BI Norwegian Business School - campus Oslo

# GRA 19703

Master Thesis

Thesis Master of Science

How to use an interest rate forecast in deciding upon a bond investment strategy


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## 1. Abstract

Because of the inverse relationship between interest rates and bond prices, we have made an interest rate forecast to choose an investment strategy for bonds. In this forecast we find that the interest rate will make a drop in 2019 and then increase moderately in the time period up until 2049. We will therefore recommend a *bond laddering* investment approach for risk-averse investors, and a *bond swapping* approach for investors more open for taking on risk.

## 2. Introduction

We will start by looking at the research question, before we move to the introduction, where the question is described and the general direction of the thesis is discussed. After that will we shortly look at the results of the interest rate forecast and some of the implications with the findings.

### *2.1 Research Question*

*How do you forecast the interest rate, and how do you use this information when deciding upon a bond investment strategy?*

### *2.2 Introduction*

I have chosen to write about interest rate forecasting and bond investment strategies in my thesis. I will look into variables that could predict the interest rate, and then use this information to choose a bond investment strategy. This thesis will be solved as an empirical study, where I will try to analyze obtained data to choose an optimal bond investment strategy.

Being able to forecast interest rates is highly relevant in finance. For example, it could give a company predictability in future cash flows, making it easier for them to make strategy decisions about the future. To show how an interest rate forecast is relevant is an important part of my thesis, and that is why I have chosen to look at how I can use the forecast when trying to choose an optimal bond investment strategy.

*"Forecasting interest rates is one of the most notoriously difficult parts of applied macroeconomics"* (Bodie, Kane & Marcus, 2014, page 118).

Trying to forecast the interest rate could prove to be hard, there are many potential variables that needs to be taken into account. In finance there is something called "the Fisher effect", it states that the movements in short-term interest rates largely reflect changes in expected inflation (Baghestani, 2016). But there are also many other variables that drive the interest rates, like supply, demand, and government actions (Bodie et al., 2014, p.563).

Which bond strategy that is optimal will depend heavily on the interest rate forecast, as interest rates and bond prices have an inverse relation, which means that when interest rates increases bond prices drops, and vice versa (Bodie et al., 2014, p.463-464).

Since there are considerable amounts of money to be earned for investors if using the most optimal bond investment strategy, there has been a lot of research on this topic. This study could contribute to the research field of bond investment strategies and could give insight into how to use an interest rate forecast to decide the most optimal strategy for bond investment. This study could therefor expand the current knowledge and understanding of optimal bond investment strategies in the field.

### *2.3 Results and Implications*

From the interest rate forecast we get that the interest rate will experience a significant drop in 2019, and after that increasing moderately until 2049, when it will almost be at the same level as it was before the drop.

The main implication with this result is that it is not accurate, so using it in a bond investment strategy choice will not give us any accurate answers about the how the situation is in the real world, at this moment. With this interest rate forecast, we are set in a hypothetical situation, that is only of academic interest.

# 3. Theory

In this chapter I will look at theories that are relevant for an interest rate forecast, to investigate how and why the interest rate moves, and what kind of bond investment strategy that could benefit from this interest rate forecast.

## 3.1 Interest rate forecast

As already mentioned, making an accurate interest rate forecast is one of the most complex parts of macroeconomics. This is due to the fact that it is driven by several variables that are hard to predict, making it seemingly impossible to come up with an accurate long-term interest rate forecast. A lot of research has been done on the topic of interest rates and several theories have been developed concerning how to forecast it. In this part I will explore these theories, especially looking at the Fisher equation, to gain a better understanding of how the interest rate moves, and to hopefully get a better understanding of how it will move in the future. But before we examine the different theories, we need to understand what the interest rate is and which variables influence it.

### *3.1.1 Interest rate basics*

An interest rate is the amount that the lender charges for lending out his or her money. It is a promised rate of return that is expressed as a percentage of the loaned sum, and is usually noted on an annual basis. When looking at bonds, the interest rate will be the amount the bond issuer have to pay to the investor as a compensation for lending his or her money (Bodie et al., 2014, p.118). How interest rates work on bonds is something I will look further into in the bond part.

Even though the interest rate is considered difficult to forecast, research in the field has led to a comprehensive understanding of the fundamental factors that determine the level of interest rates (Bodie et al., 2014, p.563):

1. The supply of funds from savers.

2. The demand for funds by businesses.
3. The government's net demand for funds.

The supply of funds from savers is primarily derived from households. The demand for funds from businesses is to be used to finance investments, such as plan, equipment, inventory, etc. (real assets or capital formation). The government's net demand for funds are set by the central bank, and they can modify their demand through their actions. This effectively means that the government, through the work of the central bank, can influence the future interest rate. This is their fiscal and monetary policies, where they either want to stimulate the economy, or check its growth. For example, if the economy is moving slowly, and it sees less and less investing, the government will then usually try to find ways to invest more money, so that households will gain more money, and then again spend more money, which will stimulate the economy. One way to do this is through lowering the interest rate. By doing this, households and businesses will experience less cost when taking out a loan and at the same time get a lower rate on their own deposits in the bank, making it less attractive to save money. Still, some times, the economy could be stimulated to a degree where the general price levels increase too fast, and this could make the inflation levels to rise above the wanted levels. In this case the government could either increase taxes or they could increase the interest rate, both alternatives would slow the economy down. These three factors determine the level of real interest rate. To get the nominal interest rate we need to add expected inflation, and we get this from the Fisher equation. This will be explained further at a later point (Bodie et al., 2014, p.563-565).

### *3.1.2 Market interest rate*

When analyzing the interest rate it is important to understand that all interest rates move together. "*Although there are many different interest rates economywide (as many as there are types of debt securities), these rates tend to move together, so economist frequently talk as if there were a single representative rate"* (Bodie et al., 2014, p.121-122). The main analysis in this thesis will be carried out on the basis of this understanding, with interest rates that move together while acting like there is a single representative rate. This will be explained more thoroughly in the methodology part.

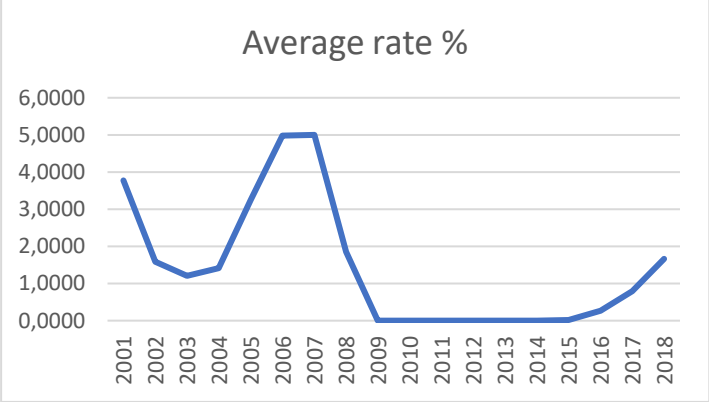
This understanding entails that we only will need one interest rate, with its historical values, to make the interest rate forecast needed for the analysis. I have therefore decided that we will look at the market interest rate. Figure 1 and 2 shows what the rate has been historically, and how it has moved on an annual average since 2001 and up until 2018. We will come back to the analysis of these rates in the preliminary analysis.

FIGUR: 1

| Year | Average rate % |
|---|---|
| 2001 | 3.7777 |
| 2002 | 1.5833 |
| 2003 | 1.2042 |
| 2004 | 1.4167 |
| 2005 | 3.2500 |
| 2006 | 4.9792 |
| 2007 | 5.0000 |
| 2008 | 1.8542 |
| 2009 | 0 |
| 2010 | 0 |
| 2011 | 0 |
| 2012 | 0 |
| 2013 | 0 |
| 2014 | 0 |
| 2015 | 0.0208 |
| 2016 | 0.2708 |
| 2017 | 0.7917 |
| 2018 | 1.6667 |

(Source: Appendix A)

FIGUR: 2




(Source: Appendix A)

### *3.1.3 The Fisher Equation*

In *Interest Rate Basics* I talked about the three fundamental factors that determines the real interest rate, which where supply demand and government actions. In this part we are going to look at how the nominal interest rate is determined, thru the Fisher equation.

To understand The Fisher Equation, we first need to understand the difference between the real interest rate and the nominal interest rate. The nominal interest rate is the stated interest rate, the agreed upon rate that you pay. While the real interest rate is an interest rate that has been adjusted so that it takes inflation into account, meaning that you get the real rate of a bond or a loan (Investopedia-interestrate, 2019). This will be clearly illustrated later.

The Fisher equation was developed by Irving Fisher in 1930, and it states that the nominal interest rate increases proportionally with the expected inflation, illustrated by this equation:

$$i_t = r_t^e + \pi_t^e \quad (1)$$

Where $r_t^e$ is the real interest rate, $i_t$ is the nominal interest rate, and $\pi_t^e$ is the expected inflation rate. If we turn the equation around, we get that the real interest rate is the nominal interest rate adjusted for inflation, as stated above.

$$r_t^e = i_t - \pi_t^e \quad (2)$$

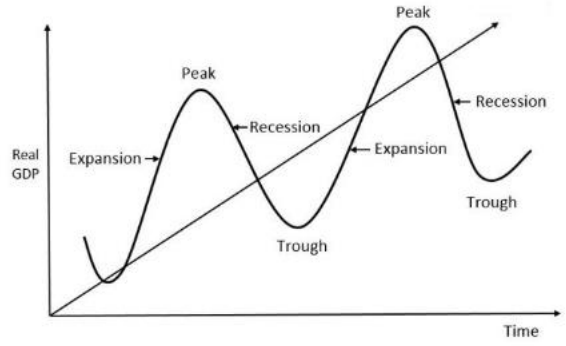
The equation has been empirically tested several times, with mixed results. This is due to the fact that we are not able to forecast the inflation rate in a satisfying way, and that real rates change unpredictable over time, more about this in the literature review.

One interesting thing to take out from the Fisher equation is how much inflation actually affects the interest rates. Since the equation implies that the real interest rate is reasonably stable, it means that changes in the nominal interest rate are due to changes in the expected inflation (Bodie et al., 2014, p.121). We know that the United States has an inflation target of 2 % (Feder Reserve, 2019). This means, according to the Fisher equation, that changes in the U.S. interest rates is due to the fact that they have not achieved their inflation target of 2 %.

### *3.1.4 The Business Cycle*

The business cycle is the ups and downs in the economy, it's the recurring pattern of recession and recovery, as you can see in figure 3. No matter what fiscal and monetary policies that are in use, the economy will pass through good and bad times. Interest rates are highly sensitive to the business cycle (Bodie et al., 2014, 566). As mentioned before, the interest rate will go down when economy is not doing so good and need to be stimulated, typically in the "recession" and "trough" points in the figure, and the interest rate will go up when the economy no longer need to be stimulated, typically when its on a "peak" or in "expansion".

FIGUR: 3



(source: Toppr, 2019)

Trying to predict the business cycle is not an easy task, but there are some indicators that could help forecast the interest rate:

Figure: 4

| Leading indicators |
| --- |
| 1. Average weekly hours of production workers |
| 2. Initial claims for unemployment insurance |
| 3. Manufacturers new orders |
| 4. Fraction of companies reporting slower deliveries |
| 5. New orders for nondefense capital goods |
| 6. New private housing units |
| 7. Yield curve slope: 10-year treasuries minus federal fund rates |
| 8. Stock prices |
| 9. Money supply (M2) growth rate |
| 10. Index of consumer expectations |

(source: Bodie et al., 2014, p.568)

These indicators are so-called leading indicators, which means these indicators are those who tend to rise or fall in advance of the rest of the economy, telling us how the business cycle will move, and thereby telling us how the interest rate will move.

## 3.2 Bond investment strategies

To choose the right bond investment strategy one first needs to understand what bonds are, and how they work. Before looking at some investment strategies on bonds, we have to understand what bonds are, consider different types of bonds, investigate how these bonds have performed historically, and evaluate different risks that you are exposed to when holding a bond.

### *3.2.1 Basics of bonds*

A bond is a debt security, where an investor gives out a loan to a corporation, government, federal agency or other organizations. For this loan the bond issuer will pay an interest to the investor, making it attractive for the investor to lend out his or her money. The bond issuer and the investor will also agree upon a future date when the issuer will have to repay the original loaned sum, this is called the bonds maturity date. Corporations or governments issue bonds when they need to raise money (Bodie et al., 2014, p.446).

Bonds are traded on two different markets, called the primary and the secondary market. The primary market is where the bond is first issued, and where it initially is traded. In the secondary market the initial buyers can resell these bonds, and this is where the bond is traded after it is issued. Not all bonds can be traded on the secondary market, but if the bind is callable you can trade it after you have bought it. Both markets are open for all investors, but the primary market is not that easy to access for all, since transactions usually takes place behind closed doors. Therefore, it is mostly large investment banks who buy on the primary market, so that they can sell on the secondary market (Bodie et al., 2014, p. 59-67).

### *3.2.2 Bond definitions*

This part is important as it will help us understand the information we are given about bonds, as well as some of the output from the analysis. When the bond issuer and the investor agree upon a deal, the investor will get some information about the bond he or she is going to hold, this will be information about its maturity date, yield, par/face value, price and coupon rate. The paragraph below will help us understand some of these concepts.

If we start with the *maturity date,* this is the time when the issuer has to repay the original loaned sum. The *yield* on a bond is the amount of return the investor will realize on the bond, and you get this return by dividing its face value by the interest of the bond. The *yield to maturity (YTM*) is the total return on a bond, if it is held until it matures. Calculating the YTM is highly complex, and I will accentuate this in the methodology part, since this is an important calculation in this thesis. *Face value*, or par value as its known as when working with bonds, is the amount paid back by the bond issuer at maturity. Bonds come with *bid and ask prices*, where the ask price is the sum you can buy the bond for while the bid price is what you can

sell your bond for. The ask price will be higher than the bid price, and the difference between them are called the bid-ask spread. A *coupon payment* on a bond is the annual interest payment, which the bondholder receives as the bond runs (Bodie et al., 2014, p.446-468).

### *3.2.3 Bond risks*

Before going into the different types of bonds on the market, we need to consider some of the risks that a bondholder face. Even though bonds are considered not to be a risky investment, compared to other investment alternatives, bonds are still exposed to some risks that are worth taking a look at. According to Fabozzi (2000, p. 5-8) there are in total nine different risks that you as a bondholder is exposed to, with interest-rate risk and default risk as the most relevant risks for this thesis.

Since this thesis is about an interest rate forecast, it is natural that *interest rate risk* becomes an important part of the risk segment. Interest rate risk entails that changes in the interest rate may change the price of the bond, and in that way making it more or less attractive to sell the bond before maturity (when the bondholder has to sell it on the secondary market). For example, if the interest rate increases, and all other relevant factors stay the same, it would mean that the price of the bond would decrease, which would inflict an investor who sells his or her bond with capital losses (Fabbozi, 2000, p.5-8). The reason that bond prices respond like this to interest rate fluctuation is due to the fact that investors expect bonds to offer them fair expected rates of return. When the interest rates go up it becomes less attractive to hold old bonds, since they were signed when the interest rates were lower, meaning that they will pay out lower interest than bonds that are signed when the interest rate is higher (Bodie et al., 2014. P.516). If you are the investor this is called *reinvestment risk*, which means that you are greatly exposed to interest rate risk at the point when you are reinvesting the cash flow received from a bond (Fabbozi, 2000, p.5-8).

The other important risk for this thesis is *default risk*, which is when the issuer of the bond is not able to make its payments to you as a bondholder. This risk does not apply for government bonds, since they are guaranteed by the government. But

default risk is important for bondholders investing in corporate bonds, where you have no guarantee that they won't go bankrupt, or struggle to such a degree that they are not able to pay its investors (Bodie et al., 2014, p.468-469).

Bond default risk is often referred to as credit risk, which are measured by Moody's Investor Services, Standard & Poor's Corporation, and Fitch Investor Services. These companies provide us with quality ratings of bond issues. They assign each bond issue with a letter grade, with "AAA" and "Aaa" being the top ratings, as you can see from the figure below. As you can see from the figure the credit rating companies distinguishes between investment-grade bonds and junk bonds, where the higher graded bonds are referred to as investment-grade bonds, while lower graded bonds are referred to as junk bonds. The lower the credit rating of a bond, the higher the chances are of default, therefore investors who invest in junk bonds would want to be fairly compensated for taking on this additional default risk (Bodie et al., 2014, p. 468-469).

Figure: 5

| | Moody's | S&P | Fitch | Meaning |
|---|---|---|---|---|
| Investment Grade | Aaa | AAA | AAA | Prime |
| | Aa1 | AA+ | AA+ | High Grade |
| | Aa2 | AA | AA | |
| | Aa3 | AA- | AA- | |
| | A1 | A+ | A+ | Upper Medium Grade |
| | A2 | A | A | |
| | A3 | A- | A- | |
| | Baa1 | BBB+ | BBB+ | Lower Medium Grade |
| | Baa2 | BBB | BBB | |
| | Baa3 | BBB- | BBB- | |
| Junk | Ba1 | BB+ | BB+ | Non Investment Grade Speculative |
| | Ba2 | BB | BB | |
| | Ba3 | BB- | BB- | |
| | B1 | B+ | B+ | Highly Speculative |
| | B2 | B | B | |
| | B3 | B- | B- | |
| | Caa1 | CCC+ | CCC+ | Substantial Risks |
| | Caa2 | CCC | CCC | Extremely Speculative |
| | Caa3 | CCC- | CCC- | In Default w/ Little Prospect for Recovery |
| | Ca | CC | CC+ | |
| | | C | CC | In Default |
| | | | CC- | |
| | D | D | DDD | |

(source: weforum, 2016)

According to Fabbozi (2000), there are still six risks that you are exposed to. These are not as relevant for this thesis, but they are still worth mentioning. First, we have *inflation risk*, which is when the value of the bonds cash flow varies due to inflation. We have *exchange-rate risk*, which only applies if the payments are done in a foreign currency. *Liquidity risk* is about how easy it is to sell the bond at its value. *Volatility risk* is when the price of the bond changes due to changes in volatility on

one of the factors that affects bond prices, for example interest rates. We have *call risk*, which is about exposure to additional risks. And last, we have something Fabbozi calls *risk-risk*, and this is when you don't know exactly what the risk associated with the bond is (Fabbozi, 2000, p.5-8).

### *3.2.4 Different types of bonds*

There are several types of bonds out in the market open for investors. In this part I will focus on the types of bonds I need in the analysis, which are U.S. Treasuries and corporate bonds. But I could have also looked at other types of bonds such as municipal bonds, TIPS (Treasury inflation-protected security), emerging markets bonds, and many more.

*U.S. Treasury Securities*

U.S. Treasury securities, often referred to as Treasuries, are issued by the United States government. Treasuries comes in three variants: Treasury bonds (T-bonds), Treasury notes (T-notes), and Treasury bills (T-bills). The main difference between these are when they mature. T-bills matures in one year or less, T-notes matures in two, three, five and 10 years, while T-bonds matures between 10 and 30 years. Another important difference is that T-bills are non-interest bearing, meaning that they don't pay out coupons (zero-coupon), while T-notes and T-bonds interest pay out on a semiannually basis (FINRA, 2019).

Treasuries are considered to be among the safest investments you can make, this is due to the fact that all treasury securities are backed by the government. With U.S. Treasuries it means that the U.S. government is obligated to take care of its bondholder, even if there is a recession or war going on (FINRA, 2019). But investing in Treasuries is still not risk free, even though it has no default risk since the government has guaranteed it. For this thesis the interest rate risk of Treasuries will be important, trying to understand how you should invest, depending on how the interest rate moves.

*Corporate bonds*

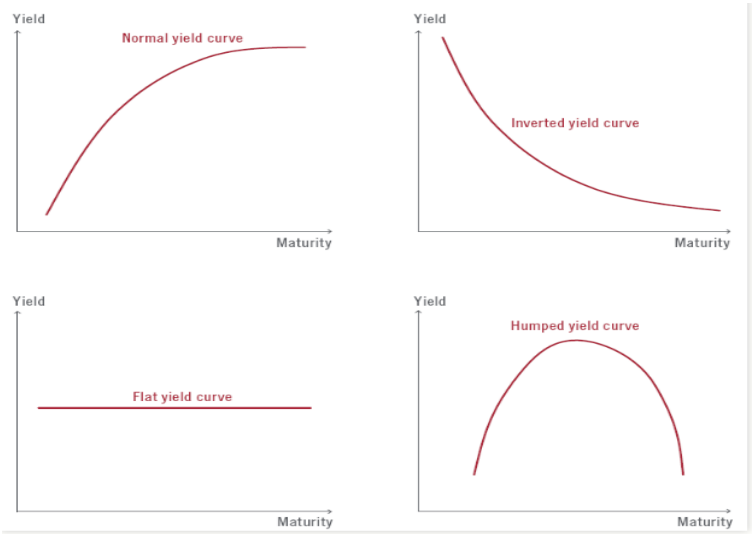
Corporate bonds are bonds issued by corporations. They do this to raise money for capital expenditures, operations, or acquisitions. Corporate bonds work in the same way as any other bonds, and as with Treasuries, they are issued with different maturities. But unlike treasuries, corporate bonds are exposed to default risk. This makes corporate bonds more volatile than government bonds, this is often reflected in the return they give, since investors expect compensations for taking on additional risk (FINRA, 2019).

### *3.2.5 Term structure of interest rates*

The term structure of interest rates is the relationship between interest rate or bond yields and different maturities, when this is graphed it is called a yield curve. We already know that bond prices have an inverse relationship with interest rates, meaning that if the interest rate go up, then the bond price go down. In this part we are going to explore the yield curve, and look at two theories that may help us predict it to some extent.

First of all, we have to understand what the yield curve is, and how it works. The yield curve is a graphical summarization of the relationship between yield and maturity, it is a plot of yield to maturity as a function of time to maturity. Interpreting the yield curve allows investors to gauge their expectations for the future interest rates against those of the market, and therefore it is central in bond valuation (Bodie et al., 2014, p.487). In figure 6 you can see four examples of yield curves, where we have a normal yield curve, an inverted yield curve, a flat yield curve, and a humped yield curve.

Figure: 6




(Source: Perspectives, 2019)

When the yield curve has a normal shape then bonds with longer-term maturities will have higher yields, relative to bonds with shorter-term maturities. But when the yield curve is inverted it's the other way around, then the bonds with shorter term maturities has a higher yield. This is a rare phenomenon, and only really happens in recessions. If the yield curve is flat, there is no or little differences in yields of long- and short-term maturity bonds. When the yield curve is humped, then bonds with a medium maturity has the highest yield. While short and long maturity bonds have low yields. Its only in one of these cases that a long maturity bond is attractive for an investor, and that is in the case of a normal shaped yield curve. In the other cases, inverted, flat, and humped, the investor is not compensated for the risks associated with holding a bond for a longer term, making it unattractive to invest in long maturity bonds with these yield curves.

There are some theories that try and help us understand what the rates are going to be in the future. We have *the expectation hypothesis*, which states that the long-term rates are determined purely by current and future expected short rates. The basic premise of this theory is that you will be just as well of if you invest in a long-term bond, as you would be if you invest in a sequence of short-term bonds up to the maturity at the long-term bond (Cox, Ingersoll & Ross. 1985. p.385).

The second theory under term structure of interest rates is the *liquidity preference theory*. This theory states that an investor would demand a higher interest rate or premium on bonds with longer term maturities, since these bonds are more exposed

to interest rate risk than bonds with shorter term maturities (Bodie et al., 2014, p.498).

### *3.2.6 Bond prices over time*

We say that a bond sells at par value when the bonds coupon rate equals that of the market. In this case the bondholder is fairly compensated for the time value of money, in the form of recurring coupon payments. The problem for a bondholder is when the coupon rate is below that of the market, because then the investor will not be compensated fairly, as he or she could have made more placing their money elsewhere in the market. In this case their money will actually lose value compared to the rest of the market, and therefore we say that they are not compensated fairly for the time value of money. This also means that if they decide to sell their bond, it would be sold below par, to compensate for the low interest (Bodie et al., 2014, p.463-464).

### *3.2.7 Bond investment strategies*

After the analysis, when we know which bonds that are interesting to invest in, we need to lay down an investment strategy that works well with the outcome of the analysis. We will look at three different strategies; *bond laddering, bond swapping,* and *reinvestment of interest income.* These are three strategies that should be simple for an investor to follow, that focuses on maximizing return while they also try to minimize risk.

Before we look at the different strategies, we will look at two different approaches to investing in funds, that is active and passive management. With an active strategy your goal is to beat the market, you will try to get higher risk-adjusted returns than the buy-and-hold strategy. To achieve this, you need to buy and sell bonds all the time, earning a maximum of what is possible on each bond. The passive approach is more about performing as the market, buying bonds that are popular, selling those who are unpopular. The passive approach is a safer way to invest, while the return

of the active management style is potentially higher, but also lower (Bodie et al., 2015, p.533-545).

*Bond Laddering*

The first strategy we will look at is bond laddering. This is a strategy that involves investing in several different bonds, with increasingly longer maturities. With this strategy you will reduce both interest rate risk and reinvestment risk. For example, if interest rates rise, you reinvest the bonds on the bottom of your ladder, which are maturing, in higher-yielding bonds. And if interest rates fall, you are protected against reinvestment risk, since you still have several bonds with long-term maturities (FINRA, 2019). This strategy is recommended for investors using bonds to generate income.

*Bond Swapping*

This strategy is about selling one bond and at the same time purchasing another similar bond with the proceeds from the sale. Investors engage in this strategy to improve their financial position. Bond swapping can reduce tax liabilities, give a higher rate of return, and help an investor diversify their portfolio (FINRA, 2019).

A bond swap could also be used to take advantage of a changing market conditions, as a change in the interest rate. If the interest rate in the market decreases, then the value of the bond increases. When this happens, an investor can trade the bond at a premium, and then use the proceeds to invest in new bonds with similar yield, priced closer to par (Investopedia, 2019).

The swap strategy could also be used to diversify against interest rate risk. If you expect the interest rate to change in the future, you can swap your existing bond with a bond with shorter-term maturity, since these bonds are less exposed to interest rate risk (Investopedia, 2019).

*Reinvestment of Interest Income*

In this strategy you reinvest the coupon payments (interest) that you receive from your bonds into new bonds. As an investor this is a demanding investment strategy, because the investor will always need to be on top of what the next investment should be.

A fourth option would be to invest in a bond fund. There exist four types of bond funds: *bond mutual funds, closed-end bond funds, exchange-traded bond funds,* and *bond unit investment trusts.* One of the pros for investing in bond funds, compared to single bonds, is that it will be more diversified. Of course, you could on your own also invest in more bonds at once, making your investment diversified, but this will take a lot of time, liquidity, and competence (FINRA, 2019). So, if an investor wants to have a passive management approach, and want to be diversified in the investment, then bond funds are recommended.

## 4. Literature review

In this literature review I will try to shed light on some of the literature that already exist on the topic of interest rate forecasting and bond portfolio strategies and I will discuss some articles/research that is or can be relevant for this thesis. The literature review is divided in to two parts, interest rate forecast and bond portfolio strategies.

We will start with the interest rate forecast, looking at several researches on the Fisher effect, and then look at how the Norwegian central bank wants to implement its interest rate changes. After that we will do the literature review on bonds, focusing on risk premium for corporate bonds, and the term structure of interest rates.

### *4.1 Interest Rate Forecast*

We will start by looking at interest rate forecasts in general. If we are to do a forecast, we first need to know what has already been done on the field. So, I will start with an article that looks into this.

Robinson (1954) focuses on the obstacles of doing a systematic forecast of the interest rate, saying that most of the theory that is out there is intuitive, making the forecast subjective. And that interest rate forecasts in general are full of misjudgments and errors (Robinson, 1954, p.87).

Further on the article discusses long-term and short-term interest rates. And states this about the rang of movement of the long-term interest rate: "*The range of movement of long term interest rates can be said to be limited by the following margins: On the low side, investors face such great risks of capital losses that long-term interest rates cannot be pushed far below the level that such investors feel to be a reasonable expectation of the future. Investors, as Keynes and many others have pointed out, will choose the alternative of holding cash or investing in short-term form rather than take the risk of such losses (Robinson, 1954, p.98-99).*" This means that investors will not be willing to take on long-term interest rates, unless they are fairly compensated for the additional risk they face.

### *4.1.1 Fisher Effect*

We have earlier looked at how the Fisher equation works, now it's time to see what the literature and research on the topic has to say about it. There is done a lot of research on this topic, so I have tried to summarize some of the research that I find relevant. From the theory we know that the Fisher effect has some implications and that the results on the topic is mixed. Most of the research reviewed in this thesis supports the existence of a Fisher effect to some degree (Argyro, 2010; Nurudeen, Obi, and Wafure, 2009; Westerlund, 2006), but it is important to remember that this does not mean that the Fisher equation is correct all the time; it means there is a possibility that the Fisher effect exists. In this part I will go through several studies, and I will try to keep them short, focusing on what kind of analysis they have done, which variables they have used, and what they concluded. I have chosen to do this so we can get an overlook at what several researchers have concluded on the topic, instead of going into the details of a few studies.

Mishkin (1991) tested the Fisher effect in the economy of the United States, using cointegration and monthly data running from 1964 – 1986. He concluded that there is no evidence for a short-term Fisher effect, but he does support the existence of a long-term Fisher effect. Mishkin did a new test on the Fisher effect in 1994, but this time he and Simon (1994) looked at Australia, using cointegration and quarterly data, with inflation and treasury notes as variables. Mishkin and Simon (1994) ended up at the same conclusion as Mishkin did in 1991. They do support the existence of a long-term Fisher effect, but could not find evidence for the short-term Fisher effect.

Crowder and Hoffman (1996) looked at the relationship between nominal interest rates and inflation in the United States. They used a vector error correction model (VEC) and quarterly data. In their research did they find considerable support for the Fisher equation. Another researcher using a vector error correction model was Wesso. Wesso (2000) tested the Fisher effect in South Africa using the yield on long-term government bonds and inflation. He concluded that long-term bond yield changes are driven by expected inflation, as stated by the Fisher effect.

Berument and Mehdi (2002) performed an interesting study on the Fisher effect, in which they wanted to compare the Fisher effect in developed countries to that of developing countries. They used treasury bills rates and inflation rate as variables.

They concluded that Fisher effect holds stronger in developed countries than it does in developing countries.

### *4.1.2 Government Actions*

As mentioned in the theory section, government action is one of the three factors that control the interest rate, with the others being supply and demand. To understand how these government actions are done, we have to look at how the central bank behaves. Therefore, I will now look at a working paper from Norges Bank, the Norwegian central bank. The paper looks at criteria for an appropriate future interest rate path (Qvigstad, 2006). Even though I am looking at the market in the United States, I believe that this paper is relevant to look at, because the paper proposes general guidelines in how they want to control the interest rate, and therefore this paper is relevant for all countries that control their interest rate.

The paper consists of six criterions, not all are relevant for this thesis, so I will only focus on the ones that are. The first three criterions concern inflation, and on how you need keep to your inflation target; a stable inflation near its target is important for a stable economy (Qvigstad,2006, p.3-8)

The fourth criterion is of relevance for the forecast, and it concerns interest rate smoothing. It states: "*Interest rate changes should normally be moderate unless the credibility of the nominal anchor is threatened" (Qvigstad, 2006, p.9)*. This basically means that the central bank should do its changes gradually, if it is possible. This will give the consumers time to adapt to the new interest rate (Qvigstad, 2006, p.9-10).

## *4.2 Bond Investment Strategy*

### *4.2.1 Risk Premium Corporate Bonds*

For the bond investment strategies, we will look at investing in both corporate and government bonds. And as discussed before is corporate bonds more exposed to risk, mainly because of their exposure to default risk, which government bonds are not exposed to. Do the corporate bonds receive a premium for this, compared to

the government bonds? Agrawal, Elton, and Gruber (2001) has investigated this. They concluded that there exists a risk premium on corporate bonds compared to government bonds. This means that we can expect higher yields and coupons on corporate bonds, when they and government bonds have equal maturity.

### *4.2.2 Term Structure of Interest Rates*

In the theory part, we looked at two theories concerning the term structure of interest rates; the expectation hypothesis and the liquidity premium theory.

The originator of the expectation hypothesis is not known, but many attributes it to Fisher (1896). The theory is simplistic, and states that the return on long term-interest rates equals the expected return of a series of short-term interest rates, maturing similarly with the long-term interest rate. This is a theory that is tested several times, with mixed results. While Meiselmann (1962) found it reliable, other researchers like Grant (1964), Malliel and Kane (1969), and Jorion and Mishkin (1991) found little evidence of this theory.

The liquidity premium theory (Hicks, 1946) is about how an investor wants to get a risk premium for holding on to longer bonds. The case is that the return on short-term bonds are more or less certain, while long-term bonds return is not certain. This is due to the fact that long-term bonds are more exposed to "shocks" in the economy, and since they are not liquid enough to react to this, investors will demand a risk premium. There is done a lot of research on the topic, and even though the determinants of the liquidity premium is unclear, most studies shows that there exists a liquidity premium, like McCulloch (1975) and Kessel (1965).

## 5. Methodology

In the methodology part we will look at the reasoning behind the choosing of tools for the analysis, and what their strength and weaknesses are. The intention of this part is for you as a reader to get a better understanding of why the analysis is solved as it is, and how the different tools work.

Before we look at the interest rate forecast, we need to look at the research question again, which states: *How to use an interest rate forecast in deciding upon a bond*

*investment strategy*. The research question will need some clarification before we move on. Because, after we have done the interest rate forecast, it will become clear to us that there are countless investment options when looking at corporate bonds, but we will only look at a few alternatives. This is because this thesis is about how you as an investor can use an interest rate forecast to your advantage when choosing a bond investment strategy, it is not about choosing the one perfect bond today. Therefore, I will only need a few corporate bonds, to show that they offer higher returns than government bonds, and also so that we can discuss the consequences of investing in them since they are exposed to more risk than government bonds.

## 5.1 Interest Rate Forecast

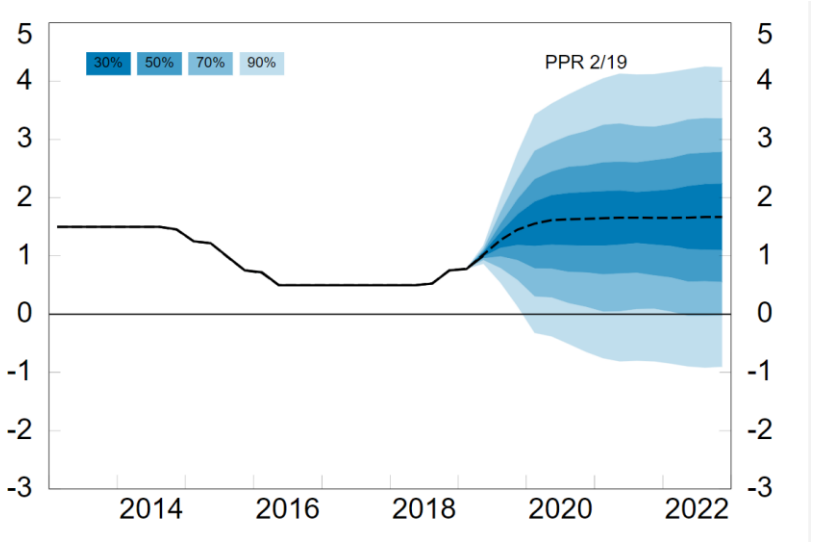
The interest rate forecast is an essential part of this thesis, which we are intended to make a bond investment strategy based on. For the investment strategy to be successful it is important that the interest rate forecast is precise.

### *5.1.1 Implications with Interest Rate Forecasting*

That making an interest rate forecast is difficult is well established. There are numerous variables that affect it, and some of these variables are also hard to predict, so to make the interest rate forecast you would need to make a forecast on several variables. One example could be to look at the Fisher equation, which consists of nominal and real interest rate, and expected inflation. These are all variables that we would need to predict to use the equation as a forecast. It could prove hard to make accurate predictions of these variables, and I believe that the Fisher equation is better for looking back at interest rate changes, and use the equation to explain why the changes occurred, rather than to use it as a forecast model. Taking all this into account, making an accurate interest rate forecast, especially over a longer time period, could prove to be difficult.

To understand how difficult it is to make an accurate interest rate forecast I will present a chart from Norges Bank, the central bank of Norway, where they have made a prediction for a future interest rate.

FIGUR: 7




Source: (Norges Bank, 2019)

This is Norges Banks forecast on their policy rate. The policy rate is the interest rates banks pay on overnight deposits in Norges Bank. They have tried to predict the future policy rates using percentages. How this graph works is that Norges Bank now say that in 2022 they can say with 90 % certainty that this rate will be between roughly 4% and -1%, with 50% certainty they say that the rate will be roughly between 2.5% and 0.5%, and so on (Norges Bank, 2019). This is just three years forward in time, and the Norwegian central bank can't really say with any certainty where the interest rate will move in the future.

This is the main reason why I believe it is better not to try to make an accurate interest rate forecast for the next 30 years, because it will be to much uncertainty around it, and the chances of making an accurate forecast is similar to nothing. So, what I have decided to do instead is to focus on what an investor should do given any interest rate forecast. But I will still make a simple forecast, to illustrate the specifics of how you should implement an interest rate forecast in a bond investment strategy.

### *5.1.2 Forecasting Alternatives*

Even though I don't try to make an accurate interest rate forecast, is it still important that the output from this forecast is realistic, that it makes sense. Therefore, I will

look at two forecasting alternatives, and decide which one of them is more likely to give me a forecast that is somewhat realistic. The two alternatives are a naïve forecast and an excel function.

A naïve forecast is a forecast where the forecast value is equal to its previous variable. This forecast technique works quite well for financial and economic time series data (Webfinance Inc, 2019). This would effectively mean that we will get a flat interest rate for the next 30-years, in my analysis. With the interest rate flat, the yield curve would also be flatter, since investors would not be exposed to any interest rate risk. But that the interest rates stay stable for the next 30 years is highly unlikely, it has actually never happened before, at least not in recent history.

The second forecast alternative we will look at is the Excel-function *TREND.* The *TREND* function tries to find underlying patterns in the data movements, and thereby predicts future behavior of the data. The only variables I need to perform this analysis is historical interest rates. And this function can forecast the interest rate as far as I want it to (Microsoft, 2019).

If I should choose to use the naïve forecast technique, then I would have had to have a shorter time frame, I don't find it realistic that the interest rate will stay the same for the next 30 years. With a shorter time frame the naïve forecast would have been considered, but since we look at a longer time frame it will give more sense to use the Excel-function approach. In the next part will I go into detail of how this function works in Excel.

### *5.1.3 TREND Function in Excel*

The *TREND* function in excel is quite easy to use. You start by listing up all the years and their average interest rate, where the years are your X-variables and the interest rates are your Y-variables. Then you fill in how many years you want to have forecasted, in this case it will be to 2049, when the last bond matures (30-year T-bond). Now you are ready to use the *TREND* function. To use it you go in to formulas in Excel, choose show all, and then find the function. Inside the function you are asked to mark all the known Y-variables, which are all the interest rates we have from previous years. Then we mark all the known X-variables, which are the years associated with the known interest rates. Last, we are asked to mark the

unknown X-variables, in our case that is all the future years that we want to analyze. After you have done this you press control + shift + enter, and then you get the output, the *TREND* forecast up to 2049 (Microsoft, 2019).

The only thing left to discuss now is how much historical interest rate data we should use. Intuitively, it is easy to think that we should use as much data as possible to get a more precise outcome. But it is important to remember that the *TREND* function is not perfect, meaning that it then potentially could pick up on some old trends that no longer are valid, or something else that gives a completely illogical result. The function is not made to only make interest rate predictions, so if we don't use the right input, we might get an illogical result, because the function doesn't know any better. To decide how far back I will go in the data when I use this function will be decided on a trial and error approach when I do the analysis, focusing on getting a realistic output.

## 5.2 Bond investment strategies

After the interest rate forecast is done, is it time to look at how this affects our bond investment strategies. I will start with discussing which corporate and government bonds I have chosen to look at. After that I will look at how we can compare the performance of the bonds up against each other. And last, I will describe how I will do the calculations when comparing them.

### *5.2.1 Which bonds we are looking at*

As mentioned before, this thesis will only look at corporate and government bonds. I believe this will give us the information we need to come up with a bond investment strategy, without making the thesis too complicated. From the theory we know that corporate bonds are more exposed to risks, mainly due to the risk of default of the company. And we know that both types of bonds are exposed to interest rate risk.

*Government Bonds*

This thesis will look at government bonds and notes. As already mentioned, the main difference between these two is when they mature, with notes maturing

between 1 and 10 years, while bonds mature between 10 and 30 years. We will look at, 2-year, 3-year, 5-year, and 10-year notes and 30-years bonds. This will give us the width and depth in results needed to compare them to corporate bonds.

*Corporate Bonds*

The corporate bonds will be chosen on the basis that they are comparable with the government bonds, which means that they need a maturity date that is somewhat similar to that of the government bond. When it comes to corporate bonds there will be numerous alternatives of investment opportunities, so based on what this thesis is about I have decided to look at two different companies. The companies will be chosen based on their credit ratings, where one will have a strong credit rating and one will have a week credit rating. This is to be able to compare what you can expect in return depending on how much risk you are willing to take on.

### *5.2.2 Comparing the Performance of the Bonds*

When comparing the performance between bonds there are two measurements who can give us the answer with respect to returns, and that is yield to maturity (YTM) and holding-period return (HPR). As mentioned, the yield to maturity (YTM) is the total return anticipated if the bond is held until it matures. While the holding-period returns (HPR) is the total realized return you get for holding a bond over some time (Bodie et al., 2014, p.127-128). Since it's the realized rate of return on a particular investment period, it will also need to have information about the bond that first is available when the bond either matures or is sold, like the market price of the bond at the end of the holding-period. Since this information is not available for me at the moment, I will have to look at the yield to maturity (YTM) when comparing bonds, since it only depends on variables that are available today, and therefore is not too difficult to calculate (Bodie et al., 2014, p. 465-466).

### *5.2.3 YTM Calculations*

Now that its been decided that yield to maturity (YTM) will be a part of the analysis we need to find a way to calculate it. There are several ways this could be done, and I have chosen to use Excel with the Excel- function *YIELD*. This function only needs to get the input, and then it does all the calculations itself.

The inputs needed in the function are: *settlement date, maturity date, annual coupon rate, bond price, redemption value,* and *coupon payments per year*. With this input in the function it gives us the output in form of yield to maturity (YTM) in decimal form (Bodie et al., 2014, p459). Where the data that is needed to do these calculations is found will be covered in the next part, in *5.3 Data Collection.*

# 6 Preliminary and data analysis

In the preliminary and data analysis part we will look at what can be expected in the main analysis, and where the data that will be used in the analysis comes from. We will start by looking at the interest rate forecast and what we can be expected from that. What are the logical changes that we will see in the interest rate in the future?

After we have looked at the interest rate, we will move on to the bond investment strategies. This is an important part of the thesis, and here we will discuss how an investor should react to any changes in the interest rate. We will go into debt about the bonds that are chosen, and try to analyze all the information that we have before we do the main analysis.

## 6.1 Interest rate forecast

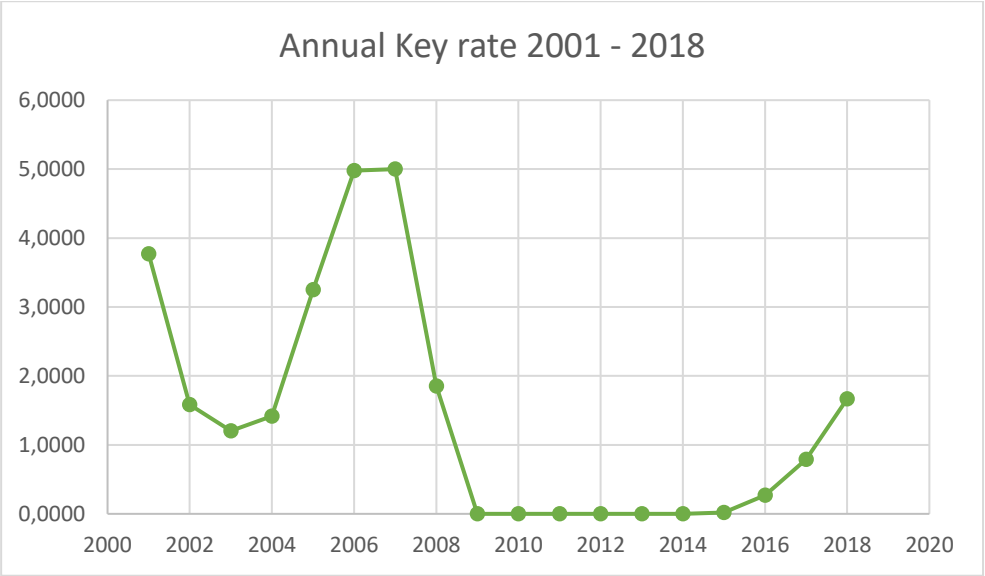
The preliminary analysis of the interest rate forecast will be built up so that we can get some sort of expectations in which direction the interest rate will move in the future. We will start by looking at the market interest rate, and how it has moved in past, to understand how it might move in the future. Then we will look at the timeframe of the data to be used in the forecast, how far back in time do we need to go to get a realistic forecast. And last, we will look at what I believe we can expect of the interest rate of the future, based on the theory and how I believe it will move.

### *6.1.1 Market Interest Rate*

The movement of the market interest rate is crucial to choose an efficient bond investment strategy. Since all interest rates move as one (Bodie et al., 2014, p.121-

122), will we look at the U.S. key rate, and try to forecast it to understand how all interest rates will move in the future. This doesn't mean that all interest rates are the same, it means that they move in the same direction, they increase and decrease together. Therefore, when we make the forecast we will look at in which direction it changes, and how much. But before the forecast we need to look at how the key rate has moved in the past. In the figure below we can see the annual key rate since 2001:

FIGUR: 8




(Source: Appendix A)

On the y-axis we have the annual key rate given in percentages, and on the x-axis we have their corresponding years. The first thing to notice is the big drop from 2007 till 2009, which is due to the financial crisis of 2008 (Bodie et al., 2014, p. 15-17). The second point is the rise from 2003 to 2005. And third is how the rate was at zero from 2009 to 2014, which was to stimulate growth in the economy after the financial crisis of 2008 (Bodie et al, 2014, p. 17-23).

The rate has been quite volatile between 2001 and 2018, especially in the interval of 2001 to 2009, when it went down, up, and then down again, with relatively large fluctuations. We know that this is not how the government wants the interest rate to move, they want to only make moderate changes to it, making it possible for consumers to adapt to the new interest rate (Qvigstad, 2006, p.9-10). Interest rate smoothing is an important part of how government wants to manage the interest

rate, as we can see that they have succeeded with since 2009. Since then the interest rate has stayed flat, because of the state the financial crisis left us in, and when the economy was starting to get going again around 2014, the interest rate started to moderately rise, which it has kept doing since.

### *6.1.2 Timeframe of the Data*

This was also discussed in the methodology part, and we concluded that the timeframe of the data would depend on the outcome of the forecast, when using the *TREND* function. And that it will be decided with a trial and error approach. At this moment I believe I will do two trials, one from 2001-2018, and one from 2009-2018. I believe that the data in the 2001-2018 interval has been to volatile, effectively making the forecast to fluctuate to much. The second interval, 2009-2018, is maybe a bit short, but this is the interval I believe will give the most realistic output. The output of the function will be analyzed in the main analysis.

### 6.1.3 *Expectations of the Interest Rate*

This part will be about what we can expect the interest rate to look like in the future; it will not be an exact prediction, but rather an estimate of which direction it will move. We will start by looking at government actions, which is one of the three factors that affects the real interest rate, besides demand and supply (Bodie et al., 2014, p.118). We know from the Fisher equation that inflation also plays a big role in future interest rates, and that the United States have an inflation target of 2% annually. Since we at this time is seeing a moderate increase in the interest rate, we can expect it to keep moderately increasing in the near future, since the government is interested in seeing interest rate smoothing.

The business cycle will also be crucial in understanding how the interest rate will move in the future. If you look at figure 3, from the theory, which shows how the business cycle moves, it is reasonable to believe that we at this point is in an expansion. If we look at the previous key rates in figure 1, we experienced a *recession* from 2007 to 2009 (due to the financial crisis), had a *trough* from 2008 to 2014 (when the interest rate was at zero), and since the interest rate started to

increase in 2015, we have been in an expansion. It is difficult to know beforehand when the expansion moves on to be a recession, but at this time it is reasonable to believe that the expansion will keep going for some time, making us see an interest rate increase over the next couple of years.

## 6.2 Bond investment strategies

A bond is, as already mentioned, a debt security where an investor gives out a loan to a corporation, government, federal agency or other organizations. For giving out this loan a bondholder will receive interest in the form of coupon payments (Bodie et al., 2014, p.446).

After the interest rate forecast is done, we will look at different bond investment strategies, to see how the future interest rate predictions will affect our investment decisions today. We will start by looking at both the corporate and government bonds that I have chosen. Then we look at how bonds have performed historically in comparison with the stock market. After that we will look at the risks a bondholder faces, and last, how an investor should choose his or her investment strategy based on the forecast.

### 6.2.1 *U.S. Treasuries*

U.S. Treasuries consist of bonds, notes, and bills, where the main difference between them is how long they run, as mentioned in the theory part. For this thesis we will focus on the bonds and the notes. Below, in figure #, have I collected some of the data needed to analyze these bonds and notes.

Figure: 9

| | Settlement day | Maturity | Coupon | Yield % | Price (bid) | Price (ask) | YTD % |
|---|---|---|---|---|---|---|---|
| 30-Year Bond | 6.19.19 | 5.15.49 | 0,02875 | 2,560 | 106,244 | 106,254 | 2,573 |
| 10-Year Note | 6.19.19 | 5.15.29 | 0,02375 | 2,082 | 102,2660 | 102,2720 | 2,093 |
| 7-Year Note | 6.19.19 | 5.31.26 | 0,02125 | 1,959 | 101,074 | 101,08 | 1,964 |
| 5-Year Note | 6.19.19 | 5.31.24 | 0,02 | 1,859 | 100,26 | 100,264 | 1,865 |
| 3-Year Note | 6.19.19 | 6.15.22 | 0,0175 | 1,831 | 99,284 | 99,29 | 1,82 |
| 2-Year Note | 6.19.19 | 5.31.21 | 0,02125 | 1,891 | 100,17 | 100,174 | 1,882 |

(Source: Appendix B)

First, we can see the Treasuries we are considering to invest in: *30-years bond, 10-year note, 7-year note, 5-year note, 3-year note,* and *2-year note.* Then we can see the settlement day, which is the date that the deal was made, which was June 19. 2019 for all of the Treasuries. Then we see the maturity, which is when issuer of the bond has to pay back the original sum. After that we can see the coupon rate and yield of the Treasuries. These are indicators of how attractive it is for an investor to hold the specific Treasury. The coupon is the interest payments one will receive semi-annually, and the yield is the amount of return the investor will realize on the bond. Then we have the prices of the bond. And last, we see YTD, which is defined as year to date, and it shows how the bond has performed so far this year (Bodie, et al., 2014, 446-468).

It is positive that the YTD is quite similar to the yield of the bonds, which means that they until now this year has performed as we expect them to, which always is reassuring for an investor that has invested in treasuries, where we don't expect fluctuations. When we look at both yields and coupons, we see that the longer you hold the Treasury the more it pays out. With one exception, the 2-year note has both higher yield and coupon than the 3-year note and the 5-year note, effectively making it a more attractive investment than those two. This is based on the information available at this moment. Which Treasuries that are more attractive than the others could change when we look at the yield to maturity in the main analysis.

### 6.2.2 *Corporate Bonds*

Corporate bonds are debt securities issued by corporations. As stated before, this thesis is not about choosing the best corporate bond out there. The corporate bonds are included here to illustrate the alternative that is to invest in corporate bonds compared to government bonds. Therefore, I have chosen bonds that are representative for how corporate bonds perform, which is illustrated in figure #

Figure: 10

| Issuer name | Symbol | Callable | Coupon | Settlement day | Maturity | Moody's®/S&P | Price | Yield % |
|---|---|---|---|---|---|---|---|---|
| Apple Inc | AAPL4122392 | Yes | 0,0285 | 6.19.19 | 5.6.21 | Aa1/AA+ | 101,553 | 1,989 |
| Apple Inc | AAPL4452439 | Yes | 0,0300 | 6.19.19 | 2.9.24 | Aa1/AA+ | 103,160 | 2,248 |
| Apple Inc | AAPL4336433 | Yes | 0,0465 | 6.19.19 | 2.23.46 | Aa1/AA+ | 118,235 | 3,571 |
| | | | | | | | | |
| American AIRLS | AAL3707307 | Yes | 0,0697 | 6.19.19 | 5.23.21 | Ba3/BB- | 102,000 | 5,927 |
| | | | | | | | | |
| American Tower Corp | AMT4040702 | Yes | 0,0500 | 6.19.19 | 2.15.24 | Baa3/BBB- | 110,175 | 2,646 |
| | | | | | | | | |
| American INTL group inc | AIG4611930 | Yes | 0,0575 | 6.19.19 | 4.1.48 | Baa2/BBB- | 105,090 | - |

(Source: Appendix B)

This layout is a bit different from that of the Treasuries, but there is still *settlement date*, *maturity*, *coupon payments*, *price*, and *yield*. But now we also have an issuer name, with a connected symbol number. You also get to know if the bond is callable, meaning that they can be traded on the secondary market, which is important information since it will affect the price and coupons of the bond. And we can see the bonds credit rating, which I will come back to later.

Initially the plan was to look at two corporations, one with a strong credit rating, and one with a weak credit rating. For companies with strong credit ratings it was easy to find different investment options, as you can see from the maturity dates on the Apple Inc bonds. They are somewhat comparable to 2-year note, 5-year note, and the 30-year bond. It is crucial for this thesis that when comparing yield to maturity on corporate and government bonds that they have maturity dates that are quite similar, so that the bonds are easy to compare. When I was looking at a company that had bonds with weak credit ratings this was much more difficult. I could not find one firm that was as weakly credit rated as I wanted, that issued bonds with the term-maturities that I was looking for. The solution was therefore to look at three different companies with weak credit ratings on their bonds, that had one bond that had a maturity quite similar to what I have been looking at for the Treasuries and Apple Inc, which was in 2 years, 5 years, and 30 years.

From figure 10, we see that you are compensated as an investor if you are willing to take on the risk of investing in a bond with worse credit rating. This was pretty much expected, that bonds with lower credit ratings pay out higher coupons and yield, but it is important to remember that these bonds also are more exposed to default risk.

### *6.2.3 Historical performance of bonds*

We have looked at how the key rate has moved since 2001, but we have not yet looked at how bonds have performed in the long run. In figure 11, we can see how bonds have performed since 1870, compared to stocks.

FIGUR: 11


(Source: Newworldeconomics, 2015)

To understand this graph, you need to know what we are looking at. What we see here is what 100 U.S. dollars would have been worth today if invested in either the stock market, U.S. government bonds, or in gold. We will only focus on bonds and stocks. The stock market is mentioned in the form of the S&P 500 index.

It is obvious that the stock market has outperformed the government bonds market clearly, so why should anyone consider to invest in bonds, when they just as easily could have invested in stocks, which would give higher return? This is because bonds are less volatile. The government bonds have given a steady rise in money since 1871, while stocks have been up and down thru the same period. This becomes especially clear when you look at economic crisis; we have the depression of the 1930s' and the financial crisis of 2008, and in both these periods you can see the stock market dropping, meaning that investors loose money. In the same periods the bond market remained stable, and kept its moderate increase, making sure its investors still were payed. But, if you were an investor with a long perspective, then

it would have been more profitable to invest in the stock market compared to the bonds market, historically.

There is also one other interesting thing we can see from this graph, and that is to study the yield curves of government bonds through history. If we look at the slope, we can see that most of the time it is looking normal, meaning that investors are compensated for taking on longer investments (since they are more exposed to risk). But at one period, approximately between 1940 and 1950 can we see that the slope almost is flat. When the curve is flat it means that investors are not compensated for taking on longer-term bonds, which makes it more attractive to invest in bonds that have shorter terms. The information here that is important is that the shape of the line at this moment looks to be normal, and that it also has "acted" normal since 1870. So, it will be reasonable to assume in the main analysis that the shape will stay normal, so that investors in the future will keep being compensated for the additional risk they are exposed to for taking on longer-term bonds.

### 6.2.4 Risk

Risk will play a big part in the main analysis; how to compare risk between the three alternatives (Treasuries, high credit rating corporate, and low credit rating corporate), when we don't really have any measure other than the credit ratings. If the bonds react as they usually do, then the bonds exposed to most risk will have the highest YTM. Therefore, is it important to take risk into account when deciding on which bonds to invest in. Different investors will act differently when exposed to risk, therefore if there is doubt between which alternative is the best, then I will do the recommendation based on what type of investor that are doing it: recommending one thing to risk averse investors and another thing to a more risk loving investor.

But it is possible to compare the risk between the corporate bonds, due to the credit ratings, shown in figure 12:

Figure: 12

| Issuer name | Symbol | Callable | Coupon | Settlement day | Maturity | Moody's®/S&P | Price | Yield % |
|---|---|---|---|---|---|---|---|---|
| Apple Inc | AAPL4122392 | Yes | 0,0285 | 6.19.19 | 5.6.21 | Aa1/AA+ | 101,553 | 1,989 |
| Apple Inc | AAPL4452439 | Yes | 0,0300 | 6.19.19 | 2.9.24 | Aa1/AA+ | 103,160 | 2,248 |
| Apple Inc | AAPL4336433 | Yes | 0,0465 | 6.19.19 | 2.23.46 | Aa1/AA+ | 118,235 | 3,571 |
| | | | | | | | | |
| American AIRLS | AAL3707307 | Yes | 0,0697 | 6.19.19 | 5.23.21 | Ba3/BB- | 102,000 | 5,927 |
| | | | | | | | | |
| American Tower Corp | AMT4040702 | Yes | 0,0500 | 6.19.19 | 2.15.24 | Baa3/BBB- | 110,175 | 2,646 |
| | | | | | | | | |
| American INTL group inc | AIG4611930 | Yes | 0,0575 | 6.19.19 | 4.1.48 | Baa2/BBB- | 105,090 | - |

(Source: Appendix B)

In the theory part concerning the credit ratings, we looked at figure #, which tells us how to interpret the different credit ratings. If we look at Apple Inc we see that all their bonds have a Aa1/AA+ rating, which is defined as high grade, and is an investment both Moody's and S&P would recommend. If we look at the ratings of the three other companies, we can see that they all are rated as junk bonds, which means that they carry a substantial risk of default. But they are highly rated as junk bonds, defined as speculative.

### *6.2.5 Bond Investment Strategies*

In this part we will look at when the different bond investment strategies are reasonable to invest in. But before we do that, we need to look at government bonds versus corporate bonds. Corporate bonds offer higher returns, yield and coupons than government bonds, so with no risk they would be more attractive. But when we add risk, and especially default risk, which is not a problem for the government bonds, it gets more complex to say which investment is more attractive for the investor. In many cases it will also vary among investors, depending on their personal risk tolerance. But combining default risk with large interest rate fluctuations will in general not be attractive for investors, who would rather choose to invest in Treasuries, which are not exposed to default risk. This means that for corporate bonds to be attractive we need as little interest rate risk as possible.

*Bond Laddering*

The bond laddering strategy is where you invest in several different bonds with increasingly longer maturities. The bond laddering approach let you diversify both interest rate risk and reinvestment risk. Should the interest rate forecast prove that the interest rate will fluctuate a lot during the timeframe we are looking at, then

bond laddering will have the solution to this, and practically diversify away the interest rate risk. Bond laddering is not for investors who are chasing big returns, it is for risk averse investors who value income over growth (FINRA, 2019).

*Bond Swapping*

The bond swapping strategy is where you immediately after selling a bond buy a similar bond with the proceeds from the sale. This approach secures you as an investor against reinvestment risk, since you always buy and sell at the same time. You could also diversify yourself from interest rate risk by swapping to shorter-term maturities, since these are less exposed to risk. But this will decrease your returns. If you use the bond swapping approach to your benefit then it could give a higher rate of return (FINRA, 2019).

*Reinvestment of Interest Income*

In this approach you reinvest the interest you receive on your bond into new bonds. This approach doesn't secure you against interest rate risk, at least not before you have earned enough to build up a large bond portfolio, then you can diversify your investment through using the bond laddering approach as well as this approach. This means that this approach is carrying a lot of risk in the beginning, before you have earned enough money to reinvest and diversify your investment. So, if the interest rate forecast shows large movements in the next years interest rate, then this investment strategy alone would not be attractive (FINRA, 2019).

### 6.3 Weaknesses of the analysis

The analysis has some weaknesses, they have all been described before, but they are important to be aware of before going into the main analysis. The most obvious weakness is that the interest rate forecast not will be correct, which makes the bond investment strategy only speculative. This is something I have discussed several times in this thesis, and it is due to the fact that making a correct interest rate forecast is too complex for this thesis. Therefore, I have decided to focus on doing a forecast that will give an indication on what direction the interest rate will move in the future.

Another weakness is that we don't have any measurement for comparing risk other than the credit ratings. This means that we have to use logical reasoning when comparing the bonds and their risk exposure.

The last weakness that some could point out is that there should have been looked at more bonds in the analysis, to see which bonds performed better, especially in corporate bonds there are endless of investment alternatives. I don't believe that this is a weakness of the thesis, because I want the thesis to focus on how you can use an interest rate forecast in deciding upon a bond investment strategy. Therefore, I will only need a few different types of bonds, with different maturities, risk, and coupons, so that I can illustrate which types of bonds there would be profitable to invest in, in the future.

## 6.4 Data Collection

For this study I will mainly need quantitative numbers, when looking at interest rates and bonds. All of this data is easy to find, so this thesis will not focus that much on collecting data.

### *6.4.1 Interest Rate Forecast*

For the interest rate forecast we only need one variable, and as I have discussed before it is the United States Federal Banks key rate. The key rate is the specific interest rate that determines the bank lending rate and what the cost of credit will be for borrowers. The key rates are collected from *countryeconomy* (2019).

### *6.4.2 Bond Investment Strategies*

For the bond investment strategies I will need several more numbers. As described earlier, the YTM calculations in Excel needs some variables, which are all described in the theory part. The data for the corporate bonds is retrieved from FINRA-markets (2019). This is a search engine, which gives most of the quantitative variables we need for the YTM calculations, *settlement date, maturity*

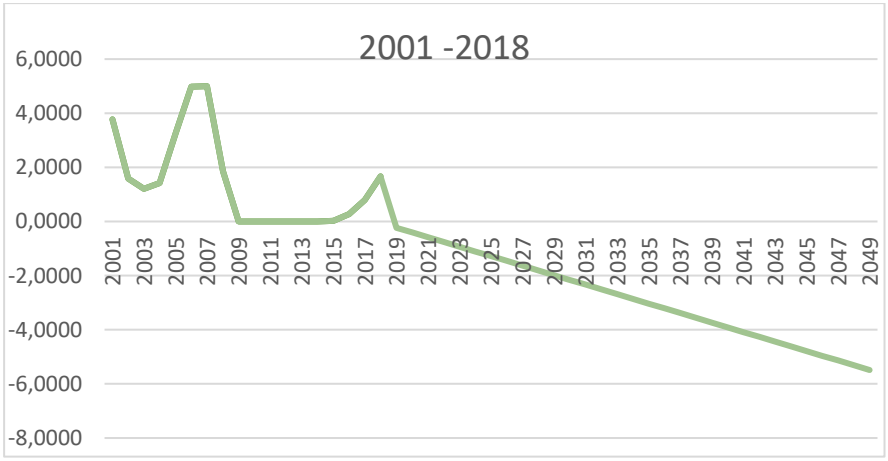
*date*, *annual coupon rate*, and *price*. It also gives us the qualitative value we need, which are the credit ratings of *S&P* and *Moody's*. For the government bonds I could have used the official site of U.S. department of treasury, but I found the site of the Wall Street Journal (2019) to be easier to use, therefore all the necessary data for government bonds is retrieved from this site.

# 7 Results and main analysis

## 7.1 Forecast of the interest rate

From the *TREND* function in Excel we get two different outputs in Excel, which predicts the future interest rate. We will start by looking at these two results, and decide which forecast seems more realistic, before we move on. First, we will look at the *TREND* function using data from 2001 – 2018:

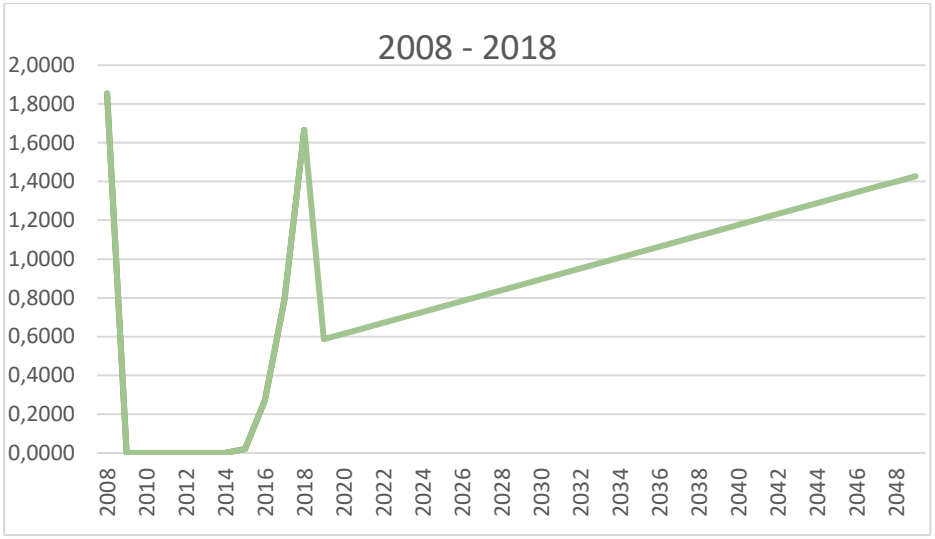
Figure: 13




(Source: Appendix C)

As we can see from this data, it predicts an immediate drop in the interest rate in 2019, and then the rate slowly and moderately decreases annually until 2049, when it is at – 5.49 %. We will look at the other forecast now before we analyze them.

Figure: 14




(Source: Appendix C)

From this forecast we also get an immediate drop in the interest rate in 2019, where it drops from 1.67 % to 0.59 %. But after this the interest rate stabilizes and we see a moderate annual increase up until 2049, when the interest rate almost is up at the same level as it was before the drop in 2019.

These are two different results. In the 2001 – 2018 forecast there is a clear negative trend in the forecasted interest rate, with an initial drop. We also see a drop in the interest rate for the 2008 – 2018 forecast, but we see that the interest rate stabilizes and moderately increases after that, almost taking it up to its initial interest rate of 2018.

The first forecast, with data from 2001 – 2019, is not really close to my predictions in the preliminary analysis. If we look at the business cycle it would mean recession for at least the next 30 years, which the world has not seen anything like in recent history. It will also mean that the interest rate in 2049 will be at an extreme level at - 5.49 %.

The second forecast, with the data from 2008 – 2018, is the one that is closest to my prediction. I did not predict a drop in 2019, but other than that it does show slow and moderately increases in the interest rate after that, which is in accordance with the interest rate smoothing that we know the central bank and government wants. And it is also in line with my predictions of where we are in the business cycle, which is in expansion. With the economy in expansion, it is natural to believe that the economy does not need stimulation, and therefore that the interest rates can increase.

Since the forecast of the 2008 -2018 data is more in line with my predictions from the preliminary analysis, I will use it when I look at the bond investment strategies.

## 7.2 Bond Investment Strategy

With the interest rate forecast done, it is time to look at how an investor should invest in bonds, starting by calculating the yield to maturity (YTM).

### *7.2.1 YTM*

First, we will look at the Treasuries and corporate bonds separately, and then we will compare them up against each other.

*Treasuries*

Figure: 15

| | YTM | YTM % |
|---|---|---|
| 30-Year Bond | 0,02573821 | 2,57 |
| 10-Year Note | 0,02119399 | 2,12 |
| 7-Year Note | 0,01957896 | 1,96 |
| 5-Year Note | 0,01943674 | 1,94 |
| 3-Year Note | 0,01995853 | 2,00 |
| 2-Year Note | 0,02033141 | 2,03 |

(Source: Appendix B)

The yield to maturity on the Treasuries are not surprising after the analysis done in the preliminary, when we saw that the 2-year note had higher coupon and yield than some of the notes that run longer. With the yield to maturity higher for a 2-year note than that of a 3-year, 5-year, and 7-year, makes it a much more attractive investment alternative than the other with lower yield to maturity. The 2-year note offers a higher yield to maturity and lower risk, since it has a shorter-term maturity. Other than that it was expected that the 30-year bond had the highest yield to maturity, which only is logical since it also is most exposed for risks.

*Corporate Bonds*

Figure: 16

| Issuer name | Maturity | Moody's®/S&P | YTM | YTM % |
|---|---|---|---|---|
| Apple Inc | 5.6.21 | Aa1/AA+ | 0,02003692 | 2,00 |
| Apple Inc | 2.9.24 | Aa1/AA+ | 0,0227792 | 2,28 |
| Apple Inc | 2.23.46 | Aa1/AA+ | 0,03582628 | 3,58 |
| | | | | |
| American AIRLS | 5.23.21 | Ba3/BB- | 0,05854353 | 5,85 |
| | | | | |
| American Tower Corp | 2.15.24 | Baa3/BBB- | 0,02660965 | 2,66 |
| | | | | |
| American INTL group inc | 4.1.48 | Baa2/BBB- | 0,05398924 | 5,40 |

(Source: Appendix B)

Also, here does the YTM act pretty much as expected, with higher yield to maturity on the bonds that are more exposed to risk. That the yield to maturity on the junk bonds is not as intuitive as one might want is due to the fact that they all have different credit ratings, with the longest-running bond having the best credit rating of the three, so it is not unnatural that it has a lower yield to maturity than the shortest-running junk bond.

If we compare the yield to maturity on the corporate and government bonds up against each other, we can see that they act as expected in the preliminary, that the riskier the bond the higher yield to maturity. With one exception, and that is the 2-year government note, which outperforms the 2-year Apple Inc bond.

### 7.2.2 *Bond Portfolio Strategy*

From the interest rate forecast we see a drop in the interest rate in 2019, and after that it increases moderately up until 2049. This means that if you are to choose the bond swapping strategy, you should, when the interest rate is dropping in 2019, swap bonds. Because when the interest rate drop, bond prices increases, this means that you can trade your bond at a premium, so that you receive capital gains, and then reinvest the proceeds in new bonds, with similar yields, but that are closer to par. This strategy will in 2019 assure that the bondholder capture capital gains. In the period after the drop in interest rate, will the rate moderately increase for the remaining period. This means that the price of the bond will decrease in this period. To take advantage of this situation with a bond swapping approach, the investor should swap his lower paying coupon bonds, since coupon on newer bonds will increase, and use the proceeds to buy new bonds with coupons that matches the

interest rates of the market. This strategy would mean that you probably will sell your bond at a loss, but it could prove to give better returns, since the bond now pay higher coupon and have a higher yield.

With the bond laddering approach, the investor will be protected against the predicted drop in interest rate of 2019, since he or she still will have several bonds that have a longer-term maturity, which now earns an higher interest than the rest of the market. The drop means that the bonds that mature after it will be traded in with bonds which pays a lower interest. After the drop of 2019 the interest rate is expected to moderately increase until 2049. In this period, investors using the bond laddering approach will have to reinvest the bonds that are maturing in new bonds, these new bonds will pay better interest than the ones that matures, since the interest rate in the market is increasing.

# 8 Conclusion

The research question stated that we were to do an interest rate forecast, and to use this forecast in deciding upon a bond investment strategy. From the forecast, which is based on the key rates from 2008 -2018 (see Appendix C), we see that the interest rates will experience a significant drop in 2019, and then moderately increase all the way up until 2049, when it almost is at the same level as it was before the drop.

From the yield to maturity calculations we see that bonds more exposed to risk generally are compensated for this in the form of a higher yield to maturity. The only surprising finding in the yield to maturity calculations was that of the 2-year government note, which had a higher yield to maturity than the 3-year, 5-year, and 7-year note, and also higher than that of the Apple Inc 2-year corporate bond. This makes investing in the 2-year government note attractive for investors, more so than the other mentioned alternatives that are all more exposed to risk, either in the form of longer-term maturity, or in the form of default risk.

The bond investment strategy is affected by the interest rate forecast, with *bond laddering* and *bond swapping* proving to be the two most lucrative alternatives for investors. Bond laddering is a safer investment approach, which easily would deal with the interest rate drop of 2019. This investment approach will give you as an investor a steady income, without being too exposed to risk. I would recommend this approach for a risk-averse investor, who is looking for a steady income over time. The bond swapping approach also deals with the 2019 drop, potentially making higher returns of it. This approach is more exposed to risk, and could potentially struggle during the steady increase period for the interest rate after the drop of 2019, since the investor then will have to sell bonds at a loss. The bond swapping approach is therefore recommended for more of a risk-loving investor, someone who is open to taken on risky investments, in the hope of earning big money.

Recommended future research on this research question would be to develop the interest rate forecast. With a better interest rate forecast this thesis would be more practical, and could be used when investing in bonds. At the moment, this thesis is most hypothetical, looking at how you could use an interest rate forecast.

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# 10 Appendix

## A. Key Rates Statistics

| Year | Average IR % |
|---|---|
| 2001 | 3,7708 |
| 2002 | 1,5833 |
| 2003 | 1,2042 |
| 2004 | 1,4167 |
| 2005 | 3,2500 |
| 2006 | 4,9792 |
| 2007 | 5,0000 |
| 2008 | 1,8542 |
| 2009 | 0 |
| 2010 | 0 |
| 2011 | 0 |
| 2012 | 0 |
| 2013 | 0 |
| 2014 | 0 |
| 2015 | 0,0208 |
| 2016 | 0,2708 |
| 2017 | 0,7917 |
| 2018 | 1,6667 |

Information calculated based on information from Countryeconomy (2019)

## B. Bonds and YTM

Treasuries:

| | Settlement day | Maturity | Coupon | Yield % | Price (bid) | Price (ask) | YTD % | Redemption Value | Coupon payments per year | YTM | YTM % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 30-Year Bond | 6.19.19 | 5.15.49 | 0,02875 | 2,560 | 106,244 | 106,254 | 2,573 | 100 | 2 | 0,02573821 | 2,57 |
| 10-Year Note | 6.19.19 | 5.15.29 | 0,02375 | 2,082 | 102,2660 | 102,2720 | 2,093 | 100 | 2 | 0,02119399 | 2,12 |
| 7-Year Note | 6.19.19 | 5.31.26 | 0,02125 | 1,959 | 101,074 | 101,08 | 1,964 | 100 | 2 | 0,01957896 | 1,96 |
| 5-Year Note | 6.19.19 | 5.31.24 | 0,02 | 1,859 | 100,26 | 100,264 | 1,865 | 100 | 2 | 0,01943674 | 1,94 |
| 3-Year Note | 6.19.19 | 6.15.22 | 0,0175 | 1,831 | 99,284 | 99,29 | 1,82 | 100 | 2 | 0,01995853 | 2,00 |
| 2-Year Note | 6.19.19 | 5.31.21 | 0,02125 | 1,891 | 100,17 | 100,174 | 1,882 | 100 | 2 | 0,02033141 | 2,03 |
| 1-Year Bill | 6.19.19 | 6.18.20 | 0 | 2,067 | | | . | | | | |
| 6-Month Bill | 6.19.19 | 12.19.19 | 0 | 2,187 | | | . | | | | |
| 3-Month Bill | 6.19.19 | 9.19.19 | 0 | 2,211 | | | . | | | | |
| 1-Month Bill | 6.19.19 | 7.16.19 | 0 | 2,174 | | | . | | | | |

Corporate:

| Issuer name | Symbol | Callable | Coupon | Settlement day | Maturity | Moody's®/S&P | Price | Yield % | Redemption value | Coupon payments per year | YTM | YTM % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Apple Inc | AAPL4122392 | Yes | 0,0285 | 6.19.19 | 5.6.21 | Aa1/AA+ | 101,553 | 1,989 | 100 | 2 | 0,0200369 | 2,00 |
| Apple Inc | AAPL4452439 | Yes | 0,0300 | 6.19.19 | 2.9.24 | Aa1/AA+ | 103,160 | 2,248 | 100 | 2 | 0,0227792 | 2,28 |
| Apple Inc | AAPL4336433 | Yes | 0,0465 | 6.19.19 | 2.23.46 | Aa1/AA+ | 118,235 | 3,571 | 100 | 2 | 0,0358263 | 3,58 |
| | | | | | | | | | | | | |
| American AIRLS | AAL3707307 | Yes | 0,0697 | 6.19.19 | 5.23.21 | Ba3/BB- | 102,000 | 5,927 | 100 | 2 | 0,0585435 | 5,85 |
| | | | | | | | | | | | | |
| American Tower Corp | AMT4046702 | Yes | 0,0500 | 6.19.19 | 2.15.24 | Baa3/BBB- | 110,175 | 2,646 | 100 | 2 | 0,0266096 | 2,66 |
| | | | | | | | | | | | | |
| American INTL group inc | AIG461830 | Yes | 0,0575 | 6.19.19 | 4.1.48 | Baa2/BBB- | 105,090 | - | 100 | 2 | 0,0539892 | 5,40 |

## C. TREND forecast

Based on 2001 – 2018:

| Year | Average IR % | Trend |
|---|---|---|
| 2001 | 3,7708 | |
| 2002 | 1,5833 | |
| 2003 | 1,2042 | |
| 2004 | 1,4167 | |
| 2005 | 3,2500 | |
| 2006 | 4,9792 | |
| 2007 | 5,0000 | |
| 2008 | 1,8542 | |
| 2009 | 0 | |
| 2010 | 0 | |
| 2011 | 0 | |
| 2012 | 0 | |
| 2013 | 0 | |
| 2014 | 0 | |
| 2015 | 0,0208 | |
| 2016 | 0,2708 | |
| 2017 | 0,7917 | |
| 2018 | 1,6667 | |
| 2019 | | -0,2309 |
| 2020 | | -0,4061 |
| 2021 | | -0,5814 |
| 2022 | | -0,7566 |
| 2023 | | -0,9318 |
| 2024 | | -1,1071 |
| 2025 | | -1,2823 |
| 2026 | | -1,4575 |
| 2027 | | -1,6328 |
| 2028 | | -1,8080 |
| 2029 | | -1,9832 |
| 2030 | | -2,1585 |
| 2031 | | -2,3337 |
| 2032 | | -2,5089 |
| 2033 | | -2,6842 |
| 2034 | | -2,8594 |
| 2035 | | -3,0346 |
| 2036 | | -3,2098 |
| 2037 | | -3,3851 |
| 2038 | | -3,5603 |
| 2039 | | -3,7355 |
| 2040 | | -3,9108 |
| 2041 | | -4,0860 |
| 2042 | | -4,2612 |
| 2043 | | -4,4365 |
| 2044 | | -4,6117 |
| 2045 | | -4,7869 |
| 2046 | | -4,9622 |
| 2047 | | -5,1374 |
| 2048 | | -5,3126 |
| 2049 | | -5,4879 |

Based on 2008 - 2018:

| Year | Average IF | Trend |
|---|---|---|
| 2008 | 1,8542 | |
| 2009 | 0 | |
| 2010 | 0 | |
| 2011 | 0 | |
| 2012 | 0 | |
| 2013 | 0 | |
| 2014 | 0 | |
| 2015 | 0,0208 | |
| 2016 | 0,2708 | |
| 2017 | 0,7917 | |
| 2018 | 1,6667 | |
| 2019 | | 0,5867 |
| 2020 | | 0,6148 |
| 2021 | | 0,6428 |
| 2022 | | 0,6708 |
| 2023 | | 0,6989 |
| 2024 | | 0,7269 |
| 2025 | | 0,7549 |
| 2026 | | 0,7830 |
| 2027 | | 0,8110 |
| 2028 | | 0,8390 |
| 2029 | | 0,8670 |
| 2030 | | 0,8951 |
| 2031 | | 0,9231 |
| 2032 | | 0,9511 |
| 2033 | | 0,9792 |
| 2034 | | 1,0072 |
| 2035 | | 1,0352 |
| 2036 | | 1,0633 |
| 2037 | | 1,0913 |
| 2038 | | 1,1193 |
| 2039 | | 1,1473 |
| 2040 | | 1,1754 |
| 2041 | | 1,2034 |
| 2042 | | 1,2314 |
| 2043 | | 1,2595 |
| 2044 | | 1,2875 |
| 2045 | | 1,3155 |
| 2046 | | 1,3436 |
| 2047 | | 1,3716 |
| 2048 | | 1,3996 |
| 2049 | | 1,4276 |

**D.**

**E.**

**F.**