Factor and risk-adjusted return

Norges Bank Investment Management

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1.1 Introduction

The purpose of the first part is to analyse the robustness of alpha estimates and factor exposures through various regression analyses. In the analyses we consider the total fund performance along with those of the equity and fixed-income asset classes and management entities. We present results from several factor regressions under both traditional and alternative model specifications subject to different sample periods. We also investigate the role of management costs through before and after-cost factor regressions. Relevant to a large investor like the fund we examine the impact of investability in the equity portfolio by using alternative factor construction schemes. Moreover, we examine the impact of using the Fama-French (F-F) and AQR Capital Management (AQR) factor universes.

All relevant data used in the analysis that is not publicly available can be found on our website www.nbim.no. For the publicly available data, the reader is referred to the section on data and methodology.

The outline of this part of the analysis is as follows. Section 1.2 and 1.3 describe the factor regression framework and the data, respectively. Section 1.4 presents results for the equity and fixed-income portfolios separately and on an aggregated fund level. Moreover, the section provides results for the investments strategies undertaken by the fund. Finally, Section 1.5 provides summary statistics for the factor return series.

1.2 Factor regressions

Throughout the analysis, we use the global five-factor model of Fama and French (2015) in Equation (1.1) as our main model for portfolio composites that hold only listed equities. For portfolio composites that hold fixed-income securities we use the credit and term factors of Fama and French (1993) but as suggested by Hallerbach and Houweling (2011) we apply a duration-adjusted credit factor. The two-factor regression model is presented in Equation (1.2). For the fund portfolio which encompass equity, fixed-income and real asset investments, we follow the recommendation in Dahlquist et al. (2015) and combine the factor models into the seven-factor model in Equation (1.3).

$$r_t - r_t^{BM} = \alpha + \beta_1 MKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \epsilon_t. \tag{1.1}$$

$$r_t - r_t^{BM} = \alpha + \beta_1 \text{DEF Adj}_t + \beta_2 TERM_t + \epsilon_t. \tag{1.2}$$

$$\begin{aligned} r_t - r_t^{BM} = \alpha &+ \beta_1 MKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t \\ &+ \beta_6 \text{DEF Adj}_t + \beta_7 TERM_t + \epsilon_t. \end{aligned} \tag{1.3}$$

For each of the regression specifications the dependent variable is the monthly return on the considered portfolio r_t minus the monthly return of the corresponding benchmark r_t^{BM}. After-cost returns are obtained by further subtracting monthly management costs.[1] Except when explicitly stated, regressions are performed on an after-cost basis. The independent variables are specified in Table 2.

1.3 Data

For our main models we use Fama-French factor data from Kenneth French's web site along with fixed-income factor return series constructed using data sourced from Barclays. For further sensitivity and robustness analysis we use data from AQR Capital Management.

The data sourced from Kenneth French's web site, AQR and Barclays cover the period January 1998-December 2022 and were downloaded on 27 February 2023. Table 2 presents the full list of factors and the data sources.

To make the analysis easier to replicate, we use monthly US dollar returns as publicly available factor returns are typically denominated in US dollars.

[1] Costs are on an annual frequency and monthly costs are obtained by distributing them evenly across the year.

In the analysis of the equity, fixed-income and total fund portfolios we consider three samples periods: last 5 years, last 10 years and since inception. The former two are self-explaining while the latter spans January 1998-December 2022 for the fixed-income portfolios and January 1999-December 2022 for the equity portfolios. When considering the investment strategies we are limited to the ten years of data available. Furthermore, the security selection investment strategy did not include any fixed-income securities before October 2014 and therefore the specific fixed-income time-series contains fewer observations.

1.3.1 Equity data

Factors sourced from Kenneth French's data library
Global research factors commonly used in empirical asset pricing studies are available from Kenneth French's data library.[2] From the data library we collect global factor returns for the CAPM, the Fama and French (1992) three-factor model, the Carhart (1997) four-factor model and the Fama and French (2015) five-factor model. Finally, for the risk-free rate we use the yield on one-month treasury bills which is also sourced from the data library.

Factors sourced from AQR
For our robustness test we use global factor returns series from AQR's webpage.[3] Return series for the market, size, value, momentum, Quality Minus Junk, and Betting Against Beta factors were downloaded from AQR's data library. AQR provides two different value factors, one based on the original Fama and French (1992) methodology which uses date aligned market prices and book values of equity. The other "AQR" version uses market prices at the rebalancing date and hence takes price movements between the fiscal year-end and the rebalancing date into account. In our robustness AQR regressions we refer to the former as "HML lag" and the latter as "HML cur".

Detailed information about the construction of the factor return series: Quality Minus Junk, Betting Against Beta and value can be found in Asness et al. (2014), Frazzini and Pedersen (2010) and Asness and Frazzini (2011), respectively. The AQR factor returns for market, size and momentum resemble their equivalents in Fama and French (1992) and Carhart (1997), but discrepancies exist due to differences in sorting procedures and country neutralisations. Cumulative return series and factor correlations are presented in Section 1.5.

Size-constrained equity factors
In order for the alpha estimate to be a valid performance measure, it is a necessary condition that the factors are investable for the manager. A robustness test for investability is to consider size-constrained factors. These factor adjustments are intended to act as a simple alignment of factors to the constraints and characteristics of the fund.

In line with the original F-F factor construction we construct size-constrained factors as averages of component returns, but using only factor portfolios classified as "Big" in Kenneth French's data library. For example the value factor is constructed according to $HML = \text{Big Value} - \text{Big Growth}$ contrary to $HML = 1/2(\text{Small Value} + \text{Big Value}) - 1/2(\text{Small Growth} + \text{Big Growth})$.

Our approach corresponds to discarding the stocks in the bottom 10 percent market capitalisations. In the unconstrained factors of Fama and French (2015) these "Small" stocks are assigned a 50 percent factor return weight.

Our constraint results in four new factors: HML-big, WML-big, RMW-big and CMA-big. For these four factors we compute the return spread between the large-cap companies in the upper 30th and the lower 30th percentile of: book-to-market, momentum, operating profitability, and investment, respectively. The approach is similar to that applied in Kok et al. (2017).

As an alternative risk factor we consider a volatility factor derived from the data library. The factor is constructed such that it reflects the spread between high and low volatility US stocks.

[2]See the "Developed Market Factors and Returns" section on http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.
[3]The data is available from https://www.aqr.com/library/data-sets

First, stocks are sorted into 5×5 portfolios according to their market capitalisations and historical 60-day return variance and value-weighted average portfolio returns are computed. Second, the lower size quintile portfolios are discarded to account for factor investability. Third, monthly factor returns are computed as the equal-weighted average return on the four high variance portfolios minus the equal-weighted average return on the four low variance portfolios.

1.3.2 Fixed-income data

Inspired by Fama and French (1993) we use a credit premium factor and a term premium factor for the fixed-income regressions. As historical series for these factors are not publicly available for a global portfolio we use data from Barclays. In particular, the data required to construct the fixed-income factors has been sourced from either Barclays Live or Barclays Point (Barclays Point being used to complement historical data), and are US dollar unhedged returns. The following three sections explain the construction of these factor returns.

Term premium factor (TERM)
We define the term premium factor as the difference between the return on the Bloomberg Barclays Global Aggregate Treasury 10+Y index (more than 10 years to maturity) and the return on the Bloomberg Barclays Global Aggregate Treasury 1-3Y index. This term premium is slightly different from the one in Fama and French (1993) which is based returns on 1-3M Treasury bills. We use 1-3Y Treasury notes since historically consistent global returns for 1-3M Treasury bills are not readily available (a similar approach is taken by Ilmanen (1996) and Ilmanen et al. (2004)).[4]

A potential issue in the construction of the global term premium is the currency mismatch between long-term and short-term treasuries. An unbalanced distribution can lead to the factor incorporating sovereign credit risk and other drivers of returns separate from maturity. Thus regression analysis with a non-zero loading to the term premium could be an exposure to both the term premium and other risk factors. In order to provide insights into the potential issue, regression analyses using a US dollar term premium factor are carried out in Section 1.4.2.

Default premium factor (DEF)
In line with Fama and French (1993) we define the default premium factor as the difference between returns on corporate bonds and treasury bonds with more than 10 years to maturity. Table 1 presents the data sources used in calculating the default premium factor.

Table 1
Sources used in computing the default premium factor returns

	Corporate bond index	Treasury bond index
Jan 1998 to Dec 1998	US Aggregate Corporate Long (Barclays Live)	US Aggregate Treasury Long (Barclays Live)
Jan 1999 to Dec 2000	Global Aggregate Corporate 10+Y (Barclays Point)	Global Aggregate Treasury 10+Y (Barclays Live)
Jan 2001 to Dec 2022	Global Aggregate Corporate 10+Y (Barclays Live)	Global Aggregate Treasury 10+Y (Barclays Live)

Note: Data sources in parentheses.

For the period beginning in 1999 we use data from the Bloomberg Barclays Global Aggregate. For the period the default premium factor return is computed as the return on the Bloomberg Barclays Global Aggregate Corporate 10+Y index less the return on the Bloomberg Barclays Global Aggregate Treasury 10+Y index. As Bloomberg Barclays Global Aggregate data is unavailable for the period prior to 1999 we use the corresponding Bloomberg Barclays US Aggregate data set. Specifically, we let the default premium factor return be given as the return on the US Aggregate

[4]Empirical observations on single currencies show that the calculated term premia using either bonds with one to three years until maturity or bonds with less than three months until maturity exhibit a high correlation.

Corporate Long index less the return on US Aggregate Treasury Long index. As shown in Table 1 corporate bond return data for the period January 1999-December 2000 is sourced via Barclays Point.

The potential currency distribution issue highlighted for the term premium factor is likewise relevant for the default premium. Therefore an additional default premium factor return series based on US dollar-denominated treasuries and corporate bonds is calculated and robustness regressions are performed.

Duration adjusted default premium factor (DEF Adj)
Hallerbach and Houweling (2011) observe that the default factor, as it is defined in Fama and French (1993), by construction captures term effects since corporate bonds in general have lower durations than government bonds. In order to achieve more reliable estimates of sensitivity to default risk compensation one must account for this duration mismatch. Therefore, we match the duration of the corporate bond series to that of the government bond series according to

$$\text{DEF Adj}_t = \frac{D_t^{GOV}}{D_t^{CORP}} r_t^{CORP} - r_t^{GOV}. \tag{1.4}$$

DEF Adj_t denotes the return on the duration adjusted default factor while r_t^{GOV} and r_t^{CORP} are the monthly total returns on the government and corporate bond indices, respectively. D_t^{GOV} and D_t^{CORP} are the month t analytical option-adjusted modified durations of the government and corporate bond indices, respectively.

The duration adjustment is comparable to that in Asvanunt and Richardson (2016) but with the difference that they estimate empirical durations while we obtain analytical durations from Barclays.

In the regression analysis we include both the unadjusted default premium and the duration adjusted default premium as independent variables.

Table 2
Factor descriptions and sources. Spanned period: January 1998 to December 2022

Factor	Description	Source
MKT	Equity market return in excess of the risk free rate	F-F AQR
SMB	Small Minus Big, return spread between small cap and large cap stocks	F-F AQR
HML	High Minus Low, return spread between high book-to-market and low book-to-market stocks[a]	F-F AQR
WML and UMD	Winners Minus Losers, return spread between past winners and losers (labelled UMD by AQR)	F-F AQR
RMW	Robust Minus Weak, return spread between high and low profitability stocks	F-F
CMA	Conservative Minus Aggressive, return spread between stocks with low and high investment ratios	F-F
HML-big	Large cap version of HML	F-F
WML-big	Large cap version of WML	F-F
RMW-big	Large cap version of RMW	F-F
CMA-big	Large cap version of CMA	F-F
VOL	Volatility, return spread between high and low volatility US stocks.	F-F
QMJ	Quality Minus Junk, return spread between quality and junk stocks as defined in Asness et al. (2014)	AQR
BAB	Betting Against Beta, return spread between low and high beta stocks as defined in Frazzini and Pedersen (2010)	AQR
DEF	Default premium, excess returns from long term corporate bonds to long-term government bonds (10Y+)	Barclays
DEF Adj	Adjusted default premium, default premium adjusted for differences in duration between corporates and treasuries	Barclays
TERM	Term premium, return spread between long (10Y+) and short term (1-3Y) government bonds	Barclays

[a]The HML variable comes in two versions from AQR, the first version based on the methodology in Fama and French (1992), and the second based on the methodology described in Asness and Frazzini (2011) where prices are chosen at the rebalancing date.

1.4 Regression results

We start by presenting results for equity and fixed-income asset class composites (as defined in the Global Investment Performance Standards (GIPS) report) net of cost against the main factor model specifications. The results are presented in Section 1.4.1. Subsequently, the robustness analysis in Section 1.4.2 targets the equity and fixed-income management. Section 1.4.3 presents the results for the investment strategies. Unless otherwise stated regressions are based on relative returns after management costs.

Before turning to the analysis Table 3 shows the time periods used in the regressions for asset classes, management entities and the fund level. The table presents annualised arithmetic monthly return averages. The start dates are aligned with the inception of the relevant composites as used in the GIPS reporting.

Table 3
Spanned time periods and average relative returns (after-costs)

			Average %-USD relative returns		
	Start	End	Since inception	Last 10 years	Last 5 years
Asset classes					
Equity	Jan 1999	Dec 2022	0.33	0.19	0.07
Fixed-income	Jan 1998	Dec 2022	0.20	0.25	0.55
Management entities					
Equity	Jan 1999	Dec 2022	0.39	0.33	0.33
Fixed-income	Jan 1998	Dec 2022	0.19	0.22	0.49
Fund	Jan 1998	Dec 2022	0.23	0.26	0.30

Note: Average relative returns are based on the annualised arithmetic average of monthly US dollar returns after management costs.

1.4.1 Asset classes: equity and fixed-income

The following two tables consider the equity and fixed-income asset classes. Table 4 reports the results from applying the Fama and French (2015) five-factor model to the after-cost return of the equity asset class across the three samples. Table 5 presents results from applying our main two-factor fixed-income model to the after-cost return of the fixed-income asset class over the three sample periods. Both tables seek to provide exposures and indications of the parameter estimate sensitivities towards the choice of sample.

Table 4
Equity asset class five-factor regressions for selected time periods

Regression results with Fama-French global return factors for selected time periods. The dependent variables are the monthly return on the equity asset class composites subtracted the return on the equity asset class benchmark and management costs. Results for the three considered periods: since inception, last 10 years and last 5 years are presented in column (1)-(3), respectively. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Since 1999 (1)	Last 10 years (2)	Last 5 years (3)
Alpha	0.29	0.21	0.13
	(1.90)	(1.42)	(0.87)
F-F MKT	0.01	0.01	0.00
	(3.90)	(2.21)	(0.65)
F-F SMB	0.04	0.02	0.02
	(5.62)	(2.54)	(2.23)
F-F HML	−0.00	0.02	0.02
	(−0.02)	(3.25)	(2.73)
F-F RMW	−0.00	−0.00	0.02
	(−0.37)	(−0.12)	(1.35)
F-F CMA	−0.03	−0.02	−0.02
	(−2.31)	(−1.76)	(−1.31)
Observations	288	120	60
Adjusted R^2	0.35	0.20	0.17

Table 5
Fixed-income asset class two-factor regressions for selected time periods

Regression results with global fixed-income factors for selected time periods. The dependent variables are the monthly return on the fixed-income asset class composites subtracted the return on the fixed-income asset class benchmark and management costs. Results for the three considered periods: since inception, last 10 years and last 5 years are presented in column (1)-(3), respectively. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Since 1998 (1)	Last 10 years (2)	Last 5 years (3)
Alpha	0.19	0.26	0.40
	(0.73)	(2.13)	(2.16)
DEF Adj	0.05	0.01	0.01
	(2.60)	(1.26)	(1.73)
TERM	−0.03	−0.05	−0.04
	(−3.32)	(−7.34)	(−5.21)
Observations	300	120	60
Adjusted R^2	0.21	0.41	0.42

1.4.2 Equity and fixed-income management entities and aggregated fund level

This section considers the equity and fixed-income management entities as well as the aggregated fund level (henceforth: fund).

In order to evaluate the robustness of the results we perform several alternative factor regressions. For the equity investments we apply the global version of the traditional Capital Asset Pricing Model (CAPM) of Treynor (1962); Sharpe (1964); Lintner (1965a,b); Mossin (1966), the three-factor model of Fama and French (1992) and the Carhart (1997) four-factor model. Moreover, we consider the effect of using size-constrained versions of the value, profitability, and investment factors. As these models are specified within the same Fama-French (F-F) factor universe they are subject to the underlying factor construction scheme. Thus we examine the effect of introducing AQR Capital Management (AQR) versions of the factors including the quality and Betting Against Beta factors.

As robustness checks for the fixed-income portfolio we consider replacing the adjusted duration premium by its unadjusted analogue along with one-factor models for each of the three factors.

Equity management
Table 6 presents regression results for the five-factor model of Fama and French (2015) applied to the three considered time periods.

Table 7 considers the full period and presents the average equity relative return after management costs in column (1) and parameter estimates from four different factor models in columns (2)-(5). The table illustrates how factor exposures change along with the extension of the model.

Besides presenting alpha estimates and factor exposures the Tables 8-13 seek to illustrate the dependency and sensitivity of the parameter estimates to factor investability through the use of unconstrained and size-constrained factors.

In particular, Table 8 shows parameter estimates for five-factor models accounting for various degrees of factor investability applied to the full period. The factor model in column (1) takes offset in the five-factor model of Fama and French (2015) while those in columns (2)-(5) apply different combinations of original and large-cap constrained factors. Table 9 extends the analysis to the three sample periods.

Likewise, Table 10 presents regression results for the full period using the three-factor model of Fama and French (1992) and the Carhart (1997) four-factor model with original and size-constrained factors. Columns (1) and (3) contain results for the two original models whereas columns (2) and (4)-(6) contain size-constrained. In Tables 11-12 the analysis is extended to the three selected time periods.

Table 13 considers the effect of management costs by comparing regression results for the five-factor model using relative returns before and after management costs.

Finally, as another robustness check, Tables 14 and 15 present estimation results for the AQR-based factor models. Specifically, Table 14 examines six different models for the full period whereas Table 15 considers the AQR six-factor model in each of three samples.

Table 6
Equity management five-factor regressions for selected time periods

Regression results with Fama-French global return factors for selected time periods. The dependent variables are the monthly return on the equity management portfolio subtracted the return on the equity management benchmark and management costs. Results for the three considered periods: since inception, last 10 years and last 5 years are presented in column (1)-(3), respectively. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Since 1999 (1)	Last 10 years (2)	Last 5 years (3)
Alpha	0.35	0.35	0.41
	(2.27)	(2.30)	(2.63)
F-F MKT	0.01	0.01	0.00
	(3.94)	(2.69)	(1.33)
F-F SMB	0.04	0.02	0.02
	(5.68)	(2.45)	(2.29)
F-F HML	−0.00	0.01	0.01
	(−0.14)	(2.55)	(2.07)
F-F RMW	−0.00	−0.01	0.00
	(−0.50)	(−1.07)	(0.43)
F-F CMA	−0.03	−0.02	−0.01
	(−2.30)	(−1.78)	(−1.23)
Observations	288	120	60
Adjusted R^2	0.36	0.23	0.22

Table 7
Equity management one-, three-, four- and five-factor regressions

Regression results with Fama-French global return factors for the full period. The dependent variables are the monthly return on the equity management portfolio subtracted the return on the equity management benchmark and management costs. Column (1) holds the unadjusted active return, whereas column (2)-(5) presents regression results for the: one-factor model, the Fama and French (1992) three-factor model, the Carhart (1997) four-factor model and the Fama and French (2015) five-factor model, respectively. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Unadj. (1)	1-factor (2)	3-factor (3)	4-factor (4)	5-factor (5)
Alpha	0.39	0.29	0.27	0.19	0.35
	(2.28)	(1.87)	(1.91)	(1.45)	(2.27)
F-F MKT		0.02	0.02	0.02	0.01
		(4.76)	(4.73)	(4.95)	(3.94)
F-F SMB			0.04	0.04	0.04
			(6.23)	(6.47)	(5.68)
F-F HML			−0.01	−0.01	−0.00
			(−2.31)	(−2.07)	(−0.14)
F-F WML				0.01	
				(2.37)	
F-F RMW					−0.00
					(−0.50)
F-F CMA					−0.03
					(−2.30)
Observations	288	288	288	288	288
Adjusted R^2	0.00	0.16	0.34	0.37	0.36

Table 8
Equity management five-factor size-constrained regressions

Regression results with Fama-French global return factors for the full period. The dependent variables are the monthly return on the equity management portfolio subtracted the return on the equity management benchmark and management costs. The applied models are based on the Fama and French (2015) five-factor model, with (1) relying on the original factors and the models in (2)-(4) using size-constrained versions of the value, profitability and investment factors, respectively. The model in (5) uses a combination of these size-constrained factors. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	(1)	(2)	(3)	(4)	(5)
Alpha	0.35	0.36	0.32	0.30	0.27
	(2.27)	(2.23)	(2.15)	(1.90)	(1.85)
F-F MKT	0.01	0.01	0.01	0.01	0.01
	(3.94)	(3.60)	(3.73)	(3.88)	(3.57)
F-F SMB	0.04	0.04	0.04	0.04	0.04
	(5.68)	(5.45)	(5.67)	(5.90)	(5.50)
F-F HML	−0.00		−0.00	−0.00	
	(−0.14)		(−0.08)	(−0.30)	
F-F RMW	−0.00	−0.00		−0.00	
	(−0.50)	(−0.49)		(−0.43)	
F-F CMA	−0.03	−0.03	−0.03		
	(−2.30)	(−2.69)	(−2.27)		
F-F HML Big		0.00			0.00
		(0.00)			(0.44)
F-F RMW Big			0.00		0.00
			(0.20)		(0.41)
F-F CMA Big				−0.02	−0.02
				(−2.67)	(−2.94)
Observations	288	288	288	288	288
Adjusted R^2	0.36	0.36	0.36	0.36	0.36

Table 9
Equity management five-factor size-constrained regressions for selected time periods

Regression results with Fama-French global return factors for selected time periods. The dependent variables are the monthly return on the equity management portfolio subtracted the return on the equity management benchmark and management costs. The models in (1), (3), and (5) are based on the original research factors, while the models in (2), (4) and (6) uses size-constrained factors. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Since 1999		Last 10 years		Last 5 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Alpha	0.35	0.27	0.35	0.33	0.41	0.39
	(2.27)	(1.85)	(2.30)	(2.23)	(2.63)	(2.43)
F-F MKT	0.01	0.01	0.01	0.01	0.00	0.00
	(3.94)	(3.57)	(2.69)	(2.21)	(1.33)	(1.18)
F-F SMB	0.04	0.04	0.02	0.02	0.02	0.02
	(5.68)	(5.50)	(2.45)	(2.27)	(2.29)	(2.29)
F-F HML	−0.00		0.01		0.01	
	(−0.14)		(2.55)		(2.07)	
F-F RMW	−0.00		−0.01		0.00	
	(−0.50)		(−1.07)		(0.43)	
F-F CMA	−0.03		−0.02		−0.01	
	(−2.30)		(−1.78)		(−1.23)	
F-F HML Big		0.00		0.01		0.01
		(0.44)		(1.62)		(2.07)
F-F RMW Big		0.00		−0.00		0.01
		(0.41)		(−0.35)		(1.10)
F-F CMA Big		−0.02		−0.01		−0.01
		(−2.94)		(−1.35)		(−1.53)
Observations	288	288	120	120	60	60
Adjusted R^2	0.36	0.36	0.23	0.23	0.22	0.22

Table 10
Equity management three- and four-factor size-constrained regressions

Regression results with Fama-French global return factors for the full period. The dependent variables are the monthly return on the equity management portfolio subtracted the return on the equity management benchmark and management costs. Column (1)-(2) presents results for the original Fama and French (1992) three-factor model and size-constrained version, respectively. Column (3) shows results for the Carhart (1997) four-factor model. The columns (4)-(6) present size-constrained versions of the Carhart (1997) model. In (4) we use a size-constrained value factor, in (5) a size-constrained momentum factor and in (6) a combination of both. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	3-factor		4-factor			
	(1)	(2)	(3)	(4)	(5)	(6)
Alpha	0.27	0.21	0.19	0.15	0.22	0.18
	(1.91)	(1.56)	(1.45)	(1.16)	(1.65)	(1.36)
F-F MKT	0.02	0.02	0.02	0.02	0.02	0.02
	(4.73)	(4.82)	(4.95)	(5.01)	(4.95)	(5.03)
F-F SMB	0.04	0.04	0.04	0.04	0.04	0.04
	(6.23)	(5.58)	(6.47)	(5.93)	(6.17)	(5.69)
F-F HML	−0.01		−0.01		−0.01	
	(−2.31)		(−2.07)		(−2.02)	
F-F WML			0.01	0.01		
			(2.37)	(2.25)		
F-F HML Big		−0.01		−0.01		−0.01
		(−2.15)		(−1.60)		(−1.56)
F-F WML Big					0.01	0.01
					(2.37)	(2.26)
Observations	288	288	288	288	288	288
Adjusted R^2	0.34	0.33	0.37	0.36	0.37	0.36

Table 11
Equity management three-factor size-constrained regressions for selected time periods

Regression results with Fama-French global return factors for selected time periods. The dependent variables are the monthly return on the equity management portfolio subtracted the return on the equity management benchmark and management costs. The models in (1), (3), and (5) are based on the original Fama and French (1992) factors, whereas the models (2), (4) and (6) apply size-constrained factors. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Since 1999		Last 10 years		Last 5 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Alpha	0.27	0.21	0.29	0.30	0.39	0.40
	(1.91)	(1.56)	(2.04)	(2.14)	(2.69)	(2.72)
F-F MKT	0.02	0.02	0.01	0.01	0.01	0.01
	(4.73)	(4.82)	(3.24)	(3.02)	(1.88)	(1.73)
F-F SMB	0.04	0.04	0.02	0.02	0.02	0.02
	(6.23)	(5.58)	(3.44)	(2.92)	(2.52)	(2.23)
F-F HML	−0.01		0.01		0.01	
	(−2.31)		(2.72)		(2.02)	
F-F HML Big		−0.01		0.01		0.00
		(−2.15)		(2.69)		(1.63)
Observations	288	288	120	120	60	60
Adjusted R^2	0.34	0.33	0.21	0.22	0.23	0.23

Table 12
Equity management four-factor size-constrained regressions for selected time periods

Regression results with Fama-French global return factors for selected time periods. The dependent variables are the monthly return on the equity management portfolio subtracted the return on the equity management benchmark and management costs. The models in (1), (3), and (5) are based on the original Carhart (1997) factors, whereas the models (2), (4) and (6) apply size-constrained factors. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Since 1999		Last 10 years		Last 5 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Alpha	0.19	0.18	0.31	0.32	0.41	0.41
	(1.45)	(1.36)	(2.09)	(2.19)	(2.69)	(2.82)
F-F MKT	0.02	0.02	0.01	0.01	0.01	0.00
	(4.95)	(5.03)	(2.74)	(2.54)	(1.47)	(1.35)
F-F SMB	0.04	0.04	0.02	0.02	0.02	0.02
	(6.47)	(5.69)	(3.42)	(2.96)	(2.49)	(2.25)
F-F HML	−0.01		0.01		0.00	
	(−2.07)		(1.79)		(1.40)	
F-F WML	0.01		−0.00		−0.00	
	(2.37)		(−0.68)		(−0.45)	
F-F HML Big		−0.01		0.01		0.00
		(−1.56)		(1.76)		(1.00)
F-F WML Big		0.01		−0.00		−0.00
		(2.26)		(−0.74)		(−0.50)
Observations	288	288	120	120	60	60
Adjusted R^2	0.37	0.36	0.21	0.21	0.22	0.21

Table 13
Equity management five-factor size-constrained regressions before and after management costs

Regression results before and after management costs with the original Fama and French (2015) five-factor model in (1) and (2) and the size-constrained factors in (3) and (4). The regressions rely on monthly relative returns computed as the monthly return on the equity management portfolio subtracted the return on the equity management benchmark. In (1) and (3) the dependent variables are relative returns before costs while they are subtracted management costs in (2) and (4). Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Original factors		Big cap factors	
	(1)	(2)	(3)	(4)
Alpha	0.47	0.35	0.39	0.27
	(2.99)	(2.27)	(2.62)	(1.85)
F-F MKT	0.01	0.01	0.01	0.01
	(3.95)	(3.94)	(3.57)	(3.57)
F-F SMB	0.04	0.04	0.04	0.04
	(5.74)	(5.68)	(5.56)	(5.50)
F-F HML	−0.00	−0.00		
	(−0.10)	(−0.14)		
F-F RMW	−0.00	−0.00		
	(−0.49)	(−0.50)		
F-F CMA	−0.03	−0.03		
	(−2.33)	(−2.30)		
F-F HML Big			0.00	0.00
			(0.49)	(0.44)
F-F RMW Big			0.00	0.00
			(0.43)	(0.41)
F-F CMA Big			−0.02	−0.02
			(−2.96)	(−2.94)
Observations	288	288	288	288
Adjusted R^2	0.36	0.36	0.36	0.36

Table 14
Equity management three-, four- and six-factor regressions using AQR return series

Regression results with AQR global return factors for the full period. The dependent variables are the monthly return on the equity management portfolio subtracted the return on the equity management benchmark and management costs. Column (1) holds the results for a three-factor specification similar to that of Fama and French (1992). Column (2) presents the results for a three-factor model using the Asness and Frazzini (2011) value factor. The difference in value factors is repeated for the column pairs (3)-(4) and (5)-(6). The columns (3) and (4) contain results for a four-factor model inspired by Carhart (1997). In the columns (5) and (6) an AQR developed six-factor model including the Betting Against Beta factor is applied. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	3-factor		4-factor		6-factor	
	(1)	(2)	(3)	(4)	(5)	(6)
Alpha	0.31	0.32	0.21	0.26	0.24	0.28
	(2.27)	(2.42)	(1.61)	(1.90)	(1.42)	(1.71)
AQR MKT	0.01	0.02	0.02	0.02	0.02	0.02
	(3.97)	(4.23)	(4.38)	(4.33)	(3.70)	(3.60)
AQR SMB	0.04	0.04	0.04	0.04	0.04	0.04
	(5.04)	(6.00)	(5.92)	(6.18)	(5.10)	(5.21)
AQR HML lag	−0.01		−0.01		−0.00	
	(−1.48)		(−1.23)		(−0.66)	
AQR HML cur		−0.01		−0.01		−0.01
		(−2.43)		(−1.65)		(−1.35)
AQR UMD			0.01	0.00	0.01	0.01
			(2.61)	(1.42)	(2.51)	(1.48)
AQR QMJ					0.00	0.00
					(0.19)	(0.02)
AQR BAB					−0.01	−0.00
					(−0.70)	(−0.60)
Observations	288	288	288	288	288	288
Adjusted R^2	0.33	0.36	0.36	0.36	0.36	0.36

Table 15
Equity management six-factor regressions for selected time periods using AQR return series

Regression results with AQR global return factors for selected time periods. The dependent variables are the monthly return on the equity management portfolio subtracted the return on the equity management benchmark and management costs. The models in (1), (3) and (5) rely on the value factor specification of Fama and French (1992) whereas the models in (2), (4) and (6) use the value factor as in Asness and Frazzini (2011). Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Since 1999		Last 10 years		Last 5 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Alpha	0.24	0.28	0.38	0.36	0.34	0.31
	(1.42)	(1.71)	(2.42)	(2.29)	(2.01)	(1.83)
AQR MKT	0.02	0.02	0.01	0.01	0.00	0.00
	(3.70)	(3.60)	(1.78)	(1.72)	(0.63)	(0.56)
AQR SMB	0.04	0.04	0.03	0.02	0.03	0.03
	(5.10)	(5.21)	(3.46)	(3.31)	(2.89)	(2.86)
AQR HML lag	−0.00		0.01		0.01	
	(−0.66)		(1.56)		(1.81)	
AQR HML cur		−0.01		0.01		0.01
		(−1.35)		(1.23)		(1.77)
AQR UMD	0.01	0.01	−0.00	−0.00	−0.01	−0.00
	(2.51)	(1.48)	(−0.44)	(−0.09)	(−0.94)	(−0.43)
AQR QMJ	0.00	0.00	−0.00	−0.00	0.01	0.01
	(0.19)	(0.02)	(−0.07)	(−0.16)	(1.36)	(1.28)
AQR BAB	−0.01	−0.00	−0.01	−0.01	−0.00	0.00
	(−0.70)	(−0.60)	(−1.30)	(−1.13)	(−0.02)	(0.14)
Observations	288	288	120	120	60	60
Adjusted R^2	0.36	0.36	0.23	0.23	0.30	0.30

Fixed-income management

Table 16 shows the regression results for a global term premium and duration-adjusted default premium two-factor model applied to the three considered periods. The table seeks to provide an indication of the exposures and the parameter estimate sensitivity towards the choice of sample.

Table 17 considers the entire sample period and illustrates the sensitivity of the alpha estimates and factor exposures to different model specifications. Columns (1) and (2) present results for one-factor models that rely on an unadjusted- and a duration-adjusted default premium factor, respectively. Column (3) holds the results from an application of a one-factor model with a global term premium factor. The columns (4) and (5) present results from models that combine the factors applied in (1)-(3).

Table 18 reports regression results for the same specifications as in Table 17, but with the factors constructed using US dollar denominated bonds.

Finally, Table 19 considers the effect of accounting for management costs. In particular, it presents regression results for the global two-factor model using raw relative returns, i.e. returns in excess of the benchmark return (1), and using relative returns subtracted management costs (2). The two-factor model relies on the duration-adjusted default premium factor and the term premium factor.

Table 16
Fixed-income management two-factor regressions for selected time periods

Regression results with global fixed-income factors for selected time periods. The dependent variables are the monthly return on the fixed-income management portfolio subtracted the return on the fixed-income management benchmark and management costs. Results for the three considered periods: since inception, last 10 years and last 5 years, are presented in column (1)-(3), respectively. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Since 1998 (1)	Last 10 years (2)	Last 5 years (3)
Alpha	0.17	0.25	0.41
	(0.67)	(2.09)	(2.32)
DEF Adj	0.05	0.00	−0.00
	(2.37)	(0.15)	(−0.05)
TERM	−0.03	−0.04	−0.04
	(−3.19)	(−6.84)	(−4.18)
Observations	300	120	60
Adjusted R^2	0.19	0.39	0.37

Table 17
Fixed-income management one- and two-factor regressions using global factor returns

Regression results with global fixed-income factors for the full period. The dependent variables are the monthly return on the fixed-income management portfolio subtracted the return on the fixed-income management benchmark and management costs. (1)-(3) presents regression results for three one-factor models using the default premium factor, duration-adjusted default premium factor, and term premium factor, respectively. The columns (4) and (5) hold estimation results from the two-factor models that uses combination of factors from the one-factor models. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	(1)	(2)	(3)	(4)	(5)
Alpha	0.14	0.11	0.25	0.17	0.17
	(0.53)	(0.44)	(0.81)	(0.66)	(0.67)
DEF	0.06			0.06	
	(2.50)			(2.31)	
DEF Adj		0.05			0.05
		(2.32)			(2.37)
TERM			−0.02	−0.01	−0.03
			(−2.83)	(−1.52)	(−3.19)
Observations	300	300	300	300	300
Adjusted R^2	0.17	0.16	0.02	0.17	0.19

Table 18
Fixed-income management one- and two-factor regressions using US factor returns

Regression results with US fixed-income factors for the full period. The dependent variables are the monthly return on the fixed-income management portfolio subtracted the return on the fixed-income management benchmark and management costs. (1)-(3) presents regression results for three one-factor models using the default premium factor, duration-adjusted default premium factor and term premium factor, respectively. The columns (4) and (5) hold estimation results from the two-factor models that uses combination of factors from the one-factor models. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	(1)	(2)	(3)	(4)	(5)
Alpha	0.17	0.15	0.25	0.17	0.17
	(0.68)	(0.56)	(0.84)	(0.66)	(0.66)
DEF	0.05			0.05	
	(2.53)			(2.16)	
DEF adj		0.04			0.04
		(2.19)			(1.89)
TERM			−0.02	0.00	−0.01
			(−3.71)	(0.17)	(−1.07)
Observations	300	300	300	300	300
Adjusted R^2	0.19	0.15	0.04	0.19	0.16

Table 19
Fixed-income management two-factor regressions before and after management costs

Regression results with global fixed-income factors for the full period. The regressions rely on monthly relative returns computed as the monthly return on the fixed-income management portfolio subtracted the return on the fixed-income management benchmark. In (1) the dependent variable is the relative return before costs while they it is subtracted management costs in (2). Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Before costs (1)	After costs (2)
Alpha	0.22	0.17
	(0.84)	(0.67)
DEF Adj	0.05	0.05
	(2.37)	(2.37)
TERM	−0.03	−0.03
	(−3.19)	(−3.19)
Observations	300	300
Adjusted R^2	0.19	0.19

Fund

Using the the seven-factor model described in the methodology section this section analyses the aggregated fund portfolio spanning equity, fixed-income and real-asset management. Using a cross-asset factor model allows equity investments to exhibit fixed-income risk factor exposure and vice versa. This implies that the estimated alphas are not directly comparable to those of the five- and two-factor models in the previous sections.

Table 20 presents the results from regressing the relative fund return after management costs onto the seven factors of the main model for different sample periods. The table provides an indication of the exposures and the parameter estimate sensitivity towards the choice of sample.

Table 21 reports regression results from applying the seven-factor model with and without size-constrained factors for the full period using before- and after-cost relative returns. The columns (1) and (3) contain results from the before-cost regression whereas columns (2) and (4) contain corresponding after-cost results.

Table 20
Fund factor regressions for selected time periods

Regression results with global seven-factor model for selected time periods. The dependent variable are the monthly fund return subtracted the return on the fund benchmark and management costs. Results for the three considered periods: since inception, last 10 years and last 5 years, are presented in column (1)-(3), respectively. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Since 1998 (1)	Last 10 years (2)	Last 5 years (3)
Alpha	0.19	0.27	0.27
	(1.23)	(2.50)	(1.80)
F-F MKT	0.01	0.00	−0.01
	(2.63)	(0.38)	(−1.10)
F-F SMB	0.03	0.02	0.02
	(5.32)	(2.30)	(1.76)
F-F HML	0.02	0.00	0.01
	(2.14)	(0.56)	(0.80)
F-F RMW	0.01	0.00	0.01
	(0.75)	(0.17)	(0.93)
F-F CMA	−0.03	0.01	0.01
	(−2.37)	(0.49)	(0.35)
DEF Adj	0.02	0.01	0.01
	(1.95)	(1.56)	(1.72)
TERM	−0.02	−0.03	−0.02
	(−3.37)	(−5.70)	(−3.17)
Observations	300	120	60
Adjusted R^2	0.38	0.38	0.32

Table 21
Fund factor regressions before and after management costs

Regression results before and after management costs with the original seven-factor model in (1) and (2) and the size-constrained factors in (3) and (4). The regressions rely on monthly relative returns computed as the monthly fund return subtracted the return on the fund benchmark. In (1) and (3) the dependent variables are relative returns before costs while they are subtracted management costs in (2) and (4). Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Original factors		Big cap factors	
	(1)	(2)	(3)	(4)
Alpha	0.26	0.19	0.23	0.16
	(1.75)	(1.23)	(1.52)	(1.01)
F-F MKT	0.01	0.01	0.01	0.01
	(2.64)	(2.63)	(2.89)	(2.88)
F-F SMB	0.03	0.03	0.03	0.03
	(5.36)	(5.32)	(5.82)	(5.77)
F-F HML	0.02	0.02		
	(2.16)	(2.14)		
F-F RMW	0.01	0.01		
	(0.76)	(0.75)		
F-F CMA	−0.03	−0.03		
	(−2.39)	(−2.37)		
DEF Adj	0.02	0.02	0.02	0.02
	(1.94)	(1.95)	(1.88)	(1.89)
TERM	−0.02	−0.02	−0.02	−0.02
	(−3.38)	(−3.37)	(−3.21)	(−3.20)
F-F HML Big			0.01	0.01
			(2.34)	(2.31)
F-F RMW Big			0.01	0.01
			(1.48)	(1.47)
F-F CMA Big			−0.02	−0.02
			(−2.37)	(−2.35)
Observations	300	300	300	300
Adjusted R^2	0.38	0.38	0.38	0.38

1.4.3 Investment strategies

In this section we perform various factor regressions for the three investment strategies: fund allocation, security selection and asset management. Finally, we emphasise that the considered return time-series are rather short from a statistical perspective.

Prior to the analysis we present the average relative strategy returns before and after costs in Table 22. Since costs are available to us on an investment strategy level but not on the sub-strategy level we are unable to present after-cost relative returns and perform factor regressions for the equity and fixed-income investments of each strategy.

Table 22
Spanned time periods and average relative returns

			Average %-USD relative returns		
	Start	End	Since inception	Last 10 years	Last 5 years
After-costs					
Fund allocation	Jan 2013	Dec 2022	-0.03	-0.03	-0.00
Security selection	Jan 2013	Dec 2022	0.75	0.75	0.93
Asset management	Jan 2013	Dec 2022	0.19	0.19	0.17
Before-costs					
Fund allocation	Jan 2013	Dec 2022	-0.03	-0.03	0.00
- equity	Jan 2013	Dec 2022	0.00	0.00	0.01
- fixed-income	Jan 2013	Dec 2022	-0.01	-0.01	0.21
Security selection	Jan 2013	Dec 2022	0.90	0.90	1.05
- equity	Jan 2013	Dec 2022	1.26	1.26	1.41
- fixed-income	Oct 2014	Dec 2022	0.42	-	0.42
Asset management	Jan 2013	Dec 2022	0.22	0.22	0.19
- equity	Jan 2013	Dec 2022	0.20	0.20	0.15
- fixed-income	Jan 2013	Dec 2022	0.28	0.28	0.29

Note: Average relative returns are based on the annualised arithmetic average of monthly US dollar returns.

The analysis uses the same set of factors as in the previous sections but with some modifications and extensions.

First, as emphasised by the expert group in Dahlquist et al. (2015) one should account for possible investment manager restrictions and factor characteristics when specifying factor regressions. Likewise, Fama and French (2017) show that regional factor models outperform global factor models in explaining the cross-section of returns. As the strategy benchmarks contain significant region and sector tilts compared to the global F-F market portfolio we perform a series of robustness tests in which we examine the effect of replacing the global market portfolio by investment strategy benchmarks. The strategy benchmarks represent alternative and attainable investment opportunities. Moreover, the replacement is in line with the recommendation of Berk and Van Binsbergen (2015) who stress the need for consistency between the investment mandate and the chosen benchmark.

Second, for the equity management we consider loadings on alternative risk proxies through regressions to the global equity market, the strategy benchmark, high volatility equities, and the Betting Against Beta factor.

Since the choice of proxy for risk will have a non-negligible impact on alpha and due to high correlation between different possible choices, we illustrate sensitivity through univariate regressions on the global equity market, the strategy benchmark, high volatility equities and the Betting Against

Beta factor.

Equity management
Table 23 reports alphas and exposures obtained from applying the Fama and French (2015) five-factor model to the equity composites of the strategies.

The effect of including the equity benchmarks of the three strategies as independent variables is illustrated in Table 24. The equity benchmarks of fund allocation, security selection and asset management differ but are in the table denoted commonly by EQ BM.

Tables 25-27 consider fund allocation, security selection and asset management, respectively, but are identical with respect to factor setup. The tables report the average relative return of the equity management of the strategies in column (1) and parameter estimates from four different factor models in columns (2)-(5). The tables illustrate how factor exposures change along with the extension of the model.

As in the previous section we accompany our Fama-French based factor analysis by regressions using the AQR factors. Each of the Tables 28-30 reports estimation results from the application of six different AQR based factor models.

Finally, Tables 31-33 present estimated alphas and exposures to the global market factor, the equity management benchmark of the strategies and equity market volatility.

Table 23
Equity management five-factor regressions for the investment strategies before management costs

Regression results with Fama-French global return factors for the three fund strategies. The dependent variables are the monthly return on the equity management portfolio of a given strategy subtracted the return on the equity management benchmark of the strategy. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Fund allocation (1)	Securities selection (2)	Asset management (3)
Alpha	0.00	1.37	0.19
	(0.02)	(2.90)	(4.76)
F-F MKT	0.00	0.02	−0.00
	(3.00)	(2.21)	(−0.78)
F-F SMB	0.01	0.05	−0.00
	(1.96)	(2.15)	(−0.97)
F-F HML	0.01	0.01	0.00
	(2.72)	(0.64)	(0.43)
F-F RMW	−0.00	−0.05	0.00
	(−0.17)	(−1.47)	(1.04)
F-F CMA	−0.01	−0.08	0.00
	(−0.94)	(−2.09)	(1.16)
Observations	120	120	120
Adjusted R^2	0.22	0.21	0.05

Table 24
Equity management five-factor regressions with benchmark factors for the investment strategies before management costs

Regression results with Fama-French global return factors and benchmark regressors for the three fund strategies. The dependent variables are the monthly return on the equity management portfolio of a given strategy subtracted the return on the equity management benchmark of the strategy. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Fund allocation		Securities selection		Asset management	
	(1)	(2)	(3)	(4)	(5)	(6)
Alpha	0.00	0.00	1.37	1.47	0.19	0.19
	(0.02)	(0.04)	(2.90)	(3.16)	(4.76)	(4.79)
F-F MKT	0.00		0.02		−0.00	
	(3.00)		(2.21)		(−0.78)	
EQ BM		0.00		0.02		−0.00
		(3.13)		(1.94)		(−0.98)
F-F SMB	0.01	0.01	0.05	0.05	−0.00	−0.00
	(1.96)	(1.93)	(2.15)	(2.14)	(−0.97)	(−0.93)
F-F HML	0.01	0.01	0.01	0.02	0.00	0.00
	(2.72)	(2.70)	(0.64)	(0.67)	(0.43)	(0.49)
F-F RMW	−0.00	−0.00	−0.05	−0.04	0.00	0.00
	(−0.17)	(−0.20)	(−1.47)	(−1.30)	(1.04)	(1.08)
F-F CMA	−0.01	−0.01	−0.08	−0.09	0.00	0.00
	(−0.94)	(−0.94)	(−2.09)	(−2.38)	(1.16)	(1.10)
Observations	120	120	120	120	120	120
Adjusted R^2	0.22	0.23	0.21	0.19	0.05	0.05

Table 25
Equity management one-, three-, four- and five-factor regressions before management costs: fund allocation

Regression results with Fama-French global return factors for the full period. The dependent variables are the monthly return on the equity management portfolio of fund allocation subtracted the return on the equity management benchmark of fund allocation. Column (1) holds the unadjusted active return, whereas column (2)-(5) presents regression results for the: one-factor model, the Fama and French (1992) three-factor model, the Carhart (1997) four-factor model, and the Fama and French (2015) five-factor model, respectively. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Unadj. (1)	1-factor (2)	3-factor (3)	4-factor (4)	5-factor (5)
Alpha	0.00	−0.04	−0.01	0.00	0.00
	(0.01)	(−0.43)	(−0.18)	(0.01)	(0.02)
F-F MKT		0.00	0.00	0.00	0.00
		(3.16)	(3.75)	(2.70)	(3.00)
F-F SMB			0.01	0.01	0.01
			(2.26)	(2.26)	(1.96)
F-F HML			0.01	0.01	0.01
			(3.73)	(2.86)	(2.72)
F-F WML				−0.00	
				(−0.79)	
F-F RMW					−0.00
					(−0.17)
F-F CMA					−0.01
					(−0.94)
Observations	120	120	120	120	120
Adjusted R^2	0.00	0.07	0.23	0.22	0.22

Table 26
Equity management one-, three-, four- and five-factor regressions before management costs: security selection

Regression results with Fama-French global return factors for the full period. The dependent variables are the monthly return on the equity management portfolio of security subtracted the return on the equity management benchmark of security selection. Column (1) holds the unadjusted active return, whereas column (2)-(5) presents regression results for the: one-factor model, the Fama and French (1992) three-factor model, the Carhart (1997) four-factor model, and the Fama and French (2015) five-factor model, respectively. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Unadj. (1)	1-factor (2)	3-factor (3)	4-factor (4)	5-factor (5)
Alpha	1.26	0.96	1.07	1.14	1.37
	(2.37)	(1.90)	(2.24)	(2.26)	(2.90)
F-F MKT		0.03	0.03	0.03	0.02
		(2.79)	(2.72)	(2.46)	(2.21)
F-F SMB			0.07	0.07	0.05
			(3.88)	(3.85)	(2.15)
F-F HML			−0.01	−0.02	0.01
			(−1.45)	(−1.47)	(0.64)
F-F WML				−0.01	
				(−0.47)	
F-F RMW					−0.05
					(−1.47)
F-F CMA					−0.08
					(−2.09)
Observations	120	120	120	120	120
Adjusted R^2	0.00	0.11	0.16	0.15	0.21

Table 27
Equity management one-, three-, four- and five-factor regressions before management costs: asset management

Regression results with Fama-French global return factors for the full period. The dependent variables are the monthly return on the equity management portfolio of asset management subtracted the return on the equity management benchmark of asset management. Column (1) holds the unadjusted active return, whereas column (2)-(5) presents regression results for the: one-factor model, the Fama and French (1992) three-factor model, the Carhart (1997) four-factor model, and the Fama and French (2015) five-factor model, respectively. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Unadj. (1)	1-factor (2)	3-factor (3)	4-factor (4)	5-factor (5)
Alpha	0.20	0.21	0.20	0.20	0.19
	(4.89)	(4.99)	(4.98)	(4.59)	(4.76)
F-F MKT		−0.00	−0.00	−0.00	−0.00
		(−1.78)	(−1.48)	(−0.95)	(−0.78)
F-F SMB			−0.00	−0.00	−0.00
			(−1.77)	(−1.76)	(−0.97)
F-F HML			0.00	0.00	0.00
			(1.88)	(1.95)	(0.43)
F-F WML				0.00	
				(0.71)	
F-F RMW					0.00
					(1.04)
F-F CMA					0.00
					(1.16)
Observations	120	120	120	120	120
Adjusted R^2	0.00	0.01	0.04	0.03	0.05

Table 28
Equity management three-, four- and six-factor regressions using AQR factors before management costs: fund allocation

Regression results with AQR global return factors. The dependent variables are the monthly return on the equity management portfolio of fund allocation subtracted the return on the equity management benchmark of fund allocation. Column (1) holds the results for a three-factor specification similar to that of Fama and French (1992). Column (2) presents the results for a three-factor model using the Asness and Frazzini (2011) value factor. The difference in value factors is repeated for the column pairs (3)-(4) and (5)-(6). The columns (3) and (4) contain results for a four-factor model inspired by Carhart (1997). In the columns (5) and (6) an AQR developed six-factor model including the Betting Against Beta factor is applied. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	3-factor		4-factor		6-factor	
	(1)	(2)	(3)	(4)	(5)	(6)
Alpha	−0.02	−0.01	0.01	−0.01	0.05	0.03
	(−0.29)	(−0.17)	(0.11)	(−0.12)	(0.57)	(0.35)
AQR MKT	0.00	0.00	0.00	0.00	0.00	0.00
	(2.69)	(1.66)	(1.51)	(1.35)	(1.00)	(0.73)
AQR SMB	0.01	0.01	0.01	0.01	0.01	0.00
	(2.24)	(1.83)	(1.97)	(1.80)	(1.00)	(0.81)
AQR HML lag	0.01		0.01		0.01	
	(3.96)		(3.16)		(3.15)	
AQR HML cur		0.01		0.01		0.01
		(4.00)		(2.82)		(2.83)
AQR UMD			−0.00	−0.00	−0.00	−0.00
			(−1.33)	(−0.12)	(−0.77)	(−0.00)
AQR QMJ					−0.01	−0.01
					(−1.28)	(−1.41)
AQR BAB					−0.00	0.00
					(−0.28)	(0.05)
Observations	120	120	120	120	120	120
Adjusted R^2	0.21	0.21	0.22	0.21	0.21	0.21

Table 29
Equity management three-, four- and six-factor regressions using AQR factors before management costs: security selection

Regression results with AQR global return factors. The dependent variables are the monthly return on the equity management portfolio of security selection subtracted the return on the equity management benchmark of security selection. Column (1) holds the results for a three-factor specification similar to that of Fama and French (1992). Column (2) presents the results for a three-factor model using the Asness and Frazzini (2011) value factor. The difference in value factors is repeated for the column pairs (3)-(4) and (5)-(6). The columns (3) and (4) contain results for a four-factor model inspired by Carhart (1997). In the columns (5) and (6) an AQR developed six-factor model including the Betting Against Beta factor is applied. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	3-factor		4-factor		6-factor	
	(1)	(2)	(3)	(4)	(5)	(6)
Alpha	1.17	1.16	1.27	1.32	1.36	1.41
	(2.58)	(2.53)	(2.60)	(2.63)	(3.04)	(3.04)
AQR MKT	0.02	0.03	0.02	0.02	0.03	0.03
	(2.47)	(2.44)	(1.99)	(2.03)	(2.23)	(2.33)
AQR SMB	0.10	0.10	0.10	0.10	0.12	0.12
	(5.29)	(5.25)	(5.14)	(5.03)	(6.14)	(6.22)
AQR HML lag	−0.02		−0.02		−0.01	
	(−1.45)		(−1.44)		(−0.97)	
AQR HML cur		−0.01		−0.02		−0.02
		(−1.14)		(−1.25)		(−0.93)
AQR UMD			−0.01	−0.02	0.00	−0.00
			(−0.71)	(−0.89)	(0.18)	(−0.11)
AQR QMJ					0.02	0.02
					(0.61)	(0.65)
AQR BAB					−0.04	−0.04
					(−1.77)	(−1.89)
Observations	120	120	120	120	120	120
Adjusted R^2	0.25	0.24	0.24	0.24	0.25	0.25

Table 30
Equity management three-, four- and six-factor regressions using AQR factors before management costs: asset management

Regression results with AQR global return factors. The dependent variables are the monthly return on the equity management portfolio of asset management subtracted the return on the equity management benchmark of asset management. Column (1) holds the results for a three-factor specification similar to that of Fama and French (1992). Column (2) presents the results for a three-factor model using the Asness and Frazzini (2011) value factor. The difference in value factors is repeated for the column pairs (3)-(4) and (5)-(6). The columns (3) and (4) contain results for a four-factor model inspired by Carhart (1997). In the columns (5) and (6) an AQR developed six-factor model including the Betting Against Beta factor is applied. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	3-factor		4-factor		6-factor	
	(1)	(2)	(3)	(4)	(5)	(6)
Alpha	0.20	0.20	0.20	0.19	0.17	0.16
	(4.89)	(4.91)	(4.48)	(4.32)	(3.87)	(3.72)
AQR MKT	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(−1.40)	(−1.54)	(−1.03)	(−1.14)	(−0.72)	(−0.90)
AQR SMB	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(−1.66)	(−1.70)	(−1.57)	(−1.60)	(−0.87)	(−0.97)
AQR HML lag	0.00		0.00		0.00	
	(1.46)		(1.62)		(1.38)	
AQR HML cur		0.00		0.00		0.00
		(1.11)		(1.40)		(1.28)
AQR UMD			0.00	0.00	−0.00	−0.00
			(0.49)	(0.79)	(−0.40)	(−0.04)
AQR QMJ					0.00	0.00
					(1.35)	(1.27)
AQR BAB					0.00	0.00
					(1.23)	(1.41)
Observations	120	120	120	120	120	120
Adjusted R^2	0.03	0.02	0.03	0.02	0.04	0.04

Table 31
Alternative equity management factor regressions before management costs: fund allocation

Regression results using the global market factor, the equity management benchmark of the strategy (EQ BM), the volatility factor, and the Betting Against Beta factor for the equity management portfolio of the fund strategies. For each of the regressions the dependent variable is the monthly return on the equity management portfolio of the considered strategy relative to its benchmark. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	(1)	(2)	(3)	(4)
Alpha	−0.04	−0.04	0.01	0.03
	(−0.43)	(−0.42)	(0.15)	(0.27)
F-F MKT	0.00			
	(3.16)			
EQ BM		0.00		
		(3.36)		
F-F VOL			0.00	
			(2.01)	
AQR BAB				−0.00
				(−0.77)
Observations	120	120	120	120
Adjusted R^2	0.07	0.08	0.04	−0.00

Table 32
Alternative equity management factor regressions before management costs: security selection

Regression results using the global market factor, the equity management benchmark of the strategy (EQ BM), the volatility factor, and the Betting Against Beta factor for the equity management portfolio of the fund strategies. For each of the regressions the dependent variable is the monthly return on the equity management portfolio of the considered strategy relative to its benchmark. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	(1)	(2)	(3)	(4)
Alpha	0.96	1.10	1.43	1.44
	(1.90)	(2.16)	(3.07)	(2.77)
F-F MKT	0.03			
	(2.79)			
EQ BM		0.03		
		(2.66)		
F-F VOL			0.04	
			(4.10)	
AQR BAB				−0.02
				(−0.78)
Observations	120	120	120	120
Adjusted R^2	0.11	0.07	0.20	−0.00

Table 33
Alternative equity management factor regressions before management costs: asset management

Regression results using the global market factor, the equity management benchmark of the strategy (EQ BM), the volatility factor, and the Betting Against Beta factor for the equity management portfolio of the fund strategies. For each of the regressions the dependent variable is the monthly return on the equity management portfolio of the considered strategy relative to its benchmark. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	(1)	(2)	(3)	(4)
Alpha	0.21	0.21	0.19	0.18
	(4.99)	(5.02)	(4.80)	(4.72)
F-F MKT	−0.00			
	(−1.78)			
EQ BM		−0.00		
		(−1.95)		
F-F VOL			−0.00	
			(−2.69)	
AQR BAB				0.00
				(1.29)
Observations	120	120	120	120
Adjusted R^2	0.01	0.01	0.06	0.00

Fixed-income management

Table 34 considers the fixed-income management of the strategies. Specifically, it presents regression results from the applications of the main fixed-income factor model across strategies. As described in the methodology section the factor model uses the duration adjusted default premium and term premium factors to describe the fixed-income returns.

Table 34
Fixed-income management two-factor regressions for the investment strategies before management costs

Regression results with a duration-adjusted default premium factor and a term premium factor for the three fund strategies. The dependent variables are the monthly return on the fixed-income management portfolio of a given strategy subtracted the corresponding return on the fixed-income management benchmark of the strategy. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Fund allocation (1)	Securities selection (2)	Asset management (3)
Alpha	0.00	0.59	0.26
	(0.02)	(2.65)	(5.50)
DEF Adj	0.01	−0.07	0.01
	(1.81)	(−5.99)	(2.45)
TERM	−0.04	0.01	−0.01
	(−6.34)	(1.45)	(−2.69)
Observations	120	99	120
Adjusted R^2	0.37	0.40	0.17

Total

In this section we consider the aggregated portfolios of the strategies. The totals of security selection and asset management contain equity and fixed-income management whereas the fund allocation portfolio contains equity, fixed-income and real-asset management. As previously mentioned we seek to explain returns on aggregated portfolios using a global seven-factor model combining the factors from our main equity and fixed-income factor models.

Table 35 reports alpha and exposure estimates from the applications of the seven-factor model to after-cost relative return series across investment strategies.

As in the analysis of the equity management we consider the effect of replacing the global market factor in the model by the return on the corresponding equity management benchmark (BM). Table 36 presents results from such factor regressions.

In order to analyse how accounting for management costs affects the regression estimates we estimate the seven-factor model on before-costs and after-costs return series for the three strategies. Table 37 presents the results. Columns (1), (3), and (5) hold the before-cost estimations whereas columns (2), (4), and (6) holds the corresponding after-cost estimations.

Table 35
Total factor regressions for the investment strategies after management costs

Regression results from applying the global seven-factor model to the three fund strategies. The dependent variables are the monthly return on a given strategy subtracted the return on the benchmark of the strategy and management costs. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Fund allocation (1)	Securities selection (2)	Asset management (3)
Alpha	−0.00	0.72	0.17
	(−0.06)	(1.88)	(6.29)
F-F MKT	−0.00	0.01	0.00
	(−0.10)	(1.45)	(0.77)
F-F SMB	0.01	0.02	0.00
	(1.87)	(1.42)	(1.11)
F-F HML	0.01	−0.04	−0.00
	(1.39)	(−1.89)	(−0.11)
F-F RMW	0.00	−0.02	0.00
	(0.19)	(−0.67)	(1.09)
F-F CMA	0.01	−0.01	0.00
	(0.60)	(−0.39)	(1.65)
DEF Adj	0.00	0.02	0.00
	(0.20)	(1.80)	(2.55)
TERM	−0.02	−0.07	−0.00
	(−3.07)	(−5.04)	(−2.82)
Observations	120	120	120
Adjusted R^2	0.33	0.25	0.14

Table 36
Total factor regressions with benchmark factors for the investment strategies after management costs

Regression results from applying the global seven-factor model to the three fund strategies. The dependent variables are the monthly return on the a given strategy subtracted the return on the benchmark of the strategy and management costs. The benchmarks included as independent variables differ across strategies but we present the exposures in a single row (BM). Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Fund allocation		Securities selection		Asset management	
	(1)	(2)	(3)	(4)	(5)	(6)
Alpha	−0.00	−0.01	0.72	0.76	0.17	0.17
	(−0.06)	(−0.07)	(1.88)	(1.98)	(6.29)	(6.36)
F-F MKT	−0.00		0.01		0.00	
	(−0.10)		(1.45)		(0.77)	
BM		−0.00		0.01		0.00
		(−0.08)		(1.06)		(0.81)
F-F SMB	0.01	0.01	0.02	0.03	0.00	0.00
	(1.87)	(1.87)	(1.42)	(1.45)	(1.11)	(1.03)
F-F HML	0.01	0.01	−0.04	−0.04	−0.00	−0.00
	(1.39)	(1.39)	(−1.89)	(−1.85)	(−0.11)	(−0.10)
F-F RMW	0.00	0.00	−0.02	−0.01	0.00	0.00
	(0.19)	(0.19)	(−0.67)	(−0.54)	(1.09)	(1.08)
F-F CMA	0.01	0.01	−0.01	−0.01	0.00	0.00
	(0.60)	(0.61)	(−0.39)	(−0.49)	(1.65)	(1.65)
DEF Adj	0.00	0.00	0.02	0.02	0.00	0.00
	(0.20)	(0.18)	(1.80)	(2.06)	(2.55)	(2.64)
TERM	−0.02	−0.02	−0.07	−0.08	−0.00	−0.00
	(−3.07)	(−2.98)	(−5.04)	(−4.84)	(−2.82)	(−2.66)
Observations	120	120	120	120	120	120
Adjusted R^2	0.33	0.33	0.25	0.25	0.14	0.14

Table 37
Total factor regressions for the investment strategies before and after management costs

Regression results from applying the global seven-factor model to the before and after-cost return series of the three fund strategies. The dependent variables in (2), (4), and (6) are the monthly return on a given strategy subtracted the return on the benchmark of the strategy and management costs. In (1), (3), and (5) the relative returns are not subtracted management costs and hence the regression is performing on a before-cost basis. Newey and West (1987) corrected t-statistics (using 3 lags) are shown in parentheses. The alpha estimates are annualised and in percent.

	Fund allocation		Securities selection		Asset management	
	(1)	(2)	(3)	(4)	(5)	(6)
Alpha	0.00	−0.00	0.87	0.72	0.20	0.17
	(0.01)	(−0.06)	(2.26)	(1.88)	(7.30)	(6.29)
F-F MKT	−0.00	−0.00	0.01	0.01	0.00	0.00
	(−0.10)	(−0.10)	(1.47)	(1.45)	(0.78)	(0.77)
F-F SMB	0.01	0.01	0.02	0.02	0.00	0.00
	(1.86)	(1.87)	(1.42)	(1.42)	(1.12)	(1.11)
F-F HML	0.01	0.01	−0.04	−0.04	−0.00	−0.00
	(1.39)	(1.39)	(−1.90)	(−1.89)	(−0.11)	(−0.11)
F-F RMW	0.00	0.00	−0.02	−0.02	0.00	0.00
	(0.19)	(0.19)	(−0.70)	(−0.67)	(1.06)	(1.09)
F-F CMA	0.01	0.01	−0.01	−0.01	0.00	0.00
	(0.59)	(0.60)	(−0.39)	(−0.39)	(1.63)	(1.65)
DEF Adj	0.00	0.00	0.02	0.02	0.00	0.00
	(0.20)	(0.20)	(1.78)	(1.80)	(2.53)	(2.55)
TERM	−0.02	−0.02	−0.07	−0.07	−0.00	−0.00
	(−3.07)	(−3.07)	(−5.02)	(−5.04)	(−2.80)	(−2.82)
Observations	120	120	120	120	120	120
Adjusted R^2	0.33	0.33	0.25	0.25	0.14	0.14

1.5 Factor return statistics

In this section we present statistics for the main factors. In particular, we report cumulative factor return time-series for the period January 1998-December 2022 along with descriptive statistics for the three analysis periods: since inception, last 10 years and last 5 years. Finally, we present a range of Fama-French and AQR factor correlations.

Figure 1 illustrates the cumulative compounded monthly return of the original Fama-French factors for the entire sample period. Figures 2-5 show the differences in cumulative returns on small and large versions of the value, momentum, profitability and investment factor. Figure 6 depicts the cumulative returns of the AQR factors.

For the fixed-income factors Figure 7 presents the cumulative return time-series.

Finally, Tables 38-40 report monthly factor return statistics for the considered periods, and Tables 41-44 present monthly factor return correlations.

Figure 1
Cumulative returns, global Fama-French factors, 1998-2022

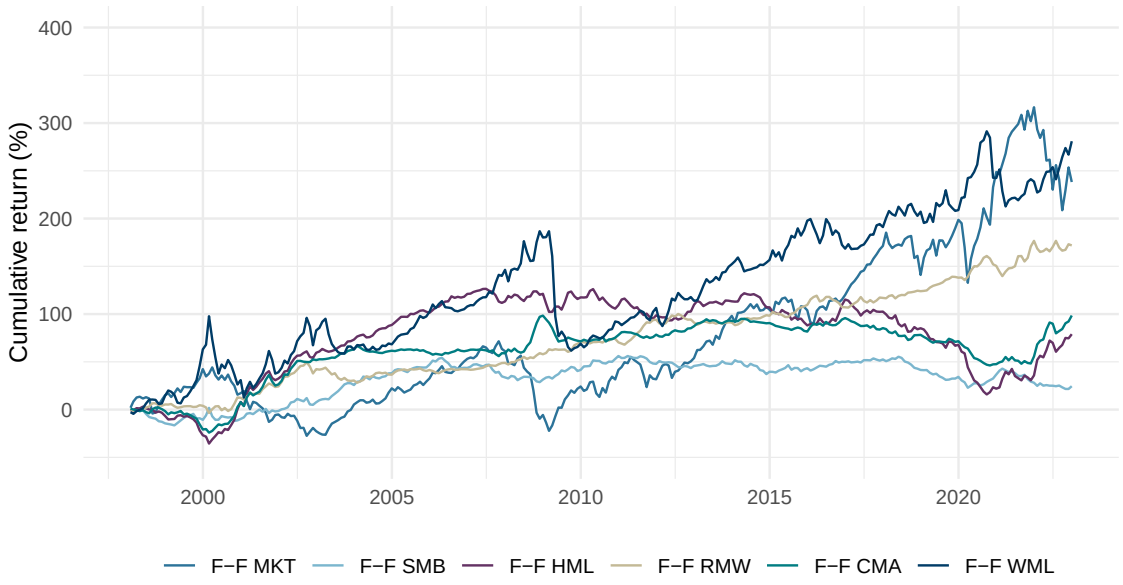

Figure 2
Cumulative returns, global HML factor along with Big and Small versions, 1998-2022

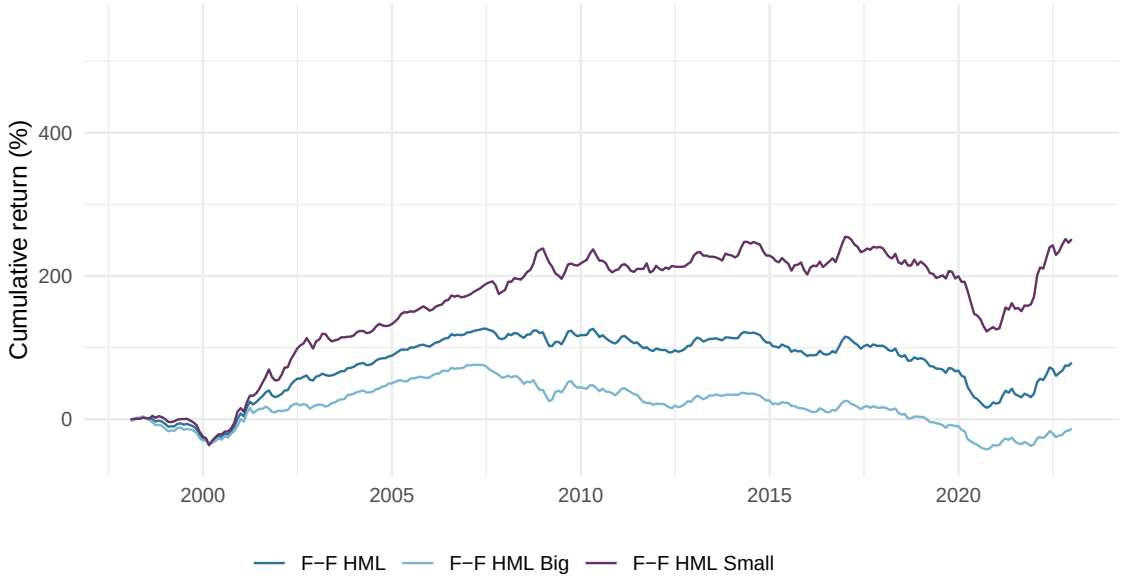

Figure 3
Cumulative returns, global WML factor along with Big and Small versions, 1998-2022

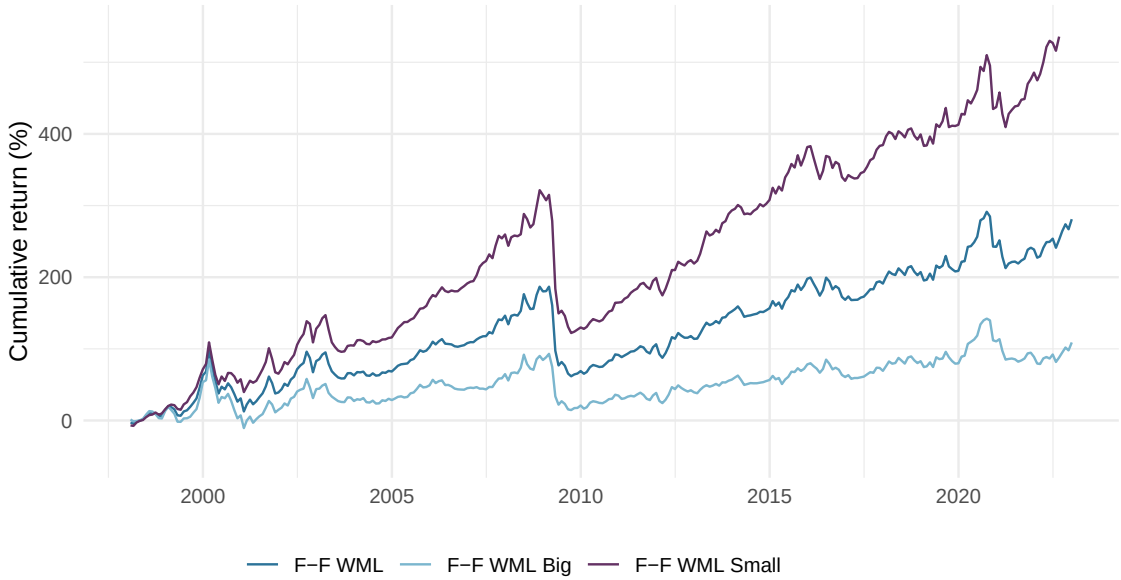

Figure 4
Cumulative returns, global RMW factor along with Big and Small versions, 1998-2022

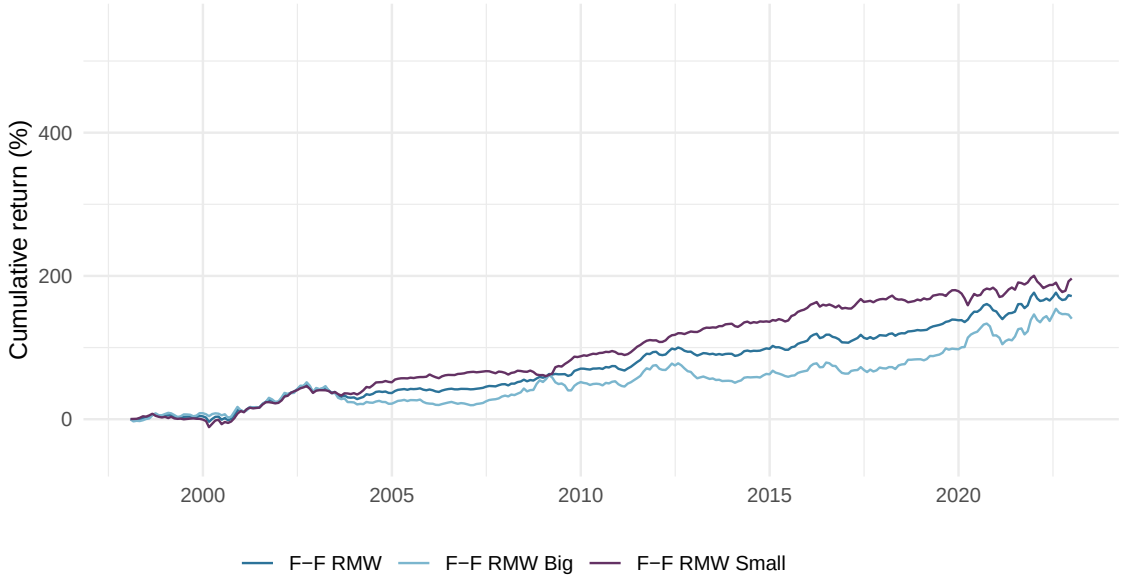

Figure 5
Cumulative returns, global CMA factor along with Big and Small versions, 1998-2022

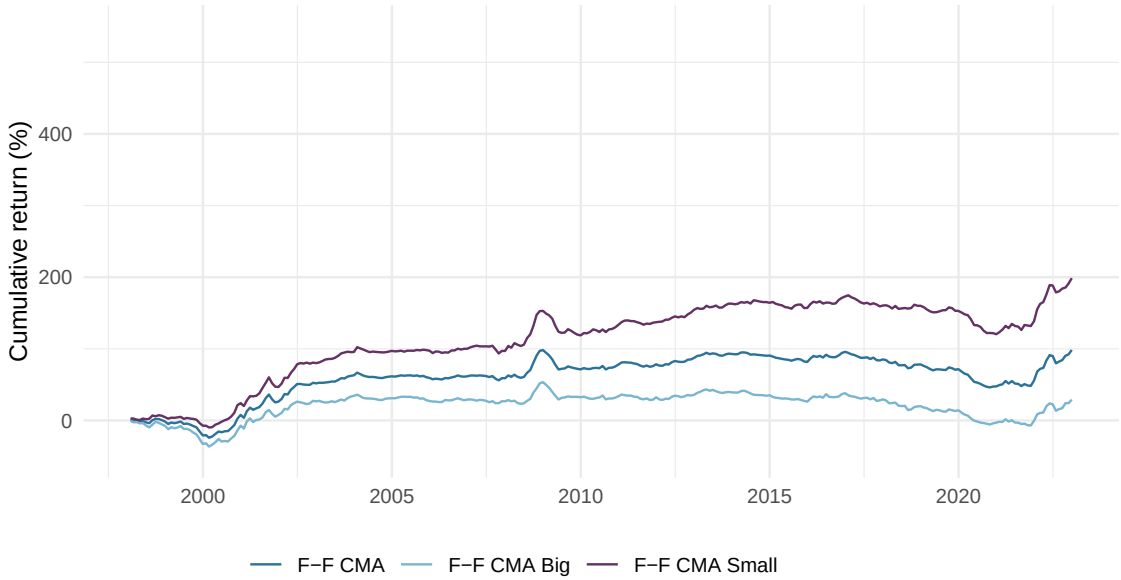

Figure 6
Cumulative returns, global AQR factors, 1998-2022

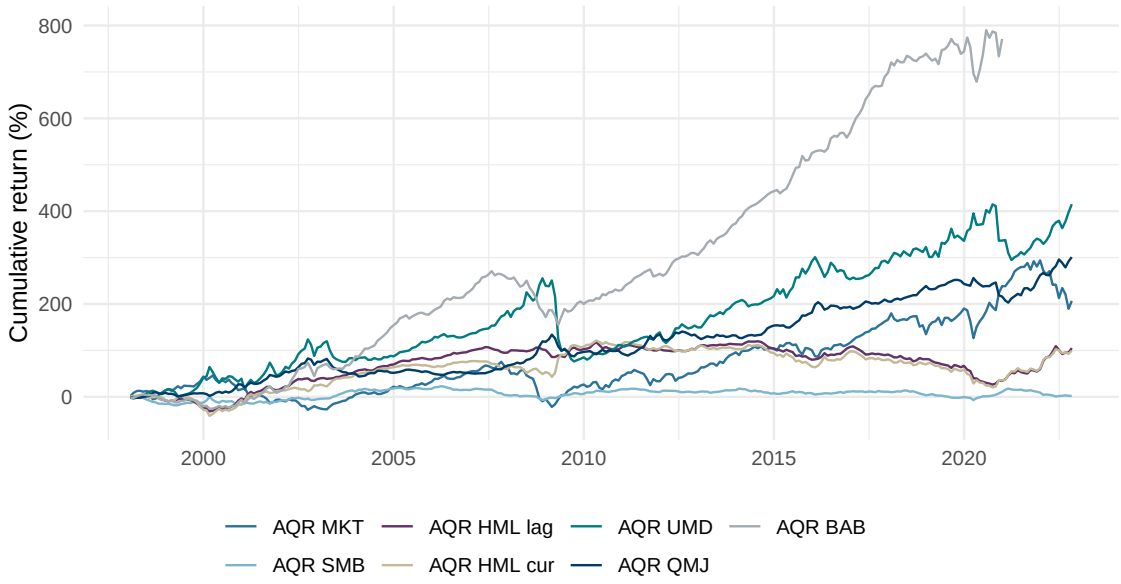

Figure 7
Cumulative returns, global fixed-income factors, 1998-2022

Table 38
Factor return statistics since 1998

Arithmetic average factor returns and factor volatilities (annualised) for the period 1998-2022

Factor	Average return	Volatility	Return-to-volatility
AQR BAB	9.80	10.49	0.93
AQR HML lag	3.30	8.82	0.37
AQR HML cur	3.54	11.72	0.30
AQR MKT	5.95	16.14	0.37
AQR QMJ	6.11	7.88	0.78
AQR SMB	0.16	6.58	0.02
AQR UMD	7.82	14.79	0.53
F-F CMA	3.00	7.23	0.42
F-F CMA Big	1.42	8.94	0.16
F-F CMA Small	4.59	6.45	0.71
F-F HML	2.80	9.78	0.29
F-F HML Big	0.05	11.11	0.00
F-F HML Small	5.56	10.30	0.54
F-F MKT	6.18	15.97	0.39
F-F RMW	4.15	5.40	0.77
F-F RMW Big	3.79	7.42	0.51
F-F RMW Small	4.51	5.58	0.81
F-F SMB	1.09	6.53	0.17
F-F VOL	-0.06	23.83	-0.00
F-F WML	6.42	14.36	0.45
F-F WML Big	4.28	16.15	0.26
F-F WML Small	8.56	13.51	0.63
DEF	0.92	6.46	0.14
DEF Adj	1.55	7.58	0.21
TERM	2.33	6.31	0.37
DEF US	0.37	8.61	0.04
DEF Adj US	1.05	9.29	0.11
TERM US	2.87	10.18	0.28

Table 39
Factor return statistics for the last 10 years

Arithmetic average factor returns and factor volatilities (annualised) for the last 10 years

Factor	Average return	Volatility	Return-to-volatility
AQR BAB	9.23	6.59	1.40
AQR HML lag	0.41	9.13	0.05
AQR HML cur	0.41	10.85	0.04
AQR MKT	8.20	14.40	0.57
AQR QMJ	6.40	6.50	0.98
AQR SMB	-0.97	5.57	-0.17
AQR UMD	8.15	10.78	0.76
F-F CMA	0.76	6.06	0.12
F-F CMA Big	-0.20	7.86	-0.03
F-F CMA Small	1.73	5.04	0.34
F-F HML	-1.12	9.76	-0.11
F-F HML Big	-3.25	11.95	-0.27
F-F HML Small	1.03	8.64	0.12
F-F MKT	8.96	14.58	0.61
F-F RMW	3.63	4.57	0.79
F-F RMW Big	4.24	6.88	0.62
F-F RMW Small	3.01	4.56	0.66
F-F SMB	-1.44	5.11	-0.28
F-F VOL	0.71	16.29	0.04
F-F WML	6.23	9.49	0.66
F-F WML Big	4.69	11.18	0.42
F-F WML Small	7.77	8.52	0.91
DEF	2.62	6.29	0.42
DEF Adj	2.84	7.68	0.37
TERM	0.81	7.19	0.11
DEF US	1.47	8.56	0.17
DEF Adj US	2.13	9.79	0.22
TERM US	0.65	11.15	0.06

Table 40
Factor return statistics for the last 5 years

Arithmetic average factor returns and factor volatilities (annualised) for the last 5 years

Factor	Average return	Volatility	Return-to-volatility
AQR BAB	4.65	8.18	0.57
AQR HML lag	2.32	11.76	0.20
AQR HML cur	3.31	13.40	0.25
AQR MKT	5.08	17.84	0.28
AQR QMJ	6.69	7.41	0.90
AQR SMB	-2.18	6.42	-0.34
AQR UMD	6.88	12.39	0.55
F-F CMA	1.68	7.93	0.21
F-F CMA Big	0.43	10.15	0.04
F-F CMA Small	2.96	6.49	0.46
F-F HML	-1.71	12.62	-0.14
F-F HML Big	-4.69	15.51	-0.30
F-F HML Small	1.32	10.80	0.12
F-F MKT	6.06	18.17	0.33
F-F RMW	4.66	5.21	0.89
F-F RMW Big	7.12	8.02	0.89
F-F RMW Small	2.18	5.58	0.39
F-F SMB	-3.89	5.58	-0.70
F-F VOL	3.59	19.91	0.18
F-F WML	5.98	10.87	0.55
F-F WML Big	5.07	13.10	0.39
F-F WML Small	6.89	9.49	0.73
DEF	2.86	6.91	0.41
DEF Adj	2.37	9.10	0.26
TERM	-2.52	7.87	-0.32
DEF US	1.40	10.64	0.13
DEF Adj US	1.32	12.50	0.11
TERM US	-2.07	12.46	-0.17

Table 41
Correlations between the Fama-French-Carhart factors and the fixed-income factors

	F-F MKT	F-F SMB	F-F HML	F-F WML	F-F RMW	F-F CMA	DEF Adj	TERM
F-F MKT	1.00							
F-F SMB	0.03	1.00						
F-F HML	-0.14	0.05	1.00					
F-F WML	-0.28	0.15	-0.29	1.00				
F-F RMW	-0.33	-0.25	0.04	0.15	1.00			
F-F CMA	-0.42	-0.04	0.77	-0.05	0.15	1.00		
DEF Adj	0.54	0.11	-0.06	-0.22	-0.11	-0.32	1.00	
TERM	-0.02	-0.03	-0.18	0.08	0.28	-0.09	0.07	1.00

Table 42
Correlations between the AQR factors

	AQR MKT	AQR SMB	AQR HML lag	AQR HML cur	AQR UMD	AQR QMJ	AQR BAB
AQR MKT	1.00						
AQR SMB	0.25	1.00					
AQR HML lag	-0.10	-0.10	1.00				
AQR HML cur	0.17	-0.04	0.75	1.00			
AQR UMD	-0.39	-0.07	-0.16	-0.71	1.00		
AQR QMJ	-0.74	-0.48	0.01	-0.29	0.49	1.00	
AQR BAB	-0.24	0.02	0.38	0.03	0.35	0.34	1.00

Table 43
Correlations between the Fama-French-Carhart factors and the AQR factors

	AQR MKT	AQR SMB	AQR HML lag	AQR HML cur	AQR UMD
F-F MKT	1.00	0.23	-0.08	0.18	-0.40
F-F SMB	0.05	0.85	0.13	0.03	0.06
F-F HML	-0.15	-0.18	0.94	0.73	-0.18
F-F WML	-0.27	0.07	-0.24	-0.74	0.96

Table 44
Correlations between global and US dollar fixed-income factors

	US DEF	US DEF Adj	US TERM
DEF	0.75	0.77	-0.17
DEF Adj	0.75	0.81	0.01
TERM	-0.25	-0.09	0.87

2 Risk-adjusted returns

The purpose of this section is to give a detailed description of a set of methods to compute risk-adjusted performance measures. These performance measures are point estimates and therefore confidence intervals are also reported in this section. Finally, an R^2 for the regression behind Jensen's alpha is computed.

The portfolio return and the benchmark return are both measured in the currency basket. The 1-month US T-bill rate collected from Kenneth French's website is used as a proxy for the risk-free return. In principle, this is not consistent with measuring the portfolio and benchmark returns in the currency basket. On the other hand, there is no established alternative.

2.1 Methodology

In the following section, the methods used for calculating risk-adjusted measures and confidence intervals are described. r_t, rb_t and rf_t are defined as the return in month t of the portfolio, the benchmark and the risk-free asset, respectively. T is the number of months in the sample period. All returns are simple rather than in logs.

2.1.1 Sharpe ratio

rx_t denotes the portfolio excess return $r_t - rf_t$ in month t. The formula for the monthly Sharpe ratio is[5]

$$\widehat{SR}_m = \hat{\mu}_{rx}/\hat{\sigma}_r, \tag{2.1}$$

where $\hat{\mu}_{rx}$ is the sample average of portfolio excess returns, and $\hat{\sigma}_r$ is the sample standard deviation of portfolio returns computed with the $T-1$ divisor. The Sharpe ratio of the benchmark is computed similarly. Monthly Sharpe ratios are annualised using

$$\widehat{SR}_a = \widehat{SR}_m\sqrt{12}. \tag{2.2}$$

This annualisation is an approximation as it ignores compounding by assuming that annual returns are sums of monthly returns. This is not the case when using simple returns. It also assumes that monthly returns have zero autocorrelation. This formula is used as it is the most conventional way of annualising Sharpe ratios and therefore makes the results comparable. To measure the uncertainty in the estimates, 95 percent confidence intervals around the annual Sharpe ratios are computed using[6]

$$\widehat{SR}_a \pm 1.96 \times se\left(\widehat{SR}_a\right), \tag{2.3}$$

where

$$se\left(\widehat{SR}_a\right) = \sqrt{12\left(1+\frac{1}{2}\widehat{SR}_m^2\right)/T}. \tag{2.4}$$

This formula is an asymptotic approximation and assumes that monthly returns are normally, independently and identically distributed. These distributional assumptions are made for simplicity and to be consistent with the way Sharpe ratios are annualised from monthly data. The same critical value (1.96) is used to compute confidence intervals for the other risk-adjusted performance measures.

[5] See Sharpe (1966, 1994).
[6] See Lo (2002).

2.1.2 Information ratio

$rrel_t$ denotes the relative return in month t, $r_t - rb_t$. The monthly information ratio is computed as

$$\widehat{IR}_m = \hat{\mu}_{rrel}/\hat{\sigma}_{rrel}, \tag{2.5}$$

where $\hat{\mu}_{rrel}$ is the sample average of relative returns, and $\hat{\sigma}_{rrel}$ is the sample standard deviation of relative returns using the $T-1$ divisor. The annualised information ratios and the corresponding confidence intervals are computed in the same way as for the Sharpe ratio.

2.1.3 Jensen's alpha

The Capital Asset Pricing Model (CAPM) regression using the benchmark as a proxy for the market portfolio is

$$rx_t = \alpha_m + \beta bx_t + \epsilon_t, \tag{2.6}$$

where $bx_t = rb_t - rf_t$ is the benchmark excess return in month t. Jensen's alpha measured on a monthly level is the Ordinary Least Squares (OLS) estimate of the intercept in this regression.[7] That is,

$$\hat{\alpha}_m = \hat{\mu}_{rx} - \hat{\beta}\hat{\mu}_{bx}, \tag{2.7}$$

where $\hat{\beta}$ is the OLS estimate of the slope coefficient in the CAPM regression (2.6), and $\hat{\mu}_{bx}$ is the sample average of benchmark excess returns. The monthly alpha is annualised using

$$\hat{\alpha}_a = \hat{\alpha}_m \times 12. \tag{2.8}$$

A 95 percent confidence interval around the annual alpha is constructed using the OLS standard error of the intercept in the monthly regression multiplied by 12. The CAPM regression can be rewritten into a relative return form by subtracting bx_t on both sides

$$rrel_t = \alpha_m + (\beta - 1)bx_t + \epsilon_t. \tag{2.9}$$

We compute the R-squared of this relative return regression and denote it as R^2_{rrel}.

2.1.4 Appraisal ratio

The monthly appraisal ratio is computed as[8]

$$\widehat{AR}_m = \hat{\alpha}_m/\hat{\sigma}_\epsilon, \tag{2.10}$$

where $\hat{\alpha}_m$ is Jensen's alpha from (2.7), and $\hat{\sigma}_\epsilon$ is the sample standard deviation of the residuals from estimating the CAPM regression model in (2.6). For computing $\hat{\sigma}_\epsilon$, we use the $T-2$ divisor to reflect the number of estimated parameters. Monthly appraisal ratios are annualised in the same way as the Sharpe ratios. For the 95 percent confidence intervals around the annual appraisal ratios, the following estimator for the standard error is used

$$se\left(\widehat{AR}_a\right) = \sqrt{12\left(\frac{\sum_{t=1}^{T} bx_t^2}{\sum_{t=1}^{T}\left(bx_t - \hat{\mu}_{bx}\right)^2} + \frac{1}{2}\widehat{AR}_m^2\right)/T}. \tag{2.11}$$

[7] See Jensen (1968).
[8] See Treynor and Black (1973).

This formula can be derived using the delta method. The derivation is similar to the derivation of the standard error for the Sharpe ratio and also assumes normally, independently and identically distributed returns.

2.2 Results

In this section, 95 percent confidence intervals for all the risk-adjusted measures are reported before and after management costs. The following composites are considered: total fund, equity- and fixed-income asset classes, equity- and fixed-income management entities and the three main strategies: fund allocation, security selection and asset management. Real estate is included in the fund and total fund allocation composites from 2017. Renewable infrastructure is included in the same composites from 2021. Subject to availability, results are computed since inception, for the last 10 years, the last 5 years and for 5-year rolling windows.

2.2.1 Sharpe ratio

Tables 45 to 53 report Sharpe ratios along with confidence intervals before and after management costs.

Table 45
Sharpe ratio before management costs for various sample sizes: asset classes

Annualised Sharpe ratio estimates before costs for various sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks.

	Asset class	Since inception	Last 10 years	Last 5 years
Portfolio	Equity	0.36 (-0.04, 0.77)	0.69 (0.06, 1.31)	0.34 (-0.54, 1.22)
	Fixed income	0.57 (0.17, 0.96)	0.23 (-0.39, 0.85)	-0.23 (-1.10, 0.65)
	Fund	0.50 (0.10, 0.89)	0.67 (0.05, 1.30)	0.31 (-0.57, 1.19)
Benchmark	Equity	0.34 (-0.06, 0.74)	0.67 (0.05, 1.30)	0.34 (-0.54, 1.22)
	Fixed income	0.51 (0.11, 0.90)	0.15 (-0.47, 0.77)	-0.33 (-1.21, 0.55)
	Fund	0.48 (0.08, 0.87)	0.64 (0.01, 1.26)	0.28 (-0.60, 1.16)

Table 46
Sharpe ratio before management costs for moving sample periods: asset classes

Annualised Sharpe ratio estimates before costs for moving sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

	Asset class	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Portfolio	Equity	-0.44	1.38	0.05	1.34	0.34
		(-1.43, 0.54)	(0.46, 2.29)	(-0.83, 0.92)	(0.44, 2.25)	(-0.54, 1.22)
	Fixed income	0.67	0.36	1.27	1.03	-0.23
		(-0.22, 1.55)	(-0.52, 1.24)	(0.37, 2.18)	(0.13, 1.92)	(-1.10, 0.65)
	Fund	-0.12	1.51	0.30	1.48	0.31
		(-1.00, 0.75)	(0.59, 2.43)	(-0.58, 1.18)	(0.56, 2.39)	(-0.57, 1.19)
Benchmark	Equity	-0.50	1.32	0.04	1.33	0.34
		(-1.49, 0.48)	(0.41, 2.23)	(-0.84, 0.92)	(0.42, 2.24)	(-0.54, 1.22)
	Fixed income	0.62	0.34	1.38	0.95	-0.33
		(-0.27, 1.50)	(-0.54, 1.22)	(0.47, 2.29)	(0.06, 1.84)	(-1.21, 0.55)
	Fund	-0.19	1.47	0.31	1.46	0.28
		(-1.07, 0.68)	(0.56, 2.39)	(-0.57, 1.19)	(0.54, 2.37)	(-0.60, 1.16)

Table 47
Sharpe ratio after management costs for various sample sizes: asset classes

Annualised Sharpe ratio estimates after costs for various sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks.

	Asset class	Since inception	Last 10 years	Last 5 years
Portfolio	Equity	0.36	0.68	0.34
		(-0.04, 0.76)	(0.05, 1.31)	(-0.54, 1.22)
	Fixed income	0.56	0.22	-0.23
		(0.16, 0.95)	(-0.40, 0.84)	(-1.11, 0.65)
	Fund	0.49	0.67	0.31
		(0.09, 0.88)	(0.04, 1.29)	(-0.57, 1.18)
Benchmark	Equity	0.34	0.67	0.34
		(-0.06, 0.74)	(0.05, 1.30)	(-0.54, 1.22)
	Fixed income	0.51	0.15	-0.33
		(0.11, 0.90)	(-0.47, 0.77)	(-1.21, 0.55)
	Fund	0.48	0.64	0.28
		(0.08, 0.87)	(0.01, 1.26)	(-0.60, 1.16)

Table 48
Sharpe ratio after management costs for moving sample periods: asset classes

Annualised Sharpe ratio estimates after costs for moving sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

	Asset class	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Portfolio	Equity	-0.45 (-1.44, 0.53)	1.36 (0.45, 2.27)	0.04 (-0.84, 0.92)	1.34 (0.43, 2.25)	0.34 (-0.54, 1.22)
	Fixed income	0.65 (-0.23, 1.54)	0.34 (-0.54, 1.22)	1.26 (0.36, 2.17)	1.02 (0.12, 1.91)	-0.23 (-1.11, 0.65)
	Fund	-0.14 (-1.02, 0.74)	1.48 (0.57, 2.40)	0.29 (-0.59, 1.17)	1.47 (0.55, 2.38)	0.31 (-0.57, 1.18)
Benchmark	Equity	-0.50 (-1.49, 0.48)	1.32 (0.41, 2.23)	0.04 (-0.84, 0.92)	1.33 (0.42, 2.24)	0.34 (-0.54, 1.22)
	Fixed income	0.62 (-0.27, 1.50)	0.34 (-0.54, 1.22)	1.38 (0.47, 2.29)	0.95 (0.06, 1.84)	-0.33 (-1.21, 0.55)
	Fund	-0.19 (-1.07, 0.68)	1.47 (0.56, 2.39)	0.31 (-0.57, 1.19)	1.46 (0.54, 2.37)	0.28 (-0.60, 1.16)

Table 49
Sharpe ratio before management costs for various sample sizes: management entities

Annualised Sharpe ratio estimates before costs for various sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks.

	Management entity	Since inception	Last 10 years	Last 5 years
Portfolio	Equity	0.37 (-0.03, 0.77)	0.69 (0.07, 1.32)	0.36 (-0.52, 1.23)
	Fixed income	0.57 (0.17, 0.96)	0.23 (-0.39, 0.85)	-0.23 (-1.10, 0.65)
	Fund	0.50 (0.10, 0.89)	0.67 (0.05, 1.30)	0.31 (-0.57, 1.19)
Benchmark	Equity	0.34 (-0.06, 0.74)	0.67 (0.05, 1.30)	0.33 (-0.54, 1.21)
	Fixed income	0.51 (0.11, 0.90)	0.15 (-0.47, 0.77)	-0.32 (-1.20, 0.56)
	Fund	0.48 (0.08, 0.87)	0.64 (0.01, 1.26)	0.28 (-0.60, 1.16)

Table 50
Sharpe ratio before management costs for moving sample periods: management entities

Annualised Sharpe ratio estimates before costs for moving sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

	Management entity	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Portfolio	Equity	-0.44 (-1.43, 0.54)	1.38 (0.46, 2.29)	0.05 (-0.83, 0.92)	1.35 (0.44, 2.25)	0.36 (-0.52, 1.23)
	Fixed income	0.67 (-0.22, 1.55)	0.36 (-0.52, 1.24)	1.27 (0.37, 2.18)	1.03 (0.13, 1.92)	-0.23 (-1.10, 0.65)
	Fund	-0.12 (-1.00, 0.75)	1.51 (0.59, 2.43)	0.30 (-0.58, 1.18)	1.48 (0.56, 2.39)	0.31 (-0.57, 1.19)
Benchmark	Equity	-0.50 (-1.49, 0.48)	1.32 (0.41, 2.23)	0.04 (-0.84, 0.92)	1.33 (0.42, 2.24)	0.33 (-0.54, 1.21)
	Fixed income	0.62 (-0.27, 1.50)	0.34 (-0.54, 1.22)	1.38 (0.47, 2.29)	0.95 (0.06, 1.85)	-0.32 (-1.20, 0.56)
	Fund	-0.19 (-1.07, 0.68)	1.47 (0.56, 2.39)	0.31 (-0.57, 1.19)	1.46 (0.54, 2.37)	0.28 (-0.60, 1.16)

Table 51
Sharpe ratio after management costs for various sample sizes: management entities

Annualised Sharpe ratio estimates after costs for various sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks.

	Management entity	Since inception	Last 10 years	Last 5 years
Portfolio	Equity	0.36 (-0.04, 0.76)	0.69 (0.06, 1.32)	0.35 (-0.53, 1.23)
	Fixed income	0.56 (0.16, 0.95)	0.22 (-0.40, 0.84)	-0.23 (-1.11, 0.65)
	Fund	0.49 (0.09, 0.88)	0.67 (0.04, 1.29)	0.31 (-0.57, 1.18)
Benchmark	Equity	0.34 (-0.06, 0.74)	0.67 (0.05, 1.30)	0.33 (-0.54, 1.21)
	Fixed income	0.51 (0.11, 0.90)	0.15 (-0.47, 0.77)	-0.32 (-1.20, 0.56)
	Fund	0.48 (0.08, 0.87)	0.64 (0.01, 1.26)	0.28 (-0.60, 1.16)

Table 52
Sharpe ratio after management costs for moving sample periods: management entities

Annualised Sharpe ratio estimates after costs for moving sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

	Management entity	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Portfolio	Equity	-0.45 (-1.44, 0.53)	1.36 (0.45, 2.27)	0.04 (-0.84, 0.92)	1.34 (0.43, 2.25)	0.35 (-0.53, 1.23)
	Fixed income	0.65 (-0.23, 1.54)	0.34 (-0.54, 1.22)	1.26 (0.36, 2.17)	1.02 (0.12, 1.91)	-0.23 (-1.11, 0.65)
	Fund	-0.14 (-1.02, 0.74)	1.48 (0.57, 2.40)	0.29 (-0.59, 1.17)	1.47 (0.55, 2.38)	0.31 (-0.57, 1.18)
Benchmark	Equity	-0.50 (-1.49, 0.48)	1.32 (0.41, 2.23)	0.04 (-0.84, 0.92)	1.33 (0.42, 2.24)	0.33 (-0.54, 1.21)
	Fixed income	0.62 (-0.27, 1.50)	0.34 (-0.54, 1.22)	1.38 (0.47, 2.29)	0.95 (0.06, 1.85)	-0.32 (-1.20, 0.56)
	Fund	-0.19 (-1.07, 0.68)	1.47 (0.56, 2.39)	0.31 (-0.57, 1.19)	1.46 (0.54, 2.37)	0.28 (-0.60, 1.16)

Table 53
Sharpe ratio for 2013-2022: strategies

Annualised Sharpe ratio estimates before costs (Gross) and after costs (Net), along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of fixed-income security selection is October 2014.

	Type	Management entity	Fund allocation	Security selection*	Asset management
Portfolio	Gross	Equity	0.67 (0.04, 1.29)	0.56 (-0.06, 1.19)	0.71 (0.08, 1.34)
		Fixed income	0.16 (-0.46, 0.78)	0.32 (-0.36, 1.01)	0.13 (-0.49, 0.75)
		Total	0.64 (0.01, 1.26)	0.59 (-0.04, 1.21)	0.67 (0.04, 1.30)
	Net	Total	0.64 (0.01, 1.26)	0.57 (-0.05, 1.20)	0.67 (0.04, 1.29)
Benchmark	Gross	Equity	0.67 (0.05, 1.30)	0.49 (-0.13, 1.12)	0.69 (0.07, 1.32)
		Fixed income	0.15 (-0.47, 0.77)	0.22 (-0.47, 0.90)	0.06 (-0.56, 0.67)
		Total	0.64 (0.01, 1.26)	0.51 (-0.11, 1.14)	0.65 (0.02, 1.27)

2.2.2 Information ratio

Tables 54 through 62 report information ratios along with confidence intervals before and after management costs.

Table 54
Information ratio before management costs for various sample sizes: asset classes

Annualised information ratio estimates before costs for various sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks.

Asset class	Since inception	Last 10 years	Last 5 years
Equity	0.62 (0.21, 1.02)	0.58 (-0.04, 1.21)	0.28 (-0.60, 1.16)
Fixed income	0.25 (-0.14, 0.64)	0.56 (-0.06, 1.18)	1.15 (0.25, 2.05)
Fund	0.47 (0.08, 0.86)	0.77 (0.14, 1.40)	0.80 (-0.09, 1.69)

Table 55
Information ratio before management costs for moving sample periods: asset classes

Annualised information ratio estimates before costs for moving sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

Asset class	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Equity	0.87 (-0.12, 1.87)	1.07 (0.17, 1.97)	0.13 (-0.75, 1.00)	0.86 (-0.03, 1.75)	0.28 (-0.60, 1.16)
Fixed income	0.52 (-0.36, 1.41)	0.08 (-0.80, 0.96)	0.22 (-0.65, 1.10)	-0.05 (-0.92, 0.83)	1.15 (0.25, 2.05)
Fund	0.96 (0.06, 1.85)	0.91 (0.02, 1.80)	0.09 (-0.79, 0.97)	0.73 (-0.15, 1.62)	0.80 (-0.09, 1.69)

Table 56
Information ratio after management costs for various sample sizes: asset classes

Annualised information ratio estimates after costs for various sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks.

Asset class	Since inception	Last 10 years	Last 5 years
Equity	0.46 (0.06, 0.86)	0.44 (-0.18, 1.07)	0.16 (-0.72, 1.03)
Fixed income	0.20 (-0.19, 0.60)	0.50 (-0.12, 1.12)	1.09 (0.19, 1.99)
Fund	0.35 (-0.04, 0.74)	0.64 (0.02, 1.27)	0.69 (-0.19, 1.58)

Table 57
Information ratio after management costs for moving sample periods: asset classes

Annualised information ratio estimates after costs for moving sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

Asset class	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Equity	0.72 (-0.27, 1.71)	0.85 (-0.04, 1.74)	-0.03 (-0.90, 0.85)	0.71 (-0.18, 1.59)	0.16 (-0.72, 1.03)
Fixed income	0.38 (-0.50, 1.26)	-0.06 (-0.94, 0.81)	0.20 (-0.68, 1.07)	-0.11 (-0.99, 0.77)	1.09 (0.19, 1.99)
Fund	0.76 (-0.12, 1.65)	0.67 (-0.21, 1.56)	0.01 (-0.87, 0.88)	0.58 (-0.30, 1.47)	0.69 (-0.19, 1.58)

Table 58
Information ratio before management costs for various sample sizes: management entities

Annualised information ratio estimates before costs for various sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks.

Management entity	Since inception	Last 10 years	Last 5 years
Equity	0.70 (0.30, 1.10)	0.94 (0.31, 1.57)	1.01 (0.11, 1.90)
Fixed income	0.24 (-0.15, 0.63)	0.53 (-0.09, 1.16)	1.17 (0.27, 2.07)
Fund	0.47 (0.08, 0.86)	0.77 (0.14, 1.40)	0.80 (-0.09, 1.69)

Table 59
Information ratio before management costs for moving sample periods: management entities

Annualised information ratio estimates before costs for moving sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

Management entity	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Equity	0.87 (-0.12, 1.87)	1.07 (0.17, 1.97)	0.13 (-0.75, 1.00)	0.88 (-0.01, 1.77)	1.01 (0.11, 1.90)
Fixed income	0.52 (-0.36, 1.41)	0.08 (-0.80, 0.96)	0.22 (-0.65, 1.10)	-0.06 (-0.94, 0.81)	1.17 (0.27, 2.07)
Fund	0.96 (0.06, 1.85)	0.91 (0.02, 1.80)	0.09 (-0.79, 0.97)	0.73 (-0.15, 1.62)	0.80 (-0.09, 1.69)

Table 60
Information ratio after management costs for various sample sizes: management entities

Annualised information ratio estimates after costs for various sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks.

Management entity	Since inception	Last 10 years	Last 5 years
Equity	0.54 (0.14, 0.94)	0.79 (0.16, 1.42)	0.87 (-0.03, 1.76)
Fixed income	0.19 (-0.20, 0.59)	0.47 (-0.15, 1.09)	1.11 (0.21, 2.01)
Fund	0.35 (-0.04, 0.74)	0.64 (0.02, 1.27)	0.69 (-0.19, 1.58)

Table 61
Information ratio after management costs for moving sample periods: management entities

Annualised information ratio estimates after costs for moving sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

Management entity	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Equity	0.72 (-0.27, 1.71)	0.85 (-0.04, 1.74)	-0.03 (-0.90, 0.85)	0.72 (-0.16, 1.61)	0.87 (-0.03, 1.76)
Fixed income	0.38 (-0.50, 1.26)	-0.06 (-0.94, 0.81)	0.20 (-0.68, 1.07)	-0.13 (-1.00, 0.75)	1.11 (0.21, 2.01)
Fund	0.76 (-0.12, 1.65)	0.67 (-0.21, 1.56)	0.01 (-0.87, 0.88)	0.58 (-0.30, 1.47)	0.69 (-0.19, 1.58)

Table 62
Information ratio for 2013-2022: strategies

Annualised information ratio estimates before costs (Gross) and after costs (Net), along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of fixed-income security selection is October 2014.

Type	Management entity	Fund allocation	Security selection*	Asset management
Gross	Equity	-0.01 (-0.63, 0.61)	0.87 (0.24, 1.50)	1.91 (1.25, 2.58)
	Fixed income	-0.01 (-0.63, 0.61)	0.52 (-0.17, 1.21)	1.78 (1.12, 2.44)
	Total	-0.07 (-0.69, 0.54)	0.82 (0.20, 1.45)	2.52 (1.82, 3.21)
Net	Total	-0.09 (-0.71, 0.53)	0.69 (0.07, 1.32)	2.20 (1.52, 2.88)

2.2.3 Jensen's alpha

Tables 63 through 71 report Jensen's alpha along with confidence intervals and relative return R-squared before and after management costs.

Table 63
Jensen's alpha before management costs for various sample sizes: asset classes

Annualised Jensen's alpha estimates before costs (percent) for various sample periods, along with 95 percent confidence intervals (parentheses) and the R-squared from a regression of relative return on a constant and the benchmark excess return. The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks.

Asset class	Since inception	Last 10 years	Last 5 years
Equity	0.35 (0.08, 0.62) $R^2_{rrel} = 0.14$	0.16 (-0.10, 0.42) $R^2_{rrel} = 0.10$	0.08 (-0.28, 0.44) $R^2_{rrel} = 0.08$
Fixed income	0.28 (-0.09, 0.66) $R^2_{rrel} = 0.01$	0.32 (0.07, 0.57) $R^2_{rrel} = 0.35$	0.47 (0.12, 0.83) $R^2_{rrel} = 0.37$
Fund	0.19 (-0.05, 0.43) $R^2_{rrel} = 0.13$	0.32 (0.06, 0.58) $R^2_{rrel} = 0.00$	0.37 (-0.01, 0.75) $R^2_{rrel} = 0.03$

Table 64
Jensen's alpha before management costs for moving sample periods: asset classes

Annualised Jensen's alpha estimates before costs (percent) for moving sample periods, along with 95 percent confidence intervals (parentheses) and the R-squared from a regression of relative return on a constant and the benchmark excess return. The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

Asset class	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Equity	1.03	0.53	0.09	0.14	0.08
	(0.07, 1.99)	(-0.16, 1.22)	(-0.51, 0.68)	(-0.25, 0.53)	(-0.28, 0.44)
	$R^2_{rrel} = 0.09$	$R^2_{rrel} = 0.08$	$R^2_{rrel} = 0.35$	$R^2_{rrel} = 0.17$	$R^2_{rrel} = 0.08$
Fixed income	0.16	0.05	0.15	0.24	0.47
	(-0.11, 0.44)	(-0.28, 0.38)	(-1.70, 2.01)	(-0.12, 0.59)	(0.12, 0.83)
	$R^2_{rrel} = 0.00$	$R^2_{rrel} = 0.03$	$R^2_{rrel} = 0.01$	$R^2_{rrel} = 0.33$	$R^2_{rrel} = 0.37$
Fund	0.43	0.16	-0.15	0.13	0.37
	(0.06, 0.79)	(-0.21, 0.53)	(-0.92, 0.62)	(-0.22, 0.48)	(-0.01, 0.75)
	$R^2_{rrel} = 0.06$	$R^2_{rrel} = 0.13$	$R^2_{rrel} = 0.48$	$R^2_{rrel} = 0.07$	$R^2_{rrel} = 0.03$

Table 65
Jensen's alpha after management costs for various sample sizes: asset classes

Annualised Jensen's alpha estimates after costs (percent) for various sample periods, along with 95 percent confidence intervals (parentheses) and the R-squared from a regression of relative return on a constant and the benchmark excess return. The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks.

Asset class	Since inception	Last 10 years	Last 5 years
Equity	0.24	0.10	0.03
	(-0.03, 0.51)	(-0.16, 0.36)	(-0.33, 0.38)
	$R^2_{rrel} = 0.14$	$R^2_{rrel} = 0.10$	$R^2_{rrel} = 0.08$
Fixed income	0.24	0.29	0.45
	(-0.13, 0.62)	(0.04, 0.54)	(0.09, 0.80)
	$R^2_{rrel} = 0.01$	$R^2_{rrel} = 0.35$	$R^2_{rrel} = 0.37$
Fund	0.12	0.27	0.32
	(-0.12, 0.36)	(0.01, 0.53)	(-0.06, 0.71)
	$R^2_{rrel} = 0.13$	$R^2_{rrel} = 0.00$	$R^2_{rrel} = 0.03$

Table 66
Jensen's alpha after management costs for moving sample periods: asset classes

Annualised Jensen's alpha estimates after costs (percent) for moving sample periods, along with 95 percent confidence intervals (parentheses) and the R-squared from a regression of relative return on a constant and the benchmark excess return. The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

Asset class	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Equity	0.87	0.36	-0.04	0.07	0.03
	(-0.08, 1.83)	(-0.33, 1.05)	(-0.64, 0.55)	(-0.32, 0.46)	(-0.33, 0.38)
	$R^2_{rrel} = 0.09$	$R^2_{rrel} = 0.08$	$R^2_{rrel} = 0.35$	$R^2_{rrel} = 0.17$	$R^2_{rrel} = 0.08$
Fixed income	0.12	-0.00	0.10	0.21	0.45
	(-0.16, 0.39)	(-0.33, 0.32)	(-1.75, 1.95)	(-0.15, 0.56)	(0.09, 0.80)
	$R^2_{rrel} = 0.00$	$R^2_{rrel} = 0.03$	$R^2_{rrel} = 0.01$	$R^2_{rrel} = 0.33$	$R^2_{rrel} = 0.37$
Fund	0.34	0.06	-0.25	0.08	0.32
	(-0.02, 0.71)	(-0.31, 0.43)	(-1.01, 0.52)	(-0.27, 0.42)	(-0.06, 0.71)
	$R^2_{rrel} = 0.06$	$R^2_{rrel} = 0.13$	$R^2_{rrel} = 0.48$	$R^2_{rrel} = 0.07$	$R^2_{rrel} = 0.03$

Table 67
Jensen's alpha before management costs for various sample sizes: management entities

Annualised Jensen's alpha estimates before costs (percent) for various sample periods, along with 95 percent confidence intervals (parentheses) and the R-squared from a regression of relative return on a constant and the benchmark excess return. The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks.

Management entity	Since inception	Last 10 years	Last 5 years
Equity	0.41	0.29	0.34
	(0.14, 0.67)	(0.05, 0.54)	(0.02, 0.65)
	$R^2_{rrel} = 0.14$	$R^2_{rrel} = 0.12$	$R^2_{rrel} = 0.11$
Fixed income	0.27	0.29	0.43
	(-0.10, 0.64)	(0.06, 0.52)	(0.13, 0.73)
	$R^2_{rrel} = 0.01$	$R^2_{rrel} = 0.37$	$R^2_{rrel} = 0.42$
Fund	0.19	0.32	0.37
	(-0.05, 0.43)	(0.06, 0.58)	(-0.01, 0.75)
	$R^2_{rrel} = 0.13$	$R^2_{rrel} = 0.00$	$R^2_{rrel} = 0.03$

Table 68
Jensen's alpha before management costs for moving sample periods: management entities

Annualised Jensen's alpha estimates before costs (percent) for moving sample periods, along with 95 percent confidence intervals (parentheses) and the R-squared from a regression of relative return on a constant and the benchmark excess return. The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

Management entity	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Equity	1.03	0.53	0.09	0.14	0.34
	(0.07, 1.99)	(-0.16, 1.22)	(-0.51, 0.68)	(-0.24, 0.53)	(0.02, 0.65)
	$R^2_{rrel} = 0.09$	$R^2_{rrel} = 0.08$	$R^2_{rrel} = 0.35$	$R^2_{rrel} = 0.18$	$R^2_{rrel} = 0.11$
Fixed income	0.16	0.05	0.15	0.23	0.43
	(-0.11, 0.44)	(-0.28, 0.38)	(-1.70, 2.01)	(-0.12, 0.58)	(0.13, 0.73)
	$R^2_{rrel} = 0.00$	$R^2_{rrel} = 0.03$	$R^2_{rrel} = 0.01$	$R^2_{rrel} = 0.33$	$R^2_{rrel} = 0.42$
Fund	0.43	0.16	-0.15	0.13	0.37
	(0.06, 0.79)	(-0.21, 0.53)	(-0.92, 0.62)	(-0.22, 0.48)	(-0.01, 0.75)
	$R^2_{rrel} = 0.06$	$R^2_{rrel} = 0.13$	$R^2_{rrel} = 0.48$	$R^2_{rrel} = 0.07$	$R^2_{rrel} = 0.03$

Table 69
Jensen's alpha after management costs for various sample sizes: management entities

Annualised Jensen's alpha estimates after costs (percent) for various sample periods, along with 95 percent confidence intervals (parentheses) and the R-squared from a regression of relative return on a constant and the benchmark excess return. The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks.

Management entity	Since inception	Last 10 years	Last 5 years
Equity	0.29	0.23	0.28
	(0.03, 0.56)	(-0.02, 0.48)	(-0.03, 0.60)
	$R^2_{rrel} = 0.14$	$R^2_{rrel} = 0.12$	$R^2_{rrel} = 0.11$
Fixed income	0.23	0.26	0.40
	(-0.14, 0.60)	(0.03, 0.49)	(0.10, 0.70)
	$R^2_{rrel} = 0.01$	$R^2_{rrel} = 0.37$	$R^2_{rrel} = 0.42$
Fund	0.12	0.27	0.32
	(-0.12, 0.36)	(0.01, 0.53)	(-0.06, 0.71)
	$R^2_{rrel} = 0.13$	$R^2_{rrel} = 0.00$	$R^2_{rrel} = 0.03$

Table 70
Jensen's alpha after management costs for moving sample periods: management entities

Annualised Jensen's alpha estimates after costs (percent) for moving sample periods, along with 95 percent confidence intervals (parentheses) and the R-squared from a regression of relative return on a constant and the benchmark excess return. The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

Management entity	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Equity	0.87	0.36	-0.04	0.07	0.28
	(-0.08, 1.83)	(-0.33, 1.05)	(-0.64, 0.55)	(-0.31, 0.46)	(-0.03, 0.60)
	$R^2_{rrel} = 0.09$	$R^2_{rrel} = 0.08$	$R^2_{rrel} = 0.35$	$R^2_{rrel} = 0.18$	$R^2_{rrel} = 0.11$
Fixed income	0.12	-0.00	0.10	0.20	0.40
	(-0.16, 0.39)	(-0.33, 0.32)	(-1.75, 1.95)	(-0.15, 0.55)	(0.10, 0.70)
	$R^2_{rrel} = 0.00$	$R^2_{rrel} = 0.03$	$R^2_{rrel} = 0.01$	$R^2_{rrel} = 0.33$	$R^2_{rrel} = 0.42$
Fund	0.34	0.06	-0.25	0.08	0.32
	(-0.02, 0.71)	(-0.31, 0.43)	(-1.01, 0.52)	(-0.27, 0.42)	(-0.06, 0.71)
	$R^2_{rrel} = 0.06$	$R^2_{rrel} = 0.13$	$R^2_{rrel} = 0.48$	$R^2_{rrel} = 0.07$	$R^2_{rrel} = 0.03$

Table 71
Jensen's alpha for 2013-2022: strategies

Annualised Jensen's alpha estimates before costs (Gross) and after costs (Net), along with 95 percent confidence intervals (parentheses) and the R-squared from a regression of relative return on a constant and the benchmark excess return. The estimates are based on monthly returns of equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of fixed-income security selection is October 2014.

Type	Management entity	Fund allocation	Security selection*	Asset management
Gross	Equity	-0.04	1.04	0.21
		(-0.20, 0.11)	(0.17, 1.91)	(0.14, 0.28)
		$R^2_{rrel} = 0.07$	$R^2_{rrel} = 0.10$	$R^2_{rrel} = 0.02$
	Fixed income	0.03	0.51	0.28
		(-0.19, 0.25)	(-0.00, 1.02)	(0.18, 0.37)
		$R^2_{rrel} = 0.33$	$R^2_{rrel} = 0.19$	$R^2_{rrel} = 0.02$
	Total	0.00	0.83	0.21
		(-0.20, 0.21)	(0.14, 1.51)	(0.16, 0.27)
		$R^2_{rrel} = 0.02$	$R^2_{rrel} = 0.02$	$R^2_{rrel} = 0.02$
Net	Total	-0.00	0.68	0.19
		(-0.21, 0.21)	(0.00, 1.36)	(0.13, 0.24)
		$R^2_{rrel} = 0.02$	$R^2_{rrel} = 0.02$	$R^2_{rrel} = 0.02$

2.2.4 Appraisal ratio

Tables 72 to 80 report appraisal ratios along with confidence intervals before and after management costs.

Table 72
Appraisal ratio before management costs for various sample sizes: asset classes

Annualised appraisal ratio estimates before costs for various sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns on the equity, fixed-income and total portfolios and corresponding benchmarks.

Asset class	Since inception	Last 10 years	Last 5 years
Equity	0.53 (0.12, 0.93)	0.39 (-0.25, 1.02)	0.19 (-0.69, 1.07)
Fixed income	0.30 (-0.10, 0.70)	0.80 (0.17, 1.43)	1.18 (0.27, 2.08)
Fund	0.32 (-0.08, 0.72)	0.79 (0.15, 1.43)	0.85 (-0.04, 1.74)

Table 73
Appraisal ratio before management costs for moving sample periods: asset classes

Annualised appraisal ratio estimates before costs for moving sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns on the equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

Asset class	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Equity	1.06 (0.05, 2.08)	0.72 (-0.23, 1.67)	0.13 (-0.75, 1.00)	0.34 (-0.60, 1.28)	0.19 (-0.69, 1.07)
Fixed income	0.52 (-0.37, 1.42)	0.13 (-0.75, 1.01)	0.08 (-0.86, 1.02)	0.61 (-0.30, 1.53)	1.18 (0.27, 2.08)
Fund	1.03 (0.13, 1.92)	0.41 (-0.54, 1.37)	-0.17 (-1.05, 0.71)	0.36 (-0.60, 1.31)	0.85 (-0.04, 1.74)

Table 74
Appraisal ratio after management costs for various sample sizes: asset classes

Annualised appraisal ratio estimates after costs for various sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns on the equity, fixed-income and total portfolios and corresponding benchmarks.

Asset class	Since inception	Last 10 years	Last 5 years
Equity	0.36 (-0.05, 0.76)	0.24 (-0.39, 0.87)	0.06 (-0.82, 0.94)
Fixed income	0.26 (-0.14, 0.65)	0.73 (0.10, 1.36)	1.11 (0.21, 2.01)
Fund	0.19 (-0.20, 0.59)	0.66 (0.03, 1.30)	0.74 (-0.15, 1.63)

Table 75
Appraisal ratio after management costs for moving sample periods: asset classes

Annualised appraisal ratio estimates after costs for moving sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns on the equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

Asset class	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Equity	0.90	0.49	-0.07	0.17	0.06
	(-0.10, 1.91)	(-0.45, 1.43)	(-0.94, 0.81)	(-0.77, 1.11)	(-0.82, 0.94)
Fixed income	0.38	-0.01	0.05	0.53	1.11
	(-0.51, 1.27)	(-0.89, 0.87)	(-0.89, 0.99)	(-0.38, 1.45)	(0.21, 2.01)
Fund	0.83	0.15	-0.28	0.20	0.74
	(-0.06, 1.72)	(-0.80, 1.11)	(-1.17, 0.60)	(-0.75, 1.16)	(-0.15, 1.63)

Table 76
Appraisal ratio before management costs for various sample sizes: management entities

Annualised appraisal ratio estimates before costs for various sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns on the equity, fixed-income and total portfolios and corresponding benchmarks.

Management entity	Since inception	Last 10 years	Last 5 years
Equity	0.62	0.75	0.94
	(0.21, 1.02)	(0.11, 1.39)	(0.05, 1.84)
Fixed income	0.29	0.79	1.25
	(-0.11, 0.68)	(0.16, 1.42)	(0.34, 2.16)
Fund	0.32	0.79	0.85
	(-0.08, 0.72)	(0.15, 1.43)	(-0.04, 1.74)

Table 77
Appraisal ratio before management costs for moving sample periods: management entities

Annualised appraisal ratio estimates before costs for moving sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns on the equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

Management entity	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Equity	1.06	0.72	0.13	0.35	0.94
	(0.05, 2.08)	(-0.23, 1.67)	(-0.75, 1.00)	(-0.60, 1.29)	(0.05, 1.84)
Fixed income	0.52	0.13	0.08	0.59	1.25
	(-0.37, 1.42)	(-0.75, 1.01)	(-0.86, 1.02)	(-0.32, 1.51)	(0.34, 2.16)
Fund	1.03	0.41	-0.17	0.36	0.85
	(0.13, 1.92)	(-0.54, 1.37)	(-1.05, 0.71)	(-0.60, 1.31)	(-0.04, 1.74)

Table 78
Appraisal ratio after management costs for various sample sizes: management entities

Annualised appraisal ratio estimates after costs for various sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns on the equity, fixed-income and total portfolios and corresponding benchmarks.

Management entity	Since inception	Last 10 years	Last 5 years
Equity	0.44 (0.04, 0.85)	0.59 (-0.05, 1.23)	0.79 (-0.10, 1.68)
Fixed income	0.24 (-0.15, 0.64)	0.71 (0.08, 1.34)	1.17 (0.27, 2.08)
Fund	0.19 (-0.20, 0.59)	0.66 (0.03, 1.30)	0.74 (-0.15, 1.63)

Table 79
Appraisal ratio after management costs for moving sample periods: management entities

Annualised appraisal ratio estimates after costs for moving sample periods, along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns on the equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of active investment for the equity portfolio is January 1999.

Management entity	1998-2002*	2003-2007	2008-2012	2013-2017	2018-2022
Equity	0.90 (-0.10, 1.91)	0.49 (-0.45, 1.43)	-0.07 (-0.94, 0.81)	0.18 (-0.76, 1.12)	0.79 (-0.10, 1.68)
Fixed income	0.38 (-0.51, 1.27)	-0.01 (-0.89, 0.87)	0.05 (-0.89, 0.99)	0.52 (-0.40, 1.43)	1.17 (0.27, 2.08)
Fund	0.83 (-0.06, 1.72)	0.15 (-0.80, 1.11)	-0.28 (-1.17, 0.60)	0.20 (-0.75, 1.16)	0.74 (-0.15, 1.63)

Table 80
Appraisal ratio for 2013-2022: strategies

Annualised appraisal ratio estimates before costs (Gross) and after costs (Net), along with 95 percent confidence intervals (parentheses). The estimates are based on monthly returns on the equity, fixed-income and total portfolios and corresponding benchmarks. The asterisk is to indicate that inception of fixed-income security selection is October 2014.

Type	Management entity	Fund allocation	Security selection*	Asset management
Gross	Equity	-0.19 (-0.82, 0.44)	0.75 (0.11, 1.38)	2.01 (1.32, 2.69)
	Fixed income	0.09 (-0.53, 0.71)	0.68 (-0.01, 1.37)	1.80 (1.14, 2.46)
	Total	0.01 (-0.62, 0.64)	0.76 (0.13, 1.39)	2.44 (1.74, 3.14)
Net	Total	-0.00 (-0.63, 0.63)	0.63 (-0.00, 1.26)	2.13 (1.44, 2.81)

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