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MARKET TIMING USING STOCK-BOND CORRELATION

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TABLE OF CONTENTS

| | |
|--|-----------|
| 1. INTRODUCTION | 9 |
| 1.1. Introduction to the topic | 9 |
| 1.2. Purpose & Motivation of the Study | 10 |
| 1.3. Hypotheses | 10 |
| 1.4. Contribution & Limitations | 11 |
| 1.4.1. Limitations | 11 |
| 1.4.2. Practical Contributions | 11 |
| 1.4.3. Theoretical Contributions | 12 |
| 1.5. Structure of the Study | 12 |
| | |
| 2. PREVIOUS LITERATURE | 13 |
| 2.1. Stock-Bond Correlation | 13 |
| 2.2. Bond-Equity Yield Ratio (BEYR) | 21 |
| | |
| 3. THEORETICAL BACKGROUND | 25 |
| 3.1. Portfolio Theory and the C.A.P.M | 25 |
| 3.2. Stock Characteristics | 27 |
| 3.2.1. Stock Price Prediction | 27 |
| 3.2.2. Stock Price Movement | 29 |
| 3.3. Bonds | 31 |
| 3.3.1. Treasury Bonds | 31 |
| 3.3.2. Corporate Bonds | 32 |
| 3.3.3. Safe Haven | 33 |
| 3.4. Stock-Bond Correlation & Co-Movement | 34 |
| 3.5. Bond-Equity Yield Ratio (BEYR) | 35 |
| 3.6. Market Indicators | 36 |
| | |
| 4. DATA & METHODOLOGY | 38 |
| 4.1. Data Description | 38 |
| 4.1.1. United States Treasury Bonds | 39 |
| 4.1.2. United States Corporate Bonds | 40 |
| 4.1.3. United States Stock Market Proxy: The Standard & Poor's 500 | 42 |
| 4.1.4. High Beta Index | 43 |

| | |
|---|-----------|
| 4.1.5. Low Beta Index | 45 |
| 4.2. Hypothesis & Expected Results | 46 |
| 4.3. Methodology | 48 |
| 5. EMPIRICAL RESEARCH & RESULTS | 52 |
| 5.1. Correlations Between Asset Classes | 52 |
| 5.2. Results for the market timing strategy. Evidence: SP500 | 55 |
| 5.3. Results for the effect of beta on the market timing strategy | 57 |
| 5.4. Results for the predicting ability of the stock-bond correlation | 60 |
| 6. CONCLUSIONS | 64 |
| 6.1. Conclusions | 64 |
| 6.2. Ideas for further research | 67 |
| 7. REFERENCES | 69 |

LIST OF FIGURES AND TABLES

FIGURES

| | |
|---|----|
| Figure 1. Annual Log Returns of indices sorted by beta. | 31 |
| Figure 2. Treasury Bond Index. | 40 |
| Figure 3. Treasury Bond Returns. | 40 |
| Figure 4. Corporate Bond Index. | 41 |
| Figure 5. Corporate Bond Returns. | 42 |
| Figure 6. SP500 Index. | 43 |
| Figure 7. SP500 Returns. | 43 |
| Figure 8. High Beta Index. | 44 |
| Figure 9. High Beta Returns. | 45 |
| Figure 10. Low Beta Index. | 46 |
| Figure 11. Low Beta Returns. | 46 |
| Figure 12. Rolling Correlations Between the Indices. | 54 |
| Figure 13. Active Strategy with SP500. | 56 |
| Figure 14. Active Strategy with Low Beta. | 58 |
| Figure 15. Active Strategy with High Beta. | 59 |
| Figure 16. Active Strategy with Corporate Bonds. | 60 |

TABLES

| | |
|--|----|
| Table 1. Asset Beta. | 27 |
| Table 2. Data statistics. | 39 |
| Table 3. Average Correlations Between the Indices. | 53 |
| Table 4. Percentage of negative correlations. | 55 |
| Table 5. SP500. | 56 |
| Table 6. Low Beta. | 57 |
| Table 7. High Beta. | 58 |
| Table 8. Corporate Bonds. | 59 |
| Table 9. SP500 with one-month lag. | 61 |
| Table 10. SP500 no lag. | 61 |
| Table 11. Low beta with one month lag. | 61 |
| Table 12. Low beta no lag. | 62 |
| Table 13. High beta with one month lag. | 62 |
| Table 14. High beta no lag. | 62 |
| Table 15. Corporate bonds with one month lag. | 63 |
| Table 16. Corporate bonds no lag. | 63 |

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ABSTRACT

The objective of the thesis is to study the market timing capabilities of the stock-bond correlation. Stock-bond correlation is a similar figure as BEYR, which is actively used in investing. Stocks and bonds are the most used financial instruments and their correlation measures their co-movement in a single figure. It would greatly benefit investors if this simple figure could be used as a guide in investing, in a similar way as BEYR is being used.

The study included the SP500, low beta, high beta and corporate bond –indices and the timeframe is from 2006 to 2015. The methods used first test whether the stock-bond correlation works in timing the market and if the index beta affects this result. This is done with a strategy where extreme negative values of stock-bond correlation mark the switch from stocks to bonds. Secondly, an OLS regression is used to test if stock-bond correlation can predict stock returns and work as a market indicator.

The results for the market timing capabilities are mixed. For corporate bonds, the active strategy using the stock-bond correlation beats the passive buy-and-hold strategy, which was the objective. For the other indices the passive strategies outperform the active ones, when observed during the entire investment period. The results for the regressions show that the correlation works in predicting corporate bond returns, but does not predict returns for any of the stock market indices.

KEYWORDS: Stock-bond correlation, investment strategy, market timing, stock market indices, active strategies

1. INTRODUCTION

1.1. Introduction to the topic

We are often told about the power of the typical buy-and-hold strategy, by the amount one dollar invested a long time ago has grown up over the years. Yet it could be so much more, if the investor was able to avoid the biggest crashes of the stock exchange or even make profit during them. The most usual tip given by stockowners is: “Buy low and sell high”, which is in its simplicity a great challenge. On the long run stock returns tend to be positive, but on a daily, monthly or annual basis they tend to vary a lot. An investor, at least a sophisticated one, wants to avoid these downward swings in asset values by including both stocks and bonds in their portfolio, in order to minimize risk on a certain level of expected return (Markovitz 1952).

The two most commonly traded assets on the markets are stocks and bonds. Their co-movement, measured by correlation, tells us how much one is expected to appreciate or decrease when the other asset's price changes. This knowledge is vital for an investor trying to minimize his portfolio's variance or when he is trying to find a hedge.

Traditionally, stocks have been viewed as a risky investment; capable of high returns, but delicate during market turmoil, while bonds are usually thought as a safe, low-yielding investments, which offer returns close to bank deposits. Older research depicted their co-movement, correlation, as stable, positive and weak. However, recent research has shown that their relationship is time variant. Usually, stock and bond prices tend to move to the same direction, but there are times when this correlation turns negative. (Andersson, Krylova & Vähämaa 2008.)

The fact that stock-bond correlation is time variant and capable of changing from positive to negative presents this thesis with its main motivation and most importantly offers investors a new tool to manage their portfolio more efficiently. This thesis attempts to find a convenient way of using the stock-bond correlation as an investment tool in actively managing a portfolio. We will solve a rolling correlation between the asset classes to find out how the correlation changes through time. After obtaining a time series of the correlations, we will regress the stock returns on the correlations, in order to find out the answer to the most important question of the thesis: how can the stock-bond correlation be used as an indicator and investment tool.

A further point of interest for the thesis is if the stock-bond correlation works as a leading or simultaneous indicator. A leading indicator would signal a change in asset prices beforehand and a simultaneous indicator would signal coincidentally with the price change. As another extension to the study, we will include indices of high and low beta stocks and corporate bonds, in addition to the SP500, which will all be compared to treasury bonds, which are considered as benchmark for the risk-free investment. While all of the asset classes are alike, they still have different characteristics and price movements and thus it is interesting to observe them separately.

The expected results for the study are threefold. Firstly, all four asset classes are expected to correlate positively with treasury bonds during normal times and turn in to negative correlation during times of stock market turmoil. The correlation with the high beta stocks is expected to change most significantly. Secondly, the relationship between the stock-bond correlation and asset prices is expected to move hand-in-hand. During good times the correlation tends to be positive and turn negative when stock prices decrease. This is consistent with the flight-to-quality phenomena (Andersson, Krylova & Vähämaa 2008). Thirdly, stock-bond correlation can be expected to be a leading indicator. Bonds get investments due to flight-to-quality, before large scale stock market crashes.

1.2. Purpose & Motivation of the Study

The purpose of the study is to investigate the stock-bond correlation as a tool for investors. Its appeal comes from its simplicity: a single figure with easy interpretation. As stocks and bonds make an overwhelming majority in most investors' portfolios, understanding their dynamics is important for every player on the market and motivates me for studying the subject. By studying the stock-bond correlation, revealing new information and making it known, the possibility of helping many investors is the greatest motivation possible. Also understanding more about how the markets work and how very different assets, stocks and bonds, co-move is both interesting and rewarding.

1.3. Hypotheses

The thesis has three hypotheses, chosen to accurately and thoroughly investigate the investing capabilities that stock-bond correlation may offer investors. The first

hypothesis is that stock-bond correlation can be used as a profitable investment strategy by investing in equity when the stock-bond correlation is “normal” and selling equity and shifting investments to bonds during extreme values of the stock-bond correlation. The second hypothesis is that the beta of stocks, in other words the riskiness of assets, has an effect on the outcome of the strategy introduced in hypothesis 1. High beta, low beta and corporate bond indices are assumed to work differently than the market index. The third and final hypothesis of the thesis is about the predicting power of stock-bond correlation. According to the hypothesis 3, stock-bond correlation can be used as a market indicator. All the hypotheses will be derived in chapters where they are closely related to and presented in a group in chapter 4.2.

1.4. Contribution & Limitations

1.4.1. Limitations

The most notable limitation of the study arises through its biggest contribution: By extending the thesis to include indices of high and low beta stocks, we have to limit the time frame of the observations, due to available data. Data for all five indices used was only available from the past decade so the study will focus on the most present years. Longer time frame would have given a more valid study because it would have included more market swings. Data from the last years is valid for the purpose of this thesis; the stock and bond markets have moved considerably during the past ten years and will therefore give the thesis the required data to draw conclusions.

1.4.2. Practical Contributions

The practical contributions of the thesis are risk management, asset allocation and market timing tools for investors. Andersson, Krylova and Vähämaa (2008) note that the co-movements between stocks and bonds directly affect the decisions behind asset allocation and risk management. Investigating the stock-bond correlation gives investors a relatively simple way to time the market and predict future movements, which is essentially what every investor yearns for.

1.4.3. Theoretical Contributions

The theoretical contributions of this thesis are extending the literature on stock-bond correlation. The topic has been studied extensively in recent years, but most of the studies on it have focused on either of the two: what causes the correlation change and how it has changed. This thesis focuses more on how to benefit from the changes and thus brings something new to the current level of research.

1.5. Structure of the Study

The remainder of the thesis is structured in a following way. Chapter 2 contains the previous literature centered around this field of study. It is built up around the studies focusing on the nature and determinants of stock-bond correlation and those associated in investing with the BEYR-ratio. This study contains something of a mix of the two fields, so they make up a suitable previous literature -section.

Chapter 3 is made up of the theoretical background for this thesis. Both stocks and bonds are covered in this chapter, with the focus on asset pricing, price prediction and different kinds of stock and bond instruments. The rest of the chapter includes stock theory behind stock-bond correlation, bond-equity yield ratio and market indicators.

Chapter 4 contains a summary about the data used. As the thesis focuses on 5 different indices, each of the indices is introduced in chapter 4. The second part of the chapter focuses on the hypotheses. The hypotheses are introduced before this point, but it is in chapter 4 when we go through them in more detail. The third and final section of chapter 4 contains the methodology; how we we will test our hypotheses.

Chapter 5 contains the empirical results achieved with our methodology and further on, their implications to investors, while Chapter 6 concludes the study with most important remarks and ideas for further research.

2. PREVIOUS LITERATURE

The previous literature behind our topic can be roughly divided into two major fields of research: studies examining stock-bond correlation and studies about investing using the BEYR-ratio as a tool. In this section, we will cover the most prominent research articles from both of the subtopics, since they play an important part behind our research.

2.1. Stock-Bond Correlation

The relationship between stock and bond returns has received increasing interest starting in the early 1990's. Shiller and Belratti (1992) conduct a research of the relationship between stock prices and long-term interest rates and of the relationship between stock and bond market excess returns in the United States and United Kingdom, using a data sample ranging from the late 1940's until the late 1980's. Their results reveal surprisingly strong correlations between the asset classes. Negative correlations for the stock prices and interest rates (-0,4 for United States and -0,6 for the United Kingdom) and positive correlations for excess stock and bond returns (0,4 for United States and 0,6 for the United Kingdom). Based on their present value formulas, they expected correlations with similar signs (negative for prices and interest rates and positive for returns), but with a significantly smaller scale. The results were robust for both long- and short-term horizons. Shiller and Belratti (1992) argue that since stock prices are affected by discount rates, which are influenced by the risk-free rate, or equivalently the yield of the government bonds, the correlation is caused by either overreaction to changes in long-term yields or overreaction due to inflation, which is affecting the rates also. They find inflation's effect to be diminishingly small for changes in stock prices and also small for bonds. Thus they conclude that the discount rate is the driving force behind the correlation between stocks and bonds, which is larger than expected.

Campbell and Ammer (1993) find a positive, yet very low correlation for stock and bond returns in the United States, with a similar time frame as Shiller and Belratti (1992). The study pointed out three factors why the correlation with the two asset classes remains low. Firstly, they argue that the only factor affecting the returns of both stocks and bonds is the real interest rate, and since it varies only to some extent, the correlation remains low and stable. Secondly, the excess returns for both asset classes

seem to be correlated strongly, but as excess returns is not a major part of bond returns, this factor doesn't create a strong correlation between the returns of stocks and bonds. Thirdly they find that stocks and bonds react differently to a change in expected inflation, which tends to drive the stock market up and the bond market in an opposite direction, thus creating negative correlation and partially offsetting the positive correlation created by similar reactions to interest rates, which were mentioned previously.

Both Shiller and Beltratti (1992) and Campbell and Ammer (1993) find a positive, weak and stable correlation between stock and bond returns. If not breathtaking, their research was at least pioneering work, which was later continued and extended by several other researchers.

Ilmanen (2003) investigates stock and bond returns, correlation changes and especially the drivers behind the change in the correlation between stocks and bonds. Unlike the studies previously mentioned, Ilmanen finds out that the correlation has hardly been stable. It has mostly remained positive, but has turned negative for three prolonged periods in the last century. He finds out that negative correlation occurs simultaneously with decoupling returns for stocks and bonds, which intuitively makes sense. He states that different directions for stock and bond markets are an immediate factor affecting the stock-bond correlation becoming negative, for example positive stock returns tend to lead to poor bond returns the next month, but he adds that correlation does not mean causality and thus more factors are needed to explain the change in correlation.

Ilmanen (2003) includes business cycle, monetary policy, inflation level and volatility shocks as explanatory variables behind stock and bond returns and their correlation. Firstly, the business cycle, whether the economy is expanding or contracting, is seen as key factor in decoupling asset performance and an element behind negative stock-bond correlation. Stocks tend to perform better in expansions, while bonds outperform stocks during contractions. Near the end of a recession and the start of expansion periods offer highest stock returns, while bonds perform best in the middle of contractions and the stock-bond correlation is at its lowest from the peak until the middle of the contraction. Secondly, monetary policy affects both assets classes, but the effects seem to be affecting the assets likewise, thus it is not a factor behind negative correlations. Thirdly, inflation is another key driver of the correlation change. Times of high inflation affect stock and bonds similarly due to their common discount rate, thus driving the stock-bond correlation upwards. However, during periods of negative inflation or equivalently

deflation, equity risk premiums are increased and bond premiums decreased, leading to an inverse relationship and a negative correlation. Finally, volatility shocks also seem to be a significant factor behind correlation changes. Higher volatility leads to events such as flight-to-quality, which boosts bonds and hurts stocks, causing negative correlation and decoupling of returns.

Andersson, Krylova and Vähämaa (2008) conduct a research similar to Ilmanen (2003), investigating the reasons behind change in stock-bond correlation and in particular focusing on inflation, GDP growth and stock market uncertainty. They note, that for the United States, correlation long time average was slightly positive 0,12, but the figure changed constantly over time, ranging from -0,876 to 0,835 and the biggest one-month change was over 0,6. Their study shows that similarly to Ilmanen's (2003) findings, discount rate changes dominate inflation when it is high, but low or negative inflation can cause a negative stock-bond correlation. Their research results confirm this, with stock-bond correlation being above average (0,33) during high inflation and below average during low inflation (-0,212). They continue with growth expectations and show that it has no affect on stock-bond correlation. For the United States, the stock-bond correlation remained positive in all scenarios of GDP growth. Finally, stock market uncertainty, measured by implied volatility, is a clear driver of stock-bond correlation. When implied volatility is high, stock-bond correlation is negative (-0,199 for the United States) and when the market uncertainty decreases, stock-bond correlation has high levels (0,323). Especially high stock market uncertainty leads to stocks and bonds move in different directions, which is consistent with the flight-to-quality phenomena.

Connolly, Stivers and Sun (2005) extend the research by using data based on non-return variables. Based on Campbell and Ammer (1993), the only factor capable of inflicting negative stock-bond correlation is inflation. Since inflation remained relatively low and stable during the observation period, but negative stock-bond correlations occurred, Connolly, Stivers and Sun (2005) argue, that the fundamental approach of previous research fails to capture the periods of negative stock-bond correlation. They believe that the time varying correlation may be also caused by cross-market hedging, where a shock to one asset class may have consequences to another asset class through asset allocation. Behind their theory, they have evidence from the Asian financial crisis, where decoupling of the two asset classes was caused by increased stock-market volatility and uncertainty.

Connolly, Stivers and Sun (2005) focus on two different, but connected issues of the change in stock-bond correlation. Firstly, in their forward-looking focus, they investigate whether increased volatility in the stock market increases the chances of negative stock-bond correlation. Their findings show that when the VIX index is over 25%, which is a sign of higher than average stock market volatility, then there is significantly higher change of a negative stock-bond correlation. Secondly, they investigate this phenomenon on a daily basis, whether days with increased stock market volatility offer substantial excess returns for bonds. Their findings show that bond returns exhibit significant increases relative to stocks during days of high VIX index values. An earlier study by Stivers and Sun (2002) similarly showed, that high stock-bond correlation occurs during low values of VIX and that high VIX values correspond with no-, or even negative stock-bond correlation. Stock returns tend to be relatively higher during positive stock-bond correlations and bond returns during negative correlations, which is consistent, with the flight-to-quality phenomenon.

Similarly to the other studies of this chapter, Gulko (2002) also finds stocks and bonds positively and weakly correlated on the long-term, but with significant time-variation. His return-based research finds decoupling of stocks and bonds and negative correlation during bear market, which is seen as a flight-to-quality phenomenon.

Li (2002) finds similar results when researching the effect of macroeconomic factors to the returns of stocks and bonds in the G7 countries. The factor with the most significant impact on the correlation is the uncertainty of inflation, with unexpected inflation and interest rates having a minor role.

De Goeij and Marquering (2004) investigate the stock and bond market relation and its implications to portfolio managing by assuming the covariance between the assets follows a multivariate GARCH process, allowing the covariance (correlation) to be time variant. A portfolio manager choosing optimal weights for assets makes his decisions largely based on the correlation of the assets, so it is assumed that letting this correlation vary, can lead to excess returns. They find, in line with the previous studies, that the conditional covariance between stocks and bonds changes over time and thus a symmetric correlation is restrictive and wrong. They add that especially after bad news in the stock market and good news in the bond market, the covariance tends to be very low.

A few studies have focused in particular in to crisis times and the relationship between stock and bonds during them. Hartmann, Straetmann and De Vries (2001) study cross-country contagion and flight-to-quality phenomena in the G5-countries. The most important finding, from the perspective of this thesis, is that national borders don't seem to limit the flight-to-quality phenomenon, but the correlations between stocks and bonds from different countries are remarkably close to those of a single country. Another interesting finding of theirs' is that United States bonds seem to act as a safe haven for other G5-countries during market turmoil, especially for European investors.

Baur and Lucey (2009) extend the studies focusing on crisis period flights-to-quality, flights-from-quality and include cross-asset contagion within their study. Contagion is separated from interdependent assets, by highlighting that it is a change in correlation in a specific time, crisis. Similarly to previous studies on stock-bond correlation (Gulko 2002, Ilmanen 2003), Baur and Lucey (2009) find that the correlation is volatile and an equilibrium level cannot be determined. They also point out that seven out of eight countries experience a similar correlation through out 1996 until 2006; a positive correlation in the beginning of the time frame, which then declines and reaches negative values, approximately during the millennium, until finally turning positive and growing steadily until the end of the observation period. Here we can also see a similarity to the study of Hartmann et. al. (2001), who observed strong interdependent between global markets, which extends to the stock-bond correlation. Baur and Lucey (2009) find simultaneous changes in stock-bond correlations across different markets and draw conclusions, that this is due to a common factor, most likely increased stock market uncertainty across all the markets observed.

Baur and Lucey (2009) also investigate the time-variant level of the stock-bond correlations. They find it to range from 0,5 to -0,5 in all the observed markets. They find the level of the correlations at crisis times especially interesting. The observation period 1996-2006 included several financial crises, during which the correlation changed significantly. It was positive during the Asian Flu in 1997, turned negative during the Russian financial crisis in 1998, became positive again and once again turned negative during the 9/11 attacks and Enron scandal. Here we can clearly see the relationship between negative stock-bond correlations and financial turmoil. Finally, Baur and Lucey (2009) investigate, whether these crisis periods created flight, and if they did, which direction did the investments flow. The Russian financial crisis affected all markets by starting a flight-to-quality phenomenon, whilst the Enron created a flight-from-quality, investors changing their investments from bonds to stocks. Baur and

Lucey (2009) also argue, that flights give stability and flexibility to the markets, offering an investment class with value in it, in the midst of market turmoil.

Yang, Zhou and Wang (2009) research the determinants of the stock-bond correlation using a massive dataset of 150 years of asset values. This kind of huge data is used to provide maximum robustness for the results. Similarly, to Andersen, Krylova and Vähämaa (2008), Yang, Zhou and Wang (2009) document that for the United States the stock-bond correlations are higher during expansions than recessions. Interestingly, they find out that the opposite is true for the United Kingdom, where correlations are higher during recessions, indicating that bonds are better hedge in the United States. In this finding, we can see similarities to the study conducted by Hartmann, Straetmann and De Vries (2001), who found that the United States bonds seem to be the best safe haven - asset. Since our study focuses on United States data, the safe haven capabilities of bonds are important to know. Yang, Zhou and Wang (2009) also document, similarly to Ilmanen (2003), that higher stock-bond correlations tend to follow higher short rates and higher inflation in the previous period.

The final few papers of this chapter are from the recent years, to demonstrate, where the research on stock-bond correlation has reached.

Chiang, Li and Yang (2015) investigate the dynamic relationship between stocks and bonds and specifically compare the stock-bond correlation to market uncertainty. Like previous studies (Ilmanen 2003, Andersson, Krylova, Vähämaa 2008), they note that the stock-bond correlation varies through time. They find it to be positive when economic prospects are good and negative during economic crises. They find twofold results when investigating the relationship between stock-bond correlation and stock market uncertainty, measured by the VIX index. Similarly to Connolly, Stivers and Sun (2005), they find that when uncertainty on the stock market increases, the stock-bond correlation turns negative and thus these two have a negative relationship. They note that this is due to “flight-to-safety” and holds especially in the long run. However, on the short run, the stock market uncertainty can also be positively related to stock-bond correlation, due to the sentiment of short-term profits. In such cases, the relationship again turns negative after some time has passed.

For bond market uncertainty, Chiang, Li and Yang (2015) find interesting results, which are significantly different than for the stock market uncertainty. While an increase in VIX shifts investors to selling stocks and buying bonds, in the pursuit of safety, and

thus creating a negative stock-bond correlation, the bond market uncertainty moves the assets to the same direction. An increase in bond market uncertainty will increase bond risk premiums, but will also “spill over” to the stock market, raise risk premiums there and create a positive correlation.

Aslanidis and Christiansen (2011) conduct a similar study, investigating what macroeconomic variables have the most influence on the stock-bond correlation and which of them cause a positive and which a negative correlation between the two asset classes. They find the three most dominating factors to be the short-rate, yield-spread and stock market uncertainty, measured by VIX. The short-rate rate and the yield spread have a positive impact on the stock-bond correlation, while the VIX has a negative relationship. Aslanidis and Christiansen (2011) interpret these results so, that when the economy is in good shape, the stock-bond correlation remains positive and when uncertainty drives investors to safe havens, the correlation decreases and can become negative. These results are in line with Yang, Zhou and Wang (2009) and Connolly, Stivers and Sun (2005). Another interesting and contradicting finding by Aslanidis and Christiansen is that market fundamentals, such as inflation and business cycle, play a big role in influencing stock-bond correlation during market turmoil and only a small and insignificant role during prosperous economic times. They explain this by the fundamentals effect on stock price movements; in a large scale, stock prices are only affected by market fundamentals during volatile times.

As we have progressed chronologically with the previous literature, it is logical that the final paper is from the recent years. Dimic, Kiviahö, Piljak and Äijö (2015) conduct a research about market uncertainty and macroeconomic factors affecting the stock-bond correlation. Their data is from the emerging markets, which makes the study slightly different, since most other studies focus on the United States or G7 countries. They also split the study to both long and short horizons. The short-term stock-bond correlations is characterized by dramatic movements, for example in Russia, the correlation changed from 0,7 to -0,65 in two months. In all the observed emerging markets, the correlation changes sign and does it quickly. Also prolonged periods of negative correlation take place in the short run, coinciding with crises, which can be interpreted as a flight-to-quality phenomenon. On the long run, the stock-bond correlations of the emerging markets are stable, positive and very high, with almost a perfect positive correlation between the asset classes. This is explained by the tendency of the risky emerging market bonds becoming “equity like” in market expansions.

More interestingly from the perspective of our study, Dimic, Kiviaho, Piljak and Äijö (2015) do a similar test on United States data. On the short run, the United States stock-bond correlation acts very similarly to emerging markets: rapid movements, changes from negative to positive quickly and experiences very low values (-0,85 during the financial crisis). On the long run United States correlations differ from those of emerging markets. Since the data included several crisis periods, United States correlations are mostly negative on the long run, where bonds outperform stocks during economic turmoil and a negative correlation between the assets is created. Turning to factors influencing the stock-bond correlation, there is again significant deviation between the United States and emerging markets. On the short term, the United States correlation is mostly influenced by bond market uncertainty and inflation, with stock market uncertainty also being a statistically significant factor. Meanwhile, the most influencing factor for emerging markets is domestic monetary policy, which can have either a positive or negative effect on stock-bond correlation, depending on the country. On the long run, inflation is the key driver of stock-bond correlation, both in the emerging markets and United States. Inflation is positively correlated with stock-bond correlation, indicating it is negatively correlated with both of the asset classes, driving them to the same direction (Ilmanen 2003). Other influential factors on the long run are stock market uncertainty and business cycle.

Dimic, Kiviaho, Piljak and Äijö (2015) do a good job in summarizing what the literature has covered so far. The factors affecting stock-bond correlation are complex, relatively new as a field of research and still have some different and contradicting opinions among researchers. This chapter has papers arguing that market fundamentals, such as inflation and business cycle and short rate are the key drivers behind the time-varying stock-bond correlation (Ilmanen 2003, Yang, Zhou, Wang 2009), while others argue that stock market uncertainty is the key driver behind stock-bond correlation changing (Andersson, Krylova, Vähämaa 2008, Baur and Lucey 2009). In a way, the study of Dimic, Kiviaho, Piljak and Äijö (2015) reveals results which combines these two, contradicting views: on the short run, stock market uncertainty is the key driver of stock-bond correlation, while inflation is most important in the long run.

Based on previous literature, we are able to conclude that a negative stock-bond correlation occurs when stock and bond returns move to opposite directions. Either stocks plummet while bonds produce good returns, or while negative bond returns and positive stock returns. Most of the papers (Ilmanen 2003, Andersson, Krylova & Vähämaa 2008) in this section have showed that negative stock-bond correlation occurs

during flights-to-quality, or in other words, when stock returns plummet and bond returns soar. This is a central presumption of the thesis and due to extensive evidence, will not be further tested in this study.

2.2. Bond-Equity Yield Ratio (BEYR)

The Bond-Equity Yield Ratio, or BEYR, is a ratio of bond and equity yields, used to determine whether one of the assets is cheap or expensive compared to the other one. A high BEYR indicates cheap bonds and expensive equities and low BEYR the vice versa. (Giot & Petitjean 2007.)

BEYR offers a relative simple trading strategy. A long run average BEYR is considered to be between 2,0 and 2,4. When above 2,4, stocks are considered expensive, and are expected to decrease in value to again reach the long-term BEYR-level. When below, equities are considered cheap compared to bonds and similarly are expected to increase in value. Thus, a strategy using BEYR is simple: when below the equilibrium level, invest in bonds and sell stocks and while above the equilibrium value, sell stocks and invest in bonds. (McMillan 2010.)

BEYR-strategy was tested by investing in the UK for different sectors. The test was twofold, firstly to test for the market timing abilities of BEYR and secondly if it can beat a buy-and-hold strategy. Of the ten sectors included in the research, nine had positive returns when BEYR was below 2,0 and seven out of ten had negative returns when the BEYR was above 2,4. BEYR was able to beat the buy-and-hold strategy in seven out of ten sectors and lost clearly in only two. Based on this study, BEYR can be used to time the market and predict stock returns. (McMillan 2010.)

Levin and Wright (1998) find that the BEYR is useful for predicting stock and bond returns; it contains price information. Their approach to the topic is that the equilibrium value for BEYR is expected to be time variant, changed by for example inflation level. The changing equilibrium level is important for investors to take into account, in order to spot changes in the BEYR caused by mispricing from those caused by other factors such as inflation. They add that BEYR alone is not enough for asset allocation, but it needs the time variant equilibrium to be useful for investors. (Levin & Wright 1998.)

Similar results were found by Shen (2003), when comparing investing in “long spreads” and the market index. Long spreads refer to a strategy, where investing shifts between SP500 and 10-year government bonds, when their difference exceeds certain threshold values. This is essentially the same idea as in BEYR. Shen’s (2003) results show that the strategy beat the buy-and-hold strategy comfortably, having both higher mean returns and lower volatility.

A number of other studies on the BEYR have also found it successful in predicting future prices. Clare, Thomas and Wickens (1994) find that the BEYR is better than a buy-and-hold model and only marginally loses to a more sophisticated trading model. According to them, a successful BEYR strategy favors predicting stock returns and is directly against efficient market hypothesis, into which we were look more in chapter 3.

Brooks and Persaud (2001) also found evidence in favor of BEYR. They argue that arbitrary limits of BEYR, for example buying equities when BEYR is below 2.0, are not sufficient, but require a more sophisticated way of determining whether the BEYR is low or high and whether investors should be investing in stocks or bonds. Using a Markov switching-regime, Brooks and Persaud are able to use the BEYR very efficiently, clearly beating the other strategies and the buy-and-hold strategy. In practice, this means not setting a limit to the BEYR randomly, but let this regime-switching model determine when stocks and bonds are cheap and when they are not. (Brooks & Persaud 2001.)

On the contrary, Giot and Petitjean (2007) find that BEYR may not be mean reverting after all, or at least mean reversion is too slow for investors. They study the co-integration of the BEYR and find that it doesn’t exhibit mean reversion and prices can drift randomly for years. According to them, even when mean reversion can be detected, it takes a long time. In their study, two out of six countries had no mean reversion, others had a slow mean reversion on a scale of several years and even for them, the BEYR had no additional information than P/E –ratio, thus questioning the use of bonds as a predictor. An investor attempting to time the market on a daily to monthly basis would therefore gain no help from BEYR. (Giot and Petitjean 2007.)

Giot and Petitjean (2009) also test the BEYR and the regime-switching strategy. They find these active strategies to beat the passive buy-and-hold only in the United States. They also get the best risk-adjusted returns when timing the market with BEYR. However, these excess returns seem not to be caused by market timing and BEYR is

economically insignificant. Similarly, to Brooks and Persaud (2001), Giot and Petitjean (2009) get the best results with the regime-switching model. However, they find it to be closely correlated with extreme value strategy. When one of the two strategies fails, so does the other and therefore, Giot and Petitjean (2009) argue against the market timing capabilities of the BEYR.

In practice the regime-switching strategy used by Giot and Petitjean (2009) works the following way: initially funds are invested in to stocks and the fund is managed by following the level of BEYR. When BEYR is unusually high, which means low equity yields and high bond yields, the stocks are sold and the funds are invested into long-term government bonds. In time when the BEYR again drops, meaning better equity returns, the bonds are sold and the funds are again invested back into stocks. This way the fund embodies only stocks during “normal” levels of BEYR and only bonds during high levels of BEYR. As a level for high BEYR, Giot and Petitjean (2009) use the 90th percentile of the return distribution. This means that the top 10% of BEYR values are classed as unusually high and during them, the funds are shifted to bonds. Giot and Petitjean (2009) find this strategy to be superior compared to the Buy-and-Hold strategy. (Giot & Petitjean 2009.)

Using of BEYR has received critique from academics, because it mixes nominal and real rates together. Bonds yields are nominal variables, while equity yields are real variables and the usage of BEYR has been criticized as money illusion. However, investors required rates of return tend to change with inflation, and thus it is not theoretically wrong to compare the bond and equity yields. Another criticism towards BEYR is related to limits of arbitrage. When equities get expensive, BEYR decreases and sends a signal to sell. Even though fundamentally overpriced, investor sentiment can still favor these stocks and keep the price high, thus any fundamental strategy, such as BEYR, creates losses. (McMillan 2010.)

BEYR is in many ways very close to the topic of this thesis, stock-bond correlation. While BEYR compares the two main asset classes stocks and bonds by the relation of their yield, stock-bond correlation compares them by their co-movement. As described earlier by Giot and Petitjean (2009), a simple BEYR strategy of selling equities when the BEYR is high and buying them when the BEYR is low, was able to beat the buy-and-hold strategy in most cases. From the use of BEYR, we derive our first hypothesis, where buying equities when the stock-bond correlation is above its long term average

and selling them when below, yields superior returns compared to buy-and-hold strategy.

3. THEORETICAL BACKGROUND

Chapter 3 presents the theoretical background for the thesis. It gives the reader all the required information to understand the stock-bond correlation, how and why it evolves through time and how this affects decisions in portfolio management.

We begin the chapter with stocks; how they are valued, how their value changes and how beta affects the price. Next, we move on to bonds and take a look how their price is formed, how it evolves and how different risks affect bond price movement. Thirdly, the chapter takes a look at the co-movement of stocks and bonds. While Chapter 2 focused on the determinants of stock-bond correlation, this chapter will look at their historical levels and calculation. Fourthly, we will go through market indicators, to understand how variables and assets are used to predict the future movement of other assets.

3.1. Portfolio Theory and the C.A.P.M

Modern portfolio theory was invented by Harry Markovitz in 1952. According to it, investors view returns as a positive thing and variance as a negative one, and thus want to maximize returns on their portfolios and minimize their variance. An investor wants the maximum expected return for any given level of variance and a minimum variance to any given level of expected return. Investors will therefore choose a portfolio according to their risk tolerance, but will nevertheless attempt to maximize expected returns and minimize risks. Formulas 1 and 2 depict the way expected return and variance are calculated in a portfolio containing two or more assets. (Markovitz 1952.)

$$(1) \quad E = \sum R_i X_i$$

where R_i is the expected return on a security and X_i is the proportion invested in it.

$$(2) \quad \sigma_p^2 = \sum w_i^2 \sigma_i^2 + \sum \sum w_i w_j \sigma_i \sigma_j \rho_{ij}$$

where, σ_i^2 measures variance, w_i proportion invested and in a security and ρ_{ij} the correlation coefficient between two securities. (Markovitz 1952.)

Rarely, the best combination of risk and return can be found in a single security. But almost always this is done by combining different assets. Diversification to many different assets tends to lead to a most efficient portfolio. Similar assets tend to face same risks and thus move in to the same direction, while assets of different kind do not co-move strongly, in other words, they do not have a high correlation coefficient. Thus, diversification done by investing in many assets is not sufficient, but the assets need to be of the right sort, so that while some assets do badly, the other assets balance the portfolio by doing well at the same time. An efficient portfolio is not one which includes a lot of investments in a same industry, because they probably correlate strongly with each other. (Markovitz 1952.)

Also, investing in assets with a low variance is not sufficient in making the portfolios variance small. Again, the assets should be chosen based on their covariance, since it greatly affects the variance of the portfolio, as is seen from Formula 3. For example, investing all your assets in a relatively safe industry is not enough, but rather you should invest some of your wealth in another industry, which correlates weakly with the other. (Markovitz 1952.)

The most crucial idea of the modern portfolio theory is that by putting multiple risky stocks in a portfolio, the variance of the portfolio can be lower than for any one of the stocks included. This is due to favorable covariances. Of course you cannot reduce all the risk by diversifying indefinitely. By investing in roughly 20 stocks, investors reduce about 70-80% of the risk, known as unsystematic risk, but are still able to follow their investments. After this the addition of stocks doesn't grant any significant reductions in risk. (Malkiel 1999.)

The Capital Asset Pricing model was created by William Sharpe in 1964. It builds on the work of Markovitz (1952) to price a single asset. An efficient portfolio diversifies all unsystematic risk, also know as firm specific risk, away. Thus an investor is left with systematic risk, or market risk, which cannot be diversified away. If a single asset is presumed to be part of an efficient portfolio, then its risk can also be solely expected to be market risk. The Capital Asset Pricing Model is used to price single assets based on how much they vary in relation to the overall market. If an asset is riskier than the market, in other words its price varies more, its required return should also be higher than that of the market. Similarly, if an asset is less risky than the market, its required return should be lower. Also, if an asset has zero variation with the market, it will yield the risk-free interest rate. (Sharpe 1964.)

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

Where $E(R_i)$ is the expected return of the asset, β_i is its co-movement with the market benchmark and r_f is the risk free rate.

Formula 3, the CAPM, can be interpreted in a simple way. Every asset has an expected return of the risk free rate plus the market risk premium, times how much the asset varies in relation to the market. The relationship between expected return and non-diversifiable risk is linear; the more the asset moves in relation with the market, the higher expected return it has. This non-diversifiable risk is measured by beta, which is described in more detail in Table 1. Beta is intuitively logical: asset's co-movement with the market divided with the variation of the market itself. Beta reveals whether the asset moves more or less than the overall market. (Fama 1976: 258–267.)

$$(4) \quad \beta_i = \text{cov}(r_i, r_m) / \text{var}(r_m)$$

Table 1. Asset Beta.

| Beta β | Asset variation with the market |
|--------------|---|
| <0 | The asset moves to the opposite direction. |
| 0 | The asset does not move with the market. |
| 0<1 | The asset moves to the same direction as the market, but with less fluctuation. |
| 1 | The asset's movement is identical to the market index. |
| 1< | The asset moves to the same direction as the market and with larger magnitude. |

(Fama 1976.)

3.2. Stock Characteristics

3.2.1. Stock Price Prediction

Whether or not stock prices can be predicted or not has caused a considerable amount of debate over the past century. It can be roughly divided into two camps: academics who argue that the stock market can be predicted and excess returns made and academics who argue against this. According to academics, the stock prices follow a random walk,

which means that future prices cannot be predicted with past data and actions. The legendary phrase of a monkey throwing darts at the Wall Street Journal and picking investments has evolved from this debate. (Malkiel 1999: 24.)

Market efficiency measures the degree to which stock prices reflect available information and an efficient market is described as a market in which prices reflect available information. Weak-form efficiency states that all historical information is included in the prices, semi-strong efficiency includes all publicly available information and strong efficiency includes also private information, known by insiders only. Markets are usually weak- or semi-strong form of efficiency, meaning that public information is reflected in the prices. (Fama 1970: 414–415.) So when new information about a company comes available to investors, most commonly an earnings announcement, the market prices should adjust accordingly to the new information, leaving no arbitrage opportunities.

While academics argue that the market is efficient and unpredictable, especially in the short run, finance professionals attempt to do this in two ways: fundamental and technical analysis. (Malkiel 1999: 117–118.)

A price of a stock presents the value of the future discounted cash flows its owner is entitled to as the stockholder. Stocks pay out dividends which present the stream of cash the owner will receive by owning the stock. These cash flows are discounted by the required rate of return to get the present value of the stock. (Fisher 1930.) Fundamental analysis attempts to find out the real, intrinsic value of a stock, compare it with the current market price and find an investment opportunity. Arguably, most finance professional are in this school of thought, where finding wrongly priced securities is the way to go. (Malkiel 1999: 118–119.)

Another field of finance professionals concentrate on technical analysis. It is done by examining charts and finding how similar patterns have worked out in the past. Contrary to fundamental analysis, technical analysis places more weight on how other investors have behaved and will behave and trying to do the opposite, in order to make profits. (Malkiel 1999 118–119.)

3.2.2. Stock Price Movement

The most commonly used proxy for the United States stock market is the SP500. It represents roughly 80% of the United States market capitalization and is made up of 500 large cap stocks from various industries. The SP500 has had an annualized average return of 6,9% over the last decade and an annual volatility of 15,28% over the same period. During the last decade it has produced positive returns nine times out of ten, with 2008 being the exception. The best year for investors was 2013, with 31,55% total returns and the worst year was 2008 with -37,45% total return from the index. (SP Dow Jones Indices LLC 2016.) In this thesis, SP500 is the used market proxy.

SP500 returns from the last century tell an interesting story. From 1930 – 2010, two decades have produced negative annualized returns, with the 1930s' and 2000s' leaving the investor in the red. Also noteworthy of these losses is that they have been less than a percent on average per year, although some individual years have been far worse. All other decades in the time frame have been positive for investors. For example, the 1950s' and 1980s' gave investors nearly 20% average annual returns. (Marketwatch 2014.)

Volatility, the amount returns disperse from the mean has naturally also changed a lot. The average annual volatility, measured by standard deviation, has been roughly 15% for the SP500, with the bulk of the observations lying between 10% and 20%. From the 1950s' onwards, three years have had an annual volatility of over 25%, the latest during the Financial Crisis of 2008. Stock market performance and volatility are negatively correlated. During years of low volatility, the market has a significantly higher chance for positive returns, while high volatility periods coincide more frequently with negative stock returns. (Crestmont Research 2016.)

As mentioned in the previous chapter, stocks are compared with beta, a measure of non-diversifiable risk. Further, stocks indices can be constructed to include stocks sorted out by beta. By this way, we can get indices which include only high or low beta stocks. Low beta stocks face less swings than the market and are thus safer, but according to the CAPM, they also produce smaller returns (Fama 1976: 258–267). Low beta stocks are attractive investments in reducing risk during bear market and a possible alternative to traditional safe havens such as gold. Low beta stocks tend to outperform the overall market during recessions and short-term market turmoil. (Levisohn 2011.) Low beta stocks are usually called defensive stocks and they include sectors such as utilities,

healthcare and consumer staples; things that people need regardless of the market cycle. For example, in January 2015, the overall market index came down 3,2 %, while all the sectors mentioned above produced positive returns. Although safer than the SP500, even defensive, low-beta stocks are still equities and have some risk in them. (Marketrealist 2015.)

While low beta stocks are less risky than the market index, high beta stocks contain more risk, but the upside is the possibility of greater returns. Stocks with high beta move more than the market and are good during bull market and when volatility is not high. They are usually favored by short-term investors. In 2013, there were 45 stocks in the SP500 with a beta over 2 and 3 with a beta of over 3. High beta stocks include sectors such as technology, IT and financials, which' performance is strongly tied to the business cycle. (CNBC 2013.)

A noteworthy market anomaly is centered around low-beta stocks. According to the CAPM, in order to make higher returns, you need to take more risk, since return and risk go hand-in-hand. However, the performance of low-volatile, low-beta stocks has been terrific. During a period of 1968 to 2010, the least volatile stocks returned an annual average of 10,2 %, beating both the overall index (9,6 %) and the most volatile stocks (6,6 %). This kind of stock market behavior is explained by investor buying glamour-stocks, making them overpriced on the long run and reducing returns. Low-beta companies also have high dividends on average, since their cash flow is usually predictable and earnings tend to vary very little. (Levisohn 2011.) Baker, Bradley and Taliaferro (2013) find similar results in their study. They document that both the United States and other developed markets have had a trend where low-risk stocks outperform stocks with higher volatility. According to them, this kind of market inefficiency results from irrational investors and limits to arbitrage. (Baker, Bradley & Taliaferro 2014.)

The following figure present annual log returns from the SP500, low beta index and high beta index. From it we can clearly see how low beta stocks move less than the market, e.g. have less volatility in their returns. Also high beta stocks can be seen having the highest returns, both positive and negative. During upswings the high beta stocks tend to outperform the market and the low beta stocks generate the smallest returns. During market crashes, investors lose the least amount of money when they are tied to low-beta stocks. From stocks with different betas we arrive to our second hypothesis. As this thesis compares the correlations between assets, we will find out how stocks with different betas differ in their correlation with the treasury bonds.

Hypothesis 2 is that beta has an effect on strategies using stock-bond correlation. Low beta, high beta and corporate bond indices will be tested similarly as the market index SP500 in hypothesis 1. As Figure 1 depicts, the different indices move somewhat differently, have different risk levels and are therefore expected to yield different results than the market index in general.

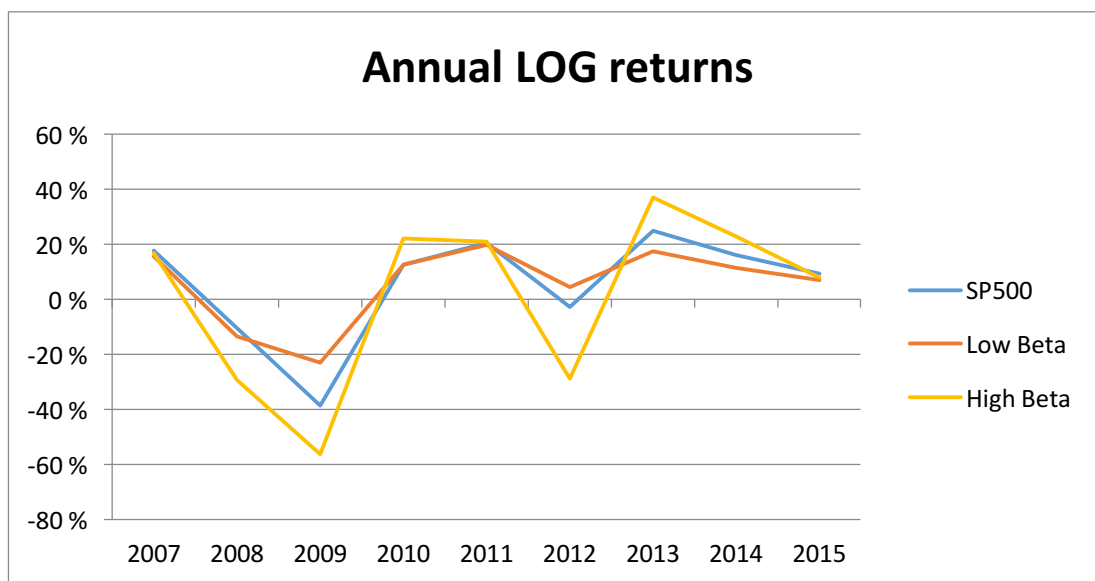


Figure 1. Annual Log Returns of indices sorted by beta.

3.3. Bonds

3.3.1. Treasury Bonds

Treasury securities are United States government debt instrument sold for investors. Those with a maturity of less than a year are called bills, maturities of over one year up to ten years are notes and over 10 years, ranging up to 30 years, are called bonds. They pay coupon payments every 6 months and the face value of the bond at maturity. They are sold in increments of 100 \$ and their price and yield is determined at an auction. A bond's price can be greater, smaller or equal to its face value. This is determined by the yield to maturity. If it higher than the interest rate interest paid by the bond, the current price will be lower than face value, and vice versa. Formula 5 presents the most used formula in bond valuation, from which we can observe that bonds present value is the sum of discounted cash flows and principal. (Treasurydirect 2016.)

$$(5) \quad PV = \sum \frac{Coupon}{(1+r)^t} + \frac{Face Value}{(1+r)^n}$$

where, r is the yield to maturity, coupon the periodic payment and face value the payment received at maturity.

Characteristics, that specify bonds as their own asset class are a fixed periodic payment, coupons, and a fixed maturity. Thus the only thing affecting the value of a bond is change in the discount rate. The discount rate is primarily affected by three factors: default risk, maturity and the overall level of interest rates. Government debt has no default risk and usually bonds with longer maturities have higher yields than shorter maturities. Mostly the bond price is affected by changes in inflation. Higher inflation increases bond yields and thus lowers the value of already issued bonds. Inflation and bond yields have a negative correlation. (Stern Business School 2015.)

3.3.2. Corporate Bonds

Corporate bonds are debt instruments issued by companies. An investor buying them lends money to the business and in return gets a legal obligation from the company to pay periodic interest payments and the principal back at maturity of the bond. The biggest difference when compared to company equity is ownership and the right for periodic payments. Owners of corporate bonds don't own a portion of the company, unlike in the case of equity, but they get their periodic interest payments with a much higher probability than stock owners get their dividends, because the company is legally obliged to pay the interest. (Securities and Exchange Commission 2013.)

Corporate bonds have different maturities and different grades. Such as treasury bonds, corporate bonds are issued with very short and very long maturities and their credit rating is based on the overall risk the investment faces. Bonds with longer maturity and lower credit rating have both higher risk premiums and higher spreads compared to treasury bonds. (Elton, Gruber, Agrawal, Mann 2001.)

Corporate debt is mainly divided into two main categories: the investment grade bonds and non-investment grade, also commonly known as junk bonds. The former is made up of safe bonds, with low probability of default, while the latter consists of riskier bonds. The bonds are further divided into more categories, ranging from the safest bonds rated A, to the most risk bonds rated CCC. During a ten year period from 1978 to 1987,

1,86% of corporate bonds defaulted each year, costing the investors annually 1,2% of the invested sum. Highest graded bonds AAA suffered 0% of defaults, while the lowest-graded junk bonds, rated C, defaulted over 30% of times. The spread of corporate bonds and treasury bonds increases as the credit rating goes down. The best-rated bonds have an annual average 0,45% spread, bonds with a rating of BBB have an annual average spread of 1,71% and the CCC bonds have a 5,19% premium every year. However, all bonds produced positive returns, regardless of the high default rates. (Altman 1989.)

Corporate bonds have higher yields than government bonds for a number of reasons. Firstly, due to the risk of default. While government bonds are practically default-free, corporate bonds risk default and thus investor require a premium for this risk. Secondly, they are taxed differently. In the United States, corporate bond holders pay state taxes, while government bonds are free of these taxes. Thus another premium in corporate bonds. Thirdly, corporate bonds are less liquid than treasury bonds. Investors require a premium for both the higher bid-ask-spread and the difficulty of finding a counter party while trading these bonds. Fourthly, corporate bonds are found to be influenced with similar risks as equity, which also increases the risk premium. (Elton, Gruber, Agrawal & Mann 2001.)

3.3.3. Safe Haven

As mentioned previously, investors construct their portfolios with assets that do not correlate strongly, in order to diversify the unsystematic risk away (Markovitz 1952). During periods of financial turmoil, asset classes that in general do not correlate a lot with each other, tend to become more highly correlated and thus increase the risks of the portfolio. As fear spreads through out the markets, most assets become more riskier and thus they correlate more highly. This happens through assets, industries and countries: they become more interdependent in crisis periods, which narrows down safe havens and motivates their search. (Dornbusch et al. 2000.)

A safe haven is defined to be an asset that is uncorrelated or negatively correlates with other assets during crisis periods. A safe haven asset is not one if it correlates positively with other assets during crisis periods, but it can still be a safe haven if it correlates positively in good times. (Baur & McDermott 2010.)

Treasury Bonds are the most obvious safe haven asset. This is because of their fixed returns. An investor gets them regardless of the bonds performance, unlike with stocks.

Bonds also have a relatively low bid-ask-spread, meaning an investor pays little premium of them. The risks of investing in bonds include default risk, currency risk and inflation risk, but as mentioned previously safe haven assets are required especially during market crashes, when all else is losing value. (Baur & McDermott 2015.)

Habib and Stracca (2015) find three major findings about the safe haven characteristics of stocks and bonds. Firstly, all stock market exhibit “exiting” during crisis periods. Investors sell their owning and head for safer assets. Secondly, there is no absolute global safe haven that would work during all crisis periods. The third finding is an exception to the second finding: United States government debt has been a safe haven through out most crisis, so according to Habib and Stracca (2015) it is the closest thing to a global safe haven there is.

Long-term government bonds tend not to move in line with other assets such as stocks, a historical trend which has shown no sign of changing. Their long-run correlation is also low enough to offer important diversification benefits. (Malkiel 1999: 230.)

3.4. Stock-Bond Correlation & Co-Movement

The correlation between stocks and bonds is usually measured with the Pearson product-moment correlation coefficient, which is better known as Pearson’s r . Correlation and covariance are a measure of linear dependence between variables. Covariance is defined as the sum of cross-products between the variable. Its problem is that it is not scaled, but its size depends on the value of the variables. Correlation coefficient measures the same thing as covariance, but it is scaled and its values lie between -1 and 1, so it is easy to interpret. Formula 6 describes Pearson’s R , the most used correlation estimate. (Rodgers & Nicewander 1988.)

$$(6) \quad R = s_{xy} / s_x s_y$$

Where s_x and s_y are the standard deviations for the two assets.

Investing in bonds provides the investor with a fixed income, while investing in stocks is risky with no certain incomes, but also rewarding with higher possible gains. Thus, a portfolio is usually constructed as a combination of the two asset classes, in order to diversify risk, while still maintaining a relatively high expected return. In a dynamic

market environment, where the relationship, correlation, between stocks and bonds is time-variant, a constant proportion of stocks and bonds in a portfolio is not advisable. (Chiang, Li & Yang 2015.)

The stock-bond correlation evolves through time. As portfolios are a combination of the two asset classes, its change affects the diversification abilities of bonds. A lower correlation indicates better diversification, because it means that stocks and bonds tend not to move in the same direction. During a period from 1855 to 2001, the average stock-bond correlation was positive and low, 0,154. It was lower during recessions than expansions. (Yang, Zhou & Wang 2009.)

Corporate bond correlations with treasury bonds and equities also affect investors, since corporate bonds are increasingly part of portfolios due to high returns with less risk than the stock market has. (Alliance Bernstein 2014.) Corporate bonds have historically had weak, but positive correlations with the stock market, on average 0,27. But riskier high-yield bonds correlate much stronger with the stock market, on average 0,74. Investment Grade Corporate Bonds have had a historical correlation of 0,5 with the treasury bonds and high-yield bonds have had a correlation of -0,1 with the treasury bonds. (MarketRealist 2015.) According to Alliance Bernstein (2014), high-yield bonds have had average correlations of 0,60 with SP500 and only 0,14 average correlation with United States Treasury Bonds, indicating they track stocks stronger than bonds and as the risk of bonds increase, the more equity-like they become. (Alliance Bernstein 2014.)

The stock-bond correlation is very influential when investors allocate their assets. Also, portfolio optimizing, risk management and hedging can benefit, when investors truly understand the stock-bond correlation, and especially its tendency to vary through time. (Dimic, Kiviaho, Piljak & Äijö 2015.)

3.5. Bond-Equity Yield Ratio (BEYR)

The Bond-Equity Yield Ratio, or BEYR, is an investment tool to value the market. It is calculated as a ratio of bond and equity yields and the two asset classes are compared in relative value towards each other. The Bond Yield is estimated as the yield to maturity of long term government bonds (R), while two different calculations exist for the equity yield: the dividend yield (D/P) and the earnings yield (E/P). The following formula presents the calculation of BEYR. (Giot & Petitjean 2007.)

$$(7) \quad \text{BEYR} = R/D$$

Where,

R = yield to maturity on long term government bonds,

D = ratio of dividends to stock price, also known as dividend yield.

(Giot & Petitjean 2007.)

The BEYR has become popular in recent decades, especially among financial practitioners such as portfolio managers (McMillan 2010). Giot and Petitjean (2007) argue that after traditional valuation models, such as the P/E ratio performed poorly in predicting stock market movement, there was a demand for a new model. McMillan (2010) states that rather than focusing on a single ratio, the BEYR allows a comparative yield analysis, focusing on two asset classes and comparing which is more attractive to invest in, and create value for a portfolio by timing the market.

Investors view bonds and equities as competing assets. While the BEYR doesn't directly compare prices, it compares the yield of an asset class in relation to the other asset classes' yield. When stock prices rise, the earnings and dividend yields decrease and if simultaneously bonds are unaffected, the BEYR will increase. A high BEYR signals that stocks are expensive compared to bonds, while a low BEYR indicates the opposite. The BEYR is expected to stay relatively stable on the long run and not diverge too much from its equilibrium level, since this difference can easily be exploited by shifting investments from stocks to bonds or vice versa. (McMillan 2010.)

3.6. Market Indicators

Market indicators are part of technical analysis used to predict future asset prices. On top of ordinary price-based indicators, they add a variety of methods in to the forecasting of prices. These indicators may include factors such as volatility, investor sentiment and trading volume. (Fan, Qin & Jacobsen 2014.)

Market indicators can be divided into two categories: market sentiment indicators and market strength indicators. Market sentiment measures investor psychology and predicts rising or falling asset prices based on the investor sentiment. Bullish sentiment is associated with rising prices and bearish sentiment with declining prices. Sentiment reveal how investors felt about current prices, which at the moment are not known to be

under- or overpriced, but will only later be revealed to be wrongly priced. Sentiment indicators reveal information that is not obtained by analyzing past prices. This information can be obtained either by surveys or by examine the prices of underlying derivatives prices, but not the stock market itself. Well known market sentiment indicators include Barron's Confidence Index, Volatility Index VIX, the volumes of put and call options and short sale volumes. (Fan, Qin & Jacobsen 2014.)

Market strength indicators measure how strong the sentiment of the investors is. While investor sentiment gives a direction to the market, it is the strength indicators which describe the volume, equally important in predicting the market moves. Market strength indicators can be roughly divided into three categories. Firstly, volume indicators focus on the total volume of trades, measuring the activity of investors. Secondly, total number of rising or declining stocks, in order to capture the strength of the trend. Thirdly, total number of stocks reaching periodic heights. (Fan, Qin & Jacobsen 2014.)

The performance of market indicators has been tested and the results have been mixed. In the most comprehensive study, Fan, Qin and Jacobsen (2014) test the predictive ability of 93 different indicators. 30 indicators had predictive power on the 10% confidence level, 10 of these remained predictive after robust tests, but none of them was able to beat the buy-and-hold strategy when transaction costs were taken into account. (Fan, Qin & Jacobsen 2014.)

The track record for market indicators is not too good (Fan, Qin & Jacobsen 2014) but some of them have still been able to predict the market and benefit investors. We now arrive at our third and final hypothesis: Can the stock-bond correlation be used as a market indicator? Indicators include both stock and bond market data, but not used together, so this hypothesis will extend the research on indicators.

4. DATA & METHODOLOGY

In Chapter 4 we will go through the data used in the thesis, with a description, sources of data and some statistics. Then we will move on the three hypothesis briefly introduced earlier in the thesis. The hypotheses will be presented more thoroughly in this chapter and with their expected results. Finally, we go through the methodology of testing the data in order to find answers to our hypothesis and solve the main research problem of the thesis: how can stock-bond correlation be used by investors.

4.1. Data Description

This section gives an introduction to the data used in this thesis. We use five different stock and bond indices to test for the stock-bond correlation with slightly different assets to draw conclusions and make this thesis to contribute to the existing literature. The thesis focuses on United States stock and bond markets only, with all the indices from there. The indices included are the Treasury Bond Index, Corporate Bond Index, SP500, High Beta Index and Low Beta Index, which are all described in more detail in their own chapters.

The time period chosen for the thesis is 9 years, from 16.05.2006 to 09.12.2015. The time frame is long enough to feature a few financial crises, which helps us to draw conclusions. Preferably, the time period could have been longer, but finding data longer than ten years was problematic for the high and low beta indices, so we will settle for the nine-year frame. All of the data was obtained as daily price data. The figures in this chapter were created with monthly data obtained from the daily data, because the figures are much clearer for the reader to interpret than in the case of daily data figures. The empirical part of the thesis uses daily data, because correlations differ when switching from monthly to daily data and daily data gives us the most relevant and accurate material to work with. All of the five sub chapters contain two charts, one describing the index value and another the monthly logarithmic returns from the index. The data is balanced; all dates with one or more missing observations have been deleted and the start and closure date have been chosen to fit all five time-series.

Table 2. Data statistics.

| | SP500 | Low Beta | High Beta | Corporate Bonds | Treasury Bonds |
|------------------------|---------|----------|-----------|-----------------|----------------|
| Number of observations | 2392 | 2392 | 2392 | 2392 | 2392 |
| Avg. Daily Return | 0,019 % | 0,023 % | -0,001 % | 0,022 % | 0,024 % |
| Avg. Standard Dev. | 1,33 % | 0,98 % | 2,42 % | 0,33 % | 0,44 % |
| Neg. Return % | 45,7 % | 46,32 % | 47,87 % | 44,23 % | 46,57 % |

4.1.1. United States Treasury Bonds

The data for the Treasury Bonds has been obtained from the Thomson Reuters database. The index representing treasury bonds is made by Bank of America Merrill Lynch 7-10, including government bonds with 7-10 years of maturity, which are commonly used in the literature. The index is a total return index, meaning that all cash flows are reinvested. The index has been calculated since 1973, but as mentioned previously, we only use the values from 2006 onwards.

Table 2 provides descriptive statistics about the treasury bond index. It has fared relatively well in terms of monthly return, when compared to the other asset classes and it has had a modest standard deviation, which can be expected from a treasury bond index. The figures 2 and 3 describe its movements during the observation period. The index has avoided large crashes and had relatively stable growth from 1400 to 2400 during the nine years. The majority of its returns are small and positive, with the negative returns pretty small as well. A few larger monthly returns also occur during the observation period.

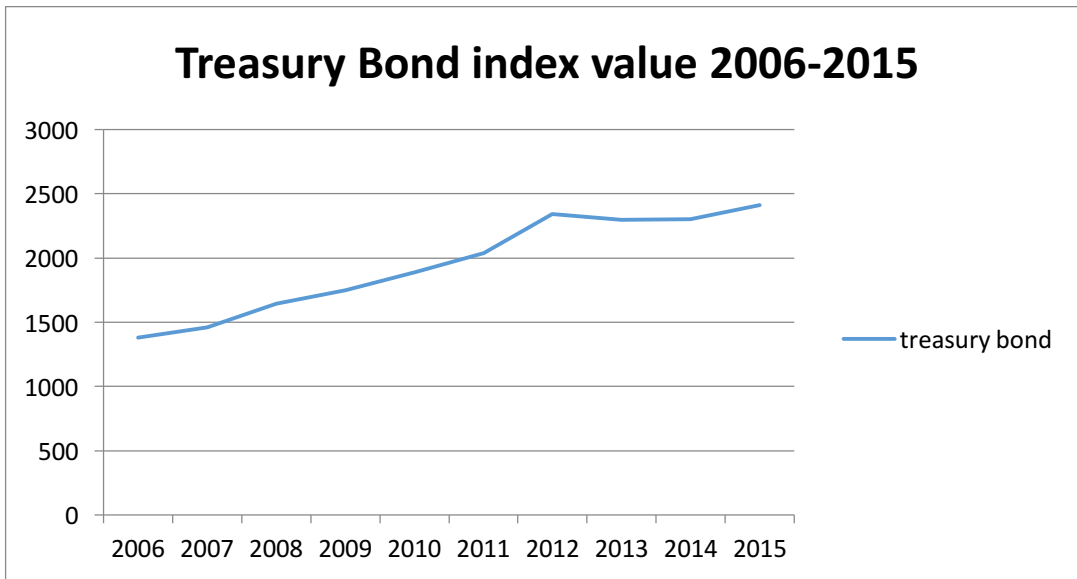


Figure 2. Treasury Bond Index.

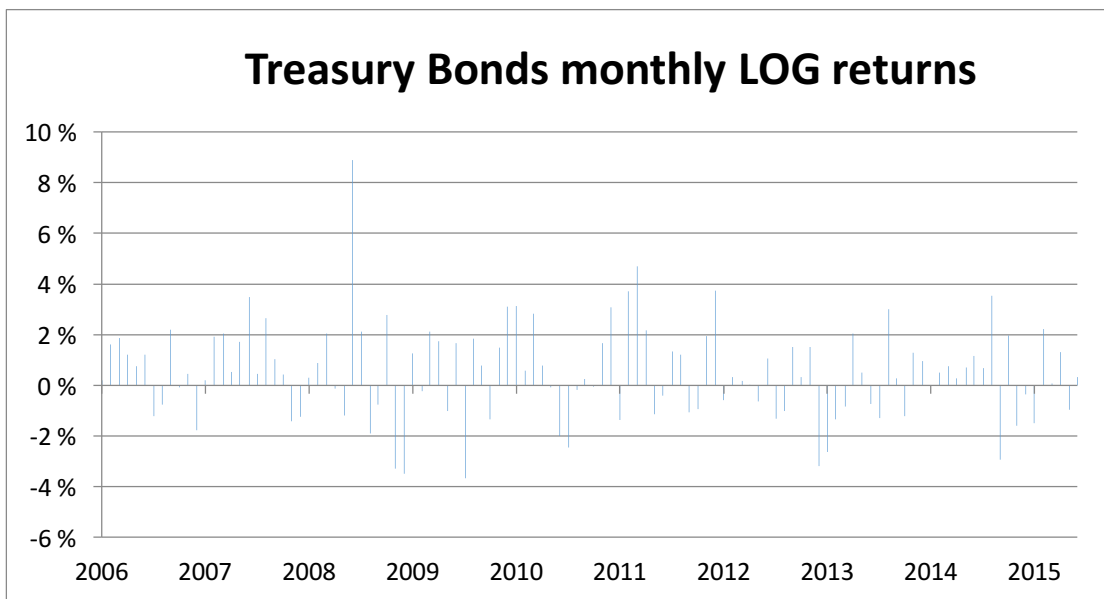


Figure 3. Treasury Bond Returns.

4.1.2. United States Corporate Bonds

The corporate bond index was obtained from S&P Dow Jones Indices (us.spindices.com). The index holds corporate bonds issued in the United States by

investment grade and high-yield bonds, which are denominated in dollars. It was created in 2002, it is rebalanced monthly and is market value weighted. It holds roughly 4 billion in bonds and has an average maturity similar to the treasury bonds, 10 years.

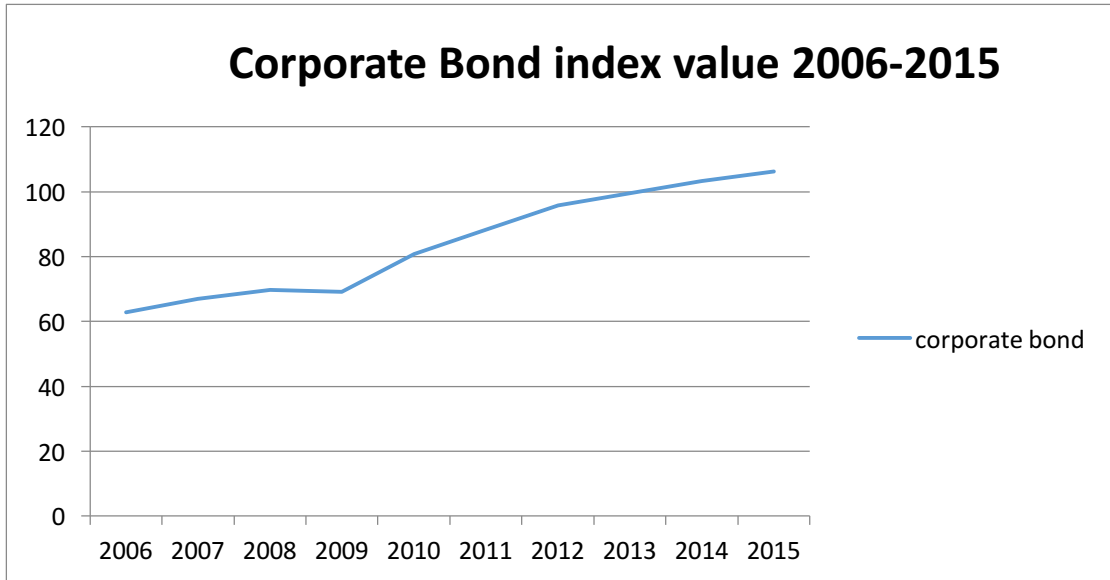


Figure 4. Corporate Bond Index.

Table 2 provides descriptive statistics about the corporate bond index. In terms of return, it has performed similarly to the treasury bonds and stock indices, while having the lowest standard deviation. Figures 4 and 5 support this by showing it has gradually progressed from 65 to 110 during the observation period. It has had a few months with large losses, but these have been compensated with mostly small and positive returns. Table 2 also shows that corporate bonds had the least amount of negative return – months. An interesting finding from Figure 4 is that the corporate bond index has performed equity-like. Its ups and downs have coincided more with those of the stock market, rather than the treasury bonds. Of course this observation is based on eye-sight and not statistical testing, but it will be tested later on in the thesis, if the corporate bonds correlate with the treasury bonds in a similar way as the three stock indices do.

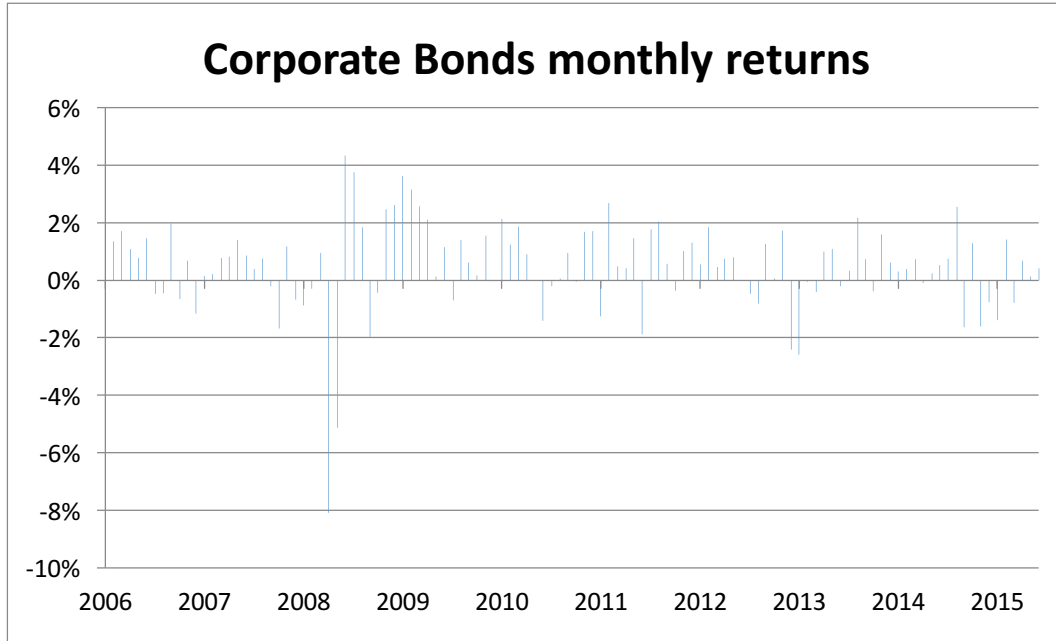


Figure 5. Corporate Bond Returns.

4.1.3. United States Stock Market Proxy: The Standard & Poor's 500

As a stock market proxy, we use the S&P 500 index, which is the most followed index in the financial world. The data for it has been obtained from the FED of St. Louis. The S&P 500 contains the 500 largest companies in the United States, representing roughly 75% of the equity market, and over 500 billion in market capitalization. Unlike the treasury bond index, this index is a price index, so it doesn't include dividends. But as the thesis focuses on the direction of returns and not their magnitude, this is not a concern.

Table 2 provides statistics about the index. During the observation period, the S&P 500 has performed pretty much equally compared to the two bond indices, but with considerably higher standard deviation and thus poorer risk-adjusted returns. Figures 6 and 7 also depict it has experienced more loss-months and its returns have ranged more from zero, than for the bond indices.

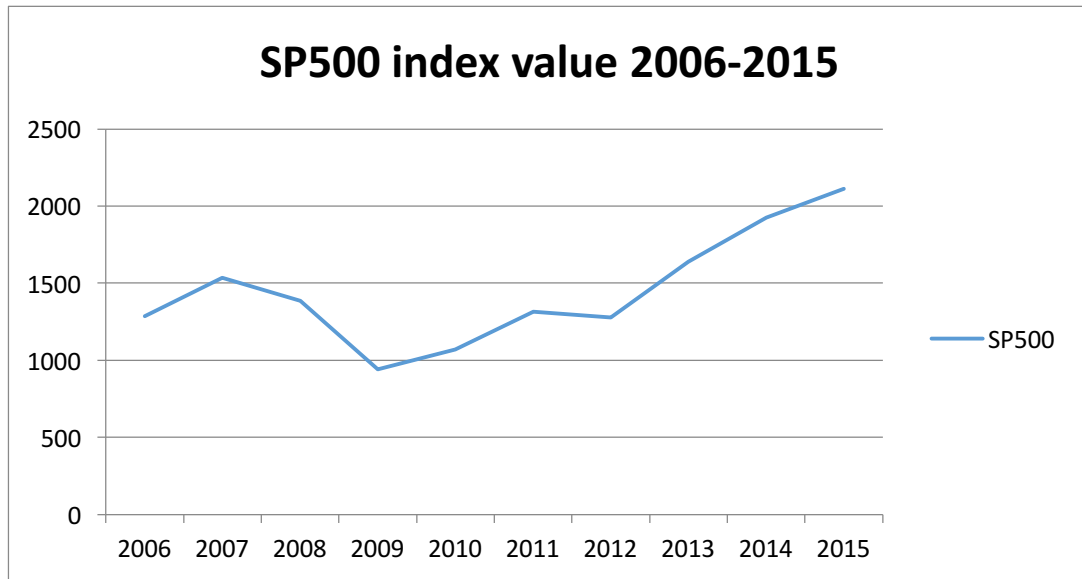


Figure 6. SP500 Index.

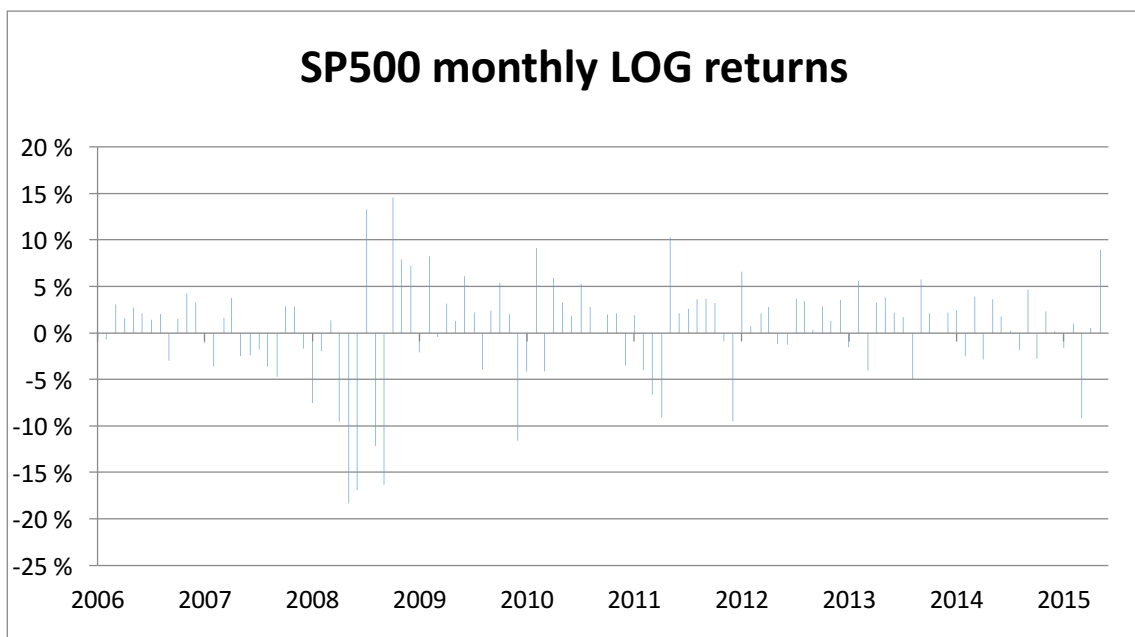


Figure 7. SP500 Returns.

4.1.4. High Beta Index

The high beta index has been obtained from S&P Dow Jones Indices (us.spindices.com). The index has been created to include the 100 stocks in the S&P 500 index with the highest beta, which are the most sensitive stocks. It is rebalanced

quarterly based on the current beta levels of the S&P 500 stocks. Its mean market capitalization has been 28 billion and its constituents come from a variety of sectors, most dominant the energy and financials sectors, with roughly 30% share for both.

Table 2 shows the poor performance of the high beta index during the observation period, relative to the other four indices. It has had the lowest average monthly return, highest standard deviation and the greatest number of negative return months. Figure 8 supports this claim, as it shows that the high beta index has had considerable swings during the observation period.

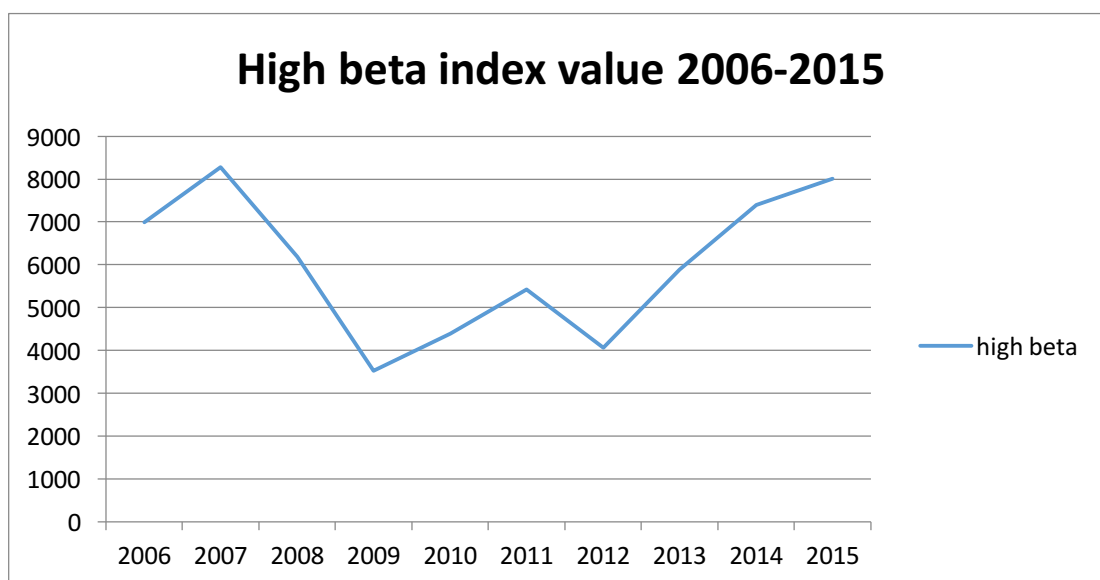


Figure 8. High Beta Index.

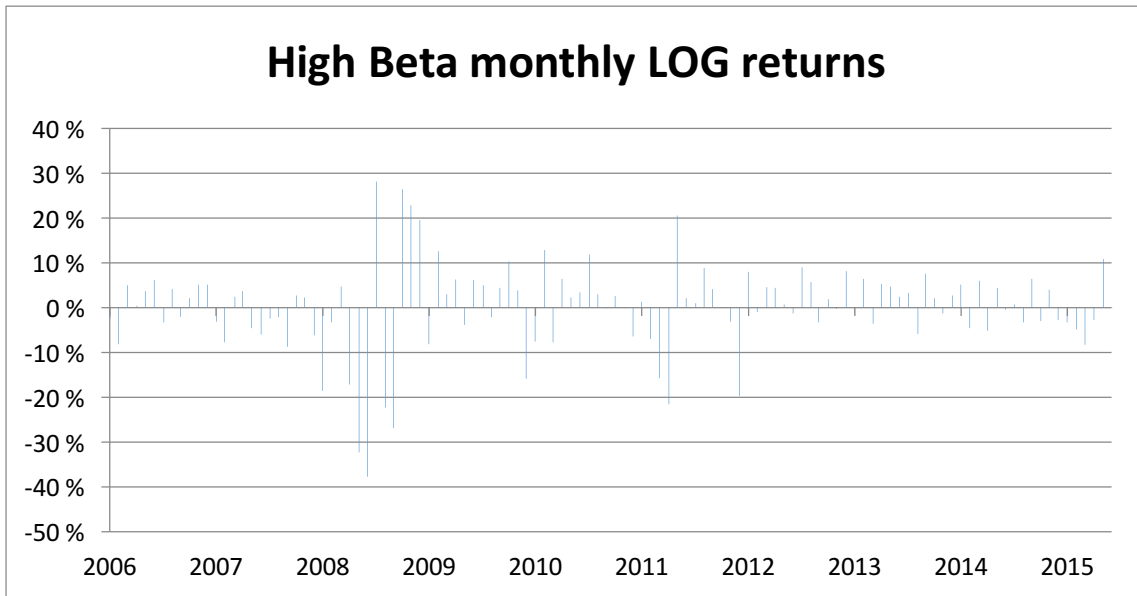


Figure 9. High Beta Returns.

4.1.5. Low Beta Index

The low beta index was obtained from S&P Dow Jones Indices (us.spinindices.com). The S&P 500 Low Volatility Index was constructed from the 100 least-volatile stocks of the S&P 500, which are least sensitive and considered non-cyclical. Unlike the high beta index, here the weighting method is volatility instead of beta, but for the purposes of the thesis, both work fine. It is also rebalanced quarterly by volatility, has a mean market capitalization of 58 billion and its two biggest sectors are utilities and consumer staples.

From Table 2 we see that the low beta index has performed better than the two other stock indices, with lower standard deviation, but still similar returns as the whole S&P 500. Figures 10 and 11 speak the same story. The low beta index has had similar trends as the other two stock market indices, but with smaller fluctuations and more stability.

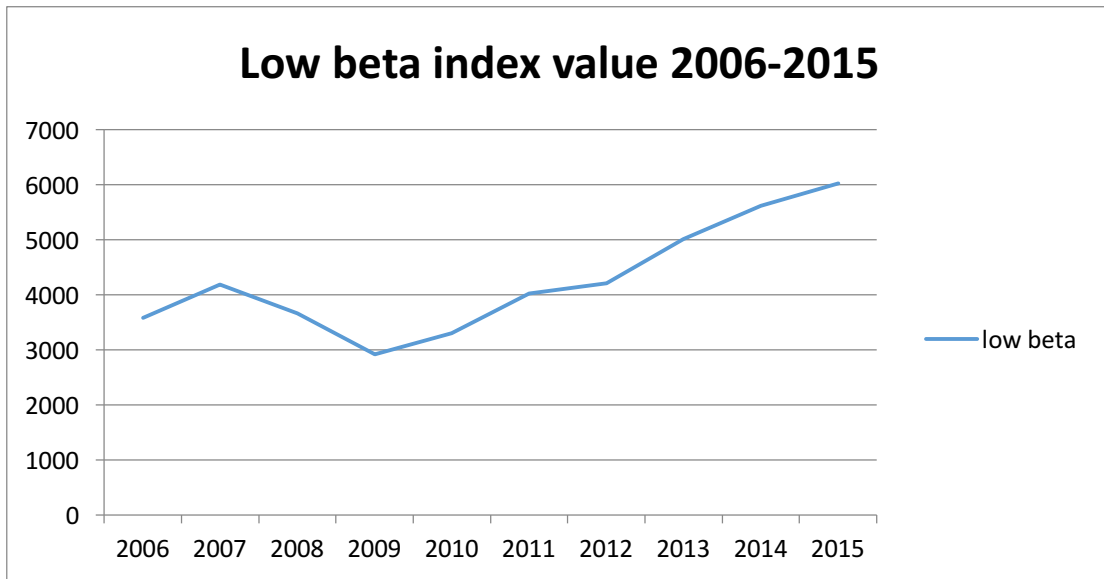


Figure 10. Low Beta Index.

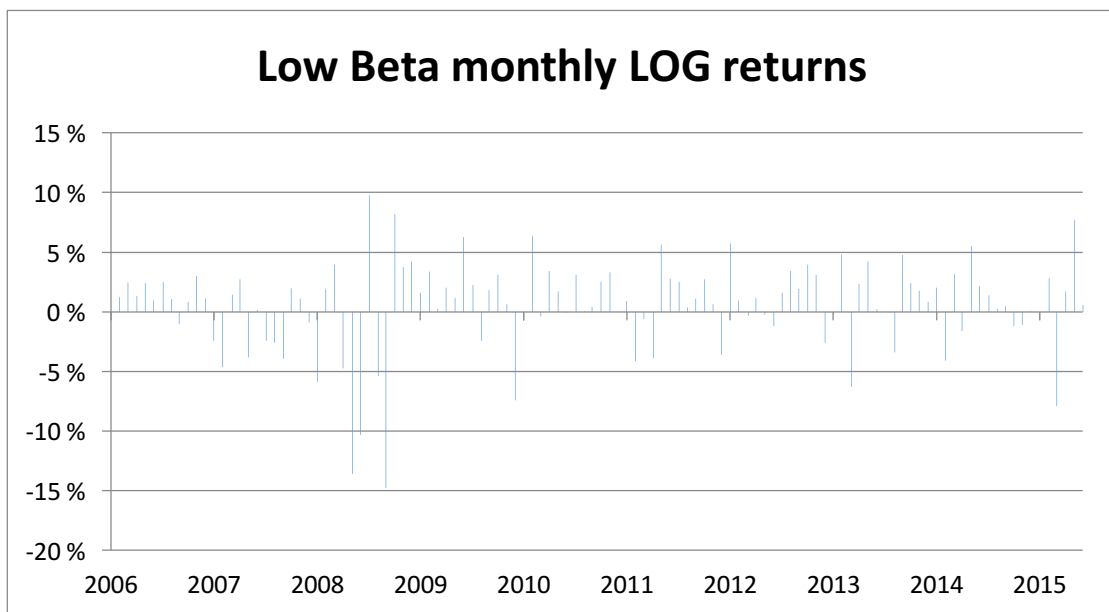


Figure 11. Low Beta Returns.

4.2. Hypothesis & Expected Results

The purpose of this thesis is to investigate the market timing abilities of the stock-bond correlation. In the previous chapters we have derived and briefly introduced the three hypotheses we will test for in the empirical part of this thesis. In this Chapter we will

wrap up the three hypothesis more thoroughly and lay a solid ground for the remainder of the thesis.

Hypothesis 1 is about timing the market by adjusting your portfolio weights based on the time variation of the stock-bond correlation. When the stock-bond correlation is normal, funds are invested in to stocks and when it is in extreme values, the stocks are sold and then the funds invested in to bonds. The extreme values mean the smallest values of the stock-bond correlations. The logic behind this is simple: based on previous literature, low and even negative stock-bond correlations occur during poor stock market performance (Ilmanen 2003). By shifting the funds from stocks to bonds during times of low correlation, we are possibly able to avoid the worst days of the stock market and stick with bonds during those rough days and then switch back to usually-high-yielding-stocks. Hypothesis 1 was introduced when covering the previous literature of BEYR. BEYR was tested (Giot & Petitjean 2009) against a naïve buy-and-hold strategy by adjusting portfolio weights based on the level of BEYR and as stock-bond correlation is very similar to BEYR, it is convenient and practical to perform a similar test to our data of stock returns. As BEYR was able to beat the buy-and-hold strategy with this methodology (Giot & Patitjean, 2010), the expected result of hypothesis 1 is that by adjusting stock weights based on the level of stock-bond correlation, we are able to make superior returns and beat the buy-and-hold strategy.

Hypothesis 2 takes into account the differences in the stock indices. According to it, beta affects the strategy using stock-bond correlation. In other words, the market timing strategies with low beta, high beta and corporate bond indices are assumed to yield different returns than the strategy with SP500. Low beta stocks are described to be partial safe havens (Levisohn 2011) and high beta stocks are depicted good during bull market and bad during bear market (CNBC 2013). Also Figures 8 and 10 show that low volatility stocks are much safer than high beta stocks and Figure 4 and Alliance Bernstein (2014) argue for the stock-like characteristics of corporate bonds. Similarly to hypothesis 1, it is also expected that this market timing strategy is able to beat the buy-and-hold strategy.

Finally, Hypothesis 3. Can the stock-bond correlation be used as a market indicator? Of course the other two hypotheses are in many ways similar and provide evidence and answers to the same question, but hypothesis 3 formally tests it. Hypothesis 3 was introduced in the chapter of market indicators. Fan, Qin and Jacobsen (2014) test for the market indicating capabilities of 93 market indicators, but don't have stock-bond

correlation as one of them, so the last hypothesis will fill the void in their study. Based on the study of Fan, Qin and Jacobsen (2014), the stock-bond correlation is expected to at least be able to predict the market to the degree of the best indicators of their study. Approximately a third of the indicators had predicting power, but none were able to beat the market after robustness-tests and taking into account the trading costs.

4.3. Methodology

In this chapter we present the methodology used to test for the hypotheses introduced earlier in the thesis. The methodology for testing the hypotheses will be twofold. Firstly, we will use the data to calculate a rolling stock-bond correlation for each of the asset classes. We will use Pearson's correlation. We will only calculate the correlations between treasury bonds and the other assets. This is because usually the stock-bond correlation is calculated between stocks and treasury bonds and now we expand the study by calculating not only the correlation between SP500 and treasury bonds, but also how high beta, low beta and corporate bonds correlate with the treasury bonds. For the purpose of the thesis, these are the relevant correlations, we do not need for example correlations between the high and low beta indices. Table 3 illustrates the four correlations this thesis is interested in. Since we are not interested in a static figure, a single correlation, we calculate the rolling correlation between the assets. The correlations will be calculated as rolling correlations from daily returns. A 30-day window of past prices will be used for each of the correlations, so that every day's correlation of two indices is the correlation of their last 30-day returns.

$$(8) \quad R = s_{xy} / s_x s_y$$

Where s_x and s_y are the standard deviations for the two assets.

The second step of the methodological part is to test the hypotheses with the correlations we have obtained during our first phase. For all of the hypothesis, we have an already existing study to follow. Using the same methodology, but different data and somewhat different variables, we can test our hypotheses with known methods of financial research. Hypotheses 1 and 2 are essentially identical, but answer slightly different questions. While hypothesis 1 finds evidence whether stock-bond correlation works as a market timing strategy, hypothesis 2 answers whether asset beta affects the performance of this strategy.

Hypothesis 1 features testing stock-bond correlation in a similar fashion in which BEYR was tested. Giot and Petitjean (2009) test BEYR by determining a threshold level for BEYR to act as a signal of switching asset class. A very high BEYR means expensive stocks and cheap bonds, so the highest BEYR levels mark the days when Giot and Petitjean (2009) switch their investments from stocks to bonds. In practice their strategy worked in a way that funds were invested into stocks and kept the position until a day of very high BEYR came. Then the funds were shifted into bonds until the BEYR dropped into normal levels, on which the funds were again invested back into stocks. As mentioned in the hypothesis-section, the goal of this is to invest in high-yielding stocks, but avoid the bad days by following the BEYR.

It is noteworthy that BEYR and stock-bond correlation signal similar things at opposite values. A high BEYR and low stock-bond correlation mean expensive and low-yielding equity and low BEYR and high stock-bond correlation on the other hand are a signal of high yielding, cheap equity. In practice, this means that we will first invest in stocks, the SP500 index, and when the stock-bond correlation becomes very low, the stocks will be sold and the funds invested into bonds, which are Treasury Bonds. The logic is similar as in the strategy implemented by Giot and Petitjean (2009).

Also a minor difference between this hypothesis and the test by Giot and Petitjean (2009) is the threshold value when switching from equities to bonds. They used the 90th percentile of the income distribution, meaning that when the BEYR was in the top 10 % of largest values, the funds were shifted from stocks to bonds. We use the 95th percentile of the income distribution in this thesis. This means that the lowest 5 % of values for the stock-bond correlation mean shifting funds into government bonds and the other values (95%) mean they are invested into the stock index. This was done for practical reasons, because when using daily data, there were too many observations with the 90th percentile as a threshold, so the 95th was chosen. This makes investing both easier and keeps transaction costs significantly lower. Setting a certain threshold, such as the 90th or 95th percentile has the advantage of easy duplication, because all data can be sorted like this. For example McMillan (2010) did not use a percentile value, but opted a certain level (2,0–2,4) of BEYR in his strategy. It worked well, but was difficult to copy for further use. To draw conclusions, we first see if the strategy made profits and then if it was able to beat the competing buy-and-hold strategy. We will not include transaction costs, so the buy-and-hold strategy should be beaten with a clear margin in order to claim it beaten.

As a conclusion, the days with the 95 % highest stock-bond correlations are days when we are fully invested into stocks. The days with smallest stock-bond correlations, the 5 %, are days when we are fully invested into bonds.

Hypothesis 2, is about beta of the index affecting the market timing strategy. This is tested in a similar way as we did in hypothesis 1, but the SP500 is replaced with Low Beta, High Beta and Corporate Bond Indices. Funds are initially invested into the indices, and when stock-bond correlations reach the lowest 5 %, the funds are shifted into treasury bonds, similarly as in hypothesis 1.

Hypothesis 3, can stock-bond correlation be used as a market indicator will be tested with the methodology presented by Fang, Qin and Jacobsen (2014). In their study, they test for the predicting ability of technical market indicators by running a standard OLS regression to test the predictability of the indicators. Formula 9 presents an ordinary least squares regression used in the research. It is a commonly used measure of linear dependency.

$$(9) \quad R_t = \alpha_t + \beta I_{t-1} + \varepsilon_t$$

Where, R_t is the daily return of the index, I_{t-1} is the periodic percentage change of the correlation one period ahead, and ε_t is the residual term.

In this thesis, the formula 9 will be used eight times to test for the predicting ability of each of the four correlations. In each case, R_t will represent the return from the tested index. We will test each index correlations with a lag and without a lag, so all four indices will be regressed twice. I_{t-1} is used when there is a lagged variable and I_t when there is no lag. This way we are able to observe if there is more prediction power when using today's correlation to predict returns today or one month beforehand. Fang, Qin and Jacobsen (2014) used a conservative 10% significance level to accept that an indicator has predicting power. We will accept predicting power with the 10 % confidence level, but 5 % and 1 % levels would give more convincing results.

All in all, these three hypothesis and the methodology involved are designed to comprehensively test the market timing abilities of the stock-bond correlation. There may be some overlapping in the methods used; they may partly answer for the same

questions, but they nevertheless increase the validity of this thesis in terms of studying the use of stock-bond correlation as a tool for investors.

5. EMPIRICAL RESEARCH & RESULTS

Chapter 5 contains the empirical research and results of this thesis. In the previous chapters we have introduced the hypothesis, which will now be tested and analyzed, in order to answer the fundamental question behind this study: can investors use the stock-bond correlation as a tool to help their investment decisions.

Chapter 5 is constructed in the following way. Firstly, we go through the correlations we have obtained from our indices. These correlations give us some insight about the relationships between the different assets and will be essential in remainder of the empirical research. Next, we move on to the hypotheses. Each of the hypotheses have their own sub-chapters, since this seemed as the most logical way to organize the chapter. The chapters of the hypotheses include both the results and the discussion and implications of these results.

5.1. Correlations Between Asset Classes

Table 3 presents correlations between the indices. These correlations are static, average figures from the entire observation period. They measure the co-movement the indices on average have between each other. For example, the average correlation for SP500 and treasury bonds between 2006 and 2015 has been -0,39. Table 3 includes correlations between all the indices, but we are only interested in the correlations which include treasury bonds. Therefore, those four correlations have been bolded.

A few interesting observations can be made from these average correlations. Firstly, corporate bonds have moved in almost perfect positive co-movement with the treasury bonds, indicating they are very similar assets. This is somewhat in contradiction with the previous studies (Market Realist 2015, Alliance Bernstein 2014), since they have found corporate bonds to co-move much less with the treasury bonds.

Secondly, all three stock market indices have had very similar correlations with the treasury bonds. Based on this, beta does not seem to affect the correlation too

much, since the difference between high and low beta correlations is relatively small. This also contradicts the safe haven capabilities low beta stocks have been found to have (Levisohn 2011). Third, and perhaps the most crucial finding for the purposes of this thesis is the negative average correlation of all stock market indices with the treasury bonds. Most prior literature has found the stock-bond correlation to be fluctuating, but nevertheless slightly positive on the long-term (Yang, Zhou & Wang 2009, Ilmanen 2003). Now we have an over 9-year period where the average correlation is negative. A possible explanation to this can be the occurrence of the Financial Crisis of 2008, but nevertheless 9 years is a long period for a usually positive correlation to remain negative on average.

Table 3. Average Correlations Between the Indices.

| | <i>SP500</i> | <i>Low Beta</i> | <i>High Beta</i> | <i>Corporate Bonds</i> | <i>Treasury bonds</i> |
|----------------|----------------|-----------------|------------------|------------------------|-----------------------|
| SP500 | 1 | | | | |
| Low Beta | 0,9310 | 1 | | | |
| High Beta | 0,9318 | 0,7881 | 1 | | |
| Corporate Bond | -0,2947 | -0,2218 | -0,2965 | 1 | |
| Treasury Bond | -0,3993 | -0,3232 | -0,3869 | 0,8611 | 1 |

Figure 12 depicts the rolling correlations between the asset classes. A rolling correlation is a correlation of the returns of the past 30 days, giving us a dynamic view of the relationships between the asset classes. While Table 3 provided us with an average, static number of the long-term correlation, figure 12 shows how this relationship changes on a day-to-day basis.

The most important finding from the rolling correlations is the constant movement. The correlations are hardly ever stable and have moved for the entire observation period. The rolling correlation of the three stock market indices has moved hand-in-hand. The correlation with the stock market and the treasury bonds has evolved constantly, but the three stock market indices have moved very much in the same direction. The SP500 is actually difficult to spot from Figure 12, because it is below the other two graphs, a further demonstration of similar movement. Table 3 supports this claim, as the stock market indices have a strong positive correlation on the long-run. Low Beta stocks have had a slightly higher correlation than the other two stock market indices, but this

difference is very small. All the stock market indices have been negative most of the time, but have also experienced notable periods of positive correlation. The highest correlations have been around 0,6 and lowest -0,8, which signals nearly perfect negative co-movement.

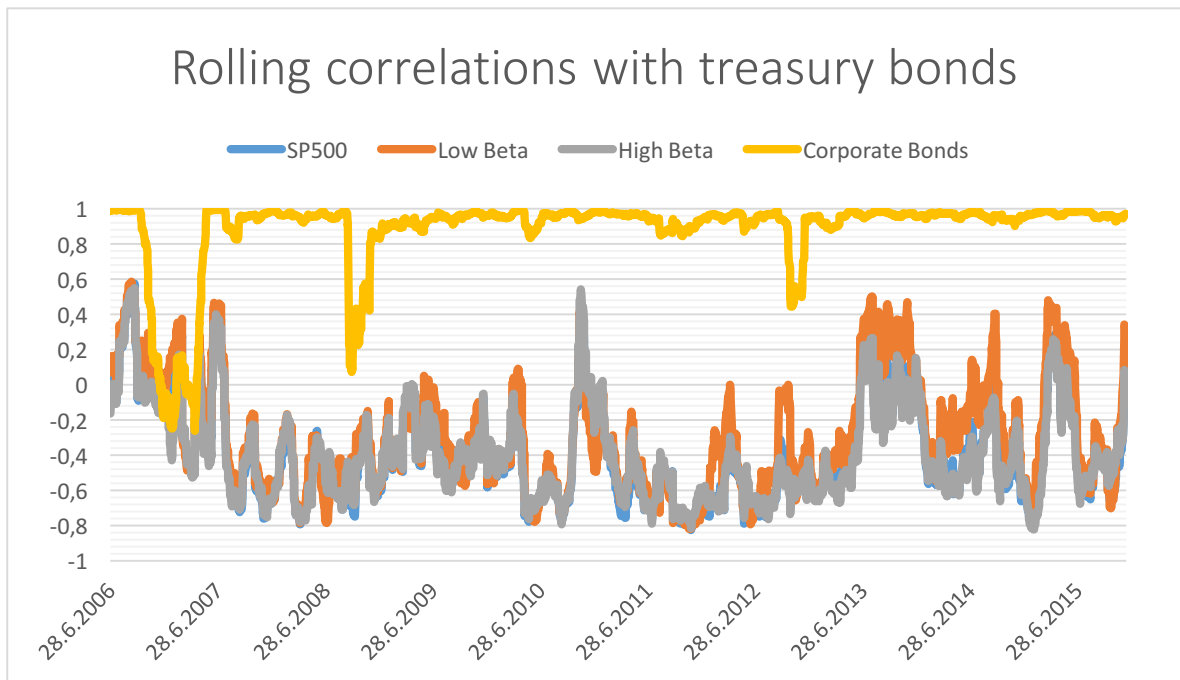


Figure 12. Rolling Correlations Between the Indices.

The rolling correlation for corporate bonds illustrates how the two bonds, treasuries and corporate bonds, have co-moved, and more importantly, how time variant this co-movement has been. Table 3 revealed that the average correlation between the two bond-classes was very high, 0,86. Figure 12 depicts that for most of the time, the correlation has been even higher than the average 0,86, moving between 0,8 and 1. However, the correlation has occasionally dropped and has even reached negative values in 2007. This is a considerable change from nearly perfect positive correlation. In Chapter 4.2 we found out that the corporate bonds returns were equity-like. These observations challenge that theory, but in a way also support it. The strong correlation with the treasury bonds naturally tells us that corporate bonds are very similar financial instruments as government bonds. However, their tendency to correlate negatively with treasury bonds from time to time sheds a different light on the case. By interpreting the Figure 12, the low-correlation periods for corporate bonds seem to coincide with the

low correlations for the stock markets, signaling a similar flight-to-quality phenomenon as the stock markets have had during crisis periods. Based on Figure 12, corporate bonds are something in between stocks and government bonds: bond-like during good times and stock-like during bad times.

Table 4. Percentage of negative correlations.

| | SP500 | Low Beta | High Beta | Corporate Bonds |
|-------------------------|---------|----------|-----------|-----------------|
| % Neg. Cor. | 87,73 % | 80,03 % | 90,86 % | 2,50 % |
| Neg. Correlation Return | 0,01 % | 0,02 % | -0,01 % | 0,00 % |

% Neg. Cor. Measures the amount of daily correlations with the treasury bonds, which are negative. The Neg. Correlation Return measures the average daily return during the days of negative correlation with the treasury bonds.

Table 4 shows the percentage of negative correlations between the four indices and the treasury bonds, and the average returns during those negative correlations. The stock indices are mostly negatively correlated with the treasury bonds, with 80–90 % of the observations negative. This is inline with Figure 12 from which we can clearly witness that the majority of the correlations lie below 0. Table X also includes the average daily returns from these negative correlations. They should be compared to the average returns from the whole sample, provided by Table 2. Noteworthy is that for all the four indices, returns during negative correlations are lower than on average. However, the differences are relatively small, for example for the SP500, only 0,01 % daily. Also, as the majority of the observations for the stock indices are negative, it is natural that the returns during negatively correlation are very close to the average return of the whole sample.

5.2. Results for the market timing strategy. Evidence: SP500

This chapter gives results for the first hypothesis: does the stock-bond correlation work as a market timing tool? Table 5 and Figure 13 provide the results from the tests, which followed the research done by Giot and Petitjean (2009). The strategy was implemented in a way that 10000 USD was invested into the SP500. The funds were shifted into United States Treasury Bonds when the trading day's stock-bond correlation was among the lowest 5 %, and otherwise kept in the stock index. Table 5 presents the strategy and compares it to a passive buy-and-hold strategy, in which all funds are simply invested

into the SP500 and kept there for the duration of the investment period. From Table 5 we can see that the strategies performed very evenly, with the difference in the annual returns only 0,16 %. Nevertheless, the active strategy was not able to beat the buy-and-hold strategy, even though our strategy ignored transaction costs. The investment horizon was 9 years.

Figure 13 portrays the same as Table 5, but shows how the active and passive strategy fared for the duration of the investments. The active strategy performed better until roughly 2012, after which the strategies performed hand-in-hand and finished pretty evenly, the passive strategy narrowly beating the active one. During some cases of very low correlations, the strategy was able to avoid the big stock market crashes and switch into bonds during market turmoil. However, on the long run the passive strategy has been slightly better.

Table 5. SP500

| | Active strategy | Buy-and-hold |
|---------------------|-----------------|--------------|
| Original investment | 10 000 | 10 000 |
| Value | 16 198,881 | 16 433,547 |
| Annual return % | 5,24 % | 5,40 % |



Figure 13. Active Strategy with SP500.

5.3. Results for the effect of beta on the market timing strategy

Chapter 5.3 answers hypothesis 2, does beta affect the market timing strategy tested in chapter 5.2. We will begin with results from Low Beta Index, then move on to High Beta Index and end the chapter with Corporate Bonds. The chapter is constructed similarly as the previous chapter 5.2, with a table and figure for each strategy and a comparison to the passive strategy buy-and-hold. The strategy used is identical to the one used in chapter 5.2, only the indices used are different.

Table 6 provides us the results from the active strategy with the Low Beta Index. The strategy gave a 5,04% annual return and added 5917 \$ value to an investor, but was clearly beaten by the simple buy-and-hold strategy, with 1,15% difference in annual return. And as the primary objective of the strategy is to beat the buy-and-hold strategy, we can say that for the Low Beta Index, the strategy was not successful.

Figure 14 shows how the values of the active and passive strategy evolved during the investment period. From year 2006, until 2011 the two strategies performed very evenly, with no practical difference. However, from 2011 onwards, the buy-and-hold strategy clearly beat the active strategy.

Table 6. Low beta.

| | Active strategy | Buy-and-hold |
|---------------------|-----------------|--------------|
| Original investment | 10 000 | 10 000 |
| Value | 15 917,583 | 17 639,070 |
| Annual return % | 5,04 % | 6,19 % |

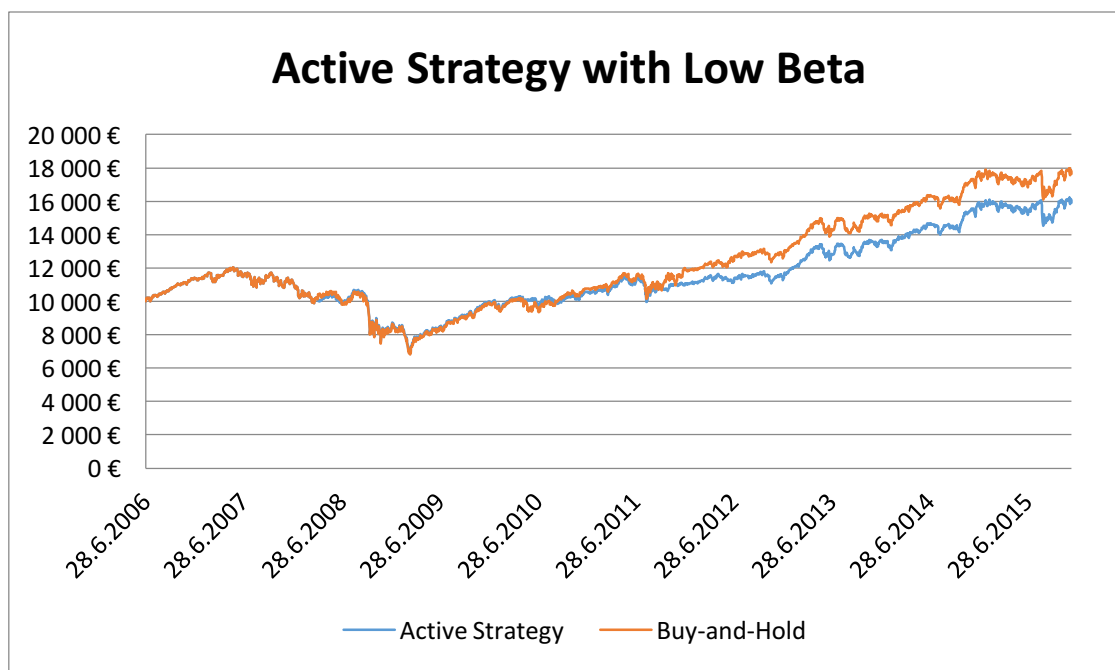


Figure 14. Active Strategy with Low Beta.

Table 7 provides results for the market timing strategy using High Beta Index. Unlike the other two strategies, the High Beta strategy resulted in losses for the investment period. Invested 10000 \$ turned into little over 8000\$ with a negative annual return of -2,09. It was also again beaten by the buy-and-hold strategy, which got in the black, but with smaller gains than in the previous two cases.

Figure 15 shows how the active and passive strategy involving High Beta Index performed. Noteworthy points are that the active strategy was behind the active strategy for almost the entire duration of the investment period, was negative for most of the time and also the large magnitude of the Financial Crisis of 2008 can be clearly seen from Figure 15.

Table 7. High beta.

| | Active strategy | Buy-and-hold |
|---------------------|-----------------|--------------|
| Original investment | 10 000 | 10 000 |
| Value | 8 188,424 | 10 514,852 |
| Annual return % | -2,09 % | 0,53 % |

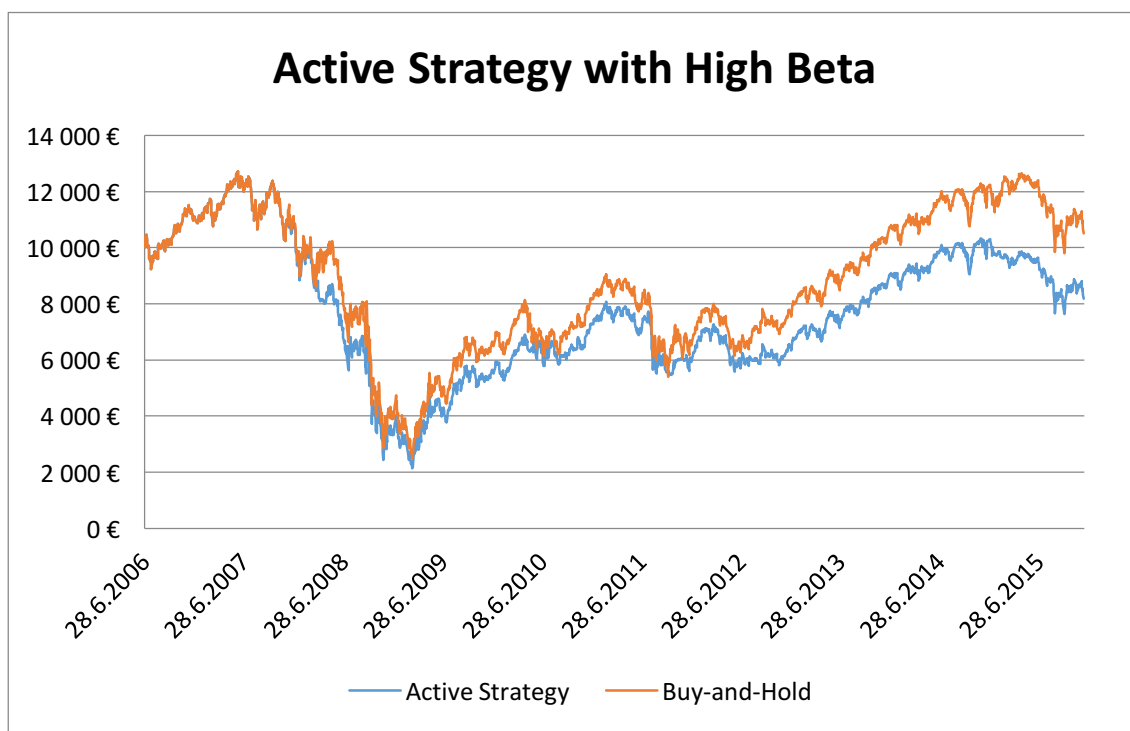


Figure 15. Active Strategy with High Beta.

Finally, Table 8 and Figure 16 report the results for the strategy using the Corporate Bond Index. An investment of 10000\$ resulted in 17561\$ in 9 years, or 6,14% annually, which is the best of the four indices. The active strategy was also able to beat the buy-and-hold strategy, with a margin of 0,37% annually. This was the only case in the four indices, in which the active strategy outperformed the passive.

Figure 16 depicts how the active and passive strategy have evolved. They began evenly, then roughly in 2009 the active strategy rose above and kept that advantage until the end of the investment. Both active and passive strategies gave investors good returns compared to the previous indices.

Table 8. Corporate bonds.

| | Active strategy | Buy-and-hold |
|---------------------|-----------------|--------------|
| Original investment | 10 000 | 10 000 |
| Value | 17 561,676 | 16 986,564 |
| Annual return % | 6,14 % | 5,77 % |

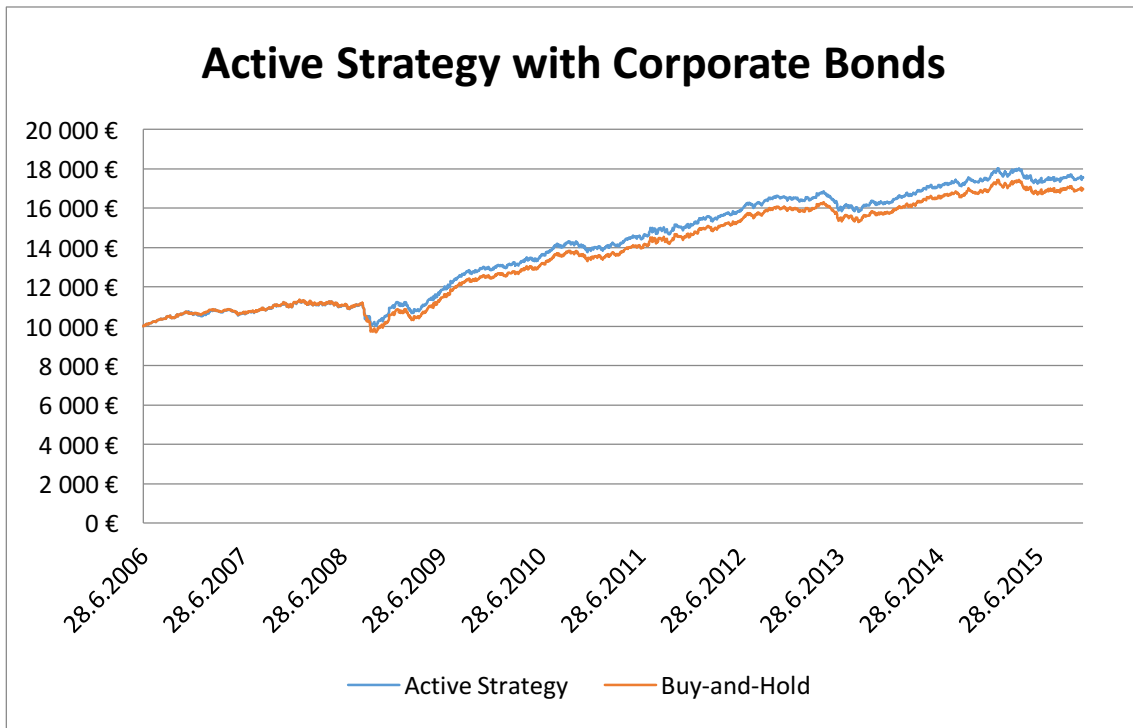


Figure 16. Active Strategy with Corporate Bonds.

5.4. Results for the predicting ability of the stock-bond correlation

This chapter presents the results for the third hypothesis: Can the stock-bond correlation be used to predict the market? Tables 9-16 present regression results for the regression. In each regression the dependent variable is the index return and the independent variable is either the correlation of the index and treasury bonds or the correlation with a one-month lag. First two tables depict the SP500, the next two Low Beta index, then the High Beta index and finally the corporate bond index. For each observation, coefficient, standard error, t-statistic and P-value are reported, as well as R^2 and adjusted R^2 .

Tables 9 and 10 present the results for the regression where SP500 returns are regressed with the stock-bond correlation of the SP500 and Treasury Bonds. In Table 9, the independent variable is the correlation from the previous month and in Table 10 it is the same months as the dependent variable. The variables CorrSP500Lag and CorrSP500 are both statistically insignificant, with small t-statistics and large P-values and are insignificant even on the 10%-level.

Table 9. SP500 with one month lag.

| | Coefficients | Standard Error | t Stat | P-value |
|--------------|--------------|----------------|--------|---------|
| Intercept | 0,000383 | 0,000463 | 0,8268 | 0,408 |
| CorrSP500Lag | 0,000458 | 0,000961 | 0,4763 | 0,634 |

R² 9,69468E-05Adjusted R² -0,000330**Table 10.** SP500 no lag.

| | Coefficients | Standard Error | t Stat | P-value |
|-----------|--------------|----------------|--------|---------|
| Intercept | 0,000454 | 0,000459 | 0,990 | 0,322 |
| CorrSP500 | 0,000629 | 0,000955 | 0,659 | 0,510 |

R² 0,000184Adjusted R² -0,000240

Tables 11 and 12 present the results for the Low Beta regressions. Table 11 has a one-month lag, while Table 12 has no lagged variable. The t-statistics and P-values for CorrLowBetaLag and CorrLowBeta are very similar to those values we previously found from Tables 9 and 10. They show us that, neither of the Correlations between Low Beta index and Treasury bonds has any predicting power. The results are statistically insignificant.

Table 11. Low beta with one month lag.

| | Coefficients | Standard Error | t Stat | P-value |
|----------------|--------------|----------------|--------|---------|
| Intercept | 0,000161 | 0,000274 | 0,587 | 0,557 |
| CorrLowBetaLag | -0,000239 | 0,000629 | -0,380 | 0,704 |

R² 6,18013E-05Adjusted R² -0,000366

Table 12. Low beta no lag.

| | Coefficients | Standard Error | t Stat | P-value |
|-------------|--------------|----------------|--------|---------|
| Intercept | 0,000240 | 0,000271 | 0,886 | 0,376 |
| CorrLowBeta | -0,000003 | 0,000624 | -0,005 | 0,996 |

R² 9,28108E-09Adjusted R² -0,000424

Tables 13 and 14 depict the results for the High Beta regressions. Similarly to the earlier regressions, Table 13 and its independent variable CorrHighBetaLag are results with a one-month lag in correlations and Table 14 shows the results with no lag. Again, the results from both Tables are statistically insignificant on all levels, with high P-values and small t-values and show us that the correlation between the high beta index and treasury bonds offers no predicting power towards stock returns.

Table 13. High beta with one month lag.

| | Coefficients | Standard Error | t Stat | P-value |
|-----------------|--------------|----------------|--------|---------|
| Intercept | 0,000390 | 0,000884 | 0,442 | 0,659 |
| CorrHighBetaLag | 0,000885 | 0,001850 | 0,478 | 0,633 |

R² 9,77228E-05Adjusted R² -0,0003296**Table 14.** High beta no lag.

| | Coefficients | Standard Error | t Stat | P-value |
|--------------|--------------|----------------|--------|---------|
| Intercept | 0,000404 | 0,000876 | 0,461 | 0,645 |
| CorrHighBeta | 0,000972 | 0,001840 | 0,528 | 0,597 |

R² 0,0001183Adjusted R² -0,0003052

Finally, Tables 15 and 16 report the results for the regressions with corporate bonds and treasury bonds. Table 15's results are similar to those of all the three stock indices presented earlier in this chapter, the lagged correlation has no predicting power. On the contrary, Table 16 provides interesting results from the correlation with no lag. Its p-

value is 0,03 and it is therefore statistically significant on the 5% level. The coefficient is positive, but also very small.

Table 15. Corporate bonds with one month lag.

| | Coefficients | Standard Error | t Stat | P-value |
|------------------|--------------|----------------|--------|---------|
| Intercept | 0,000350 | 0,000272 | 1,289 | 0,197 |
| CorrCorporateLag | -0,000148 | 0,000297 | -0,498 | 0,618 |

R² 0,0001060

Adjusted R² -0,0003213

Table 16. Corporate bonds no lag.

| | Coefficients | Standard Error | t Stat | P-value |
|---------------|--------------|----------------|--------|---------|
| Intercept | -0,000335 | 0,000271 | -1,239 | 0,216 |
| CorrCorporate | 0,000631 | 0,000296 | 2,131 | 0,033 |

R² 0,001920

Adjusted R² 0,001498

6. CONCLUSIONS

6.1. Conclusions

The main goal of this thesis was to research the market timing abilities of the stock-bond correlation. The two most common financial instruments in portfolios are stocks and bonds. The stock-bond correlation could offer investors information when to switch holdings from stocks to bonds or vice versa. This is important, because stocks are known for high returns accompanied with high volatility, while bonds usually offer low, but stable returns. A well-timed switch is what all risk-averse investors hope for and this would give them an additional tool for their asset allocation and risk management purposes.

A secondary goal and theme of the thesis is dividing stocks into different sub-categories and compare, whether they have a different relationship with treasury bonds. The different assets used in the thesis have been the high and low beta indices, representing stocks of high and low volatility, respectively, the SP500 as a proxy for the entire stock market and corporate bond index, which is something in between stocks and treasury bonds.

The thesis began with an overview of the literature behind the topic. The chapter introduced both the stock-bond correlation and the bond-equity-yield-ratio, more commonly known as BEYR. Generalizing, we can say that the literature behind the stock-bond correlation focused on theory and the literature concerning BEYR was more about practical tools for the stock market, which this thesis attempts to combine.

Next we moved on to the most important theories behind influencing the study and worth mentioning. The theoretical framework began with portfolio theory and the CAPM, to illustrate how portfolios are built as a combination of stocks and bonds and how assets should be priced according to their market risk. Next we had a chapter for both stocks and bonds, to tell the reader about the different kinds of stocks and bonds there are and which will be used in this thesis. The theoretical framework also briefly included stock-bond correlation and BEYR, the two topics introduced in the previous chapter. This was done to summarize their most important aspects and to show how they are calculated. The theoretical part ended with a chapter on market indicators, which we assume the stock-bond correlation is.

After the previous literature and the theoretical framework, the thesis moved on to the empirical research. Chapter 4 presented the used data, hypotheses and methodology of research, while Chapter 5 contained the research results. The data used was from the most recent 9 years to give relevance to the study and be more interesting than research made with older data, and the methodology used was chosen from well known research papers and converted to the purposes of this thesis. The hypotheses of the thesis were limited to three. The first hypothesis is that the stock-bond correlation can be used to time the market and perform as a profitable investment strategy. The second hypothesis acts as an extension to the first one and predicts that stock beta affects the profitability of the strategy, used in hypothesis 1. The third hypothesis is that the stock-bond correlation works as a market indicator, which has also been extended to include all 4 indices. The hypothesis have been chosen to test the stock-bond correlations capabilities from two different aspects and provide a possible investment strategy for investors.

Chapter 5 contains the empirical research of the thesis. It first has a sub-chapter about the correlations between the asset classes and then sub-chapters for results of each of the three hypothesis. The correlations between the asset classes were surprising. The average correlations for all of the stock indices were negative, while historically they have been positive (Yang, Zhou & Wang 2009) and corporate bonds were almost perfect substitutes for treasury bonds. In a longer perspective, the correlation of the two bond classes has not been so high (Alliance Bernstein 2014). Figure 12 in the same sub-chapter shows the rolling correlation, which will later on be used in the hypotheses testing. From it we can clearly spot the similar movement of the stock market indices and how the correlations have constantly changed. The similar movement of SP500, high beta and low beta indices is interesting, since stocks can be very different, but yet they interact very similarly with treasury bonds.

Next we move on to testing our three hypothesis. We will go through the hypothesis one-by-one, presenting the results and then providing discussion of the results, before moving on to the next hypothesis. The first hypothesis tested the market timing abilities of stock-bond correlation by trying to avoid the worst days of the stock market with it. The strategy was first used by Giot and Petitjean (2009), who used BEYR in the place of stock-bond correlation, but otherwise a similar strategy. The results for the tests were that the active market timing strategy was not able to beat the passive buy-and-hold strategy. It was profitable and only narrowly lost to the buy-and-hold strategy, but

nevertheless, stock-bond correlation cannot be said to be a good tool in market timing if it cannot beat the buy-and-hold. Thus the first hypothesis was rejected.

The strategy implemented failed to produce superior returns. This is interesting since for Giot and Petitjean (2009), it was the best of the testable strategies. Either the stock-bond correlation is not as good as the BEYR or the period was just wrong for the strategy. Looking at Figure 13, we can see that initially the active strategy did well, but in the later years was not able to outperform the passive strategy. One possible explanation for this could be that during the last five years, stock markets have done well, with new record levels for SP500, while simultaneously bond markets have been hit by low interest rates due to government actions. Thus a strategy only involving stocks could fare better than a strategy involving both financial instruments.

The second hypothesis was an extension to the first one and involved high beta, low beta and corporate bond indices used in a market timing strategy similarly as the SP500 in hypothesis 1. The low beta index had a very similar performance as the SP500; it was profitable, but was not able to keep up with the buy-and-hold strategy in the later years of the strategy and eventually lost. This similar pattern can clearly be seen when comparing Figures 13 and 14. For the high beta index, the results were somewhat different. It was the only index that produced negative returns when used with the market timing strategy and it also lost to the buy-and-hold strategy. This can be explained by poor performance of high beta stocks during the observation period, which Figure 8 presents. Finally, corporate bonds were tested in a similar strategy. They were the only index in which the active strategy managed to beat the buy-and-hold strategy. By shifting investments from corporate bonds into treasury bonds when their correlation became low, and vice versa when the correlation normalized, produced a winning strategy and good returns for investors.

Hypothesis 2 can be partially accepted. While the low beta index gave no difference to the SP500 and hypothesis 1, high beta performed much worse and corporate bonds better than the market proxy. So in two out of three cases the beta and asset riskiness affected the strategy performance and at least corporate bond investors could use the strategy introduced in the thesis. In addition, the strategy worked for the stock indices during some periods of market turmoil, but failed to work during others. Each of the three indices had a few periods, during which stock-bond correlation gave the signal to sell stocks and buy bonds and with it the investor could avoid a significant drop in the

stock price. From this we can draw a conclusion that with little adjustment and fine-tuning, the strategy could really work.

Hypothesis 3 tested whether the stock-bond correlation works as a market indicator. In it each of the four stock market indices are tested twice with a standard OLS regression. The regression attempts to predict the index returns with the stock-bond correlation as an independent variable and does it both with a one-month lag and with no lag between the correlation and return. The methodology was taken from the research by Fang, Qin and Jacobsen (2014). The results show that the stock-bond correlation does not work in predicting market returns and hypothesis 3 can be rejected. Seven out of eight regressions are not statistically significant even on the 10 % level, with very large P-values. This is in line with the by Fang, Qin and Jacobsen (2014), where they also found out that most market indicators do not work and even those that work, cannot outperform the market returns. This results support the efficient market hypothesis (Fama 1970: 414-415) and at least in this case technical analysis does not work.

Again, corporate bonds were the only case in which the research got significant results. Corporate bond returns could be predicted on the 5 % level using the same days correlation of corporate bonds and treasury bonds. This could offer corporate bond investors a tool to forecast returns, but for the other indices it does not work. As concluding remarks, corporate bond investors could benefit from the findings of this thesis. Investors investing in the three stock market indices have to either wait for a better timing or modify the stock-bond correlation –strategies. There is clearly potential in it, but based on these findings, it seems a bit incomplete to consistently beat the market.

6.2. Ideas for further research

The study was clearly influenced by the Financial Crisis of 2008, which can be seen in the average stock-bond correlations of the sample. Although the stock-bond correlation has historically moved from negative to positive and changed level almost constantly, it has nevertheless been positive and low on average. During our sample the stock-bond returns were negative, which can also affect the effectiveness of the trading strategies used in the thesis. Therefore, the first idea

for future research would be to perform the same tests with either much older data or in a few years with the data then available.

A second idea for further research among this field of study would be to extend it outside the United States and preferably to emerging markets. The bonds of emerging markets are not safe haven instruments like the United States Treasury Bonds, so the use of the strategies of this thesis should result in very different outcomes. On the other hand, European markets are in many ways similar to those of the United States so similar research in Europe would also be interesting to perform and interpret.

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