic Research 2008)

> *"A recession is a significant decline in economic activity spread across the economy, lasting more than few months, normally visible in real GDP, real income, employment, industrial production, and wholesale retail. A recession begins just after the economy reaches a peak of activity and ends as the economy reaches through. Between through and peak, the economy is in expansion."*
>
> - *The National Bureau of Economic Research, 2008*

According to NBER (2008), real gross domestic product (GDP) is the best variable to measure economic growth. The real GDP is prioritised over other variables, such as employment due to the possibility of employment and GDP might behave differently. In this thesis, the focus is also in stock markets, and thus the recessions are measured as declines in a stock market index as well. Due to the GDP data being available only quarterly for NBER, the bureau also uses several monthly updated variables to accustom for the gaps in data availability. Even though the data updates frequently and the chronology is readjusted accordingly, the recession dating procedure is still trailing back. After a recession or expansion has started, the Business Cycle Dating Committee normally can determine the event after 6 to 18 months. It is extremely difficult to define a peak or a significant decline in economic activity when it is happening and therefore it must be done retrospectively to ensure that the decline as a matter of fact was a recession. Sometimes the declines are just normal deviations or the declines cannot be defined to be severe enough to be a recession because the economy expands again after the decline. (National Bureau of Economic Research 2008)

The base studies for this thesis define a recession to be six consecutive months of declining markets. The official statement by NBER does not state that it is like that each time. According to the NBER's Recession Dating Procedure, it is possible that a shorter time period is defined as a recession. However, it is stated that most of the recessions recognised by NBER are in fact two or more quarters. This "loophole" in their own definition is often used, because of the trailing nature of the statistics. For example, a

single quarter of declining real GDP might be defined as a recession. This might be done after analysing other economic and financial factors. NBER states an example from 2001. The NBER defined the quarter 3 of that year to be a recession by analysing the other aggregate statistics. In hindsight, it was discovered the real GDP had been declining also in quarters 1 and 2. Thus, NBER was correctly predicted even though it was not perfectly clear at the time that the economy was, in fact, in a recession. Therefore, the methodology of this thesis will follow the base studies' methodology which is in line with NBER's definition in most cases. This assists the model specification as well to be clearer. (National Bureau of Economic Research 2008)

The NBER uses three distinct approaches when assigning variables in the data for periods of recession and expansion. The periods NBER uses are either months or quarters. The fundamental idea is the same in all three. The periods are assigned either 1 or 0. Binary value 1 means that in that specific period the economy is in recession and correspondingly 0 for expansion periods. The first interpretation is called *the midpoint method.* In this method the starting point of the recession is the midpoint of the period that contains the peak. Respectively, the end of the recession is the midpoint of the period that contains the trough. This method assigns binary digit 1 to the most periods since both the peak and trough periods are included. The second interpretation is the *peak method.* This method assigns the first day of the period that contains the peak as the starting point of the recession. The period that contains the trough is the first period to be assigned 0 after the recession. The third method is called *the trough method* and it is similar with the peak method, however in this method the recession is shifted one month ahead. In this method the first day of the recession is the first day of the period that follows the peak. Correspondingly, the last day of the period that contains the trough is the last period that is included in the recession and thus assigned a binary digit 1. NBER uses the trough method and therefore this in this thesis the same method will be applied. (National Bureau of Economic Research 2008)

As implied in the section above, the economy is cyclical. *Business cycle* is the term used to describe the nature of the economic activity. The peak and trough were defined in the earlier chapter. A full business cycle is the time period from one peak to the next or correspondingly from trough to the next one. Naes, Skjeltorp & Ödegaard (2011) link the NBER recessions with liquidity draining in the United States markets. Adrian, Estrella & Shin (2010) link the business cycle to follow the monetary cycle governed by *central banks.* Central bank is the governing body that regulates the money supply. In United States this organisation is the Federal Reserve System (Fed) and in European monetary

union this function is dedicated to European Central Bank (ECB). The money supply is controlled with several tools, the most profound being *the federal funds rate*. (Naes, et al. 2011, Adrian et al. 2010)

According to Adrian et al. (2010) an *inverted yield curve* will signal a recession in 12 to 18 months. In this case, the long-term interest rates are lower than short-term interest rates. Adrian et al. (2010) state the following.

> *"Since 1955, twelve recessions have occurred, each of which has been preceded by an inversion of the yield curve. Conversely, there has only been one episode in the United States since 1955 where an inversion of the yield curve in 1966 was not followed by a recession."*

The year 1966 was, however followed up by a phase of higher unemployment. *Monetary tightening* is linked with the inversion of the yield curve. It is alleged that the tightening actions conducted by the central banks tend to happen right before recessions. Not all monetary tightening cycles precede a recession. Some of this tightening are followed by so called "soft landings." Monetary policy is linked with inflation, and the predictive power of the yield curve was originally discovered to signal inflation changes (Estrella & Mishkin, 1996). NBER (2008) includes unemployment as one of the factors that contribute to the decision whether a decline in the economy is or is not a recession. Gross Domestic Product is the main indicator however (NBER, 2008). Adrian et al. (2010) include unemployment and state that an increase in unemployment is followed by monetary tightening cycles. (Adrian et al. 2010)

3.3. Yield curve as a predictor of future economic activity

The probability unit model (probit) used in the empirical section of this thesis is closely tied to the previous literature related to predicting recessions based on the term structure. The probit model was established by Estrella and Mishkin (1996). The benefit of the probit model is that it provides past results based on the information that was available at the time (Liu et al. 2004). They test several financial variables and their ability to predict United States recessions. The variables consisted of several classes divided into 5 categories (Estrella et al. 1996):

- *Interest rates and spreads*
- *Stock prices*
- *Monetary aggregates*
- *Individual macro indicators*
- *Indices of leading indicators*

To test the ability of these indicators to predict United States inflation and recessions, Estrella and Mishkin apply the probit model. The model is described in equations 11:

$$Y_{t+k} = \beta' x_t + \epsilon_t \tag{11}$$

the variable Y_{t+k} takes values of either 1 or 0. If the value of Y_t is 1 at a given time point, it means that the economy is in a recession. The length of the forecasting horizon is denoted by k and ϵ is a normally distributed error term. β' is the coefficient for the variable x_t which is the variable for the term spread. The intercept is included in x_t. The equation 12 that is then estimated is the following (Estrella et al. 1996):

$$P(R_{t+k} = 1) = F(\beta' x_t), \tag{12}$$

Where P is the probability forecast of a recession. F is the cumulative normal probability density function. R_{t+k} is the recession indicator and it is 1 if the stock market is in a recession in time t and 0 otherwise.

In the probit formula, Estrella and Mishkin (1996) introduced many dependent variables to test their power of predicting recessions. Almost every variable performed quite poorly in this study. The term structure and stock price levels were the only variables that generated results that indicated that these financial indicators produced important information in macroeconomic prediction. The term spread generates such consistent predictions that it is tested also in tandem with other variables tested in the paper. Overall, the most striking discovery of this paper is that predicting future recession based on financial factors is quite difficult, however the term structure of interest rates offers great statistically significant results. (Estrella et al. 1996)

3.4. Yield curve as a predictor of stock market recessions

Resnick & Shoesmith (2002) utilise the discoveries made by Estrella & Mishkin (1996). The original paper tests leading indicators against a broader economy. Resnick & Shoesmith (2002) transform the model to time the *stock* market. The same probit model is expanded to predict United States stock market recessions. The probit model is successfully transformed to capture important information about the probability of a recession in the following period. They introduce the idea of switching between stocks and bonds based on the probability of a recession. (Resnick & Shoesmith 2002) An intuitive approach would be to use 50% probability screening when determining the threshold to change from bonds to stocks. However, Liu et al. (2004) state that recession signals are quite rare in real life and even 20% probability might prove to be too high. First, the appropriate probability screening is tested. It is discovered that 35% or 40% probability screening gives the best results. This means that every time the probit model gives a probability of 40% or higher that the market is in recession in the following period, stocks are sold and bonds are bought. Then again if the probability falls below 40%, stocks are acquired once again. When using the probability screening of 35% the same idea is applied but with lower percentage threshold. This threshold of 35% gives the best results when compared to a classic "*buy-and-hold"* strategy. (Liu et al. 2004)

Buy-and-hold strategy is often used as the benchmark strategy when testing investment strategies. Buy-and-hold strategy means normally investing in a stock index. For example, Resnick & Shoesmith (2002) use the S&P500 index returns as a benchmark buy-and-hold strategy. As stated in chapter 2.2, the United States government bond is considered *risk-free.* When the probit model produces a high probability of a recession, the investor switches his position out of riskier stocks into safer bonds. With this approach Resnick & Shoesmith (2002) are able to generate 2,29% excess returns when compared to the traditional buy-and-hold strategy. (Resnick & Shoesmith, 2002)

To expand the idea to a global framework, Bernard & Gerlach (1998) use the probit model to estimate the ability of the term spread to predict recessions in eight countries including Belgium, Canada, France, Germany, Japan, Netherlands, United Kingdom and United States. Bernard & Gerlach (1998) are able to confirm the hypothesis that the predictive power of the yield curve is a global phenomenon and not only restricted to United States. They discover that term spread is able to predict recessions as far ahead as eight quarters. The term structure of interest rates of Germany is also discovered to offer valuable information regarding the recessions in other countries. (Bernard & Gerlach, 1998)

Liu et al. (2004) develop the idea of using the yield curve to predict recessions in the stock market. The main aim of the paper is to test United States influence on several other markets. They produce an investment strategy where the portfolio position is changed based on signals produced by the probit model that is originally introduced by Estrella & Mishkin (1996). The idea is that if the probit model produces a certain probability of a recession in the following month, the position is changed from stocks to bonds to avoid losses. The sample period is from January 1980 to June 2001 and the study focuses in Australia, Belgium, Canada, France, Germany, Netherlands, Sweden, United Kingdom and United States. (Liu et al. 2004)

The probit model is slightly changed from the one in Estrella and Mishkin (1996). For example, Liu et al. (2004) use monthly data instead of quarterly data. United States' role as a leading market power is brought in by using the spread from T-bills and T-notes to predict domestic stock market recessions in the remaining sample countries. In almost every country included in the sample had higher returns on the strategy relying on the United States term spread instead of the domestic term spread. The model specification is introduced in equations 13, 14 and 15. With these three strategies a basic buy-and-hold strategy will be tested to get an understanding if the strategy performs better than the model specified below. A similar approach will be implemented in the empirical section of this thesis. (Liu et al. 2004)

$$(13) \quad P\left(Y_{FC,LC,t+1} = 1\right) = F(\alpha_0 + \alpha_1 SPRD_{FC,LC,t})$$

$$(14) \quad P\left(Y_{FC,LC,t+1} = 1\right) = F\left(\alpha_0 + \alpha_1 SPRD_{US,DL,t}\right)$$

$$(15) \quad P\left(Y_{FC,LC,t+1} = 1\right) = F(\alpha_0 + \alpha_0 + \alpha_1 SPRD_{FC,LC,t} + \alpha_1 SPRD_{US,LD,t})$$

The general idea is the same as in Estrella and Mishkin (1996). The FC,LC,t denotes "foreign country from local currency investors perspective using home country interest rate spread." US,DL,t means the same but using the United States spread on stock market index denoted in US dollars. In the third equation, the domestic and US spread are combined to test whether bivariate approach is superior to the single spread alternatives. The first model uses domestic yield curve to predict domestic stock market recessions and therefore to switch between stocks (for instance German stock index) and United States Treasury bills. The second one uses United States yield curve to switch between domestic stocks and United States bonds. The third model combines the previous two. As it turns out, the US spread alone generates the best results across the sample markets. This

result is somewhat striking and means that United States is to some extent a dominating economic power in the world today. The combination model does not offer significant benefit compared to the two single variable models. (Liu et al. 2004, Estrella et al. 1996)

The paper discusses two distinct approaches. The first is the point of view of *a local currency* investor investing in local stock market if the probability falls below the predetermined threshold. When the probit model produces higher probability of recession, the local currency investor switches the position to local currency. The second point of view is *a dollar investor* who invests in foreign stock markets denominated in US dollars when the probability of a future recession is less than the predetermined probability screening. The investor then switches the position to United States T-bill if the probability of recession goes up. (Liu et al. 2004)

The results are somewhat surprising in Liu et al. (2004). The countries tested are Australia, Belgium, Canada, France, Germany, Netherlands, Sweden, United Kingdom and United States. The median compound annual return in the tested markets is found to be 17,67%. The median return for buy-and-hold strategy is lower at 16,55%. These results apply for the sample markets outside of United States. In United States the results for the market timing strategy and the buy-and-hold strategy were relatively similar producing annual median returns of 16,66% and 15,63% respectively. This result is calculated with the local currency investor's point of view. When the dollar investor's point of view is taken into consideration, the difference in market timing strategy returns and buy-and-hold return is even larger. United States dollar investor would receive an annual average compound return of 15,75% compared to buy-and-hold returns of 13,56%. When applying the market timing strategy to the United States stock market, the advantage is slightly smaller, but the returns are still higher than while suing buy-and-hold. In countries such as Belgium, France and Netherlands the effect is quite pronounced. In other countries, the United States yield curve model is superior as well. The only exception being Sweden as mentioned before. The fact that switching between United States treasury bond and foreign stock index might feed the ”flight to quality” phenomenon which will be explained in the section 3. (Liu et al. 2004)

Sharpe reward-to-variability ratio which was introduced in the previous section is also considered as a measure of the success of the market timing strategy. The Sharpe ratios are only tested at the 35% probability screening which is the most successful in market timing returns both from US dollar investor's and local currency investor's point of view. The results are somewhat similar as with the straight-forward testing with only returns. Swedish investor does not benefit from the market timing strategy. The rest of the sample

yields mostly higher Sharpe ratios when using US yield curve as the predictor compared to the buy-and-hold and domestic yield curve strategies. Germany experiences some discrepancies when looking at the local currency investor's perspective. For example, the German yield spread performs better in some instances than United States yield spread. This result also feeds the research problem of this thesis. (Liu et al. 2004)

Estrella, Rodrigues & Schich (2003) use data from both United States and Germany to estimate whether the predictive ability of the yield curve stays stable. German and United States' yield curve is reported to be correlated with inflation in the following periods. The relationship relies on the maturities the government bonds are. The results are consistent with the preceding literature in the scope of predicting inflation. The results regarding inflation development in short-term, the yield curve does not offer much statistical significance, however, in longer time horizons, the yield curve offers robust results. Overall, measuring both economic growth and inflation with the yield curve is stated to be again predictable to some extent with the yield curve. Estrella et al. (2003) state that yield curve can be used "with a certain confidence" to predict future inflation and economic activity and the effect is relatively stable. This applies for both Germany and United States yield curves. (Estrella, Rodrigues & Schich, 2003)

4. GLOBAL FINANCIAL MARKETS

The following section discusses the global financial markets. Themes that have grown in the recent times are emphasised. Such themes are the interconnection of global stock markets and crisis contagion from foreign stock markets. *Contagion,* which will be discussed further in section 4.1, is a phenomenon not exactly tied to the term structure of interest rates. However, the role of the yield curve as an indicator of future recessions in foreign markets makes crisis transmission and interdependence of the global economy a meaningful discussion subject. The way that recessions are transferred from one market to another supports the discussion about the hypothesis of Finnish stock market recessions being predictable by statistics from another country. Thereafter, the role of United States as a leading market power will be discussed in section 4.2. Finally, the characteristics of the Finnish economy and stock market will be discussed briefly. The following sections motivate the decision of the chosen sample countries further.

4.1. Contagion and interdependence

According to Allen & Gale (2000), the financial sector is severely vulnerable to shocks. The crises in the financial sector are transferred to real economy through credit restrictions which in turn lower the supply of money and thus diminish real activity. The shocks that might affect only a single or a handful institutions or organisations are transferred to the broader economy through *contagion* and *spillover* (Bekaert, Ehrmann, Fratzscher, Mehl 2014). Contagion is used in this sense in the same way as viruses are transferred in populations. In crisis, the markets tend to move to the same direction more than normal fundamentals justifies. This surplus correlation is often attributed to contagion and spillover effects. According to Bekaert, Harvey & Ng (2005) contagion is difficult to define only by the increased co-movement by different markets. (Allen et al. 2000, Bekaert et al. 2014)

Contagion occurs theoretically because of the interconnections in the financial sector. According to Allen & Gale (2000) this is one theory explaining contagion. Shocks that only involve a minor portion of institutions, such as banks or companies, or a small geographical area are then transferred to the economy as a whole. The idea is developed by Allen & Gale (2000) to include banks and their claims. If a single bank is struggling, other banks that have liabilities in the bank will also generate losses. Thereafter, the effect will move forward as the banks and other institutions start generating losses due to being

interconnected with these banks. If this chain reaction is strong enough, the crisis that started locally, can become a global crisis that affects many countries. (Allen et al. 2000)

Contagion was the main reason for the financial crisis of 2007-2009. The crisis started as a local mortgage crisis in the United States housing market. From there, the turmoil advanced to foreign financial sectors and from there to the real economy. According to the NBER, the downturn that followed was 18 months long, lasting for the whole year 2008 and first six months of 2009 reach the trough in June 2009. (NBER, 2017) One of the possible reasons the crisis became so severe was the fact that it originated in the US, which is the most substantial financial market and the largest economy in the world. This means that the way United States was connected to other developed countries resulted in losses for developed countries closely tied to the United States. This subsequently moved forward in the economies and therefore to the emerging markets that were not closely tied to United States. (Cheung et al. 2010)

The crisis of 2007-2009 was different from the preceding global crises. According to Cheung et al. (2010) the crises such as 1997 Asian crisis, 1998 Russian crisis and 1999 Brazilian did not result in such global turmoil. This is due to the fact that the United States is the largest economy in the world and allegedly dominates other countries when it comes to predicting the economy. This is very prevalent is Liu et al. (2004) and as stated before, is one of the reasons that predictions on the rest of the world can be made simply based on the statistics from United States. The role of the United States as a leading market power will be discussed in the following section. (Cheung et al. 2010)

An important topic related to the contagion is the observation that in non-crisis time periods the markets are not very correlated and move in their own individual paths. When uncertainty hits the market in a form of crisis, the global markets tend to experience more correlation between each other. In Bekaert et al. (2005) state that “segmentation and integration” have a significant impact in global contagion processes. A possible situation is, that in smaller economies and smaller regions a local crisis might see “intraregional correlations” increase. However, the correlations between smaller regions might decrease which means that the contagion occurs only within the region. Contagion is often described to be a global phenomenon and in the scope of this thesis, the transmission should at least be strong enough to transfer within developed countries. (Bekaert et al. 2005)) As stated by Cheung et al. (2010) the 2007-2009 showed that the crisis transferred through the global system to both developed and emerging markets.

4.2. United States' role as a leading economic power

The role of the United States as a leading economic power is one of the carrying topics of this thesis. United States is world's largest economy and third most populated country. United States stock market is the largest in the world as well with market capitalisation of listed domestic companies worth 27 trillion USD. The next on the list is China with 7 trillion USD market capitalisation. Based on numbers only, United States is dominating the rest of the world in sheer size and economic activity and according to Gotzmann & Jorion (1999) the estimates of the global economy are often collected merely from United States' economy. (World Bank, 2016)

The role is so profound that there is even a possibility that United States are affecting other countries in a way that foreign stock returns can be predicted by numbers from United States. Furthermore, Rapach, Strauss & Zhou (2013) study United States stock returns as a leading indicator of foreign stock returns. They research 11 industrialized countries and discover that the returns in these economies can be predicted with lagged United States market returns. This effect only goes one way, which means that the lagged market returns in the rest of the sample countries are not able to produce robust predictions in United States stock market. (Rapach, Strauss & Zhou, 2013)

The reason why United States market returns can be used to predict other countries' stock returns is relatively simple according to Rapach et al. (2013). If a country is a close trading partner with another country, there is information linkages which cause changes in returns of the other country. Due to United States being a close trading partner with most of the industrialized world, the shocks travel to developed countries relatively easily from United States. (Rapach et al. 2013)

When uncertainty grows in the market, investors start to desert their long-term commitments and hoard towards better liquidity and safer returns. United States government issued debt obligations are considered a "safe haven" security. United States government bonds are considered default-free and thus among the few good investment options in uncertain environment. Therefore, when markets start to fall, the returns on United States Government bonds tend to become more popular. This phenomenon is known as "flight to quality." This means that in the midst of a financial crisis investors tend to start panicking in the uncertainty and therefore move their money away from risky securities such as stocks to safer and less risky assets. These flight to quality episodes happen in unstable markets. Often an unexpected event in the market forces investors to

re-evaluate their positions and whether they preserve their value as safely as previously thought. (Caballero & Khrishnamurthy 2008)

4.3. Finnish stock market

Finnish economy is closely reliant on export trade (Statistics Finland, 2017). Finland trades mostly with its close geographical neighbours Sweden, Germany and Russia. These countries are the countries with largest import volume to Finland. For export, United States ranks the third highest volume instead of Russia. The total export volumes has been in above 50 billion € in the 2010s. (Statistics Finland 2016)

Finland's dependency on its neighbours was proved in the beginning of 1990s. As the Soviet Union collapsed, the Finnish economy went into the deepest non-war recession for an industrialised country since the Great Depression in 1929. GDP declined massively, unemployment peaked and over half of wealth in the Finnish stock market vanished. The Finnish depression was unique. The crisis stayed within Finnish borders and did not spread to other Nordic countries, for example. Gorodnichenko, Mendoza & Tesar (2012) argue, that the fundamental reasons behind the Finnish recession of 1991-1993 were an expensive restructuring of the Finnish manufacturers and the sudden rise of energy costs due to supply side problems in Soviet Union. (Gorodnichenko, Mendoza & Tesar 2012)

The 2008 global financial crisis had its impact on Finland. Foreign trade declined by 30% from 2008 to 2009. GDP declined 8,3% from 193,7 billion € to 181,1 billion €. The Finnish economy has not recovered back to the level of 2007 until the year 2016 according to Statistics Finland (2017). As visualised in section 3.1, the United States yield curve was downward-sloping which supports the hypothesis that the Finnish stock market might be predictable based on United States yield curve. (Statistics Finland 2017, Cheung et al. 2010)

In the following section, the data and methodology and data of the empirical section will be discussed. The previous section motivated the chosen countries for the purpose of this thesis.

5. DATA AND METHODOLOGY

5.1. Data

This study uses Datastream, Federal Bank of St. Louis and Organisation of Economic Co-Operation and Development (OECD) as the source of its data. As stated in previous chapters, the leading market power United States is selected to predict Finnish stock market recessions. To support the focus of Finland, the two closest trading partners, Germany and Sweden, are selected into the sample (Statistics Finland 2016). The following time series data is collected from each sample country.

- 3-month treasury bond rate
- 10-year treasury bond rate

Based on the 3-month and 10-year Treasury bond the difference is calculated which is the term spread. The yield spread is used as the independent variable in the probit model. The dependent variable is the recession indicator calculated with two distinct approaches.

1. Numerical stock index approach similar to Liu et al. (2004)
2. Recession and expansion chronology published by the OECD.

The former is based on the increases and declines in the index, the recession indicator is calculated solely based on the stock index data. Every six-month period that experiences a continuous decline is assigned the dummy variable 1 which means that it is a recession period. Every other period is assigned a 0 (expansion). The OECD recession indicators are predetermined by OECD based on economic activity and employment statistics. The following time series data will be collected to conduct 8 market timing model combinations (Equations 16-23) in total:

- Finnish stock market recession indicator
- OECD Recession indicators
- 3-month and 10-year yield spreads from Finland, Sweden, Germany and United States

The chosen data period is from December 1987 to September 2017. This mostly decided because of data availability on the term spreads for these countries. The period contains monthly time series data. The total number of observations is therefore 358. As visualised

in the following section 5.2, the total number of stock market recessions is 6 in 1960-2017. Four of these stock market recessions fall into the period studied in this thesis.

5.2. Methodology

The main purpose of this study is to test the power of the interest rate spreads in predicting future recessions in Finland. A traditional buy-and-hold strategy is the benchmark strategy and Finnish stock index and Finnish government 3 month bond will be used for the purpose. They are tested to determine whether they are better than a market timing strategy based on term spreads of Finland, Sweden, Germany and United States. A bear market is defined as ”six or more consecutive months of a generally declining stock market, where any interim increase in the stock market level does not establish a new high.” This definition is also consistent with the NBER definition that a recession is a continuous negative development in economic growth that lasts at least two quarters. For the recession dummy variable, the trough method is used to assign variables for the periods. This means that the peak month is not included in the recession period and therefore is assigned a zero. The trough month is included in the recession and is assigned a binary value 1. This approach complies with the recommendations from the National Bureau of Economic Research. (Liu et al. 2004, NBER 2008)

The model that will be used is that of Liu et al. (2004). The probability unit model introduced by Estrella & Mishkin (1996) and further developed by Resnick & Shoesmith (2002) and Liu et al. (2004) will be utilised with slight moderations the model specification for this thesis is in the form shown in equations 16, 17, 18 and 19. In this set of equations the dependent variable is the stock market recession indicator calculated with the stock market index ticker data. The alternative to the stock market recession indicator is the OECD based indicator. OECD updates the business cycle chronology, however, the statistic applies to the recessions in the broader economy. The peaks and troughs defined by NBER and OECD do not apply for stock markets directly even though the stock market somewhat follows the development of the real economy and thus an alternative approach to define stock market recessions (NBER, 2008). For this purpose, the numerical approach by Liu et al. (2004) can be used in tandem with the NBER/OECD chronology. For European Union countries, OECD updates the chronology. NBER and their Business Cycle Dating Committee updates the chronology for United States. The OECD, however, uses similar methodology for the business cycle as NBER. (Liu et al. 2004)

(16) $$P(Y_{HEX,EUR,t+1} = 1) = F(\alpha_0 + \alpha_1 SPRD_{FI,EUR,t})$$

(17) $$P(Y_{HEX,EUR,t+1} = 1) = F(\alpha_0 + \alpha_1 SPRD_{US,DOL,t})$$

(18) $$P(Y_{HEX,EUR,t+1} = 1) = F(\alpha_0 + \alpha_1 SPRD_{DE,EUR,t})$$

(19) $$P(Y_{HEX,EUR,t+1} = 1) = F(\alpha_0 + \alpha_1 SPRD_{SE,SEK,t})$$

The model is similar with Liu et al. (2004) with a change of perspective. In Liu et al. (2004) the focus is on the effect of United States on the rest of the sample countries. This thesis focuses on the effect of the rest of sample countries on Finland Stock Index (HEX). The equations 16, 17, 18 and 19 describe this relationship. $P(Y_{HEX,EUR,t+1} =1)$ is the probability distribution of Finnish stock market being in a recession in the following period which in this study is the next month. The probability is given by the probit model which is estimated with the term spread of the sample countries: United States, Germany, Sweden and Finland itself. Model 16 has the term spread of Finland itself as the explanatory variable. Thereafter, models 17, 18 and 19 contain United States, Germany and Sweden term spreads as independent variables respectively.

The equations 20, 21, 22 and 22 visualise relationship of the four country term spreads with the OECD chronology recessions.

(20) $$P(Y_{OECDFI,EUR,t+1} = 1) = F(\alpha_0 + \alpha_1 SPRD_{FI,EUR,t})$$

(21) $$P(Y_{OECDFI,EUR,t+1} = 1) = F(\alpha_0 + \alpha_1 SPRD_{US,DOL,t})$$

(22) $$P(Y_{OECDFI,EUR,t+1} = 1) = F(\alpha_0 + \alpha_1 SPRD_{DE,EUR,t})$$

(23) $$P(Y_{OECDFI,EUR,t+1} = 1) = F(\alpha_0 + \alpha_1 SPRD_{SE,SEK,t})$$

The market timing aspect is tested on several probability screenings in both of the approaches. Every time the probability of a recession in the next month rises above a certain level, the position is changed from the Finnish stock index to the 3-month Finnish Government bond. Respectively, when the probability of recession in the following month falls below the chosen threshold level, the position is yet again switched back to stocks. These results are then reflected on the traditional buy-and-hold strategy in the

Finnish market. The Helsinki Stock Index (HEX) is the index that the buy-and-hold strategy is following. The section 6 shows the results of these 8 models. (Liu et al. 2004)

The amount of recessions in Finland changes dramatically when changing between the OECD definition of a recession in the broader economy and the one derived specifically from the stock market recessions. OECD dates a chronology of recessions in the broader economy and these statistics are compiled by analysts in hindsight. The Liu et al. (2004) definition is derived from stock market indices only.

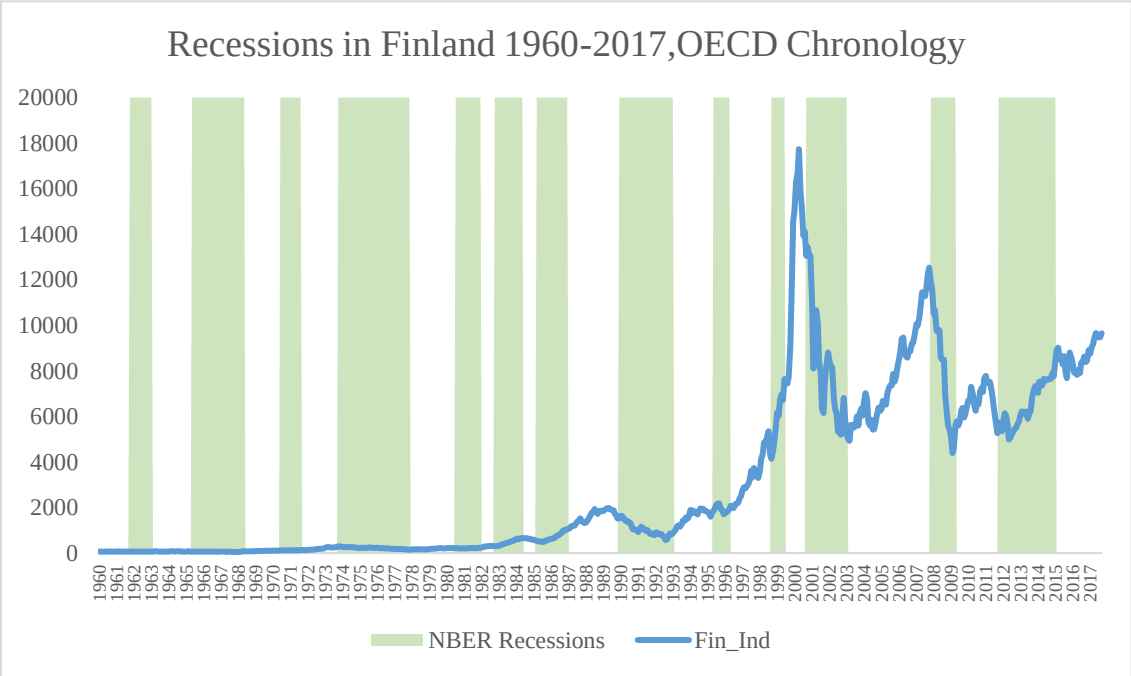

Figure 3 Helsinki Stock Index 1960-2017. OECD defined recessions are shaded green.

As can be seen from the figure 3, there has been 13 recessions in Finland since 1960. The shaded recessions somewhat follow the stock market development. However, sometimes the stock market moves in complete opposite direction as can be seen for example between from 2012 to 2015. (NBER, 2008, Datastream, 2017)

When applying the stock market perspective on the recessions the amount of recessions decreases quite dramatically. As it turns out, there are not so many occasions of the stock market sloping downward for six consecutive months or two quarters. The recessions are visualised in figure 4. (Datastream 2017)

As can be seen in figure 4, the amount of recessions falls to 7 and the duration becomes smaller for a single recession. From these observations, 4 recessions are in the sample

Figure 4 Helsinki stock Index 1960-2017. All periods of continuous decline with a duration of 6 months are shaded grey.

period of this thesis (1987-2017). The latter definition does not consider the magnitude of the declines. For example, the dot-com crash which is the highest peak in the figure is not considered to be a recession until the very end of the crisis because of the intra-period increases within. The arithmetic average holding period returns, however for stock market recessions are -23,7%. This means, that if an investor always went long in the beginning of the recession, on average at the end of a recession the investor would have lost 23,7% during the recession. For the OECD recessions, the arithmetic average holding period return is, however, +13,7%. Therefore, if an investor would have been able to invest in the Finnish stock index in the beginning of the NBER recession and sold the position at the end of the recession, the arithmetic average holding period return would be positive. The average length of a recession as OECD defines it is 25 months or roughly 2 years. Thus, the yearly return would be lower than the average yearly return of the Finnish stock index. (OECD 2018, Datastream 2017, NBER, 2008, Liu et al. 2004)

The difference of the amount of recessions with the two recession definitions mentioned above is what motivates to research the market timing model with these two distinct methodologies. The OECD approach considers real economy factors such as gross domestic product and unemployment as the factors that define the assigned variable.

Intuitively, the stock market approach should generate more robust results and better abnormal returns since the market timing model is seeking to generate profits in the stock market, not in the real economy so to speak. As it turns out in section 6, the results are quite the opposite. The anticipated results hold to some extent and the hypotheses which are presented in the following sections hold as well for some approaches.

5.3. Robustness tests

The model testing is done without considering the effect of transaction costs. For this purpose, for each switch from stocks to bonds a transaction cost is assigned. This gives information about the real-world implications of the investment strategy. According to Graham, Michaely & Roberts (2003), it is possible that even while being profitable in theory, transaction costs can make the investment strategy obsolete. Bringing transaction costs into the calculation the switching procedures become significantly less profitable. The profits are typically reduced by 20 percent when transaction costs are adjusted. This figure grows as the profits become smaller, even turning the profits negative. The change the investment environment by decreasing the frequency of changing the positions. Graham et al (2003) state that the median transaction cost is 2% on a day that does not follow a dividend paying day for a certain stock. This is the figure that will be attributed for each switch from stocks to bonds and vice versa. (Graham, Michaely & Roberts 2003)

6. EMPIRICAL FINDINGS

6.1. Descriptive statistics

In Table 1 the descriptive statistics on the Finnish Stock Index (FIN_IND), Finnish recession dummy variables calculated from the stock index as visualised in section 5 (FIN_REC), (FIN_REC_OECD), and four sets of yield spreads from Finland (FIN_SPRD), Germany (GER_SPRD), Sweden (SWE_SPRD), and the United States (USA_SPRD). The former of the recession inficators is the numerical approach defined by Liu et al. (2004) and the latter is the chronology updated by the Organisation for Economic Co-Operation and Development

	Finnish Stock Index	Finnish Stock Market recession indicators	Finnish OECD Recession indicators	Yield Spread Fin (-1)	Yield Spread Swe (-1)	Yield Spread Ger (-1)	Yield Spread USA (-1)
Mean	5694,071	0,070	0,429	1,178	1,055	0,945	1,414
Median	6035,350	0,000	0,000	1,150	1,190	1,010	1,490
Maximum	17734,500	1,000	1,000	4,960	3,530	3,210	3,570
Minimum	572,940	0,000	0,000	-3,580	-8,940	-1,800	-1,210
Std. Dev.	3502,271	0,256	0,496	1,392	1,317	1,133	1,265
Skewness	0,472	3,370	0,289	-0,429	-1,774	-0,310	-0,127
Kurtosis	3,037	12,355	1,083	4,368	12,467	2,612	1,918
Jarque-Bera	13,27	1977,53	59,60	38,76	1520,34	7,96	18,37
Probability	0,001	0,000	0,000	0,000	0,000	0,019	0,000
Sum	2032783,00	25,00	153,00	420,51	376,53	337,27	504,88
Sum Sq. D	4,37E+09	23,25	87,43	690,17	617,82	457,24	569,61
Obs	357,00	357,00	357,00	357,00	357,00	357,00	357,00

Table 1 Descriptive statistics of Finnish Stock markets and the sample yield spreads.1987M12-2017M09, Datastream, St. Louis Federal Bank.

According to the definition by Liu et al. (2004) definition of a recession, there has been 25 periods that qualify as a recession. The threshold length of a recession is 6 months, therefore, the total amount of stock market recessions is 4 during the sample period 1987-2017. One of these recessions had a duration of 7 months which was the aftermath of the dot-com bubble crash in periods 2002M01-2002M07. As discussed in section 5, the amount of recessions is higher when using the NBER or OECD chronology on recessions. The amount of periods which are assigned a 1 for recession period is 153 with OECD chronology. The previous literature by Estrella & Mishkin (1996) suggests that the yield spread can anticipate the recessions in broader economy. Resnick & Shoesmith (2002)

and Liu et al. (2004) discover the connection between declined yield spread values and recessions in the stock market. The data show that the amount of recessions becomes significantly smaller when using the definition strictly on stock market indices. For example, during the sample period 1987-2017, there were in total 0 recessions in the German stock market (Datastream 2017). This observation does not hinder the significance of the results in the following sections. Figure 4 shows, that the total amount of recessions during the 1987-2017 period is 4. When looking at the OECD recession indicator statistics, the amount of recession becomes larger and the duration becomes longer. The total amount of recession in the sample period is 7 with an average duration of 22 months. The mean values of the two recession indicators are completely different, mean stock market indicator being 0,07 and mean OECD indicator 0,43. Therefore, the OECD recessions are quite much longer in duration and more frequent. However, it must be considered that the OECD chronology is updated by financial professionals, and the stock market index approach is strictly numerical and does not consider the development of the real economy whatsoever.

The spreads behave somewhat similarly when compared to each other. The variation, and size of the spread in terms of median, standard deviation and minimum and maximum values are relatively close to each other. Sweden has one massively low value of the yield spread. -8,94, which was in August 1992. This single observation is somewhat anomalous, since the values directly before and after this particular period are roughly the same as the maximum values of the other countries' yield spreads. The spreads are visualised in figure 6. The spreads co-move quite significantly and stay positive for the majority of the period.

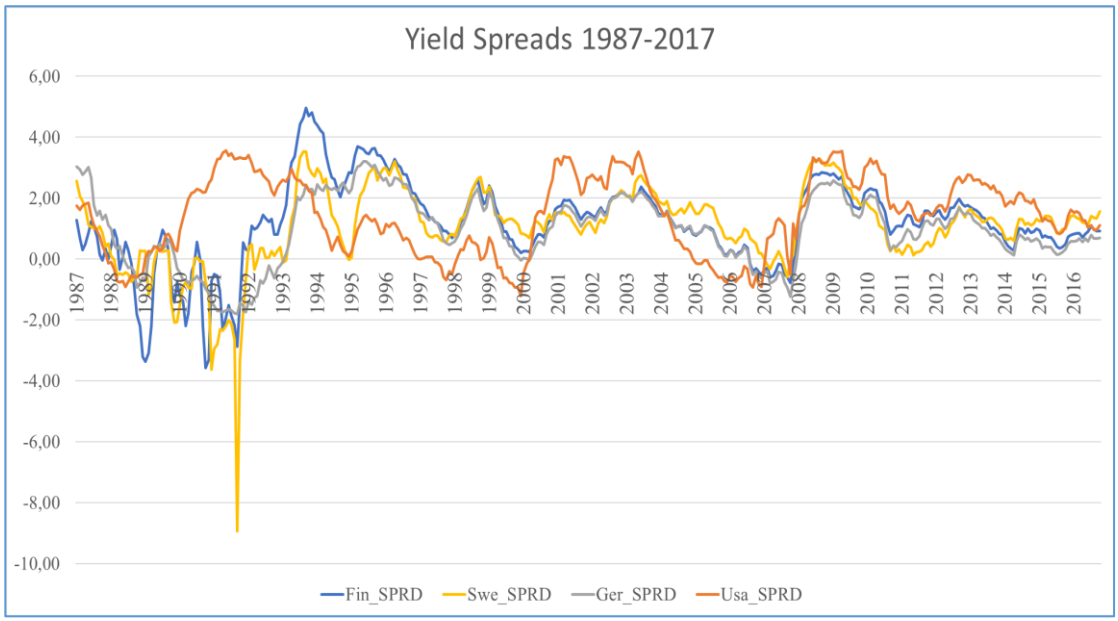

Figure 5 Finnish, Swedish, German and United States 3-month-10-year yield spreads 1987-2017.

6.2. Timing the Finnish stock market with Stock Market Recessions

When using the definition of Liu et al. (2004) to determine recessions in the Finnish stock market, the probabilities for recessions in the following period are quite low, when comparing the values attained from the base study. The popular probability screenings 25%, 30%, 35% and 40% have rarely any effect on the outcome. The complete set of results is in table 1. The top two rows are reserved for the two benchmark returns in Finnish stock market and investing simply in 3-month Finnish government bond. The results do not account for possible transaction costs, so switching between positions has no additional cost which in real markets does not hold (Graham, Michaely & Roberts 2003). The yearly benchmark return for the Finnish stock market is 6,92% for the whole period 1987-2017. This means, that investing in the end of the year 1987 would have generated 6,92% returns yearly on average. The maximum yearly return for a single month is 29,4% and minimum is -28,9% and the standard deviation of the monthly data is 0,051. The 3-month Finnish government bond has generated, unsurprisingly, lower yearly returns at 4,41%. The best month is 1,37% and the lowest -0,03% with a standard deviation of 0,004 which fits the earlier definition of government bonds being virtually risk free. The results are ex-post, which means, that the forecasted probabilities are based on the complete sample of data.

The probability screenings are significantly lower than the ones derived by Liu et al. (2004). In their paper, the most viable probability screenings are 35% and 40%. In table 1 it can be seen, that there are no switches between stocks and bonds in these probability screenings during the complete sample period and thus the return is close to the benchmark index. However, at lower probability screenings, some abnormal returns can be generated. Positive abnormal returns are visualised in **bold**. Especially, the 10% probability screening seems to generate abnormal returns when using the Finnish, Swedish and German yield spreads. The interesting finding in table 1 is that United States yield spread as the independent variable in the model is unlikely to generate any abnormal returns thus pointing to the similar result with Liu et al. (2004) where Sweden did not experience any additional benefit from the market timing model with United States yield spread as the independent variable.

The results are further analysed by country and by the recession chronology definition in the following sections. First the predictive power over the Finnish stock market will be first tested with the definition of the declining stock markets idea, and then with the OECD recession chronology. For both approaches, each country will be discussed in depth.

Probability Screening	**5 %**	**10 %**	**15 %**	**20 %**	**25 %**	**30 %**	**35 %**	**40 %**	**45 %**
Fin_Ind	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %
Sharpe	0,337	0,337	0,337	0,337	0,337	0,337	0,337	0,337	0,337
Fin_3m Government Bond	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %
Excess to Fin_Ind	-2,512 %	-2,512 %	-2,512 %	-2,512 %	-2,512 %	-2,512 %	-2,512 %	-2,512 %	-2,512 %
Sharpe	0	0	0	0	0	0	0	0	0
Fin_Sprd	6,576 %	9,329 %	6,832 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %
Excess to Fin_Ind	-0,345 %	**2,409 %**	-0,089 %	0,000 %	0,000 %	0,000 %	0,000 %	0,000 %	0,000 %
Sharpe	1,07	0,70	0,33	0,34	0,34	0,34	0,34	0,34	0,34
Swe_Sprd	7,601 %	7,969 %	5,930 %	6,726 %	6,726 %	6,726 %	6,726 %	6,921 %	6,921 %
Excess to Fin_Ind	**0,680 %**	**1,048 %**	-0,991 %	-0,195 %	-0,195 %	-0,195 %	-0,195 %	0,000 %	0,000 %
Sharpe	1,22	0,50	0,21	0,31	0,31	0,31	0,31	0,34	0,34
Ger_Sprd	7,981 %	8,793 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %
Excess to Fin_Ind	**1,061 %**	**1,873 %**	0,000 %	0,000 %	0,000 %	0,000 %	0,000 %	0,000 %	0,000 %
Sharpe	1,218	0,653	0,337	0,337	0,337	0,337	0,337	0,337	0,337

Table 2 Empirical results of probit model estimations with Liu et al. (2004) definition of a recession being six consecutive months of declining markets. The probability screenings vary from 5% to 45%. Finnish recession indicator is the dependent variable. The independent variables are the yield spreads of Finland, Sweden, Germany and United States respectively. The returns of the investment strategy are shown first, then respective to the benchmark index and finally, the Sharpe ratio of the investment strategy through the period is shown.

6.2.1. Finnish Yield Spread

In figure 6 the probability estimates 1987-2017 are visualised based in the stock market recessions. The values rarely go over 10%, none of the values being over 10% in the 2000s. This enforces the statement made by Estrella & Mishkin (1996) that probability forecasts using 50% might be extremely high. The values in the beginning of the sample

period reach higher. The market timing model generates positive abnormal returns only at the 10% probability screening when using the stock market index defined recession indicators.

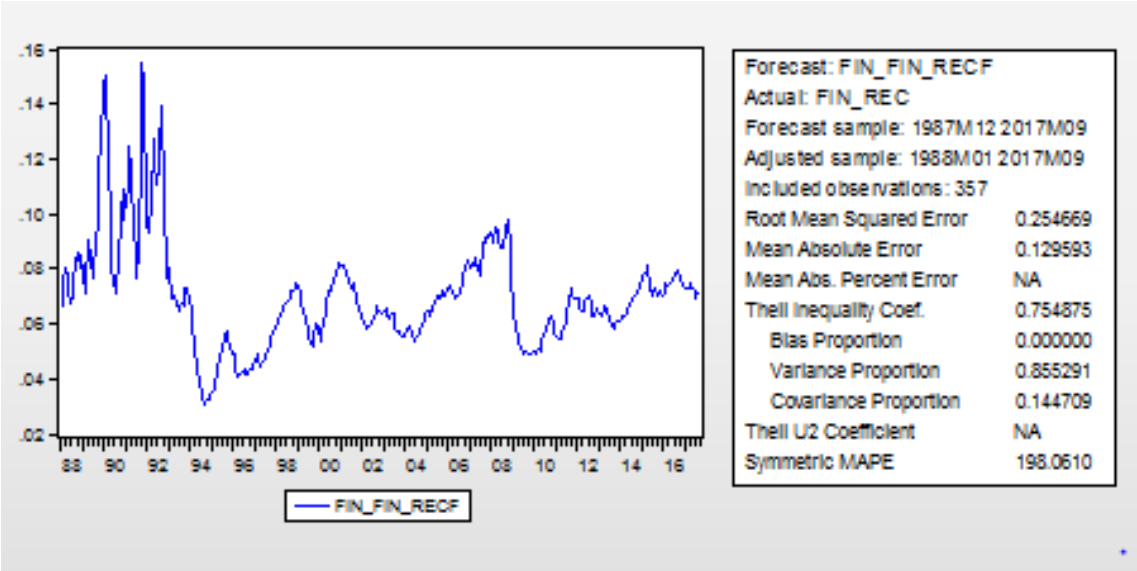

Figure 6 Probability forecast of a recession in the Finnish stock market estimated based on the index movements and the Finnish yield spread. Every period of six months of declining markets is defined as a recession.

6.2.2. Swedish Yield Spread

In table 1, the Swedish yield spread based investment strategy generates excess returns when using probability screenings of 5% and 10%. The yearly returns of this investment strategy are 7,6% and 8,0% respectively beating the index by 680 and 105 basis points respectively. Therefore, hypothesis 4 has support. The strategy becomes obsolete when using higher probability forecasts as was the case with the investment strategy based on the Finnish yield spread. Even though the 10% probability screening generates better returns, the 5% probability screening generates a more attractive Sharpe ratio. Therefore, it can be assumed that the risk in the lower probability level is "safer." Overall, the investment strategy has support, since there are levels where abnormal returns can be made. Therefore, in the Finnish stock market it can be stated that term structure of interest rates might be a viable investment strategy. Furthermore, the motivation for adding Sweden and Germany was questionable when generating the research hypothesis. With

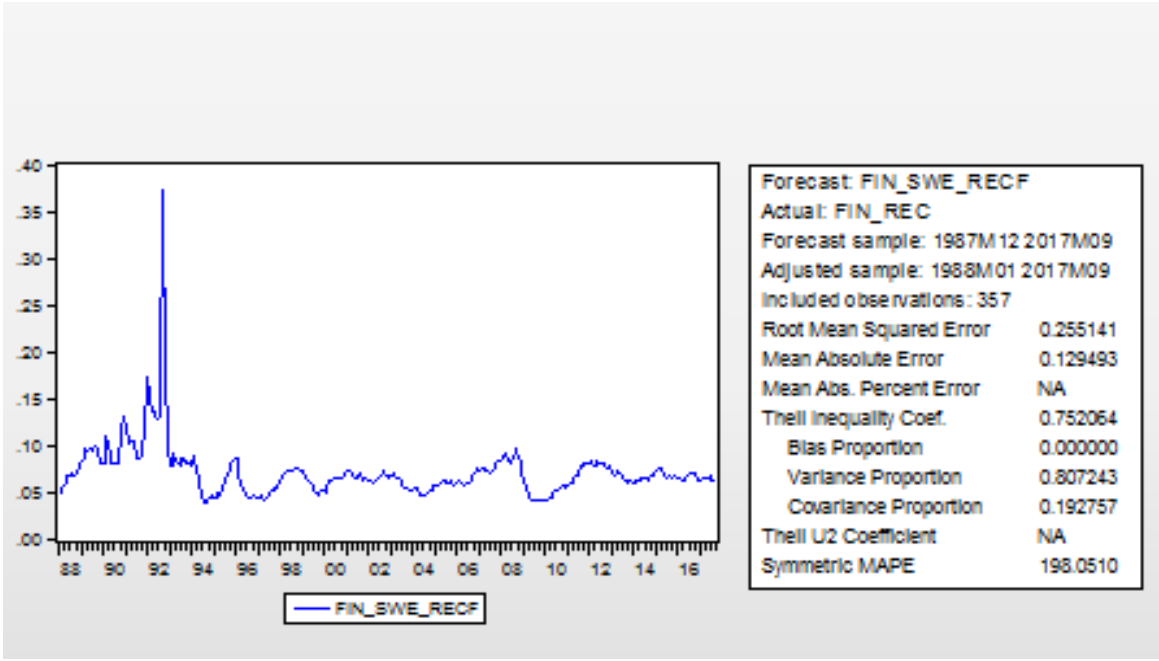

Figure 7 Probability forecast of a recession in the Finnish stock market estimated based on the index movements and the Swedish yield spread. Every period of six months of declining markets is defined as a recession.

this result, adding Sweden turns out to be a good decision. The results from the market timing model with German yield spread as the independent variable are analysed below.

6.2.3. German Yield Spread

In figure 8, the probability forecasts of a recession in the Finnish stock market are visualised. The forecasts have more variation than in the previous samples of Finland and Sweden going from close to 0 to almost 15% probability of a recession.

The results in table 1 present similar results as Swedish yield spread. Investing based in the German yield spread generates 8,0% yearly returns for the probability screening of 5% and 8,8% for the probability screening of 10% beating the market index and thus supporting hypothesis 3 that the German term structure of interest rates indeed has predictive power over the Finnish stock market. A similar phenomenon occurs with the German yield spread as with the Swedish spread. The higher return of the 10% probability screen strategy generates a lower Sharpe ratio. Therefore, the risk level of the higher probability screening strategy can be assumed to be higher.

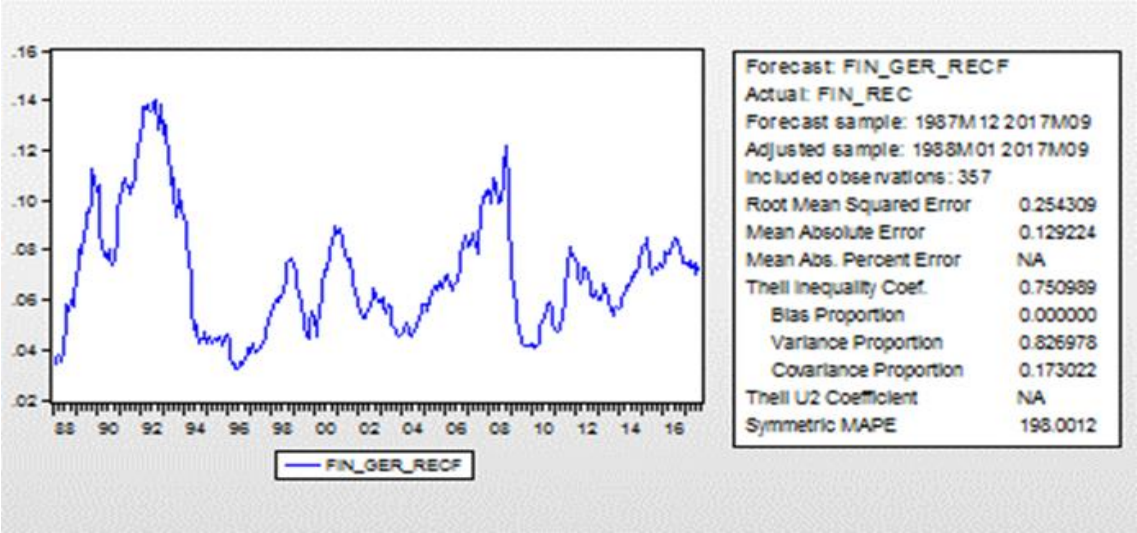

Figure 8 Probability forecast of a recession in the Finnish stock market estimated based on the index movements and the German yield spread. Every period of six months of declining markets is defined as a recession.

The decision to include Germany as well is justified with the results shown above. The market timing model is able to generate abnormal returns with both Swedish and German yield spreads. As can be seen in the next section, the United States yield spread is not as viable decision.

6.2.4. United States Yield Spread

In figure 9, the probability forecasts for the Finnish stock market recessions with United States yield spread are visualised. The figure does not experience much deviations. The probability reaches values of 8% at peaks and declines to lower than six only very briefly. Due to the low and unchanging values, the investment strategy based on United States yield spread does not generate excess returns compared to the benchmark index at almost any probability screening. Table 1 visualises the probability screenings at 5% intervals. At 8% probability screening (not visualised), the investor is able to generate 7,3% average yearly returns. However, the probability forecast deviations are so small and the 7% and 9% probability screening levels generate no excess returns which means that abusing this the strategy with United States yield spread is virtually impossible in real life. This observation is conflicting hypothesis 2. Therefore, Finland's close economical partners' yield spread performs better than United States' yield spread. This result is in line with

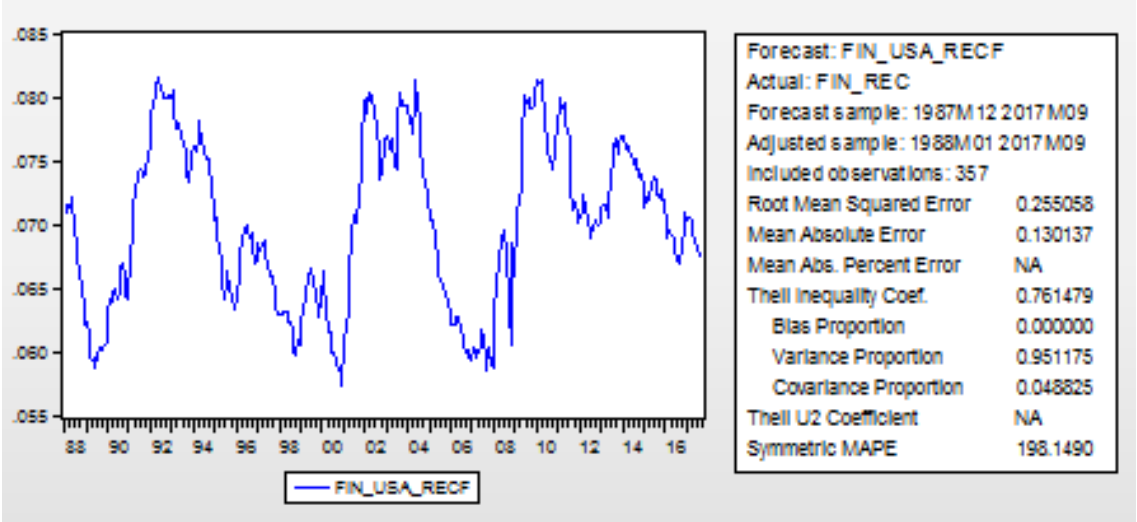

Figure 9 Probability forecast of a recession in the Finnish stock market estimated based on the index movements and the United States yield spread. Every period of six months of declining markets is defined as a recession.

the results obtained by Liu et al. (2004). As stated in the previous sections, Sweden did not benefit from the investment strategy based of United States either.

The Results in this section are surprising in two ways. Firstly, the probability forecasts shown in figures 6, 7, 8 and 9 are significantly lower than those that Resnick & Shoesmith (2002) and Liu et al. (2004) predict. This can be attributed to the low number of events that have six consecutive months of declining markets. Therefore, the recession definition in stock markets might need some adjusting to really experience benefits from this approach. Due to the low probability forecasts, the abnormal returns by the market timing model were moderate and only viable at the 10% probability screening. Secondly, the lack of predictive power of the United States term spread generates no excessive returns in the market timing model at any probability screening. The relationship between Finland and United States seems to be similar with Sweden and the interconnection between Finland and Sweden seems to be more impactful than the relationship between Finland and United States.

In the market timing model, Finnish, Swedish and German yield curves generate excess returns when compared to the Finnish stock index. Thus, when using the definition of a recession that is only limited to be defined by stock market index values, hypotheses 1, 3 & 4 are supported by the data at the 10% probability screening. However, the excess returns compared to the benchmark index are relatively low. This means, that switching

between stocks and bonds and the transaction costs attributed to it may bring the return back to the index level. This will be tested in Section 6.4.

In the next section, the predictive power of the yield curve will be tested with OECD chronology recessions as the dependent variable. As stated in the earlier sections, the number of recessions is larger when using the OECD chronology instead of the Liu et al. (2004) definition. This might produce more robust results.

6.3. Timing the Finnish stock market with OECD Chronology Recessions

Table 3 shows the estimation results of the returns of the two benchmark strategies accompanied by the four strategies which are based on the yield spread of Finland, Sweden, Germany and United States. OECD chronology recession indicators are used as the dependent variable. The indicators are not strictly numerical and the indicators have been assigned by professionals based on real economic activity. As the following sections will demonstrate, the probability forecasts of future recessions are significantly higher with OECD recession indicator as the dependent variable. This section conducts a similar analysis as was done in section 6.2. As can be seen in table 3, the probability screenings are significantly higher and the positive abnormal returns are generated at higher probability screenings, furthermore, the area where abnormal returns are positive is wider in terms of probability screenings.

Probability Screening	**20 %**	**25 %**	**30 %**	**35 %**	**40 %**	**45 %**	**50 %**	**55 %**	**60 %**
Fin_Ind	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %
Sharpe	0,337	0,337	0,337	0,337	0,337	0,337	0,337	0,337	0,337
Fin_3m Government Bond	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %
Excess to Fin_Ind	-2,512 %	-2,512 %	-2,512 %	-2,512 %	-2,512 %	-2,512 %	-2,512 %	-2,512 %	-2,512 %
Sharpe	0	0	0	0	0	0	0	0	0
Fin_Sprd	5,461 %	6,431 %	7,334 %	9,510 %	10,734 %	12,908 %	13,731 %	13,470 %	12,658 %
Excess to Fin_Ind	-1,460 %	-0,490 %	**0,413 %**	**2,590 %**	**3,814 %**	**5,987 %**	**6,810 %**	**6,550 %**	**5,737 %**
Sharpe	0,72	0,96	1,07	1,22	1,31	1,53	1,52	1,35	1,21
Swe_Sprd	10,245 %	11,759 %	11,704 %	12,909 %	13,190 %	13,741 %	12,076 %	12,955 %	13,383 %
Excess to Fin_Ind	**3,324 %**	**4,838 %**	**4,783 %**	**5,989 %**	**6,269 %**	**6,820 %**	**5,155 %**	**6,034 %**	**6,463 %**
Sharpe	1,68	1,90	1,83	1,91	1,77	1,70	1,28	1,38	1,43
Ger_Sprd	6,955 %	8,724 %	8,723 %	11,367 %	12,864 %	13,557 %	11,305 %	11,860 %	10,406 %
Excess to Fin_Ind	**0,035 %**	**1,803 %**	**1,802 %**	**4,447 %**	**5,943 %**	**6,636 %**	**4,385 %**	**4,939 %**	**3,486 %**
Sharpe	1,920	1,867	1,382	1,585	1,724	1,713	1,163	1,192	0,912
Usa_Sprd	4,409 %	4,409 %	4,409 %	4,409 %	3,582 %	5,748 %	6,921 %	6,921 %	6,921 %
Excess to Fin_Ind	-2,512 %	-2,512 %	-2,512 %	-2,512 %	-3,339 %	-1,173 %	0,000 %	0,000 %	0,000 %
Sharpe	0,00	0,00	0,00	0,00	-0,20	0,22	0,34	0,34	0,34

Table 3 Empirical results of probit model estimations with OECD chronology for Finnish recessions. Finnish recession indicator is the dependent variable. The returns of the investment strategy are shown first, then relative to the benchmark index and finally, the Sharpe ratio of the investment strategy through the period is shown.

6.3.1. Finnish Yield Spread

In Figure 10 the probability forecasts 1987-2017 of recessions in the following month based on the OECD recession indicators and Finnish yield spread. The values have a lot more variance and they are higher on average as well. The market timing model produces high abnormal returns based on the 30%-60&% probability screening. With these probability forecasts an investor would generate abnormal returns in the Finnish stock market using the market timing model with Finnish yield spread. The best results are attained at the 50% probability screening which generate 13,7% average yearly returns, 680 basis points in excess of the benchmark index. The average yearly returns stay above 10% for the rest of the probability screenings as well. The risk adjusted returns are also superior to the previous section. 50% probability screening 13,7% return has a sharpe of 1,52. Therefore, using the market timing model for the Finnish stock market is quite beneficial with the Finnish yield spread as the independent variable. Furthermore, the OECD approach is better than the stock market recession indicator approach which signals a possibility of the real economy having a profound impact on the returns in the stock market.

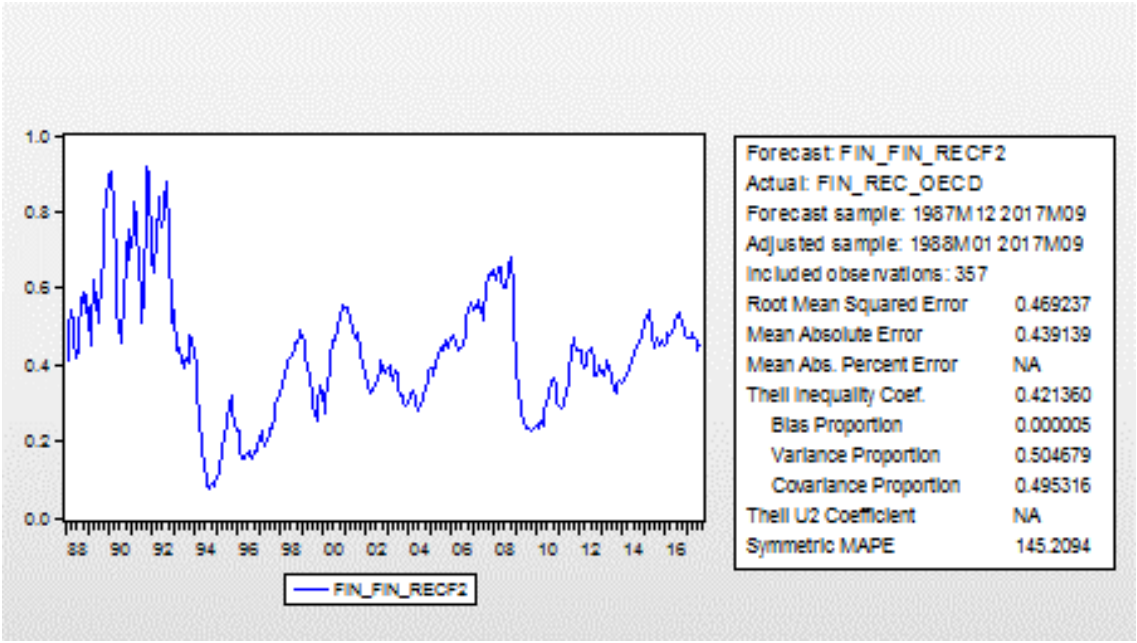

Figure 10 Probability forecast of a recession in the Finnish stock market estimated based on the OECD Chronology recession indicators and Finnish yield Spread.

6.3.2. Swedish Yield Spread

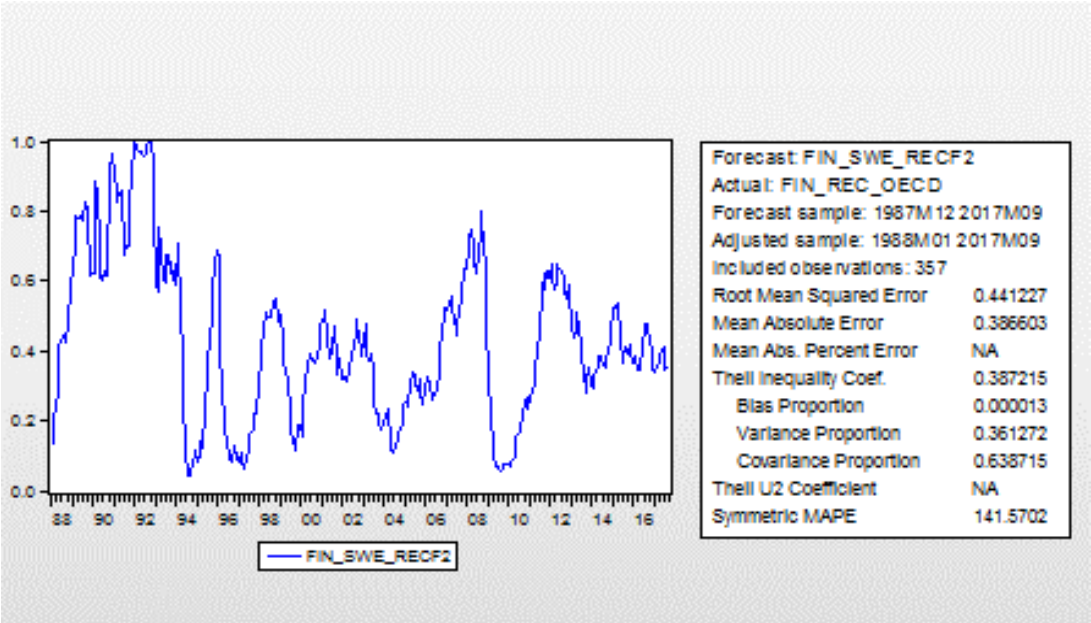

Figure 11 Probability forecast of a recession in the Finnish stock market estimated based on the OECD Chronology recession indicators and Swedish yield Spread.

In figure 11, the probability forecasts for recessions in the Finnish stock markets are visualised with Swedish yield spread as the independent variable. The probability forecasts vary from almost 0% to 100%. AS shown in table 3, the Swedish term spread produces abnormal returns with *every* probability screening. This result supports hypothesis 4 massively. The average yearly returns of this strategy are over 10% at every probability screening. Moreover, the 45% probability screening produces the highest average yearly returns of 13,7%. This is in line with the results of the Finnish yield spread market timing model estimations, where the 50% probability screening is able to generate the highest returns. Therefore, it seems, that using the OECD chronology is at its highest predicting power close to the 50% probability of a recession in the following period. As stated by Estrella & Mishkin (1996) and Liu et al. (2004) the probabilities of a recession very rarely over 50%. Liu et al. (2004) define 35% and 40% probability screenings to generate best market timing results. Sharpe ratios generated by the market timing model with Swedish Yield spread generally over 1,7 which is quite high.

6.3.3. German Yield Spread

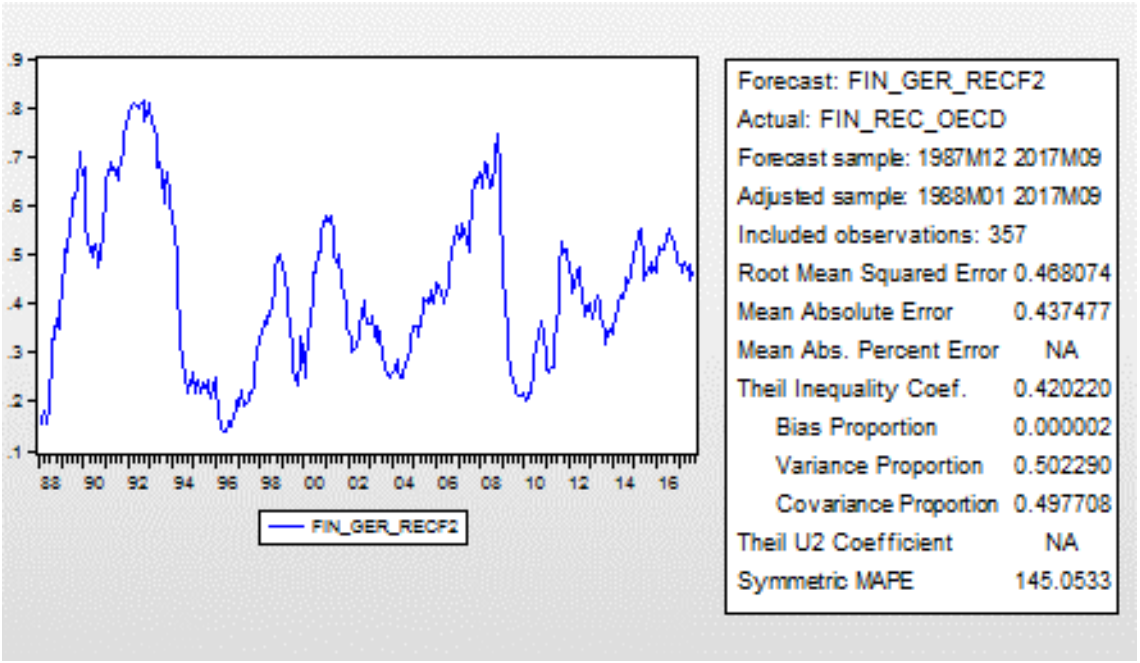

Figure 12 Probability forecast of a recession in the Finnish stock market estimated based on the OECD Chronology recession indicators and Swedish yield Spread.

Figure 12 visualises the development of the probability forecast of Finnish recessions 1987-2017 based on the German yield spread. Similarly to Sweden, the values vary quite substantially when compared to the forecasts in section 6.2. The average yearly returns of the market timing strategy exceed the benchmark index at *every* probability screening level. The values can be seen in table 4. The highest average yearly returns are produced by the strategy with 45% probability threshold. Overall, the average yearly returns and Sharpe ratios very similar with the strategy in section 6.3.2. The hypothesis 3 receives thus massive support with previously discussed hypothesis 4.

The Swedish and German yield spreads generate the most robust results in the OECD recession indicator approach as well. The transaction costs will be applied in section 6.4. The result is promising to an investor in the Finnish stock market and this phenomenon might be possible to be exploited in real markets as well. The Finnish term spread market timing model with the OECD recession indicators as the dependent variable offers abnormal returns as well. The United States yield spread model will be discussed in the following section. This approach once again gives questionable results when compared to the previous three models.

6.3.4. United States Yield Spread

The probability forecasts 1987-2017 estimated based on the United States yield spread are visualised in figure 13. The variation is significantly smaller than with the forecasts attained from Swedish and German yield spread market timing models. The forecasted values never exceed 50%. The previous forecasts varied from almost 0% to nearly 100% probabilities. The United States yield spread therefore seems to not be a viable option to generate abnormal returns in the Finnish stock market. The average yearly returns using the market timing model with United States yield spread as the independent variable do not exceed the benchmark index at any probability screening. The results are visible in table 3. The best yearly average returns are either the benchmark indices or even lower than the 3-month Finnish government bond. The probability screening 40% which was he most robust in Liu et al. (2004) generates average yearly returns of 3,58% which is worse than the 3-month Finnish government return of 4,41% yearly average returns. Therefore, an investor would do better by just investing in the Finnish stock index than utilising the market timing model with United States yield Spread as the independent variable.

United States yield spread not having any predictive power over Finnish recessions was also the result of section 6.2. The magnitude of the effect of the asset class changes between the two approaches of recession indicators are not very different. The United States yield spread market timing model experiences only few switches between stocks and bonds during the sample period.

Overall, the results from the OECD recession indicators as the dependent variable are better. OECD recession indicators produce significantly more robust results with Finnish, Swedish and German yield spreads as independent variables. United States yield spread, however, has no predictive power over Finnish economy and therefore generating excess returns with the market timing model is not possible with United States yield curve. The usable probability screenings are more widespread when using the OECD recessions as the dependent variable. As mentioned before, this signals, that real economy variables are useful signals of the returns in the stock market as well. This leads to rejection of the hypothesis 2. Liu et al (2004) discover that United States is dominating the rest of the world. Sweden was not part of these countries and neither is Finland with the approach used in this thesis.

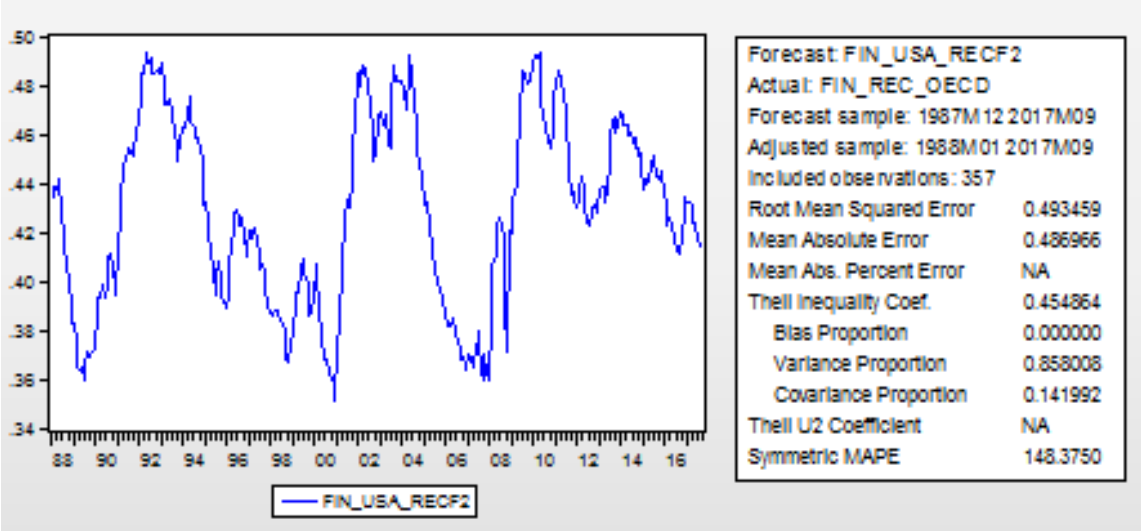

Figure 13 Probability forecast of a recession in the Finnish stock market estimated based on the OECD Chronology recession indicators and United States yield Spread

6.4. Robustness tests

As mentioned in section 5.4, the transaction costs are assumed to be 0% in the market timing model. Graham (2003) states that the median transaction cost is 2%. This number will be applied in this section to test whether the market timing model would work in real markets. The results are presented in table 4 combined. The first two rows are the two benchmark indices and then the return on the investment strategy based on the Finnish, Swedish, German yield spread respectively. United States term spread is excluded from the table to save space since the model did not generate abnormal returns in either approaches on any probability screening. Each country's term spread is represented on two areas, first being the definition of Liu et al. (2004) of stock market recessions and the second being the OECD recession indicators as the dependent variable. The transaction costs are applied in a simple manner. For every switch from stocks to bonds or vice versa, a 2% cost is appointed for the switch. This declines the total value of the investment by 2%

	Stock Index Recession Indicator			OECD Recession indicator				
Probability Screening	**5 %**	**10 %**	**15 %**	**40 %**	**45 %**	**50 %**	**55 %**	**60 %**
Fin_Ind	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %	6,921 %
Fin_3m Government Bond	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %	4,409 %
Fin_Sprd Original	6,576 %	**9,329 %**	6,832 %	**10,734 %**	**12,908 %**	**13,731 %**	**13,470 %**	**12,658 %**
Switches 1987-2017	7	10	4	21	29	16	22	10
Fin_Sprd Transaction costs	6,070 %	**8,589 %**	6,542 %	**9,166 %**	**10,706 %**	**12,502 %**	**11,788 %**	**11,895 %**
Swe_Sprd Original	**7,601 %**	**7,969 %**	5,930 %	**13,190 %**	**13,741 %**	**12,076 %**	**12,955 %**	**13,383 %**
Switches 1987-2017	13	6	4	28	26	22	14	18
Swe_Sprd Transaction cost	6,655 %	**7,530 %**	5,643 %	**11,058 %**	**11,750 %**	**10,414 %**	**11,886 %**	**12,006 %**
Ger_Sprd Original	**7,981 %**	**8,793 %**	**6,921 %**	**12,864 %**	**13,557 %**	**11,305 %**	**11,860 %**	**10,406 %**
Switches 1987-2017	15	14	0	15	19	16	14	6
Ger_Sprd Transaction costs	6,887 %	**7,764 %**	**6,921 %**	**11,720 %**	**12,101 %**	**10,103 %**	**10,802 %**	**9,957 %**

Table 4 Market timing model adjusted for transaction costs.

The insignificant probability screenings from the two approaches in previous sections are excluded in table 4 to summarize the most significant findings. The probability screenings 5%-15% are included with stock market recession approach and 40%-60% are included from the OECD recession indicator based estimations. United States term spread benefited no investors in the Finnish stock market and is therefore excluded. The total amounts of switches are relatively high in some probability screenings, however, the overall yearly average returns do not decrease enough to even become near the benchmark index returns. For the OECD indicator approach, the number of switches is relatively high with over 20 switches during the sample period for Finnish and Swedish yield spread models.

The market timing model preforms well with stock market recession approach in probability screening 10% and is not able to benefit investors at any other probability screening when transaction costs are applied, thus making it relatively difficult to profit with the strategy in real markets in the future. The OECD recession indicator market timing model performs well with every country's term spread regardless of probability screening. Even though the sum of switches during the sample period is quite high in some cases, the returns of the investment strategy stay well above the benchmark index. The best performing probability screenings are yet again 45% and 50%. The Finnish and Swedish yield spread approaches generate over 20 switches during the sample period across the board. The German yield spread model generates 15-19 switches at many probability screenings, the 60% level being lower at 6 switches. The 60% probability screening level still is able to generate 9,96% average yearly returns with minimal changes. The OECD recession indicators turn out to be very useful to be used as a predictor of future recessions in the Finnish stock market. The finding enforces the view that stock market returns follow somewhat the path of real economy.

7. CONCLUSIONS

The historical predictive power of the term structure of interest rates both to the real economy recessions and stock market recessions is the main point of interest in this thesis. The yield curve has been able to produce signals before every major recession from 1960s to today. Therefore, an investor is able to exploit this relationship from seemingly unrelated statistics and generate abnormal returns with it. (Estrella et al. 1996, Liu et al. 2004)

This thesis researches the interconnection between Finland and its close economical partners. The main research question is whether abnormal returns can be generated based on recession indicators generated by sheer stock market index numbers or recession statistics ruled by the Organisation for Economic Co-Operation and Development (OECD). The original discoveries made regarding this subject can be attributed to Estrella & Mishkin (1996) and Liu et al. (2004). The former test the subject with economic recessions and the latter further develop the idea to predict stock market recessions in foreign countries. Both of these ideas are utilised to research the possibility of generating abnormal returns in the Finnish stock market both by estimating the effect through Finland's own yield spread and the foreign yield spreads from Sweden, Germany and United States.

The countries in the base study of Liu et al. (2004) benefit from using the United States yield spread as the independent variable in the market timing model. These countries' stock markets have enough correlation over the United States yield curve that it is possible to predict downturns in the stock market and thus generate abnormal returns based on only the yield spread value of the United States. However, Sweden did not experience this phenomenon, and that fact motivated this thesis. The question is expanded to account for more than only United States yield curve as the predictor of recessions in the Finnish stock market with German and Swedish yield curves. The results from the perspective of a Finnish investor are somewhat anticipated, somewhat surprising.

The first section of the empirical research section tests the approach of using the stock market index data to assign binary variables for different periods. This approach generates significantly smaller probability forecasts across the board. Regardless of the low probability forecasts, the model is able to generate abnormal returns consistently compared to the benchmark Finnish stock market index with Finnish, Swedish and

German yield spreads as the independent variables. Utilising the probit model with United States yield spread, however did not perform well.

Similar phenomenon happens when utilising the OECD recession indicators as the dependent variable in the probit model. The probability forecasts were significantly higher and had more variation. With this approach the abnormal returns increased sharply in models with Finnish, Swedish and German yield spreads as the independent variables. Yet again, the Finnish stock market experiences no predictive benefit from utilising the United States yield spread. Probability screenings that are higher than those of Liu et al. (2004) are useful to generate abnormal returns in the Finnish stock market. Each time that the probit model produces a probability forecast of 50% or higher that there will be a recession in the following month, the position will be switched from stocks to bonds. This probability screening gave the best results across the sample countries. Overall, the market timing model with Finnish stock market recession indicators as dependent variable is consistent with 10% probability screening for Finnish, Swedish and German yield spreads. The model with OECD recession indicators generates consistently abnormal returns at probability screenings 45% and 50% for Finnish, Swedish and German yield spreads. Therefore, hypotheses 1, 3 and 4 remain and hypothesis 2 is rejected, due to the fact that United States yield spread offers no additional returns.

The results give additional information of the connections of broader economy to the Finnish stock market. The OECD recession chronology considers real-economy factors such as GDP and unemployment as determining factors of the peaks and troughs. Even though the indicators are determined by the real business cycle the stock market seems to follow the real economy with its declines to some extent. The stock market returns are higher when utilising the investment strategy based on the yield spreads from Finland, Sweden and Germany. This connection to the geographically and economically close countries in the European Union might help an investor predict future recessions in the region and perhaps profit from this phenomenon.

Adding transaction costs for robustness makes no significant difference in the results. Even though the OECD-Finnish Yield Spread model had at most 29 switches between asset classes, the returns did not fall below. When using Swedish yield spread, there are only 2 switches during the complete sample period 1987-2017 and the model is still able to almost double the yearly profits

A possible point of future research would certainly be the approach of ex-ante estimations. The results presented here only work this particular data period, and thus

expanding the strategy would be more beneficial for investors today. This development could be done by modifying the probit model to have a rolling window that is utilised when forecasting the recessions. Furthermore, an expansion of this approach to the connections of Nordic countries might produce interesting future research topics.

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