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Risk Aversion & Asset Allocation in a Low Repo Rate Climate

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Abstract

This paper addresses the issue of risk aversion and asset allocation for investors under the current globally low repo rate climate, as we try to examine how the low rate affects investor decisions. As a proxy for investors we have sampled data from several mutual funds, consisting of 50 balanced mutual funds and 15 pension targeting funds, all registered in the United States. Our measures of reallocation within the funds are the beta-values and risk is measured through the funds variance. According to our hypothesis a low repo rate should affect the risk-free asset, lowering its yield. Investors on the market will therefore be inclined to reallocate their portfolios towards the market and away from the risk-free asset, thus taking on more risk. The hypothesis and reasoning in this paper is based on Markowitz assumptions of investors which are risk-averse and mean-variance optimizers, as well as the assumptions of Capital Asset Pricing Model that all investors act homogenous and facing the same risky portfolio and risk-free asset. The result of this paper indicates that a shift within investors risk aversion and asset allocation have occurred, but in a somewhat inconclusive way. The shift seems to depend on the funds' risk aversion and their willingness to change it when exposed to an increased market variance rather than as a direct response to a low risk-free rate. Rendering in the conclusion that the low repo rate affects risk aversion and asset allocation mostly through an increased variance.

Keywords: Repo rate, Asset allocation, Risk aversion.

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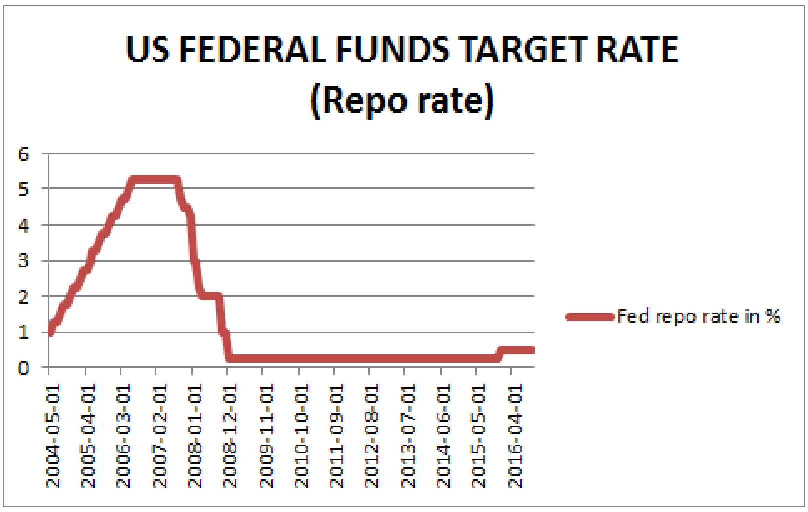
1. Introduction

It is almost nine years since the subprime mortgage crisis began in the United States in December 2007. The crisis, that caused a global recession, struck the world's economies fiercely and when it finally ended in June 2009, it left hundreds of thousands of people with almost all of their invested earnings washed away. Today we are experiencing an economy which has recovered from the recession, but still struggles with a low inflation, causing the Federal Reserve to keep the repo rate at a record low level in an effort to stimulate the inflation upwards. However, this has not happened during these past years, which is keeping the repo rate at a constant low level way below previously experienced levels, creating a new norm for the repo rate level.

Diagram 1 - Shows the Repo rate issued by the Federal Reserve



These new extreme conditions have given rise to a series of interesting questions regarding hypothetical effects within the area of portfolio selection, since the new low repo rate should have a negative impact on the interest rates of risk-free assets and possibly even affect other kinds of assets (Federal Bank of San Francisco, 2000; Shahidi, 2014). Together with the theory of mean-variance analysis and portfolio management, one could argue that as a result of these extremely low interest rates investors should need to rethink their investment strategies (Markowitz, 1952). Along similar lines one could claim that since William F. Sharpe argues in *The Journal of Finance* (1964) that investors act homogeneously when evaluating assets and therefore invest in an identical portfolio called the market, the low interest rate would generate a shift towards higher market exposure for investors.

The purpose of this paper is therefore to investigate whether the decreasing repo rates compel investors to reallocate asset allocation towards higher risk assets (stocks and bonds). To exam this we look at a group of balanced mutual funds and target pension funds who will work as a proxy for investors and their behavior. With support from financial theory we measure and observe both variance and beta values for each fund, thus trying to find support for the claim that investors shift their assets away from the risk-free alternative and become less risk averse.

1.2 Disposition

The following parts of this paper is divided into four different chapters, the next one being chapter two, where we will present and explain the difference between risky and risk-free assets, how they are defined and their role within the theory of asset allocation. The chapter will also discuss the theoretical premises behind Markowitz's assumptions and how they affect an investor's allocation on the market. From these grounds, the discussion moves on to the theory regarding Sharpe's capital asset pricing model to clarify how the beta value can be used as a measurement of risk exposure. In chapter three we discuss our sample of funds and the chosen risk-free asset. The focus will be on justifying why we have chosen our specific funds as well as T-bills (risk-free) and how this may impact the result of this paper. Equations used to calculate and process the data will also be discussed to provide a clear picture of how conclusions have been reached.

Furthermore, chapter four contains the results of the data sample. Here we will provide a clear picture of what happened in our data set under the different repo rates. Our paper will end in chapter five were we provide a full analysis of the presented data, linking it to previous mentioned theory and present the main conclusions of this paper. Finally we summarize the findings and reflect upon what can be improved with our thesis for future research in the same field.

2. Theory, models and assumptions

The following chapters will deal with the theory behind why investors want to reallocate their resources in the first place. It will also describe the assumptions from which we will analyze and predict the investors' reactions when exposed to a low repo rate.

2.1 Capital and Asset allocation

To fundamentally understand asset allocation one must firstly understand what different types of assets capital can be designated to. Therefore, we begin with concluding that any investor primary has two different types of assets to invest in, the ones that carry risk and the ones that do not. The risk-free asset is an asset in which no exposure for a default of payment exists. In reality some risk exposure is inevitable in any asset; even cash holds some risk since it might be subject to inflation (Shahidi, 2014). Therefore risk-free assets are determined as low volatile assets such as cash, certificates of deposits and securities issued by the government which have a low probability of default. In our thesis, we have determined to treat T-bills as the risk-free asset. A more thorough explanation to why follows in chapter three, but it is primary due to the fact that T-bills are considered one of the safest short-term financial instruments of the US government, since the capital invested are more easily transformed into cash again compared to other government securities and T-bills have a short lifespan making them less susceptible to interest rate components (Federal Bank of San Francisco, 2000).

Risky assets on the other side include all other assets which an investor might also invest in, such as stocks, bonds, commodities etc. Historically they have been much more volatile than the risk-free assets, i.e. they have carried more risk, but they have also paid a higher yield to compensate for this risk. The risky assets that will be mostly treated in this paper are stocks and bonds, since they make up the bulk of the funds that we investigate and therefore have the biggest impact on these.

Since the risk-free assets carry no risk they must all, according to standard arbitrage theory, pay the same yield. The argument goes that if any risk-free asset paid higher yields than the others, everyone would sell the other risk-free assets and buy that one, making a no risk profit, an arbitrage. This makes the selection between different types of risk-free assets trivial. Risky assets on the other side hold different amounts and types of risk. For example, various stocks have different variance and react to external events inconsistently. The choice of which risky assets to include in a portfolio is therefore highly interesting and is in the end the decisive factor of the mean and variance in a portfolio. For our funds this selection would be a selection of how much to allocate in stocks compared to bonds and by that decide how much risk and return they are willing to hold. From here on we will refer to this "selection" as asset allocation. (Bodie, Kane & Marcus, 2014). The selection between how much capital investors allocate in the different types of assets; the risky and risk-free asset is called capital allocation and the selection of individual securities within the asset class security selection (Bodie et al. 2014)

Further on in this paper we will also refer to what is called strategic asset allocation. Strategic asset allocation entails that asset allocation should depend on a chosen target portfolio with a certain risk and return and that the weights in the portfolio should be rebalanced when they are skewed by changes in asset returns. Strategic asset allocation implies a long-term perspective on portfolio characteristics, such as mean and variance, and indicates that investors' optimum allocation targets future expected return (Kwon, Lee. C-G & Lee. M 2016).

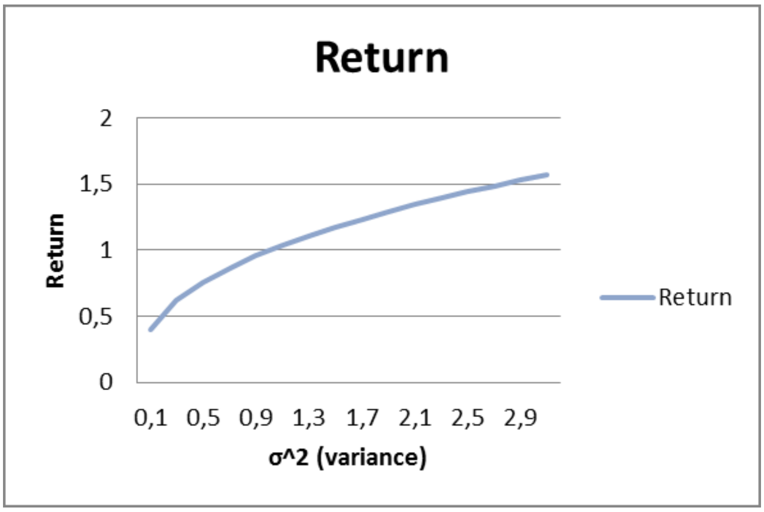
Under strategic asset allocation there are, however, numerous conditions and situations that could make it difficult or non-preferable for investors to rebalance their portfolios towards their target portfolio when needed. Two common examples are illiquidity in assets and market timing. Illiquid assets refer to the fact that some assets are difficult to liquidate, which renders asset weights that not always can be altered at will. Market timing instead captures the problematic with some financial transactions and investment strategies dependence of certain market conditions. If there is a need of rebalancing a portfolio with assets that require market timing, and the markets conditions are not in favor, the re-allocation cannot be made (Kwon et al. 2016). A third possible explanation to why investors would not rebalance their portfolio when needed could be that they are hindered by restriction, either forced upon them or put in place by themselves. Regardless of the reason there might be circumstances where an investor wants to rebalance his portfolio, but cannot do this, which results in an asset allocation which is not at its optimum in regard of strategic asset allocation.

However, for both standard and strategic asset allocation, the allocation will always be set to fulfill the target of an investor, to generate return. How this is best achieved depends on the investor's view of risk, but to understand why risk occurs we must first investigate how risk generates return in risky assets.

2.2 Variance, Return and excess return

We have already concluded that there are two different types of assets, risky and risk-free and that the expected return of risk-free assets does not differ while the expected return of risky assets varies. The part of the return of the risky assets that is above the risk-free rate is referred to as the excess return and the size of it is depending on the amount of risk the asset holds and return is often thought of as a diminishing function of risk, i.e. variance, see diagram 2. Noteworthy is that it is the expected return of the asset that is higher than the expected risk-free rate and not the *de facto returns*, indicating that the actual return of the risky assets might be less than the risk-free rate (Shahidi, 2014). The word risk in investment theory is in the end only an approximation of the probability that an asset pays less than expected.

Diagram 2 – Shows the relationship between risk and return



Primary there are three different factors affecting assets variance. These are shifts in expected economic environment, shifts in investors risk appetite and shifts in expected cash rate, (repo rate) (Shahidi, 2014). Because these shifts affect the risk of assets they also modify the risk premium and excess return of said asset. Shifts in expected economic environments affect variance and expected return of risky assets since all risky assets are somewhat biased towards the economic environment, i.e. unexpected changes in the environment reflects in the asset through the bias. The level of risk appetite investors have influence the risk and expected return by increasing or decreasing the demand of risky assets, making them more or less volatile. Both these explanations lead to a higher return and excess return of the assets, since the repo rate is not directly connected to the market or risk appetite, though one can argue that they are somewhat correlated (Shahidi, 2014).

Unexpected changes in expected cash rate on the other hand most certainly are connected to the risk-free rate, since they are more or less the same. These changes directly affect the excess return of risky asset as they directly improve or lessen the excess value of assets, depending on whether the rate increase or decrease. As an example, consider a bond that initially has an excess return of 5 % and faces an unexpected increase in the risk-free rate by 3 %. Suddenly the excess return is only 2 % for the bond and the value of the bond has significantly decreased. If the rate instead would go down 3 %, the excess return of the bond would increase to 8 % and the value of the bond would increase (Shahidi, 2014).

As described these factors are connected to the repo rate in different ways and accordingly they should react differently to a lower repo rate. As an example, a lower repo rate historically increases the misinterpretation of interest rates, creating more unexpected changes in the repo rate and thus increasing the volatility of asset return based on it, increasing average variance in low rate periods. One could also argue that the lower rate indirectly affects both the risk appetite and the economic environment since it lessens the cost of capital and often occur in troublesome times (Shahidi, 2014). As a result we can conclude that the lower rate should render us with a higher volatility in the market and therefore increase the risk and return of all assets. Noticeable is that the volatility in risk-free asset, which theoretically does not exist, also should increase somewhat since the repo rate has become harder to predict (Shahidi, 2014).

To summarize, the above-mentioned factors are ultimately what decides the risk and return of an asset and while shifts in risk appetite and unexpected changes in risk-free rate are impossible to hedge for, some, if not all the impact of altering economic environment can be reduced. This can be done since various assets are biased in different ways to economic factors. By combining assets that have the opposite or close to opposite biases, investors can reduce the changes in expected return and through that the variance in their portfolio, which leads to one of the fundamentals of asset allocation: the mean- variance analysis (Shahidi, 2014).

2.3 Mean-variance analysis

As stated asset allocation is the selection of various asset proportions in a portfolio and should be made in consideration to the different return and variance determination factors mentioned above. The foundation to how to make this selection is often thought of as the mean-variance analysis developed by Markowitz (1952).

According to this theory investors which are only concerned about the mean and variance of an asset, i.e. the return and risk of an asset, maximizes their utility by maximizing the discounted value of future returns in proportion to the amount of risk taken, assuming a constant belief of future earnings. This implies that to fully take advantage of the utility in a portfolio investors should try to maximize the return given the amount of variance they can accept. Or in other words they should compose their portfolio so that it holds as little risk as possible, but with maximum return (Markowitz, 1952). This is rational since any investor who falls under the standard assumption of risk-averse investors should choose a portfolio with a higher mean-variance ratio.

Considering the argument from chapter 2.2, regarding the possibility of ridding yourself of the variance caused by changes in the economic environment, it implicates that diversification in portfolios targeting assets covariance is beneficial for mean-variance maximizing investors. At least it should be if it is done properly and assets with low covariance are added, since portfolios diversified with regard to low covariance result in either higher return and/or lower variance in the portfolio (Markowitz, 1952; Shahidi, 2014). Thus, security selection and asset allocation decisions taken by investors fitting the assumptions will be a trade-off between return and risk. If a security or asset has a positive total effect on the ratio between return and risk, a rational investor should include the security in its portfolio, but if its total effect is negative, he should refrain from adding it (Markowitz, 1952). The result of the mean-variance analysis is therefore that any investor should try to maximize the mean-variance ratio by diversifying the portfolio. Thus, all investor should chose to hold the portfolio which renders the highest possible return for any given amount of risk they can accept (Markowitz, 1952).

However, this theory can be further enhanced by creating a portfolio consisting of a risk-free asset and the mean-variance maximizing portfolio, i.e. the portfolio with the largest possible ratio between excess return and risk. Since the risk-free asset holds zero or close to zero variance the total risk of the portfolio now depends on the proportion invested in the mean-variance portfolio, i.e. the variance of the portfolio will be

$$p^* = w_p \sigma_P \quad (2.1)$$

Where w_p is the weight in the risky portfolio, σ^2_p is the variance in the risky portfolio and p^* is the variance in the investor's optimal portfolio. Therefore, an investor can: by altering the proportions of the risky and risk-free asset - construct a portfolio with any given amount of risk and still hold the biggest possible mean-variance ratio. This implies, since the mean-variance portfolio by definition is the utility maximizing portfolio for an investor, that any investor independent of risk preferences, can hold the utility maximizing portfolio. Consequently, all investors will, given that they have the same investment opportunities, hold the same portfolio under the mean-variance criteria: the mean-variance maximizing portfolio (Campbell & Viciera, 2003; Tobin, 1958).

The result above is called the mutual-fund theorem (Tobin, 1958) and implies that any portfolio during the mean-variance analysis rationally will be considered as a portfolio consisting of only two different assets. A risky asset, made up by the mean-variance portfolio, and the risk-free asset. This holds since there is no changes that can be done to the mean-variance portfolio to make any investor better off, the portfolio is already at its optimum. Thus, a rational investor will only care about the proportions of the risky and the risk-free asset since they are the only parameters affecting the optimal portfolios characteristics (Tobin, 1958).

As a result asset allocation can be equalized with capital allocation under the mean-variance analysis. As a result, the trade-off line between the risky and risk-free asset is referred to as the capital allocation line, referred to as the CAL from now on. The CAL represents all the rational allocation options an investor can make with the available capital and depending on the risk aversion the investor will choose the best fitting proportions of assets along the line (Bodie et al. 2014). In our case, this will imply that all our funds should hold roughly the same assets in their risky portfolio and that their asset allocation will become a choice of capital allocation. The impact of the alterations in individual risky assets created by the lower repo rate should therefore have little impact on an investor's decisions. However, if the general asset variance shifts, this might still have an impact since the mean-variance ratio then might be modified.

Finally, there is one alternative way to view asset allocation under the mean variance analysis which is described as balanced asset allocation by Shahidi (2014). Balanced asset allocation tries to make the expected return as steady as possible and hence minimizing volatility by using diversification. As already discussed expected return is driven by three different factors and one of them changes in economic environment and can be diversified away.

In balanced asset allocation, the investor chooses asset proportions with regard to how strongly biased they are towards different market factors. By doing so, one can create a portfolio that yields almost the same return regardless of changes in the economic environment. It is basically the same as mean variance analysis, but instead of targeting the biggest spread between return and risk, investors target risk minimization, which according to Shahidi (2014) is preferable. This could be debated and an investor's preferences regarding what to target through the individual asset allocation comes down to risk aversion.

2.4 Risk aversion and utility functions

Risk aversion can be defined as an individual's personal willingness to engage in financial endeavors where there is a possibility for a negative outcome (Grable & Chatterjee, 2016). In other words, risk aversion models a person's preferences regarding risk and return and determines how a person reacts to different kinds of hazardous financial opportunities. Further on risk aversion in economics is considered to be dependent of an individual's expected wealth and the consumption possibilities it brings, although other parameters than expected wealth has been proved to affect risk aversion. As an example of these other parameters an individual's preferences and timing regarding liquidation affects risk aversion, since a need of soon liquidation increases the risk aversion of an investor and a longer investment horizon decreases it (Gusio & Paiella, 2008; Campbell & Viciera, 2003). Our funds' risk aversion should therefore be decided by their investors risk appetite, wealth and saving horizon.

To be able to measure risk aversion economist uses the fact that risk aversion is considered a function of wealth and constructs utility functions to visualize the effect of risk aversion on investments. The function should be created so that it matches the investor's expected utility with regard to personal preferences. As an example, an investor who is only interested in the mean of an investment would have a utility function that only pays respect to the return of the investment. For a more realistic function we can assume a mean-variance maximizing investor who´s utility would be depending on not only the expected mean, but also the variance of the investment and thus also the risk aversion (Campbell & Viciera, 2003).

Naturally the shape of these functions should also be created so that they describe the corresponding preferences and assumptions made in the best way possible. Since risk tolerance, the negation of risk aversion, is conceived to be a diminishing function of wealth, risk aversion must decrease with increasing wealth, rendering risk aversion to be a convex function of the same (Gusio & Paiella, 2008). This makes a power function, more exactly a quadratic function, preferable as a utility function. The reason for this, other than already stated, is that it is only necessary for an investor's two first moments of wealth distribution to enter the utility function for risk aversion in order for the function to behave accordingly (Lioui, 2016; Campbell & Viciera, 2003).

Therefore, a common way of modeling an investor's utility function is,

$$U = E(r) - \frac{1}{2}A\sigma^2 \quad (2.2)$$

where E(r) is the expected return, $A\sigma^2$ is the quadratic utility parameter, which represents the combined impact of risk and risk aversion on investment decisions. To calculate the investor's maximum utility one just simply solve for the equations first order condition and set it to zero, resulting in the equation

$$Y^* = \frac{(E(r_p) - r_f)}{A\sigma^2} \quad (2.3)$$

(Bodie et al. 2014; Sharpe, 2007). Here Y* represents the optimal proportion to invest in the risky asset and the other constants are the same. This equation fulfills all the assumptions of an investor's expected utility and makes it a diminishing function of wealth. (Bodie et al. 2014) It is also the function we will assume our funds to follow.

2.5 CAPM and its assumptions

To further enhance our study, we will use the capital asset pricing model (CAPM), which is a set of assumptions regarding expected return on risky assets during equilibrium. The model has its foundation in the economist's, Harry Markowitz theory and assumptions regarding mean-variance analysis and was further developed and published by, William F. Sharpe, in in *The journal of Finance* (1964). In his article, he put forward the claim that individual investment contains two types of risk:

1. Systematic Risk, i.e. non-diversifiable risk or market risk. This risk consists of recessions, interest rates and global conflicts etc. and an investor cannot "shield" the investment from this type of risk. In conclusion, all those factors that affects the two determining factors of excess return that cannot be hedged.

2. Non-systematic risk, i.e. idiosyncratic risk or specific risk. This is risk specific to each individual asset within a portfolio and can be almost eliminated by including enough assets, i.e. the economic environment biases.

The observant reader might now object and point out that there seems to be little differences between the two types of risk, the systematic risk does seem to include what we called economic environmental changes in chapter 2.2, which was considered diversifiable. It is therefore important to point out that the systematic risk refers to the impacts of the environmental changes, for example a shift in risk appetite and not the changes itself (Shahidi, 2014).

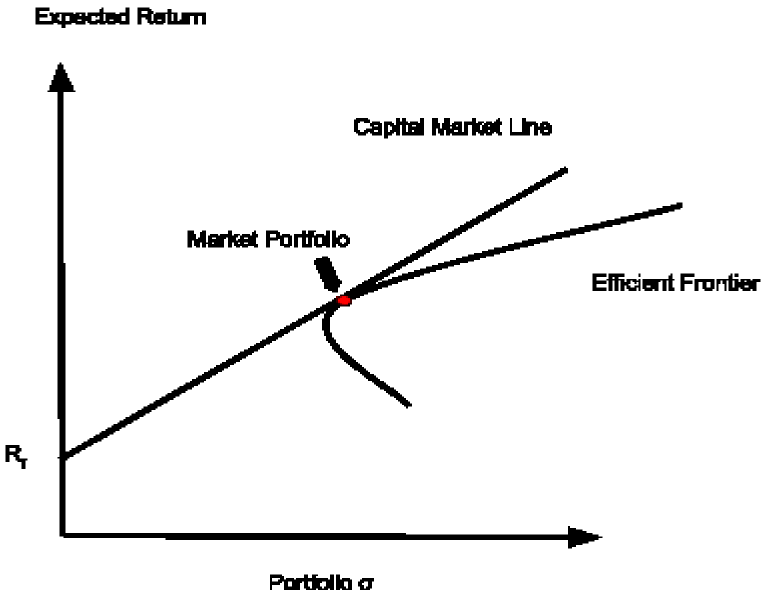
Furthermore, Sharpe (1964) makes two crucial assumptions to derive conditions for capital market equilibrium, upon which the CAPM is built on. The first assumption is the possibility to borrow and lend funds at a common interest rate, equal for all investors. Secondly, all investors act homogenous when it comes to expectations on the market. In other words, they agree on various variables on different investments, e.g. expected return and standard deviation etc. These assumptions are not realistic, but necessary, something Sharpe also addressed in his article (Sharpe, 1964).

For Sharpe's second assumption to work the CAPM model also assume a universe where all assets are traded in markets and there are no transactions costs or taxes. Further on all investors are rational and mean-variance optimizers, i.e. they are risk-averse and behave in accordance to the mean-variance model and are prepared to take on more risk only if they receive a higher expected return (Byström, 2014). If the assumptions above hold true, this means that all investors will have identical efficient frontiers combined with the common risk-free asset, leading them to draw identical capital allocation lines arriving in the same risky portfolio (P), which we already proved.

This leads CAPM theory to imply that every investor will hold an identical portfolio, the market portfolio (M), along the same CAL, the capital market line (CML). This is because that all investors will choose the same weights for each risky asset and since the market portfolio contains all assets in the investors' universe it will have the same weights as all the investors' identical portfolios. Thus, the investors will combine the market portfolio with the risk-free asset along the capital market line (CML). This line, which describes a linear relationship between the above-mentioned assets, has an intercept equal to the expected return of the risk-free asset and a slope equivalent to the risk premium (of the market portfolio) per each unit of risk. According to CAPM theory each portfolio at the CML is superior to the portfolios along Markowitz efficient frontier in the sense of risk premium per unit of risk.

This holds true for all possible portfolios along the CML except for the tangent point. Diagram 3 shows this optimal point where the efficient frontier is tangent to the CML and the investor at this point will not get better of anywhere else along the line (Bodie et al. 2014).

Diagram 3 – Shows the point where the Capital Market Line tangent the Efficient Frontier



For our funds this would mean that we can see them as holders of only two assets, just as under the mean-variance portfolio, but the two assets are now the market and the risk-free rate. In which degree the funds hold the market decides their risk and are referred to as their beta value.

2.6 Beta-value and its role in CAPM

As said, in CAPM an investor is not rewarded for idiosyncratic risk, since it is diversifiable, but only for systematic risk. The systematic risk is, as mentioned earlier in chapter 2.5, the risk associated with the market, which cannot be diversified away. The theory states that the individual asset's contribution to the risk of the overall portfolio, determines the desired risk premium of that specific asset. Higher risk contribution demands a higher return and vice versa. The contribution of risk (to M) of a single asset is determined by the weight held in that particular asset, as well as the covariance with M;

$$w_i * Cov(r_M, r_i) \quad (2.4)$$

The formula above shows this, where w_i is the weight and $Cov(r_M,r_i)$ is the covariance between the asset and the market. In the same manner, we can conclude that the individual asset's contribution to risk premium (to M) is derived using the following formula;

$$w_i * E(R_i) \quad (2.5)$$

Where w_i is the weight and $E(R_i)$ is, the assets expected risk premium (Bodie et al. 2014). From this we can derive the reward-to-risk ratios for both the individual asset and the market portfolio;

$$w_i * \frac{E(R_i)}{w_i} * Cov(r_M, r_i) = \frac{E(R_i)}{Cov(r_M, r_i)} \quad (2.6)$$

And

$$\frac{E(R_M)}{\sigma_M^2} \quad (2.7)$$

Where, the R_M is the market's risk premium and σ^2_M denotes the market variance. We are using the market variance when weighing the market risk premium against the market risk, this follows from the simple fact that the covariance with the market itself equates to the market variance. Equation (2.7) is also referred to as the market price of risk since it explains the relation between investors demand for extra return when faced with carrying more portfolio risk (Bodie et al. 2014). In accordance with the assumptions of market equilibrium and investors acting rational, i.e. striving to achieve the highest possible return for lowest possible risk, each investment held should offer an equal reward-to-risk ratio. If this is not the case the portfolio should be rearranged so that more weight is shifted towards assets with higher reward-to-risk ratios and away from those assets with a lower ratio. Since all investor would act homogenous this would affect asset prices until the ratios were equalized. Thus, we conclude that the individual assets reward-to-risk-ratio should equal the market price of risk (Bodie et al. 2014);

$$\frac{E(R_i)}{Cov(r_M, r_i)} = \frac{E(R_M)}{\sigma_M^2} \quad (2.8)$$

And this can be rearranged to determine the fair risk premium of the individual asset

$$E(R_i) = (\frac{Cov(r_M, r_i)}{\sigma_M^2}) * E(R_M) \qquad (2.9)$$

From equation (2.9) we get the ratio, which is also known as beta (β). The beta value shows how much the individual assets variance influence the market portfolio's variance as a fraction of the total variance of the portfolio. Knowing the beta ratio, we can rewrite equation (2.9) to find the mean-beta relationship (Bodie et al. 2014);

$$\mathrm{E}(\mathrm{r_i}) = \mathrm{r_f} + \beta_\mathrm{i}(\mathrm{r_M} - \mathrm{r_f}) \qquad (2.10)$$

Equation (2.10) holds true for any combination of assets since it according to CAPM holds true for any individual asset. From this we can create a portfolio using above equation, just multiplying with the specific asset weight for each individual equation and adding them together.

$$w_1 * E(r_1) = w_1 * r_f + w_1 * \beta_1(r_M - r_f)$$
$$+ w_2 * E(r_2) = w_2 * r_f + w_2 * \beta_2(r_M - r_f)$$
$$+ \quad \ldots = \ldots$$
$$+ w_n * E(r_n) = w_n * r_f + w_n * \beta_n(r_M - r_f)$$

$$E(rp) = rf + \beta_p(r_M - r_f) \qquad (2.11)$$

Where w_i denotes the individual asset weight and i denoting the asset, ranging from 1 to n. Since this holds for the overall portfolio, this must also hold for the market portfolio (see chapter 2.6). Thus, we get the following equation for the expected return on the market portfolio itself.

$$E(r_M) = r_f + \beta_M(r_M - r_f) \qquad (2.12)$$

From the beta ratio in equation (2.9) follows that the beta for the market portfolio must be equal to 1. In other words, beta can be described as an assets correlation to the systematic risk with regards to the whole market. High beta values of an asset indicate above-average sensitivity to changes in the market, i.e. assets with high beta values is considered more aggressive, while low beta value assets are considered defensive as result of being more impervious to market swings. Following this derivation, we can see that the beta can be used as a proxy for the optimal allocation an investor should have in the risky asset, since it mirrors how much risk he holds (Bodie et al. 2014). Indicating that the y* in equation 2.3 can be substituted for the beta value from CAPM, since they both equalize the risk exposure of the portfolio.

3. Methodology, data sample and analyzing measurements

In the following chapters, we will discuss how we have chosen our data and what it consists of. We will also describe the methods and formulas we use to process and analyze the sample and how we have structured it.

3.1 General methodology of the paper

According to the theory unexpected changes in central bank interest rates should affect the volatility within risky and risk-free assets. By doing so the repo rate should also modify the asset's excess return or change the ratio between risk and return. Considering this the utility function we established earlier and its maximizing first-order condition, equation 2.2 and 2.3, clearly conclude that a decrease in the mean-variance ratio should lead to a decrease in risk aversion or if we assume that funds use strategic asset allocation, to a rebalancing of assets from risky to risk-free. From this springs our hypothesis that changes in repo rate should create an effect on mutual funds asset allocation or their risk aversion. To examine if and how this affect expresses itself we have collected daily price data from 65 different mutual funds, which can either be categorized as balanced mutual funds or target retirement funds, over 13 years. We also collected both data over daily changes in interest rate on US three month treasury bills, called T-bills, on the secondary market and price data of the Russell 3000 index. Both the data on T-bills and Russell 3000 we used as a proxy, T-bills for the repo rate and Russell 3000 for the market.

The collected data sample we then divided into two different time periods, one with what we denote as high interest rate and one with low. The break point we choose to implement were when the interest rate went above or below one percent, rendering us with a high repo rate period stretching from 2004-05-07 to 2008-09-15 and a low rate period from 2008-09-16 to 2016-10-31, with average interest rates of 3.34 % and 0.11 % respectively. From these two-time periods, we then calculated various kinds of portfolio characteristics such as mean, variance, Sharpe ratios and beta values, with the intention to map potential differences. We also calculated running values for the variance, covariance and the beta values to enable us to perform a regression on the impact of interest rates on these factors.

3.2 Fund anatomy, the difference between our chosen categories

The funds which we have based our analysis on, which, as said, form the basis of this paper, consist of 50 balanced mutual funds and 15 target retirement funds. Before anything else it is worth mentioning that all funds chosen have their legal registration in the United States of America. We made this choice, to include only funds with this attribute, to narrow down the sample, since our whole sample now have the same legal restrictions. Notice that the legal restrictions may differ between the mutual balanced funds and the targeting retirement funds, but the restrictions in place is still issued by the same country and judicial system. We do not treat the legal framework in more detail than this, considering it is not the purpose of this paper, but nevertheless awareness should be raised around the fact that this may impact the funds restrictions and how they act on the market.

In our sample the 50 balanced mutual funds are divided into five different categories based on the level of asset allocation in equity. The different levels held in equity are as follows; 15 % - 30 %, 30 % - 50 %, 50 % - 70 %, 70 % - 85 % and 85 % +. Notice that these asset allocation ratios are just guidelines, i.e. the funds do not have a portfolio exactly consistent with their specific ratio, but they have a ratio in equity close enough. Another important variable that we need to address is that none of the funds (in our sample) in the (85 % +) -category have a 100 % allocation in equity, simply because they would not be balanced funds if they did. Our chosen funds need to have at least some allocation designated towards the risk-free asset.

The (15 % - 30 %) - category have the lowest holdings in equity and should therefore also have the lowest market exposure (defensive funds). Following the same reasoning, we conclude that the (85 % +) - category have the highest market exposure due to the high percentage held in equity (aggressive funds). The foregoing discussion (see chapter 2.6) implies that the beta which could be described as the market correlation coefficient should be low for the (15 % - 30 %) - category and high for the (85 % +) - category. Under the assumption of an unexpected high and long lasting decline in T-bill rate, and its presumed effect on risk in the economy, it exists two possible outcomes: the beta values for the different funds increases provided they are in a position where they can rebalance their portfolio, or the investors' excess return decreases. An increase in the beta-value follows from the assumptions in CAPM, based on the Markowitz's theory, that all investors act rationally and therefore will shift their portfolio towards the alternative with higher return and decrease their holdings in the risk-free asset (Bodie et al. 2014). This outcome is possible, only if the market risk premium increase enough in relation to the market variance and that the investors are willing to change their risk aversion (A, in equation 2.2) (Byström, 2014). If they are not willing to take more risk (change in A) then we should observe a decrease in the expected return, assuming they hold some floating bonds and cash in their portfolio.

The sample also contains 15 target retirement funds. This type of fund is aimed toward pension savings in the sense that you invest in the fund with the desired holding period, based on when you retire, and then you let your money grow within the fund until the day of your retirement. Funds with a shorter investment period tend to have less risk exposure, while funds with a longer investment period are more willing to take a larger risk exposure since there is more time to recover in the event of a big loss. Consequently, target retirement funds will decrease their market exposure the closer they get to their designated retirement. Because of this their beta will decrease since they reallocate more assets towards the risk-free alternatives. The 15 different target retirement funds in our sample has already reached their target date which should imply a stable beta value since they want to have a steady and secure return to be able to pay out retirement to their investors.

The notion to restrict our investigation to balanced and target retirement funds is because they consist of different types of assets and therefore are ideal for analysis of asset allocation. The possibility to track an "individual's" shift in allocation with regard to shifts in risk created by the interest rates is after all the purpose of the paper. They are also preferable since they in a better way replicate the investment options a standard investor has. We are aware that it would have been possible to do our investigation on single asset funds, but it seemed trivial since they cannot reallocate resources in the same way as the funds we choose. Of course, single asset funds could shift their allocation to a more or less risky asset within the asset group, but it would be security selection, not asset allocation, which under CAPM assumptions becomes trivial.

The selection of balanced funds and retirement targeting funds we examine have been selected based on Morningstar ranking and availability of historical data. The mutual funds are represented by balanced funds with a Morningstar ranking of five which means they are sold at a discount based on Morningstar's calculation models. Some of the things the models consider are excess return, fees, risk (variance), investment horizon and if the fund have an ethical investment strategy. All funds have historical data available for at least 13 years on DataStream. The target retirement funds are restricted by the same time limit, but have a Morningstar ranking from three to five. The reason for the more liberal approach to the target retirement funds was simply due to an otherwise lack of suitable funds. The logic behind the sample selection of well-endorsed funds was that we wanted well performing funds that would mirror rational ideas and reactions. To then use Morningstar ratings to create our sample felt natural since they are one of the world's most acknowledged fund rating companies. The data criterion was more or less forced upon us since we needed the data to cover both high and low interest rate periods.

3.3 The risk-free rate

As a proxy for the risk-free rate we decided to use T-bills. They are a short-term risk instrument with a maturity of less than a year which is issued by the government when they need to increase the state finance inflow. T-bills are sold on auctions where investors bid on the issued bills available. Therefore, two very relevant factors which influence the auction price is supply and demand. Thus, prices tend to increase when the economy is experience a boom and they tend to fall during a recession, as most assets. This is because during a boom the consumption is high, investment will be high and the countries BNP is increasing due to the rise in consumption which leads to higher production. As a result, the state finance increases and the government do not need to issue as many bills which make the supply decrease, driving up the auction price.

The opposite is happening during a recession, when the government need more cash inflow they issue more T-bills which decrease the auction price. Each bill has a predetermined, in the future, positive value called the par value. At the date of maturity this value is realized and the investor receives a positive cash inflow equal to the par. This holds true only if the investor chooses to keep the bill to maturity (Federal Bank of San Francisco, 2000). T-bills are often sold at a discount rate which equals the following;

$$\frac{Par\ Value - Purchase\ Price}{Par\ value} * \frac{360\ days}{Number\ of\ days\ to\ maturity}$$

The income the investor receives from a T-bill is equal to the difference between the par value and the purchase price, also known as the bill spread. The interest rate received from holding a T-bill to maturity is the spread divided by the purchase price. From above reasoning one can clearly see that the interest received from T-bills has quite a high correlation with the demand and supply of the bills itself. This is since the auction price, which determines the size of the bill spread, stand in direct correlation to the demand and supply.

Another variable also affecting the interest rate on T-bills is the Federal Bank's monetary policy actions. When the Federal Bank changes the repo rate, this causes changes in the Federal funds rate and this affect the interest rates for T-Bills since they are a close substitute (Federal Bank of San Francisco, 2000).

The Federal Bank uses the repo rate, to control the country's inflation to keep the inflation in line with the country's target level of two percent (Board of Governors of the Federal Reserve System, 2015). When the economy is experience a boom, the Federal Bank tend to increase the repo rate, which in turn increases the overnight lending rates between the banks which in turn causes a rise in the rates in which a consumer can borrow from the bank. This prevents the economy from overheating since higher bank rates encourage people to keep their money in the bank due to higher interest return. As a result, consumption decreases as well as investment. The exact opposite is happening when the Federal Bank decreases the repo rate, in an effort to "ignite" the inflation and keep the economy from falling further into a recession (Fregert & Jonung, 2014).

Diagram 4 – Shows the interest rate on T-bills on the primary market

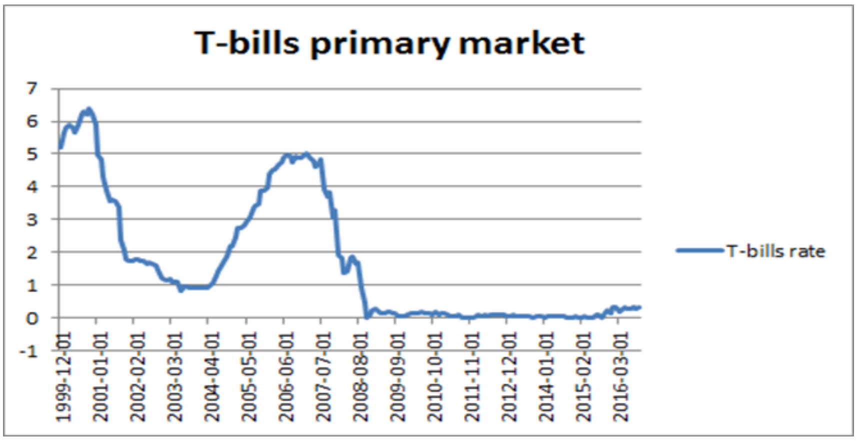
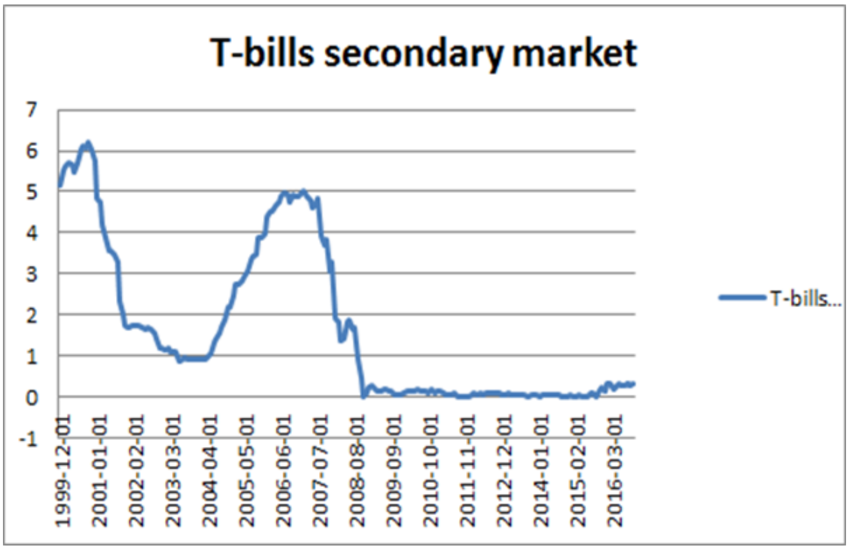


Diagram 5 – Show the interest rate on T-bills on the secondary market



The data we use for the T-bills are, however, from the secondary market and not the primary which needs some comments. Initially this means that the T-bills are sold and bought in a market where investors already own them, versus the primary market where they are sold directly by the government when they first issue the bills. The reason for using data on the secondary market for T-bills is that we needed daily data for our regressions and the primary market for T-bills only change once a week. However, the difference between the moment in the primary and secondary market is diminishing small when they are compared, as shown in the graphs 4 and 5.

The determinant of the range of our time periods was, as stated earlier, when the interest rate on T-bills went above and below one percentage. The intention behind this were to create two various periods with a significant variation in interest rates, which we succeeded with. The time periods 2004-05-07 to 2008-09-15 and 2008-09-16 to 2016-10-31, are also fairly equal in length and should therefore give a satisfactory result. Further on the interest rate have not risen above the one percent mark (see diagram 5), except in the transition period, since its drop in the autumn of 2008, giving us two conclusive time periods without noisy interruptions, as visualized in the graph above. Naturally one could always make the argument that another level of interest rate as a break point would be more ideal, but we think it satisfies our purpose.

3.4 Limitations in the data sample

There are some other problematics that can be found in our data sample. To begin with it would have been even more ideal to have data on all balanced funds with a five star Morningstar ranking, since this would have widened our sample. However, we needed sufficient historical data and this was not possible for all funds so we had to limit our sample and therefore the possible conclusion of the paper. Further on, one could always argue that ranking companies can be biased and that their rankings do not mirror the reality in a good way, which could render us with irrational or poor decision making funds. However, the credibility and acknowledgement held by Morningstar is quite robust. Lastly the sample, as all sample of funds, suffer from what is called survivorship bias (Bodie et al. 2014). This means that we only hold data from successfully managed funds, since the ones that radically misjudged the market have been dissolved and no data is available. This limits the possibility to find extremes in the sample and tilts the mean result of the funds in a positive direction. Since we in either way have chosen to focus on the most successful funds, the negative effect of this aspect is somewhat limited (Bodie et al. 2014). The program we used to access our data were *Thomson Reuters DataStream* which is one of the world's biggest commercial economic databases and should not bias our result.

3.5 Portfolio characteristic

In this chapter, we will explain which performance measurements and formulas we have used to analyze the data. However, since the purpose of this paper is not to explain theoretical formulas we will keep the explanations short. All formulas, except those in the end of this chapter (OLS regression and AR (1)) is based on the same literature (Bodie et al. 2014).

The different measurement of portfolio performance and behavior are all calculated from the dataset retrieved from DataStream. The daily means are calculated from the prices according to equation

$$r_i = \frac{P_t - P_{t-1}}{P_t} \quad (3.1)$$

Where r_i denotes the daily returns, P_t the price of the fund at certain point t, and P_{t-1} the price of the fund at the previous point t. The periodic means are the arithmetic mean of the daily return during the time period, i.e.

$$\frac{1}{n} * \sum_{i=1}^{n} r_i \quad (3.2)$$

Where r_i represent the daily returns and n the number of observations. The excess returns are simply

$$\mathrm{R_i} = \mathrm{r_i} - \frac{\mathrm{r_f}}{262} \quad (3.3)$$

Where R_i denotes the excess return, r_i the total return, r_f the yearly risk-free rate and 262 the number of observations each year. In other words, it is the return the asset provides above the discounted risk-free rate. Further on, the variance and the standard deviation is calculated with the standard formulas

$$\sigma^2 = \frac{\sum (x_i - \mu)^2}{(n-1)} \quad (3.4)$$

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \mu)^2}{(n-1)}} \quad (3.5)$$

Where the n once again represents the number of observations, x_i the observed value and μ is the mean value. The running standard deviation uses the same formula with a constant n of 262, but it shifts the sample period one day forward for each day. In a similar manner, running values for the variance were also calculated to measure increases and decreases of risk exposure within the funds.

The covariance for the funds and the market were calculated by using the standard equation.

$$\mathrm{Cov}(x, y) = \frac{\Sigma(x_i - \mu_x)(y_i - \mu_y)}{n} \quad (3.6)$$

Here x_i is the observed values of the funds, μ_x the mean value of funds, y_i the observed value of the market proxy and μ_y the mean of the market. n is as usual the numbers of observations and the running values for the covariance were calculated with the same formula and a constant n=262, with a shift in the sample a day forward for every calculated value. The same as we calculated the running standard deviation and variance.

The Beta values are calculated in two different ways. Firstly, they are estimated through a regression made on the fund's excess return upon the market's excess return. Secondly, they are calculated using the formula.

$$\frac{\mathrm{Cov}(r_M, r_i)}{\sigma_M^2} \quad (3.7)$$

Where $\mathrm{Cov}(r_M, r_i)$ is the covariance between the market and the fund and σ_M^2 is the market variance. The running beta value is calculated in a similar way as the running variance. We use our calculated running covariance for each fund and the market and then divided it with a running value for the market variance, each measurement with a constant sample size of n=262. The correlation between the market and the funds has also been calculated, to compare against the beta-values. The following formula was used:

$$\rho = \frac{\sigma_{iM}}{\sigma_i * \sigma_M} \quad (3.8)$$

Where ρ denotes the correlation coefficient, σ_{iM} the covariance between the market and the fund, σ_i the standard deviation for the fund and σ_M the standard deviation for the market. Our performance measure equations are the following, Sharpe ratio:

$$S = \frac{R_i}{\sigma_i} \quad (3.9)$$

Where S stands for Sharpe, R_i the excess return for the fund and σ_i the standard deviation for the fund. Treynor index:

$$T = \frac{R_i}{B_i} \quad (3.10)$$

Where T stands for Treynor, R_i the excess return for the fund and B_i the beta value for the fund. Our formulas for calculating risk aversion and optimal proportions have we already discussed, equation 2.5 and 2.6.

We have also processed the running variance and beta values in Eviews, making regressions to be able to test the variance and the beta values of the funds to see in which manner they are affected by the repo rate and if these effects are statistically proven. The regression we have used is called the ordinary least squares (OLS) and is structured in the following manner;

$$Y_i = \beta_0 + \beta_1 x_{i,1} + \varepsilon_i$$

Where Y_i denotes the dependent variable, β_0 the intercept, β_1 the regression coefficient for the independent variable, $x_{i,1}$ the independent variable (repo rate) and ε_i, also called Epsilon, which denotes unobservable changes that adds noise to the regression. For an example, all independent variables that could explain Y and that are not included in the regression fall into Epsilon (Dougherty, 2011). The above variables in the linear regression are the absolute true values, and since those values are unknown we must make an estimation of each variable by constructing a regression in the following manner;

$$y_i = b_0 + b_i x_{i,1} + e_i$$

Where y_i denotes the dependent variable, b_0 the estimated intercept, b_1 the estimated regression coefficient for the independent variable, $x_{i,1}$ the independent variable (repo rate) and e_i which denotes the regression residual, an estimation of Epsilon. When using this OLS regression one of the assumptions is that the regression has zero autocorrelation. This is a criterion our data of the running variance and beta values do not fulfill, since the independent variable from for both samples follow an autoregressive process with one lag. This can be explained with an autoregressive model (AR (1));

$$X_t = c + \varphi X_{t-1} + \varepsilon_t$$

In this model c is a constant, φ is the parameter determining the level of autocorrelation and ε_t is the noise-parameter. One can easily see that X_i (in this case the beta value of a fund) is determined by time and dependent on the previous value of itself, X_{t-1} (Dougherty, 2011). This caused our data do get a first degree of autocorrelation and to solve this problem we utilized the Newey-West estimator to adjust for autocorrelation. This is an estimator designed to give a more general estimation of data that does not follow the assumptions of homoscedasticity (even distribution in residuals) and non-existing autocorrelation. The regressions returned where significant and showed sufficiently good R^2 values for us to draw conclusions from. Running values for the variance (equation 3.4) were also calculated to measure increases and decreases of risk exposure within the funds.

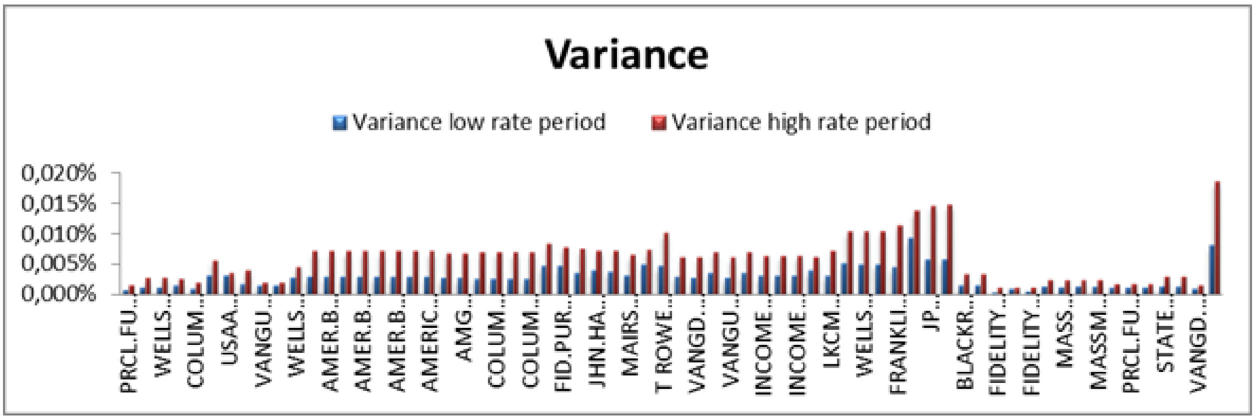
To statistically prove the changes, we can observe in the beta values in our Excel-data we have used t-test. Using the Excel function, we could compare the before period with the after period and observe that the change indeed is significantly different from H_0 (no difference between the two-time periods).

4. Result

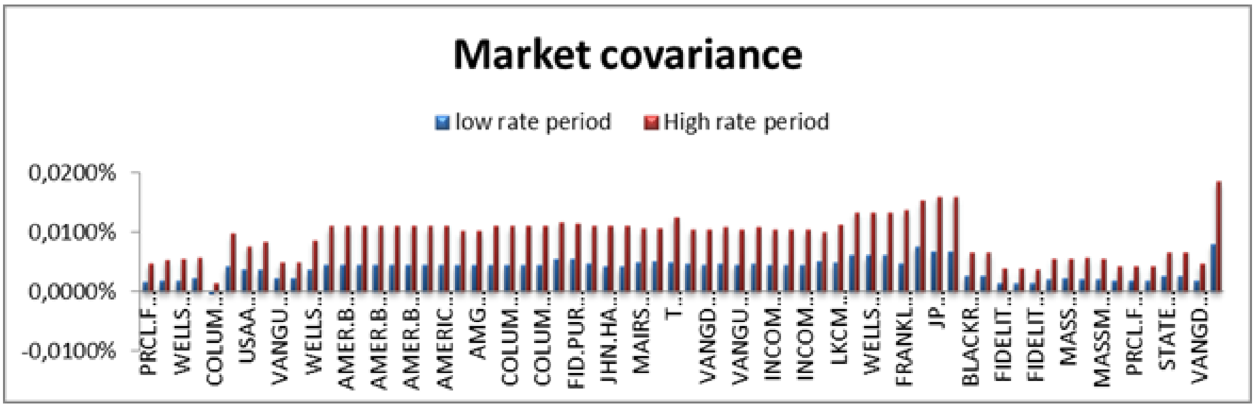
In this section, the discussion centers on the results of the data samples and regressions. The analysis of this will be reviewed in chapter 5.

To begin with we can conclude that at a glance our hypothesis seems to be correct. The results differ quite clearly between the high rate period and the low rate period in asset variance, covariance and correlation with the market. In all cases the values are higher for the period with lower interest rate, indicating that the low interest rate has increased the risk and market dependence of every single one of our investigated funds, see graphs 1-3. Here one could always make the argument of reversed causation and instead say that these changing factors, primarily the increased variance, have led to a decreased repo rate. This argument is not without credit since the repo rate is used as a tool by the central bank to stimulate the economy in troublesome times, where the market variance also often increases. Typically something that actually happened around our break point for the time periods. However, as stated in the earlier chapters, the economy has since long recovered from the latest recession and is only struggling with low inflation, which is keeping the repo rate at a constant low level. Implying that the repo rate in our sample is not a response to increased variance, instead it has adopted to a new lower normal level.

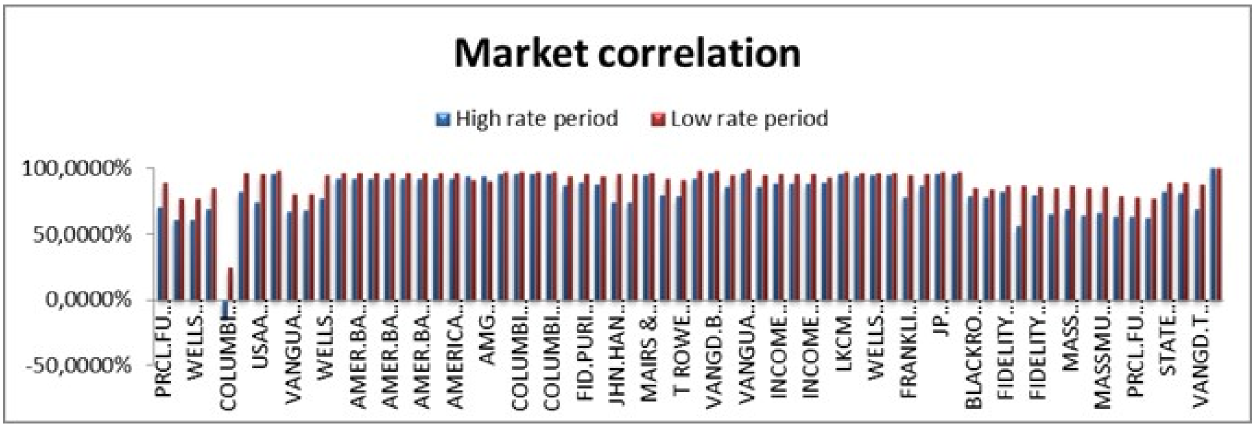
Graph 1: The variance of all the funds in the two different time periods.



Graph 2: The covariance of all the funds towards the market in the two different time periods.



Graph 3: The Correlation of all the funds towards the market in the different time periods.

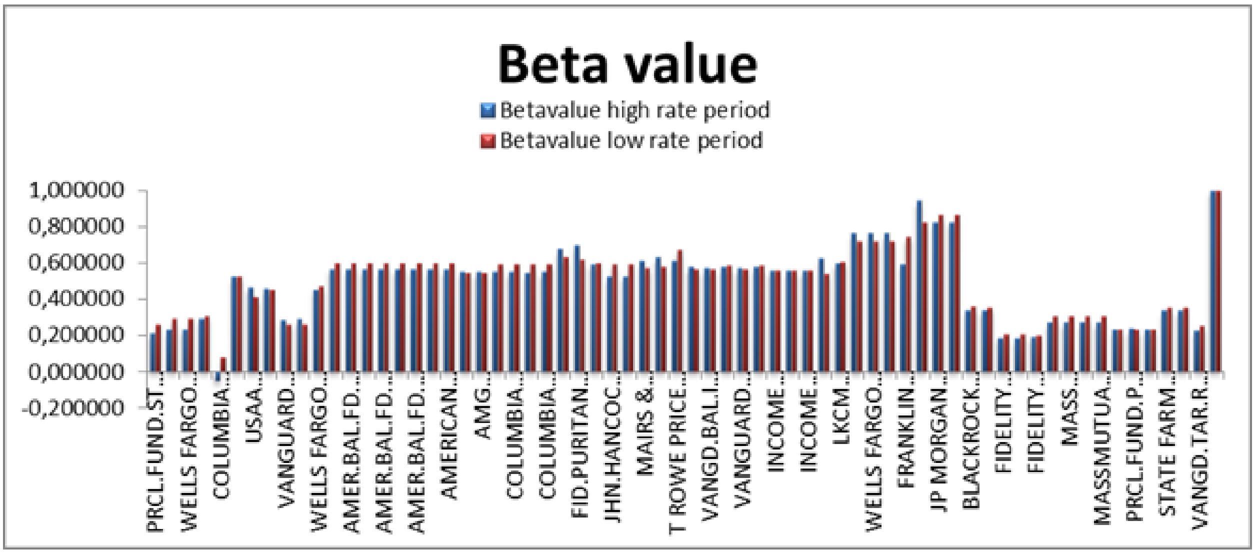


The values of the portfolio characteristics in the different time periods are, however, more inconclusive. The Sharpe ratios in time period one are pending between positive and negative, but are in the second period all, except one, positive and in all but two cases the ratio is higher than the ones of the first time period. Roughly the same holds true for the Treynor indices except for one big exception. The fund "Columbia Capital Allocation Moderate Portfolio Class R5" by far outperforms its performance in the later period during time period one. Almost the same holds true for the risk aversion values, they are both negative and positive during the first time period and in the second time period all but one are positive, as we can see in the appendix, table 2. The portfolio characteristics are also generally higher in the second time period than in the first, with a few exceptions. All in all, the portfolio characteristics indicates that the funds perform better in period two and that they have a higher risk aversion than in the first period. This result is however somewhat skewed by the fact that the return in time period one was exceptionally low.

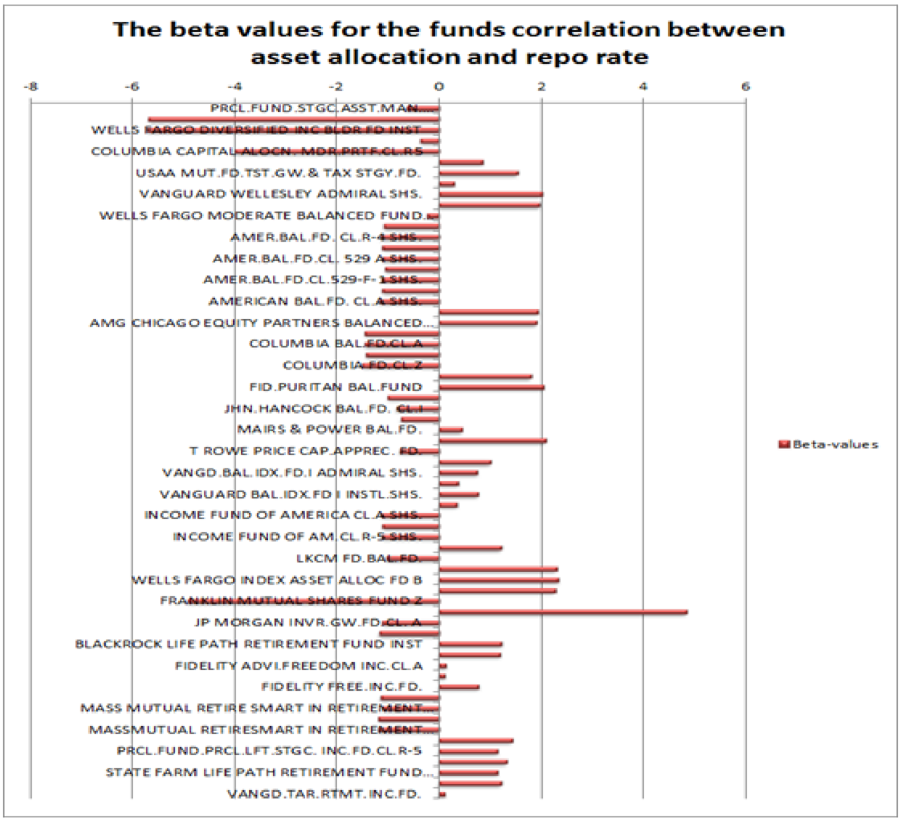
Moving on to the beta values for the funds in our sample, which were, as mentioned in chapter 3.4, calculated using two different methods. The first method estimated the beta through a regression made on the fund's excess return upon the market's excess return. The second estimation of beta was calculated from the equation 3.7. Both calculations returned almost identical beta values, showing that beta for 42 of the 65 funds increased from the first-time-period to the second-time-period, while the remaining 23 funds have either decreased or experienced no change in their beta values from period one to two (see graph 4). We also performed a t-test to make sure that there was a significant difference between the average beta value between period one and two rendering us with a p value of 3,421 %. This results in a conclusion on a one star level that the beta value significantly differs between the two periods.

As said, we also calculated a running beta value for the whole timespan of our observations based on equation 3.7 and performed a regression where the beta values of the funds were dependent on the repo rate. Because these calculations gave rise to autocorrelation as a result of that each beta value is based on the previous one, we had to adjust, as mentioned in previous chapter, the regression with the Newey-West estimator and run a new regression. In the appendix, table 5 one can see that after we adjusted for autocorrelation the calculations showed worse t-statistics (column 2 & 3) and greater standard errors (column 7 & 8) then the original regression. However, in column 5 we see that we still have good R^2-values with most of them circulating around 11 % - 35 %, and some even above 60 %, resulting in an average of 27 %. It also can be observed from the fourth column in the table that we can reject the null-hypothesis (no correlation between the T-bill rate and beta-values) for every fund except one. *"VANGD.TAR.RTMT.INC.FD"* shows an R^2-value below one percent as well as p-value above 5 %, leaving us with inconclusive results on this fund. In column 1 one can observe that the beta-values for the funds are both positively and negatively correlated with the T-bill rate.

Graph 4: The beta value, exposure to market risk, for all the funds in the two different time periods



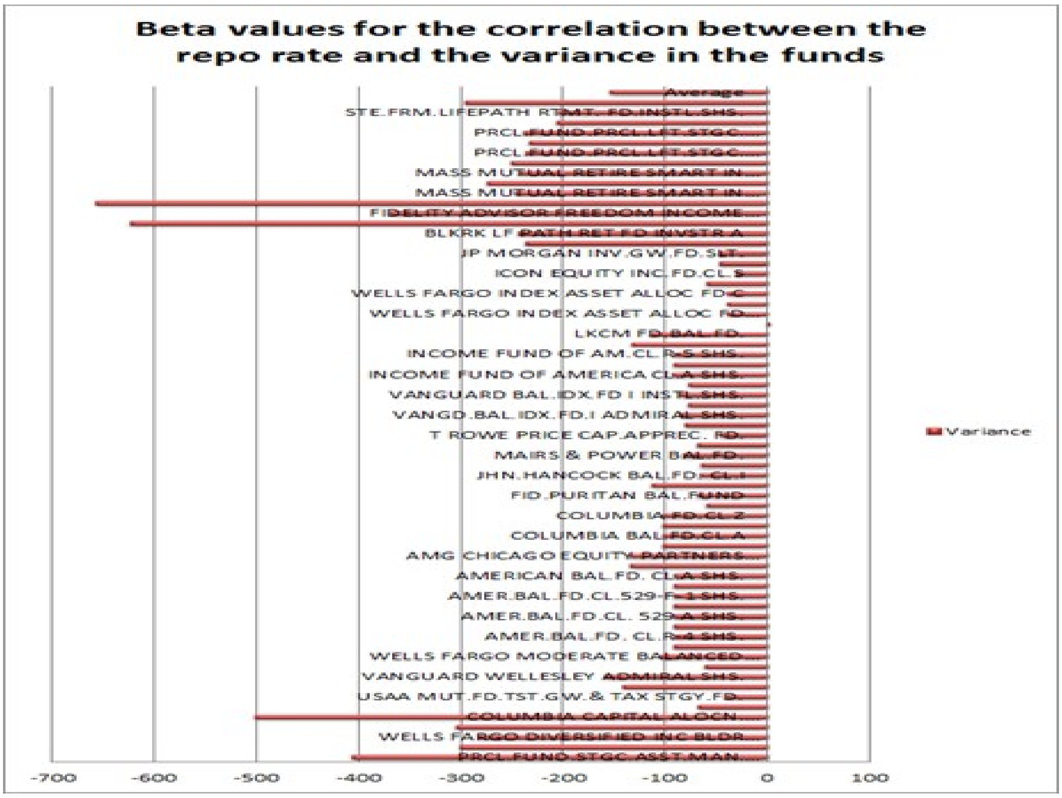
Graph 5: The correlation coefficient (b) from the regression made on the beta value, exposure to market risk, as dependent on the repo rate of all the funds.



Examining the regression upon running variance as dependent on the repo rate in the same manner as done above, we see an inverse correlation for all funds (see graph 6). Like the beta regression the regression on running variance was also adjusted for autocorrelation (see appendix table 4) and similar to the table for beta we can observe worse t-statistics (column 2

& 3) and greater standard errors (column 7 & 8) after adjustments are done. In column 5 the R^2-values show that our regressions explain the fund's changes with the T-bill rate with approximately 10 %, which unfortunately is quite low. The regressions are significant (column 5) and the null-hypothesis (no correlation between the T-bill rate and the variance) can be rejected for every fund. As a result, we can conclude that the variance for each and every fund is negatively correlated with the T-bill rate. Regarding causation we refer to the beginning of this chapter.

Graph 6: The correlation coefficient (b) from the regression made on the variance as depending on the repo rate for all the funds.

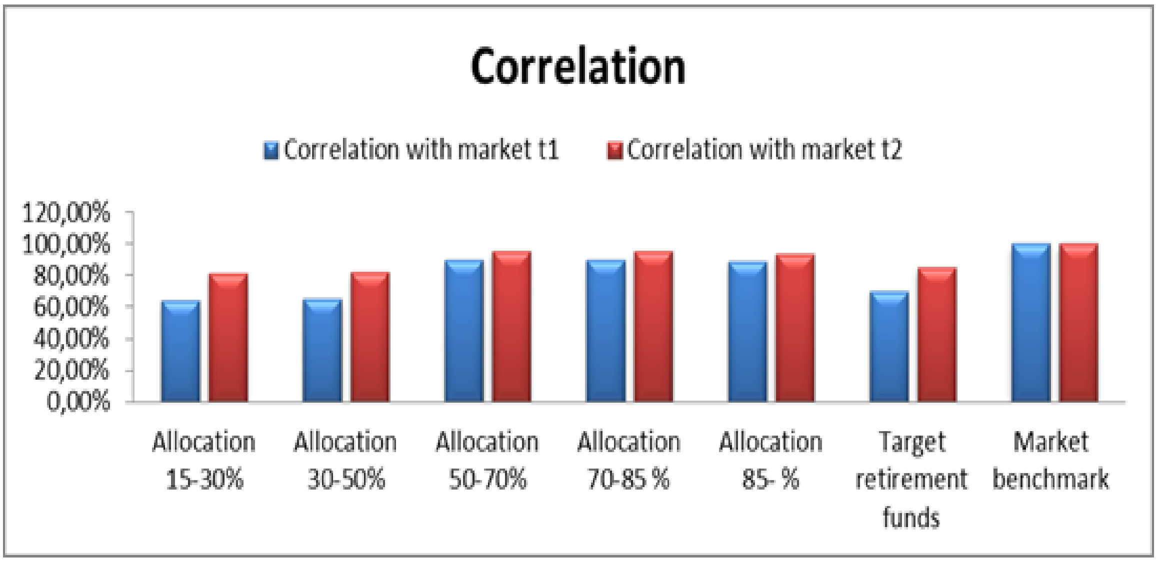


Above we have presented the result and changes in the overall sample for the examined funds, but we will also discuss the changes that occurred in the specific fund categories we have. From the appendix (table 2), row 1 and 2 and graphs 7-11, we can see that the excess return from period one to period two increases quite strongly in all categories. Likewise, one can also deduce an increase in the standard deviation, variance, covariance, correlation and so on.

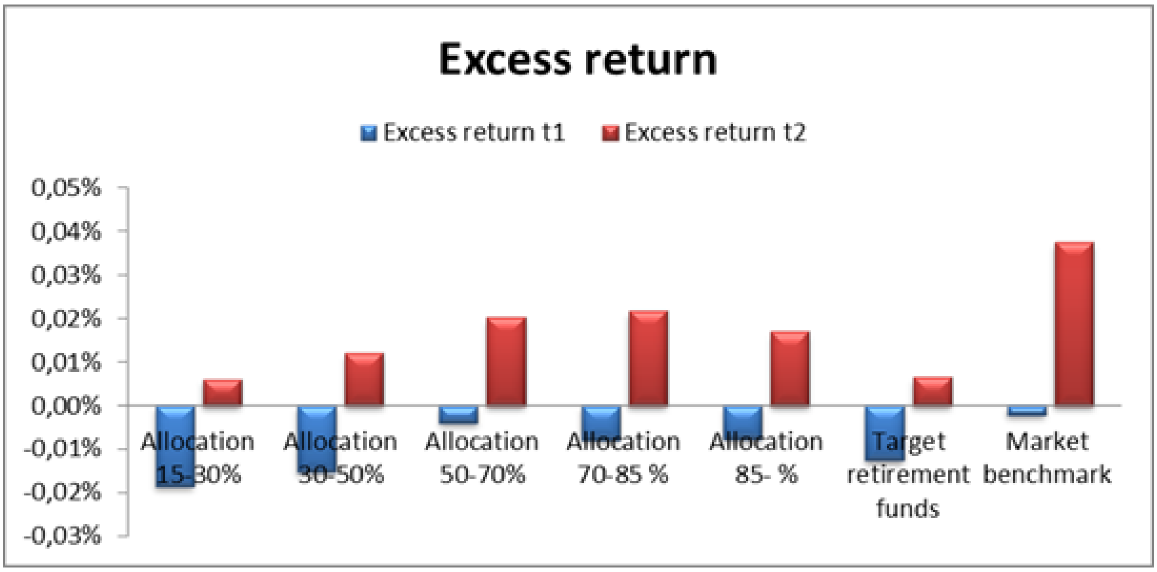
In fact, every single value has increased between the two time periods, except the beta values for the categories, which have left a more inconclusive result.

The beta values for the fund categories have increased for balanced funds with allocation 15-30 %, marginally increased for retirement targeting funds and for balance funds with 30-50 % and 50-75 % allocation in equity and marginally decreased for the funds with asset allocation 70-85 % and 85- %. The majority of them even proved to have no significant difference at all in a t-test, only the 15-30 % allocation and the target retirement funds showed a significant difference, 30-50 % almost had one star significance, rendering us a somewhat inconsistent result. Another deviation from the category result is the correlation to the market for balanced funds with asset allocation 50-75 %, which has declined were all other have increased or stayed put. Further on we can see that the standard deviation and variance have increased most in the equity heavy funds, the same goes for the covariance. The biggest change in market correlation happened in the 15-30 % allocation category.

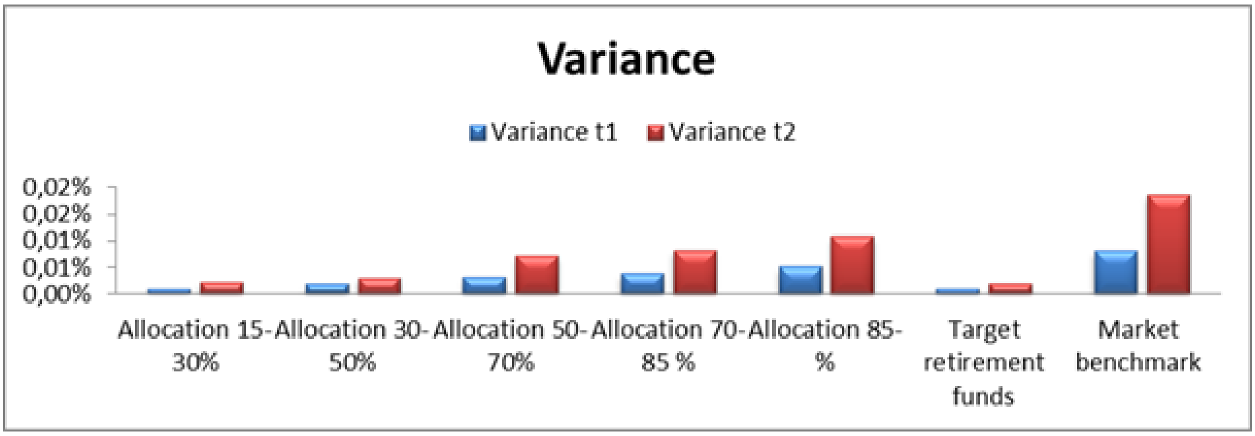
Graph 7: Correlation with the market for the different fund categories in both time periods.



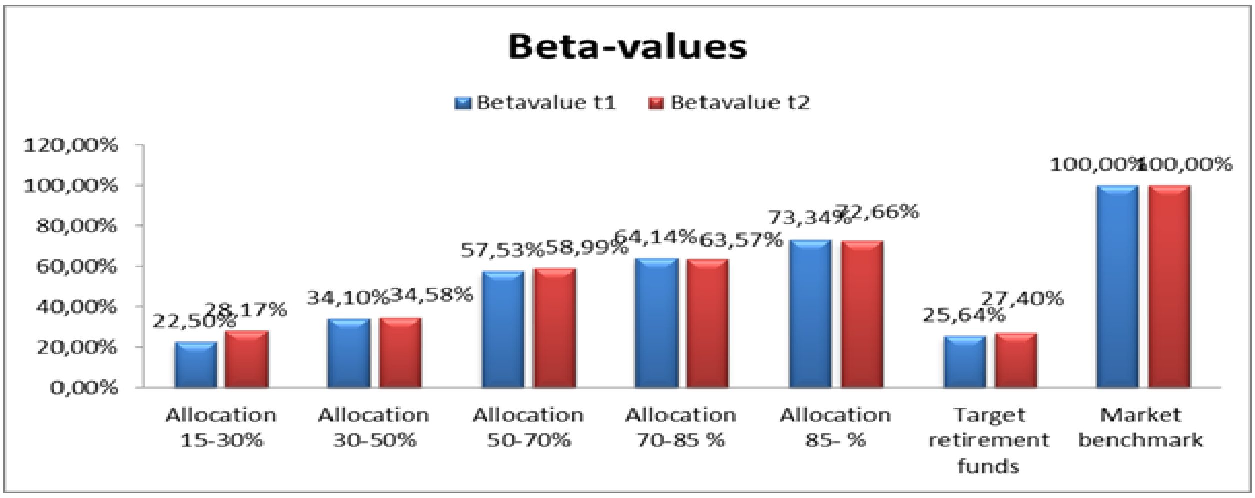
Graph 8: Excess return (R) for the different fund categories in both time periods.



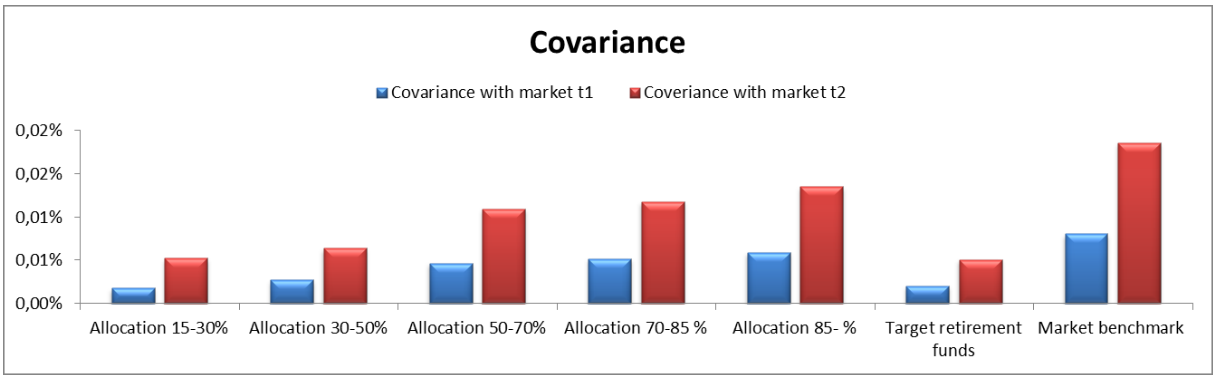
Graph 9: Variance for the different fund categories in both time periods.



Graph 10: Beta Value, exposure to market risk, for the different fund categories in both time periods.



Graph 11: Covariance for the different fund categories in both time periods.



The average portfolio characteristics for our fund categories show almost the same result as the individual funds did. The excess return have negative values in the first time period and positive values in the second, rendering us with a result that points to very poor decisions made during the first time period and an improvement during the later. We also see that the mean variance ratio is better in period two regardless of the measurement for risk, both Sharpe and Treynor values have increased.

As a result, we must finally address the problem that most of our samples in the first time period generated a negative excess return. Since we use the historical prices as a proxy for the expected return this creates a quite unlikely prerequisite, mainly that investors in this period most have been risk lovers, i.e. they would have been willing to pay for taking on risk. This is a quite unrealistic assumption. More likely this indicates a period of bad decisions and high turbulence. Anyhow, it contradicts most of the standard assumptions made in economic theory and definitely contradicts the assumptions of CAPM, which makes it difficult, if not to say useless, to analyze the portfolio characteristics of the funds we have and as a result render us with less material to draw conclusions from. It should be said that periods like this occur relatively often, but are considered abnormalities in economic studies.

5. Analysis

In this chapter, we will focus on the analyzing of the results we can derive from our data. We will explain the outcome and connect it to relevant theory mentioned in earlier chapters, to establish a descriptive picture of why the data sample behaves as it does. The focus will be on determine whether the lower repo rate increase risk and if it affect risk aversion and asset allocation.

5.1 The impact of a decreased repo rate on portfolio variance

Initially, we can without hesitation conclude that the repo rate is negatively correlated to fund managers and investors willingness to hold variance, i.e. risk, at least to some degree. The regression we did upon the running variance values and the repo rate established this without a doubt (see graph 6). We can therefore conclude that the lower repo rate creates an increased variance. The explanation to this relationship can, however, depend on either one of three alternative reasons.

Firstly, a change in an undiversifiable risk, created by the lower repo rate, could have established a shift in the overall market variance and therefore in the risk aversion of investors. This could have occurred since unexpected changes in repo rate are an undiversifiable risk which tends to increase during low rate climate (Shahidi, 2014). As a result, this would render us with an, in average, higher variance within all assets, i.e. an increase in the market volatility, which also can be observed in graph 1.

By itself this would not need to imply a change in the variance held by investors, since the investors might acknowledge the higher risk and therefore rebalance their portfolios towards less risky asset, avoiding the increased risk in accordance to strategic asset allocation. However, if investors chose to not reallocate their resources either as a deliberate choice or because of failure to acknowledge the higher risk climate, the carried risk for the investors will increase and an upward shift in investors risk appetite has been created by the lower rate, as long as the expected return does not increase in the same manner. It is notable that this would render investors whom are unable to rebalance their portfolio, for any reason, with a higher risk and a lower risk aversion.

The second possible reason for the increased variance in the funds is a deliberate shift in risk aversion as a response to a decreased expected return. If an investor thinks that the new lower yield from the risk-free rate renders in a too low total yield of his portfolio, he or she might shift resources from the risk-free asset to more risky assets. This would indicate that the investor changes his or her risk aversion even if the alteration of asset proportions is done to preserve the previous return since the investor now holds a higher proportion of risky assets in the portfolio. Noteworthy is that the excess return of an investor in this situation also will rise, which follows from equation

$$R_i = r_i - \frac{r_f}{262} \quad (3.3)$$

which indicates a preserved total return with a decreased risk-free rate equals higher excess yield. Also, notice that this explanation does not require an alteration of the return to risk ratio to occur, only an alteration of the risk aversion of investors and hence their optimal asset proportions. A shift in the ratio could have occurred but is not necessary since the investor here focus on reversing a shift in return and not excess return, which is the numerator in the ratio. Therefore, the shift in asset allocation would increase the risk of the investor, but might also increase the excess return, rendering in the possibility that the current mean-variance ratio persists and a movement along the CAL for the investor.

Finally, the negative correlation between variance and the repo rate might be due to the fact that lower rate generates a higher excess return. Considering our utility function, including risk aversion, and the formula for optimal proportions derived from it, equation 2.2 & 2.3,

$$U = E(r) - \frac{1}{2}A\sigma^2 \quad (2.2)$$

$$Y^* = \frac{(E(r_p) - r_f)}{A\sigma^2} \quad (2.3)$$

we can see that regarding on how the excess return over the period has shifted the increase in variance can be justified inside the equation without altering risk aversion. From this it can be determined that an increase in excess return would demand an increase in variance as well, ceteris paribus. If this does not happen the risk aversion would have to increase, since a smaller allocation in the risky asset would generate an equally large yield as the one previously received. This indicates that an increase in excess return should be followed by an increase in variance, ceteris paribus. It is also natural that the excess return increases in the period with lower interest rate since the equation for excess return subtracts the interest rate from the assets return, implying that a lower interest rate yields a higher excess return.

5.2 Does the increased variance indicate a shift in asset allocation and risk aversion?

The easy answer is yes, since we have a significant difference in beta value between our two time periods. For a more thorough answer, one can look at the last explanation to the increased variance above, which differs somewhat from the two previous ones. In the two earlier explanations, we assumed that it was the risk aversion that have shifted in the investor's utility function; now we see that it is possible for the investor to carry the increased variance without altering their risk aversion or asset allocation. It is therefore easy to credit the total increase of the variance held by our funds to this last explanation, since the difference in excess return and the shift in Sharpe ratios from period one to two is substantial in our sample, resulting in the conclusion that no shift in risk aversion or asset allocation have occurred.

However, one should remember that all the explanations in the previous chapter are theoretically possible and have evidence supporting them. In addition, we should not draw too many conclusions from the fact that the excess return increased from period one to two, due to the extremely poor return of period one. To conclude, it is possible and even quite likely that the increased excess return partly explains the increased variance, but it does not hold the whole explanation. Moreover, if we also consider the fact that the majority of the beta values of the funds have altered, see graph 4, and that there is a significant difference in average beta value between the two time-periods, we can actually conclude that the shift in variance caused by the repo rate impossibly can depend only on an increased excess return. This argument is founded on the fact that the beta values works as a proxy for the funds optimal proportions, i.e. their asset allocation, and since we can see a change in them we can also assume an alteration of the funds proportions in risky and risk-free assets.

In its turn this must indicate that the investors found reasons to alter these proportions and assuming investors who follows strategic asset allocation this must depend on modifications in the ratio of excess return and the quadratic utility parameter. Conclusively, the variance and excess return has not shifted equally. Once again, we can consult the utility function (equation 2.3) for clarity.

$$Y^* = \frac{(E(r_p)-r_f)}{A\sigma^2} \quad (2.3)$$

Since the proxy for the proportions, Y*, has altered, this would naturally mean that a change of the asset proportions has been made, indicating that the ratio between excess return and the quadratic utility parameter have been modified. These observed proportion changes are either done to rebalance the portfolio to a new riskier climate or to compensate for an alteration in the investor's risk aversion. In other words, these shifts in asset proportions are directly associated with the two first explanations to the increased variance under the lower repo rate. Rendering us to conclude that the lower interest rate has modified the risk aversion of the funds and therefore also their asset allocation due to the increased variance.

5.3 What determines the direction of the shift in investors' asset allocation during a low repo rate climate rate?

What is interesting is that the lower interest rate creates both changes upwards and downwards in the beta values depending on the observed fund, even if there is a significant upward change for the whole sample. At the same time the changes in correlation towards the market for all funds is strictly positive, rendering us with a somewhat confusing result, see graph 3 & 4. One explanation to this can be determined as how the funds interpreted the new low repo rate climate.

Initially, the funds in our sample that experience both an increase in beta and in correlation to the market must have been inclined to react to the lower repo rate as a lowering of yield, not an increase in variance. This would, as already explained, have caused them to reallocate their resources to a higher risk and market exposure to compensate for their lower risk-free yield and total return. As a result, they would acquire more equities and through that increases their correlation towards the market but also towards the market risk. It could be said that these investors would have changed their strategic asset allocation target portfolio instead of rebalancing it to maintain a constant return and thus rendering them with a higher excess return. Investors might be inclined to do this during low rate periods not only due to the poor direct return of the risk-free asset but also because the cheap price of capital. Notice that we here refer to the direct return of the risk-free asset, the total return of the risk-free asset might be much higher.

Moving on to the funds that show a declining beta and a higher correlation to the market. At first glance this might seem contradictory, since a larger correlation to the market should indicate that the funds are more pronounced to the market swings than before and therefore would have a higher exposure towards the systematic risk and thus a higher beta. The answer to this contradiction is found within the formulas used for calculating the two measurements.

$$\frac{\mathrm{Cov}(r_M, r_i)}{\sigma_M^2} \quad (3.7)$$

$$\rho = \frac{\sigma_{iM}}{\sigma_i * \sigma_M} \quad (3.8)$$

Equation 3.7 describes the beta-value and equation 3.8 describes the correlation coefficient. The two formulas use the same numerator, the covariance between the market and the fund, but different denominators. While equation 3.7 uses the market variance as its denominator the correlation coefficient uses the funds individual standard deviation times the markets standard deviation. From graph 1 we see an increase in both the market's and the fund's variance. The increase in the market variance, however, is bigger than the increase in any of the funds. From this we can conclude that the increase in market standard deviation is bigger than the increase in any of the funds. Also, notice that the denominator in equation 3.7 can be rewritten as the market standard deviation times itself. The denominator in equation 3.7 will therefore be bigger than the denominator in equation 3.8 since $\sigma_M > \sigma_i$ for all funds. A fund that have experienced just a slight increase in the standard deviation in the second time period could therefore experience an increase in the correlation at the same time as a decrease in the beta-value, since the numerator in both equations will consist of the covariance. Looking at graph 1 and 4 we see that most the funds with a decreasing beta-value between the time periods exhibits just a small increase in the variance. We also know that the covariance increases quite a lot from the first time period to the second and we can therefore conclude that the drastic increase must be mainly due to the increase in the market variance. These results provide confirmatory evidence for that the beta-values for some funds could decrease at the same time as their correlation to the market increases.

The question why these funds also have increased their own variance at the same time as they decreased their exposure to market risk follows roughly the same argumentation and can be explained by alteration in the market price of risk.

$$\frac{E(R_M)}{\sigma_M^2} \quad (2.7)$$

This ratio has shifted from the first period to the second period and as discussed in chapter 2.6 the individual assets reward-to-risk-ratio should equal the market price of risk for market equilibrium to hold (Bodie et al. 2014).

$$\frac{E(R_i)}{Cov(r_M, r_i)} = \frac{E(R_M)}{\sigma_M^2} \quad (2.8)$$

So the funds should according to CAPM theory be affected, since their own reward to risk ratio will change in a similar way as the markets. Since unsystematic risk is not treated in accordance with CAPM theory we know that the shift must be affecting the systematic risk. As we have already showed the risk has increased within the market, which implies that the systematic risk also has increased. Therefore, the funds should decrease their exposure towards the market or otherwise suffer from a decrease in their own risk aversion, since the same asset allocation now contains a higher risk. Normally a rebalancing of assets like this would imply a decrease in the investor's expected return since their portfolios holds less systematic risk than before. However, as stated multiple times, the sample in time period two holds an on average higher systematic risk which according to theory should generate a higher average return. It is therefore possible for the funds that rebalance their portfolios, and as a result take on less systematic risk, to still experience an increase in their expected return.

This last argument follows the same argumentation as the one regarding changes in undiversifiable risk and its result of increased variance as described in paragraph 5.1. The reasoning could also actually be equalized with a rebalancing of a portfolio according to strategic asset allocation, since the investor adapts his portfolio to the new riskier environment. Indicating that the investor interprets the impact of the lower repo rate as an increase in variance and not decreased excess return. We could therefore summarize our conclusions regarding the shifts created in the beta values as depending on whether the investor decides to keep his previous targeted portfolio or not, allowing either for the asset allocation or the risk aversion to be altered. It also seems, as stated, that this decision depends on whether the investor consider the lower repo rate as an increase in variance or as a decrease of return.

5.4 Differences between investors with divergent reactions to the lower repo rate

To examine what this divergence between investors might depend on we can look at our different fund categories. We see in table 2 and 3 in the appendix and in graph 4 that the largest positive change in beta values between the two periods happened in the funds with least allocation in equity. The only significant change in beta values were also for these funds, the 15-30 % allocation to equity and target retirement funds. This could indicate that there might be a connection between the reaction to lower repo rate and an investor's current asset allocation. If we only consult our result from the two different time periods it surely seems so. The changes in beta over our periods are, as said, positive and large for our low equity category of funds and the opposite in the high equity category in our samples even if the difference is not significant for the higher equity funds. This could also indicate that the changes in asset allocation are only relevant for conservative investors.

A possible explanation for this difference could be that depending on restrictions regarding asset allocation investors are inclined to interpret the lower rate differently and therefore react to the lower rate differently, as concluded above. This is reasonable since the lower repo rate would impact funds differently depending on their current asset allocation. To exemplify, the increased market variance, i.e. the increased average asset variance would, as already concluded, lead to a higher risk and correlation to the market if investor's portfolios are not rebalanced. As a result, investors whom are not willing to change their risk aversion are forced to decrease their beta value, since each unit of beta now holds a larger proportion of risk. Investors whose portfolios already hold a high amount of risk and market correlation would feel this increase in risk more heavily. Resulting in funds with already high market exposure trying to minimize the impact of the increased variance and therefore decrease their beta value and market exposure.

More conservative funds on the other side, whom hold less risky-asset, might instead be more inclined to alternate their risk aversion to maintain their present return, since they would be more prone to look at the decreased repo rate as a decreased return, because of their bigger holdings in the risk-free asset. This renders investors to increase their risky holdings and therefore shift their asset allocation to a higher market exposure. Notice that this could either be done by increasing their allocation in risky asset or by just preserve their current holdings, since the market variance has shifted. Giving the investor the possibility to shift their risk aversion without changing their asset allocation, which could partly explain that the shift in beta-values is quite small for a lot of the funds and non-significant for a lot of categories (see graph 4).

Following the argumentation above, we can conclude that a possible explanation to the different reactions of investors towards a lower repo rate might depend on their current asset allocation and risk degree. However, this argumentation is built upon the effect the increased variance created by the lower repo rate have and is therefore not a proven causality. If we instead try to find this causality and look on the regression made upon the running beta values as dependent on the repo rate, a more inconsistent result appears.

5.5 Some contradictory result from the regression between running beta values and the repo rate

To begin with, the results of our regression on the running beta-values as dependent on the repo rate confirms that the alteration of variance created by the lower repo rate results in different reactions from different investors. The regression concludes that the beta values are dependent on the repo rate, although not in a consistent way at all. Roughly half of the funds beta values are negatively correlated with the interest rate and half is positively correlated, see graph 5. As already explained this inconsistency in the correlation to the interest rate depends on the simple fact that investors seem to react differently to the lower interest rate. Investors who feel contempt with their current target portfolio will adjust their asset allocation so that it matches the increasing risk which the lower interest rate brings, implying a positive correlation between the interest rate and the beta value. On the other hand, investors who experience the decreased interest rate as a reduction in yield would be inclined to raise their beta values to compensate for it, creating a negative relation between the repo rate and the beta value (see graph 4).

However, the whole argumentation above regarding factors that makes investors react differently to the lower rate climate is seriously flawed by the fact that the regression mentioned shows a somewhat different result. Here we cannot find any consistent result between the different asset allocations policies and the correlation with the interest rate. The regression instead defines three of our different fund categories as negatively and three as positively correlated. The ones with a negative correlation have 15-30, 50-70 and 85 + percent of their holdings in equity, leaving no clear connection to current asset allocation within the funds. Instead the regression indicates that the underlying reason for the funds behavior might depend on the variance shift created by the lower repo rate, but that the repo rate itself affects the beta in a much more inconsistent way. This forces us to either find reasons to why they differ from our previous stated hypothesis or to seek an alternative explanation to why different investors have divergent correlation between their asset allocation and the repo rate.

One possible explanation to why the regression does not conclude with our argumentation above could be the different restrictions each fund category face. We can determine from equation 2.6;

$$w_i * \frac{E(R_i)}{w_i} * Cov(r_M, r_i) = \frac{E(R_i)}{Cov(r_M, r_i)}$$

that if the funds are limited by their restrictions to act in a certain way a reversed correlation might be forced upon them. Consider as an example the 85+ percent equity funds, all but one of them have their minimum allowed holdings in equity the 6 of December 2016 (Morningstar, 2016).

This indicates that even if the fund would like to rebalance their portfolio they cannot hold a higher amount in assets that are not equity. This renders the fund to unwillingly increase their beta-value since the market variance has increased and therefore the total risk in the portfolio. This follows the same argument as made numerous times before in this paper. An increase in overall variance should be compensated by a reallocation of assets in portfolios that intend to keep their current degree of risk. Naturally if the fund is unable to perform this reallocation the risk of the portfolio and therefore the beta would increase.

This argumentation is even more adequate for the 85 + stocks funds since the only fund in this category that has not minimized their equity holdings, “Icon Equity Income Fund Class S“ has a positive correlation with the interest rate. Implying, that the fund has decreased their market exposure to compensate for the increased market risk. In its turn this implies that the other funds in the same category might want to act in a similar way, but are unable to do so.

Resulting in the conclusion that current asset allocation still might affect the reactions towards a lower repo rate as argued above.

A similar argumentation also holds for the target retirement funds, which have a positive correlation to the repo rate in the regression made on running beta values and the repo rate, but have increased their beta from period one to two. Since they are in their final phase and should focus on keeping a steady value and expected yield, their restriction forces them from investing more heavily in the market even if they want to. This is due to the fact that they do not have an investment horizon position allowing them to take on more risk, even if it would result in a higher yield; since they need to stay liquidate. In other words, one might say that they follow a balanced asset allocation and therefore tries to minimize the variance instead of finding the maximizing return ratio. As stated above this implies an increased risk aversion and the fund cannot increase their profit in the same way as the other low equity funds we see in our sample.

These two examples visualize how different restrictions might affect investors' reactions to lower repo rate, unfortunately, this argumentation does not hold for the funds with asset allocation 30-50 % in equity, rendering us to conclude that there are more than the regulations on asset allocation that affects an investor's correlation to the interest rate. Indeed, this visualize the problem with our regression made on variance not showing a higher R^2 rate, see appendix table 5, as the degree of how much the increased repo rate affects investors' decisions is limited. As stated in the theory chapter of this paper, a lot of other possible explanations exist for the absence of shift in asset allocation, one example would be illiquidity. Sadly, our data does not provide what this additional factor might be and it will be left for future research to determine this.

As a result of the last two chapters we determine that the different fund categories seem to react to the lower interest rate in different ways depending on their asset allocation before the low rate was introduced. Funds with lower risk, i.e. higher risk aversion seem to endure a change in risk aversion and alter their asset allocation towards higher risk. On the contrary the funds that held higher amount of risk before try to rebalance their portfolios in a manner that makes them keep their current degree of risk aversion. This is a quite surprising result since more conservative investors seem to embrace the higher risk and return while more aggressive investors do the opposite. As argued above this might depend on various reasons. This result is, however, based on the correlation the repo rate has with investors preferences to hold variance. If we instead look directly on the relationship between the repo rate and the beta value a more inconsistent picture appear and it becomes more difficult to point to a direct relationship between investors' asset allocation and the repo rate. One reason that the result would differ from the argumentation above is that different restrictions within the funds might hinder them to act against changes in the economic environment, resulting in unwanted changes in risk aversion and asset allocation.

Summary

From the presented results and reasoning in last chapter it can be determined that the repo rate is without a doubt negatively correlated to the amount of variance held by investors. Indicating that investors become more confident in carrying risk in a lower repo rate climate. We can also conclude that the foundation of this alteration depends on either one of three explanations. Firstly, it can depend on a forced modification of the investor's risk aversion, created by a shift in the market variance. Secondly, it might depend on a chosen modification of the investor's risk aversion due to a decreased return. Finally it could be a result of an increased excess return. Further on the beta-values within the funds alters as well when the risk-free rate decreases, which implies that the asset allocation of the funds changes under the lower repo rate as well. Although, this do not seem to be a direct effect of the decreasing repo rate itself, rather an effect of the mentioned increase in variance during the same period.

The factor deciding how the funds will change their asset allocation and reallocate resources due to the lower repo rate seems to be whether the investor views the result of the lower rate as an increased risk or reduced return, were the majority of the funds seem to do the later. We also see that the willingness to take on more risk is dependent on a fund's current allocation, their possibility to reallocate resources within the fund as well as their chosen or forced restrictions. As a result, we can finally conclude that the repo rate seems to be a contributing factor to the existing changes in asset allocation within our sample, however we cannot determine that it is the only factor affecting investors.

With this said, further research in this area may target different possible explanations to why investors react differently to a lower repo rate, with one example being the unsystematic risk. A similar study upon the different effects of diversifiable risk could perhaps shed some new light over the problem. Further on studies made upon time periods that have more normal returns could enhance the result even more since it would then be possible to compare portfolio characteristics. A possibility to properly compare risk aversion values would enhance the paper substantially, but since we had negative excess return in our first period this becomes trivial for us. Yet another improvement for future research to make is the selection of data that allows for the possibility to choose x number of distinguished points in time, rather than to choose a certain level (1%) in time that we did. This will allow for a breakpoint test to be performed on the selected points and avoid autocorrelation. Finally, it would be interesting to form a hypothesis specifically for the purpose of measuring how big impact the variance versus the risk-free rate have on an individual's asset allocation when you expose the individual to an increase/decrease in one of them separate as well as in both at the same time.

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Appendix

Table 1: Fund statistics for the high rate period

Column1	r t1	R t1	STD t1	Variance t1	Covarians with m t1	correlation with m t1	Beta t1 regr	Beta t1 Ri/Rm	Beta cov(im)/sigm(m^2) t1	Sharpe ratio t1	Treynors index t1	Risk Aversion t1
PRCL.FUND.STG	-0,0009%	-0,0139%	0,2666%	0,0007%	0,0017%	70,33%	0,211402354	6,389656096	0,211359561	-5,20%	-0,07%	-8,102692594
WELLS FARGO D	-0,0079%	-0,0208%	0,3241%	0,0011%	0,0019%	60,95%	0,229740672	9,582117153	0,229694166	-6,42%	-0,09%	-11,18111946
WELLS FARGO D	-0,0080%	-0,0209%	0,3294%	0,0011%	0,0019%	61,04%	0,233920841	9,639142357	0,233873489	-6,35%	-0,09%	-11,04666479
COLUMBIA CAPI	-0,0090%	-0,0219%	0,3842%	0,0015%	0,0024%	68,43%	0,294431094	10,09105484	0,294371493	-5,70%	-0,07%	-9,187864715
COLUMBIA CAPI	-0,0015%	-0,0144%	0,2963%	0,0009%	-0,0004%	-14,51%	-0,048021765	6,655855327	-0,048012044	-4,88%	0,30%	37,15587153
GOLDMAN SACH	-0,0003%	-0,0132%	0,5626%	0,0032%	0,0042%	82,31%	0,524003711	6,097061107	0,523897639	-2,35%	-0,03%	-3,119233472
USAA MUT.FD.T	-0,0071%	-0,0200%	0,5602%	0,0031%	0,0038%	74,30%	0,46753982	9,227952741	0,467445178	-3,58%	-0,04%	-5,291130267
VANGUARD TAX	0,0101%	-0,0028%	0,4189%	0,0018%	0,0037%	96,20%	0,458588752	1,310642425	0,458495921	-0,68%	-0,01%	-0,766165375
VANGUARD WEI	0,0000%	-0,0129%	0,3816%	0,0015%	0,0023%	67,41%	0,288431323	5,936747054	0,288372937	-3,38%	-0,04%	-5,517823705
VANGD.WELLESI	0,0000%	-0,0129%	0,3809%	0,0015%	0,0023%	67,68%	0,28906656	5,936098821	0,289008045	-3,38%	-0,04%	-5,505096882
WELLS FARGO M	-0,0101%	-0,0230%	0,5233%	0,0027%	0,0037%	77,07%	0,454278783	10,61127814	0,454186825	-4,40%	-0,05%	-6,261911744
AMER.BAL.FD. C	0,0012%	-0,0117%	0,5381%	0,0029%	0,0046%	92,53%	0,565118005	5,404298481	0,56500361	-2,18%	-0,02%	-2,563668578
AMER.BAL.FD. C	0,0012%	-0,0117%	0,5403%	0,0029%	0,0046%	92,14%	0,564877616	5,398389876	0,56476327	-2,17%	-0,02%	-2,56195548
AMER.BAL.FD. C	0,0012%	-0,0118%	0,5412%	0,0029%	0,0046%	91,86%	0,56390189	5,419589113	0,563787742	-2,17%	-0,02%	-2,576466554
AMER.BAL.FD.CL	0,0012%	-0,0117%	0,5376%	0,0029%	0,0046%	92,23%	0,562844326	5,405092938	0,562730391	-2,18%	-0,02%	-2,574403228
AMER.BAL.FD.CL	0,0012%	-0,0117%	0,5376%	0,0029%	0,0046%	92,62%	0,565082555	5,381668841	0,564968168	-2,17%	-0,02%	-2,55309378
AMER.BAL.FD.CL	0,0012%	-0,0117%	0,5393%	0,0029%	0,0046%	92,02%	0,563354524	5,400950697	0,563240486	-2,17%	-0,02%	-2,570100608
AMER.FUND.AM	0,0012%	-0,0117%	0,5396%	0,0029%	0,0046%	92,15%	0,564106359	5,400054422	0,563992169	-2,17%	-0,02%	-2,566249273
AMERICAN BAL.	0,0012%	-0,0117%	0,5392%	0,0029%	0,0046%	92,04%	0,563092522	5,377422262	0,562978537	-2,16%	-0,02%	-2,560094984
AMG CHICAGO E	0,0160%	0,0031%	0,5185%	0,0027%	0,0044%	94,13%	0,54955522	-1,431084022	0,549443975	0,60%	0,01%	0,698096553
AMG CHICAGO E	0,0160%	0,0031%	0,5203%	0,0027%	0,0045%	93,94%	0,55052563	-1,415067753	0,550414189	0,59%	0,01%	0,689066901
COL.BAL.FD.CL.C	0,0170%	0,0041%	0,5038%	0,0025%	0,0044%	96,20%	0,549588232	-1,87505623	0,549476981	0,81%	0,01%	0,914615525
COLUMBIA BAL.	0,0171%	0,0042%	0,5050%	0,0026%	0,0044%	95,87%	0,548772377	-1,92584897	0,548661291	0,83%	0,01%	0,940787808
COLUMBIA BAL.	0,0170%	0,0041%	0,5025%	0,0025%	0,0044%	96,23%	0,548146399	-1,872131155	0,548035439	0,81%	0,01%	0,915590765
COLUMBIA FD.C	0,0171%	0,0042%	0,5055%	0,0026%	0,0044%	95,71%	0,548533072	-1,913108736	0,548422034	0,82%	0,01%	0,934971852
EATON VANCE B	0,0189%	0,0060%	0,6819%	0,0046%	0,0055%	86,47%	0,676274908	-2,760522555	0,676138012	0,88%	0,01%	1,09428318
FID.PURITAN BA	0,0074%	-0,0055%	0,6860%	0,0047%	0,0056%	89,53%	0,69721775	2,539631485	0,697076614	-0,80%	-0,01%	-0,976481378
FIDELITY PURITA	-0,0051%	-0,0180%	0,5988%	0,0036%	0,0048%	87,62%	0,594339336	8,294748242	0,594219025	-3,01%	-0,03%	-3,741368044
JHN.HANCOCK B	0,0280%	0,0151%	0,6200%	0,0038%	0,0042%	74,05%	0,523946392	-6,954273884	0,523840331	2,43%	0,03%	3,558169515
JOHN HANCOCK	0,0280%	0,0151%	0,6168%	0,0038%	0,0043%	74,57%	0,525077104	-6,953951771	0,524970814	2,45%	0,03%	3,550342824
MAIRS & POWEI	0,0090%	-0,0039%	0,5649%	0,0032%	0,0049%	94,47%	0,609276768	1,786922604	0,609153434	-0,69%	-0,01%	-0,786235813
PRUDENTIAL BAI	-0,0013%	-0,0143%	0,6997%	0,0049%	0,0051%	79,74%	0,62887691	6,57444393	0,628749609	-2,04%	-0,02%	-2,802561001
T ROWE PRICE C	0,0107%	-0,0022%	0,6887%	0,0047%	0,0049%	78,56%	0,609519741	1,023591511	0,609396358	-0,32%	0,00%	-0,450194928
TRANSAM.PTNS.	0,0021%	-0,0108%	0,5466%	0,0030%	0,0047%	92,53%	0,575943985	4,981451083	0,575827399	-1,98%	-0,02%	-2,318661338
VANGD.BAL.IDX.	0,0120%	-0,0009%	0,5160%	0,0027%	0,0046%	96,88%	0,568765173	0,419969773	0,568650039	-0,18%	0,00%	-0,197946003
VANGD.WELLIN	0,0057%	-0,0072%	0,5927%	0,0035%	0,0047%	85,79%	0,575499689	3,339535914	0,575383192	-1,22%	-0,01%	-1,555617153
VANGUARD BAL	0,0121%	-0,0009%	0,5170%	0,0027%	0,0046%	96,86%	0,56978567	0,397541796	0,569670331	-0,17%	0,00%	-0,187039344
VANGUARD WEI	0,0057%	-0,0073%	0,5938%	0,0035%	0,0047%	85,63%	0,575520161	3,343112263	0,57540366	-1,22%	-0,01%	-1,557227686
INCOME FUND C	0,0011%	-0,0119%	0,5523%	0,0031%	0,0045%	88,68%	0,556822037	5,467213651	0,556709321	-2,15%	-0,02%	-2,632154205
INCOME FUND C	0,0010%	-0,0119%	0,5527%	0,0031%	0,0045%	88,79%	0,557893	5,490941434	0,557780067	-2,16%	-0,02%	-2,638503031
INCOME FUND C	0,0011%	-0,0118%	0,5524%	0,0031%	0,0045%	88,70%	0,557149735	5,442804751	0,557036953	-2,14%	-0,02%	-2,618861461
BOSTON TST.ASS	0,0106%	-0,0023%	0,6242%	0,0039%	0,0051%	89,17%	0,625414522	1,071415596	0,625287922	-0,37%	0,00%	-0,459252681
LKCM FD.BAL.FD	0,0133%	0,0004%	0,5521%	0,0030%	0,0049%	95,59%	0,59910199	-0,173306828	0,598980716	0,07%	0,00%	0,077549073
WELLS FARGO IN	0,0044%	-0,0085%	0,7106%	0,0050%	0,0062%	94,37%	0,762820116	3,920694828	0,762665701	-1,20%	-0,01%	-1,377852094
WELLS FARGO IN	0,0047%	-0,0082%	0,7082%	0,0050%	0,0062%	94,57%	0,76147094	3,795084494	0,761316798	-1,16%	-0,01%	-1,336071848
WELLS FARGO IN	0,0045%	-0,0085%	0,7082%	0,0050%	0,0062%	94,60%	0,761766387	3,902556063	0,761612185	-1,20%	-0,01%	-1,373374702
FRANKLIN MUTU	0,0053%	-0,0076%	0,6676%	0,0045%	0,0048%	78,17%	0,591465997	3,517863975	0,591346268	-1,14%	-0,01%	-1,594450196
ICON EQUITY IN	-0,0065%	-0,0194%	0,9660%	0,0093%	0,0076%	86,56%	0,941649309	8,939705998	0,941458694	-2,01%	-0,02%	-2,545046619
JP MORGAN INV	0,0130%	0,0001%	0,7627%	0,0058%	0,0067%	95,41%	0,826277741	-0,042355757	0,826110481	0,01%	0,00%	0,013741942
JP MORGAN INV	0,0134%	0,0004%	0,7625%	0,0058%	0,0067%	95,45%	0,826308033	-0,201651541	0,826140766	0,06%	0,00%	0,065421616
BLACKROCK LIFE	0,0007%	-0,0122%	0,3834%	0,0015%	0,0028%	78,43%	0,339870884	5,613467688	0,339802085	-3,18%	-0,04%	-4,427707915
BLKRK LF PATH R	-0,0006%	-0,0135%	0,3856%	0,0015%	0,0027%	77,89%	0,33921613	6,211235269	0,339147464	-3,50%	-0,04%	-4,908662611
FIDELITY ADVI.FF	0,0001%	-0,0128%	0,2001%	0,0004%	0,0015%	82,02%	0,186192049	5,901070953	0,186154359	-6,40%	-0,07%	-8,496330603
FIDELITY ADVISO	0,0004%	-0,0125%	0,2927%	0,0009%	0,0015%	56,13%	0,184071338	5,755830283	0,184034077	-4,27%	-0,07%	-8,382691988
FIDELITY FREE.IN	-0,0007%	-0,0137%	0,2169%	0,0005%	0,0016%	79,22%	0,193857822	6,293737749	0,19381858	-6,30%	-0,07%	-8,703361285
MASS MUTUAL F	-0,0027%	-0,0156%	0,3644%	0,0013%	0,0022%	64,98%	0,269083879	7,193731978	0,269029409	-4,29%	-0,06%	-7,166849277
MASS MUTUAL F	-0,0030%	-0,0160%	0,3464%	0,0012%	0,0022%	68,76%	0,271440965	7,355999744	0,271386018	-4,61%	-0,06%	-7,264872774
MASS MUTUAL F	-0,0027%	-0,0156%	0,3674%	0,0013%	0,0022%	64,76%	0,270022828	7,188523143	0,269968168	-4,25%	-0,06%	-7,136756706
MASSMUTUAL R	-0,0032%	-0,0161%	0,3561%	0,0013%	0,0022%	66,46%	0,269270591	7,423837858	0,269216083	-4,53%	-0,06%	-7,390966823
PRCL.FUND.PRCI	0,0007%	-0,0122%	0,3246%	0,0011%	0,0019%	63,53%	0,233675522	5,633999894	0,23362822	-3,77%	-0,05%	-6,463463657
PRCL.FUND.PRCI	0,0010%	-0,0119%	0,3278%	0,0011%	0,0019%	63,66%	0,236350326	5,479724185	0,236302482	-3,63%	-0,05%	-6,215329997
PRCL.FUND.PRCI	0,0012%	-0,0117%	0,3340%	0,0011%	0,0019%	62,27%	0,235133945	5,395601494	0,235086347	-3,51%	-0,05%	-6,15157374
STATE FARM LIFE	0,0040%	-0,0089%	0,3613%	0,0013%	0,0027%	82,41%	0,337166708	4,10839009	0,337098457	-2,47%	-0,03%	-3,266545297
STE.FRM.LIFEPAT	0,0039%	-0,0090%	0,3657%	0,0013%	0,0027%	81,54%	0,337703571	4,140732579	0,337635211	-2,46%	-0,03%	-3,28702667
VANGD.TAR.RTN	0,0057%	-0,0072%	0,2929%	0,0009%	0,0018%	68,73%	0,227162224	3,311964301	0,227116241	-2,45%	-0,03%	-3,908510043
Market benchma	0,0107%	-0,0022%	0,8999%	0,0081%	0,0081%	100,00%	1	1	1	-0,24%	0,00%	-0,268078323

Table 2: Fund statistics for the low rate period

Column1	r t2	R t2	STD t2	Variance t2	Covarians with m t2	Correlation with m t2	Beta t2 regr	Beta t2 Ri/Rm	Beta t2 cov(im9/sigm(m^2)	Sharpe ratio	Treynors index	Risk Aversion
PRCL.FUND.	0,007%	0,006%	0,399%	0,002%	0,005%	89,085%	0,260639011	0,167308666	0,259305319	2%	0%	1,296725936
WELLS FARG	0,007%	0,006%	0,515%	0,003%	0,005%	77,316%	0,292301019	0,162233816	0,290805312	1%	0%	1,121192629
WELLS FARG	0,006%	0,006%	0,523%	0,003%	0,005%	77,264%	0,296372639	0,159389041	0,294856098	1%	0%	1,086399431
COLUMBIA (	0,005%	0,005%	0,494%	0,002%	0,006%	85,126%	0,30839702	0,12773006	0,30681895	1%	0%	0,836666006
COLUMBIA (	0,004%	0,004%	0,448%	0,002%	0,001%	24,643%	0,080953402	0,106795529	0,080539163	1%	0%	2,664938228
GOLDMAN S	0,014%	0,014%	0,749%	0,006%	0,010%	96,306%	0,529094717	0,367134456	0,526387335	2%	0%	1,40171881
USAA MUT.	0,018%	0,017%	0,587%	0,003%	0,008%	95,721%	0,411786574	0,461166394	0,409679459	3%	0%	2,262323201
VANGUARD	0,020%	0,020%	0,630%	0,004%	0,008%	98,377%	0,454123264	0,529891998	0,451799512	3%	0%	2,357125958
VANGUARD	0,012%	0,012%	0,447%	0,002%	0,005%	80,121%	0,262592044	0,312195247	0,261248358	3%	0%	2,40167315
VANGD.WE	0,012%	0,012%	0,446%	0,002%	0,005%	80,205%	0,26245235	0,312294792	0,26110938	3%	0%	2,403717668
WELLS FARG	0,013%	0,013%	0,678%	0,005%	0,009%	94,773%	0,47091564	0,335400648	0,46850596	2%	0%	1,438765326
AMER.BAL.F	0,022%	0,022%	0,842%	0,007%	0,011%	96,844%	0,598178735	0,579977207	0,595117849	3%	0%	1,958615273
AMER.BAL.F	0,022%	0,022%	0,844%	0,007%	0,011%	96,752%	0,598922363	0,581452596	0,595857673	3%	0%	1,961159718
AMER.BAL.F	0,022%	0,022%	0,844%	0,007%	0,011%	96,624%	0,59782715	0,582141714	0,594768064	3%	0%	1,967081102
AMER.BAL.F	0,022%	0,022%	0,844%	0,007%	0,011%	96,746%	0,598486123	0,581318261	0,595423665	3%	0%	1,962135796
AMER.BAL.F	0,022%	0,022%	0,842%	0,007%	0,011%	96,856%	0,598030993	0,580454275	0,594970864	3%	0%	1,960710627
AMER.BAL.F	0,022%	0,022%	0,844%	0,007%	0,011%	96,676%	0,597985785	0,581553064	0,594925887	3%	0%	1,964570728
AMER.FUND	0,022%	0,022%	0,843%	0,007%	0,011%	96,735%	0,598130878	0,580741953	0,595070238	3%	0%	1,961354778
AMERICAN	0,022%	0,022%	0,844%	0,007%	0,011%	96,723%	0,598429699	0,581881444	0,595367529	3%	0%	1,964221905
AMG CHICA	0,014%	0,014%	0,823%	0,007%	0,010%	91,014%	0,549183914	0,373547335	0,546373736	2%	0%	1,374032528
AMG CHICA	0,015%	0,014%	0,825%	0,007%	0,010%	90,863%	0,549436876	0,375080906	0,546625403	2%	0%	1,379038313
COL.BAL.FD.	0,026%	0,025%	0,833%	0,007%	0,011%	97,608%	0,595946449	0,67171493	0,592896986	3%	0%	2,276915668
COLUMBIA	0,026%	0,025%	0,836%	0,007%	0,011%	97,401%	0,596854793	0,672411086	0,593800682	3%	0%	2,275806638
COLUMBIA	0,026%	0,025%	0,833%	0,007%	0,011%	97,624%	0,596186483	0,671079979	0,593135791	3%	0%	2,273847517
COLUMBIA	0,026%	0,025%	0,836%	0,007%	0,011%	97,311%	0,596721518	0,671250083	0,593668089	3%	0%	2,272384581
EATON VAN	0,015%	0,015%	0,913%	0,008%	0,012%	94,416%	0,631719816	0,396471353	0,628487301	2%	0%	1,267816773
FID.PURITAI	0,017%	0,017%	0,884%	0,008%	0,011%	95,381%	0,618526613	0,442582775	0,615361607	2%	0%	1,445457401
FIDELITY PU	0,015%	0,015%	0,868%	0,008%	0,011%	94,325%	0,600459443	0,387416927	0,597386887	2%	0%	1,303359114
JHN.HANCO	0,017%	0,017%	0,851%	0,007%	0,011%	95,406%	0,595267497	0,444845782	0,592221508	2%	0%	1,509615991
JOHN HANC	0,017%	0,017%	0,850%	0,007%	0,011%	95,519%	0,595362365	0,446263077	0,592315891	2%	0%	1,514184365
MAIRS & PO	0,023%	0,023%	0,807%	0,007%	0,011%	97,063%	0,574038099	0,600647726	0,571100741	3%	0%	2,113724104
PRUDENTIA	0,016%	0,016%	0,853%	0,007%	0,011%	92,586%	0,579069432	0,412645787	0,576106329	2%	0%	1,439514207
T ROWE PRI	0,022%	0,022%	1,006%	0,010%	0,013%	91,615%	0,675932274	0,582026337	0,672473523	2%	0%	1,73943672
TRANSAM.P	0,024%	0,024%	0,788%	0,006%	0,010%	98,056%	0,566451355	0,635249628	0,563552819	3%	0%	2,265431731
VANGD.BAL	0,024%	0,023%	0,781%	0,006%	0,010%	98,950%	0,566716056	0,617075163	0,563816165	3%	0%	2,199589968
VANGD.WE	0,017%	0,017%	0,836%	0,007%	0,011%	95,311%	0,584435822	0,443576952	0,581445259	2%	0%	1,533208877
VANGUARD	0,024%	0,023%	0,781%	0,006%	0,010%	98,957%	0,566379912	0,616967563	0,563481741	3%	0%	2,200511638
VANGUARD	0,017%	0,017%	0,837%	0,007%	0,011%	95,275%	0,584508787	0,443420446	0,58151785	2%	0%	1,532476596
INCOME FU	0,016%	0,016%	0,800%	0,006%	0,010%	95,662%	0,561199125	0,417347946	0,558327464	2%	0%	1,502278582
INCOME FU	0,016%	0,016%	0,799%	0,006%	0,010%	95,654%	0,560699714	0,416586418	0,557830609	2%	0%	1,500873026
INCOME FU	0,016%	0,016%	0,802%	0,006%	0,010%	95,541%	0,561579827	0,418471913	0,558706218	2%	0%	1,505303238
BOSTON TST	0,020%	0,020%	0,789%	0,006%	0,010%	93,541%	0,541191849	0,522120908	0,538422565	2%	0%	1,94889759
LKCM FD.BA	0,027%	0,027%	0,846%	0,007%	0,011%	98,021%	0,608024316	0,705242377	0,60491305	3%	0%	2,34307739
WELLS FARG	0,028%	0,028%	1,021%	0,010%	0,013%	96,671%	0,723448601	0,735078765	0,719746709	3%	0%	2,052557709
WELLS FARG	0,028%	0,028%	1,020%	0,010%	0,013%	96,772%	0,723919631	0,745376525	0,720215328	3%	0%	2,079957866
WELLS FARG	0,028%	0,028%	1,021%	0,010%	0,013%	96,774%	0,724240974	0,736043958	0,720535027	3%	0%	2,053004215
FRANKLIN M	0,019%	0,019%	1,068%	0,011%	0,014%	95,327%	0,746521833	0,502829832	0,742701874	2%	0%	1,360653998
ICON EQUIT	0,019%	0,018%	1,174%	0,014%	0,015%	96,185%	0,828363024	0,484989404	0,824124283	2%	0%	1,18271669
JP MORGAN	0,024%	0,024%	1,213%	0,015%	0,016%	97,532%	0,867462351	0,626851212	0,863023539	2%	0%	1,459765231
JP MORGAN	0,024%	0,024%	1,214%	0,015%	0,016%	97,585%	0,868460319	0,633342068	0,864016401	2%	0%	1,473185841
BLACKROCK	0,002%	0,002%	0,573%	0,003%	0,007%	85,012%	0,357236377	0,045570882	0,355408395	0%	0%	0,257692001
BLKRK LF PA	0,000%	0,000%	0,580%	0,003%	0,007%	83,773%	0,356355853	-0,006193922	0,354532377	0%	0%	-0,035111633
FIDELITY AD	0,004%	0,004%	0,324%	0,001%	0,004%	87,160%	0,207300662	0,099347281	0,206239903	1%	0%	0,968109486
FIDELITY AD	0,004%	0,004%	0,326%	0,001%	0,004%	87,010%	0,208190852	0,100489576	0,207125537	1%	0%	0,97505374
FIDELITY FRI	0,004%	0,003%	0,320%	0,001%	0,004%	86,176%	0,20216884	0,08741225	0,201134341	1%	0%	0,873428297
MASS MUTU	0,010%	0,009%	0,487%	0,002%	0,006%	85,208%	0,304318754	0,248062711	0,302761552	2%	0%	1,646652468
MASS MUTU	0,009%	0,008%	0,478%	0,002%	0,006%	86,817%	0,304651049	0,226020363	0,303092147	2%	0%	1,498697801
MASS MUTU	0,010%	0,009%	0,491%	0,002%	0,006%	85,055%	0,305970588	0,249673634	0,304404934	2%	0%	1,648398389
MASSMUTU	0,010%	0,009%	0,482%	0,002%	0,006%	86,311%	0,305211125	0,245324864	0,303649357	2%	0%	1,623717191
PRCL.FUND.	0,007%	0,006%	0,404%	0,002%	0,004%	78,523%	0,232477889	0,17102903	0,231288298	2%	0%	1,486131913
PRCL.FUND.	0,007%	0,006%	0,405%	0,002%	0,004%	77,797%	0,231097095	0,172548017	0,22991457	2%	0%	1,508289356
PRCL.FUND.	0,007%	0,007%	0,412%	0,002%	0,004%	76,938%	0,232595184	0,174097113	0,231404992	2%	0%	1,512028695
STATE FARM	0,008%	0,008%	0,540%	0,003%	0,007%	89,962%	0,35636732	0,20379278	0,354543785	1%	0%	1,155207776
STE.FRM.LIF	0,008%	0,008%	0,543%	0,003%	0,007%	89,576%	0,356462896	0,20298593	0,354638873	1%	0%	1,150325601
VANGD.TAR	0,010%	0,010%	0,394%	0,002%	0,005%	87,467%	0,252511021	0,265451174	0,25121892	3%	0%	2,12360379
Market ben	0,038%	0,038%	1,364%	0,019%	0,019%	100,000%	1	1	1	3%	0%	2,020082844

Table 3: Fund categories characteristics: Gives the value of different characteristics for the different fund categories as well as for the market benchmark.

Column1	Allocation 15-30%	Allocation 30-50%	Allocation 50-70%	Allocation 70-85 %	Allocation 85-%	Target retirement	Market benchmark
Excess return t1	-0,02%	-0,02%	0,00%	-0,01%	-0,01%	-0,01%	0,00%
Excess return t2	0,01%	0,01%	0,02%	0,02%	0,02%	0,01%	0,04%
Standard deviation t1	0,31%	0,44%	0,57%	0,63%	0,72%	0,32%	0,90%
Standard deviation t2	0,48%	0,56%	0,84%	0,91%	1,04%	0,44%	1,36%
Variance t1	0,00%	0,00%	0,00%	0,00%	0,01%	0,00%	0,01%
Variance t2	0,00%	0,00%	0,01%	0,01%	0,01%	0,00%	0,02%
Covarians with market t1	0,00%	0,00%	0,00%	0,01%	0,01%	0,00%	0,01%
Coverians with market t2	0,01%	0,01%	0,01%	0,01%	0,01%	0,01%	0,02%
Correlation with market t1	64,10%	64,86%	90,09%	90,30%	88,96%	70,17%	100,00%
Correlation with market t2	81,22%	81,91%	95,88%	96,00%	94,08%	84,84%	100,00%
Betavalue t1	22,50%	34,10%	57,53%	64,14%	73,34%	25,64%	100,00%
Betavalue t2	28,17%	34,58%	58,99%	63,57%	72,66%	27,40%	100,00%
T-test for differnce in	0,59%	81,43%	5,49%	80,35%	86,80%	0,05%	100,00%
Sharpe ratio t1	-6,04%	-3,46%	-0,69%	-1,25%	-1,08%	-3,90%	-0,24%
Sharpe ratio t2	1,28%	2,14%	2,40%	2,39%	1,61%	1,48%	2,76%
Treynors index t1	-0,08%	-0,04%	-0,01%	-0,01%	-0,01%	-0,05%	0,00%
Treynor index t2	0,02%	0,03%	0,03%	0,03%	0,02%	0,02%	0,04%
Risk aversion t1	-1017,26%	-549,04%	-84,19%	-150,63%	-130,76%	-607,87%	-26,81%
Risk aversion t2	116,89%	186,42%	184,59%	183,57%	124,46%	128,50%	202,01%

Table 4: Statistics from the regression made on running variance as dependent on the repo rate

	Fund	Beta	T-statistic	T-static adjusted for auto correlation	p-value	R^2	F-statistic	Std error	Std error adjusted
Balanced mutual funds asset	PRCL.FUND.STGC.AS	-406,203	-19,1708	-9,6718	0	0,1015	367,5182	21,1887	41,9986
	WELLS FARGO	-300,0834	-24,4916	-9,4508	0	0,1556	599,8386	12,2525	31,7521
	WELLS FARGO	-282,5671	-24,0647	-9,4445	0	0,151	579,111	11,742	29,9187
Balanced mutual funds asset allocation 30-50 %	COLUMBIA CAPITAL	-304,6681	-18,8566	-10,1476	0	0,0985	355,5694	16,1572	30,0235
	COLUMBIA CAPITAL	-501,3852	-27,2623	-10,7262	0	0,1859	743,2347	18,3911	46,7439
	GOLDMAN SACHS	-67,3157	-13,5369	-9,7588	0	0,0533	183,2475	4,9727	6,8979
	USAA	-39,7286	-4,1049	-2,8484	0,0044	0,0052	16,8499	9,6784	13,9472
	VANGUARD TAX-	-140,7429	-18,4634	-9,7344	0	0,0948	340,8962	7,6228	14,4583
	VANGUARD	-158,819	-9,4377	-8,6424	0	0,0266	89,0704	16,8281	18,3768
	VANGD.WELLESLEY	-61,2895	-9,5351	-8,6984	0	0,02717	90,92	16,9152	18,5424
	WELLS FARGO	-102,927	-15,0145	-9,8259	0	0,0648	225,4358	6,8552	10,4751
Balanced mutual funds asset allocation 50-70 %	AMER.BAL.FD. CL.R-	-91,97	-20,5768	-9,6909	0	0,1151	423,4056	4,4696	9,4904
	AMER.BAL.FD. CL.R-	-91,4593	-20,5495	-9,6882	0	0,1148	422,2798	4,4505	9,4398
	AMER.BAL.FD. CL.R-	-91,5892	-20,5037	-9,6951	0	0,1144	420,4	4,467	9,4469
	AMER.BAL.FD.CL.	-91,9888	-20,5936	-9,6832	0	0,1153	424,0946	4,4669	9,4998
	AMER.BAL.FD.CL.	-91,5987	-20,5142	-9,6934	0	0,1145	420,8536	4,465	9,4496
	AMER.BAL.FD.CL.529	-91,3065	-20,483	-9,6961	0	0,1142	419,5541	4,4577	9,4168
	AMER.FUND.AMER.	-91,3486	-20,4893	-9,6937	0	0,1142	419,7705	4,4586	9,4235
	AMERICAN BAL.FD.	-91,9662	-20,6047	-9,6861	0	0,1154	421,5516	4,4634	9,4947
	AMG CHICAGO	-133,4933	-23,7129	-9,2134	0	0,1473	562,3012	5,6296	14,4923
	AMG CHICAGO	-134,482	-23,8951	-9,2153	0	0,1492	570,9856	5,628	14,5933
	COL.BAL.FD.CL.C	-102,7998	-21,6616	-9,3361	0	0,12	469,2253	4,7457	11,011
	COLUMBIA	-102,7482	-22,162	-9,4787	0	0,1311	491,1533	4,6324	10,84
	COLUMBIA	-102,8326	-22,1014	-9,4838	0	0,1305	488,4714	4,6528	10,8429
	COLUMBIA FD.CL.Z	-102,7446	-22,1987	-9,4757	0	0,1315	492,7841	4,6284	10,8429
	EATON VANCE	-59,6937	-16,6303	-9,9692	0	0,0783	276,5657	3,5895	5,9878
	FID.PURITAN	-68,8581	-16,1711	-9,8907	0	0,0744	261,5039	4,2581	6,9619
	FIDELITY PURITAN	-113,2002	-23,049	-9,4559	0	0,1403	531,2597	4,9113	11,9714
	JHN.HANCOCK	-65,37	-15,3698	-10,3502	0	0,0677	236,2321	4,2531	6,3158
	JOHN HANCOCK	-64,964	-15,3686	-10,3254	0	0,0676	236,1945	4,2271	6,2916
	MAIRS & POWER	-82,0659	-17,9566	-9,7776	0	0,09	322,4382	4,5702	8,3933
	PRUDENTIAL	-68,195	-14,1247	-9,7108	0	0,0578	199,5066	4,8281	7,0226
	T ROWE PRICE	-45,8503	-15,7905	-10,2405	0	0,0711	249,3384	2,9037	4,4773
	TRANSAM.PTNS.INS	-80,5032	-16,92	-9,7582	0	0,081	286,284	4,758	8,2498
	VANGD.BAL.IDX.FD.I	-85,1644	-17,694	-9,847	0	0,0877	313,0772	4,8132	8,6481
	VANGD.WELLINGTO	-77,0783	-16,8411	-10,0062	0	0,082	283,6218	4,5768	7,7031
	VANGUARD	-85,0145	-17,6593	-9,8358	0	0,0874	311,8518	4,8141	8,6434
	VANGUARD	-76,8439	-16,7978	-10,0062	0	0,0798	282,167	4,5746	7,6796
Balanced mutual funds asset allocation 70-85 %	INCOME FUND OF	-92,2251	-18,8442	-9,8472	0	0,0984	355,1032	4,8941	9,3656
	INCOME FUND OF	-91,9296	-18,7832	-9,851	0	0,0978	352,816	4,8942	9,3319
	INCOME FUND OF	-91,7056	-18,8437	-9,8546	0	0,0984	355,0837	4,8666	9,3058
	BOSTON TST.ASSET	-132,8266	-19,1	-9,9715	0	0,1008	364,8114	6,9543	13,3207
	LKCM FD.BAL.FD.	-113,6401	-23,0873	-9,7068	0	0,1407	533,0225	4,9222	11,7073
	WELLS FARGO	2,515	14,2562	6,6654	0	0,0588	203,2404	0,1764	0,3773
	WELLS FARGO	-38,7495	-15,4877	-10,0179	0	0,0686	239,8689	2,502	3,868
	WELLS FARGO	-38,7156	-15,4874	-10,0165	0	0,0686	239,8588	2,4998	3,8652
	WELLS FARGO	-38,8478	-15,5479	-10,0109	0	0,0691	241,7332	2,4986	3,8806
Balanced mutual funds, asset allocatio	FRANKLIN MUTUAL	-59,5574	-20,4373	-10,1414	0	0,1137	417,6843	2,9141	5,8727
	ICON EQUITY	-30,7733	-12,9029	-8,5393	0	0,0516	166,4836	2,385	3,637
	JP MORGAN	-46,8619	-21,1634	-9,7278	0	0,121	447,8903	2,2143	4,8188
	JP MORGAN	-47,0232	-21,2392	-9,7249	0	0,1217	451,1048	2,214	4,8353
Retirement targeting funds	BLACKROCK LIFE	-236,9063	-20,7194	-9,6894	0	0,1165	429,2924	11,4341	24,4498
	BLKRK LF PATH RET	-243,6989	-21,5541	-9,6642	0	0,1249	464,5405	11,3064	25,2967
	FIDELITY	-624,4172	-19,6519	-9,6051	0	0,1078	386,2	31,7738	65,0091
	FIDELITY ADVISOR	-368,6627	-12,5306	-6,0414	0	0,04368	157,0165	29,4209	61,0229
	FIDELITY	-657,4246	-18,7053	-9,8181	0	0,097	349,8886	35,1625	66,9909
	MASS MUTUAL	-247,0496	-16,0963	-9,1449	0	0,0779	259,0907	15,3482	27,0151
	MASS MUTUAL	-274,7113	-17,4683	-9,1431	0	0,0905	305,1411	15,7263	30,0459
	MASS MUTUAL	-242,3987	-16,0657	-9,151	0	0,0776	258,1055	15,088	26,4889
	MASSMUTUAL	-250,1257	-16,2975	-9,1468	0	0,0797	265,6094	15,3475	27,3457
	PRCL.FUND.PRCL.LF	-236,1809	-12,3002	-8,9839	0	0,0449	151,2967	19,2013	26,2894
	PRCL.FUND.PRCL.LF	-233,4904	-12,1582	-8,8922	0	0,0439	147,821	19,2044	26,2578
	PRCL.FUND.PRCL.LF	-238,859	-12,304	-8,859	0	0,0462	151,3892	19,4131	26,9628
	STATE FARM LIFE	-206,4403	-18,0617	-9,9264	0	0,0915	326,2254	11,4297	20,797
	STE.FRM.LIFEPATH	-204,8792	-18,0052	-9,9367	0	0,0909	324,1871	11,3789	20,6184
	VANGD.TAR.RTMT.I	-296,2587	-13,8044	-9,8332	0	0,0574	190,56	21,4613	30,1285
	Average	-153,525803	-17,52649394	-9,248975758	0,000067	0,093281061	338,8428561	8,968625758	16,64650303

Table 5: Statistics from regression made upon the running beta value as dependent on the repo rate

	Column1	Beta	T-statisti	T-static adjusted for auto correlation	p-value	R^2	F-statistic	Std error	Std error adjusted
Balanced mutual funds asset	PRCL.FUND.STGC.ASST.M	-0,6422	-24,0586	-8,507	0	0,151	578,8144	0,0267	0,0755
	WELLS FARGO DIVERSIFIED	-5,6816	-75,5884	-33,5838	0	0,6371	5713,598	0,0752	0,1692
	WELLS FARGO DIVERSIFIED	-5,7035	-75,4819	-33,6445	0	0,6364	5697,523	0,0756	0,1695
Balanced mutual funds asset allocation 30-50 %	COLUMBIA CAPITAL	-0,3621	-15,5911	-5,6734	0	0,0695	243,082	0,0232	0,0638
	COLUMBIA CAPITAL	-4,0019	-21,2255	-10,3319	0	0,1216	450,5225	0,1885	0,387342
	GOLDMAN SACHS INC.BLR.	0,8571	20,2867	9,2329	0	0,1122	411,547	0,0423	0,0928
	USAA MUT.FD.TST.GW.&	1,5359	47,1048	12,2916	0	0,4054	2218,864	0,0326	0,125
	VANGUARD TAX-	0,3005	27,3221	13,0401	0	0,1866	746,497	0,011	0,023
	VANGUARD WELLESLEY	2,0101	61,2446	24,3954	0	0,5354	3750,897	0,0328	0,0824
	VANGD.WELLESLEY	1,9691	61,03	24,422	0	0,5336	3724,57	0,0323	0,0806
	WELLS FARGO MODERATE	-0,2301	-7,4335	-2,9667	0,003	0,0167	55,2563	0,031	0,0776
Balanced mutual funds asset allocation 50-70 %	AMER.BAL.FD. CL.R-3 SHS.	-1,07	-27,9785	-13,5372	0	0,1939	782,7939	0,0382	0,079
	AMER.BAL.FD. CL.R-4 SHS.	-1,1373	-30,1248	-14,6168	0	0,218	907,528	0,0378	0,0778
	AMER.BAL.FD. CL.R-5 SHS.	-1,1057	-29,055	-14,0613	0	0,2059	844,1938	0,0381	0,0786
	AMER.BAL.FD.CL. 529 A	-1,1036	-28,8145	-13,9925	0	0,2032	830,2735	0,0383	0,0788
	AMER.BAL.FD.CL. 529 E	-1,0555	-28,0832	-13,6766	0	0,195	788,6657	0,0376	0,0772
	AMER.BAL.FD.CL.529-F-1	-1,1039	-28,6652	-14,0284	0	0,2016	821,6962	0,0385	0,0787
	AMER.FUND.AMER.BAL.FD	-1,1023	-28,7448	-14,0385	0	0,2025	826,2593	0,0383	0,0785
	AMERICAN BAL.FD. CL.A	-1,1709	-30,6687	-14,8332	0	0,2242	940,567	0,0382	0,079
	AMG CHICAGO EQUITY	1,9413	34,7221	18,6373	0	0,2703	1205,626	0,056	0,1042
	AMG CHICAGO EQUITY	1,8966	34,2557	18,094	0	0,265	1173,45	0,0554	0,1052
	COL.BAL.FD.CL.C	-1,4448	-50,1415	-25,1431	0	0,4446	2514,172	0,0288	0,0575
	COLUMBIA BAL.FD.CL.A	-1,444	-45,2003	-24,2421	0	0,3856	2043,07	0,032	0,0596
	COLUMBIA BAL.FD.CL.B	-1,4243	-44,613	-24,481	0	0,3794	1990,324	0,032	0,0582
	COLUMBIA FD.CL.Z	-1,503	-46,305	-24,4807	0	0,3941	2144,148	0,0325	0,0614
	EATON VANCE	1,7928	36,4832	15,2797	0	0,2902	1331,027	0,0491	0,1173
	FID.PURITAN BAL.FUND	2,0415	37,6222	17,0143	0	0,303	1415,435	0,0543	0,111
	FIDELITY PURITAN FD.	-0,9996	-17,9525	-8,1204	0	0,09	322,2919	0,0557	0,12321
	JHN.HANCOCK BAL.FD. CL.I	-0,8263	-25,2478	-9,4273	0	0,1637	637,4492	0,0327	0,087
	JOHN HANCOCK	-0,7494	-22,8713	-8,3366	0	0,1385	523,098	0,0328	0,0899
	MAIRS & POWER BAL.FD.	0,449683	24,0327	11,088	0	0,1577	577,5693	0,0187	0,0401
	PRUDENTIAL BALANCED	2,0883	48,8256	19,11	0	0,4228	2384,035	0,0428	0,1093
	T ROWE PRICE	-0,7719	-18,2371	-8,6907	0	0,093	332,5907	0,0423	0,0888
	TRANSAM.PTNS.INSTL.BAL	1,0051	45,476	17,9538	0	0,3885	2068,065	0,0221	0,056
	VANGD.BAL.IDX.FD.I	0,7486	59,6509	24,2283	0	0,5222	3558,237	0,0125	0,0309
	VANGD.WELLINGTON	0,373	19,7479	8,4572	0	0,107	389,9793	0,0188	0,044
	VANGUARD BAL.IDX.FD I	0,7584	62,6623	27,672	0	0,5467	3926,56	0,0121	0,0274
	VANGUARD WELLINGTON	0,3569	18,7437	8,2008	0	0,0974	351,3273	0,019	0,0435
Balanced mutual funds asset allocation 70-85 %	INCOME FUND OF	-1,133	-20,3541	-7,3752	0	0,1129	414,2898	0,0557	0,1536
	INCOME FUND OF AM.CL.F	-1,0981	-19,815	-7,2189	0	0,1076	392,6304	0,0554	0,1521
	INCOME FUND OF	-1,118	-20,054	-7,2507	0	0,1099	492,2021	0,0558	0,1542
	BOSTON TST.ASSET	1,2068	16,6803	7,1676	0	0,0787	278,2316	0,0723	0,1684
	LKCM FD.BAL.FD.	-1,0219	-22,4939	-10,6929	0	0,1345	505,9762	0,0454	0,0956
	WELLS FARGO INDEX	2,2994	35,1782	15,7561	0	0,2755	1237,503	0,0654	0,1459
	WELLS FARGO INDEX	2,3389	35,707	15,8906	0	0,2815	1274,986	0,0655	0,1472
	WELLS FARGO INDEX	2,269	34,8578	15,7857	0	0,2718	4323,188	0,0651	0,1437
Balanced mutual funds, asset allocatio	FRANKLIN MUTUAL	-4,9247	-42,8321	-12,695	0	0,3605	1834,591	0,115	0,388
	ICON EQUITY INC.FD.CL.S	4,8392	55,7565	20,1778	0	0,5037	3108,783	0,0868	0,2398
	JP MORGAN	-1,1073	-25,1463	-9,893	0	0,1627	632,3372	0,044	0,1119
	JP MORGAN	-1,1753	-26,5923	-10,2948	0	0,1785	707,1479	0,0442	0,1142
Retirement targeting funds	BLACKROCK LIFE PATH	1,2208	42,4522	12,9902	0	0,3564	1802,189	0,0288	0,094
	BLKRK LF PATH RET FD	1,1981	41,436	18,9519	0	0,3453	1716,944	0,029	0,093
	FIDELITY ADVI.FREEDOM	0,1346	6,9639	3,2674	0,0011	0,015	48,497	0,0193	0,0412
	FIDELITY ADVISOR	0,1164	5,4717	2,5312	0,0114	0,0092	29,94	0,0213	0,046
	FIDELITY FREE.INC.FD.	0,7699	42,7769	17,6523	0	0,3599	1829,865	0,018	0,0436
	MASS MUTUAL RETIRE	-1,1397	-44,6393	-17,1409	0	0,4254	2269,502	0,024	0,0665
	MASS MUTUAL RETIRE	-1,0963	-45,3167	-15,892	0	0,4011	2053,606	0,0242	0,069
	MASS MUTUAL RETIRE	-1,1777	-46,7718	-16,8559	0	0,4185	2206,348	0,0244	0,0681
	MASSMUTUAL	-1,1835	-51,0522	-17,4828	0	0,4595	2606,328	0,0232	0,0677
	PRCL.FUND.PRCL.LFT.STGC	1,4217	37,6974	18,7333	0	0,3062	1421,097	0,0377	0,0759
	PRCL.FUND.PRCL.LFT.STGC	1,1514	39,6355	19,9029	0	0,328	1570,973	0,0382	0,0761
	PRCL.FUND.PRCL.LFT.STGC	1,3243	39,3087	17,9955	0	0,3307	1545,176	0,0337	0,0736
	STATE FARM LIFE PATH	1,1434	40,7855	12,3892	0	0,3392	1663,454	0,028	0,0923
	STE.FRM.LIFEPATH RTMT.	1,213	41,9132	13,2958	0	0,3516	1756,716	0,029	0,0912
	VANGD.TAR.RTMT.INC.FD.	0,1113	3,9757	0,9508	0,3418	0,005	15,8064	0,028	0,9508
	Average	-0,12194	1,117802	0,143844615	0,005496923	0,26982	1491,690937	0,04158769	0,113114646

Table 6: Category statistics for table 4

Fund	Beta	T-static	T-static adjusted for auto correlation	p-value	R^2	F-statistic	Std error	Std error adjusted
Allocation 15-	-4,0091	-58,3763	-25,2451	0	0,474833333	3996,645133	0,059166667	0,138066667
Allocation 30-	0,259825	21,5922625	8,05125	0,000375	0,247625	1450,154475	0,0492125	0,11656775
Allocation 50-	-0,16890063	-2,980774074	-2,221148148	0	0,263111111	1319,645633	0,035355556	0,075633704
Allocation 70-	0,4678875	4,9632875	2,7577875	0	0,17155	1114,875888	0,060075	0,1450875
Allocation 85-	-0,592025	-9,70355	-3,17625	0	0,30135	1570,714775	0,0725	0,213475
Retirement	0,34718	10,30911333	4,752593333	0,02362	0,296733333	1502,429427	0,02712	0,129933333

Table 7: Category statistics for table 5

Fund	Beta	T-static	T-static adjusted for auto correlation	p-value	R^2	F-statistic	Std error	Std error adjusted
Allocation 15-30 %	-329,618	-22,5757	-9,522366667	0	0,136033	515,4892667	15,0610667	34,55646667
Allocation 30-50 %	-172,11	-14,52643	-8,7977625	0,00055	0,069534	255,6529875	12,1775875	19,9331375
Allocation 50-70 %	-88,3381	-19,27479	-9,737162963	0	0,10343	379,1433926	4,5442	9,13442963
Allocation 70-85 %	-70,6805	-14,54724	-8,067888889	0	0,089022	320,6153444	3,80091111	7,224711111
Allocation 85- %	-46,054	-18,9357	-9,53335	0	0,102	370,79075	2,43185	4,79095
Retirement targeting	-304,1	-16,38152	-9,189026667	0	0,079359	277,7576067	18,8464267	33,64792667