Universidade do Minho
Escola de Economia e Gestão

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German Bond Mutual Fund
Performance in Periods of Crisis and non-Crisis

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German Bond Mutual Fund Performance in Periods of Crisis and non-Crisis

Nesta dissertação são analisados fundos de obrigações alemães que investem na Alemanha ou na Zona Euro durante o período de Janeiro de 2005 até Dezembro de 2020. A performance é analisada usando um modelo multifactor não condicional, incluindo como factores de risco a rendibilidade em excesso de um fundo de acções e um spread de crédito. Também são analisados o modelo condicional que incorpora variáveis de informação como o diferencial das taxas de juro de longo e curto prazo e uma medida de aversão ao risco (IRW) e o modelo com uma variável dummy diferenciando períodos de recessão e expansão. A performance dos fundos de obrigações que compõem a amostra é negativa onde a maior parte dos portfólios de fundos não conseguem superar o mercado, com alfas negativos em todos os modelos. Os resultados suportam o uso do modelo de avaliação de performance condicional, com comprovação de risco variável e desempenho dependente das variáveis de informação.

O modelo condicional e modelo com variável dummy acrescentam poder explicativo em relação ao modelo não condicional. Os fundos de obrigações parecem ter um desempenho neutro durante períodos de recessão com apenas um coeficiente significativo negativo para o portfólio de obrigações Corporate.

Palavras chave: Fundos de obrigações, Mercado Alemão, Períodos de crise e não-crise, Modelos condicionais

German Bond Mutual Fund Performance in Periods of Crisis and non-Crisis

In this dissertation we analyze the performance of German bond funds that invest either in Europe, Eurozone or in Germany during the period of January 2005 to December 2020. Performance is analyzed using an unconditional multifactor model, with the excess return on a bond market index, the excess return on a stock market index and a default spread factor as risk factors. In addition, a conditional model incorporating as information variables available to investors at the time returns were generated, the term spread and a measure of risk aversion (IRW), and a model using a dummy variable to distinguish expansion and recessions periods are also analyzed. The performance of the bond funds overall is negative with the majority of the funds underperforming the market, with negative alphas across all models. Our findings support the use of the conditional performance evaluation model, since it is found strong evidence of both time-varying risk and performance.

The conditional model and the model with the dummy variable add explanatory power in relation to the unconditional model. Bond funds have a neutral performance during recession periods with only one significant and negative coefficient for Corporate bond portfolio.

Keywords: Bond funds, German Market, Periods of crisis and non-crisis, Conditional models

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1. Introduction

Mutual fund performance is a vastly studied and examined academic topic with extensive research throughout the years. However, the majority of the literature focus on funds that either invest on common stock or that invest in both stock and debt instruments, balanced funds, laying aside funds that include only debt instruments, bond funds.

According to the 2020 EFAMA Asset Management Report, at the end of 2018 bond assets represent 42% of investment portfolios managed by asset managers revealing its wider influence on the European mutual fund market, compared to the 28% of equity assets and 6% for money assets. Clearly European investors value more secure instruments for investing capital and generate income than in other markets since according to the Investment Company Institute (ICI) 2019 Fact Book, bond funds only represent 18% of total regulated open-end funds in the worldwide market.

More particularly, the German mutual fund industry has grown during the last decades as well as its importance on the European and Global markets too. According to the European Central Bank report, German investment funds have 2786,4 billion euros in total assets and 1115,6 billion euros correspond to debt securities in the first quarter of 2021. Still, in terms of research, the German mutual fund market is relatively unexplored. Usually bond fund studies focus on U.S. bond funds which have larger importance than German funds. The major German mutual fund companies are bank subsidiaries and most of their market is over the counter. Banks sell their own funds and guide their clients to buy them and, as a result of its bank-based system and small stock market, the mutual fund industry in Germany became more restrictive and less relevant as stated by Krahnen, Schmid and Theissen (2006). Previous studies on German bond funds include Maag and Zimmermann (2000), and Dietze, Entrop and Wilkens (2009) who investigate investment grade German mutual funds, with both finding underperformance matching roughly the expenses and management costs.

The majority of bond mutual fund research finds evidence of underperformance equivalent to the expense costs, regardless the model used and the market. As examples of research on this topic we have Blake, Elton and Gruber (1993) and Gallo, [1]Lockwood and Swanson (1997) for international bond funds specifically, in the U.S. market, Gallagher and Jarnecic (2002) in the Australian market, Silva, Cortez and Armada (2003) in the European market, and Ayadi, Lazkrak, Liao and Welch (2018) in the Canadian market.

[1] https://sdw.ecb.europa.eu/reports.do?node=1000003517
https://www.efama.org/newsroom/news/asset-management-europe-overview-asset-management-industry-november-2020

The use of conditional models is also a consensus, leading to more precise results and better estimations of fund performance. Early approaches using time-varying expectations of returns on asset pricing models were used by Chang and Huang (1990). Investigation on this topic was followed, Ferson and Harvey (1991) and later Ferson and Schadt (1996) applied public information variables on returns, Chen and Knez (1996) identified several critiques on the performance measurement process and Silva, Cortez and Armada (2003) applied conditioning information in measuring European bond fund performance. Information variables are useful to measure bond returns adding explanatory power to the model and according to Soderlind (1999), can have more influence on measuring fund performance than fund categories.

Periods of crisis and non-crisis effects on fund performance are still inconclusive. Kosowski (2011) finds that mutual fund underperformance is due to expansion periods and performance is actually understated in recession periods. Ayadi, Lazkrak, Liao and Welch (2018) conclude that funds have a worse performance during recession periods. Kosowski (2011) studied fund performance using cycles of expansion and recession, both concluding that with the incorporation of different economic periods a new return variation is captured.

In terms of performance persistence Chen, Ferson and Peters (2010) adjust the Treynor and Mazuy (1966) model to non-linearity to measure bond fund performance and find that there is no investment manager ability after expenses. The general view of the studies analyzed is that there is no significant persistence at all, Leite and Cortez (2017) affirms that if it exists is likely to be in non-crisis periods and Groose, Dasilas and Alexakis (2014) say that it is negative (cold hands effect).

The objective of this research is to examine the performance of German bond funds in the last 15 years, 2005-2020, an interval with some recession periods like the subprime crisis and the Euro sovereign crisis which can demonstrate if there is any difference on abnormal returns. On periods of crisis, bond funds may assume a more safe-status than equity funds since they have less risk and investors usually reduce their risk exposure in recession periods, when they have a higher marginal utility of wealth.

An unconditional three factor-model is used, where the fund returns are compared to the respective benchmarks. As returns and risks are likely to change overtime depending on the state of the economy, the unconditional approach may not be the best to analyze fund performance. The three-factor model in a conditional version is also used as an alternative model. Chen and Knez (1996) and Ferson and Schadt (1996) found that using continuous information variables helps on achieving more precise performance estimates. In addition, a discrete state approach is also used in order to analyze the crisis effect on bond fund

performance where a dummy variable is employed to observe the performance in recession and expansion periods.

The rest of the dissertation organized as follows. Section 2 presents the literature review, Section 3 describes the methodology, Section 4 describes the data and Section 5 presents the empirical results and Section 6 presents conclusion remarks.

2. Literature Review

Bond mutual funds have a quite considerable weight in the investment industry and it is surprising that there is little research on bond funds. Literature on bond fund performance is troublesome to find and the majority of previous studies are on equity or balanced mutual funds and in the U.S. market.

Methodologically, the application of the Capital Asset Pricing Model (CAPM) on bond performance analysis soon was questioned. Problems arising on how to specify the benchmarks to evaluate performance, how to replicate bond markets and its segments, like maturity, using indexes or index families are a consistent focus point of investigation.

In one of the first attempts to understand fixed-income securities performance, Gultekin and Rogalski (1985) examine the factor structure of U.S. Treasury security returns and test the Arbitrage Pricing Theory (APT) comparing with the CAPM model during a 20-year period, 1960-1979. The results are more favorable to multi-factor models than to single index models or the CAPM. Following the investigation on what can influence bond performance and the best way to measure it, Litterman and Scheinkman (1991) employed empirical research to determine the common factors that have affected prices of fixed-income securities and find that the main influences are represented in the zero yield curve. Afterward, Knez, Litterman and Scheinkman (1994) do a similar analysis but to describe money market returns and disclose confirmation for the existence of stylized facts. They analyze three and four factor models on money markets securities over the period of January 1985 to August 1988. Both studies conclude that returns are better explained with three or four state variables, including level of interest rates, steepness of the yield curve, spread between the T-bill market and the private issuer market and a fourth variable that considers the changes in the credit spread between Commercial Paper and other private issuer markets.

Blake, Elton and Gruber (1993) were one of the earliest academic researches that evaluate specifically bond fund performance and not mutual funds in general. They considered all bond funds that existed at the end of 1991 over a period of 10-years, beginning of 1979 to the end of 1988, using both single and multi-index models using bond indexes as factors. Again later, Blake, Elton and Gruber (1995) analyzed

the time series returns of bond funds adding unanticipated changes in economic variables and using a relative asset pricing model (APT). As previously their sample consists on all the funds that existed at the end of 1991 but within a 6-year period, starting in 1986 and ending in 1991. Both studies show that overall bond funds underperformed equal to the average management expenses. However, the addition of the economic variables led to an improvement of the explanation of the expected returns, since the differences in investment styles were no longer relevant to the analysis.

Traditional performance measures consider unconditional expected returns. However if expected returns and risks vary over time, unconditional approaches can be biased and unreliable. To solve this problem some research uses public information variables so managers that makes use of public information as a strategy are not considered to achieve superior performance, and some research focuses on the use of different periods, usually expansion and recession periods, to compare the differences.

Chang and Huang (1990) used a multifactor-model with changing expectations and considered long-term corporate bonds during the period of January 1963 to December 1984. Later Ferson and Harvey (1991) also analyze the components that permit to predict bond portfolio returns. Once again, an asset pricing model was employed which also examines the importance of the economic risk variables using a conditional model. In both studies the multifactor-model proved to be better to measure abnormal performance. Regarding the conditional approach, the results showed that the predictability of returns can be explained using time-varying rationally expected returns and time-variation must be considered in testing asset pricing models.

Changes in economic activity can be a main drive of fund return movement and its impact should be considered when analyzing fund performance. Therefore periods with different economic conditions should lead to different results and conclusions. Cornell and Green (1991) investigate the performance of low-grade bond funds during the period of January 1960 to December 1989 using a multi-factor. In addition to the model, macro-economic variables were included and a dummy variable for a “recession period” according to NBER business cycles. They conclude that low-grade bonds are less sensitive to changes in interest rates but more sensitive to stock movements and high-grade bonds are more sensitive to market movements in recession periods. Further low-grade bonds are more sensitive to interest rates and perform more poorly during recessions.

Public information can be a source of information and managers can use it and lead to measured abnormal performance. In order to eliminate this bias, Ferson and Schadt (1996) assume market prices fully reflect available information and investigated conditional performance evaluation of open-end mutual funds in changing economic conditions in which return expectations are conditioned on predetermined public

information variables, from January 1968 to December 1990. The results show that using the conditional approach there are no evidence of negative timing ability, average fund performance appears better and the use of conditioning information is statistically and economically significant.

Chen and Knez (1996) analyzed managed portfolio performance and pointed out several critiques and, in order to turn around them, they specify a minimum set of conditions that any performance measure must satisfy to. Their main critiques were that the choice of benchmarks can transform performance measurement in an arbitrary process, similar returns lead to similar rankings, abnormal performance can be misleading if that is possible to be obtained by uninformed investors and fund excess returns can be proportional to securities gross returns. However, their results showed that any performance value can be assigned to a fund that enlarged the investment opportunity set by choosing the right performance measure if it satisfies their minimal conditions. On a positive side if each performance measure is required to be positive, performance measurement becomes less dependent on the particular performance measure used. They also developed a structure capable of measuring performance independent of asset pricing models and enable the conducting of conditional performance evaluation.

Timing ability is the ability to use superior information about the future expectations of common factors that affect bond returns causing non-linearity in fund returns. Nonetheless, there exist several sources of non-linearity related with non-timing ability, which is important to control when measuring bond fund performance. Chen, Ferson and Peters (2010) look at timing ability and performance of bond funds after adjusting for possible biases and dynamic strategies over the period January 1962 to March 2007. They adjust the Treynor and Mazuy's (1966) model to non-linearity on the measurement of bond fund performance, explaining a commonly found evidence of negative performance. Their conclusion was in agreement with perspective that some funds have investment ability, however after costs and management expenses this advantage is dissipated, especially on high cost funds.

Managerial skill is an important concept on theoretical asset pricing and practical investment decision making. A mutual fund with a skilled manager is expected to perform well in the future consistently where the opposite occurs when a mutual fund has an unskilled manager. So performance persistence is commonly believed to be an indication of managerial skill. Du,Huang, and Blanchfield (2009) analyzed high-quality corporate-bond mutual funds and find sustentation for performance persistence for short-periods. Winner funds obtain consistently positive abnormal returns before expenses and looser funds continually underperform the benchmark, even before expenses. The abnormal returns generated by managerial skills are only sufficient to cover expenses.

The majority of studies analyze bond funds that invest in the U.S. bond market. Nonetheless, some research focuses on other bond markets, some in multiple markets, and aiming to analyze the distinct characteristics of the different markets. Gallo, Lockwood and Swanson (1997) evaluated the performance of U.S. based international mutual funds using both single and multi-index models during a 65-month period, November 1988 to March 1994 and during two consecutive subperiods. Detzler (1999) studied the risk and return characteristics of global mutual funds starting November 1988 and ending November 1995, using one-index and three-index models and compare its diversification benefits to US investors. He concludes that investors do not benefit of diversification present on global funds net of expenses and exchange rate movements appear to be an important factor explaining returns on global mutual funds. Both studies find underperformance across all funds and conclude that multifactor-models explain better the returns. Clare O'Sullivan, Sherman & Zhu (2019) made a detailed study on the performance of US bond mutual fund industry including a total sample of 884 mutual funds and with self-declared benchmark, analyzing performance using a single-index model with the self-declared benchmark, a multi-factor model, market timing ability and performance persistence. They find an overall positive abnormal performance on both models, including the control for bond fund exposition to credit risk and term risk, including net-of-fees performance and abnormal performance is superior in the post financial crisis period. Findings on timing ability indicate an inverse relation and on performance persistence only evidence for negative persistence as in previous literature

The European market by itself has become the second largest mutual fund market in the world, but not much research has focused on its study, especially on European bond funds. European bond funds have an even more significant role on the industry than US bond funds, representing a larger percentage of the total market than their American equivalents. Silva, Cortez and Armada (2003) evaluated the performance of European bond funds using unconditional and conditional models and single and multi-index models, during the time interval of February 1997 to December 2000. They find that, in general, bond funds are not able to outperform passive strategies and this finding is robust to all the models. With the incorporation of information variables there is an improvement of performance and with multi-index models there is an increase in explanatory power. This is consistent with the hypothesis that conditional models help in measuring better fund performance.

Groose, Dasilas and Alexakis (2014) examine the performance of government debt bond funds in Portugal, Italy, Greece and Spain and its persistence. The sample period of 11 years had various subperiods of increased volatility, which are important to test for possible biases. Negative performance persistence appears in both Sharpe and conditional approaches and observable at medium- and long- term intervals.

Nonetheless, short-term persistence is weaker during the 2009-2010 period, a result caused by falling bond prices.

Several previous studies also show that different business cycles lead to different conclusions on bond fund performance. In the European market, and more specifically in Portugal, Leite, Faria and Armada (2016) evaluated the effects of the Euro Sovereign Crisis on the performance and performance persistence of bond funds that invest in Euro-denominated bonds between January 2001 and December 2012 using a conditional model. One year later, Leite and Cortez (2017) analyzed the conditional performance of a similar sample using public information available to investors during an also identical period, January 2003 to December 2014. Both studies found underperformance and more accurate results using the conditional approach. The earlier research recognizes that funds performed better during crisis periods and the latter findings conclude that persistence on returns on both short- and long-term horizons during non-crisis periods.

On other international markets, excluding the U.S. and European markets, there is some research that follows the thread of literature on bond fund performance, testing models already used or using different ones to analyze their results. Gallagher and Jarnecic (2002) investigated Australian open-ended funds within a 10-year period to September 1999 using an unconditional and a conditional model with the addition of fund flow information. They present evidence that fund flows may have a negative impact on market timing when flow is not considered in unconditional models. Ayadi, Lazkrak, Liao and Welch (2018) assess the performance of Canadian fixed-income mutual funds from 1980 to 2011 using Markovian-switching models in two distinct periods, expansion and recession. The use of the multivariate regime-switching approach proved to estimate more accurate results than univariate models, but the use of economic variables didn't improve the model. Also, their results display worse performance during recession periods. Both studies conclude that active bond funds don't outperform the market benchmark after-costs and that conditional models provide better insights on performance than traditional models.

In terms of German bond fund research, there have been several studies that investigate multifactor models and their use on performance evaluation. Theissen and Greifzu (1998) discuss the inability of the CAPM model on measuring German bond fund performance and test the applicability of various performance measures. They conclude that the application of the one-factor model may be empirically justified for portfolios of constant structure but generates inconsistent results when applied to their sample of funds. Maag and Zimmermann (2000) also considered German bond mutual funds, analyzing their performance and the influences of the different benchmarks, using a single and a multi-index model as well an asset class factor model over the time period of June 1992 to November 1996. They arrive at the conclusion that bond funds exhibit negative performance, but it matches more or less the average industry's expense. Dietze, Entrop and

Wilkens (2009) examined a specific sector of the German mutual fund market, funds that invest solely in euro-denominated investment grade corporate bonds, using single, multi-index and asset class factor models during a 5-year period, July 2000 to June 2005. It is the first research to take into account the specific characteristics of investment grade corporate bonds, employing rating-based and maturity-based indices as benchmarks. Overall, the rating-based models contribute to a better understanding of returns than maturity-based models. Similar to previous studies, they found that all the funds exhibit underperformance net of total expenses, robust across all models.

On performance persistence in German mutual funds, Cuthbertson, Hayley and Nitzsche (,2016) apply a parametric and non-parametric approaches to test market and style timing ability of German equity and bond funds over a 20-year period of 1990-2009, which is then divided in two subperiods (1990-1999 and 2000-2009). Overall, the presence of positive market timers is insignificant. There is evidence of positive and negative timing ability in the 2000-2009 period, some managers may move to long duration bonds after guessing a fall in interest rates and some may do the opposite, and it is proposed for future investigation the use of economic factors in the parametric approach rather than bond indices.

Regarding the conditional methodology, there is not much research on bond mutual funds but research on equity mutual funds considers the use of several public information variables. Ferson and Schadt (1996) measured conditional performance using lagged public information variables as short-term yield, dividend yield, term structure rates, a high yield spread and a dummy for the month of January. Groose, Dasilas and Alexakis (2014) followed Ferson and Schadt (1996) and used in their model public information variables like the term structure, short term rate, dividend yield, default spread and a dummy for January. Silva, Cortez and Armada (2003) also applied as conditional variables a real bond yield and a dummy for January, additionally to the term spread and the inverse relative wealth used by Ilmanen (1995). Ferson and Qian (2004) studied the robustness of the conditional performance of equity mutual funds using also discrete variables constructed based on the public information variables to measure economic conditions. They confirm that conditional alphas account for some underperformance present in traditional approaches and reveal patterns in returns that traditional analysis would overlook. However, they conclude information on economic conditions is useful in measuring performance and risk exposures of the mutual funds.

An alternative approach consists of using a dummy variable to distinguish periods of expansion and recession. Kosowski (2011) examined the performance of domestic U.S. equity mutual funds during NBER business cycles and came to the conclusion that mutual fund underperformance comes expansion periods when funds have negative risk-adjusted performance and not in recession periods. Also equity funds perform better in recessions than in expansion periods, when marginal utility is higher.

This type of approach was used in other studies such as Moskowitz (2000), and Glode (2011) also for conventional equity funds, and Silva and Cortez (2016) for green equity funds. As for bond funds Leite, Faria and Armada (2016) analyzed bond funds and evaluated the impact of the Euro Sovereign Crisis.

3. Methodology

To assess bond fund performance this research uses the Jensen measure (Jensen, 1968), which is the intercept in a regression that compares fund excess returns with benchmark excess returns. Multi-index models, using both the unconditional and conditional approaches are used to see which model explains better the returns and to compare different performance measures. The multi-index model is used for a more comprehensive model and as a way to capture corporate, government and high risk bond markets and to track general economic conditions with the following factors: an aggregate bond market factor, the ICE BofA Euro Broad Market in excess of the risk-free rate, a stock market factor, the MSCI Germany Total Return in excess of the risk-free rate, and a default spread factor, the difference between the return of the ICE BofA BBB Euro Broad Market and the return of the ICE BofA AAA Euro Broad Market. These risk factors are commonly used in previous studies. Blake, Elton and Gruber (1995) considered a bond, a stock index and a default spread in their model, in addition to the mortgage index which is not available in Germany. Silva, F., Cortez, C. & Armada, R. (2003) applied in their model a bond index, a stock index and a default spread as well. Gallo, Lockwood and Swanson (1997) also used a bond index and a government/corporate bond index.

The multi-index model used on this research is a three-factor model,. The model is expressed as follows:

$$R_{p,t} = \alpha_p + \beta_{1p} Bindex_t + \beta_{2p} Sindex_t + \beta_{3p} DS_t + \varepsilon_{p,t} \quad (1)$$

where Rp,t represents excess return of portfolio p in period t, αp is the measure of abnormal performance, Bindex represents the excess return on a Bond market index in period t, Sindex represents the excess on a stock market index in period t, DS is the Default spread in period t and εp,t is the error term

The fact that public information variables can be used to achieve superior performance through market timing, like interest rates, is another challenge for fund performance literature. The conditional approach takes into account information that is available to investors at the beginning of the period (Farnsworth, 1997, p.23) and assumes that expected return and risks vary with that public information. So the Jensen measure becomes positive only when a manager does a better use of it than the market does. Ferson and Schadt (1996) argued that the traditional CAPM based approach ignores the influence of public information variables in the portfolio management process, and don't allow for time-varying risk and returns.

Beta is then required to vary linearly according to a vector of conditioning information variables. They model the time-varying betas as a linear function of a vector z_{t-1}, as follows:

$$\beta_p(Z_{t-1}) = \beta_{0p} + \beta'_p z_{t-1} \quad (2)$$

Where, Z_{t-1} represents the information variables, and $z_{t-1} = Z_{t-1} - E(Z)$ represents deviations of Z_{t-1} from the average, β_0 is the average of the conditional beta, and β'_p measures the response of the conditional beta to the information variables lagged one period.

Christopherson, Ferson and Glassman (1998) extend the conditional information to the performance measure, so as the conditional alpha is expressed as:

$$\alpha_p = \alpha_0 + A'_p z_{t-1} \quad (3)$$

where α_0 is the average alpha and A'_p is a vector that measures the response of the conditional alpha to the information variables lagged one period.

Applying the conditional beta and alpha equation 1 becomes:

$$R_{p,t} = \alpha_p + A'_p z_{t-1} + \beta_{1p} Bindex_t + \beta_{2p} Sindex_t + \beta_{3p} DS_t + \\ +(\beta'_{1p} Bindex_t + \beta'_{2p} Sindex_t + \beta'_{3p} DS_t)(z_{t-1}) + \varepsilon_{p,t} \quad (4)$$

To analyze the influence of different economic cycles on bond fund performance a dummy variable is also employed, as an alternative, to differentiate between periods of crisis and non-crisis. The alternative model is expressed as follows:

$$R_{p,t} = \alpha_p + \alpha_{rec\,p} D_t + (\beta_{1p} Bindex_t + \beta_{2p} Sindex_t + \beta_{3p} DS_t) + \\ D_t(\beta_{1p,rec} Bindex_t + \beta_{2p,rec} Sindex_t + \beta_{3p,rec} DS_t) + \varepsilon_{p,t} \quad (5)$$

where Dt is a dummy variable that assumes the value of 1 in periods of crisis/recessions and the value of 0 in periods of non-crisis/expansions, $\alpha_{rec\,p}$ is the incremental abnormal return when the dummy variable is 1 (periods of crisis), and $\beta_{rec\,p,k}$ measures the change on the sensitivity of portfolio p to index k in periods of recession.

4. Data

The objective of this research is to examine the performance of German bond funds over the period January 2005 to December 2020. The dataset is composed of funds that invest in Germany and in the Eurozone or European markets. The funds must have return information on, at minimum, 36 monthly observations. The funds are classified in the following categories:

- Bond EUR
- Bond Corporates
- Bond Government
- Bond Europe

The returns are collected from the Refinitiv platform. The returns are measured monthly and are continuously compounded.

The dataset was constructed by searching bond funds within the Refinitiv platform and obtaining its monthly returns followed by a logarithmic process. Next, excess returns are computed relative to the risk-free rate, which for this study it is considered the Euribor 1-month rate through the period of January 2005 to December 2020.

First, as the study concentrates on German bond fund performance, only mutual funds domiciled in Germany are considered which either invests in Germany or in Europe aiming for a more focused market approach. These criteria result in a dataset with 128 funds. The dataset is free of survivorship bias, considering that liquidated and merged funds are included. In order to later divide funds into investment groups for a more detailed analysis, all funds on a sample have a LIPPER Global parameter that distinguishes their investment group.

Then follows an initial elimination process conductive to exclude funds with less than 36 monthly observations, requiring sample funds to have a 3 years minimum performance data to help assure conclusions were not substantially influenced by the initial stage of the fund furthermore sustaining enough observations to consider in the individual fund regressions. Later this process is proceeded by the exclusion of all the funds that don't belong to the 4 LIPPER categories focused on this analysis: Bond EUR, Bond Europe, Bond Corporate and Bond Government resulting in a total dataset of 128 funds with 81 classified as Bond EUR funds, 15 as Corporate funds, 18 as Government funds, 14 as Bond Europe funds. Regarding the risk factors, the following are used: the excess return on an aggregate bond market index, the ICE BofA Euro Broad Market minus the risk-free rate, a stock excess return, the MSCI Germany Total Return in excess of the

risk-free rate and finally a default spread factor specific to the Eurozone, which is calculated as the difference between the return of the ICE BofA BBB Euro Broad Market and the return of the ICE BofA AAA Euro Broad Market. All these return series are obtained from the Datastream database.

An equally weighted portfolio was formed with all the funds. The major descriptive statistics for the equally weighted portfolio are displayed in Panel A of Table 1.

The average mean monthly excess return is 0.125% per month for the period of the analysis and standard deviation equals to 0.74%. In most funds kurtosis is larger than 3 since the total equally weighted portfolio has an average kurtosis of 6.858 showing that sample fund returns have some degree of outliers and the return distribution is slightly skewed to the left with average negative skewness of -1.33.

Overall the sample bond funds show positive performance, counting 115 funds with a positive excess return mean value and 13 funds with a negative. This result was not expected since usually mutual funds underperform but seems relevant to state that the values are low and risk factors display higher mean excess returns. In order to examine normality, a Shapiro-Wilk (1965) test was employed on all the funds present in the sample, and for all 128 bond funds present in the sample, only for 14 it is not possible to reject the hypothesis of normality with a 95% confidence interval and for 10 bond funds with a 90% confidence interval. It is clear that normality is not present for most of the bond funds and, as necessary assumption for the regression models, could present a problem to the validity of the results.

Funds are also grouped into equally weighted portfolios according to the Lipper Global Classification closely resembling their investment objectives, within the 4 investment fund group styles: Government, Corporate, Bond EUR and Bond Europe.

The mean monthly return of the equally weighted portfolios varies from 0.102% (Government) to 0.242% (Corporates). Standard Deviation varies between 0.720% (Bond EUR) to 1.23% (Bond Corporate). The Corporate equally weighted portfolio has the larger mean returns and variance probably as a consequence of incorporating corporate debt in their portfolios making their performance much more volatile and as such more susceptible to high/low returns. In the Bond Euro portfolio, almost all funds exhibit positive excess return mean with 10 portfolios with negative values, in the Government portfolio, only one fund exhibits negative performance and in the Corporate Bond and Bond Europe portfolios all funds exhibit positive performance with values of excess return mean above 0. The maximum value of excess returns belongs to equally weighted portfolio Bond Corporate with 3.68% and the lowest value corresponds to -7.38% related to

the portfolio of Corporates bonds. Kurtosis varies across all categories at intervals of 0.752 (Bond Government) to 8,986 (Corporate) and skewness varies at -1.619 (Corporates) to -0.315 (Bond Government).

Nevertheless, applying the Shapiro-Wilk (1965) test to assess normality at a 95% level of significance it is not possible to reject normality for 8 of the 85 bond funds present in the Bond EUR, for none in the Corporate Bond, for 2 of the 21 bond funds present in the Government Bond and for 3 of the total 14 bond funds in the Bond Europe portfolio.

In terms of autocorrelation, usually bond returns are correlated at the 1 lag level, heavily decreasing autocorrelation values when looking at the second lag. This type of results are somewhat expected since returns are usually correlation at the 1 level lag, having much less influence when it is moved to a 2 level lag.

Panel B of Table 1 presents descriptive statistics of the three market risk factors used in the multifactor model: the bond market risk factor measured by the excess return on the -" ICE BofA Euro Broad Market Index"-, the stock market risk factor measured by the excess return on the - "MSCI Germany stock Index"-,- and the -"Default Spread"- factor measured by the difference between the return of the ICE BofA BBB Euro Broad Market and the return of the ICE BofA AAA Euro Broad Market.

Table 1 – Summary Statistics for Bond Funds

	Minimum	Maximum	Mean	SD	Kurtosis	Skewness	AD	P-Value
Panel A								
All funds	-4.492	1.840	0.125	0.753	6.858	-1.331	0.895	0.061
Bond EUR	-4.102	1.595	0.105	0.720	6.726	-1.356	0.083	0.003
Government	-2.86	1.894	0.102	0.866	0.752	-0.315	0.885	0.001
Corporate	-7.383	3.681	0.242	1.227	8.986	-1.619	0.764	0.000
Bond Europe	-3.736	2.643	0.185	0.949	0.961	-0.413	0.944	0.109
Panel B								
Bond Index	0.256	-3.386	3.045	0.998	0.417	-0.278	1.106	0.007
Stock Index	0.516	-17.147	17.161	4.92	1.78	-0.506	1.732	0.002
Default Spread	0.076	5.975	2.237	1.418	5.982	-1.095	3.747	0.000

This table reports summary statistics for the equally weighted portfolios (Panel A) and the Bond, Stock, and Default Spread factors (Panel B) over the period of January 2005 to December 2020. Monthly mean excess returns, minimum and maximum excess returns and standard deviation, expressed in percentage, and results on skewness and kurtosis are reported during the period of analysis. The Anderson-Darling test and probability values are reported as well to verify the normality of returns. The summary statistics for the risk factors are reported in panel B.

The average returns range between 2.237 for the Default Spread and 17.161 for the Stock market factor. Standard Deviation varies between 0,998 for the bond market factor and 4,920 for the stock market factor. The fact that the stock factor has a superior average return and is more volatile is somewhat expected

however the volatility of the bond index is low, displaying relative stability during the whole sample period periods of significant market volatility were present. Also, the results on Panel A show that none of the equally weighted portfolios have outperformed the bond market index in mean returns.

For the conditional model, the information variables used are the lagged slope of the term structure of interest rates (term spread), measured using the difference between the yield of a long-term bond, the Datastream 10-year Government Bond Benchmark, and the inverse relative wealth.

Ilmanen (1995) inverse relative wealth proxy is the ratio of the average past real stock market index level to the current index level, where the real stock market is the value-weighted stock index deflated by consumer's price index.

$$INVEREL\ Wt = \frac{ewa\ Wt - 1}{Wt} = \frac{(Wt - 1 + 0.9 * Wt - 2 + 0.9^2 * Wt - 3 + \cdots) * 0.1}{Wt}$$

The information variables are stochastically detrended and have a zero mean.

5. Empirical results

In order to analyze bond fund performance, several models are used, namely an unconditional three-factor model, a conditional three-factor model and a three-factor model including a dummy variable to distinguish expansion and recession periods. The unconditional model adds to the market risk factor, a stock risk factor and a default risk factor. The conditional model incorporates lagged public information variables containing information about the economic conditions into the model, specifically the Term Spread and the IRW. An alternative approach to analyze the impact of economic conditions is also considered by adding a dummy variable that takes the value of 0 in expansions and 1 in recessions as defined by the CEPR Euro Area business cycles. Performance is analyzed at the individual fund level and also at the portfolio level considering the different categories of bond funds. Heteroscedasticity is not rejected for all portfolios in the three models that were used to measure excess returns and, in order to correct this problem, a Francisco Cribari-Neto (2004) Asymptotic Inference was employed for all the regression coefficients.

Table 2 presents the estimations of the regression for the unconditional model, where the columns present the results for the Bond EUR, Bond Corporate, Bond Government and the Bond Europe funds.

Almost all the intercepts (Jensen Alpha) are negative or neutral for individual funds suggesting that some funds in the sample were not able to beat the market. In sample most funds are accentuated for its low excess returns values and inferior performance in relation to the benchmark, with 97 funds with a negative

alpha and 33 with a statistically significant coefficient at a 5% level, representing only 25.6% which is a small fraction of the sample. On the other hand, some funds are accentuated for its higher excess return values and superior performance in relation to the benchmark where funds have 31 positive alpha and 17 are statistically significant at a 5% level contemplating 1,3% of the total sample. In all equally weighted portfolios, individual bond fund neutral performance is more common leading to a very low number of statistically significant coefficients, roughly one quarter. The Bond EUR portfolio has 25 of a total of 81 bond funds with statistically significant coefficients, where 25 are negative (31%), the Bond Europe has 3 of 14 bond funds with statistically significant coefficients, 1 is positive (7%) and the other two are negative (14%), the Bond Government has 5 of a total of 18 bond funds with statistically significant coefficients, all negative (27.78%), and the Bond Corporate has only 2 of the total 15 bond funds with statistically significant coefficients, one positive (6.7%) and one negative (6.7%). As for Standard Deviation, Bond EUR funds seem to have the highest value and the Bond Europe portfolio the lowest across all equally weighted portfolios.

Regarding the coefficients of the bond market factor there are 126 funds with positive coefficients, representing a large part of the sample, and all of bond funds reject the hypothesis of non-significance at a 95% level of confidence, which represents 98.4% of the total sample. On the contrary the same inverse relation, a negative coefficient, is not present among the sample, where a decrease in fund excess returns is caused by an increase in the bond factor excess and there are only 2 statistically insignificant portraying only 0.3% of the total sample, both present in the Bond EUR portfolio where the other 79 coefficients are positive (97.5%). The Bond Corporate, the Bond Government and the Bond Europe funds display all bond funds with positive statistically significant coefficients, 15 coefficients, 18 coefficients and 14 coefficients respectively at a 5% level.

Bond funds generally are a more conservative approach and an alternative to invest in stocks, nonetheless the Stock market factor also impacts bond fund excess returns and mostly with positive impact. In total there are 93 funds (72.7%) of the total 128 with a positive stock market factor coefficient 39 (30.5%) are statistically significant at a 5% level. The positive coefficient implies an increase in bond fund excess returns when there is a stock index positive market movement, indicating that this portion of bond funds is more likely to incorporate corporate bonds than the rest of the sample. As for negative coefficients, a decrease in excess returns when the stock index goes up, there are 11 funds (8.6%) of a total of 35 funds with a statistically significant coefficient at 5% level.

Table 2 – Regression estimates for the unconditional model for individual funds

Alpha	Bond EUR	Bond Corporate	Bond Government	Bond Europe
Average	-0.0490	-0.0037	-0.0480	-0.0359
St. Dev.	0.0849	0.0691	0.0756	0.0563
% +	18.5%	53.3%	38.9%	69%
% sig. +	0%	6.7%	0%	7.1%
% -	81.5%	46.7%	61.1%	31%
% sig. -	30.9%	6.7%	27.8%	13.3%
β Bond	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.5055	0.5894	0.5279	0.7593
St. Dev.	0.2974	0.2081	0.3634	0.3243
% +	100%	100%	100%	100%
% sig. +	97.5%	100%	100%	100%
% -	0%	0%	0%	0%
% sig. –	0%	0%	0%	0%
β Stock	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.0186	0.0673	-0.0074	0.0246
St. Dev.	0.0362	0.0212	0.0096	0.0211
% +	76.5%	100%	22.2%	85.7%
% sig. +	35.8%	100%	0%	42.8%
% -	23.5%	0%	77.8%	14.3%
% sig. –	6.2%	0%	33.3%	0%
β DS	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.0294	0.0662	-0.0473	-0.0463
St. Dev.	0.1287	0.1197	0.0703	0.1583
% +	53.1%	60%	33.3%	28.6%
% sig. +	28.4%	33.3%	11.1%	21.4%
% -	46.9%	40%	66.7%	71.4%
% sig. –	16.1%	0%	44,4%	42.9%

"Average" represents the average of the regression coefficients, "Std. Dev." represents the standard deviation of the same coefficients, "% +" and "% -"represent the percentage of funds with a positive or negative coefficient respectively, "% + sig." and "% - sig." represent the proportion of funds with a positive or negative statistically significant coefficient respectively at a 5% level of significance.

As for the categories present in the portfolios, there is some evidence for this negative relation for the Government funds, 6 statistically significant coefficients and negative (33.3%). As for the rest of the portfolios, the Bond EUR has 29 positive statistically significant coefficients (36%) and 5 are negative (6%), the Bond Europe portfolio with 6 positive statistically significant coefficients (42.8%) and the Bond Corporate with all the 15 positive statistically significant coefficients (100%).

The Default Spread as a risk factor measures the compensation of risk, specifically bond risk, where the yield of a bond with low investment quality rises with an increase in the Default Spread factor. The sign of the coefficients are mixed across fund categories where a positive Default Spread coefficient suggest that a rise in riskier bond yields increase bond funds excess returns in 57 bond funds (44.5%), 33 with statistically significant coefficients at 5% (25,8%). On the other hand, funds that are negatively influenced by the Default Spread factor increase its excess returns when the yields of bond with less risk increase, with overall 71 funds (55.5%) with a negative coefficient and 27 are statistically significant at a 5% level (21.1%). As for the rest of the funds, the Bond EUR shows 43 statistically significant coefficients (53%) and 23 are positive (28.4%), the Bond Government shows 10 statistically significant coefficients (55.6%), where only 2 are positive (11,1%) and the other 8 are negative (44,4%), the Bond Europe doesn't show much of influence to Default Spread, with 9 statistically significant coefficients with 3 positive (21,4%) and 6 negative (42,8%) and the Bond Corporate portfolio with 5 statistically significant coefficients at a 5% level and all are positive (33,3%).

Table 3 contains the multifactor unconditional model results for the equally weighted portfolios presenting the results for all 4 equally weighted portfolios as for the equally weighted portfolio with all funds.

Table 3 – Regression estimates for the unconditional model for equally weighted portfolios

	Intercept	Bond Index	Stock Index	DS	Adj R^2	Shapiro P-value	BP-Value
All funds	-0.062**	0.667***	0.027***	0.016	0.890	0	0
Bond EUR	-0.066***	0.601***	0.022***	0.033**	0.870	0	0
Corporate	-0.061	0.789***	0.084***	0.169**	0.710	0	0
Government	-0.066***	0.700***	-0.009**	-0.059***	0.927**	0	0
Bond Europe	-0.052*	0.804***	0.048***	0.031	0.863	0	0

This table reports the regression estimates for the equally weighted portfolios resulting from the unconditional model. Average unconditional alphas and conditional alphas, all expressed in percentage, as well as average unconditional betas on Bond, Stock and Default Spread factors and the in-sample adjusted coefficient of determination of the regressions (R2adj.) are reported. Tests on regression residuals are reported as well using the Shapiro-Wilk (1965) for normality test for normality and the Breusch and Pagan (1979) test for heteroscedasticity. In order to correct the problem of heteroscedasticity the Francisco Cribari-Neto (2004) Asymptotic Inference was performed resulting in the estimated coefficients.

* 10% level of statistically significance ** 5% level of statistically significance *** 1% level of statistically significance

Almost all equally weighted portfolio funds show statistically significant coefficients, excluding the Bond EUR portfolio, with only two statistically insignificant coefficients maybe explaining the lower bond coefficient. The Bond Corporate, the Bond Government and the Bond Europe funds display all bond funds with positive statistically significant coefficients, 15 coefficients, 18 coefficients and 14 coefficients respectively at a 5% level. The Bond Europe displays the least negative alpha coefficient, which can be associated to the highest bond fund average, and the Bond Government and the Bond EUR the most negative bond fund coefficient, which can due to a lower bond fund percentage of statistically significant coefficients and lower bond fund average present in all the equally weighted portfolios respectively.

For the bond market factor all coefficients are positive and statistically significant, showing a positive correlation between the bond factor and the equally weighted portfolio excess returns, and since the sample focuses on bond funds, this result is somewhat expected. This risk factor seems to be particularly influential with the highest coefficient affecting the Bond Europe portfolio, where an increase in 1% on the Bond Index will result in an increase of returns equal to 0,804%, funds with the highest bond fund average for excess returns, and a smaller coefficient corresponding to the Bond EUR with an increase of 0,601%, with the lowest bond fund average coefficient present in the equally weighted portfolios and the only portfolio that does not have a 100% percentage of statistically significant positive coefficients.

Regarding the Stock factor nearly all the coefficients are significant at the 1% level and positive, except for the Government bond portfolio with a negative and significant coefficient at the 5% level. Funds present in this portfolio all exhibit a negative coefficient and the only negative fund average. This sign can be interpreted as whenever the stock market declines, investors prefer more stable and secure financial products, increasing their demand on government bonds with less risk. Since the Stock factor has an expected positive mean return, the opposite occurs and investors may discard risk as barrier, decreasing expected returns on government bonds. The influence of the stock factor is more limited than the bond factor with the Bond Europe portfolio showing a higher statistically significant coefficient, an increase in 1% on the Stock Index will result in an increase of returns equal to 0,048%, which can be explained by its highest bond fund average coefficient, and where the only negative coefficient corresponds to the Bond Government decreasing only -0,009% probably connected to the lowest bond fund average coefficient and the highest percentage of statistically significant negative coefficients.

Finally, the coefficients of the Default Spread factor are significant at the 1% level for the Government Bond portfolio and significant at the 5% level for the Bond EUR portfolio and the Bond Corporate portfolios. The Default Spread risk factor measures default risk that normally affects funds where risk is an intrinsic

element. Coefficients are nearly all positive excluding the Government Bond portfolio which has the exact opposite response. The Default Spread factor is more impactful on the Bond Corporate portfolio where an increase in 1% on the Default Spread will result in an increase of the returns of 0.155%, the equally weighted portfolio with the highest bond fund average coefficient and the highest bond fund percentage of statistically significant coefficients, and with the only negative coefficient corresponding to the Bond Government, where an increase of 1% in the Default Spread results with a decrease of -0.059%, the portfolio with the lowest bond fund average coefficient of all equally weighted portfolios and the lowest percentage of statistically significant coefficients.

It is also tested the regression residuals on all the equally weighted portfolios using the Shapiro-Wilk (1965) normality test and the Breusch–Pagan (1979) test for heteroscedasticity. In almost all the portfolios the normality of the residuals is rejected. Only for the Bond Europe equally weighted portfolio it is not possible to reject the normality of the residuals with 95% confidence. Additional normality tests on normality were made on equally weighted portfolio with all the bond funds specifically the Residuals vs Fits, the Normal Q-Q, Scale Location and the Residuals vs Leverage present in the appendix 1.

Table 4 presents the estimations of the excess returns for the conditional model, where the columns present the results for the Bond EUR, Bond Corporate, Bond Government and the Bond Europe portfolios.

The conditional model incorporates economic information, particularly the Term Spread and the IRW variables, increasing excess returns where almost all the intercepts (Jensen Alpha) are positive with some with a negative alpha. The majority of conditional alpha coefficients display positive performance for bond funds present in the sample with the Term Spread and IRW information variables incorporated for a total of 128 funds where 30 of them have significant coefficients (23.4%), rejecting the hypothesis of non-significance at a 95% level. For 24 funds (18.8%) there is a negative coefficient that is significant with a 95% confidence level. Regarding equally weighted categories, the Bond EUR portfolio has 22 statistically significant coefficients with only one positive (1.2%) against 21 negative coefficients (25.9%), which is the highest percentage of statistically significant negative coefficients, the Bond Europe portfolio with 2 statistically significant coefficients, one is positive (7%) and the other is negative (7%), the Bond Government portfolio has 5 of 18 total bond funds with statistically significant coefficients and all are negative (28%), exhibiting the highest percentage of statistically significant negative coefficients, and the Bond Corporate portfolio has only one statistically significant coefficient and is positive (7%). Performance values overall worsen, with a positive average alpha coefficient across all equally weighted portfolios and again the Bond Corporate bond funds seem to have the highest average alpha coefficient of all equally weighted portfolios indicating a better

performance and the Bond EUR a worse performance as the unconditional model. As for standard deviation the Bond Government portfolio shows the highest value and the Bond Corporate shows the lowest.

With the inclusion of the Term Spread and IRW variables when measuring bond returns, bond index influence adjusts to this new information. Positive conditional coefficients suggest that bond fund excess returns increase as the bond index rises, amounting to 128 fund coefficients and 114 of them are significant at a 5% level, representing 89% of the total sample and none of the coefficients are negative. All equally weighted portfolio show a greater number of coefficients that are positive, however positive coefficients nearly exceed the negative coefficients. In the Bond EUR portfolio, 80 funds (98.8%) of a total of 81 have significance at a 5% level and all are positive, the Bond Europe shows all bond funds with positive statistically significant coefficients (100%), for the Bond Government portfolio all 18 coefficients are statistically significant and positive (100%) and for the Bond Corporate all the 15 coefficients are statistically significant and positive (100%) with the a high percentage of positive statistically significant coefficients for all equally weighted portfolios indicating a wider influence of the Bond index on the sample. The Corporate bond funds exhibit the highest coefficient and the Bond EUR the lowest, indicating the smallest and highest correlation between equally weighted portfolios and the bond index. As for standard deviation, the Bond Europe exhibits a higher parameter than the rest of the equally weighted portfolios and the Bond Corporate the lowest.

Stock index influence also adjusts to the information variables Term Spread and IRW which implies a change from the unconditional model. From all the 128 coefficients only 56 are statistically significant at a 5% level (43,8%), with 95 positive coefficients (74%) and 46 are statistically significant at a 5% level (36%), implying that a positive correlation is a more common result on this risk factor. On the other hand, from the rest 40 negative coefficients (31%), only 10 are statistically significant (8%). The Bond EUR portfolio shows 34 (42%) funds of a total of 81 where significance at a 5% level is found, with 29 positive coefficients (35,8%) and 5 are negative (6%) on bond funds, for the Bond Government portfolio only 4 coefficients are statistically significant at 5% all negative (22.2%), the Bond Corporate where all the coefficients are statistically significant, the highest positive influence of the Stock index, and for the Bond Europe displays 4 bond funds with significant coefficients, with 1 negative (7%) and 3 positive (21.4%). All bond funds exhibit a positive average coefficient indicating possibly that the stock market influence is incremental when measuring excess returns with the incorporation of the information variables except for the Bond EUR equally weighted portfolio. As for standard deviation, the Bond Europe exhibits a higher parameter than the rest of the equally weighted portfolios and the Bond Government the lowest.

The conditional Default Spread accounts for the influence of an increase or decrease of the Default Spread in bond yields on bond funds excess return mean when IRW and the Term Spread variables are taken

into account in the model. Of the total sample, 100 funds have positive coefficients and almost all have a statistically significant coefficient at a 5% level excluding one, representing 77% of the total sample. As for the funds present in the equally weighted portfolios, statistically significance at a 5% level is displayed in 30 bond funds (37%) present in the Bond EUR with 16 positive (19%) and 13 negative (16%), the Bond Corporate portfolios, with no statistically significant coefficients, the Bond Europe shows 2 of 14 bond funds with positive coefficients (14%) and the other 12 are negative (86%), with 7 statistically significant coefficients, and the Bond Government displays 11 of the 18 bond funds with statistically significant coefficients where 8 are negative (44%), which is the highest percentage of statistically significant negative coefficients, and only 3 are positive (17%) with the highest percentage of statistically significant positive coefficients. The Bond Government portfolio shows the only negative average bond fund coefficient and the Bond Europe funds display the highest average, so Default Spread positive movements seem to be more positively correlated with Bond Europe funds excess returns and inversely correlated with Bond Government funds.

Table 4 – Regression estimates for the conditional model for individual funds

α	Bond EUR	Bond Corporate	Bond Government	Bond Europe
Average	-0.0420	0.0113	-0.0411	-0.0232
St. Dev.	0.0787	0.0708	0.0599	0.1455
% +	22.2%	66.7%	22.2%	42.9%
% sig. +	1.2 %	6.7%	0%	7.1%
% -	77.8%	33.3%	77.8%	57.1%
% sig. -	25.9%	0%	27.8%	7.1%
β Bond	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.5038	0.6297	0.5183	0.8789
St. Dev.	0.2973	0.2183	0.3596	0.3036
% +	100%	100%	100%	100%
% sig. +	98.8%	100%	100%	100%
% -	1.2%	0%	0%	0%
% sig. –	0%	0%	0%	0%
β Stock	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.0193	0.0631	-0.0055	0.0223
St. Dev.	0.0366	0.0219	0.0096	0.0538
% +	76.5%	100%	33.3%	85.7%
% sig. +	35.8%	93.3%	0%	21.4%
% -	23.5%	0%	66.7%	14.3%
% sig. –	6.2%	0%	22.2%	7.1%
β DS	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.0184	0.0088	-0.0519	-0.1451
St. Dev.	0.1168	0.0582	0.0885	0.1213
% +	53.1%	46.7%	33.3%	14.3%
% sig. +	19.8%	0%	16.7%	0%
% -	46.9%	53.3%	66.7%	85.7%
% sig. –	16.1%	0%	44.4%	50%

α Cond TS	Bond EUR	Bond Corporate	Bond Government	Bond Europe
Average	0.0637	0.0360	0.0767	-0.1590
St. Dev.	0.2262	0.1322	0.1322	0.2532
% +	63%	60%	33.3%	50%
% sig. +	7.4%	0%	16.7%	0%
% -	37%	40%	15%	50%
% sig. -	1.2%	0%	10%	0%
α Cond IRW	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	-0.0807	-0.2882	0.1442	-0.9467
St. Dev.	0.9534	1.0319	0.2769	1.9273
% +	60.5%	64.3%	72.2%	28.6%
% sig. +	8.6%	0%	0%	0%
% -	39.5%	35.7%	27.8%	71.4%
% sig. -	16.1%	20%	0%	7.1%
β Bond Cond TS	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	-0.0132	0.1049	-0.0452	-0.1217
St. Dev.	0.1354	0.1608	0.1578	0.2316
% +	48.1%	73.3%	33.3%	21.4%
% sig. +	7.4%	20%	11.1%	0%
% -	51.9%	26.7%	66.7%	78.6%
% sig. –	11.1%	0%	27.8%	7.1%
β Bond Cond IRW	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	-0.0178	0.4331	-0.2041	-0.9467
St. Dev.	0.7052	0.9656	0.6054	1.9273
% +	54.3%	66.7%	50%	21.4%
% sig. +	17.2%	33.3%	5.6%	0%
% -	45.7%	33.3%	50%	78.6%
% sig. –	17.2%	0%	16.7%	0%

β Stock Cond TS	Bond EUR	Bond Corporate	Bond Government	Bond Europe
Average	-0.0102	-0.0530	0.0030	0.0273
St. Dev.	0.0349	0.0345	0.0210	0.1163
% +	38.3%	6.7%	61.1%	64.3%
% sig. +	0%	0%	0%	0%
% -	61.7%	93.3%	38.9%	35.7%
% sig. –	11.1%	6.7%	5.6%	0%
β Stock Cond IRW	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.0124	0.0811	-0.2041	0.1840
St. Dev.	0.0795	0.1101	0.6054	0.4290
% +	38.3%	73.3%	22.2%	64.3%
% sig. +	3.7%	13.3%	0%	0%
% -	61.7%	26.7%	77.8%	35.7%
% sig. –	3.7%	0%	5.6%	0%
β DS Cond TS	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.0068	0.0854	-0.0103	0.0585
St. Dev.	0.1796	0.1785	0.0747	0.1130
% +	58%	66.7%	44.4%	71.4%
% sig. +	12.3%	33.3%	0%	0%
% -	42%	33.3%	55.6%	28.6%
% sig. –	12.3%	0%	5.6%	0%
β DS Cond IRW	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.0440	0.5313	0.0153	0.6000
St. Dev.	0.7204	0.9560	0.4662	1.2289
% +	51.9%	53.3%	38.9%	64.3%
% sig. +	17.3%	40%	16.7%	0%
% -	48.1%	46.7%	61.1%	35.7%
% sig. –	13.6%	0%	11.1%	0%

"Average" represents the average of the regression coefficients, "Std. Dev." represents the standard deviation of the same coefficients, "% +" and "% -"represent the percentage of funds with a positive or negative coefficient respectively, "% + sig." and "% - sig." represent the proportion of funds with a positive or negative with a statistically significant coefficient at a 5% level of significance.

The incorporation of the variable Term Spread in the conditional model influences Bond Fund performance (alpha coefficient) increasing or decreasing in conformity to the difference in yields between long-term bond yields and short-term bond yields. Funds with positive coefficients increase its excess return mean when the yields of long-term bonds increase and yields of short-term bonds decrease representing the most statistically significant common result with a total of 73 fund coefficients (57%) and only 9 have a statistically significant, 7% of the total sample. The negative coefficient represents the opposite increasing performance when yields of long-term bonds increase and short-term bond yields decrease, in which 62 funds (48%) have negative coefficients and only one of them is significant at a 5% level (0.8%). When looking for equally weighted portfolios performance, there are mixed evidence of performance where the Bond EUR portfolio, with statistically significance at a 5% level found in only 7 (9%) of the 81 total bond funds, with 6 positive (7%) and only 1 negative coefficient (1%) and the Bond Government shows 3 of the 18 bond funds with statistically significant coefficients, and all are positive (17%), displaying the highest percentage of positive statistically significant coefficients and only a small part of this equally weighted portfolio. The rest of the portfolios, the Bond Europe and Bond Corporate portfolios with have no statistically significant coefficient. Overall, a positive alpha coefficient is the common result with Term Spread movements considerably correlated with funds excess returns, where the Bond Government funds display the highest average for coefficients.

The variable Term Spread adjusts the Bond factor influence on excess returns according to the increase or decrease in long-term bond yields or short-term bond yields with a predominant bond factor coefficient. In sample, there are 59 positive fund coefficients (46%) and 11 are statistically significant at a 5% level rejecting the null hypothesis with a 95% level of confidence (8.6%). When funds invest more heavily on short-term bonds, Bond fund positive influence can also decrease considering that short-term bond yields are now less advantageous in the bond market. 69 coefficients within the sample are negative (54%) and 15 are statistically significant at a 5% level (11.8%). With the incorporation of this information variable, all equally weighted portfolios seem almost all to have a positive coefficient average in which the bond influence of Bond Corporate funds excess returns increases more and the Bond EUR funds decrease more. Bond Europe funds demonstrate most variation on excess returns than the rest of the funds present in the sample and Bond Government funds exhibit the least variation.

The Stock factor influence on bond excess returns is consequently affected by Term Spread activity when using the conditional model, increasing or decreasing according to the widening or narrowing of long-term and short-term yield spread. Positive coefficients account for nearly half of the negative, with 52 coefficients (40.6%) and only one is statistically significant and related to the Bond EUR (1.2%). Negative coefficients indicate that the stock factor decreases with a wider Term Spread, possibly because long-term

bond yields have an inverse relation to stocks, with 76 bond coefficients (59%) and 14 are statistically significant at a 5% level (11%). With the incorporation of this information variable, half of the funds seem to have an inverse correlation of the bond market with the Term Spread variable and the other half a positive correlation. The Bond EUR funds excess returns in average decrease more with positive market movements and the Bond Europe increase more. Standard deviation seems to indicate that the Bond EUR funds excess returns vary more in average than the rest of the portfolios and the Bond Corporate seems to not vary at all when the Term Spread variable is incorporated.

The Default Spread factor influence on bond funds also changes when the Term Spread is accounted for. The impact of the spread between yields of riskier and safer bonds can change as the Term Spread increases or decreases. In total, there are 75 total funds with positive coefficients (59%) and 15 are significant at a 5% level (12%). So when the Default Spread factor influence increases with Term Spread movement there is indication that funds with long-term bonds incorporate risk, since a wider Default Spread indicates a rise in riskier bond yields. Negative coefficients count to 53 (41%) and 11 of them are statistically significant at a 5% level (9%). Overall with the incorporation of the Term Spread variable all equally weighted portfolios have a positive coefficient average, where Bond Corporate funds excess returns seem to increase more with Default Spread positive movements than the rest of the equally weighted portfolios and the Bond Government increase less. Standard deviation shows higher variation in Bond EUR funds and lower variation in Bond Europe funds, which seems common in all coefficients that integrated the Term Spread variable.

The IRW is the other information variable incorporated in the conditional model affecting performance in accordance to aversion to risk. As aversion to risk increases, bond fund excess returns can increase likewise indicating that bond funds serve as a safe investment. Positive coefficients amount to a total of 75 (59%) and only 7 (5%) are statistically significant at a 5% level. Negative fund coefficients amount to 53 (41%) and 17 (13%) are statistically significant at a 5% level. A positive relation to aversion to risk is also displayed when looking at all the equally weighted portfolios with the exception of the Bond Europe which has only 1 fund with a statistically significant coefficient and none of them are positive estimating 7% of the bond funds. Significance at a 5% level is also found in the equally weighted portfolios where the Bond EUR portfolio has 20 (29.7%) of 81 bond fund coefficients that are statistically significant and 7 are positive (8.6%) and the rest 13 are negative (16%), representing a higher negative influence of this same variable. The Bond Government has no funds with statistically significant coefficients and the Bond Corporate portfolio exhibits only 3 bond funds with statistically significant coefficients and they are negative (20%), which has the highest percentage of negative influence of aversion to risk. As for equally weighted portfolios average excess returns increase when aversion to risk increases for all funds are presented in the sample. Bond EUR funds exhibit the most

incremental relation in average excess returns in correlation with aversion to risk and Bond Government funds increase less.

Regarding the Bond Factor, funds can have excess returns increase or decrease more or less according to bond market movements when the IRW is incorporated in the model. Positive conditional coefficients signal funds that invest in less riskier bonds, as when aversion to risk increases so does the bond market compensation for excess returns. A total of 66 funds (52%) have a positive coefficient and 20 (16%) are statistically significant at a 5% level. Nonetheless funds can be more compensated by the bond market when aversion to risk decreases, possibly because they invest in higher risk bonds. Negative coefficients count up to a total of 62 funds (48%) and 17 are statistically significant at a 5% level of significance (13%). Bond market influence on equally weighted portfolio funds excess returns is somewhat mixed and a positive relation between aversion to risk and excess returns is found in Bond Corporate and Bond EUR funds and a negative relation in Bond Europe and Bond Government funds. Bond Corporate funds exhibit the most positive relation of average excess returns with aversion to risk and Bond Europe funds the larger decline.

Bond funds excess returns can be influenced by the stock market differently when the IRW variable is integrated on the model. Positive coefficients count to 66 coefficients (52%) with 6 (5%) statistically significant coefficients at a 5% level indicating that a rise in the stock market compensates more bond fund excess returns when aversion to risk increases. A smaller part of the sample bond fund coefficients are negative since bond funds don't usually invest in risk having 59 (46%) coefficients and only 4 (3%) are significant at a 5% level. Bond Government and seems to have its stock market more influenced negatively affected by aversion to risk and Bond Corporate the opposite. There is the possibility that a share of the sample funds integrate bonds with risk since a positive relation indicates that when aversion to risk increases positive stock market movement rewards on bond funds excess returns. As for the opposite effect, an increase in the IRW, will lower the stock market influence, which usually happens when funds incorporate less riskier bonds

Default spread influence on bond excess returns can be changed when the IRW variable is integrated in the model. A wider Default Spread coefficient generates an increase or decrease in bond excess returns depending of the degree that aversion to risk correlates with the coefficient. Statistically significant coefficients count to 36 coefficients (28%) and 23 (18%) are positive and statistically significant at a 5% level which is evidence that a wider Default Spread influence that is positively correlated to aversion to risk is a more prevailing result for great part of the funds presented in the sample, a positive correlation between aversion to risk and Default Spread movement. Bond Corporate portfolio funds have its excess returns positively affected with an increase on the Default Spread when aversion to risk increases, with a higher percentage of

statistically significant positive bond funds, and the Bond Government portfolio funds increase less, with a higher percentage of statistically significant negative bond funds.

Table 5 shows the results for the conditional multi-index model for all the equally weighted portfolios. Again the abnormal returns on the equally weighted portfolios are negative and nearly all are significant except the Bond Europe and Corporate portfolios consistent with the unconditional model reaffirming the hypothesis that there is no proof that funds did beat the market.

As for the alpha coefficient the conditional model shows that equally weighted portfolios have negative excess returns and below the market average with statistically significant coefficients at the 1% level for the equally weighted portfolio with all the funds, for the Bond EUR and for the Bond Government portfolios. As in the other models results are not very different with the coefficients nearly all similar. The lowest coefficient corresponds to the Bond Government portfolio equal to 0.063% and can be associated to the most negative average coefficient of all equally weighted portfolios, and the least statistically significant negative coefficient corresponds to the Bond EUR portfolio, equal to 0.060% nonetheless the portfolio with the least negative average of all the statistically significant bond funds.

For the bond market factor all equally weighted portfolio coefficients are positive and significant as in the previous unconditional model and the perception of the influence of this factor did not change with addition of information variables. This indicates that bond market movements again are a positive influence on funds excess returns, which is expected since this analysis focus on bond funds. The Bond Index continues to be highly influential with the highest coefficient corresponding to the Corporate Bond portfolio where an increase in 1% on the Bond Index will result in an increase in returns of 0.878%, which can be explained by the highest average of bond fund excess returns, and the smallest coefficient corresponds to the Bond EUR portfolio with a small increase of 0.60%, possibly linked to the lowest average of excess returns and the only portfolio without a 100% percentage of statistically significant positive bond fund coefficients.

Table 5 – Regression estimates for the conditional model

	Alpha	Alpha*TS	Alpha*IRW	Bond Index	Stock Index	Default Spread
All funds	-0.062**	0.061	-0.156	0.675***	0.028***	-0.006
Bond EUR	-0.060**	0.072	-0.104	0.600***	0.022***	0.018
Corporate	-0.026	0.109	-0.862***	0.878***	0.070***	0.014
Government	-0.063***	0.040	0.236	0.703***	-0.008***	-0.049*
Bond Europe	-0.040	0.000	-0.525*	0.841***	0.047***	-0.044**

	Bond Index		Stock Index		Default Spread				
	TS	IRW	TS	IRW	TS	IRW	Adj R^2	Shapiro P-Value	BP P-Value
All funds	0.152	0.017	0.017	-0.019	0.233	0.043	0.874	0	0
Bond EUR	0.077	-0.004	0.022	-0.014	0.055	0.019	0.869	0	0
Corporate	1.456**	0.270***	-0.010***	-0.084	1.861***	0.317***	0.776	0	0
Government	-0.269	-0.006	-0.012	-0.001	0.002	-0.010	0.925	0	0
Bond Europe	0.067	0.029	-0.046***	-0.032	1.016***	0.141***	0.893	0.	0

This table reports the regression estimates for the equally weighted portfolios resulting from the conditional model using IRW and Term Spread as information variables. Average conditional alphas and conditional alphas (alpha*IRW and alpha*TS), all expressed. in percentage, as well as average conditional betas on Bond. Stock and Default Spread factors and conditional betas dependent on information variables and the in-sample adjusted coefficient of determination of the regressions (R^2adj.) are reported. Tests on regression residuals and autocorrelation function up to 3 lags are reported as well using the Shapiro-Wilk (1965) normality test for normality and the Breusch and Pagan (1979) for heteroscedasticity. In order to correct the problem of heteroscedasticity the Francisco Cribari-Neto (2004) Asymptotic Inference was performed resulting in the estimated coefficients.

* 10% level of statistically significance ** 5% level of statistically significance *** 1% level of statistically significance

The stock market factor has all coefficients within a 99% confidence interval the Government Bond equally weighted portfolio and only for the Bond Government is negative which indicate an inverse correlation. So stock market movements seem to be positively correlated with the equally weighted portfolios present in the sample, having its excess returns increased by incremental stock movement. The influence of the stock factor is bigger than the unconditional model, however smaller than the Bond Index, where the highest coefficient corresponds to the Bond Corporate portfolio and an increase in 1% on the Stock Factor will result in an increase of returns equaling 0.070%, associated with the highest bond fund average of all the equally weighted portfolios and highest percentage of statistically significant positive bond coefficients, and the only negative statistically significant coefficient corresponds to the Bond Government portfolio with a narrow decrease of 0.008%, the portfolio with funds with the lowest bond fund average and highest bond fund percentage of statistically significant negative bond coefficients.

As for the Default Spread factor results indicate non-significance across all equally weighted portfolios except the Government Bond and Bond Europe portfolios. It appears that information variables incorporated some variance tied in with economic conditions since the factors influence shrinks with only 2 statistically significant coefficients, the Government Bond portfolio has a statistically significant negative coefficient at the 10% level and the Bond Europe portfolio has a statistically significant negative coefficient at the 5% level. The lowest coefficient corresponds to the Bond Government portfolio where a 1% increase in the Default Spread factor will cause a decrease in returns of 0.049%, due to the fact that funds presented in this portfolio have the lowest coefficient average of the sample and highest bond fund percentage of statistically significant negative coefficients, and the Bond Europe portfolio with a decrease of 0.044% respectively.

Concerning the conditional information variables the Term Spread and IRW, the Term Spread variable only has no statistically significant alpha coefficient and the IRW has two statistically significant alpha coefficients. Nonetheless all term spread coefficients seem to be positive and the expected return of the portfolio is going to be positively affected by an increase of longer term bond yields and a decrease on shorter term bond yields. For the IRW variable both Bond Corporate and Bond Europe, with the most negative average fund coefficient, have statistically significant negative coefficients at the 1% level and at the 10% level, respectively when the variable for aversion to risk is taken into account, so a negative correlation between aversion to risk and the portfolio excess returns. The Government Bond portfolio has the only positive coefficient non-significant nonetheless.

Lagged information variable can affect risk factors by influencing their impact on bond excess returns. For the bond index, the term spread variable has only one statistically significant coefficient at the 5% level on the Corporate Bond portfolio, where an additional percent of the Term Spread relative to the Bond

Index will result in an increase of 1.456%, correlating with the highest bond fund average of excess returns and highest bond fund percentage of statistically significant positive coefficients. For the IRW variable and an additional 1% will result in an increase of 0.270%, linking with the highest bond fund average coefficient and highest percentage of statistically significant coefficients. The Stock Index is only influenced by the Term Spread where statistically significant coefficients at 1% level of significance are displayed for the Corporate Bond portfolio and the Bond Europe portfolio. A one percent increase in the Term Spread variable in relation to the stock index excess returns will result in a decrease of 0.010% for the Corporate bond portfolio with the equally weighted portfolio with the least negative bond coefficient and a decrease of 0.046% for the Bond Europe portfolio the most negative bond fund coefficient. As for the Default Spread factor there are 2 statistically significant coefficients at a 1% level of significance for the Term Spread variable on the Bond Corporate portfolio with an increase of 1.861%, explained by the highest average of bond fund excess returns and highest bond fund percentage of statistically significant positive coefficients, and the Bond Europe portfolio where a one percentage point increase in the Term Spread variable relative to the default spread will result in a 1.016% increase on bonds excess returns. The IRW variable influences also the same equally weighted portfolios with two coefficients at a 1% level with an increase of 0.317% for the Corporate portfolio, also the highest bond fund percentage of statistically significant positive coefficients, and with an increase of 0.141% for the Bond Europe portfolio

In terms of goodness of fitness of the model the conditional model presents a higher adjusted R^2 and lower standard error than the unconditional model for all the equally weighted portfolios, nonetheless the regressions for the Bond Euro and the Bond Government portfolios display an increase of the residual standard error. The Bond Corporate presents the largest difference between models with the most positive difference of the adjusted R^2. The Bond Europe presents the highest value of adjusted R^2 and the Bond Government portfolio the lowest value.

It's also tested the regression residuals on all the equally weighted portfolios using the Shapiro-Wilk (1965) normality test and the Breusch–Pagan (1979) test for heteroscedasticity. In almost all the portfolios normality of the residuals is rejected, only for the Bond Europe equally weighted portfolio that is not the case. For the Bond Europe portfolio the hypothesis of the residuals non-normality cannot be rejected with a 90% confidence interval. It is not possible to reject heteroscedasticity for all portfolios, meaning that the residuals variance is not constant across time. Additional normality tests on normality were made on equally weighted portfolio with all the bond funds specifically the Residuals vs Fits, the Normal Q-Q, Scale Location and the Residuals vs Leverage present in the appendix 2.

The dummy variable model was applied in order to see the differences in bond excess returns during recessions and expansions periods. Usually in expansion periods investor shift their focus from safer to riskier bonds leading potentially to higher performance of bond funds that incorporate more risk in relation to the funds that incorporate less.

Table 6 presents the estimations of the excess returns for the dummy variable model where the columns present the results for the Bond EUR. Bond Government, Bond Corporate and the Bond Europe portfolios.

There are 100 negative coefficients and 29 are significant with a 95% level of confidence interval. A negative coefficient implies that funds present in the sample did not beat the market and underperformed. Positive coefficients however imply the inverse effect where excess returns are greater than the overall market excess returns making a total of 28 coefficients and none is statistically significant, thus implying that funds did not beat the market. Fund performance is mixed when considering equally weighted portfolios where some show a greater portion of the bond funds with negative performance, specifically the Bond Government has 8 of 18 bond funds with statistically significant coefficients, where all are negative (44%). As for the rest of the portfolios positive or neutral performance is the pattern where the Bond EUR portfolio has 19 of the total 81 bond funds with statistically significant coefficients all negative (23%), the Bond Corporate portfolio with no statistically significant coefficient, and the Bond Europe 2 bond funds with statistically significant coefficients also both negative (14%). Results suggest that the bonds during expansion periods decrease their performance with the Bond Government funds showing a higher percentage of negative statistically significant coefficients which can indicate a higher probability of negative performance and Bond Corporate funds display the opposite with less evidence of negative performance. Following this information the only positive average alpha coefficient is for Bond Corporate funds and the most negative average corresponds to funds in the Bond Government portfolio, which it's understandable when looking at the percentage of statistically significant negative coefficients.

In regressions, usually the opposite occurs and demand for riskier bonds decreases, probably detrimental to performance of funds that incorporate risk in their portfolio. Positive performance is predominant bond funds making a total of 81 adding more 53 coefficients than in expansion periods (65%) and with 16 significant coefficients at a 5% level (19.8%), which in expansion periods were equal to 0. Negative coefficients on recessions decrease in relation to expansion periods with a number of 47 coefficients (37%) where 7 are statistically significant at a 5% level (5.5%). At the equally weighted portfolio level, the Bond Government portfolio with 2 of a total 18 bond funds with statistically significant positive coefficients (11%). The Bond EUR portfolio has 15 funds (18.5%) of the 81 with statistically significant coefficients, 11 are positive

(14%) and 4 negative (5%) and the Bond Europe portfolio has 3 of 14 bond funds with statistically significant coefficients and 3 are positive (21%), exhibiting the highest alpha coefficient average and the highest average of positive statistically significant coefficients, and the Bond Corporate with no statistically significant coefficient although with the lowest and the only negative average bond fund coefficient.

Bond Index also influence excess returns and the dummy model investigates in both expansions and recession periods where a rise on the bond market can cause a rise or fall of fund performance. In expansions periods a rise in bond index performance can lead to an increase or decrease in bond excess returns. The number of positive coefficients, around 127 funds with 116 statistically significant funds at a 5% level (91%), demonstrates that the larger part of the sample has its excess returns positively correlated with bond market movements in economic expansion periods. Negative coefficients are not found in any of the bond funds presented in the sample. As for the equally weighted portfolios level of significance at 5% level, the Bond EUR portfolio has 72 of 81 bond funds with statistically significant coefficients and all are positive (89%), the Bond Europe has all the 14 coefficients and all are positive (100%) and both the Bond Government and Bond Corporate funds have statistically significance in almost all bond funds, where positive coefficients account to 17 (94%) and 13 (87%) respectively. Bond Europe is the equally weighted portfolio with the highest average of positive statistically significant coefficients which implies that a majority of these funds have a positive performance and the Bond Corporate portfolio funds exhibit a lowest average of negative alpha intercepts with a higher percentage of funds with negative performance.

In recessions overall bond fund influence also increases with 83 positive coefficients (65%) and the rest are negative with 17 negative (13%) and 40 positive with statistically significant at a 5% level (31%). Probably bonds have a higher demand and bond yields rise during periods of economic crisis leading to a smaller compensation in bond funds excess returns. When looking at the equally weighted portfolios, in general the influence of the bond market decreases in periods of economic recession with the exception of the Bond EUR where almost all bond funds have statistically significant coefficients, 41 funds (51%) of a total of 81 with 31 positive (38%) and 10 negative (12%). The Bond Europe has 5 (36%) of a total 14 bond funds with statistically significance, 4 negative (29%) and excluding 1 that is positive (7%), the Bond Government shows 9 bond funds with statistically significance at a 5% level (50%), 6 are positive (33%) and the other 3 are negative (17%), the Bond Corporate portfolio with 12 of the total 15 bond funds with statistically significance and all are positive (80%). The equally weighted portfolio with the highest average of positive coefficients corresponds to the Bond Corporate which indicates that this type of funds have a higher increment in excess returns when the bond index goes up and the Bond Government the lowest average of negative coefficients.

Stock Factor influence also changes in expansion and recession periods increasing or decreasing within economic periods. In expansion periods positive coefficients indicate that the bond index increases excess returns with positive bond market movements. Positive coefficients account for 88 coefficients which is a smaller fraction of the bond funds specifically 69% and all are significant at a 5% level. Negative coefficients account for 40 coefficients (31%) and 9 of them are significant at 5% equaling to 7% of the total bond sample. This indicate that bond fund excess returns decrease with an upward movement of the bond market and encapsulates a lesser part of the sample since risk is not common on bonds. A negative correlation with the stock market continues to be seen in all portfolios, where significance at a 5% level is shown in the Bond EUR portfolio, 52 bond funds (64%) have a positive bond coefficient and 17 are statistically significant (21%) and from the other 29 negative coefficients (36%), 3 are statistically significant at a 5% level (4%). The Bond Europe shows almost 14 bond funds with positive coefficients, with 6 statistically significant coefficients (43%), the Bond Government has 7 (67%) of the 18 bond funds coefficients are positive and the rest are negative with 6 coefficients that are statistically significant at a 5% level (33.3%) and the Bond Corporate portfolio all funds have a positive coefficient and 12 are statistically significant at a 5% level (80%). The Bond Government portfolio bond fund average intercept indicates that this type of funds have a negative relation with the stock index and the Bond Corporate with the higher bond fund average indicates a higher increment in returns which can be expected since this types of bonds are more highly influenced by corporations.

In recession periods positive coefficients account for 87 total coefficients (68%) where 23 have a statistically significant at a level of 5% which equate for 18% of the total sample thus it appears that in periods of economic crisis a larger portion of bond funds are more compensated by the stock market movements since a lower number of negative coefficients is displayed. Only 41 bond funds have a negative coefficient (32%) and only 5 are statistically significant at a 5% level representing 4% of total sample. In spite of a more predominant negative relation seen in the bond fund sample, looking at the equally weighted portfolios a positive relation between the bond market and the bond fund returns is more common where the Bond EUR portfolio has 23 (28%) of a total 81 bond funds with statistically significant coefficients, 19 are positive (23%) and 4 are negative (5%), the Bond Europe with only one fund with a statistically significant coefficient and is negative (7%), the Bond Government portfolio presents 10 bond funds with a positive coefficient (56%) and only one is statistically significant (5.6%), and the Bond Corporate shows only one fund with statistically significant coefficient and is positive (7%). The Bond Europe demonstrates a negative relation with the stock index on recession periods with the only negative average coefficient and the Bond Corporate portfolio the higher average coefficient increasing more with a positive movement in the Stock Index.

As the Default Spread increases, yields of riskier bonds increase in relation to safer bonds, fund excess returns variance is different across economic periods. The larger part of the funds has a positive coefficient with 24 significant coefficients at a 5% level (19%), where a rise of riskier bond yields increases bond performance. The other part of the funds has negative coefficients up to 11 (9%), all significant at a 5% level. On individual funds present in the equally weighted portfolios significance at a 5% level is found in the Bond EUR where positive coefficients count to 21 (26%) and negative to 5 (6%), the Bond Europe portfolios where exhibit one positive statistically significant coefficient (7%) and 3 negative (21%), the Bond Government has statistically significant coefficient with 2 positive coefficients (11%) and 3 negative (17%) and the Bond Corporate with no statistically significant coefficient.

In recessions, 43 funds (34%) the larger part of the sample has negative coefficients with significance within a 95% confidence interval for 19 funds (15%), increasing the number of funds with performance influenced by safer bond yields, 48 coefficients are positive (38%) but only with significance at 5% in 11 funds (9%) where performance increase as riskier bond yields increase. As in recession the negative correlation with the Credit Spread continues to be seen in all equally weighted portfolios excluding the Bond Corporate portfolio with 2 bond funds composing the portfolio with statistically significant coefficients (13.3%), although the one that have its excess returns with a higher increase by a rise in the Default Spread. The Bond EUR portfolio has 23 bond funds (28%) with a statistically significant coefficient, 15 negative (19%) and 8 positive (10%), showing a higher percentage of positive statistically significant coefficients, the Bond Europe with 2 statistically significant coefficients, 1 positive (7%) and the other negative (7%), and the Bond Government with 3 coefficients and all are negative (17%), displaying a higher percentage of negative statistically significant coefficients. The equally weighted portfolio where the Default Spread influences more positively the excess returns corresponds to the Bond Corporate portfolio and the Bond EUR portfolio displays the opposite result with a more substantial negative influence.

Table 6 – Regression Estimates for the dummy variable model for individual funds

α	Bond EUR	Bond Corporate	Bond Government	Bond Europe
Average	-0.0529	0.0084	-0.0564	-0.0538
St. Dev.	0.0439	0.0583	0.0679	0.0006
% +	18.5%	66.7%	88.9%	7.1%
% sig. +	0%	0%	0%	0%
% -	81.5%	33.3%	6.7%	92.9%
% sig. -	23.5%	0%	44.4%	14.3%
β Bond	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.4706	0.2779	0.5188	0.7891
St. Dev.	0.3548	0.1258	0.3676	0.0004
% +	98.8%	100%	100%	100%
% sig. +	88.9%	86.7%	94.4%	100%
% -	1.2%	0%	0%	0%
% sig. –	0%	0%	0%	0%
β Stock	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.0136	0.0257	-0.0087	0.0322
St. Dev.	0.0214	0.0252	0.0152	0.0004
% +	64.2%	100%	38.9%	100%
% sig. +	21%	80%	0%	42.9%
% -	35.8%	0%	61.1%	0%
% sig. –	3.7%%	0%	33.3%	0%
β DS	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.0429	0.0420	-0.0244	-0.0670
St. Dev.	0.1574	0.0599	0.0914	0.0017
% +	64.2%	100%	50%	28.6%
% sig. +	25.9%	0%	11.1%	7.1%
% -	35.8%	0%	50%	71.4%
% sig. –	6.2%	0%	16.7%	21.4%

α Dummy	Bond EUR	Bond Corporate	Bond Government	Bond Europe
Average	0.0321	-0.0120	0.0410	0.0600
St. Dev.	0.1302	0.1302	0.0606	0.0017
% +	63%	46.7%	77.8%	64.3%
% sig. +	13.6%	0%	11.1%	21.4%
% -	37%	53.3%	22.2%	45.7%
% sig. -	4.9%	0%	0%	0%
β Bond Dummy	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.0856	0.2779	0.0153	-0.0780
St. Dev.	0.1901	0.1258	0.1722	0.0020
% +	65.4%	20%	75%	35.9%
% sig. +	38.3%	0%	75%	7.1%
% -	34.6%	80%	25%	64.3%
% sig. –	12.3%	60%	20%	28.6%
β Stock Dummy	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	0.0108	0.0257	0.0040	-0.0141
St. Dev.	0.0296	0.0252	0.0178	0.0003
% +	71.6%	93.3%	55.6%	35.7%
% sig. +	23.5%	21.4%	5.6%	0%
% -	28.4%	6.7%	44.4%	64.3%
% sig. –	4.9%	0%	0%	7.1%
β DS Dummy	**Bond EUR**	**Bond Corporate**	**Bond Government**	**Bond Europe**
Average	-0.0295	0.0291	-0.0042	0.0367
St. Dev.	0.1323	0.1323	0.1088	0.0019
% +	34.6%	100%	33.3%	50%
% sig. +	18.5%	13.3%	0%	7.1%
% -	65.4%	0%	66.7%	50%
% sig. –	9.8%	0%	16.7%	7.1%

"Average" represents the average of the regression coefficients. "Std. Dev." represents the standard deviation of the same coefficients. "% +" and "% -"represent the percentage of funds with a positive or negative coefficient respectively, "% + sig." and "% - sig." represent the proportion of funds with a positive or negative statistically significant coefficient respectively at a 5% level of significance.

Table 7 reports the results for the model with a dummy variable identifying expansion and recession periods, as measured by the CEPR Euro Area business cycles available at the Euro Area Business Cycle Network.

During expansion periods nearly all the portfolios have statistically significant alphas and all are negative, which are in line with the previous results. The equally weighted portfolio of all funds presents a significant alpha at the 1% level, the Government Bond portfolio and the Bond Europe portfolio exhibit significant alphas at the 5% level and the Corporate Bond portfolio show a non-significant alpha. The Bond EUR with the highest statistically significant coefficient has also the highest bond fund average of all equally weighted portfolios and the Bond Government with the lowest statistically significant coefficient, which can be explained by the lowest bond fund average and a higher percentage of negative statistically significant bond fund coefficients. Regression results for the recession periods show only one statistically significant coefficient, the Bond Corporate portfolio equivalent to -0,098%, and is negative for 1% level, which can be to the fact that it incorporates the lowest bond found average.

The influence of the bond market factor continues to be important as almost all coefficients are positive and statistically significant at the 1% level in periods of economic growth excluding the Bond Europe, the Bond Government equally weighted portfolio has the highest statistically significant increase by 1% equivalent to 0.758%, with the highest percentage of statistically significant positive coefficients, and the Bond EUR portfolio with the lowest statistically significant coefficient with an increase equivalent to 0.530%. In recessions almost coefficients are positive except for the Corporate bond portfolio but none is statistically significant.

Table 7 – Regression Estimates for the dummy variable model

					Dummy						
	Intercept	Bond Index	Stock Index	DS	Alpha	Bond	Stock	DS	Adj R^2	Shapiro P-Value	BP Test P-Value
All funds	-0.071***	0.624***	0.020***	0.027	0.034	0.105	0.019	-0.026	0.881	0.000	-0.061
Bond EUR	-0.069***	0.530***	0.014**	0.040**	0.047	0.077	0.012	-0.032	0.877	0.001	0.094
Corporate	-0.027	0.685***	0.068***	0.056	-0.098**	0.301	0.027	0.179	0.736	0.004	0.044
Government	-0.113**	0.758***	-0.018***	-0.030**	0.076	-0.031	0.019	-0.067	0.927	0.000	0.038
Bond Europe	-0.059	0.797	0.049	-0.011	0.036	0.021	0.001	0.065	0.864	0.073	0.000

This table reports the regression estimates for the equally weighted portfolios resulting from the unconditional model using a dummy variable to distinguish crisis and non-crisis periods. Alphas and all expressed in percentage and beta estimates for crisis and non-crisis periods. as well the in-sample adjusted coefficient of determination of the regressions (R^2adj.) are reported. Tests on regression residuals autocorrelation function up to 3 lags are reported as well using the Shapiro-Wilk (1965) for normality test for normality and the Breusch and Pagan (1979) test for heteroscedasticity. In order to help correcting the problem of heteroscedasticity the Francisco Cribari-Neto (2004) Asymptotic Inference was performed resulting in the estimated coefficient.

* 10% level of statistically significance ** 5% level of statistically significance *** 1% level of statistically significance

For the stock market factor almost all the coefficients are positive and significant at the 1% level of significance level except for the Bond Euro portfolio with no significance and the Government bonds with a negative coefficient. Usually government bonds have lesser risk incorporated and as in other regressions there is an inverse relation between the stock market factor and this type of bonds. Stock market coefficients show still a small effect in the stock index where a 1% increase in the stock index will result in an increase equal to 0.068% related to the Bond Corporate portfolio, the equally weighted portfolio with the highest bond fund average for this coefficient and the highest bond fund percentage of statistically significant positive coefficients, and a decrease in the Government Bond portfolio equal to 0.018% with the lowest average of the bond fund coefficients and the highest bond fund percentage of statistically significant negative coefficients. In recessions all coefficients are positive but none is statistically significant for all equally weighted portfolios.

The Default Spread factor displays only two significant coefficients in expansion periods, the Government Bond portfolio and the Bond EUR portfolio at the 5% level, so if expected returns on corporate/risky bonds increase in relation to the risk-free rate. Bond EUR, where a high positive average seems to relate to the higher coefficient present in the sample, and Government bonds expected returns increase as well. Default Spread coefficients also display a narrow influence in bond returns where a 1% increase in the Default Spread factor will result a significant statistically significant increase equaled to 0,040% for the Bond EUR portfolio, the portfolio with the highest average for bond funds for this coefficient and the highest bond fund positive percentage of statistically significant coefficients, and a decrease in the Government Bond portfolio equal to 0.030%, which can be related to the lowest average for bond fund coefficients and highest percentage of statistically negative coefficients. In recessions the default spread has no statistically significant coefficients and no influence over the equally weighted portfolios.

In terms of goodness of fitness of the model, it has a higher adjusted R^2, lowering only for the Bond Corporate and Bond Europe and lower standard error for most of the equally weighted portfolios than both the unconditional and conditional but the one presented in the Bond Government in the unconditional model continues to be lower. The equally weighted portfolio with all funds presents the highest value for adjusted R^2 and the Bond Government portfolio the lowest value.

We also tested the regression residuals for all the equally weighted portfolios using the Shapiro-Wilk (1965) normality test and the Breusch–Pagan (1979) test for heteroscedasticity. Normality of the residuals is rejected for almost all portfolios, only for the Bond Europe equally weighted portfolio it is not possible to reject normality with 95% confidence. Heteroscedasticity is not rejected for all portfolios meaning that the residuals

variance is not constant across time. Additional normality tests on normality were made on equally weighted portfolio with all the bond funds specifically the Residuals vs Fits, the Normal Q-Q, Scale Location and the Residuals vs Leverage present in the appendix 3.

Autocorrelation is not very impact full when measuring bond excess return using the model with the dummy variable as the coefficients values close to 0 in all the equally weighted portfolios.

6. Conclusion

This dissertation investigates German bond fund performance using several methodologies, an unconditional approach, a conditional approach using conditioning information variables and a dummy variable approach considering periods of expansion and recession. The funds in the dataset are domiciled in Germany with a range of investment located in Germany or in Europe with at least 36 monthly observations. In addition, we only consider bond funds of the four main LIPPER Categories of Bond funds: Bond Euro, Bond Government, Bond Corporate and Bond Europe.

The factors used on the multi-index model are a bond market factor, a stock market factor and a default spread factor. For the conditional model the Inverse Relative Wealth and the Term Spread are used as information variables allowing for both time-varying alphas and betas. This model appears to add some explanatory power compared to the unconditional model since the adjusted R^2 increased for most portfolios of funds.

The model with the dummy variable has the advantage of identifying two important market states and gives the possibility of an analysis of returns between recession and expansion periods. This type of methodology considers that fund performance is state dependent as argued by Glode (2011) and Kosowski (2011). The dummy variable proved to be useful when measuring bond returns since the adjusted R^2 increased in relation to both unconditional and conditional models except for Bond Corporate and Bond Europe portfolios.

The results show that in general bond funds exhibit negative performance however we cannot reject the hypothesis of neutral performance for the Bond Corporate portfolios applying the unconditional and for the Bond Europe and Bond Corporate applying the multifactor conditional model and the model with the dummy variable.

The unconditional model exhibits positive coefficients for almost all equally weighted portfolios for all the factors excluding two negative significant coefficients, one for the Stock Index, the other for Default Spread and both for the Government Bond portfolio. It is comprehensible that upward bond market movements cause an increase in excess returns, since this analysis focus on bond funds and the stock market movement influence is also understandable for the fact that some funds incorporate corporate bonds. However, Default Spread coefficients indicate that risker bonds are more commonly found in the sample than safer bonds since a wider Default Spread increases bond fund excess returns.

The conditional model shows consistency to the unconditional model results when attending the influence of the Bond and Stock risk factors with positive significant coefficients in almost all equally weighted portfolios excluding one negative statistically significant coefficient for the Stock Index. However, the influence of the Default Spread risk factor seems to withdraw with no positive statistically significant coefficients and only two statistically significant negative coefficients, one also present in the unconditional model and the other added on. These results suggest that the incorporation of economic information variables optimized the perception of the impact of bond default risk on measuring equally weighted portfolios excess returns, removing a seemingly positive influence of riskier bond yields.

As for the influence of the information variables on portfolio excess returns, the Term Spread no statistically significant alpha coefficient and the IRW has two negative statistically significant alpha coefficients implying that expected bond returns decrease as aversion to risk increases and increase with a rise of long-term bond yields and a fall of short-term bond yields.

Regarding the interaction of the lagged information variables with the risk factors, the term spread variable shows that bond influence is positively affected by an increase in the Term Spread variable showing that long-term bond yields have incremental influence over fund excess returns. As for the stock index the term spread has two statistically significant coefficient and both are negative meaning that a wider term spread leads to a lower compensation for an upward stock market movement. Finally the Default Spread is influent on two portfolios both with a positive coefficient suggesting that a wider term spread leads to a higher payoff for the portfolio expected return when there is a rise in riskier bond yields and a decline in safer bond yields.

The lagged information variable IRW has influence on the bond market factor with one positive statistically significant coefficient. This leads to the conclusion that aversion to risk increases demand for bonds since the influence of the bond index increases on portfolio's excess returns. IRW also strengthens an influence of a wider Default Spread on bond funds excess returns with two positive statistically significant coefficients, implying that aversion to risk reinforces the effect of an upward movement of riskier bond yields on portfolios excess returns.

The dummy variable model shows consistency with the unconditional model results on the influence of the risk factors, with positive statistically significant coefficients excluding two mentioned above for the Stock Index and the Default Spread and without the significant coefficient for the Default Spread found in the conditional model. As for the effects of economic periods on bond returns only for the Bond Corporate portfolio there are statistically significant differences in performance with a negative alpha coefficient indicating that in periods of economic recession this portfolio's bond returns are lower than in periods of economic

expansion. Since Corporate bonds have more risk incorporated it can be expected that in periods of economic stress investors do not buy this type of bonds.

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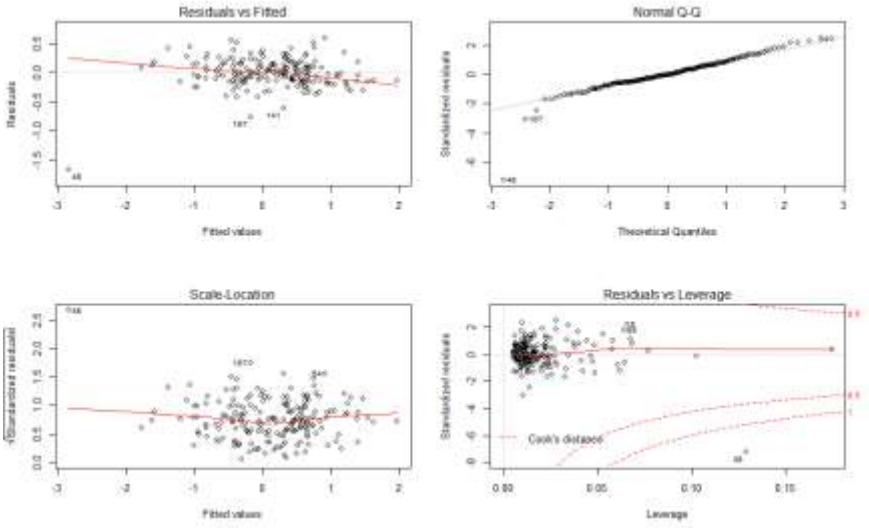
Appendices

Appendix 1 – Normality test for the residuals of the unconditional model

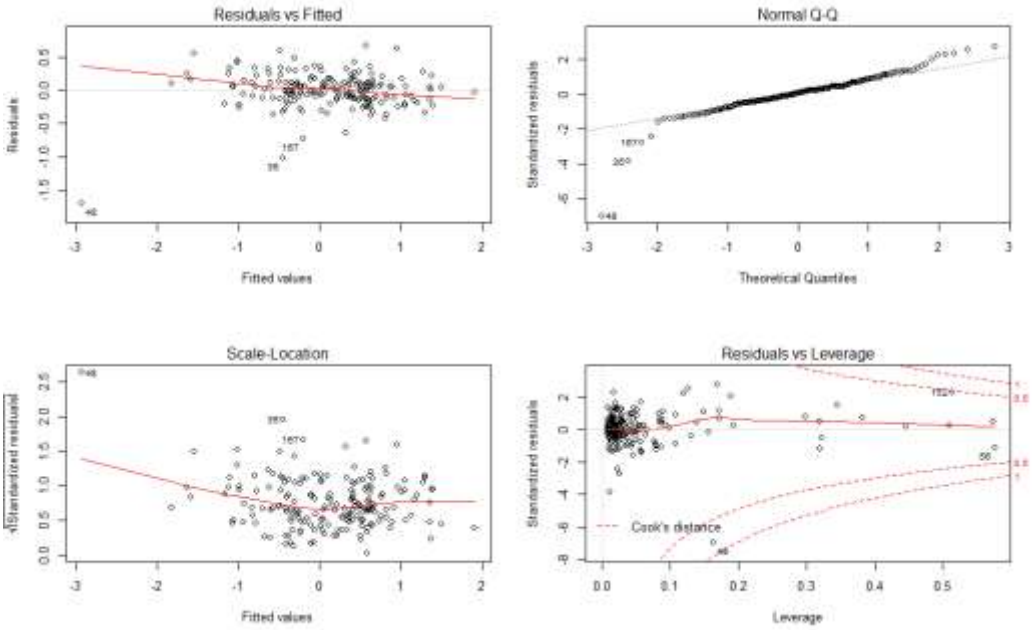
In order to have a more detailed analysis on the normality of the regression residuals several plots were analyzed to observe if a linear regression model is appropriate to the data for all the models.

Plots assessing normality for the unconditional model are shown below. The residuals vs fits plot red line isn't straight so linearity can be a problem, in spite of the spread of the residuals around that line not being too large. Normal Q-Q plot demonstrates extreme values on the edges, so it has a straight line and standardized residuals quantiles fit in with normal distribution outer quantiles do not fit by a large gap. The Scale Location plot suggests heteroscedasticity with a line that isn't horizontal. In the Residuals vs Leverage plot, looking at Cook's line, extreme values are seen where its deletion would cause a major shift in the pattern of returns.



Appendix 2 – Normality test for the residuals of the conditional model

The graphics with the analysis of the regression residuals for the conditional model are shown in below. The residuals vs fits plot shows that the estimated regression line around the 0 axis isn't horizontal which can be a sign of a non-linearity problem. The normal Q-Q plot shows some heavy tails with some points on the extremes. The Scale Location plot shows that the spread around the red line shows that the variability of magnitudes varies as a function of the fitted values suggesting heteroscedasticity. In the Residuals vs Leverage plot, the changing spread around the red regression line also indicates heteroscedasticity and looking at the Cook's line it is possible to see that the deletion of some outliers have high influence over the model but no the extreme seen in the other two models.



Appendix 3 – Normality test for the residuals of the dummy model

Graphics for the dummy variable model are presented below. The residuals vs fits plot indicates that residuals are not too big to cause incoherency in the assumption of linearity and have no distinct pattern, however estimated regression line around the 0 axis isn't horizontal in fact it is a diagonal. which shows problems in linearity. Normal Q-Q plot indicates that even if a big part of the standardized residuals quantiles fit in the normal distribution quantiles. the extreme values are not comparable to a normal distribution by a large gap. The Scale Location plot shows a changing spread around the red line, since it is not horizontal, suggesting heteroscedasticity. In the Residuals vs Leverage plot, looking at Cook's line, it is possible to see that the deletion of some outliers have extreme influence over the model.