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The explanatory power of expenses in the performance of Eurozone mutual funds

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Abstract. We studied the relationship between the mutual fund's expenses and their profitability, as well as their ability to predict future performance. We used regressions in panel data with a sample of equity mutual funds of the eurozone area from 2003 to 2014. We concluded that expenses are an important determinant of performance in the eurozone and we show evidence that there is, in the short-term, a negative relationship between the profitability of the year and the level of expenses of the fund. Furthermore, there is also a relationship between the profitability of mutual funds with their level of expenses after one and three years. On the other hand, by applying the quantile regression, it seems clear that the funds with the highest returns have a positive relationship with the level of expenses.

Keywords. mutual funds, expenses, performance, ratings

JEL Codes. G20; G23; G28

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1. Introduction

The financial performance of mutual funds has been widely discussed in the literature, and this kind of product has acquired great importance for investors and savers. There is a debate around the management value added mutual funds and expenses, and the funds with the largest expenditures can bring value to the investors/savers, which has led to a debate between active and passive management in the industry. This debate is related to agency theory, since in many funds the returns of investors are against the returns of the managers. Authors such as Gruber (1996), Livingston and O'Neal (1996), Capon, Fitzsimons and Prince (1996), Carhart (1997), Alexander, Jones and Nigro (1998), Sirri and Tufano (1998) or Chalmers, Edelen and Kadlec (1999) document the negative relationship of expenses with the performance of funds, verifying those managers rarely manage to beat the market after discounting costs to gross returns. On the other hand, more recent studies support that management expenses may represent a contribution to management if the fund portfolio differs from the market index. Studies such as those carried out by Cremers and Petajisto (2009) or Petajisto (2013) conclude that the most active funds (which therefore differ from the market) have outperformed their benchmarks even

after taking costs into account. The objective of this study is to understand the role of expenses on euro zone funds for predicting future performance in the short and long term or if they affect current performance. This study brings several contributions to the literature. Firstly, we use a data sample for the eurozone, knowing that the economic area is a fundamental determinant in the performance of the funds (see, for example, Ferreira, Keswani, Miguel and Ramos 2012), and since most of the studies have been carried out for the American or British market. Secondly, we use a metric widely used in studies of mutual funds, but little used in studies that analyse the role of expenses (4-factor alpha), in addition to other more traditional ones (Sharpe, Sortino and returns net). In third place, we carry out an analysis for the main categories of mutual funds in the euro zone. Many previous studies do not consider category differences which can influence their results and focus their analysis on the American market. Fourth, we use different econometric techniques, including quantile regression for the panel data, to show the complex relationship that may exist between expenses and returns. Therefore, this study is not only of interest to the scientific community, but also to professionals, investors, researchers, and financial advisers. The work is structured as follows: section 2 will develop the literature review; section 3 will describe the sample and the performance metric's, section 4 presents the empirical study, and section 5 concludes.

2. Literature review

2.1 Negative relationship of expenses with performance

Much of the mutual fund literature focuses on analysing whether fund managers generate returns to beat their benchmark and justify the associated transaction costs and fees (see for example Daniel, Grinblatt, Titman and Wermers, 1997; Malkiel, 1995). Studies such as Gruber (1996), Livingston and O'Neal (1996), Capon, Fitzsimons and Prince (1996), Carhart (1997), Alexander, Jones and Nigro (1998), Sirri and Tufano (1998), Chalmers, Edelen, and Kadlec (1999) among others, documented the negative relationship between mutual fund´s expenditures and their performance. The reasoning is that the return of the index equals the weighted average return of active and passive investors before investment expenses. Therefore, active management would be a zero-sum game. Sharpe (1991) calls this fact the arithmetic of active management. The author states that active investors cannot exceed the returns obtained from passive investment strategies. Sharpe (1966) found that part of the difference in returns to funds could be explained by the difference in spending levels. Grinblatt and Titman (1992) found that expenses contributed to the difference between funds classified as "winners" or "losers." Carhart (1997) showed that expenses can explain the persistence of adjusted risk return and, therefore, may be used as a good predictor of future performance. O'Neal (2004), Haslem, Baker and Smith (2008) Gil-Bazo and Ruiz-Verdu (2009) also support the negative relationship between performance and expenses. Wermers (2000) related funds that performed worse to those with high asset turnover

and, therefore, high expenses. Hereupon, he argues that funds with more expenses perform worse. Also, Berk and Green (2004) found that the alpha performance metric obtained by investors has zero return after eliminating expenses. On the other hand, investors in funds with higher expenses are considered in the literature as unsophisticated, with low sensitivity to low returns (Gil-Bazo and Ruiz-Verdu, 2009). Philips and Kinniry (2010) show that funds with higher expenses have lower returns than those with lower expenses, suggesting passive investing or indexing as an investment strategy. Ferruz and Alda (2012) carried out a study of expenses for the Spanish market, concluding that there is a negative relationship between the commissions charged and the adjusted return risk provided by the pension plans. Fernández and Órtiz (2015) also attribute to the high costs paid by members the disappointing performance in pension plans. A very important part of the cost of the funds corresponds to their marketing and the distributor receives, in general, remuneration higher than that of the managers. In addition, part of the commission generates conflicts of interest and the incentive to sell the product for higher commissions.

Nevertheless, several papers have supported a positive relationship between expenses and performance. Diaz-Mendoza, Lopez-Espinosa, and Martinez-Sedano (2012) suggest that fund´s performance is positively related to the magnitude of the performance fees. Flood (2015) found that many of the costs are “hidden costs” that can reach 80% of the total costs in the case of actively managed funds. On the other hand, there is some evidence that the best funds would be related to higher expenses. Servaes and Sirgusson (2018) studied the funds fees of European Union, Norway and Switzerland, finding that mutual funds with higher expenses achieved superior performance. This relationship is justified by Kosowski, Timmermann, White and Wermers (2006) who find that some managers have superior skills and charge higher expenses but obtain better returns (Gruber, 1996; Livingston and O'Neal, 1996; Capon, Fitzsimons and Prince, 1996 and Carhart,1997). Also, Alexander, Jones and Nigro (1998), Sirri and Tufano (1998) or Chalmers, Edelen and Kadlec (1999) support the existence of a positive relationship between expenses and fund performance. In this way we formulate our first hypothesis:

H1: Mutual fund`s expenses are negatively related to their performance.

2.2 The predictive power of expenses in return/adjusted risk return

In addition to studying the relationship between expenses at a given time, it is also interesting to analyse whether expenses can predict the future behaviour of funds in terms of risk-adjusted returns. Russel Kinnel, (Morningstar's managing director of research), indicated that the level of expenses is a good predictor of the future returns of mutual funds, so it should be one of the main

variables to consider by investors[1]. Financial Research Corporation (2002) analysed the factors that can predict future performance (including, but not limited to, past performance, Morningstar ratings, and the expense ratio), concluding that only the expense ratio is can of predicting future performance. This goes against Cremers and Petajisto (2009) and Petajisto (2013), who found that the expense index is not a good variable to predict future profitability as they are the so-called "active share", the size or past returns. Several studies directly attributed the poor performance of funds to increased expenses resulting from management costs, such as Berk and Green (2004). The result is repeated in the United Kingdom (Cuthbertson, Nitzsche and O'Sullivan, 2006) and Spain (Matallin-Saez, Soler-Dominguez and Tortosa-Ausina, 2012), reaching conclusions comparable with studies in the United States. Based on the previous literature, our second research hypothesis is:

H2: Mutual fund expenses have the power to predict future performance.

2.3 Morningstar ratings

Another relevant issue is the relationship between the rating or rating of a fund and its level of expenses. Investors frequently use ratings to select investment funds (Otero and Durán, 2021). Howe and Pope (1996), Blake and Morey (2000), Morey and Gottesman (2006), Morey (2005), Duret et al. (2008), Philips and Kinniry (2010) and Chotivetthamrong (2015) studied ratings and their predictive power, concluding that they have little power to predict future performance. Blake and Morey (2000) studied the rating obtained by Morningstar, showing that a low rating was a good predictor of future bad behaviour, but they no found evidence that funds with good ratings had a better performance than the average. A later work by Morey (2005) focused on the funds with the best ratings, found that these had a high probability of being worse in the next three years: the authors think that this is due to inflows in the funds with better ratings, which makes managers unable to adequately accomplish new flows. On the other hand, Otero, Durán and Domingues (2019) found that Morningstar's star rating, which is the main rating analysed by the investor, can predict short and medium-term performance and the authors find evidence that the expenses may partly explain the classification. Morey and Gottesman (2006), Müller and Weber (2014), Meinhardt (2014), Antypas, Caporale, Kourogenis and Pittis (2009) reach similar conclusions. Otero and Duran (2021) find that star ratings can have predictive power. This power can be improved when it is used to complement another´s variables such as costs and analysts' ratings.

[1] Study carried out in 2010 and updated in 2016. See: https://www.morningstar.com/articles/347327/how-expense-ratios-and-star-ratings-predict-success and https://www.morningstar.com/articles/752485/fund-fees-predict-future-success-or-failure The other variable that the study considers to have an impact on future performance, to a lesser extent, are sta ratings.

H3: Combining Morningstar star ratings with mutual funds expenses help understand the funds that outperform their benchmark.

3. Sample and performance metrics

The sample is made up of euro area equity mutual funds rated by Morningstar with a quantitative star rating, for the period between 2003 and 2014. We limit our sample to funds included in the following Morningstar categories: Eurozone Flex-Cap Equity, Eurozone Large-Cap Equity, Eurozone Mid-Cap Equity and Eurozone Small-Cap Equity. The funds are of the "open funds" category, that is, those that have a variable number of shares. Fund selection was made for all active and inactive funds to avoid the so-called survival bias. In addition, to avoid multicollinearity problems, a single class was selected for each fund, according to the following preferences (ordered from highest to lowest priority): institutional class, lowest administrative expenses, lowest net expenses, higher volume of assets, older start date and preferably accumulation class (vs. distribution classes). Our final sample is an unbalanced panel with data from 2003 to 2014 made up of 1,763 observations. Table 1 summarizes the number of funds by category and rating, and the mean and standard deviation of the level of expenditures. Thus, the sample is made up of 118 funds from the Flex Cap category of the eurozone, 53 funds from the mid-cap category of the eurozone, 1,117 funds from the large capitalization category of the zone euro and 56 euro zone small cap category funds. These funds are rated according to Morningstar Star Ratings criteria from one to five stars. It is observed that, for the different categories, funds with fewer stars (worst rating) have a higher level of expenditure than those with more stars (better rating), although this behaviour is not uniform.

Table 1. Number of observations by category, Rating and level of expenses.

Flex cap				Mid cap			
Stars	**Obs.**	**Mean**	**s.d.**	**Stars**	**Obs.**	**Mean**	**s.d.**
1	23	3.493	1.439	**1**	1	2.240	-
2	14	2.905	1.491	**2**	7	1.953	0.795
3	31	2.662	1.296	**3**	16	1.511	0.789
4	26	2.440	1.194	**4**	20	1.342	0.776
5	24	2.370	0.893	**5**	9	1.711	1.542
Large cap				**Small cap**			
Stars	**Obs.**	**Mean**	**s.d.**	**Stars**	**Obs.**	**Mean**	**s.d.**
1	74	2.105	1.089	**1**	7	1.856	0.733
2	198	1.640	0.839	**2**	9	1.764	0.710
3	412	1.342	0.793	**3**	21	1.829	0.985
4	296	1.377	0.940	**4**	12	2.505	0.966
5	137	1.448	0.984	**5**	7	1.986	1.107

To measure the performance of mutual funds we used several metrics: Carhart's four-factor alpha, Sharpe ratio, Sortino ratio, and annual return. The Sharpe ratio allows you to measure the risk-adjusted return by dividing the excess of a fund's return over the risk-free interest rate by the volatility or standard deviation of that return. The Sortino ratio uses in the numerator the standard deviation generated by the negative returns of the portfolio. Carhart's four-factor alpha allows you to adjust for other factors that skew the fund's performance analyses (market, value, size, and momentum). Net returns allows you to analyse the funds from the view of the retail investor, who does not use risk-adjusted metrics.

The four-factor model based on Carhart (1997) that includes market return (Mkt), size (SMB), book-to-market (HML) and momentum (MoM) permits to control the effect of different styles of investment in fund performance. In this way, the excess return of the fund over the risk-free interest rate is given by:

$$R_{i,t-}R_{f,t} = \alpha_{i,t} + \beta_{i,1}Mkt_t + \beta_{i,2}SMB_t + \beta_{i,3}HML_t + \beta_{i,4}MoM_t + \varepsilon_{i,t} \quad [1]$$

Where:

$R_{i,t}$ is the return of fund i at the moment t;
$R_{f,t}$ is the return on a risk-free asset at time t;
Mkt_t; is the monthly return of the market portfolio minus the risk-free rate
SMB_t captures exposure to the returns of diversified portfolios of small- and large-cap stocks;
HML_t captures exposure to returns between high and low book-to-market portfolios;
MoM_t is the momentum;
$\varepsilon_{i,t}$ is the stochastic error term.

The β parameters in equation (1) measure the sensitivity of the excess return of fund i to each risk factor, where α is the excess return of the fund.

The Sharpe ratio metric that is given by:

$$Sharpe_{i,t} = \frac{(R_{i,t-}R_{f,t})}{\sigma_{i,t}} \quad [2]$$

Where:

$R_{i,t}$ represents the profitability of fund i at time t,
$R_{f,t}$ represents the risk-free rate (1-month Euribor) at time t,
$\sigma_{i,t}$ is the standard deviation of background i at time t,

The Sortino ratio is a variant of the Sharpe ratio that only considers the deviation of declines (negative returns) or downside deviation in the denominator.

$$Sortino_{i,t} = \frac{(R_{i,t-}R_{f,t})}{downside\sigma_{i,t}} \quad [3]$$

where

$downside\sigma_{i,t}$ is the *downside deviation*

Finally, within the variables explained, we use a performance metric without adjusting for risk, the annual net return (Annual Return).

The other variables that we will use later as explanatory ones are the fund's expense ratio (Net Expenses) and the global star rating of the fund awarded by Mornigstar. The expense ratio of an investment fund has been calculated with the difference between the fund's gross and net return. Morningstar's rating is based on the fund's position within its category based on a risk-adjusted performance measure (the so-called Morningstar Risk-Adjusted Return, MRAR). The top 10% of funds receive 5 stars, the next 22.5% receive 4 stars, the next 35% 3 stars, then 22.5% 2 stars, and the 10% worst funds 1 star. Morningstar establishes its 3, 5 and 10 year ratings for each fund, with the overall rating being a weighted average of the above. Finally, as control variables, we used the dummy variable to age (yield per year), dummies of the Morningstar fund categories, the years of experience of the fund managers and size. The source of the data is Morningstar Direct for all variables, except for Carhart's alpha, which are based on own calculations from the website of Professor Kenneth R. French[2]. To assess the independence degree between the indicators and the other variables, an analysis of the correlations between variables and the calculation of the VIF (variance inflation factor) was performed, ruling out the existence of multicollinearity problems between the variables studied.

4. Empirical study

4.1. Econometric Models

The first model used was a regression with panel data with random effects. The methodology based on panel data can control individual effects with advantages such as reduction of collinearity and efficiency, among others (Baltagi, 2010). Armstrong, Genc and Verbeek (2018) also used the panel data methodology to evaluate the performance of mutual funds using ratings. In this sense, we estimate the following equations:

$$Y_{it} = \alpha_i + \beta_1 \,\text{Net expenses} + \beta_2 \text{Tenure}\,(t-1)_{it} + \beta_3\, fund\ years\ (t-1)_{it} + \beta_4\, Netassets + \beta_i \sum_i Year_i + \beta_j \sum_j Category_j + \varepsilon_{it} \quad [4]$$

[2] See https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

where:

Y_it is the performance measure for fund i at time t. The measures used are the 4-factor alpha (Alpha), the Sharpe ratio (Sharpe), the Sortino ratio (Sortino), and the net annual return.

Net expenses is total expenses for fund i.

Tenure is the average years of management experience of the fund managers.

Fund Years is the age (years) of the fund.

$Net\ Assets$ is the logarithm of the fund's net assets.

Year is a dichotomic variable that assume 1 when is the year in cause.

Category_j is a dummy variable of the Morningstar fund categories.

α_i and β are the parameters to estimate in the regressions and ε_ (i, t) are the estimation errors.

In the second models, the overall Morningstar ratings are also entered. In this way, we estimate the following equations:

$$Y_{it} = \alpha_i + \beta_1 Net\ expenses\ (t-1)_{it} + \beta_2 \text{Tenure}\ (t-1)_{it} + \beta_3\ (fund\ years)\ (t-1)_{it} + \beta_4\ Net\ Assets\ (t-1)_{it} + \beta_k \sum_i Rating\ \ (t-1)_{it} + \beta_i \sum_i Year_i\ + \beta_j \sum_j Category_j + \varepsilon_{it} \quad [5]$$

where *Rating* is the Morningstar rating being the dummy variable for funds from 1 to 4 stars.

Based on Chen and Huang (2011) we also used quantile regression to extend the regression model to conditional quantiles of different performance metrics, because it is more appropriate for a heterogeneous universe of mutual funds, where strategies and objectives may vary. This model makes it possible to capture information on the coefficients in different quantiles of the dependent variable, given the set of endogenous variables (classification by stars). Furthermore, the conditional quantile regression developed by Koenker and Bas-sett (1978) is well suited to distorted distributions of fund returns. In particular, we adopted the method proposed by Efron (1979). As a vector of exogenous variables that represent the classification of funds, the quantile model can be written as:

$$y_i = X_i^{'}\beta_\phi + u_{\phi i} \quad [6]$$

where:

$$Quant_\phi(y_i|X_i) = X_i^{'}\beta_\phi \quad [7]$$

$$Quant_\phi(u_{\phi i}|X_i)=0$$

4.2. Results

In Table 2 we estimate the dynamic data panel models using regression with random effects. It can be seen a negative and significant relationship between the risk-adjusted returns (Sharpe and Sortino) and the level of expenses of the funds themselves in the year. There is also a negative, although not significant, relationship with the 4-factor (Alpha) adjusted performance measures and the net annual return. In addition, it appears to be a negative and significant relationship between the performance and age of the fund, and a positive relationship with respect to size.

Annex 1 also analyses the ability of past expenses to predict future performance. There is a negative and significant relationship for risk-adjusted measures. This means that one year's expenses have some power to predict risk-adjusted or non-risk-adjusted performance one year in advance, given that higher expenses funds will underperform significantly in the next year.

Table 3 shows that when we use a 3-year lag, that is, the expenses of the T-3 period, there is also a negative and significant relationship for all the performance measures used (Alpha, Sharpe, Sortino, and Annual Return). In this way we obtain evidence of the predictive power of expenses on the future performance of mutual funds at 1 and 3 years.

Table 2. Regression of expenses and performance, with random effects.

Variable	Alfa	Sharpe	Sortino	Annual return
Net Expenses	-0.0335	-0.0238***	-0.0478***	-0.2040
Tenure	-0.0059	0.0005	0.0003	0.0021
Net Assets	0.0051	0.0181***	0.0262***	0.0840
Fund years	-0.0044	-0.0049***	-0.0078***	-0.0563**
Flexcap	0.4586**	0.0982	0.1908	2.3688*
Largecap	0.3339*	0.0057	0.0051	0.3598
Midcap	0.5914***	0.2075**	0.3424**	6.6403***
Smallcap	0.5986***	0.1531*	0.2310	5.6062***
_cons	0.1932	1.0635***	2.0937***	1.7214
N	1411	1185	1185	1388
r2_w	0.5796	0.9511	0.9153	0.9432

Note: Alpha represents Carhart Factor Adjusted Return; Sharpe and Sortino are risk-adjusted profitability measures; Annual return is the net annual return; Net expenses are the expenses of the funds for year n; Flexcap, Largecap, Midcap and Smallcap are control variables that adjust the Morningstar categories of equity funds; Tenure is a control variable for management experience; Net Assets is the control variable for the size of the fund, while Years of the fund measures the age of the fund. The estimation of the dummy variables for time is not shown. N is the number of funds and r2_w the adjusted coefficient of regression. * Significant at 10%; ** significant at 5% and *** significant at 1%.

Table 3. Regression of panel data, of the expense ratio (T-3) of funds with respect to their performance, with random effects.

Variable	Alfa	Sharpe	Sortino	Annual return
Net expenses(T-3)	-0.0477***	-0.0258***	-0.0394**	-0.5287***
Tenure (T-3)	-0.0001	-0.0012	-0.0029	-0.0200
Net assets (T-3)	0.0097	-0.0100**	-0.0074	0.0915
Funds years(T-3)	0.0002	-0.0029	-0.0068*	-0.0439*
Flexcap	0.1173	-0.0062	0.0157	-0.1748
Largecap	0.1412	-0.0422	-0.1100	-0.9987
midcap	0.0296	0.2375**	0.4300**	2.7538*
smallcap	0.2878**	0.2125**	0.3142	3.7286***
constant	0.2764	1.5384***	2.6899***	3.6384*
N	1154	1163	1163	1163
r2_w	0.7487	0.9413	0.9066	0.9232

Table 4. Regression in the panel data, of the expense ratio (T-3) of the funds with respect to their performance with star rating control variables (T-3), with random effects.

Variable	Alpha	Sharpe	Sortino	Annual Return
Net expenses (T-3)	-0.0555***	-0.0374***	-0.0651***	-0.5939***
Tenure (T-3)	0.0004	-0.0013	-0.0037	-0.0389
Net assets (T-3)	0.0156	-0.0115**	-0.0056	0.0940
Funds years (T-3)	0.0019	-0.0022	-0.0041	-0.0144
1 Star (T-3)	-0.0480	-0.0851**	-0.3035***	-1.5617*
2 Stars (T-3)	-0.0947	-0.0175	-0.1518***	-1.0800
3 Stars (T-3)	-0.0243	-0.0210	-0.1263**	-1.1791*
4 Stars (T-3)	-0.0407	-0.0387*	-0.1219**	-0.2052
Flexcap	0.0750	0.0377	0.1047	-0.2923
Largecap	0.0790	0.0449	0.0396	-0.8909
Midcap	-0.0157	0.2455**	0.3878*	2.0371
Smallcap	0.3006*	0.2934***	0.4884**	3.0196*
Constant	0.2508	1.5205***	2.6476***	4.2060
N	887	895	895	895
r2_w	0.7607	0.9465	0.9107	0.9282

Note: Stars 1, 2, 3, and 4 are Morningstar's quantitative ratings of 1, 2, 3, and 4 stars respectively.

Table 4 shows the relationship between expenses and performance, using Morningstar ratings as a control variable. All variables are lagged for 3 years. It turns out that, in the long term (3 years), the expenses are effective in predicting future performance for all metrics, even incorporating the Morningstar ratings. **Annex 2** shows the relationship between expenses for the year itself, and performance taking into account the information on the rating of a fund that we knew in the previous period (T-1).

We can see a negative relationship between the fund's expenses and its future performance for the performance measures of Alfa, Sharpe and Sortino, although it is positive and significant for the annual net return. This means that when we use ratings in the model, the ability of expenses to predict performance is lost, since ratings absorb some of that predictive power. Which means that ratings help us predict performance and virtually eliminate the predictive power of expenses.

Annex 3 shows the relationship between the expense ratio from a year ago, and performance. We can see a negative relationship between the fund's expenses and its future performance for all risk-adjusted performance measures. This means that when we use the stars (ratings) in the model, the ability of expenses to predict the risk-adjusted return (Sharpe and Sortino) at 1 year is lost, since the ratings absorb part of that predictive power. Still, expenses can help predict performance for Alpha 4-factor adjusted returns and net returns.In Table 5 we show the results of the quantile regression models, which allow estimating heterogeneous behaviours according to different levels (quantiles) of the dependent variable. Quantile 0,25, median and quantile 0,75 (q25, q50, q75) were used, observing that there is a negative relationship between performance and the level of expenditure for all risk-adjusted measures and the gross annual return for quantiles 0.25 and 0.5.

However, in the 0.75 quantile the situation is different, with a positive relationship between performance and the level of spending. This means that in the best funds, the higher the expenses, the better is your performance. This result is consistent with Livingston, Yao and Zhou (2019) who also, through quantile regression techniques, showed that funds with a higher level of expenses have greater volatility in performance. In Annex 4 we run a quantile regression and Morningstar ratings as control variables. Here we confirm the results previously achieved (a negative relationship in the 0.25 and 0.5 quantiles and a positive relationship in the 0.75 quantile). The results are consistent with the conclusions drawn without the Morningstar ratings, even though by using the ratings, significance is lost in q75 in relation to Alfa, Sharpe and Sortino, maintaining the annual performance.

4.3 Robustness

As a robustness test, we used a quantile regression, but with different quantiles from those used previously. In this way, we use the first decile, the median and the ninth decile (q10, q50, q90). Table 6 shows the robustness of the results. It is observed for the lowest quantiles, in this case the 0.1 and 0.5 quantiles, spending has a negative relationship with the different performance measures. For the 0.9 quantile there is a positive relationship between performance and spending. These results are consistent with those found previously in Table 5. Annex 5 shows the estimate when we incorporate fund ratings as an explanatory variable. It is observed that expenses have a negative and significant relationship in the lower quantiles (0.10, 0.50) and a positive and significant relationship in the upper quantile (0.90).

Table 5. Quantile regression of the relationship between performance and expenses.

Variable	Alfa	Sharpe	Sortino	Annual Return
		q25		
Net expenses	-0.1067***	-0.0356***	-0.0438***	-0.8261***
Tenure	0.0039	0.0012*	0.0007	0.0510
Net assets	0.0009	0.0144***	0.0150***	0.0981
Funds years	0.0010	-0.0040***	-0.0043***	-0.0337
Flexcap	0.1602	-0.0638	-0.0403	0.6385
Largecap	0.2255	-0.0248	-0.0142	1.4982
Midcap	0.1994	0.0965**	0.1842***	2.3506
Smallcap	0.2150	-0.0824	-0.0889	1.0160
Const	-0.6271**	-0.5372	-0.6436***	9.0485**
		q50		
Net expenses	-0.0208	-0.0241**	-0.0262**	-0.2419
Tenure	0.0006	0.0010	0.0008	0.0110
Net assets	0.0018	0.0057*	0.0057	-0.0095
Funds years	-0.0040***	-0.0020	-0.0022	-0.0445
Flexcap	0.3272***	0.1063*	0.1160*	1.9252
Largecap	0.2596***	0.0439	0.0566	0.5439
Midcap	0.5121***	0.2788***	0.3776***	5.6020*
Smallcap	0.5766***	0.1945**	0.1810	3.9711*
Cons	-0.3512*	-0.4582	-0.5763***	12.6173***
		q75		
Net expenses	0.0174	-0.0102*	-0.0109	0.6517**
Tenure	-0.0026	-0.0004	-0.0013	0.0202
Net assets	-0.0053	0.0021	0.0041	-0.0043
Funds years	-0.0046	-0.0011	-0.0014	-0.0485
Flexcap	0.3798*	0.1790***	0.2323***	4.6076
Largecap	0.0397	0.0017	0.0217	-0.0687
Midcap	0.4172**	0.2886***	0.4871***	9.4906**
Smallcap	0.5675***	0.2503**	0.3850***	8.6049**
Cons	0.0113	-0.2822	-0.4368**	13.9186***
N	1411	1185	1185	1388

Note: q25, q50, q75 refer to the quantile estimate made for the 25th quantile, the median and the 75th quantile, respectively.

Table 6. Quantile regression of the relationship between performance and expenses.

Variable	Alfa	Sharpe	Sortino	Annual Return
		q10		
Net expenses	-0.1508***	-0.0568***	-0.0649***	-0.9561***
Tenure	0.0041	0.0021**	0.0023	-0.0021
Net assets	0.0122	0.0249***	0.0244***	0.3866***
Funds years	0.0087***	-0.0018**	-0.0026*	-0.0353
Flexcap	1.0371**	-0.0220	0.0059	-0.2857
Largecap	1.0281**	0.0229	0.0457	1.7556
Midcap	0.8306	0.1355	0.1827	2.1185
Smallcap	0.8512*	-0.1164	-0.0275	-2.7582
Const	-1.8438***	-0.8137***	-0.9105*	3.1581
		q50		
Net expenses	-0.0208	-0.0241***	-0.0262**	-0.2419*
Tenure	0.0006	0.0010	0.0008	0.0110
Net assets	0.0018	0.0057**	0.0057	-0.0095
Funds years	-0.0040**	-0.0020*	-0.0022*	-0.0445
Flexcap	0.3272***	0.1063*	0.1160*	1.9252
Largecap	0.2596**	0.0439	0.0566	0.5439
Midcap	0.5121**	0.2788***	0.3776***	5.6020***
Smallcap	0.5766***	0.1945***	0.1810*	3.9711
Const	-0.3512	-0.4582***	-0.5763***	12.6173***
		q90		
Net expenses	0.0541**	-0.0005	-0.0054	0.7930***
Tenure	-0.0060	-0.0022	-0.0005	-0.0906*
Net assets	-0.0209	0.0065	0.0056	0.0249
Funds years	-0.0104***	-0.0019	-0.0020	-0.0313
Flexcap	0.5107***	0.2191***	0.3139**	6.3175***
Largecap	0.1018	0.0390	0.0467	0.5299
Midcap	0.7697**	0.3080***	0.5209***	10.7623**
Smallcap	0.7123**	0.4793***	0.7060***	12.3191***
Const	0.5300	-0.1870	-0.1827	16.3357***
N	1411	1185	1185	1388

There are more than a hundred metrics in the performance literature (see Cogneau and Hübner 2009a, 2009b). We have performed as a robustness test the analysis of the results of using other frequently used metrics such as the Treynor ratio (1965) and the Jensen alpha (1968). This study reports results very similar to those obtained previously.

5. Conclusions

This study focuses on understanding the relationship between the level of expenses of mutual funds in the euro zone and their current and future performance. In our study, there appears to be evidence, similar to Daniel, Grinblatt, Titman and Wermers (1997) or Malkiel (1995), that the

funds' expenditures are related to their performance. On average, we can say that there is a negative relationship between both variables. However, the results are consistent with Livingston, Yao, and Zhou (2019), showing that the best performing funds may have a high expense value.

Given that, through quantile regression techniques, we demonstrate the existence of a negative relationship of performance expenses in the worst-performing funds and a positive relationship in the best performing funds. Second, we conclude that the past spending level of mutual funds can be a good indicator for selecting funds, with the objective of obtaining a better future performance, with a stronger relationship at 3 years than at 1 year. Finally, by incorporating the Morningstar star ratings, we conclude in line with Morey and Gottesman (2006), Müller and Weber (2014), Meinhardt (2014), Antypas, Caporale, Kourogenis and Pittis (2009) and Otero, Durán and Domingues (2019) that these can add useful information to select funds. In particular, we find that the rating has strong predictive power in the short term. However, in the long term, spending has greater explanatory power. In this sense, if investors use Morningstar star ratings and the fund's expense levels, they can improve the selection process for short and long-term mutual funds. Therefore, we can conclude that spending is an important variable in selecting the most profitable funds in the short and medium term. However, other variables need to be added to understand the determinants of their performance better. As we discussed earlier, there are multiple metrics that Investors can use. In this way, as a limitation of this work, we have to indicate, it could be that other metrics not analysed did not maintain the results achieved in this article, since not all have been analysed. The use of dynamic models and incorporating other variables into the models are proposed for future research.

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Annex 1. Regression in the panel data of the expenditure ratio (T-1) of the funds with respect to their performance, with random effects.

Variable	Alfa	Sharpe	Sortino	Annual Return
Net expenses (T-1)	-0.0369**	-0.0154**	-0.0268**	-0.6968***
Tenure (T-1)	0.0013	0.0011	0.0010	-0.0084
Net assets (T-1)	-0.0076	0.0075*	0.0157**	-0.1399
Funds years (T-1)	0.0001	-0.0037**	-0.0064**	-0.0320
Flexcap	0.2485	0.0583	0.1223	1.9633
Largecap	0.1583	-0.0037	0.0008	0.1106
Midcap	0.2714*	0.2490***	0.4068***	5.7077***
Smallcap	0.3249**	0.2271***	0.3822***	5.3183***
_cons	0.4959**	1.2121***	2.2216***	6.4395***
N	1349	1231	1231	1361
r2_w	0.7128	0.9431	0.9204	0.9444

Annex 2. Regression in the panel data of the fund's expense ratio with respect to its performance with star rating control variables (T-1), with random effects.

Variable	Alfa	Sharpe	Sortino	Annual Return
Net expenses	-0.0190	-0.0092	-0.0205	0.4999*
Tenure	0.0003	-0.0001	-0.0006	-0.0048
Net assets	-0.0037	0.0108***	0.0159**	0.2073
Funds years	0.0015	-0.0009	-0.0006	-0.0836*
1 Star (T-1)	-0.3501***	-0.4447***	-0.7626***	-0.8520
2 Stars (T-1)	-0.1372**	-0.3160***	-0.5964***	1.3952*
3 Stars (T-1)	-0.1157**	-0.2356***	-0.4549***	1.1838
4 Stars (T-1)	-0.1250**	-0.1611***	-0.3202***	0.4315
Flexcap	0.3118**	0.0858	0.1956**	1.7596
Largecap	0.3028**	0.0097	0.0080	0.7730
Midcap	0.4016***	0.1528**	0.2488**	5.8792**
Smallcap	0.6900***	0.1959***	0.2889***	7.6662***
_cons	0.3502	1.2970***	2.4671***	-2.1236
N	978	990	990	990
r2_w	0.7059	0.9503	0.9134	0.9493

Annex 3. Regression in the panel data, of the expense ratio (T-1) of the funds with respect to their performance with star rating control variables (T-1), with random effects.

Variable	Alfa	Sharpe	Sortino	Annual Return
Net expenses (T-1)	-0.0399**	-0.0097	-0.0166	-0.6335***
Tenure(T-1)	0.0007	0.0006	0.0006	0.0022
Net assets (T-1)	-0.0075	0.0042	0.0096	-0.1236
Funds years (T-1)	0.0027	-0.0011	-0.0025	-0.0193
1 Star (T-1)	-0.2097***	-0.3912***	-0.6179***	-2.5680***
2 Stars (T-1)	-0.0424	-0.2968***	-0.5103***	-0.0497
3 Stars (T-1)	-0.0448	-0.2283***	-0.4071***	-0.4580
4 Stars (T-1)	-0.0253	-0.1503***	-0.2846***	-0.7123
Flexcap	0.1775	0.0353	0.0857	2.1077
Largecap	0.1723	-0.0126	-0.0146	0.6891
Midcap	0.1683	0.1867***	0.3049**	5.5410***
Smallcap	0.3561*	0.2441***	0.4076***	6.7557***
_cons	0.4901*	1.4092***	2.5632***	5.8080**
N	1057	1068	1068	1068
r2_w	0.7362	0.9492	0.9317	0.9431

Annex 4. Quantile regression of the relationship between performance and expenses.

Variable	Alfa	Sharpe	Sortino	Annual Return
		q25		
Net expenses	-0.0702*	-0.0240***	-0.0277***	-0.8025***
Tenure	0.0022	0.0005	-0.0002	-0.0163
Net assets	0.0026	0.0074***	0.0080*	0.2224
Funds years	0.0018	-0.0003	-0.0007	-0.0245
1 Star (T-1)	-0.0492	-0.0765***	-0.0853***	0.5591
2 Stars (T-1)	0.0297	-0.1427***	-0.1612***	1.0409
3 Stars (T-1)	-0.0083	-0.2092***	-0.2617***	0.3229
4 Stars (T-1)	-0.1836*	-0.3979***	-0.4442***	-3.3262**
Flexcap	0.3285	-0.0199	0.0331	-0.8882
Largecap	0.4634	-0.0402	-0.0323	-0.0239
Midcap	0.3544	0.0468	0.1116	-1.3407
Smallcap	0.4629	0.0257	0.1189	3.3524
cons	-2.1484***	-0.2399	-0.2950	11.2904**
		q50		
Net expenses	-0.0072	-0.0048	-0.0008	-0.1178
Tenure	-0.0003	-0.0012	-0.0013	0.0171
Net assets	-0.0001	0.0032	0.0080	-0.0410
Funds years	-0.0040	-0.0004	-0.0006	-0.0402
1 Star (T-1)	-0.0447	-0.1611***	-0.2567***	-0.4815
2 Stars (T-1)	-0.0191	-0.2339***	-0.3299***	-0.7586
3 Stars (T-1)	-0.0354	-0.3018***	-0.4159***	-1.2543**
4 Stars (T-1)	-0.2094**	-0.4241***	-0.5603***	-2.9690**
Flexcap	0.2435	0.0353	0.0494	1.3275
Largecap	0.2022	0.0009	0.0120	0.2749
Midcap	0.4264**	0.1545***	0.1784	5.0437***
Smallcap	0.6319***	0.1524***	0.2179**	5.7617**
_cons	-1.3687***	-0.1087	-0.2121	15.9763***
		q75		
Net expenses	0.0142	0.0127	0.0125	1.0721***
Tenure	-0.0019	0.0020**	0.0011	-0.0205
Net assets	-0.0219*	-0.0001	-0.0014	0.0020
Funds years	-0.0035	0.0007	0.0012	-0.0724*
1 Star (T-1)	-0.1619*	-0.2028***	-0.3736***	-1.4230
2 Stars (T-1)	-0.2081***	-0.2678***	-0.4655***	-1.3905
3 Stars (T-1)	-0.1937**	-0.3293***	-0.5324***	-1.8922*
4 Stars (T-1)	-0.4484***	-0.4122***	-0.6508***	-4.0835**
Flexcap	0.2156	0.1274**	0.1495	5.0003*
Largecap	0.0231	0.0441	0.0323	0.6572
Midcap	0.2512	0.2447***	0.3048**	10.0087***
Smallcap	0.7108***	0.2875***	0.3794**	10.4067***
_cons	-0.4533	0.0570	0.2241	14.9986**
N	978	990	990	990

Annex 5. Quantile regression of the relationship between performance and expenses.

Variable	Alfa	Sharpe	Sortino	Annual Return
		q10		
Net expenses	-0.1388**	-0.0361***	-0.0428***	-0.9359*
Tenure	0.0035	-0.0001	-0.0001	-0.0464
Net assets	0.0370*	0.0159***	0.0125	0.4255**
Funds years	0.0050	-0.0011	0.0001	-0.0052
1 Star (T-1)	-0.0370	-0.0923***	-0.1069***	0.8661
2 Stars (T-1)	0.1080	-0.1242***	-0.1449***	2.2749***
3 Stars (T-1)	0.1269	-0.2003***	-0.2275***	0.9547
4 Stars (T-1)	-0.1922	-0.3749***	-0.5223***	-2.1320
Flexcap	0.5610	0.0474	0.1328	-0.4422
Largecap	0.6909*	0.0471	0.0865	2.1836
Midcap	0.5366	0.0947	0.1885	2.3780
Smallcap	0.3318	0.0481	0.0757	-2.2973
_cons	-3.3475***	-0.5832**	-0.6522	1.4839
		q50		
Net expenses	-0.0072	-0.0048	-0.0008	-0.1178
Tenure	-0.0003	-0.0012	-0.0013	0.0171
Net assets	-0.0001	0.0032	0.0080	-0.0410
Funds years	-0.0040*	-0.0004	-0.0006	-0.0402
1 Star (T-1)	-0.0447	-0.1611***	-0.2567***	-0.4815
2 Stars (T-1)	-0.0191	-0.2339***	-0.3299***	-0.7586
3 Stars (T-1)	-0.0354	-0.3018***	-0.4159***	-1.2543
4 Stars (T-1)	-0.2094**	-0.4241***	-0.5603***	-2.9690*
Flexcap	0.2435	0.0353	0.0494	1.3275
Largecap	0.2022	0.0009	0.0120	0.2749
Midcap	0.4264*	0.1545**	0.1784***	5.0437**
Smallcap	0.6319***	0.1524**	0.2179**	5.7617**
_cons	-1.3687***	-0.1087	-0.2121	15.9763***
		q90		
Net expenses	0.0578**	0.0186*	0.0220*	1.0605***
Tenure	0.0047	-0.0020	-0.0024	-0.1076
Net assets	-0.0254	0.0062	0.0073	-0.0549
Funds years	-0.0028	0.0009	0.0002	0.0277
1 Star (T-1)	-0.1689	-0.3160***	-0.6012***	-0.7371
2 Stars (T-1)	-0.2990**	-0.4050***	-0.7306***	-0.8581
3 Stars (T-1)	-0.2882**	-0.4606***	-0.7774***	-0.5163
4 Stars (T-1)	-0.3749*	-0.5503***	-0.8814***	-1.7424
Flexcap	0.2929*	0.1091	0.1917	5.3523**
Largecap	0.0699	-0.0032	0.0378	-0.2782
Midcap	0.6350***	0.2548**	0.4390**	10.3151***
Smallcap	1.2761***	0.3646***	0.5398	12.2550***
_cons	0.0923	0.1675	0.4179	17.9412***
N	978	990	990	990