The performance of investment grade corporate bond funds: evidence from the European market

Leif Holger Dietze, Oliver Entrop, Marco Wilkens

Angaben zur Veröffentlichung / Publication details:

Dietze, Leif Holger, Oliver Entrop, and Marco Wilkens. 2009. "The performance of investment grade corporate bond funds: evidence from the European market." *The European Journal of Finance* 15 (2): 191–209. https://doi.org/10.1080/13518470802588841.

The performance of investment grade corporate bond funds: evidence from the European market

Leif Holger Dietze, Oliver Entrop* and Marco Wilkens

Catholic University of Eichstätt-Ingolstadt, Ingolstadt, Germany

This paper examines the risk-adjusted performance of mutual funds offered in Germany which exclusively invest in the 'rather new' capital market segment of euro-denominated investment grade corporate bonds. The funds are evaluated employing a single-index model and several multi-index and asset-class-factor models. In contrast to earlier studies dealing with (government) bond funds, we account for the specific risk and return characteristics of investment grade corporate bonds and use both rating-based indices and maturity-based indices, respectively, in our multi-factor models. In line with earlier studies, we find evidence that corporate bond funds, on average, under-perform the benchmark portfolios. Moreover, there is not a single fund exhibiting a significantly positive performance. These results are robust to the different models. Finally, we examine the driving factors behind fund performance. As well as examining the influence of several fund characteristics, particularly fund age, asset value under management and management fee, we investigate the impact of investment style on the funds' risk-adjusted performance. We find indications that funds showing lower exposure to BBB-rated bonds, older funds, and funds charging lower fees attain higher risk-adjusted performance.

Keywords: performance measurement; European corporate bond market; investment grade corporate bond mutual funds; multi-index model; asset-class-factor model; generalized Treynor ratio

JEL Classifications: G11; G23

1. Introduction

The European corporate bond[1] market is a rapidly growing capital market sector which boasted a nominal value of approximately €1370 billion at the beginning of 2005 and growth rates of 16.8% in 2003 and 9.5% in 2004. The European Monetary Union in 1999 merged the formerly separate and comparatively small local markets for corporate bonds. Many European companies have started issuing bonds in order to benefit from the 'new opportunities' of this capital market segment. As a consequence, the European corporate bond market now attracts more diverse investor groups than it did 10 years ago. Another reason for this market's success among investors may be the fact that it achieved higher returns on average than both the euro-denominated government bond market and the European stock market over the recent period of 2000–05.

For private investors, given the highly asymmetrical distribution of corporate bond returns and the de facto existence of minimum investment amounts in this market, the most feasible way to take advantage of the risk and return characteristics of this sector is to invest in broadly diversified corporate bond mutual funds. However, a large number of mutual bond funds traditionally invest in government bonds or in a large variety of different bond types such as government, mortgage, corporate, foreign currency bonds, etc. In addition to these government or mixed bond funds,

*Corresponding author. Email: oliver.entrop@ku-eichstaett.de

there is now a rapidly rising number of specialized mutual funds concentrating on the European corporate bond market which reflects their attractiveness for private investors. Surprisingly, to our knowledge, there is no published academic research dealing with the performance of these 'new' funds.

There are only a few studies on the performance of bond funds. Cornell and Green (1991) examine the performance of low-grade bond funds in the USA but their sample of funds serves as a proxy for the low-grade bond market, rather than for analyzing the performance of active fund management. Blake, Elton, and Gruber (1993) is the first major study to investigate the performance of bond funds in the USA. They apply single-index models (SIMs) and multi-index models (MIMs) and a multi-factor model similar to Sharpe (1988, 1992). In addition to their first study, Elton, Gruber, and Blake (1995) analyze the performance of US bond funds using APT-based MIMs. Kahn and Rudd (1995) measure performance employing an asset-class-factor model but their work focusses on performance persistence. Gallo, Lockwood, and Swanson (1997) and Detzler (1999) evaluate globally investing US-based bond funds using SIMs and MIMs. Ferson, Henry, and Kisgen (2006) are the first to apply conditional performance measures to the US government bond fund market using a stochastic discount factor approach. The Australian government bond fund market is examined by Gallagher and Jarnecic (2002) who apply conditional and unconditional factor models. None of these studies focuses on corporate bond funds.

The same holds for the very few studies of the European bond fund market. Maag and Zimmermann (2000) investigate the performance of German government bond funds using SIM and MIM and an asset-class-factor model. Silva, Cortez, and Armada (2003) analyze the bond fund market in Europe using conditional and unconditional factor models. They refer to a sample of bond funds for six European countries, but only the UK sample based in the non-euro zone explicitly contains a sub-sample that consists of funds that concentrate on corporate bonds.

Our study is the first to investigate a sample of mutual funds primarily investing in euro-denominated investment grade corporate bonds. We limit our analysis to investment grade corporate bond funds since, compared with the US, the European high-yield market is still poorly developed. Given their different focus, none of the studies mentioned above takes into account the specific risk profile of corporate bond funds that can be largely attributed to different rating classes. Hence, our paper also represents the first study to apply letter-rating-based indices, in addition to maturity-based indices, as factors that capture the risk and return characteristics of investment grade corporate bond funds in detail. In addition to investigating the fund performance itself, we analyze the relation between fund characteristics and performance. We examine the influence of the fund characteristics, chiefly management fee, fund size and age. Finally, we assess whether investment style is related to performance.

The paper is organized as follows. Section 2 outlines the research objectives and our hypotheses. The methodology is described in Section 3. Section 4 contains the data and specification of the models. The empirical results are discussed in Section 5.[2] Conclusions and implications are presented in Section 6.

2. Research objectives and hypotheses

The following investigation has been carried out to analyze the risk-adjusted performance of European corporate bond funds. For the US bond fund market, Blake, Elton, and Gruber (1993), Elton, Gruber, and Blake (1995), Kahn and Rudd (1995), Gallo, Lockwood, and Swanson (1997), Detzler (1999), and Ferson, Henry, and Kisgen (2006) report that fund managers under-perform or do not outperform passive benchmark portfolios. Gallagher and Jarnecic (2002) find significant under-performance in the Australian government bond mutual fund market. Analog results are found by Maag and Zimmermann (2000) and Silva, Cortez, and Armada (2003) for (government) bond mutual funds in Europe.

So far, most studies investigating the performance of actively managed bond mutual funds report under-performance or report non-superior performance. This result is robust to both the specific models and benchmark indices as well as the specific market under consideration. This indicates that the considered markets are at least so efficient that a possible out-performance (before costs) is outweighed by the cost of the funds.[3] Since we expect the same in the European corporate bond market, we hypothesize:

Hypothesis 1 (H1) Funds under-perform passive benchmark portfolios, net of expenses.

In addition to the measurement of performance, a well-studied issue in the (government) bond fund market is the relation between expense ratios and performance. For the US market, Blake, Elton, and Gruber (1993) find that, for most of their fund subgroups and models, the expense ratios account for the major part of the under-performance. An analogous negative relation between the expense ratio and the performance is reported by Kahn and Rudd (1995). The findings of Blake, Elton, and Gruber (1993) imply that, on average, a percentage-point increase in expenses reduces performance by about one percentage-point. Detzler's (1999) results indicate an even more inverse relationship for the major part of her models, whereas Maag and Zimmermann (2000) find a less negative and not significant relation in the German government bond fund market. Since we expect the relationship between fees and performance to be similar in similar markets, we hypothesize for our bond fund sample:[4]

Hypothesis 2 (H2) There is a negative relationship between the fund management fees and performance.

Another issue of interest is the relation between fund size and performance. Larger funds should achieve economies of scale that can be realized by spreading the fixed costs, e.g. reporting and marketing, over a larger amount of assets under management and by reducing variable costs, e.g. by efficiencies in security transactions and back-office functions (Collins and Mack 1997). Hence, they should operate at lower costs, as found by Malhotra and McLeod (1997) for US equity mutual funds. On the other hand, larger funds tend to have disadvantages in trading resulting from the price impact of purchasing or selling large amounts of securities when acting in comparatively non-liquid markets.

So far, the relation between fund size and performance has primarily been addressed by studies dealing with equity mutual funds, such as Grinblatt and Titman (1989). Based on US equity mutual fund data, they find an inverse relationship between fund size and performance when analyzing gross returns. In contrast, the performance based on net returns is unrelated to size. In a more recent study, Chen et al. (2004) find evidence that fund size erodes the performance of US equity mutual funds. This effect is more pronounced for small cap funds where it affects the performance significantly. This finding suggests that liquidity may be the driving factor reducing the performance of large-size funds in small markets, outweighing the possible advantage of a better cost structure.[5] As the corporate bond market in Europe is a small market, one might expect that the same holds for corporate bond funds. To test whether this is true, our third hypothesis is:

Hypothesis 3 (H3) There is a negative relationship between the fund assets under management and performance.

In addition to a possible size effect, the performance may be related to fund age.[6] Malhotra and McLeod (1997) find that older US equity mutual funds tend to operate at lower cost.[7] If that were true for our sample and if H2 were valid, and assuming that lower costs result in lower fees, we would expect older funds to have higher risk-adjusted performance. Thus, we hypothesize for the European corporate bond fund market:

Hypothesis 4 (H4) There is a positive relationship between the fund age and performance.

Finally, performance could be related to investment style. The less developed (and efficient) a market is, the more rewarded research activities should be. As the BBB market is known to be less homogeneous and (in Europe) less developed than the higher rating classes, one could expect funds primarily investing in this segment to show higher risk-adjusted performance. Therefore, our last hypothesis for the European corporate bond fund market is as follows:

Hypothesis 5 (H5) There is a positive relationship between the engagement of a fund in BBB bonds and performance.

3. Models

As there is still no evidence on how to apply particular equilibrium models to fixed-income markets such as the corporate bond market, we follow the majority of the papers cited in Section 1 and employ SIMs and MIMs and asset-class-factor models to measure the risk-adjusted performance of the fund management.

In MIMs, the performance measure is the intercept in a regression of fund excess returns on benchmark excess returns, while the benchmark consists of different indices. The general form of the models is given by Blake, Elton, and Gruber 1993:

$$R'_{it} = \alpha_i + \sum_{j=1}^{K} \beta_{ij} I'_{jt} + \varepsilon'_{it}, \tag{1}$$

where R'_{it} is the 1-month excess return on fund i in month t, I'_{jt} the 1-month excess return on index j in month t, β_{ij} the sensitivity of fund i to index j, and ε'_{it} the residual for fund i in month t. α_i measures the risk-adjusted performance of fund i. K represents the number of indices which is simply one in the case of a SIM. Using discrete excess returns, the estimated sensitivities can be interpreted as weights in a passive portfolio, assuming the difference between 1 and the sum of βs is being invested in the risk-free asset. Therefore, excess returns of this benchmark portfolio represent the result of a passive strategy. The ordinary least squares (OLS) method selects βs and α in such a way that the risk of the resulting passive portfolio best mimics the risk of the examined fund.

The shortcoming of the model presented above is its failure to incorporate the restrictions facing the fund management. Negative βs would imply short positions in the corresponding indices, which is normally not allowed in fund management. A sum of the βs exceeding unity would imply a leverage of the fund which is generally not the case either. Both investment strategies, shorting and leverage, can be assumed to be even less feasible for an individual investor. To overcome these shortcomings, we additionally employ the constrained asset-class-factor model of Sharpe (1988, 1992):

$$R_{it} = \sum_{j=1}^{K+1} \beta_{ij} I_{jt} + \varepsilon_{it}, \qquad (2)$$

where R_{it} is the 1-month return on fund i in month t, I_{jt} the 1-month return on index j in month t, and β_{ij} the sensitivity of fund i to index j. $I_{K+1,t}$ denotes the 1-month return of the risk-free asset class. ε_{it} is the residual for fund i in month t which accounts for a possible α of the fund, too. The aim is to find the best set of index exposures (βs) that conforms with fund restrictions (no leverage and no short sales). Following Sharpe (1987, 1988, 1992), we employ a quadratic optimization procedure that minimizes the variance of the residual. More specifically:

$$\min\ Var\left(R_i - \sum_{j=1}^{K+1} \beta_{ij} I_j\right) \quad \text{s.t.} \sum_{j=1}^{K+1} \beta_{ij} = 1 \text{ and } \beta_{ij} \geq 0, \quad \forall j = 1, \ldots, K+1. \qquad (3)$$

Note that in order to keep the constraints simple, returns instead of excess returns are used. For that reason, the risk-free asset has to be included as a separate asset class. If the benchmark portfolio estimated by the unconstrained regression approach in a MIM does not imply a violation of fund constraints, i.e. if $\beta_{ij} \geq 0$ and sum of βs ≤ 1 holds in the MIM, the estimated weights of the benchmark indices of the corresponding asset-class-factor model are exactly the same.

In Sharpe's asset-class-factor model, the mean of the residuals is generally not equal to zero as the residuals still contain the α. Normally, having estimated the βs and, hence, determined the passive portfolio, performance in the sense of Sharpe (1992) is measured out-of-sample as the difference between fund return and return of the benchmark portfolio in the next month (selection return). In order to compare the performance based on the constrained model with that of the unconstrained model, we slightly modify the Sharpe procedure for the measurement of performance. We use our β estimates resulting from the return data of the whole observation period, not for determining the appropriate benchmark for the next month, but for the whole observation period. The risk-adjusted performance, α, is then measured in-sample as the difference between the average fund return and the average benchmark return, i.e. the average of the residuals.[8]

4. Data and model specification

We investigate the period from July 2000 to June 2005. The euro zone capital market in this period is characterized by, on average, declining government bond yields and a first declining and then rising equity market. However, the average return of the equity market over the whole sample period is negative.

In our analysis, we concentrate on those mutual funds primarily investing in euro-denominated investment grade corporate bonds that are offered in Germany, which is one of the largest markets for mutual funds in Europe. All fund data were provided by the German fund rating company Feri Trust according to their internal fund style classification as euro-denominated investment grade corporate bond funds. For each fund, we compared the style classification by Feri Trust with the portfolio classification provided in the latest available fund report.

To be included in our data sample, funds have to have a complete time-series history throughout the five-year period from July 2000 to June 2005 and more than €20 million assets under management, according to the latest available fund report. As reported by Feri Trust, only one fund with an inception date before July 2000 was liquidated during this time period. Hence, our later results should not be substantially affected by survivor-only conditioning, which can cause biased estimates of performance, i.e. survivorship bias in performance, and biased results concerning the relationship between performance and fund characteristics (Carhart et al. 2002). The resulting sample consists of 19 investment grade corporate bond funds. We examine monthly discrete total returns, net of management fees and other expenses, while load charges are not taken into account.

Table 1 shows major characteristics of the funds and descriptive statistics of their excess returns, where the excess return is calculated as the difference between fund return and the 1-month Euribor. The funds have an average age of 7.8 years, but most of them were founded in 1999 or 2000. The average asset value equals €356 million, five funds have an asset value of less than €100 million and one fund an asset value of more than €1000 million. The average mean monthly excess return of the funds is 0.263%. For most funds, the return distribution is slightly skewed to the left. Further, we find a kurtosis of less than 3 in most cases. Nevertheless, applying the Jarque–Bera test, we cannot reject the hypothesis of normal distribution except for two funds (Deka, HSBC Trinkaus).

As benchmark indices in our later regressions, we choose total return indices from the iBoxx € bond index family offered by International Index Company Ltd. Today, these indices are suitable to represent the euro-denominated investment grade corporate bond market. This is also reflected by the fact that banks start offering index-tracking exchange-traded funds based on iBoxx indices. The process of index construction and index calculation is transparent to a large extent, resulting in ex-ante information on all bonds constituting the indices and public availability of used bond prices and corresponding bond characteristics on a daily basis.[9]

Specifically, we use the total return iBoxx € Corporates index and its rating-specific and maturity-specific sub-indices. Thus, unlike the studies mentioned above, which typically apply just one overall investment grade index and (sometimes) one overall non-investment grade index to capture credit risk, we can have a closer look at the impact of credit quality within the investment grade corporate bond market. In the iBoxx € index family, there are four rating-specific indices (AAA, AA, A, BBB) that include (like the funds) financial and non-financial bonds with identical letter ratings, as well as five maturity-specific indices (1–3, 3–5, 5–7, 7–10, 10+ years) that include those bonds with similar (nominal) time to maturity.

In addition, we apply the total return iBoxx € Sovereigns index as a broad euro zone government bond index and the DJ Stoxx 600 performance index as a broad equity index. Apart from euro zone-based companies, the DJ Stoxx 600 also includes stocks of non-euro zone-based companies. However, we have also applied other (smaller) euro zone indices as well. As subsequent results do not change, we use the broad DJ Stoxx 600.

Table 2 presents the average Macaulay duration[10] of the bonds included in each index, the empirical duration of the indices and descriptive statistics for the monthly excess returns. The empirical duration is given by the negative of the slope that is obtained by regressing the index returns on the change of the 10-year German governmental spot rate. The mean excess returns of the BBB and the Sovereigns indices are striking. While one might expect the mean of the returns to increase with lower rating, i.e. with higher credit risk, this is not true of the mean of the BBB index (0.298%) which is lower than the AA (0.393%) and A (0.403%) means. This may be caused by the different durations of the indices, since a higher duration yields higher returns in general. Further, the returns of lower-rated bonds are generally more equity-linked than those of higher-rated bonds. Since we find a negative average excess return of the DJ Stoxx 600 (−0.460%) in our sample period, the comparatively low BBB mean return gains further plausibility. Furthermore, the mean and volatility of the Sovereigns index, consisting of government bonds, are higher than

Table 1. Fund characteristics and descriptive statistics for fund excess returns.

		Fund characteristics				Descriptive statistics of excess returns			
Fund	ISIN	Age	Asset value	Management fee per month (%)	Mean (%)	Volatility (%)	Skewness	Kurtosis	Jarque–Bera
ADIG	LU0011193892	16.74	127.00	0.067	0.277	0.736	0.054	2.379	0.992
Balzac	FR0000018483	5.64	99.89	0.042	0.272	0.769	−0.217	2.743	0.635
Bayern LB	LU0110699088	5.07	154.23	0.071	0.267	0.656	−0.121	3.259	0.313
CA	LU0119099819	6.02	717.03	0.067	0.311	0.783	−0.007	2.402	0.894
Capital Invest	AT0000859046	18.04	642.21	0.050	0.304	0.707	0.252	2.593	1.049
Deka	LU0112241566	5.16	693.60	0.071	0.181	0.917	−1.055	5.332	24.724***
dit	LU0079919162	7.83	220.40	0.083	0.276	0.759	0.169	2.187	1.936
Rothschild	LU0112663983	5.04	30.55	0.067	0.183	0.499	−0.079	2.511	0.660
Fortis	LU0083949205	7.39	800.01	0.063	0.288	0.744	−0.277	2.446	1.533
HSBC Trinkaus	DE0005152003	5.28	80.20	0.058	0.173	1.032	−1.246	8.048	79.231***
ING	LU0092545796	6.75	396.51	0.017	0.325	0.824	−0.430	2.846	1.907
KBC	LU0094437620	6.33	571.16	0.063	0.298	0.802	−0.331	2.683	1.343
LB	LU0078314985	11.12	40.90	0.042	0.180	0.635	−0.012	2.828	0.075
LODH	LU0095725387	6.40	304.37	0.063	0.306	0.734	−0.183	2.393	1.255
Pictet	LU0128470845	5.59	224.27	0.058	0.214	0.725	−0.205	2.573	0.874
Schroder	LU0113257694	5.00	281.50	0.083	0.246	0.755	−0.102	2.545	0.620
Spängler	AT0000768296	5.83	39.44	0.079	0.293	0.828	−0.028	2.528	0.566
UBAM	LU0095453105	6.31	253.67	0.079	0.298	0.826	−0.306	2.502	1.554
Uni	LU0045581039	12.25	1095.80	0.050	0.312	0.743	−0.016	2.734	0.179
Average		7.78	356.46	0.062	0.263	0.762	−0.218	3.028	6.334
Median		6.31	253.67	0.063	0.277	0.755	−0.121	2.573	0.992
Maximum		18.04	1095.80	0.083	0.325	1.032	0.252	8.048	79.231
Minimum		5.00	30.55	0.017	0.173	0.499	−1.246	2.187	0.075

This table reports main fund characteristics and descriptive statistics for monthly excess returns of funds over the period July 2000–June 2005. Age is given in years as of June 2005. The asset value under management is given in € million. Asset values and management fees were obtained from the funds' latest reports prior to June 2005. The excess return is calculated as the difference between the fund's discrete monthly total return and the 1-month Euribor. The last column shows the Jarque-Bera test for normality.
*10% level. **5% level. ***1% level.

Table 2. Average duration and descriptive statistics for excess returns of the benchmark indices.

Index	ISIN	Average duration	Empirical duration	Descriptive statistics of excess returns: Mean (%)	Volatility (%)	Skewness	Kurtosis	Jarque–Bera
Corporates	DE0006301161	4.73	4.17	0.374	0.807	−0.224	2.476	1.188
Corporates AAA	DE0006304454	3.98	4.12	0.284	0.716	−0.290	2.728	1.027
Corporates AA	DE0006600083	5.33	5.39	0.393	0.916	−0.384	2.774	1.600
Corporates A	DE0006601024	4.95	4.54	0.403	0.845	−0.312	2.404	1.862
Corporates BBB	DE0006601362	4.15	3.13	0.298	1.000	−1.271	7.390	64.345***
Corporates 1–3	DE0006301187	1.94	1.76	0.177	0.402	−0.057	2.523	0.601
Corporates 3–5	DE0006301518	3.60	3.40	0.302	0.714	−0.226	2.560	0.996
Corporates 5–7	DE0006301534	5.16	4.94	0.411	0.943	−0.146	2.459	0.945
Corporates 7–10	DE0006301559	6.81	5.88	0.538	1.121	−0.209	2.576	0.886
Corporates 10+	DE0006301575	10.64	8.55	0.729	1.609	−0.194	2.879	0.412
Sovereigns	DE0009682831	5.54	5.40	0.340	0.911	−0.394	2.707	1.767
DJ Stoxx 600	EU0009658210	–	–	−0.460	4.971	−0.394	3.045	1.556
Average				0.316	1.246	−0.342	3.043	7.444
Median				0.357	0.914	−0.258	2.642	1.108
Maximum				0.729	4.971	−0.057	7.390	64.345
Minimum				−0.460	0.402	−1.271	2.404	0.412

This table reports the average Macaulay duration and the empirical duration of the benchmark indices and descriptive statistics for their monthly excess returns over the period July 2000–June 2005. The average Macaulay duration is the mean of the average Macaulay durations of the bonds included in each index as reported by International Index Company every month. We calculated the empirical duration by regressing the discrete monthly total returns of each index on the monthly change of the German governmental 10-year spot rate. It is given by the negative of the respective slope coefficient. The excess return is calculated as the difference between the fund's discrete monthly total return and the 1-month Euribor. The last column shows the Jarque–Bera test for normality.
*10% level. **5% level. ***1% level.

the respective values of the AAA index which could also be explained by the higher duration of the Sovereigns index.

To specify the SIM, we apply the iBoxx € Corporates as a broad index representing the whole market. Two types of multi-index- and asset-class-factor models are specified, the first one related to rating segments and the second one to maturity segments. The first type has four rating-based factors, the iBoxx € Corporates AAA, AA, A, and BBB, which represent all factors in the first MIM, called MIM-1. In the second and third MIM, MIM-2 and MIM-3, the iBoxx € Sovereigns index and the DJ Stoxx 600 are added. The latter also allows us to control for fund investments in non-investment grade bonds as well, since the stock market is well known to be more strongly correlated to the non-investment grade bond market than to the investment grade bond market (see Merton (1974) for theoretical and Cornell and Green (1991) for empirical evidence). The maturity-based model MIM-4 contains the five iBoxx € Corporates maturity indices. The DJ Stoxx 600 is added in the last model, called MIM-5. The five asset-class-factor models, ACFM-1 to ACFM-5, are specified in the same way as the MIMs, but the 1-month Euribor is added to represent the risk-free asset in each model. Table 3 provides a summary of our models.

Before presenting our empirical results, the (possible) problem of multicollinearity has to be addressed. Table 4 provides the correlations of the excess returns of the indices in our data sample. As expected, the AAA, AA, and A rating-specific indices and the Sovereigns index are highly correlated (above 0.9). From this strong dependence, it follows that the coefficients of these factors that are estimated later can be very sensitive to slight modifications of the data set. Therefore, in terms of style analysis, these coefficients need to be treated with caution. On the

Table 3. Specification of the MIMs and the asset-class-factor models.

MIM-1 (Rating)	MIM-2 (Rating + Sovereigns)	MIM-3 (Rating + Sovereigns + Stock)	MIM-4 (Maturity)	MIM-5 (Maturity + Stock)
Corporates AAA Corporates AA Corporates A Corporates BBB	Corporates AAA Corporates AA Corporates A Corporates BBB Sovereigns	Corporates AAA Corporates AA Corporates A Corporates BBB Sovereigns DJ Stoxx 600	Corporates 1–3 Corporates 3–5 Corporates 5–7 Corporates 7–10 Corporates 10+	Corporates 1–3 Corporates 3–5 Corporates 5–7 Corporates 7–10 Corporates 10+ DJ Stoxx 600
ACFM-1 (Rating)	**ACFM-2 (Rating + Sovereigns)**	**ACFM-3 (Rating + Sovereigns + Stock)**	**ACFM-4 (Maturity)**	**ACFM-5 (Maturity + Stock)**
Euribor Corporates AAA Corporates AA Corporates A Corporates BBB	Euribor Corporates AAA Corporates AA Corporates A Corporates BBB Sovereigns	Euribor Corporates AAA Corporates AA Corporates A Corporates BBB Sovereigns DJ Stoxx 600	Euribor Corporates 1–3 Corporates 3–5 Corporates 5–7 Corporates 7–10 Corporates 10+	Euribor Corporates 1–3 Corporates 3–5 Corporates 5–7 Corporates 7–10 Corporates 10+ DJ Stoxx 600

This table reports the specification of the MIMs and the asset-class-factor models. For each model, the included factors are provided. Except for DJ Stoxx 600 and 1-month Euribor, the indices belong to the iBoxx € index family. The MIMs are based on the respective excess returns. The asset-class-factor models are based on the returns of the respective indices and the 1-month Euribor.

Table 4. Correlation between indices.

	AAA	AA	A	BBB	1–3	3–5	5–7	7–10	10+	Sovereigns	DJ Stoxx 600	Corporates
AAA	1.00											
AA	0.98	1.00										
A	0.91	0.95	1.00									
BBB	0.55	0.62	0.77	1.00								
1–3	0.80	0.81	0.88	0.78	1.00							
3–5	0.84	0.87	0.95	0.88	0.91	1.00						
5–7	0.88	0.92	0.97	0.80	0.89	0.95	1.00					
7–10	0.87	0.93	0.97	0.83	0.84	0.94	0.96	1.00				
10+	0.85	0.91	0.92	0.71	0.77	0.84	0.90	0.96	1.00			
Sovereigns	0.97	0.98	0.91	0.53	0.75	0.82	0.87	0.88	0.88	1.00		
DJ Stoxx 600	−0.49	−0.43	−0.29	0.11	−0.25	−0.18	−0.24	−0.20	−0.22	−0.47	1.00	
Corporates	0.88	0.92	0.98	0.85	0.90	0.98	0.98	0.99	0.93	0.87	−0.21	1.00

This table reports the correlations of the monthly excess returns of the respective indices over the period July 2000–June 2005. The excess return is calculated as the difference between the index's discrete monthly total return and the 1-month Euribor. Except for DJ Stoxx 600, the abbreviations refer to the respective indices of the iBoxx € index family.

other hand, the main focus of this paper is on the performance of the funds in comparison to a passive benchmark portfolio consisting of the indices. This performance is measured by the α, which is not in general affected by multicollinearity. The same observations hold for the maturity models. The only hypothesis in which we apply (a bit of) style analysis is hypothesis H5. Since we aim to regress the αs against the coefficients of the BBB index (as a measure of the BBB exposure of the funds) in Section 5.3, these coefficients must be reliable. The correlations of the BBB index to the other rating indices and the Sovereigns index are in a range from 0.77 (A) to 0.53 (Sovereigns). Moreover, we calculated the variance inflation factor (VIF) of the BBB index for each rating-based model. The VIF is smaller than 5 for all our models which means that multicollinearity should not be a statistical problem in our analysis (Kennedy 2003, 213).

5. Empirical results

5.1 *Performance*

In order to examine the risk-adjusted performance of the funds, we first apply the SIMs and the MIMs. We estimate the α and the βs of the funds by applying the OLS procedure. Significance tests are based on heteroscedasticity- and autocorrelation-adjusted covariance matrices according to Newey and West (1987). The αs and the average (adjusted) R^2 are summarized in Table 5 (Panel A). These adjusted R^2 are comparable to those reported, for instance, by Blake, Elton, and Gruber (1993) and Maag and Zimmermann (2000) for the US bond and the German government bond fund market, respectively. On the whole, the rating-based models provide a better fit than the maturity-based models.

Furthermore, a comparison of MIM-1 and MIM-2 shows that adding the iBoxx € Sovereigns index does not really improve the explanatory power of the models. The DJ Stoxx 600 does not add much explanatory power to the models either, which tells us that the funds do not exhibit a material equity exposure.[11] In addition, interpreting the stock index as a proxy for non-investment grade bonds, we can conclude that the funds in our sample do not participate significantly in the low-quality segment either. These results are in line with the fund policies, as we require the fund in our sample to invest primarily in high-quality corporate bonds.

The overall findings concerning the performance of our fund sample displayed in Table 5 support hypothesis H1. There are just two funds (Bayern LB, Capital Invest) that have a positive α. In contrast to this, 17 funds show a negative α. Depending on the model, we have statistical significance at the 10% level for 9 to 12 funds with negative αs.[12] The sign and significance of the αs are quite robust to different models. The average α of the fund sample (-0.051% per month) is slightly less negative than its average management fee (0.062% per month; Table 1).

Table 5 (Panel A) also provides the corresponding results for the asset-class-factor models. Again, there are only the same two funds (Bayern LB, Capital Invest) showing an average positive α. In contrast, again 17 funds have a negative α on average. For significance tests in the asset-class-factor models, we apply the method of Kim, White, and Stone (2005) and use Monte Carlo simulation for deriving the distributions of αs and β coefficients. Following Kim, White, and Stone (2005), we set the pretest level at 50% and the number of Monte Carlo draws at 5000. Depending on the model, we have statistical significance at the 10% level for 9 to 10 funds with negative αs. Again, sign and significance of the αs are quite robust to different models. The average α of the fund sample is -0.047% per month. The differences between the αs of the MIMs and the αs of the respective asset-class-factor models are small in comparison to the α size. However, the average fund αs

Table 5. Alphas.

	SIM and MIM							Asset-class-factor models					
	SIM	MIM-1	MIM-2	MIM-3	MIM-4	MIM-5	Average	ACFM-1	ACFM-2	ACFM-3	ACFM-4	ACFM-5	Average
Panel A: Single funds													
ADIG	−0.038	−0.011	−0.011	−0.011	−0.027	−0.026	−0.021	−0.011	−0.011	−0.011	−0.028	−0.028	−0.018
Balzac	−0.072**	−0.027	−0.020	−0.018	−0.065***	−0.064***	−0.044	−0.027*	−0.023	−0.023	−0.064**	−0.064***	−0.040
Bayern LB	−0.012	0.002	0.013	0.012	0.004	0.003	0.004	0.002	0.009	0.008	0.000	0.000	0.004
CA	−0.027	−0.001	−0.016	−0.016	−0.016	−0.016	−0.015	−0.001	−0.001	−0.001	−0.016	−0.016	−0.007
Capital Invest	0.020	0.040	0.044	0.044	0.006	0.006	0.027	0.040	0.044	0.044	0.012	0.012	0.031
Deka	−0.188**	−0.165**	−0.189***	−0.191***	−0.178*	−0.180**	−0.182	−0.156***	−0.156***	−0.162***	−0.169**	−0.166**	−0.162
dit	−0.041	−0.057*	−0.051*	−0.057**	−0.026	−0.026	−0.043	−0.051	−0.051	−0.056*	−0.032	−0.032	−0.045
Rothschild	−0.030	−0.032*	−0.029*	−0.029*	−0.022	−0.021	−0.027	−0.030	−0.030	−0.030	−0.021	−0.021	−0.027
Fortis	−0.043*	−0.033*	−0.030	−0.031*	−0.047*	−0.045**	−0.038	−0.033*	−0.030*	−0.031*	−0.047**	−0.047**	−0.038
HSBC Trinkaus	−0.181*	−0.121*	−0.120**	−0.126**	−0.175*	−0.181**	−0.151	−0.109*	−0.109**	−0.123**	−0.162*	−0.156**	−0.132
ING	−0.032	−0.048*	−0.053*	−0.053*	−0.022	−0.021	−0.038	−0.044	−0.044*	−0.045	−0.031	−0.031	−0.039
KBC	−0.065***	−0.043**	−0.052**	−0.054***	−0.066***	−0.066***	−0.057	−0.043**	−0.043**	−0.045**	−0.066**	−0.066**	−0.052
LB	−0.067	−0.088***	−0.081***	−0.081***	−0.052	−0.049*	−0.070	−0.074***	−0.067**	−0.067**	−0.059	−0.059	−0.065
LODH	−0.009	0.000	−0.004	−0.007	−0.002	−0.001	−0.004	0.000	0.000	−0.003	−0.004	−0.004	−0.002
Pictet	−0.093***	−0.095***	−0.065**	−0.065**	−0.089***	−0.086***	−0.082	−0.095***	−0.075***	−0.075***	−0.092**	−0.092**	−0.085
Schroder	−0.084**	−0.073***	−0.074**	−0.076***	−0.088***	−0.087**	−0.080	−0.073***	−0.073***	−0.075***	−0.088***	−0.088***	−0.079
Spängler	−0.067**	−0.069**	−0.079**	−0.084***	−0.056**	−0.058**	−0.069	−0.058*	−0.058*	−0.069**	−0.056*	−0.058*	−0.060
UBAM	−0.064*	−0.059***	−0.048***	−0.049***	−0.068*	−0.065**	−0.059	−0.059***	−0.048***	−0.049***	−0.068**	−0.068*	−0.058
Uni	−0.014	−0.009	−0.019	−0.020	−0.014	−0.014	−0.015	−0.007	−0.007	−0.008	−0.014	−0.014	−0.010
Average	−0.058	−0.047	−0.046	−0.048	−0.053	−0.052	−0.051	−0.044	−0.041	−0.043	−0.053	−0.052	−0.047
Median	−0.043	−0.043	−0.048	−0.049	−0.047	−0.045	−0.043	−0.043	−0.043	−0.045	−0.047	−0.047	−0.040
Maximum	0.020	0.040	0.044	0.044	0.006	0.006	0.027	0.040	0.044	0.044	0.012	0.012	0.031
Minimum	−0.188	−0.165	−0.189	−0.191	−0.178	−0.181	−0.182	−0.156	−0.156	−0.162	−0.169	−0.166	−0.162
Positive αs (*)	1 (0)	3 (0)	2 (0)	2 (0)	2 (0)	2 (0)	2	3 (0)	3 (0)	2 (0)	1 (0)	2 (0)	2
Negative αs (*)	18 (9)	16 (12)	17 (11)	17 (12)	17 (9)	17 (10)	17	16 (10)	16 (10)	17 (10)	18 (9)	17 (9)	17
Average adjusted R^2	0.836	0.868	0.869	0.869	0.853	0.864		0.862	0.861	0.861	0.845	0.849	

(*Continued*)

Table 5. Continued

	SIM and MIM							Asset-class-factor models					
	SIM	MIM-1	MIM-2	MIM-3	MIM-4	MIM-5	Average	ACFM-1	ACFM-2	ACFM-3	ACFM-4	ACFM-5	Average
Panel B: Portfolios of funds													
Equally weighted	−0.058***	−0.047***	−0.046***	−0.048***	−0.053***	−0.053***	−0.051	−0.047***	−0.046***	−0.048***	−0.053***	−0.053***	−0.049
Size-weighted	−0.051***	−0.038**	−0.043**	−0.044**	−0.048***	−0.048***	−0.045	−0.038**	−0.038*	−0.040**	−0.048***	−0.048***	−0.043
Average adjusted R^2	0.959	0.951	0.951	0.951	0.962	0.961		0.950	0.949	0.949	0.961	0.960	

Panel A reports monthly αs (in percent) for the SIM, the MIM and the asset-class-factor models specified in Table 3 for each fund i. The sample period is July 2000–June 2005. The index models are given by $R'_{it} = \alpha_i + \sum_{j=1}^{k} \beta_{ij} I'_{jt} + \varepsilon'_{jt}$, where R'_{it} and I'_{jt} denote the excess returns of the fund and the indices, respectively. The excess returns are calculated as the difference between the fund's and the indices' discrete monthly total returns and the 1-month Euribor. The model parameters are estimated via OLS. Significance tests are based on heteroscedasticity- and autocorrelation-adjusted covariance matrices according to Newey and West (1987). The asset-class-factor models are estimated by minimizing $\text{Var}(R_i - \sum_{j=1}^{k+1} \beta_{ij} I_j)$, where R_i and I_j denote the discrete monthly total returns of the fund and the indices, respectively, and the 1-month Euribor (I_{K+1}). The βs are restricted to $\sum_{j=1}^{k+1} \beta_{ij} = 1$ and $\beta_{ij} \geq 0$. The αs are given by the difference between the average fund return and the average benchmark return. Significance tests are based on 5000 simulations and a pre-test level of 50% according to Kim, White, and Stone (2005). The second and third to last row of Panel A show the number of positive and negative αs, respectively, for each model. The number in brackets gives the number of significant αs at the 10% level where the null hypothesis is $H_0 : \alpha \geq 0$. The last row of Panel A shows the average adjusted R^2 for each model. Panel B analogously shows monthly αs (in percent) and average adjusted R^2 for equally weighted and size-weighted portfolios of the funds in our sample.
*10% level. **5% level. ***1% level.

obtained by the rating-based asset-class-factor models tend to be slightly higher than the αs of the respective MIMs. In contrast, average αs of the maturity-based models remain almost unchanged. Hence, our overall findings are almost identical to the results we reported for the MIMs.

We find analog results considering portfolios of funds instead of single funds. Table 5 (Panel B) shows the results for an equally weighted and a size-weighted portfolio, respectively. Naturally, the adjusted R^2 are higher than in the single-fund case as idiosyncratic risk is diversified in the portfolios. All αs are negative and significant, which again shows that funds are not able to beat the market on average.

Summarizing our results, we can conclude that hypothesis H1 holds for most funds. This result is robust against the type of model and the model specification. However, absolute average αs are a bit smaller than average management fees. Since total costs (expense ratios) exceed management fees, this indicates that many funds are able to beat the benchmarks ex-expenses. However, on average, this out-performance is not large enough to cover the costs incurred by active fund management.

5.2 *Ranking*

While the risk-adjusted performance measure obtained from single- or multi-factor models is a 'reliable' measure when a fund is compared with a passive benchmark, α-rankings of funds have to be treated with caution. It is well known that the α is not invariant to changes in portfolio leverage with the risk-free asset. In fact, a ranking of funds based on this measure can be 'leverage biased' (Modigliani and Pogue 1974). Hence α-based rankings can be biased if the funds have differing systematic risk (e.g. due to differing cash holdings). A measure that is closely related to the α but leverage bias-free in the single-factor case is the Treynor ratio (Treynor 1966). In the following, we will apply its generalization by Hübner (2005) to the multi-factor case in order to analyze the effect of leverage bias on rankings in our data sample. The recently published leverage bias-free generalized Treynor ratio (GTR) is defined as the α of fund i per unit of premium-weighted average systematic risk, normalized by the market premium-weighted average systematic risk. Technically, it is defined by

$$GTR_i = \frac{\alpha_i}{\sum_{j=1}^{K} w_j \beta_{ij}} \sum_{j=1}^{K} w_j \beta_{mj} \text{ with } w_j = \frac{\overline{I'_j}}{\sum_{j=1}^{K} \overline{I'_j}}, \tag{4}$$

where (again) α_i denotes the α of fund i obtained by the selected multi-index or asset-class-factor model and β_{ij} is the corresponding sensitivity of fund i to index j. β_{mj} is the sensitivity of an arbitrarily chosen benchmark portfolio m to index j. $\overline{I'_j}$ represents the average monthly excess return of index j and K the number of indices of the applied model, not including the risk-free asset class. The GTR-ranking of funds is independent of the concrete benchmark portfolio (see Hübner (2005) for details).

As a benchmark portfolio for each model, we choose an equally weighted portfolio of the included indices. For each fund and model, we calculate the GTR and rank the funds. To compare this GTR-ranking with the α-based ranking, we calculate Spearman's rank correlation coefficient between the two rankings. It varies between 0.96 and 0.99 for the MIMs and between 0.97 and 0.99 for the asset-class-factor models. This implies that a possible leverage bias of the αs does not substantially affect α-based rankings in our sample.

5.3 *Performance and fund characteristics*

In order to examine the relationship between fund performance and the fund characteristics management fee, the fund's size, its age, and its BBB exposure, we run a regression of the fund αs on the fund characteristics separately for each model and each characteristic.[13] Table 6 summarizes the results.

Based on several studies dealing with similar fund markets, we hypothesized in Section 2 that higher fees are associated with poorer performance (H2). The sign of the coefficients of the management fee (slope) is negative across all models, and, hence, in line with our hypothesis. The average slope of −0.464 is similar to the results of Maag and Zimmermann (2000) but explicitly less negative than the results reported by Blake, Elton, and Gruber (1993) and Detzler (1999). However, the relationship is not significant in our sample.

Moreover, in Section 2, we focus on how performance varies with the size of a corporate bond fund. The slope of the respective regressions is positive for each model. This sign might suggest that, in our data sample, large funds may realize economies of scale that outweigh the possible disadvantages of large mutual funds in trading in comparatively non-liquid markets. However, as the coefficient is not significant (negative or positive), a detailed analysis of the relation between performance and fund size in the European corporate bond market must be left for future research when more fund data are available.

Our next hypothesis H4 deals with the relationship between fund performance and fund age. The positive slopes are statistically significant at the 5% level which supports our hypothesis that older corporate bond funds tend to have higher αs. This relationship could be caused by a better cost structure of older funds since they can be assumed to achieve greater operating efficiency than newly established funds.

Finally, our last hypothesis H5 refers to the investment policy of the funds. We expected that funds with a higher exposure to BBB-rated bonds would have higher αs. Our first three MIMs (MIM-1 to MIM-3) and our first three asset-class-factor models (ACFM-1 to ACFM-3) estimated the (average) weights of the iBoxx € BBB Corporates index in the appropriate passive benchmark portfolios. In order to assess our hypothesis, we regress fund αs on the BBB βs in the corresponding models. All slope coefficients exhibit negative signs and, naturally, the null hypotheses of negative slopes cannot be rejected. Note that the opposite null hypothesis of positive signs can be rejected for the asset-class-factor models at the 10% level. Owing to the assumed investment restrictions, the asset-class-factor models should be more realistic when dealing with investment policy. Based on the regression results, we reject our hypothesis H5, concluding that the fund engagement in BBB bonds was not rewarded by a better, but by a poorer performance. Of course, this result is not caused by the comparatively low mean return of the iBoxx € Corporates BBB index in our sample (reported in Section 4), as this effect is already accounted for by the benchmark portfolio.

6. Summary and conclusions

This paper represents the first performance study of the 'new' segment of actively managed funds that are primarily investing in the euro-denominated investment grade corporate bond market. We followed earlier studies dealing with other bond fund markets and applied several multi-index and asset-class-factor models to measure risk-adjusted performance. Specifically, in order to take into account the particular characteristics of the market in question, we employed several rating-based and maturity-based models. All our results turned out to be robust across the different models.

Table 6. α regressed on fund characteristics.

	Fee			Asset value			Fund age			BBB exposure		
Model	Slope	p-value H_0: Slope ≥ 0	R^2	Slope	p-value H_0: Slope ≥ 0	R^2	Slope	p-value H_0: Slope ≤ 0	R^2	Slope	p-value H_0: Slope ≤ 0	R^2
SIM	−0.485	0.268	0.023	2.96E-07	0.760	0.030	6.00E-05**	0.028	0.198	–	–	–
MIM-1	−0.417	0.282	0.020	3.34E-07	0.808	0.045	5.79E-05**	0.022	0.218	−0.00055	0.825	0.051
MIM-2	−0.450	0.276	0.021	1.54E-07	0.647	0.009	5.88E-05**	0.026	0.203	−0.00061	0.830	0.054
MIM-3	−0.515	0.252	0.027	1.66E-07	0.656	0.010	6.00E-05**	0.026	0.204	−0.00051	0.781	0.036
MIM-4	−0.481	0.267	0.023	1.76E-07	0.664	0.011	5.37E-05**	0.044	0.162	–	–	–
MIM-5	−0.503	0.262	0.024	1.78E-07	0.663	0.011	5.47E-05**	0.044	0.162	–	–	–
ACFM-1	−0.439	0.259	0.025	2.88E-07	0.787	0.038	5.70E-05**	0.017	0.238	−0.00071	0.905	0.099
ACFM-2	−0.455	0.249	0.028	2.52E-07	0.759	0.030	5.63E-05**	0.017	0.237	−0.00081	0.933	0.127
ACFM-3	−0.518	0.230	0.033	2.79E-07	0.772	0.033	5.91E-05**	0.017	0.239	−0.00085	0.915	0.108
ACFM-4	−0.415	0.285	0.019	2.05E-07	0.700	0.016	5.38E-05**	0.034	0.183	–	–	–
ACFM-5	−0.423	0.276	0.021	2.04E-07	0.703	0.017	5.31E-05**	0.032	0.188	–	–	–
Average	−0.464	0.264	0.024	2.30E-07	0.720	0.023	5.68E-05	0.028	0.203	−0.00067	0.865	0.079

This table reports the results of the regression α = intercept + Slope* fund characteristic + error. We run this regression for each model and each fund characteristic separately. The abbreviations of the models correspond to the model specifications in Table 3. The monthly αs are given in Table 5. Fund characteristics are given by the management fee per month, the asset value in € million, fund age in years as of June 2005 (Table 1), and the BBB exposure measured by the respective β coefficient of the iBoxx € Corporates BBB. Significance tests are based on t-statistics.
*10% level. **5% level. ***1% level.

We found evidence that most funds under-performed relevant benchmark portfolios consisting of several indices. Across all models, there is not a single fund showing significant positive performance. These general findings for corporate bond funds are consistent with the results of earlier studies focusing on the performance of mutual funds investing in (government) bonds; for instance Blake, Elton, and Gruber (1993) for the US and Maag and Zimmermann (2000) for the German market. Additionally, the application of the GTR showed that an α-based ranking for our data sample would not substantially be affected by a possible leverage bias.

Recent studies on bond funds report that fund performance obtained from conditional models is substantially comparable to results obtained from unconditional models (Silva, Cortez, and Armada 2003, Ferson, Henry, and Kisgen 2006). It is a challenging topic for future research to analyze whether analogous conclusions hold for the type of funds we look at here. However, more research about determinants and predictability of corporate bond spreads in Europe must first be carried out.

The average under-performance of the funds in our data sample seems to be primarily due to management fees. The average size of the α (of the under-performance) is smaller than the average management fee. Since total expense ratios of the funds exceed management fees, this indicates that many fund managers would be able to beat the benchmark portfolios if gross returns were considered.

In addition to the impact of management fees, we analyzed the influence of fund age, fund size, and the BBB fraction in the funds' passive benchmark portfolios, i.e. their BBB exposure, on performance. Our analysis suggests that investors willing to invest in actively managed European corporate bond funds should select older funds with low management fees and low exposure to BBB-rated bonds.

Acknowledgements

Financial support by Konrad-Adenauer-Stiftung is gratefully acknowledged by Leif Holger Dietze. Parts of this research were done while Oliver Entrop was visiting the School of Banking and Finance, University of New South Wales. He thanks Terry Walter and the academic and administrative staff for their hospitality and support. Parts of this research were done while Marco Wilkens was visiting the Australian Graduate School of Management, University of New South Wales. He thanks Timothy Devinney and the academic and administrative staff for their hospitality and support.

We thank Feri Trust for providing data and Anette Dyroff at Feri Trust for assistance with their database. We are grateful to participations at the finance seminar at University of Hohenheim, the 18th Australasian Banking and Finance Conference 2005, Sydney, the French Finance Association International Meeting 2005, Paris, the 2006 Financial Management Association European Conference, Stockholm, the European Financial Management Association 2006 Conference, Madrid, the 4th Portuguese Finance Network International Conference 2006, Porto, and, especially, to Jonathan Fletcher, Frank K. Reilly, James D. Rosenfeld, Gilles San Filippo, and Hendrik Scholz for helpful comments and suggestions on an earlier draft of this paper. Furthermore, we thank two anonymous referees and Chris Adcock, the editor, for their helpful comments.

Notes

1. We refer to corporate bonds as both financials and non-financials.
2. To save space, we omit reporting certain details (such as the β coefficients from the regressions) and several additional analyses (such as average selection returns) we carried out. Details are available from the corresponding author upon request.
3. Many studies such as Blake, Elton, and Gruber (1993), Maag and Zimmermann (2000) and Ferson, Henry, and Kisgen (2006) report on average neutral before-cost performance.
4. Note that there is a difference between expense ratios in the studies mentioned above and the management fees we use, as the former contain, in addition to management fees, other directly chargeable operating costs that we do not have information on. However, management fees can be assumed to account for the major part of the total costs.

5. Moreover, another reason may be organizational diseconomies based on hierarchy costs (Chen et al. 2004). For a detailed analysis of all these so-called diseconomies of scale, see Perold and Salomon (1991).
6. See, e.g. Sawicki and Finn (2002) for an overview and an investigation of effects due to size and age in the smart money context.
7. For US bond mutual funds Malhotra and McLeod (1997) report an inverse, albeit not significant, effect.
8. Following Sharpe (1992), we also calculated the average selection return for each fund out-of-sample using a moving time window. As this does not change our findings, we do not report the results.
9. The indices are capitalization-weighted and rebalanced monthly. In order to be included, corporate bonds must fulfill certain criteria. For example, they have to be denominated in euros or pre-euro currencies with an outstanding amount of not less than €500 million; however, the issuer's nationality is not relevant. See International Index Company Ltd. (2004) for details.
10. It is well known that Macaulay duration has to be interpreted with caution when bonds with embedded options such as callable bonds are considered (Fabozzi 2000, 360–61), where effective duration is more suitable. However, these bonds are less common in Europe than in the US. For example, callable bonds typically represent only a minor part (about 20% in June 2006) of the Corporates BBB index as reported by International Index Company Ltd.
11. This is also supported by Wald tests of the β coefficients: in MIM-2, the coefficient of the Sovereigns index is significant at 10% level for only four funds; in MIM-3, the coefficients of the Sovereigns and the Stoxx index are jointly significant for only five funds; in MIM-5, the Stoxx index is significant for 10 funds. The latter is plausible: as the maturity-based indices are dominated by high-quality bonds, the Stoxx index can be expected to serve as a proxy for lower quality bonds (BBB). None of these coefficients are significant when portfolios of funds, described below, are considered. Analog results hold if t-tests of the coefficients are carried out.
12. None of the funds has a significantly positive α when we change the null hypothesis from $\alpha \geq 0$ to $\alpha \leq 0$. The same holds for the asset-class-factor models.
13. We also ran analogous regressions on the transformed variables log(size) and log(age). The results are qualitatively the same.

References

Blake, C.R., E.J. Elton, and M.J. Gruber. 1993. The performance of bond mutual funds. *Journal of Business* 66: 371–403.

Carhart, M.M., J.N. Carpenter, A.W. Lynch, and D.K. Musto. 2002. Mutual fund survivorship. *Review of Financial Studies* 15: 1439–63.

Chen, J., H. Hong, M. Huang, and J.D. Kubik. 2004. Does fund size erode mutual fund performance? The role of liquidity and organization. *American Economic Review* 94: 1276–302.

Collins, S., and P. Mack. 1997. The optimal amount of assets under management in the mutual fund industry. *Financial Analysts Journal* 53, no. 5: 67–73.

Cornell, B., and K. Green. 1991. The investment performance of low-grade bond funds. *Journal of Finance* 46: 29–48.

Detzler, M.L. 1999. The performance of global bond mutual funds. *Journal of Banking and Finance* 23: 1195–217.

Elton, E.J., M.J. Gruber, and C.R. Blake. 1995. Fundamental economic variables, expected returns, and bond fund performance. *Journal of Finance* 50: 1229–56.

Fabozzi, F.J. 2000. *Bond markets, analysis and strategies*. Upper Saddle River: Prentice Hall.

Ferson, W., T.R. Henry, and D.J. Kisgen. 2006. Evaluating government bond fund performance with stochastic discount factors. *Review of Financial Studies* 19: 423–55.

Gallagher, D.R., and E. Jarnecic. 2002. The performance of active Australian bond funds. *Australian Journal of Management* 27: 163–85.

Gallo, J.G., L.J. Lockwood, and P.E. Swanson. 1997. The performance of international bond funds. *International Review of Economics and Finance* 6: 17–35.

Grinblatt, M., and S. Titman. 1989. Mutual fund performance: an analysis of quarterly portfolio holdings. *Journal of Business* 62: 393–416.

Hübner, G. 2005. The generalized Treynor ratio. *Review of Finance* 9: 415–35.

International Index Company Ltd. 2004. Guide to the iBoxx € benchmark indices, Version 3.1, December 2004.

Kahn, R.N., and A. Rudd. 1995. Does historical performance predict future performance? *Financial Analysts Journal* 51, no. 6: 43–52.

Kennedy, P. 2003. *A guide to econometrics.* Malden: Blackwell.

Kim, T., H. White, and D. Stone. 2005. Asymptotic and Bayesian confidence intervals for Sharpe-style weights. *Journal of Financial Econometrics* 3: 315–43.

Maag, F., and H. Zimmermann. 2000. On benchmarks and the performance of DEM bond mutual funds. *Journal of Fixed Income* 10: 31–45.
Malhotra, D.K., and R.W. McLeod. 1997. An empirical analysis of mutual fund expenses. *Journal of Financial Research* 20: 175–90.
Merton, R.C. 1974. On the pricing of corporate debt: The risk structure of interest rates. *Journal of Finance* 29: 449–70.
Modigliani, F., and G.A. Pogue. 1974. An introduction to risk and return – II. *Financial Analysts Journal* 30, no. 3: 69–86.
Newey, W., and K. West. 1987. A simple positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica* 55: 703–8.
Perold, A.F., and R.S. Salomon. 1991. The right amount of assets under management. *Financial Analysts Journal* 47, no. 3: 31–9.
Sawicki, J., and F. Finn. 2002. Smart money and small funds. *Journal of Business Finance and Accounting* 29: 825–46.
Sharpe, W.F. 1987. An algorithm for portfolio improvement. In *Advances in mathematical programming and financial planning,* eds. K.D. Lawrence, J.B. Guerard, and G.D. Reeves, 155–70. Greenwich: JAI Press.
Sharpe, W.F. 1988. Determining a fund's effective asset mix. *Investment Management Review* November/December: 59–69.
Sharpe, W.F. 1992. Asset allocation: Management style and performance measurement. *Journal of Portfolio Management* 18: 7–19.
Silva, F., M. Cortez, and M.R. Armada. 2003. Conditioning information and European bond fund performance. *European Financial Management* 9: 201–30.
Treynor, J.L. 1966. How to rate management investment funds. *Harvard Business Review* 43: 63–75.