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Preliminary Master Thesis

Using the interest rate term spread as a means to predict stock market returns

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Content

1 Introduction

The relationship between interest rate term spread and economic growth has been thoroughly studied in the past. Inspired by the article “Rentekurven som ledende indikator” (the yield curve as leading indicator) by Stein Svalestad (2011), we took interest in this subject that investigates the relationship between the yield curve and real economic growth. As much research has been done on the ability to make excess returns by active stock picking, and the popularity of index investing is rising, we rather wish to investigate the ability to predict asset class performance. In our master thesis, we will examine the relationship between interest rate term spread and real GDP growth further and build an investment strategy using the interest rate term spread to time positions in the stock market and find whether such a strategy can provide excess returns relative to passive exposure in stock market indices (“beating the market”).

The idea behind our hypothesis is that growth in the real GDP results in positive stock market returns and vice versa, so that if the fixed income markets are useful predictors for economic growth, we can also use the same information to predict future stock market returns. If our working hypothesis is true, we can possibly argue against the efficient market hypothesis, as we are able to use public interest rates to make excess returns by timing stock market exposure. Svalestads (2011) empirical model shows that there was a statistically significant relationship between the interest rate term spread and the real GDP growth in the period 1985-2010 in Norway. Then he implements a simple portfolio strategy where you invest in the stock market (using Oslo Børs Benchmark Index) when long-term interest rates are higher than short-term, and invest in the money market if not. This model gave more than six times the accumulated return of being passively invested in the stock market during the period, largely due to not being exposed to the stock market during its heaviest declines (e.g. the dot-com bubble and the financial crisis of 2007 – 2008).

We wish to see if we can replicate the same findings in Norway, and also apply the same model to some of the largest stock market indices to see if the results are consistent. The indices must be geographically limited because our proxies for interest rates and the stock market must all belong to the same economic market.

2 Literature review

The yield curve spread (yield spread) as an indicator of economic growth has been widely researched over the past 50 years. Much research has been done using long-term (10-year) Treasury Bonds (government-backed debt obligations) and short-term (3-month) Treasury Bills (T-Bills) in the United States and other OECD countries. The spread in the yield curve is the difference between the yield of the 10-year bond and the 3-month bill. The spread has been found to contain information that is helpful to predict macro-economic factors such as output growth, inflation, industrial production, consumption and recessions. The yield spread's forecasting ability is considered a stylized fact by many macroeconomists (Wheelock & Wohar, 2009).

Several different researchers have tried to establish a horizon for the forecasting ability of the yield spread. Research conducted by Estrella and Hardouvelis (1991) found that the spread could predict the cumulative real outputs for four years into the future and marginal real outputs for one and a half years. Later, Estrella and Mishkin (1998) found that the yield spread outperforms other predictive variables in a one-on-one comparison for horizons beyond one quarter. Gerlach and Bernard (1998) found that the yield spread could predict recessions for up to two years in several European and North-American countries. Other researchers find the predicting ability to range from one quarter to three years into the future. Most research are empirical studies to find *if* the yield spread has forecasting abilities, with little concern for *why* it is able to perform so well.

Researchers has not agreed upon a theory for *why* the yield spread is a good predictor for the economic cycle, the phenomenon is referred to as a *"stylized fact in search of a theorem"* (Benati & Goodhart, 2008). Estrella and Hardouvelis (1991) conclude that historically, the spread has shown predictive ability for the future macro-economic direction and could be beneficial as an economic predicator not only for private investors but also for the Federal Reserve, as it reflects factors which are not controlled by the monetary authorities. However, they noted that it is unclear how well the spread could predict the economic growth in the future, especially if the monetary authorities adopted it as a leading indicator. This is due to the uncertainty in whether the historical correlation is policy invariant. Recent studies find that the predictive ability of the spread has declined since the middle of the 1980's (Wheelock & Wohar, 2009).

3 Theoretical framework

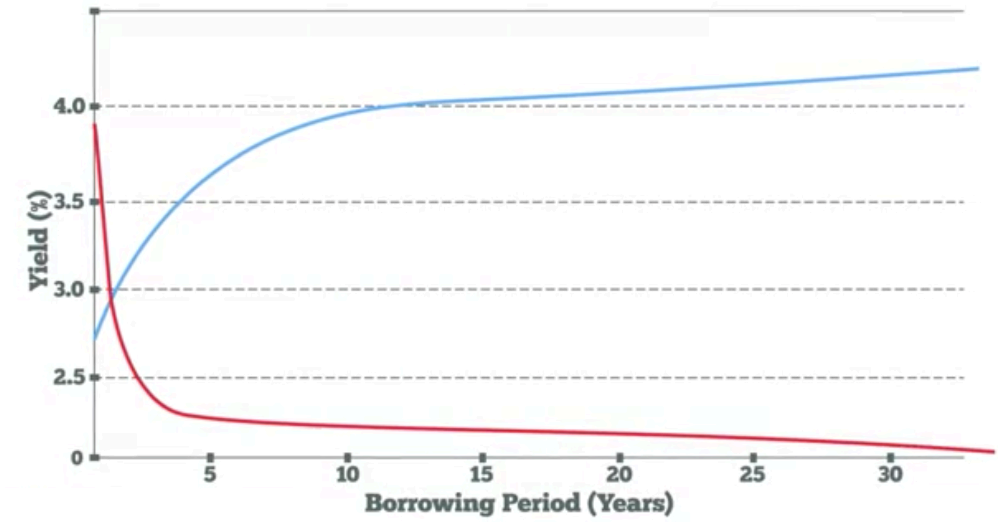
As described in Chapter 2, much research has been conducted on the predictive ability of the yield spread on the future macroeconomic situation. Less research has been done directly on the yield spreads ability to forecast the stock market. This is valuable information for private and institutional investors, which may help forecast the future market performance.

Stein Svalestad (2011) conducted an analysis of the performance of a portfolio invested in the Norwegian stock market (OSEBX) in periods with positive yield spread, and invested in short-term NIBOR (3-month) in periods with negative yield spread. He found that the cumulative profit would be over six times the return of a passively managed portfolio over the period from 1985 – 2010. We have not been able to find extensive research beyond Svalestad's article on this field.

3.1 Term structure of interest rates

Important for this thesis is the term structure of interest rates. The term structure of interest rates is the relationship between the yield to maturity for bonds with different time to maturity. The normal term structure of interest rates is an upward sloping yield curve implying that long-term bonds yield higher interest rates than shorter term bonds. The opposite is an inverted yield curve with a downward sloping trend. This occurs when the short-term interest rate is higher than the long-term interest rate and is usually interpreted as a sign of an imminent recession.

Plot 1: Term Structure of Interest Rates



Plot 1: Term structure of interest rates with yield to maturity on the Y-axis and time to maturity on the X-axis. The blue graph shows a normal yield curve and the red graph shows an inverted yield curve.

To explain the term structure of interest rates we have the Expectations Hypothesis and the Liquidity Preference Theory, which we will describe in the following subchapters.

3.2 Expectations Hypothesis

The Expectations Hypothesis states that the forward interest rates equal the market's expectations to the future interest spot rates. Under the assumption of no arbitrage and no liquidity premium, the long-term interest rate equals the short-term interest spot rate and all forward interest rates required to cover the period of the long-term interest rate, as shown in equation [1]:

$$(1+r_n)^n = (1+r_{n-k})^{n-k} * (1+ {}_{n-k}r_n)^k \qquad [1]$$

r_n *spot rate for period 0 – n (long-term)*

r_{n-k} *spot rate for period 0 – n-k (short-term)*

${}_{n-k}r_n$ *forward rate for period n-k – n (short-term)*

If the forward interest rate is equal to the expected future spot rate and the Expectation Hypothesis holds, we can use the yield curve to make predictions on the market's expectations to future economic states. Under the Expectations Hypothesis, high long-term rates and low current short-term spot rates must be compensated by high expedited future spot rates. This indicates market expectations of future economic growth. Similarly, low long-term rates and high current short-term spot rates, indicates that the market expects a recession in the near future.

Both nominal and real term structures can be applied in the formula. Applying real interest rates may give indications on the expected inflation in the near future. Much of the research done on this area is using the nominal term structure. Wheelock and Wohar (2009) argue that under fiat monetary regimes (money not being backed by a commodity) inflation tends to be persistent, meaning that shocks to the inflation tends to shift the expected inflation equally over all time horizons. In research done under these persistent inflations, empirical evidence pertains nominal interest rates rather than real interest rates.

Furthermore, the stock market data are given in nominal terms. Based on these arguments we will be using nominal terms in our thesis rather than real terms.

3.3 Liquidity Preference Theory

The Liquidity Preference Theory states that long-term investors will not invest in short-term bonds unless the forward rate is higher than the expected future spot rate. Furthermore, short-term investors will not invest in long-term bonds unless the forward rate is higher than the expected future spot rate. Supporters of the Liquidity Preference Theory claims there are more short-term investors than long-term investors and empirical evidence shows that the forward short-term rate typically overestimate the subsequent short-term spot rate (Kessel, 1971). The forward rate minus expected spot rate is the liquidity premium. The same relationship holds as in equation [1], however, now the ${}_{n-k}r_n$ -term consists of expected future spot rate plus the liquidity premium, which increases the long-term spot rate.

Kessel (1971) studied T-Bills price behavior over the period 1959 – 1962, which spans one complete economic cycle to conduct his analysis. He concludes that the term structure of interest rates builds upon both the Expectations Hypothesis and the Liquidity Preference Theory. When adjusting the prices for the risk premium he finds that the Expectations Hypothesis does a good job in predicting the short-term interest rates for up to one year ahead.

3.4 Theories to why the relationship holds

The predictive ability of the yield spread on future economic growth or recessions has been thoroughly investigated and economists widely agree that there exists a relationship between the spread and the future state of the economy. However, there is no consensus to why the relationship exists. There are two major explanations to why the spread is able to predict the growth in the economy (Bjønnes, Isachsen & Stoknes, 1998). Both explanations assume that the Expectation Hypothesis holds.

3.4.1 Theory 1

The first theory assumes that the yield curve is primarily driven by the monetary policy. We assume that strict monetary policies work contractive on the real growth in the economy. If the monetary authorities raise the key policy rate, this will impact short-term interest rates, which will increase. However, strict monetary policies are assumed to be temporary and will not affect the long-term interest rate at the same scale. The result is a less steep or even inverted yield curve. Implications of this are that the yield spread predicts the real growth in the economy.

3.4.2 Theory 2

The other theory assumes that the yield spread reflects the market expectations to growth in GDP (Svalestad, 2011). When the economy is facing times of expansion, there are more growth opportunities and more projects with positive NPV's. In this situation corporations will undertake more investments financed by debt. These investments have a long time horizon and the corporations will issue long-term debt. With an increase in the supply of long-term debt the bond prize will fall, resulting in a steeper yield curve. Here we can assume that the market also expects the monetary authorities to increase the key policy rate, resulting in an even steeper yield curve.

3.5 Market Efficiency Theory

The Market Efficiency Theory states that stock prices reflect all publicly available and relevant available information at any given time. According to theory all stocks trade at a fair market value. As changes in the stock prices will only move after new and unpredictable news, the theory claims that no investor is able to consistently beat the market. Under the market efficiency theory stock prices are unpredictable and follow a random walk. With this argument, the optimal choice for a long-term investor is to invest in market indices providing a well-diversified portfolio without exposure to idiosyncratic risk.

In this thesis, we try to exploit the yield spread to create long-term excess returns and effectively beating the market. If we succeed in finding a strategy which is able to provide us with such excess returns, we have evidence against the market efficiency theory and we can prove that the stock market do not reflect all publicly available information.

3.6 Time horizon of long- and short-term interest rates

Most research on the field has been conducted using 3-month bills as short-term interest rates and 10-year bonds as long-term interest rate. We aim to use 10-year government bonds and 3-months LIBOR/NIBOR rates. This keeps the time horizon of interest rates consistent with standard time horizons in previous research. The NIBOR/LIBOR is the closest substitute to a 3-month bill we can obtain and is justifiable with theory (Kozicki, 1997). Even for the economies where the government issues 3-month debt we will stick to the LIBOR to keep the research consistent. In addition we can argue that the LIBOR is a better proxy for the market expectations to real growth as it takes into account more risk factors than government debt, and can provide useful information in our signals. Hence, the Interbank Offered Rates may be more volatile and may give better predictions for the stock market.

4 Methodology

4.1 The interest rate term spread

In order to perform an analysis on the predictive power of the interest rate term spread on the stock market, we will create a dummy variable describing the term spread, using the key parameters r_L (long-term interest rate) and r_S (short-term interest rate). Note that only the current spread in each period is relevant, and the slope of the yield curves are not taken into account in any way, i.e. we only care about the yield curve being normal or inverted, the size of the spread does not matter.

The interest rate term spread in period *t* is then given by equation [2]:

$$r_{L,t} - r_{S,t} = SPREAD_t \tag{2}$$

Using a dummy variable *d*, all periods with a *positive spread* ($r_{L,t} > r_{S,t}$) will be assigned a value of d = 1, while periods with a *negative spread* ($r_{L,t} < r_{S,t}$) will be assigned a value of d = 0. Our next task will be to investigate whether the dummy variable can explain statistically significant differences in average returns in the stock market and thus be used as a timing signal for asset reallocation.

4.2 The Asset Allocation Model

Using the dummy variable *d* obtained from the interest rate term spread, we will employ the model empirically in several stock market indices to test for statistically significant differences in average returns depending on *d*. Hence, we will compare two strategies; (1) a passive stock market index investing strategy, and (2) the asset allocation model (AAM), where all capital is invested in the stock market in positive spread periods and all capital is invested in the money market in negative spread periods.

Model (2) is the model that we are going to study and discuss further, while (1) is simply the return of the market, and a passive strategy that we need to include for comparison purposes. Is the return of the asset allocation model able to outperform the return of the stock market?

The difference in average returns in positive spread periods and negative spread periods is interesting, but does not really tell much about the performance of the model in itself. What would be of greatest importance to investors is the cumulative return of the AAM compared to the cumulative return of passive index investing, and hence, if the difference in cumulative returns between investing in the stock market or in the money market in each period can be explained by the interest rate term spread. Investors would always prefer to invest in the highest yielding asset in any investment period to obtain the highest possible cumulative returns, and the question is if the spread can predict which asset will yield the highest returns in the future.

4.3 Analysis

Each investment period *p* is the period from one change in the dummy variable to the next. We obtain investment periods of various lengths, where periods of d = 1 signals investment in the stock market, and periods of d = 0 signals investment in the money market.

Then we calculate the returns of investing in the stock market versus investing in the money market in each period to obtain a difference

$$r_{stock,p} - r_{debt,p} = \alpha_p \,, \tag{3}$$

where, in period p:

$r_{stock,\,p}$ = stock market return

$r_{debt,\,p}$ = money market return

α_p = difference in return between stock market and money market

Investors clearly want to invest in the stock market in every period t with a *positive* α, and rather invest in the fixed income market in every period with a *negative* α. What we want to investigate is if our dummy variable *d* can explain the differences in α.

4.4 Pseudo out-of-sample test

In order to say anything about the predictability of the model, a Pseudo out-of-sample test can be used.

Signal changes (long-term interest rate crossing the short-term interest rate) often occur with monthly or yearly intervals, and the out-of-sample test should therefore optimally also be over a longer period of time. This requires collection of data for a long period of time in order to have enough data to both fit a regression and test the regression out-of-sample.

5 Data

5.1 Input data

We will test the same model in several economies in order to see if our results are consistent. We will employ the model in the economies of Norway, United States, Japan and United Kingdom, and the chosen long- and short-term interest rates, and stock indices are summarized in the table below.

Table 1: Long- and short-term interest rates and stock indices

Norway	Long-term interest rate: Norway 10Y Government Bond Short-term interest rate: NIBOR 3M Stock index: OSEBX
United States	Long-term interest rate: US 10Y Government Bond Short-term interest rate: USD LIBOR 3M Stock index: S&P 500
Japan	Long-term interest rate: Japan 10Y Government Bond Short-term interest rate: JPY LIBOR 3M Stock index: Nikkei 225
United Kingdom	Long-term interest rate: UK 10Y Government Bond Short-term interest rate: GBP LIBOR 3M Stock index: FTSE 100

For long-term interest rates, we have chosen to use the 10-year government bond for each respective country, the main standard benchmark for long-term interest rates in literature. The choice of short-term interest rates is not just as given, as we have several possible usable proxies in the different economies. A question is whether we want to use T-Bills or LIBOR (NIBOR). The LIBOR is a benchmark rate for lending between banks, and is quoted in all our relevant currencies. The spread between T-Bills and LIBOR is called the TED spread, and is argued to be an indicator of trust in the banking sector, as the spread between these can be interpreted as the risk premium of lending to banks relative to lending to the government, which is normally considered to be the least risky borrower in the economy. Due to this implication, we choose to use the Interbank Offered Rates (LIBOR/NIBOR) as they incorporate this risk premium in our signals.

5.2 Investment options

When investing in the stock market (d = 1), we use the stock indices as mentioned in the previous paragraph.

In the d = 0 periods we wish to invest in the money market in hopes of yielding higher returns than the stock market provides, primarily by avoiding future recessions. We have considered several investment opportunities possible for these periods. Available options for an investor are for example money market funds, bank savings accounts eventually government debt obligations. Money market funds life spans are rarely long enough to cover the time horizon for our research and will thus not provide sufficient data in our research. Banks' historical savings account rates are not publicly available and rates often differ significantly, both between banks and due to demands and limitations incorporated in different products. Hence, it is not suitable in our research. 3-month government bills are available in some countries, but not all, and would therefore be inconsistent across the countries that we investigate.

The 3-month LIBOR/NIBOR gives us a realistic market proxy of the risk-free interest rate available to investors. These data are publicly available, can be obtained for long periods of time, and is the same as the data we use for short-term interest rates in our signals. To keep the consistency throughout the research we stick to the LIBOR also in economies where 3-month government bills are available.

5.3 Data collection

The data we need are easily obtainable public information, and can be downloaded from databases such as Bloomberg or Thomson Reuters. We want to collect data as far back in time as possible, and might therefore choose other similar proxies if expedient (for example choose another correlating stock index if more data is available).

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