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GERMAN EQUITY MUTUAL FUND'S ALPHA. A TRUSTWORTHY OR QUESTIONABLE FINANCIAL INDICATOR.

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Abstract

This paper analyses the relationship of benchmark picking behaviour of fund managers regarding German domiciled equity mutual funds and the corresponding alpha. Previous studies have shown that average mutual funds underperform the market and do not generate positive risk-adjusted returns (Reuter & Guercio, 2011). However, the benchmark picking behaviour of managers can significantly impact the risk-adjusted return and therefore explain better performance than actually achieved with a different benchmark. Studies from the Norwegian mutual funds alpha have shown that strategic benchmark picking behaviour of managers lead to an alpha with higher risk-adjusted returns (Bukhvalova, 2017). Conversely, this paper comes to the conclusion that equity funds domiciled in Germany have on average 0.7886% higher best-fit-alpha performance than fund manager selected alpha. Therefore, this paper concludes that fund managers in Germany do not choose benchmarks in order to expose better alpha performance.

Key words: German funds, equity mutual fund market, mutual funds, alpha, fund manager

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List of Abbreviations

a^*	Best-fit-alpha
ACWI	All Country World Index
a^M	Managers alpha
CAPM	Capital Asset Pricing Model
DAX	Deutscher Aktienindex (German Stock Index)
$E(a^* < a^M)$	Average Managers Alpha
$E(a^* > a^M)$	Average Best-fit-Alpha
EMMI	European Money Markets Institute
ETF	Exchange Traded Fund
Euribor	Euro Interbank Offered Rate
ISIN	International Securities Identification Number
MAXR2	The highest R-squared calculated
MiFID II	Markets in Financial Instruments Directive
MSCI	Morgan Stanley Capital International
REIT	Real Estate Investment Trusts
R^2	R-Squared
S&P	Standard and Poor's

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1. Introduction

In academic literature the volume of mutual funds research papers is large and has a wide range of profound analysis. This is not surprising, as for example the US market of mutual funds gathered more than 88 million shareholders and over 11 trillion dollars in assets 9 years ago (Fink, 2011). Not only the US market is highly attractive because of its volume and liquidity, but also different markets around the world have developed their own mutual fund industry. The German one is not as big as the US market. However, equity mutual funds domiciled in Germany have different jurisdictions from funds in the US and therefore every investor has to review their due diligence by themselves in order to invest into the German market. Studies by Wayne Ferson and Jerchern Lin (Ferson & Lin, 2014) have shown that alpha is not the most important indicator whether to buy a fund or not. Therefore, other indicators certainly also influence the fund picking behaviour of investors. Furthermore, studies have also shown that mutual funds have the tendency to outperform the market and not as many investor falsely assume of mutual funds underperformance to the US market according to studies by Frahm (Frahm & Huber, 2019) and Del Guercio (Del Guercio & Reuter, 2011). This in mind, the research done in this paper provides essential knowledge for the industry and especially for individual investors considering purchasing equity mutual funds domiciled in Germany.

The research goal of this master thesis is to determine whether there is a relationship between mutual fund managers benchmark picking behaviour and higher alpha values compared to benchmarks which are chosen through financial econometrics. Whether we are talking about individuals or corporations, this paper tries to provide transparency for the mutual funds market. This is the research gap this thesis tries to close in order to have additional information to choose an appropriate and risk specific asset for investors.

Furthermore, the goal is not only to give investors, but also asset managers and wealth managers, an insight in the industry they operate in. Fundamental data about competitors and the industry will certainly represent reliable data to stakeholders in the German mutual fund market. Therefore,

this paper claims the following research hypothesis, which is going to be proved using financial econometrical approaches:

German mutual equity funds manager alpha a^M is on average higher than the best-fit-alpha a^*.

This in mind, taking the Modern Portfolio Theory (Markowitz, 1952) into consideration, an investor can invest their assets more efficiently in the German equity market with the results presented in this paper. If the hypothesis is true, investors might take the expected return and variance into consideration while choosing a mutual fund, rather than alpha for decision making investments. The impact of the results on the industry should mainly provide data to individual investors and protect them from misleading fund managers' information.

1.1 Funds

In order to explain the mechanics of mutual funds correctly, this section firstly focuses on explaining what a share/stock of a company actually is.

Shares are a shareholder and equity investment part of a company reflected in its stock exchange listed price and shareholder part depending on the size of purchase. After an Initial Public Offering a company is listed in the stock exchange and the shares can be purchased in the secondary market through a broker. The nature of a share is to show how much a company is worth according to its market capitalization. To establish the value of a company, the share price has to be multiplied with the amount of stocks in the market. This is also known as the enterprise value. There are two widely known approaches to calculating the share price analytically. On the one hand, fundamental analysis can provide the stock value through several factors such as discounted cashflows, multiples and several future and past assumptions influencing the price of the company. On the other hand, technical analysis provides an expected price based on historical data of stock prices. Studies have shown that systematic use of both analysis approaches together results in significant profits (Amini, Rahnama, & Alinezhad, 2015).

To invest in several shares a transaction fee is payed for every stock. Investing in a whole basket can make the investment extremely expensive this way. Here, funds in general are a good alternative to invest into a market or industry, as a fund includes several shares (Del Guercio & Reuter, 2011). One can buy a considerable number of shares simultaneously and pay the broker a one-time fee only for the purchase.

Not only lower transaction fees, but also the needed volume of the investment is smaller for diversification. Taken four shares A, B, C and D each having a value of $250 on the market. Assuming an investor wants to buy all four shares to an equal amount to have a portfolio corresponding to his risk profile, a minimum investment of $1000 is needed. A fund first invests into all four shares buying 1000 shares of each company and finally divides the total amount of $250' 000 Dollars into $25 shares of the fund to an amount of 10'000 shares. In this example, a shareholder can buy A, B, C, and D for $25, transaction fees and commissions excluded.

For the asset allocation process and rebalancing of the portfolio the management charges a management fee. There are different kind of funds which are handled differently. Cost structures are also different depending on several factors, such as whether the fund cashes out dividends, included water marks, transaction costs, commissions, common fees, performance fees and more. Analyzing the cost structure would overstretch the scope of this paper, this is why calculations are made in net returns and costs are therefore already subtracted from the total return.

Funds have an identification number like stocks, which identifies every fund specifically through a standardized ISIN-number. With this system, every tradeable fund can be found online or on any brokerage trading platform (Del Guercio & Reuter, 2011).

1.2 Benchmark

A benchmark is generally an index which funds are compared to in terms of their performance. For this reason, one can take serval indices as a benchmark, for example S&P (Standard and Poor's) 500 in the US market or DAX 30 (Deutscher Aktienindex; German stock index) in the German market. They are given in points and not currencies. Furthermore, they have different

approaches regarding their methodology. Some are price-weighted indices, others are value-weighted indices and even unweighted indices exist. This paper particularly focuses on price-weighted and value-weighted indices. Special differentiation between those types of indices is not further discussed, as both are weighted the same way in terms of the methodological approach in this paper. Indices represent a whole industry or market section. An index which performs in comparison with a fund is called benchmark. The approach to choosing the right benchmark for a specific fund matters for performance evaluation, which provides data for investment analysis purpose. (Kent , Grinblatt, Titman, & Wermers, 1997).

1.3 Important Fund Types

In this paper we focus on mutual funds but understanding the mechanics of Exchange Traded Funds (ETFs) and hedge funds is also important. Mainly to distinguish different investment vehicles for investors in the financial market, this paper gives a quick overview of three popular fund types named ETF, hedge fund and mutual funds. There are many further fund types available on the market such as Real Estate Investment Trusts (REIT), but further explanation on fund types would exceed the purpose of this master thesis.

1.3.1 Mutual Funds

Mutual funds include different kinds of investment vehicles such as bonds and equities. The higher the fixed income part in the fund, the lower the equity part and risk within a fund (Graham B. , 1959). In this paper only equity funds are taken into consideration, meaning the funds excluding fixed income securities and only consisting of shares of companies. However, mutual funds can of course contain many different securities. The reason why this paper limits the research to equity mutual funds, is to provide a first step into the direction of analysis. Further research can be done including fixed income vehicles. The fund manager of a mutual fund tries to beat the market with stock picking techniques in order to generate higher returns than the corresponding benchmark. Fees and commissions are higher than in ETFs, but rather lower than in hedge fund vehicles (Eling & Faust, 2010). Furthermore, the costs vary a lot between the different funds and they have to be calculated accordingly (Del Guercio & Reuter, 2011).

1.3.2 ETF (Exchange Traded Funds)

Exchange traded funds mainly differ from mutual funds in as fair as the follow an index, instead of trying to beat it (Bhattacharya, Loos, Meyer, & Hackethal, 2017). The fund manager developed the fund in order to reflect an index or industry as precisely as possible. Without expensive asset management teams, the total expense ratios of ETFs are remarkably low compared to mutual funds (Lettau & Madhavan, 2018). The construction to follow an underlying index is cost efficient and as a basket of securities an ETF can be traded on the stock market just like a share of any company available (Petrova, 2015).

1.3.3 Hedge Funds

Hedge funds do not lower the volatility of an investment or portfolio as wrongly assumed by many individual investors. The name can mislead unskilled investors in this respect. Hedge funds are generally involved with higher risk activities and they have less jurisdiction than other fund types, in order to act swiftly in difficult market situations or sudden turns to either bear or bull market. High returns are targeted, which in turn involves a high corresponding risk. The fees are even higher for hedge funds than for mutual funds including a performance fee, which can be around 20% of the return. Even with water marks, hedge funds are only recommended for experienced investors who know what they invest in (Duffy & Gregoriou, 2006).

1.4 CAPM

In this section of the master thesis a basic explanation is necessary to understand further approaches in the upcoming research activities. Michael Jensen developed an approach to calculating the risk-adjusted return of investment vehicles, which can be used for securities and funds. Its main variable is known as Jensen's alpha (Jensen, 1967). To understand what alpha actually is, the Capital Asset Pricing Model (CAPM) model by (Lintner, 1965) and (Sharpe, 1964) needs to be understood in a first place. The following model has to be studied for this purpose:

$$E(r_i) = r_f + \beta(r_m - r_f)$$

where

$E(r_i)$ = Expected return on security i
r = Risk free rate
β = Beta
r_m = Expected return of the benchmark m

Additionally, the model is based on the following assumptions:

1. All investors are risk-averse and maximize their investments
2. Investors have identical investment horizons and act homogenously within investment decisions
3. Investors choose their investment dependent on expected return and standard deviation
4. No transaction costs and taxes
5. All assets can be infinitively divided

1.5 Alpha

Having CAPM in mind, the difference between the expected one period return of the security or portfolio from CAPM and the actual realized return of the security or portfolio is defined as alpha. Therefore, the equation above can be rewritten as follows (Jensen, 1967):

$$R_i - R_f = a + \beta(R_M - R_f)$$

thus

$$a = R_i - [R_f + \beta(R_M - R_f)]$$

where

R_i = Realized return (on equity/portfolio)
R_f = Risk free rate
R_M = The market return
a = Alpha
β = Beta

Alpha is going to be the most important variable in this paper for calculations in the methodology section. Additionally, the error term was ignored to simplify circumstances. To integrate the formula in an econometric tool, the equation has to be written in a way the software understands what to do. For R-Studio or STATA the first equation is taken into consideration. Further information will be provided in the methods section.

1.6 R-Squared

R-squared (R^2) measures the degree to which the performance of a mutual fund can be attributed to the performance of a benchmark index. Previous studies used R^2or adjusted R^2 to compare the explanatory power of models using linear regressions. For example, Hagquist and Stenbeck (Hagquist & Stenbeck, 1998) compared the CAPM (Sharpe, 1964) with the Fama and French 3

factor model (Fama & French, 1992) and they found fundamental differences in a better model of using Fama and French comparison result in higher adjusted R^2 regressions than in the commonly used CAPM model. Also arguing the utility of the goodness of fit of R^2, the results clearly show a justified approach in the heuristics of the use of R^2. In this paper the usage of R^2 has the same purpose. The higher the R^2 rate is, the higher is the explanatory power of the model and therefore the probability for the benchmark to fit the model best, having the highest R^2 in the regression.

2. Literature Review

Paper 1# (Kaplan & Sensoy, 2005)

In this paper, Sensoy and Kaplan consider whether equity mutual funds are able to time their self-designated benchmark indexes, such as the S&P 500 (an index of large companies) or the Russell 2000 (an index of small companies). Their work extends and complements the literature on mutual fund timing in three main ways.

Firstly, they consider if mutual funds are able to time their benchmarks by differentiating their cash holdings. Many funds nowadays particularly attempt to do so. In paper #1 they also refer to the work (Graham & Harvey, 1996), studying 237 investment newsletters, where they claim to have found that suggested allocations between equity and cash generally have no predictive power for future market returns. They also refer to additional work by (Becker, Ferson, Myers, & Schill, 1999), where they insist on the theory of no predictive power for future S&P 500 returns. Here Sensoy and Kaplan investigate on their own if this is really the case.

Secondly, they check the conduction of holdings-based tests and the assertion that funds are able to time the overall stock market by varying the market betas of their portfolios, because previous research did neither analyse variations in cash holdings nor the performance relative to the benchmark of a fund.

Thirdly, their paper claims to consider benchmark timing and not market timing. Funds marketing strategy materials are often based on funds returns compared to the benchmark. According to their conclusion, investors pay attention to the performance relative to the benchmark. The performance of a fund is therefore important for new cash inflow of new investment. Successful benchmark timing is an important tool to accomplish this goal.

In the end, funds do not successfully time the benchmark by varying their cash holdings. The relation is rather driven by changes in the benchmark beta of the equity portion of fund portfolios and not its changes in weights on equity. This in mind, research about German equity mutual funds

can include the findings and results of Sensoy and Kaplan into the research process by investigating the same parameters for the German market to find out if mutual fund performance's weight in equity portion play an essential role. Attention has to be paid to change in benchmark beta as suggested and to investigate different performances by adjusting this figure.

Paper 2# (Sensoy, 2009)

In this paper Berk A. Sensoy questions the benchmarks chosen by fund managers. In order to generate a higher alpha and therefore a better performance, fund managers tend to choose the benchmark most suitable for their own funds. As this mismatch is important to investors, they pay real attention to the relative performance to the benchmark and therefore fund managers try to generate an alpha which is as high as possible. New cash inflows are also mainly generated this way. In the end it is proven by Berk, that self-designated benchmark results from strategic fund behaviour are driven by the incentive to improve flows.

Berk A. Sensoy's results are important for the following research in as far as an investigation of fund managers' behaviour is extracted. In order not to only look at the pure alpha difference, one also has to pay attention to the chosen benchmark and question that choice thoroughly. The first idea to use R^2 for research purposes in the German market was based on Berk's findings.

Paper 3# (Jensen, 1967)

Clearly one of the most famous and important papers ever written and in view of the research in this paper is the one by Michael C. Jensen. He investigates how much a fund manager's forecasting ability contributes to the returns of the fund. Additionally, the risk-adjusted measurement of portfolio performance is shown and today known as Jensen's alpha. Here 115 mutual fund managers are taken into consideration in the period of 1945 until 1964. The measure is based on Sharpe, Lintner and Treynor's theory of pricing of capital assets.

The central problem - especially in portfolio management is to evaluate the performance, as there are several ways to show performance. If the research in this paper wants to calculate averages for

example, there are already geometric, harmonic, arithmetic, etc. means for performance evaluation. Two distinct dimensions must therefore be taken into account, namely the portfolio managers and the security analysist's abilities to increase returns by successfully predicting security prices and their ability to minimize variance by effectively diversifying the portfolio.

Results show that the performance of 115 mutual funds indicates a weaker performance in security prices picking compared to a buy-and-hold strategy. In addition to this, randomly chosen portfolios were as good in performing and there was little evidence to disprove this fact. This evidence is even valid when funds returns gross of management expenses are taken into consideration (bookkeeping, research, other expenses except brokerage commissions and fees). It is important to mention that funds on average were apparently not successful enough in their trading strategy to even recoup their brokerage expenses.

Paper 4# (Ibert, Kaniel, & Van Nieuwerburgh, 2017)

In this paper, Markus Ibert, Ron Kaniel, Stijn Van Nieuwerburgh and Roine Vestman investigate the pay of mutual fund managers according to their skills.

A large and growing number of investors delegate investments in risky assets to fund companies. One major piece of evidence has been data on manager compensation which is glaringly missing in research results. Mostly, empirical analysis has focused on links between mutual fund investors and their corresponding funds. Little is known about the compensation structure in contracts between companies and managers and even less about managers' salaries according to the performance. In their paper investigation is done to exactly cover this missing information and to lighten the unknown behind the numbers. The main objective is to analyse the relationship between companies and their employers (managers of funds). Lower sensitivity of pay to manager level assets under management is one major finding in their paper. Moreover, a weak sensitivity between pay to performance was found.

As a result, their paper shows a concave relationship between fund managers pay and revenue relation. But to their own surprise, they found out weak sensitivity of pay to performance, even

after accounting for the indirect effects of performance on revenue. The main information gain of their paper, regarding the research activity into German equity funds, is definitively the weak sensitivity of pay of performance Regarding Paper #3 a mismatch of information is visible. It is said that high pay is connected to high performance. Performance fees are paid according to the additional gain of an investment and a percentage is paid according to the additional gain. Furthermore, the concave relationship of payment and revenue shows the motivation of generating high gains which could lead to riskier investments motivation underlining the assumptions of Paper #5.

The findings support the hypothesis that the average alpha of German equity mutual funds should be higher than the best-fit-alpha.

Paper 5# (Lunde, Timmermann, & Blake, 1999)

In this paper Asger Lunde, Allan Timmermann and David Blake investigate mutual funds regarding their conditional probability of closure, i.e. their hazard function. With a large sample panel of mutual funds, they investigate the factors which influence the process governing the termination of funds. Data from the UK was used, covering the period from 1972 to 1995. The numbers of dead and surviving funds are 973 and 1402, respectively. Bearing this in mind, we can say that the sample provides enough data to determine essential information about duration dependence of fund closures, as indicated by the shape of the mutual fund hazard function, hazard rate dependence on common and fund specific factors on the fund survivor function.

Furthermore, their paper relies on their theory and recent studies, which have found sizeable survivorship bias associated with the underperformance required of the specific attributes of size and nature of survivorship bias. The average time of survival of a fund and the relationship between its abnormal performance and the probability of closure affects the size of the survivorship bias. Their paper lightens up this matter. Nevertheless, I think it would be more valuable if they shed light on the particular fund survivorship and not closure, as this would be more interesting and informative. One further criticism is their measurement of the duration profile of mutual funds. It is important for understanding the incentives under which fund managers operate.

“If these funds are generally closed down after only a very short period, then fund managers can be expected to be under significant pressure to perform in the short run. This might give the fund managers a strong incentive to follow ‘short-term’ investment strategies. “

Here one could absolutely agree with the proven assumptions, as the result would accurately lead to their prediction. In a profound research, they found out that young and very old funds are least likely to be closed down. Additionally, the relative performance and return of a fund specifically reflects the probability of a closure. Thus, it is interesting to examine the dependence of closing a fund due to its performance and/or return relation.

Furthermore, implementing the survivorship function generated by Lunde, Timmermann and Blake indicates a proportion of funds that survive up to a given age and they identified the effect of fund attribution to standard measures of persistence of fund performance. The findings in this paper could enhance the research regarding the German equity funds market as funds are also dying in relation to their performance. The consideration of choosing young and old funds is important as far as both are likely to survive in the timeframe of the ongoing paper. Unfortunately, the survivorship bias was ignored in the research of German mutual funds and therefore the findings in the paper of Lune and others (1999) is less relevant to further studies.

Paper 6# (Cremers, Petajisto, & Zitzewitz, 2012)

In this paper Martijn Cremers, Antti Petajisto and Eric Zitzewitz investigated the alpha performance based on disproportionate weight of Fama-French factors which can give valuable benefits to the research done in this paper. They take the commonly known Fama-French and Carhart model, which is statistically significantly proven for generating nonzero alphas, even for passive benchmark indices such as S&P 500 and Russel 2000. In their opinion alphas primarily arise from investments in small value stocks which have performed well in their point of view. They change the small methodological fragments in order to get rid of nonzero alphas and additionally propose factor models based on common and tradeable benchmark indices.

Fama and French already constructed a very profound methodology, which provides explainable and - more importantly - significant nonzero alpha results. However, the research provides more essential information for the thesis, as they indeed generated higher performances for portfolios. Financiers and investors mainly pay attention to fund returns to the benchmark indices, but in contrast, academics use the Carhart four-factor model and the known Fama and French three-factor model as the standard benchmark. Their paper shows evidence that practitioner's and academic approaches can generate differing returns. This is mainly due to the fact that the academic approach assigns large nonzero alphas for a long time period to passive benchmark indices. To illustrate this matter, they took the returns of S&P 500 with dividends on the Carhart four-factor model and generated a statistically significant (t=2.78) of 0.82% over their sample period from 1980 to 2005. This time period is a very common time frame to analyse mutual funds in the industry, because of its accuracy of data and few market corrections. For the Russel 200 annual alpha they found a statistically significant alpha of -2.41%. Thus, a portfolio shorting Russel 200 and long S&P 500 has an astonishing annual alpha of 5.23%.

Russel 200 and long S&P 500 are the most commonly used benchmarks in the industry covering about 85% of the U.S. equity market value. Nevertheless, these benchmark indices portfolio show a well-diversified passive portfolio, that should actually have zero abnormal returns or alphas as they represent the portfolios themselves for example, taken an ETF (Exchange Traded Fund) into account.

Paper 7# (Amihud & Goyenko, 2013)

In this paper, published by Oxford University Press and written by Yakov Amihud and Ruslan Goyenko, the authors investigate the dependency of R^2 and fund performance.

According to recent studies, fund performance is positively affected by active management if one takes deviation from a diversified benchmark portfolio into account. For many investors it is difficult to obtain and calculate the measurement of actively managed funds as the composition of these funds is rather complicated for the knowledge of an average investor. Amihud and Goyenko's paper provides additional information about the unclearly specified benchmark picking process and fills in some gaps from Paper #2.

The authors propose an alternative, which is easily calculable and understandable for all parties, especially for the active managed mutual fund, which is termed selectively. They explain this measurement with the R^2 of the fund, which is a proportion of the fund return variance. Thus, higher R^2 implicates the track of the fund is closer to the associated benchmark. As a result, they found out that higher R^2 indicates a bigger selectivity and it significantly predicts better performance. However, they also figured out that stock funds sorted into lowest quintile lagged R^2 and highest quintile lagged alpha produce significant annual alpha of 3.8%. Across all the funds, Yakow and Ruslan found out that R^2 is positively associated with corresponding fund size and negatively associating with its expenses and manager's tenure.

Paper 8# (Cremers, Petajisto, & Zitzewitz, 2012)

This paper written by Martijn Cremers and Antti Petajisto can provide valuable information for this master thesis by analysing the German market mutual funds with the findings discovered, as the authors introduce a new measure of Active Share. It mainly describes a part of the portfolio holdings which is different from the portfolio's benchmark index. They use two dimensions to explain the active management of a portfolio by using their Active Share part and the tracking error. The tracking error is the difference in variance of a benchmark and its portfolio, and it should be low for ETF's, as they try to follow a benchmark as closely as possible. For mutual funds therefore the tracking error should desirably be lower while generating higher returns, which is rather difficult as in theory higher return goes hand in hand with higher risk and therefore standard deviation. Their two dimensions are allocated to the universe of all equity mutual funds to characterize how much and what type of active management they chose. They also test the relation between active management and fund size, expenses, turnover in cross-section and they investigate the evolution of actively managed mutual funds for a certain time period.

They found out that funds with high Active Share significantly outperform their benchmark indices before and after expenses, while the index funds with the lowest Active Share underperform. In addition to this, the most active stock pickers tend to create value for investors while factor bets and closet indexing rather generate losses. Comparing with Paper #3 we can clearly see a mismatch

as Paper #3 claims an on average worse performance of mutual funds comparing to the benchmark. Here further investigation is definitively needed to clarify the circumstances for the master thesis. Although the research is not going to rely specifically on this contradiction, further studies on the approach have to be made to improve the research material. Furthermore, the paper by Cremers and Petajisto proves valuable especially by choosing which funds are relevant or not for a benchmark comparison regarding their returns.

Paper 9# (Bhattacharya, Loos, Meyer, & Hackethal, 2017)

This paper investigated whether ETFs in Germany generated reasonable returns in the timeframe of 2005 to 2010. They claim that it would have been better not to trade ETFs in this case.

In my opinion, it is absolutely necessary to trade ETFs both with a high-volume trade per day and enough volume in terms of number of shares. In the US one can find well diversified ETFs which are highly traded, such as VOO, SPY, QQQ or GLD (Gold ETF). The low liquidity of ETFs in the German market is present and this in mind one cannot compare an ETF like SPY to a German ETF building the S&P 500. Liquidity is also connected with low transaction costs, which means that high liquidity results in low transaction costs. Mr. Mongelli claims that buying and selling at the wrong time results in negative returns.

Firstly, 2008 was not the best time to trade stocks and ETFs for the short term as we experienced a financial crisis during that year. Secondly and far more importantly, ETFs are constructed for a rather long-term investment and not for short-term investments. Trading strategies such as relying on the news or other trading signals are not appropriate, especially day trading. ETFs tracking industries or countries are even exposed to lower liquidity, which makes the results even worse and is described as detrimental behaviour of investors.

3. Methods and Data Description

3.1 Data

3.1.1 Equity Funds and Benchmarks

The time frame for observations is retrieved between August 2001 and February 2020 from the Thomson Reuters database (Datastream, 2020). The data includes all funds and indices that were active at any point during the period and all returns are extracted in monthly frequency.

The library of Thomson Reuters Datastream provided over 3000 mutual funds domiciled in Germany, but looking at the data more closely, it was noticeable that many of them had missing values. The timeframe between 2001 and 2020 was chosen because the Euro was officially launched in 1999 (Bertaut & Iyigun, 1999) and therefore, it made sense to choose funds with the base currency in Euro and 19 years should be a sufficient time frame to gather observations. In addition to this, it was absolutely necessary to have as little blank data as possible, this is why most funds were excluded from the research and outliers were not taken into consideration either in order to provide clean analysis. This resulted in 122 equity funds (See Appendix A), 257 indices (See Appendix B) and 222 observations for each index and equity fund shown as monthly returns. Fortunately, Datastream shows the benchmark and fund monthly returns simultaneously, while providing the International Securities Identification Number (ISIN). On the other hand, the benchmark names are not displayed as desired, but the fund names with the additional addon of "PRICE INDEX" were available. This was a problem the research was confronted with during the examination of benchmark returns. Transferring the returns into an excel-sheet was therefore challenging. For example, the equity fund named: "DEKA AKTIENFONDS RHEIN EDITION GLOBAL" has the corresponding benchmark named "DEKA AKTIENFONDS RHEIN EDITION GLOBAL - PRICE INDEX" in Datastream excel extraction. Favourably, the benchmark name would have been suitable instead of adding the addon "PRICE INDEX" in the end of a description. However, through the ISIN code it is easily discovered which benchmark corresponds to the equity fund. Technical Indicator Benchmarks are also available in Datastream, but they do not correspond to the real benchmark chosen by the fund manager nor do they have available observations. This is why Technical Indictor Benchmarks were excluded for the research in this paper. Nevertheless, for the top benchmarks in the results a manual edit was necessary, which did not take too much

time. Secondly, the information of benchmark name was not needed for the calculations in this paper, as the research is based on other necessities. I will make further clarifications referring to necessities in the methodology section.

3.1.2 Risk-Free Rate

The Euro Interbank Offered Rate (Euribor) is retrieved from the European Money Markets Institute short EMMI (EURIBOR®, 2020) . The Euribor is the interest rate benchmark authorized by the EU Benchmark Regulation and therefore a representative risk-free rate for the methodology in this paper. In addition to this, the Euribor is declared by the European Commission (Orangeisblue, 2020) to be one of the most important interest rates benchmark in the entire world. As the returns of the month are in monthly frequency, the following calculations in this paper also use the risk free rate on a monthly basis. The main difficulty in extracting the correct data from the website was that the monthly returns were inconveniently presented in excel-files from the year 2001-2008. With manual work the data were retrievable, but only with additional effort through hundreds of clicks. From 2008-2020 the data exist in a good structure and users can easily choose from tenors of 1week, 1 month, 3 month, 6 month and 12 month rate (Orangeisblue, 2020). The calculation of the Euribor has a hybrid methodology, which is not further discussed in this paper, as it would exceed the purpose of the work. A list of the monthly risk-free rates is provided in Appendix G.

3.2 Methodology

3.2.1 Best-fit-alpha

This paper defines the best-fit-alpha a^* as the alpha calculated through the fund-index pair with the highest R^2. The alpha equals the intercept from the time-series regression and illustrates the risk adjusted return. Here the formula of Jensen's Alpha (Jensen, 1967) is used as a reminder from the introduction part:

$$R_{f,t} - R_{RF,t} = a^*_{f,i} + \beta_{f,i}(R_{i,t} - R_{RF,t})$$

where

$R_{f,t}$ = Realized return on fund f in time t
$R_{RF,t}$ = Risk free rate in time t
$R_{i,t}$ = Market return on index i in time t
$a^*_{i,t}$ = Best-fit-alpha
$\beta_{f,i}$ = Beta

In order to calculate the variables, the following definition was made to include the calculation in an econometrics software. For this master thesis R-Studio was used:

Dependent variable = $R_{f,t} - R_{RF,t}$
Independent variable = $R_{i,t} - R_{RF,t}$
Intercept = $a^*_{f,i}$

3.2.2 Managers alpha

The managers alpha, defined in this paper as a^M, is the calculated alpha through regression with the benchmark chosen by the manager and is also calculated through the formula above.

3.2.3 Approach

Firstly, a time-series regression has to be run (2001-2020) for all funds (122) with all indices (257)

monthly returns, this resulted in 122x257 = 31'354 regressions. For this execution the statistical language program R-Studio was chosen. The complexity to run such a number of regressions was heavy for STATA software and also problems appeared while uploading and working with the complexity of methodology at the very beginning.

A code had to be developed including a loop, which executes a time-series regression of each fund with each index, while calculating the maximum of R^2 (MAXR2) and alpha. To understand the mechanics, please see the following output example:

- Fund1 regressed with benchmark1 provides a R^2 of 0.91 and alpha of 0.044
- Fund1 regressed with benchmark2 provides a R^2 of 0.95 and alpha of -0.055
- Fund1 regressed with benchmark53 provides a R^2 of 0.89 and alpha of 0.012
- Fund1 regressed with benchmark257 provides a R^2 of 0.88 and alpha of -0.0065

  Here we choose benchmark2 with R^2 of 0.95 as best-fit-benchmark and therefore best-fit-alpha would be a^* = -0.055.

These mechanics also have to be executed for Fund2, Fund3, Fund… and Fund122 in order to have the best-fit-alpha for all funds. To do so, the code in Appendix C was used.

The preview results are given in the following information table 1:

Table 1: Equity Fund and Benchmark fitting through MAXR2

Equity Fund	**Benchmark**	**MAXR2**	a^*
AXA.CHANCE.INVEST.A	AXA.CHANCE.INVEST.A.-.PRICE.INDEX	0.9141	-0.0007
AXA.DEFENSIV.INVEST.A.EUR	AXA.DEFENSIV.INVEST.A.EUR.-.PRICE.INDEX	0.9659	-0.0003
AXA.INV.MGRS.DTL.EUPA.	AXA.INV.MGRS.DTL.EUPA..-.PRICE.INDEX	0.9034	-0.0014
AXA.INV.MGRS.DTL.WELT	AXA.INV.MGRS.DTL.WELT.-.PRICE.INDEX	0.9169	-0.0011
AMUNDI.GERMAN.EQUITY.A.ND	AMUNDI.GERMAN.EQUITY.A.ND.-.PRICE.INDEX	0.9001	-0.0011
AMPEGA.RENDITE.RENTENFONDS	AMPEGA.UNTERNEHMENS.-.PRICE.INDEX	0.9512	-0.0014
DWS.AKKUMULA.LC	DWS.AKKUMULA.LC.-.PRICE.INDEX	0.9049	-0.0010
DIT.ALLIANZ.AKTIEN.EUROPA	DIT.ALLIANZ.AKTIEN.EUROPA.-.PRICE.INDEX	0.8953	-0.0014

In table 1, one can see that only “AMPEGA RENDITE RENTEFONDS” has a different benchmark chosen through a higher R^2 (MAXR2) result. Here the benchmark from “AMPEGA UNTERNEHMENS” fund has a more suitable benchmark.

After the regression function the results will show two benchmarks for each fund. One benchmark which has been chosen by the fund manager and one which will be defined as a best-fit-solution for the fund through R^2. It may happen that the manager selected benchmark equals the best-fit benchmark as listed in table 1 preview.

In a second step, two things must be undertaken simultaneously: (A) a time-series regression for all funds with the highest R^2 resulted Index from step one resulting in 122 regressions must be run again AND (B) a time-series regression for all funds with their already chosen benchmark by the fund manager has to be made. This will also result in 122 regressions, in order to calculate alpha equally with the formula listed above. For this step the code in Appendix D was used.

Here it is important to see the difference in alpha between regression (A) and (B) for each fund. The hypothesis maintains that (B) regressions should result in an average of higher value of alpha than in (A). A clear overview illustrates this in the results section of this paper.

4. Results and Analysis

In the following section, I am going to present the results of the above mentioned methodology and approach. Firstly, a brief summary of the benchmark involved is going to be provided. Secondly, the results regarding best-fit-alpha and mangers alpha is presented in detail.

4.1 Benchmark

The benchmark universe used in this paper includes 257 benchmarks, which are limited to 117 different benchmarks, as some funds are compared to the same benchmark. A total number of 50 funds have a different best-fit-alpha from managers alpha, keeping this in mind, one can see in the following table 2 the ranking of how often a benchmark was selected. It is quite obvious that the majority of funds chose the MSCI Europe NR benchmark as the best-fit-index. The fund name and fund ISIN is just an example in the table below. There are several other funds with different ISIN numbers that have the benchmark shown. As mentioned in the data section, the benchmark has to be looked up manually in Datastream as the extraction of benchmark names within the returns is not compatible with Datastream.

It is not explainable why the MSCI Europe NR was chosen 26 times. One would rather choose DAX 30 TR as mostly chosen index, because it represents the German market with higher accuracy, meaning the DAX 30 includes the 30 biggest companies according to their market capitalization (Rachev, Hoechstoetter, & Fabozzi, 2005). Therefore, it makes sense that the DAX 3 comes in second. On the third place with 5 MAXR2 the MSCI ACWI NR was chosen. This is either pure luck or evidence of spurious regression, but to analyze this in particular would go beyond the scope of this paper and it is of no further relevance.

Table 2: Most used Benchmarks

Fund ISIN	Amount	Fund example	Benchmark
DE000A2PF0G6	26	DIVIDENDE.UND.SENTIMENT.AKTIEN.EUROPA(I)	MSCI Europe NR
DE0009754119	8	MEAG.PRO.INVEST.A.-.PRICE.INDEX	DAX 30 TR
DE0005547160	5	OPPENHEIM.KPL.ADVISOR.GLOBAL.-.PRICE.INDEX	MSCI ACWI NR

4.2 Equity funds alpha

In order to compare the alpha resulting from funds which have a different benchmark suggested through MAXR2, the steps described in the methodology section have been taken. In this section the results are defined through managers alpha and best-fit-alpha:

Table 3: List of important abbreviations

Abbreviations	
Form	**Meaning**
a^*	Best-fit-Alpha
a^M	Managers Alpha
$E(a^* < a^M)$	Average Managers Alpha
$E(a^* > a^M)$	Average Best-fit-Alpha

Out of the selected 122 equity mutual funds domiciled Germany, a total of 72 have the same benchmark output though MAXR2 as the fund selected benchmark. Those 72 funds are of no further interest for the analysis even though they make up the majority of funds in the sample. They represent 59 % of our sample to be exact. Conversely, there are 50 (17+33) resulting funds which have a different benchmark calculated MAXR2 output. It is important to see that the number of $a^* > a^M$ is higher than $a^* < a^M$, which is a surprising result compared to other papers such as research done in the Norwegian market (Bukhvalova, 2017) or the United Kingdom equity fund market, which also has a higher generated alpha through manager benchmark picking behavior (Mateus, Cesario, & Natasa, 2016).

4.2.1 Results long-term

Table 4: Amount of funds distribution

Amount of Funds		
$a^* < a^M$	$a^* > a^M$	$a^* = a^M$
17	33	72

To be exact, 33 fund managers have chosen benchmarks which generate a lower alpha than its corresponding alpha compared with MAXR2 calculation. In addition to this, 17 fund managers

have chosen benchmarks which generated an alpha higher than the best-fit-alpha. Here we can already make our first assumption, namely that fund managers do not tend to choose benchmarks which generate higher alpha in the German equity mutual funds market. Only 17 managers chose to take a benchmark which generates higher alpha than the best-fit-alpha. Studies have shown that fund managers actually do the exact opposite. In the US, thorough benchmark picking behavior was a finding of studies established by Jakob Keith during his research for value and growth indices (Keith, 2011).

Table 5: Average Alphas

Average Alphas (%)	
$E(a^* < a^M)$	$E(a^* > a^M)$
0.9883	1.7039

On average we have a return on equity funds of about 0.9883% from the 17 fund samples and 1.7039% from the 33 funds as seen in table 5 above. To see the returns please consult Appendix D and Appendix E. Additionally, equity funds that chose a benchmark with a higher alpha than the best-fit-alpha overtake the risk-adjusted performance by 0.9883% on average. Therefore, it can be said that the hypothesis of this paper is not true, while taking the econometrical approach of this paper into consideration.

German equity funds manager alpha a^M is on average **not** higher than the best-fit-alpha a^*.

Thus, mutual equity funds domiciled in Germany have on average a 0.7886% higher best-fit-alpha performance a^* than a fund manager selected alpha a^M. This can be calculated through the following equation:

$$\frac{(1.7039\% * 33) - (0.9883\% * 17)}{33 + 17} = 0.7886\%$$

4.3 Validity

4.3.1 Internal Validity

Regarding the internal validity of the research done in this paper, there are only few logic gaps in the problem statement. It might have been useful to include fixed income in the research and an overall analysis, which provides results through equity funds and fixed income combined. The causal relationship justification is given through the logical correlation between a benchmark and the performance of an equity fund.

Furthermore, the research model is explicit and clear, as the formulas, the calculations and the methods used are already known from previous studies. This paper simply combined know-how to generate results scaling fund manager skills which have not been analyzed in the German market before.

4.3.2 External Validity

Regarding the external validity of the research done, a solid generalization was established. In this paper a clearly defined scope is postulated in the data section. The focus is exclusively on the German equity fund market and the industry only takes products from financial institutions or companies into consideration which are able to create and distribute funds domiciled in Germany under Markets in Financial Instruments Directive (MiFID II) jurisdictions.

The time period specifications possess a profound justification regarding why and how this paper focused on them. In the data section I clearly described which sources the data comes from and why the time frame from 2001–2020 was chosen. Even if the crisis of 2008 influenced the equity market dramatically, the funds and benchmark performance are independent, as we are interested in the relationship between equity funds and benchmarks. In a crisis the benchmark goes through a recession, but so does the equity fund. A fund manager tries to restrict the losses with skills as well as possible, but the losses remain as the fund is holding to a certain industry. No matter what a fund manager does in this case, if a whole market performs negatively, the mutual funds hardly ever perform in the opposite direction. Only survivorship bias can be argued in this manner

The market is of average volatile in general as Germany is a first world country. Therefore, the results provide higher accuracy than those I would have received had I taken emerging markets into consideration. In comparison to the emerging market, equity funds show a higher volatility in general as described by Halil and Koray in their paper about the performance of US-based emerging market mutual funds (Halil & Koray, 2017).

4.3.3 Measurement

One can argue that the research does not have the lowest-error data in terms of number of benchmarks as stated above. Moreover, the returns are calculated as net returns. This is done in view of the fact that the cost structures of funds differ, as some for example include performance fees and others do not. This paper works with net returns, because it makes sense to eliminate the different cost structures behind the gross return. Supposing funds had been calculated with gross returns, the research approach would have had to be different in as far as the funds might generate different changes in alpha. This is why the costs connected to the funds and the transaction costs are ignored to simplify circumstances. Regarding the variables there is no evidence of failure. The variables used in this paper are widely known and there is no room for doubts. Variables collected in the data section of this paper are also used in several scientific papers published in the journals of finance and economics. Already in the times of Fama and French these variables were used in three factor models (Fama & French, 1992) for example.

4.4 Reliability

Regarding the consistency of the data in this paper, the majority of data can be used in different papers as well. Returns from 2001-2020 are the same in different data bases, which are different from Datastream. For example, Bloomberg has the same data available, but the selection might be wider. Instead of 122 equity funds domiciled in Germany this paper could have analyzed data with more funds and - far more important - a higher number of indices might have been available. Even if 122 equity funds can provide fundamental analysis, the higher amount of data mostly leads to a higher accuracy of results. Therefore, sources such as Bloomberg or Morningstar would have been an additional approach. Unfortunately, these sources are available only on subscription basis, which exceeds the financial resources of this master thesis.

The findings in this paper can surely be used for further studies in the German market and generate additional value creation for the German equity market. The inclusion of fixed income might be an appropriate path to go in future research activities, and a reasonable analysis of fixed income and equity funds together would certainly be a meaningful research benefit to gather further valuable information.

Moreover, the survivorship bias is totally ignored in this paper, which can also lead to misinterpretation of the results. This might be a basis to start further investigations from, which take the factor of survivorship bias into consideration. This is important, since mutual funds might have disappeared during the periods of 2001-2020, due to bankruptcy. These funds are not at all included in this paper. This paper includes only funds with the observations given during the time frame of 2001-2020. This would be of interest in order to prove the persistence of mutual funds in the German market as researchers did in the UK market (Kenourgios, Kenourgios, & Petropoulos, 2004).

5. Discussion and Suggestions for further studies

As shown in the results, German mutual equity funds manager alpha a^M is on average not higher than the best-fit-alpha. The hypothesis of this master thesis is therefore refused and answered with a clear negative response. This rises the discussion of how accurate the approach of this master thesis was according to research standards of today.

In this section the final results are discussed, how accurate they are and to what extent they are representative. First of all, the one factor model CAPM is a simplified version to calculate the expected returns. An extension to the three factor model of Fama and French (Fama & French, 1992), would have possibly provided rather more accurate results, which could have given brought information about the analysis. The returns would have been insofar different as the Small minus Big (size premium) and High minus Low (value premium) variables would have been included. In the research of Fama and French (Fama & French, 1996), they proved the consistency of the additional factors on a statistically significant basis. The size premium underlines the performance of a portfolio providing better results, if small capitalized stocks are included. The CAPM model, written by Sharp (Sharpe, 1964) is therefore underestimating the power of small capitalized companies in the market. Moreover, the performance of a portfolio with a large amount of small capitalized stocks would seem to provide a weaker performance as they actually do in the CAPM model. In addition to this, the value premium defines, that the same analogy to the size premium, that value stocks are outperforming growth stocks. This means, that the performance of a portfolio with a large amount of value stocks would seem to provide a weaker performance as they actually do in the CAPM model. The reason why the three factor model was not used in this master thesis was to simplify circumstances, in order to see if further studies should be taken into consideration.

An additional feature would be the usage of the four factor model by Carhart (Carhart, 1997), which is also significant by using the momentum as an additional factor to the Fama and French model. This might be a motivation for further studies in the German market. The comparison of results would certainly provide useful information about the German equity fund market and the accuracy of best-fit-alpha and managers alpha could be even more accurate, than they already are.

Moreover, the survivorship bias is completely ignored in this paper, which leaves further study opportunities in the German equity funds market. Only funds which survived throughout the time frame of observations have been taken into consideration. A paper written Martin Rohleder and others provides fundamental information in which sense the data could have been handled in this master thesis. Including the survivorship bias has the advantage that bankruptcies of mutual funds are also taken into consideration and not only funds which provide observations in the specified time frame (Rohleder, Scholz, & Wilkens, 2010).

The condition of spurious regression is also a problem in this master thesis. Thorough analyzing of the matched best-fit-pair through R^2 does not always provide a reasonable pair of funds and benchmarks. The pairing might be incorrect, for example, if a DAX 30 equity fund has a best-fit match with an index for a small-cap industry in Japan. Spurious regression might be a problem regarding this match and has to be analyzed as claimed by Wayne Ferson and others (Sarkissian, Sim, & Ferson, 2003).

Furthermore, the data base of Morningstar would have provided results with higher significance. A comparison with benchmarks chosen from the Morningstar data base would have provided further numbers of benchmarks to include in the analysis of German equity mutual funds. The differentiation of three benchmarks would either justify the conclusion or provide a mismatch of the data, which would explain the little explanatory power of the research as shown by Bukhvalova (Bukhvalova, 2017). In addition to this, a supplementary risk-free rate would have had the same effect. Morningstar suggests different risk-free rates in some cases, but unfortunately the data of Morningstar benchmarks and risk-free rates are available on a paying basis only.

The benchmark universe in this paper reaches a number of 257 including only 117 different benchmarks, which also weakens the result power. A higher amount of data would have been appropriate and also a higher number of mutual equity funds, as best-fit-alpha only provided a sample of 50 equity mutual funds.

As a last point of results criticism, further research approaches using total returns might lead to different alpha results. This comparison would have been useful to show differentiation of amounts in table 4 in this thesis. Datastream provided sufficient data regarding net returns, whereas total returns of equity mutual funds were not always or not at all available to export to the software.

5.1 Managerial Implications

This thesis mainly helps investors to navigate their investment strategy in the German equity mutual funds market with reliable and transparent information. For an investor interested in a certain mutual fund, several factors influence investment decisions. Fundamental analysis, technical analysis and investors awareness are important factors in the decision-making process. One of these fundamental factors is the alpha of a mutual equity fund. This paper may also provide a starting point for further research into the field of individual investors protection for policy makers in the financial market. Regulations such as the Markets in Financial Instruments Directive MiFID II can use the findings to evaluate future implementation. The protection of individual retail customers should be the focus, and the awareness of retail customers regarding transparency of alphas should be clear to fund managers benchmark picking behavior.

6. Conclusion

To conclude, German equity mutual funds have on average a smaller managers' alpha than best-fit-alpha. A total number of 122 funds were observed and 50 out of 122 funds have a different better fitting benchmark with higher explanatory power when taking R^2 into consideration. Analyzing the chosen 50 funds led to the conclusion, that 33 funds have a best-fit-alpha higher than managers' alpha containing an expected return of 1.7039 % for the time frame 2001-2020. Conversely, 17 funds have a managers' alpha higher than the best-fit-alpha providing an expected return of 0.9883% for all 222 observations in each fund. Thus, mutual equity funds domiciled in Germany have on average a 0.7886% higher best-fit-alpha performance a^*, than a fund manager selected alpha a^M.

Therefore best-fit-alphas are not only higher in number of funds, but also provide a higher expected return, which gives us the answer to the hypothesis. German equity mutual funds have on average a smaller managers' alpha than best-fit-alpha with the methodology used in this paper. Therefore, honest benchmark picking behavior of German equity mutual funds managers is proven, if we base the assumptions on the thesis in this paper. Furthermore, equity funds that chose a benchmark with a higher alpha than the best-fit-alpha overtake the risk-adjusted performance by 0.9883% on average.

Nevertheless, different approaches might provide other results as certain constraints are not taken into consideration. The research in this paper is taken under arguable assumptions, which leads to discussions about the methodology. Therefore, this thesis does not provide final results, but rather works out fundamental research activities, which can be used for further investigations.

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Appendix

Appendix A

(Datastream, 2020)

No.	Equity Fund	ISIN Code
1	AXA Chance Invest A	DE0009789453
2	AXA Defensiv Invest A EUR	DE0009789438
3	AXA Europa	DE0009775643
4	AXA Welt	DE0008471376
5	ACATIS AKTIEN GLOBAL FONDS A	DE0009781740
6	Amundi German Equity A ND	DE0009752303
7	Amundi Top World	DE0009779736
8	Allianz Adiverba - A - EUR	DE0008471061
9	DWS Akkumula LC	DE0008474024
10	Allianz Aktien Europa - A - EUR	DE0008471483
11	Allianz Wachstum Euroland - A - EUR	DE0009789842
12	AL Trust Aktien Europa	DE0008471764
13	AriDeka CF	DE0008474511
14	DWS Concept DJE Globale Aktien	DE0009777003
15	Barmenia Renditefonds DWS	DE0008474248
16	Deka-Deutschland Aktien Strategie	DE0008479288
17	Deka-Europa Aktien Strategie	DE0008479247
18	SEB Aktienfonds	DE0008473471
19	Postbank Europa P	DE0009770289
20	Concentra - A - EUR	DE0008475005
21	Amundi Euroaktien	DE0009792143
22	Deka-Europa Potential CF	DE0009786277
23	Deka-EuropaSelect CF	DE0009786186
24	Deka-Schweiz	DE0009762864
25	DekaFonds CF	DE0008474503
26	DekaSpezial CF	DE0008474669
27	Allianz Euro Rentenfonds >>K<< A EUR	DE0008475187
28	ODDO BHF Algo Global CRw-EUR	DE0009772988
29	Allianz Geldmarktfonds Spezial - A - EUR	DE0008476276
30	Allianz Fonds Japan - A - EUR	DE0008475112
31	DWS Vermoegensbildungsfonds I LD	DE0008476524
32	DWS Euro Bond Fund LD	DE0008476516
33	DWS Emerging Markets Typ O	DE0009773010
34	DWS Aktien Strategie Deutschland LC	DE0009769869
35	DWS Biotech LC	DE0009769976
36	DWS German Equities Typ O	DE0008474289
37	DWS Deutschland LC	DE0008490962
38	DWS Financials Typ O	DE0009769919
39	DWS Internationale Renten Typ O	DE0009769703
40	DWS US Growth	DE0008490897
41	DWS Health Care Typ 0 NC	DE0009769851
42	DWS Telemedia Typ O	DE0008474214
43	DWS Global Natural Resources Equity Typ O	DE0008474123
44	DWS Technology Typ O ND	DE0008474149
45	DWS Eurovesta	DE0008490848
46	FMM-Fonds	DE0008478116
47	Invesco Umwelt und Nachhaltigkeitsfonds	DE0008470477
48	Frankfurter-Sparinvest Deka	DE0008480732
49	ODDO BHF Money Market CR-EUR	DE0009770206
50	ODDO BHF EURO Short Term Bond FT CR-EUR	DE0008478124
51	ODDO BHF Algo Europe CRw-EUR	DE0008478181
52	ODDO BHF Frankfurt-Effekten-Fonds DR-EUR	DE0008478058
53	Ampega Global Rentenfonds	DE0008481086
54	Ampega Global Aktienfonds	DE0009847301
55	Ampega Rendite Rentenfonds	DE0008481052
56	GWP-Fonds FT	DE0008478199
57	HANSAeuropa Class A	DE0008479155
58	MEAG ProInvest A	DE0009754119

No.	Equity Fund	ISIN Code
59	Invesco Europa Core Aktienfonds	DE0008470337
60	Invesco Global Dynamik Fonds	DE0008470469
61	Invest Global	DE0009757922
62	DWS ESG Investa LD	DE0008474008
63	TBF GLOBAL VALUE EUR R	DE0009781633
64	Ampega Unternehmensanleihenfonds EUR	DE0008481078
65	Deka Aktienfonds RheinEdition Global	DE0009786129
66	Deka Aktienfonds RheinEdition P	DE0008480674
67	LEA-Fonds DWS	DE0009769992
68	LIGA-Pax-Aktien-Union	DE0009750216
69	LINGOHR-SYSTEMATIC-NVEST	DE0009774794
70	Nomura Asia Pacific Fonds	DE0008484072
71	Metzler Aktien Deutschland AR	DE0009752238
72	Metzler Aktien Europa AR	DE0009752220
73	Metzler Euro Renten Defensiv	DE0009761684
74	Metzler Wachstum International	DE0009752253
75	G&W - HDAX - TRENDFONDS	DE0009765446
76	DWS Qi Eurozone Equity RC	DE0009778563
77	TBF EUROPEAN OPPORTUNITIES EUR R	DE0009781989
78	DWS European Opportunities LD	DE0008474156
79	VPV-Spezial Amundi A DA EUR	DE0008480468
80	Basler-Aktienfonds DWS	DE0008474057
81	Basler-Rentenfonds DWS	DE0008474065
82	Siemens Euroinvest Renten	DE0009772590
83	UBS (D) Equity Fund - Global Opportunity	DE0008488214
84	UBS (D) Equity Fund - Smaller German Companies	DE0009751651
85	UBS (D) Aktienfonds - Special I Deutschland	DE0008488206
86	Acatis Asia Pacific Plus Fonds	DE0005320303
87	UBS (D) Konzeptfonds Europe Plus	DE0005320329
88	DWS Top Asien LC	DE0009769760
89	DWS Top Europe LD	DE0009769729

No.	Equity Fund	ISIN Code
90	DWS Top World	DE0009769794
91	TRENDCONCEPT-UNIVERSAL-FONDS-AKTIEN-EUROPA	DE0009781773
92	HSBC German Equity	DE0008489808
93	HSBC Euro Credit Non-Financial Bond AC	DE0005152003
94	HSBC Sector Rotation	DE0009756825
95	UBS (D) Rent-Euro	DE0009752501
96	Uni21. Jahrhundert -net-	DE0009757872
97	UniDeutschland	DE0009750117
98	UniEuroAktien	DE0009757740
99	UniEuropa -net-	DE0009750232
100	UniEuropaRenta -net-	DE0009750240
101	UniFonds	DE0008491002
102	UniFonds -net-	DE0009750208
103	UniGlobal	DE0008491051
104	UniGlobal -net-	DE0009750273
105	UniJapan	DE0009750125
106	UniNordamerika	DE0009750075
107	UnionGeldmarktFonds	DE0009750133
108	WM AKTIEN GLOBAL UI-FONDS B	DE0009790758
109	terrAssisi Aktien I AMI P(a)	DE0009847343
110	KCD-Union Nachhaltig AKTIEN MinRisk	DE0005326532
111	Monega Germany	DE0005321038
112	Monega Euroland	DE0005321053
113	Monega Euro-Bond	DE0005321061
114	UniSelection: Global I	DE0005326789
115	Deka-MegaTrends CF	DE0005152706
116	Ve-RI Listed Infrastructure (R)	DE0009763342
117	Postbank Megatrend	DE0005317374
118	Degussa Aktien Universal-Fonds	DE0005316988
119	First Private Europa Aktien ULM A	DE0009795831
120	First Private Euro Dividenden STAUFER A	DE0009779611
121	DWS Nomura Japan Growth LC	DE0008490954
122	Ve-RI Equities Europe (R)	DE0009763201

Appendix B

(Datastream, 2020)

No.	Fund Manager Benchmark	ISIN Code
1	MSCI World TR EUR	DE0009789453
2	ICE BofA 1-5 Y Euro Broad Market TR EUR	DE0009789438
3	MSCI Europe TR EUR	DE0009775643
4	MSCI World TR EUR	DE0008471376
5	MSCI World TR EUR	DE0009781740
6	CDAX TR	DE0009752303
7	MSCI World TR EUR	DE0009779736
8	MSCI World/Financials TR	DE0008471061
9	MSCI World NR EUR	DE0008474024
10	MSCI Europe TR EUR	DE0008471483
11	S&P EuroZone LargeMidCap Growth TR EUR	DE0009789842
12	MSCI EMU Large Cap TR	DE0008471764
13	MSCI Europe TR EUR	DE0008474511
14	MSCI World CR EUR	DE0009777003
15	REXP TR	DE0008474248
16	HDAX TR	DE0008479288
17	MSCI Europe NR EUR	DE0008479247
18	DAX 30 TR	DE0008473471
19	EURO STOXX 50 NR EUR	DE0009770289
20	DAX 30 TR	DE0008475005
21	EURO STOXX 50 NR EUR	DE0009792143
22	MSCI Europe Mid Cap NR EUR	DE0009786277
23	MSCI Europe Growth NR EUR	DE0009786186
24	Swiss Performance Index TR	DE0009762864
25	HDAX TR	DE0008474503
26	MSCI World NR EUR	DE0008474669
27	JP Morgan EMU Bond 1-3 Year	DE0008475187
28	MSCI World TR USD	DE0009772988
29	LIBID EUR 1 Month	DE0008476276
30	Topix TR	DE0008475112
31	MSCI World NR EUR	DE0008476524
32	Markit iBoxx Euro Overall CR	DE0008476516
33	MSCI EM (Emerging Markets) NR USD	DE0009773010

No.	Fund Manager Benchmark	ISIN Code
34	HDAX TR	DE0009769869
35	NASDAQ Biotechnology CR	DE0009769976
36	MDAX TR	DE0008474289
37	CDAX TR	DE0008490962
38	MSCI World/Financials CR	DE0009769919
39	JP Morgan Global GBI Unhedged TR	DE0009769703
40	MSCI USA Growth NR USD	DE0008490897
41	MSCI World/Health Care NR	DE0009769851
42	MSCI World/Communication Services TR USD	DE0008474214
43	S&P Global Natural Resources TR	DE0008474123
44	MSCI World/IT Services TR	DE0008474149
45	MSCI Europe NR EUR	DE0008490848
46	MSCI World TR USD	DE0008478116
47	Dow Jones Sustainability World TR USD	DE0008470477
48	HDAX TR	DE0008480732
49	EURIBOR 1 Month	DE0009770206
50	JP Morgan EMU Bond 1-3 Year	DE0008478124
51	STOXX Europe 600 TR EUR	DE0008478181
52	DAX 30 TR	DE0008478058
53	JP Morgan Global GBI ex Japan TR	DE0008481086
54	Dow Jones Global Titans 50 TR	DE0009847301
55	Markit iBoxx Euro Covered TR	DE0008481052
56	HDAX TR	DE0008478199
57	STOXX Europe 600 NR EUR	DE0008479155
58	DAX 30 TR	DE0009754119
59	MSCI Europe NR EUR	DE0008470337
60	LCI MSCI World NR USD/JPM GBI Broad Trad (85:15)	DE0008470469
61	MSCI World TR USD	DE0009757922
62	MDAX TR	DE0008474008
63	MSCI World TR EUR	DE0009781633
64	Markit iBoxx Euro Corporates CR	DE0008481078

No.	Fund Manager Benchmark	ISIN Code
65	MSCI World NR EUR	DE0009786129
66	EURO STOXX 50 NR EUR	DE0008480674
67	STOXX Europe 50 CR EUR	DE0009769992
68	MSCI Europe NR EUR	DE0009750216
69	MSCI World NR EUR	DE0009774794
70	MSCI AC Asia Pacific ex Japan TR USD	DE0008484072
71	MSCI Germany NR	DE0009752238
72	STOXX Europe 600 NR EUR	DE0009752220
73	FTSE EUR 3 Months Eurodeposit	DE0009761684
74	MSCI World Growth TR USD	DE0009752253
75	HDAX TR	DE0009765446
76	EURO STOXX NR EUR	DE0009778563
77	MSCI Europe TR EUR	DE0009781989
78	LCI STOXX Europe Mid 200/STOXX Eur Small 200(7:3)	DE0008474156
79	STOXX Europe 50 TR EUR	DE0008480468
80	DAX 30 TR	DE0008474057
81	Markit iBoxx Euro Overall TR	DE0008474065
82	JP Morgan GBI Europe TR	DE0009772590
83	MSCI World NR EUR	DE0008488214
84	SDAX TR	DE0009751651
85	DAX 30 TR	DE0008488206
86	MSCI Pacific TR EUR	DE0005320303
87	MSCI Europe NR EUR	DE0005320329
88	LCI MSCI AC Far East/MSCI AC Far East x Jap(50:50)	DE0009769760
89	MSCI Europe TR EUR	DE0009769729
90	MSCI AC World NR EUR	DE0009769794
91	EURO STOXX 50 NR EUR	DE0009781773
92	DAX 30 TR	DE0008489808
93	Markit iBoxx Euro Corporates Non Financials TR	DE0005152003
94	STOXX Europe 600 CR EUR	DE0009756825
95	Bloomberg Barclays Euro Aggr 500 Mio+ 1-5 Y TR	DE0009752501
96	MSCI World TR USD	DE0009757872
97	DAX 30 TR	DE0009750117
98	EURO STOXX 50 NR EUR	DE0009757740
99	MSCI Europe TR EUR	DE0009750232

No.	Fund Manager Benchmark	ISIN Code
100	JP Morgan GBI Europe TR	DE0009750240
101	DAX 30 TR	DE0008491002
102	DAX 30 TR	DE0009750208
103	MSCI World TR USD	DE0008491051
104	MSCI World TR USD	DE0009750273
105	MSCI Japan TR EUR	DE0009750125
106	MSCI USA TR EUR	DE0009750075
107	EONIA	DE0009750133
108	MSCI AC World TR EUR	DE0009790758
109	MSCI World TR EUR	DE0009847343
110	MSCI World NR EUR	DE0005326532
111	DAX 30 TR	DE0005321038
112	EURO STOXX 50 NR EUR	DE0005321053
113	Markit iBoxx Euro Sovereigns Eurozone TR	DE0005321061
114	MSCI World TR EUR	DE0005326789
115	MSCI World NR EUR	DE0005152706
116	NMX Infrastructure Europe TR	DE0009763342
117	TecDax TR	DE0005317374
118	STOXX Europe 50 TR EUR	DE0005316988
119	MSCI Europe TR EUR	DE0009795831
120	EURO STOXX 50 NR EUR	DE0009779611
121	MSCI World TR USD	DE0005547160
122	MSCI World Growth TR USD	DE0005153860
123	STOXX Europe Sustainability ex AGTAF NR EUR	DE0007045437
124	MSCI World TR USD	DE0009789727
125	JP Morgan GBI EMU TR EUR	DE0002605078
126	MSCI WORLD ESG Leaders NR	DE0001619997
127	REXP TR	DE0009784801
128	Bloomberg Barclays World Govt Inflat Link TR EURH	DE0008484361
129	MSCI World TR USD	DE000A0D9PG7
130	MSCI Europe TR EUR	DE0005152375
131	EONIA + 200 Bps	DE0005561666
132	EURIBOR 3 Month	DE000A0F5HA3
133	MSCI World TR USD	DE0008477076
134	MSCI World Growth NR EUR	DE0005152441
135	MSCI World TR EUR	DE000A0HGMH0

No.	Fund Manager Benchmark	ISIN Code
136	MSCI World TR EUR	DE000A0JEK49
137	STOXX Europe 600 TR EUR	DE000A0DNHW4
138	SDAX TR	DE0009750497
139	MSCI World NR EUR	DE000A0LA2L3
140	MSCI World TR EUR	DE000A0KFRT0
141	STOXX Europe 50 USD CR	DE000A0KEYM4
142	Swiss Performance Index TR	DE000DWS0D27
143	Markit iBoxx Euro Sovereigns Eurozone TR	DE0009777623
144	EURIBOR 3 Month + 50 Bps	DE000A0LGNN8
145	MSCI World TR USD	DE000A0MYG12
146	EONIA	DE000A0HHGG2
147	MSCI World TR EUR	DE000A0MS7P2
148	MSCI World TR EUR	DE000A0MY1C5
149	EURIBOR 1 Year	DE000A0M8WS9
150	MSCI World TR EUR	DE000A0DPZG4
151	MSCI AC World NR EUR	DE000A0MKQK7
152	MSCI World TR EUR	DE000A0M2JH2
153	EURO STOXX Sustainability 40 NR EUR	DE0002605367
154	FTSE Gold Mines TR	DE000A0Q2SD8
155	eb.rexx Government Germany TR	DE000A0NA4H5
156	MSCI World TR USD	DE000A0NGJ10
157	Cust BM UBS-Benchmark	DE000A0M6TQ3
158	eb.rexx Government Germany TR	DE000A0RKXK2
159	ICE BofA Euro Corporate TR EUR	DE000A0RBZB5
160	STOXX Europe 600 NR EUR	DE000A0RHDB9
161	EURIBOR 3 Month + 200 Bps	DE000DK1CHU9
162	ICE BofA Euro Corporate TR LC	DE000A0Q8HP2
163	S&P Global Clean Energy TR EUR	DE000A0RHHC8
164	EURIBOR 1 Year	DE000A0YFQ92
165	MSCI World TR EUR	DE000A0M80G4
166	LCI MSCI World TR EUR/REXP TR (50:50)	DE000ANTE1A3
167	Topix TR	DE0008490954
168	STOXX Europe 600 TR EUR	DE0009763201
169	EONIA + 300 Bps	DE0009763235
170	REXP 1 Year TR	DE0005321004

No.	Fund Manager Benchmark	ISIN Code
171	EURIBOR 1 Year	DE000A0YJF83
172	ICE BofA Euro High Yield TR	DE000A0YAX56
173	EURO STOXX Small CR EUR	DE000A1CU8A9
174	REXP TR	DE000A0YAEJ1
175	MSCI World High Dividend Yield TR	DE000A0RPAP8
176	MSCI World TR USD	DE000A0YAYA8
177	SDAX TR	DE000A0YAX72
178	MSCI World TR EUR	DE000A1CS5F8
179	S&P 500 NR	DE000A1H6HH3
180	STOXX Europe 50 TR EUR	DE000A1H56E7
181	EONIA + 150 bps	DE000A1H72N5
182	MSCI World TR EUR	DE000A0KFTH1
183	EURIBOR 1 Year	DE000A1JBY86
184	eb.rexx Government Germany 2.5-5.5 TR	DE000A1H72M7
185	CDAX TR	DE000DWS08N1
186	MSCI World High Dividend Yield NR	DE000DWS08P6
187	LCI MSCI AC Far East/MSCI AC Far East x Jap(50:50)	DE000DWS08Q4
188	MSCI North America ESG Leaders NR	DE000A1JJJD3
189	MSCI Europe NR EUR	DE000A1JJJC5
190	MSCI AC World TR EUR	DE000A0HGL63
191	EURIBOR 3 Month	DE000A0Q2H14
192	EURIBOR 3 Month	DE000A0RPAL7
193	EURIBOR 3 Month	DE000A0RPAM5
194	EURIBOR 3 Month	DE000A0RPAN3
195	EURIBOR 3 Month + 100 Bps	DE000A1JRP89
196	EONIA	DE000A1C4DR1
197	LIBOR EUR 3 Month + 100 Bps	DE000A1JLSJ7
198	EURIBOR 1 Year	DE000A0Q86B3
199	DAX 30 TR	DE000A1J3WL9
200	MSCI World TR EUR	DE000A1J3117
201	ICE BofA Global Large Cap Corporate TR	DE000A1J3AH3
202	EURIBOR 3 Month + 50 Bps	DE000A1J3WM7
203	DAX 30 TR	DE000A1J9BC9
204	MSCI AC World TR EUR	DE000DWS1W80
205	EURO STOXX NR EUR	DE000A1JUW44

No.	Fund Manager Benchmark	ISIN Code
206	Markit iBoxx Euro Covered TR	DE000DWS1UL0
207	STOXX Europe TMI Small NR EUR	DE000A1J9DT9
208	EURIBOR 1 Month	DE000A1W8937
209	GCX Global Challenges Index	DE000A1T7561
210	MSCI Pacific NR EUR	DE000A1110W7
211	iBoxx Euro Non-Financials TR EUR	DE000A1110K2
212	MSCI USA TR EUR	DE000A0MY039
213	Markit iBoxx Euro Corporates TR	DE000A1T6FY8
214	EURO STOXX TMI Small NR EUR	DE000A1144B0
215	Bloomberg Commodity TR EUR	DE000A1W1MH5
216	EURO STOXX 50 TR EUR	DE000A12BS94
217	MSCI World/Health Care TR EUR	DE000A117YF1
218	MSCI AC World NR USD	DE000A12BTG5
219	MSCI World TR EUR	DE000A12BRE4
220	MSCI World TR EUR	DE000A1C81G1
221	EURO STOXX 50 NR EUR	DE000DK2J7N4
222	MDAX TR	DE000A14XN59
223	EONIA + 150 bps	DE000A14XP81
224	STOXX Europe 50 NR EUR	DE000A1145P7
225	EURO STOXX Select Dividend 30 TR EUR	DE000A1W18W8
226	EURO STOXX 50 TR EUR	DE000A12BRM7
227	STOXX Europe TMI Small NR EUR	DE000A1XDX79
228	MSCI World NR EUR	DE000A2AJHH5
229	EURO STOXX 50 TR EUR	DE000A12BRQ8
230	EONIA	DE000A2AJHY0
231	MSCI Europe NR EUR	DE000A2AJJQ2

No.	Fund Manager Benchmark	ISIN Code
232	S&P 500 NR	DE000A2AJGX4
233	CDAX TR	DE000A2ATCU8
234	EONIA	DE000A141WL3
235	DAX 30 TR	DE000A2AQYN3
236	MSCI World TR EUR	DE000A2DHTM8
237	EURO STOXX 50 TR EUR	DE000A2DR2Q1
238	MSCI Europe NR EUR	DE000A2DWUN3
239	MSCI World Growth NR EUR	DE000A2DR2L2
240	EURO STOXX 50 TR EUR	DE000A2DL4R1
241	MSCI World TR EUR	DE000A2DTLT5
242	MSCI World NR EUR	DE000A2H7N24
243	MSCI World Hedged EUR	DE000A2DL395
244	Bloomberg Barclays EM LC Govt-10%CountryCap TR GBP	DE000A2H7NT3
245	Bloomberg Barclays EM LC Govt-10%CountryCap TR GBP	DE000A2H7NV9
246	MSCI AC World NR EUR	DE000A2JF634
247	LCI Mixed Asset EUR Bal - Global	DE000A2H7N08
248	MSCI World TR USD	DE000A1CUGL4
249	S&P 500 TR	DE000A2JF683
250	MSCI EMU TR EUR	DE000A14XPH1
251	MSCI World TR EUR	DE000A14XPG3
252	EURO STOXX 50 CR EUR	DE000A2JQK35
253	MSCI World TR EUR	DE000A2PE1D2
254	STOXX Europe 600 NR	DE000A2PF0G6
255	GCX Global Challenges Index	DE000A2PS2N3
256	MSCI North America SMID Cap TR USD	DE000A2PPJ64
257	Markit iBoxx Euro Sovereigns Eurozone TR	DE000A2PSYA4

Appendix C

```
# First script

# install.packages("openxlsx")
library(openxlsx)

# import the data for MS Excel
dfFunds <- read.xlsx("Regression_First_Step.xlsx", sheet = "funds", detectDates = T)
dfIndices <- read.xlsx("Regression_First_Step.xlsx", sheet = "indices", detectDates = T, rowNames = T)

dfFunds$Date <- NULL

###################################
dfResults <- data.frame(fundName=character(ncol(dfFunds)),
                        indexName=character(122),
                        maxR2=numeric(122),
                        intcpt=numeric(122),
                        stringsAsFactors = F
                        )

for(i in 1:ncol(dfFunds)){

  #print(paste("Working with Fund", i))
  curFund <- dfFunds[ ,i]
  maxR2 <- 0
  maxJ <- 0
  maxIntc <- 0

  for(j in 1:ncol(dfIndices)){

    #print(paste("... working with Index", j))
    # print(paste("... working with Index", colnames(dfIndices)[j]))
    # take current index
    curIndex <- dfIndices[ ,j]

    # run a pw regression
    curOLS <- lm(curFund~curIndex)

    # get R^2
    curSummary <- summary(curOLS)
    curR2 <- curSummary$r.squared

    # if needed, get the coefs
    curIntc <- curOLS$coefficients[1]
```

```
    curSlope <- curOLS$coefficients[2]

    # compare
    if(curR2 > maxR2){
      maxR2 <- curR2
      maxJ <- j
      maxIntc <- curIntc
    }

  } # end of for j

  # PRINT
  # print(paste("For fund ", i, "best index is", maxJ, "with R2=", round(maxR2,2), "and intc = ",
round(maxIntc,5)))

 print(paste("For fund ", colnames(dfFunds)[i], "best index is", colnames(dfIndices)[maxJ], "with
R2=", round(maxR2,2)))

  # STORE
  dfResults$fundName[i] <- colnames(dfFunds)[i]
  dfResults$indexName[i] <- colnames(dfIndices)[maxJ]
  dfResults$maxR2[i] <- maxR2
  dfResults$intcpt[i] <- maxIntc

} # end of for i


# save the results
write.csv(dfResults, file="results.csv", quote = F, row.names = F)
```

Appendix D

```
#Second script

# install.packages("openxlsx")
library(openxlsx)

# import the data for MS Excel
dfFunds1 <- read.xlsx("Regression_Common_Alpha.xlsx", sheet = "funds1", detectDates = F)
dfIndices1 <- read.xlsx("Regression_Common_Alpha.xlsx", sheet = "indices1", detectDates = F)

dfFunds1$Date <- NULL
dfIndices1$Date <- NULL

##########################################

dfResults <- data.frame(fundName=character(122),
                        indexName=character(122),
                        R2=numeric(122),
                        intcpt=numeric(122),
                        stringsAsFactors = F)

for(i in 1:122){

  # estimate an OLS regression
  curOLS <- lm(dfFunds1[,i] ~ dfIndices1[,i])

  # get R^2
  curSummary <- summary(curOLS)
  curR2 <- curSummary$r.squared

  # the intercept
  curIntc <- curOLS$coefficients[1]

  # STORE
  dfResults$fundName[i] <- colnames(dfFunds1)[i]
  dfResults$indexName[i] <- colnames(dfIndices1)[i]
  dfResults$R2[i] <- curR2
  dfResults$intcpt[i] <- curIntc

}

##########################################
# save the results
write.csv(dfResults, file="resultsB.csv", quote = F, row.names = F)
```

Appendix E

$a^* > a^M$

Equity Fund	a^*	a^M
ACATIS.AKTIEN.GLOBAL.FONDS.A	0.037994995	0.0055082
AMPEGA.RENDITE.RENTENFONDS	-0.001418901	-0.0115995
AMUNDI.EUROAKTIEN	0.023540192	-0.0037008
AMUNDI.TOP.WORLD	0.000386755	0.0001777
ARIDEKA	-0.002458241	-0.0050335
DEKA-DEUTSCHLAND.AKTIEN.STRATEGIE	0.017781496	0.0006057
DEKA-EUROPA.AKTIEN.STRATEGIE	0.019057705	-0.0044772
DEKA.AKTIENFONDS.RHEIN.EDITION.GLOBAL	0.010176936	-0.0064695
DEKA.AKTIENFONDS.RHEIN.EDITION.P	0.014822456	-0.0019999
DEKA.EUROPA.SELECT	0.026929559	0.011108
DEKA.EUROPAPOTENTIAL.CF	0.035852801	0.0024607
DEKA.XTENSION.CF	0.033883592	0.0131477
DEKASPEZIAL	-0.000520556	-0.0031157
DWS.AKTIEN.STRATEGIE.DEUTSCHLAND.LC	0.017330495	-0.0008063
DWS.DEUTSCHLAND.LC	0.013230175	0.0050079
DWS.EUROPEAN.OPPORTUNITIES.LD	0.043768876	0.0161645
DWS.INVESTMENT.DEUTSCHE.AKN.TYP.O	0.017426321	0.0032317
DWS.QI.EUROZONE.EQUITY.RC	0.015818478	0.0109012
DWS.TOP.WORLD	0.025174926	0.0115819
G&W.-.HDAX.-.TRENDFONDS	0.018928735	0.0050053
INVESCO.KPL.UMWELT.UND.NACHHALTIGKEITS.FONDS	0.0021875	0.0007907
METZLER.AKTIEN.EUROPA.AR	0.023021427	-0.0029993
METZLER.INVESTMENT.AKN..DEUTSCHLAND	-0.001575544	-0.0038587
ODDO.BHF.ALGO.EUROPE.CRW-EUR	-0.001624202	-0.0020566
POSTBANK.EUROPA.P	-0.001503088	-0.0043233
SEB.INVEST.AKTIENFONDS	0.009732131	0.00121
UNION.INV.PRIVATFONDS.INVEST.GLOBAL	0.033334046	-0.0026373
UNION.INV.PRIVATFONDS.LIGA.PAX.AKTIEN.UNION	-0.002692216	-0.0027349
UNION.INV.PRIVATFONDS.UNI21.JAHRHUNDERT.NET	0.031695514	0.0097228
UNION.INV.PRIVATFONDS.UNIGLOBAL	0.033462854	0.0123754
UNION.INV.PRIVATFONDS.UNIGLOBAL.NET	0.032925873	0.0123189
UNION.INV.PRIVATFONDS.UNISELECTION.GLOBAL.I	0.024852111	0.0131497
UNIVERSAL.INV.GESELL..DEGUSSA.AKN.UNVL.FON.	0.010765556	0.0092877

Appendix F

$a^* < a^M$

Equity Fund	$\boldsymbol{a^*}$	$\boldsymbol{a^M}$
DEKA.FRANKFURTER.SPARINVEST	-0.001520479	0.0002648
DEKAFONDS	-0.001344936	0.0050144
DWS.ESG.INVESTA.LD	-0.000926412	0.0016534
FIRST.PRIVATE.INV.MAN..EUROPA.AKTIENFONDS.ULM	-0.000791528	0.0115327
HSBC.GERMAN.EQUITY	-0.001040668	0.0124128
KCD-UNION.NACHHALTIG.AKTIEN.MIN.RISK	-0.002027424	0.0100347
METZLER.INVESTMENT.WACHSTUM.INTERNATIONAL	-0.000360608	0.0129094
MONEGA.KPL.GERMANY	0.010415403	0.0105375
UBS.BRINSON.INVESTMENT.D.AKN.FDS.SPECIAL.I.DTL.	0.000171007	0.0120826
UBS.BRINSON.INVESTMENT.D.KEY.SLT.FD.GLB.EQTIES.	0.000432444	0.0137088
UBS.INVEST.KPL.D.KONZEPT.FONDS.EUROPE.PLUS	-0.001673187	0.0099778
UNION.INV.PRIVATFONDS.UNIDEUTSCHLAND	0.007768584	0.0113999
UNION.INV.PRIVATFONDS.UNIEUROAKTIEN	0.001845607	0.010162
UNION.INV.PRIVATFONDS.UNIEUROPA.NET	0.007053502	0.0104579
UNION.INV.PRIVATFONDS.UNIFONDS	-0.001975198	0.0107709
UNION.INV.PRIVATFONDS.UNIFONDS.NET	-0.002003995	0.0104618
UNION.INV.PRIVATFONDS.UNINORDAMERIKA	0.00053983	0.0146233

Appendix G

1 Month EMMI Risk Free Euribor rate in % (EURIBOR®, 2020)

Date	Rate
01.09.01	4.314
01.10.01	3.727
01.11.01	3.623
01.12.01	3.422
01.01.02	3.312
01.02.02	3.351
01.03.02	3.342
01.04.02	3.361
01.05.02	3.333
01.06.02	3.387
01.07.02	3.389
01.08.02	3.345
01.09.02	3.335
01.10.02	3.313
01.11.02	3.284
01.12.02	3.138
01.01.03	2.853
01.02.03	2.796
01.03.03	2.637
01.04.03	2.587
01.05.03	2.578
01.06.03	2.154
01.07.03	2.131
01.08.03	2.118
01.09.03	2.126
01.10.03	2.103
01.11.03	2.079
01.12.03	2.132
01.01.04	2.08
01.02.04	2.057
01.03.04	2.053
01.04.04	2.053
01.05.04	2.063
01.06.04	2.079

Date	Rate
01.07.04	2.074
01.08.04	2.079
01.09.04	2.076
01.10.04	2.084
01.11.04	2.103
01.12.04	2.168
01.01.05	2.107
01.02.05	2.104
01.03.05	2.103
01.04.05	2.106
01.05.05	2.105
01.06.05	2.104
01.07.05	2.107
01.08.05	2.114
01.09.05	2.115
01.10.05	2.12
01.11.05	2.175
01.12.05	2.406
01.01.06	2.389
01.02.06	2.437
01.03.06	2.633
01.04.06	2.64
01.05.06	2.664
01.06.06	2.874
01.07.06	2.916
01.08.06	3.107
01.09.06	3.125
01.10.06	3.347
01.11.06	3.379
01.12.06	3.653
01.01.07	3.629
01.02.07	3.609
01.03.07	3.771
01.04.07	3.864

Date	Rate
01.05.07	3.863
01.06.07	4.034
01.07.07	4.113
01.08.07	4.105
01.09.07	4.455
01.10.07	4.389
01.11.07	4.15
01.12.07	4.834
01.01.08	4.197
01.02.08	4.182
01.03.08	4.305
01.04.08	4.369
01.05.08	4.387
01.06.08	4.472
01.07.08	4.472
01.08.08	4.487
01.09.08	4.66
01.10.08	4.831
01.11.08	3.843
01.12.08	2.993
01.01.09	2.142
01.02.09	1.628
01.03.09	1.269
01.04.09	1.012
01.05.09	0.884
01.06.09	0.913
01.07.09	0.61
01.08.09	0.508
01.09.09	0.455
01.10.09	0.43
01.11.09	0.435
01.12.09	0.478
01.01.10	0.437
01.02.10	0.421

Date	Rate
01.03.10	0.406
01.04.10	0.405
01.05.10	0.423
01.06.10	0.446
01.07.10	0.583
01.08.10	0.64
01.09.10	0.618
01.10.10	0.784
01.11.10	0.834
01.12.10	0.811
01.01.11	0.793
01.02.11	0.894
01.03.11	0.903
01.04.11	1.127
01.05.11	1.243
01.06.11	1.279
01.07.11	1.422
01.08.11	1.373
01.09.11	1.347
01.10.11	1.363
01.11.11	1.227
01.12.11	1.143
01.01.12	0.836
01.02.12	0.626
01.03.12	0.467
01.04.12	0.409
01.05.12	0.394
01.06.12	0.38
01.07.12	0.219
01.08.12	0.132
01.09.12	0.119
01.10.12	0.111
01.11.12	0.109
01.12.12	0.111

Date	Rate
01.01.13	0.113
01.02.13	0.12
01.03.13	0.118
01.04.13	0.118
01.05.13	0.112
01.06.13	0.121
01.07.13	0.125
01.08.13	0.128
01.09.13	0.128
01.10.13	0.128
01.11.13	0.132
01.12.13	0.214
01.01.14	0.224
01.02.14	0.224
01.03.14	0.232
01.04.14	0.253
01.05.14	0.259
01.06.14	0.153
01.07.14	0.096
01.08.14	0.085
01.09.14	0.018
01.10.14	0.008

Date	Rate
01.11.14	0.01
01.12.14	0.023
01.01.15	0.005
01.02.15	0
01.03.15	-0.01
01.04.15	-0.029
01.05.15	-0.05
01.06.15	-0.063
01.07.15	-0.071
01.08.15	-0.088
01.09.15	-0.105
01.10.15	-0.116
01.11.15	-0.14
01.12.15	-0.19
01.01.16	-0.223
01.02.16	-0.246
01.03.16	-0.308
01.04.16	-0.341
01.05.16	-0.348
01.06.16	-0.356
01.07.16	-0.369
01.08.16	-0.37

Date	Rate
01.09.16	-0.371
01.10.16	-0.371
01.11.16	-0.373
01.12.16	-0.37
01.01.17	-0.371
01.02.17	-0.372
01.03.17	-0.372
01.04.17	-0.372
01.05.17	-0.373
01.06.17	-0.373
01.07.17	-0.373
01.08.17	-0.372
01.09.17	-0.372
01.10.17	-0.372
01.11.17	-0.372
01.12.17	-0.369
01.01.18	-0.369
01.02.18	-0.37
01.03.18	-0.371
01.04.18	-0.372
01.05.18	-0.371
01.06.18	-0.37

Date	Rate
01.07.18	-0.37
01.08.18	-0.37
01.09.18	-0.371
01.10.18	-0.37
01.11.18	-0.369
01.12.18	-0.367
01.01.19	-0.366
01.02.19	-0.368
01.03.19	-0.367
01.04.19	-0.367
01.05.19	-0.369
01.06.19	-0.385
01.07.19	-0.395
01.08.19	-0.41
01.09.19	-0.448
01.10.19	-0.455
01.11.19	-0.45
01.12.19	-0.453
01.01.20	-0.457
01.02.20	-0.473

Declaration of Authorship

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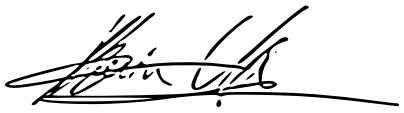
Saint Petersburg, May 31st, 2020



Kevin Ulrich