



## INVESTMENT OBJECTIVES AND FACTORS THAT INFLUENCE THE DISAPPEARANCE OF SPANISH MUTUAL FUNDS

M. Glòria BARBERÀ-MARINÉ , Laura FABREGAT-AIBAR \*,  
Antonio TERCEÑO 

*Department of Business Management, Faculty of Business and Economics, Reus, Spain*

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**Abstract.** This paper analyses which variables influence the disappearance of mutual funds in the Spanish market and whether these variables vary depending on the investment objectives. The following variables are tested: age, size, investment flows, return, volatility, Sharpe ratio, Morningstar rating, and fund family. The Kaplan-Meier estimator and an extension of the Cox model, the Andersen-Gill model are used and the results indicate that the impact of some variables on survival capacity is different depending on the fund's investment objectives. The originality of this article is twofold. The analysis of disappearance takes the investment objectives of the mutual funds into account and a new variable, the Morningstar rating, is introduced. Moreover, no previous study examines survival capacity in the Spanish market according to different investment objectives. In Spain, mutual funds are highly concentrated because most of them are in the hands of a small number of banks who also control the country's largest fund families. This characteristic not only makes the Spanish market an interesting one for analysis, but it also means that the results of this paper are significant for mutual fund investors.

**Keywords:** mutual funds, investment objectives, survival capacity, Cox model, Andersen-Gill model, Spanish market.

**JEL Classification:** G1, G2.

### Introduction

In recent years, the total net assets of mutual funds in Spain has registered a considerable increase to become one of the main investment instruments. At the end of 2016, total net assets reached a total of 235,341 million euros, 53% up on the previous three years.

The main purpose of this article is to determine which variables influence the disappearance of mutual funds in the Spanish market and whether these vary depending on the investment objectives. Some studies consider that mutual fund policy plays an important

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\*Corresponding author. E-mail: [laura.fabregat@urv.cat](mailto:laura.fabregat@urv.cat)

role in the survival of mutual funds (Jayaraman et al., 2002; Bu & Lacey, 2008; Namvar & Phillips, 2013; Filip, 2014). However, these studies only focus on equity funds, distinguishing between those that invest in stocks with strong growth prospects in terms of profits or sales (growth funds), those that invest in undervalued stocks with respect to their financial and accounting ratios (value funds), and those that combine the two aforementioned strategies (blend funds).

The National Securities Market Commission (CNMV) Circular 3/2011, of 9 June, classified mutual funds in the Spanish market into fifteen investment objectives depending on the type of assets the portfolio invested in. Eight of these investment objectives are studied in this research, grouped into two categories: i) bond funds and bond mixed funds; and ii) equity funds and equity mixed funds. The other categories are discarded because of the low number of funds available.

The Andersen-Gill model, an extension of the Cox model, is applied to both groups to analyze whether there is a relation between the risk of disappearance and the variables considered in this study. First, the Cox model is applied. A condition that must be satisfied to apply this model is that the risks are proportional. However, in this case, the risks are shown to not be proportional. Consequently, the Andersen-Gill model is used because it does not require the satisfaction of this condition. In the literature, the Cox model is used to estimate fund survival in various studies such as Lunde et al. (1999), Cameron and Hall (2003), Bu and Lacey (2008), and Linnainmaa (2013).

The following variables are used in this analysis: age, size, investment flows (calculated from the variation in size at 1 and 2 years), return (calculated from the returns at 1 and 3 years), volatility (calculated from the standard deviation at 1 and 3 years), risk-adjusted return (measured as Sharpe ratio), fund family, and the Morningstar rating.

The main contribution of this paper is the analysis based on investment objectives. Given the different investment profiles of the two categories, the impact of the variables on survival capacity may vary. Furthermore, most studies in this field have focused on equity funds, and very few of them consider the Spanish market (Fabregat-Aibar et al., 2017; Terceño et al., 2018).

The fund family and the Morningstar rating are also included as variables in the analysis. Regarding the fund family, Spanish mutual funds are mainly managed by banks as opposed to independent companies. At the end of 2016, the six main fund families, which are linked to the banks Caixabank, Santander, BBVA, Banco Sabadell, Bankia, and Kutxabank, managed a total of 149,002 million euros, 63.3% of the total net assets. There is, therefore, a considerable level of concentration in the Spanish market with most mutual funds in the hands of a small number of banks who also control the country's largest fund families. This predominance in the market makes it easier for these fund families to close and merge mutual funds because they have a wider range of funds with similar investment objectives than smaller fund families, which have a more limited offer. It would be expected, therefore, that mutual funds managed by banks are more at risk of disappearing than those whose fund family is either independent or an insurance company.

And last, the inclusion of a variable linked to risk and complementary to volatility is proposed: the Morningstar rating.

The paper is structured in six sections. The literature on the factors that influence the disappearance of mutual funds is reviewed and the hypotheses are presented in Section 1. The methodology used – the Kaplan-Meier estimator, the Cox model, and the Andersen-Gill model – is presented in Section 2. The data and their sources are examined in Section 3. The analysis and application of the results are presented in Section 4. And last, the results are discussed and the conclusions drawn in Sections 5 and 6.

## 1. Literature review

There is empirical evidence to suggest that the age of the fund influences its survival capacity. Some studies conclude that younger funds have a higher probability of disappearing (Ter Horst et al., 2001; Zhao, 2005; Khorana et al., 2007; Bu & Lacey, 2008; Rohleder et al., 2011; Boubakri et al., 2014; Lapatto & Puttonen, 2018). Unlike previous results, Lunde et al. (1999) observes that both the youngest and the oldest funds are less likely to disappear. More than 70% of funds in their sample disappeared within 3 to 15 years from their creation. Furthermore, 2% of their sample (21 out of 973 funds) disappeared in the first six months. Likewise, Cameron and Hall (2003) observes that 25% of their sample of Australian funds disappeared within the first six years and 50% had disappeared twelve years after their creation. This line of argument is hypothesized as:

*H1: Age decreases the risk of a fund disappearing*

Other studies such as Zhao (2005), Rohleder et al. (2011), and Sherrill and Stark (2018) consider that fund size plays an important role in its disappearance since smaller funds have a higher probability of disappearing. Moreover, Zhao (2005) adds that the disappearance of a fund occurs in smaller portfolios that have a smaller variety of assets. Based on this argument, the following hypothesis is formulated:

*H2: Larger size decreases the risk of a fund disappearing*

Closely related to fund size, there is empirical evidence to suggest that investment inflows-outflows can influence the disappearance or survival of funds. Ding (2006) analyzes a sample of 604 equity funds from the US market during the period 1962–1999, finding that older funds show outflows during the three years prior to closing, while younger funds present fund inflows up to the final year, which is when investors begin to withdraw capital due to the drop in performance intensely. Ding (2006), Allen and Parwada (2006), Boubakri et al. (2014) and Andreu and Sarto (2016) consider that there is an intense withdrawal of capital from mutual funds in response to uncertain, unstable economic situations. So, the following statement is hypothesized:

*H3: A positive change in net flow decreases the risk of a fund disappearing*

Several studies show that a poor past performance increases the probability of disappearance and intensifies investment outflows (Brown & Goetzmann, 1995; Carhart, 1997; Lunde et al., 1999; Jayaraman et al., 2002; Asebedo & Grable, 2004; Zhao, 2005; Bu & Lacey, 2008; Rohleder et al., 2011; Linnainmaa, 2013; Filip, 2014; Cogneau & Hübner, 2015; Andreu &

Sarto, 2016). Cogneau and Hübner (2015) analyze a sample of equity funds during the period 1994–2010, distinguishing them by currency (GBP, EUR, USD, JPY and CHF) and domicile (United Kingdom, Luxembourg, France, Italy, Belgium, and Austria), considering that the disappearance of mutual funds can be predicted from their performance in the previous year. However, two of the earliest studies on the survival capacity of mutual funds consider that a poor performance for three consecutive years increases the probability of disappearance (Brown & Goetzmann, 1995) and that a fund does not survive if it performs poorly for five consecutive years (Carhart, 1997). So, the hypothesis is:

*H4: A higher return decreases the risk of a fund disappearing*

Other studies such as Elton and Gruber (1996), Cameron and Hall (2003), Massa and Patgiri (2009), and McLemore (2019) analyze the risk of the fund calculated from its volatility. These studies conclude that the more volatile a fund, the greater the likelihood it will disappear. However, Asebedo and Grable (2004) affirms that risk cannot be a key factor in the survival of funds because higher risk does not imply better or worse performance. Therefore, the hypothesis is:

*H5: A greater volatility increases the risk of a fund disappearing*

Some studies such as Lapatto and Puttonen (2018) confirms that target portfolios have lower Sharpe ratios in the pre-merger period than their acquiring funds for different time periods and merger types. So the following hypothesis is formulated:

*H6: A higher Sharpe ratio decreases the risk of a fund disappearing*

Some studies use the Morningstar rating as a risk measure (Blake & Morey, 2000; Del Guercio & Tkac, 2010). They conclude that a low rating (1 or 2 stars) indicates poor performance, while there is no evidence to show that the best-rated funds (5 stars) perform better than those rated with 3 or 4 stars. Regarding the survival approach, Oehler et al. (2018) recently concluded that the funds with a low rating have a higher risk of fund closure. Based on this line of argument, the following hypothesis is formulated:

*H7: A higher Morningstar rating decreases the risk of a fund disappearing*

Khorana et al. (2007) and Park (2013) analyze the incidence of the fund family on the survival capacity of mutual funds. Khorana et al. (2007) examine a sample of US equity funds during the period 1999–2001, concluding that closure is more likely when the fund family is independent. This study considers that if the board is independent, it tends to be less tolerant of negative results and decides to act quickly for the benefit of the fund and its investors. On the other hand, Park (2013), in which a US equity sample for the period 1991–2004 was studied, states that funds with the same marketing company have a higher probability of disappearing because their closure allows a greater scale economies to be generated, which consequently reduce costs for the entities. Given these studies and the specific structure of the Spanish market, the following statement is hypothesized:

*H8: Mutual funds managed by banks are at greater risk of disappearing than when the fund is managed by an insurance company or an independent company*

## 2. Methodology

Survival models are based on a set of concepts, instruments, and techniques designed to study the time that elapses until a specific event of interest occurs (Fuentelsaz et al., 2004; Kleinbaun & Klein, 2012).

In this study, the empirical analysis is carried out in two stages. First, the survival probability of the funds is analyzed in two large groups: (1) bond funds and bond mixed funds<sup>1</sup> and (2) equity funds and equity mixed funds<sup>2</sup>. The influence of the fund family on the survival capacity of the two groups is also assessed using the non-parametric Kaplan-Meier estimator (1958). Second, a multivariant analysis is carried out to assess the effect each explicative variable has on the survival of funds. The Cox model (1972) is used if the assumption of proportional hazard is met, and the Andersen-Gill model (1982) is applied if this premise cannot be verified.

### 2.1. Kaplan-Meier estimator (1958)

The Kaplan-Meier estimator is one of the most used models in this type of research. It enables the survival function to be obtained taking censored data into account and comparing two or more survival curves to determine whether they are significantly different.

This instrument estimates the survival probability,  $S(t)$ , at the different moments the event occurs.

To do so, survival times ordered from smallest to largest must be known:

$$t_0 < t_1 < t_2 < \dots < t_n, \quad (1)$$

where the origin is  $t_0$  and the first event is produced in  $t_1$ . For each  $t_i$ ,  $d_i$  denotes the number of events produced at this moment, and  $n_i$  is the number of individuals at risk just before  $t_i$ .

The Kaplan-Meier estimator defines survival function as:

$$\hat{S}(t) = \prod_{t_i < t} \frac{n_i - d_i}{n_i}. \quad (2)$$

The most used test to compare survival curves is the non-parametric Log-Rank test.

### 2.2. Cox (1972) and Andersen-Gill (1982) models

The Cox proportional hazard model, unlike the estimator discussed above, analyses whether there is a relationship between the risk of a certain event occurring and one or several explicative variables.

<sup>1</sup> According to the definition provided by the CNMV, the percentage invested in Treasury bills and bonds is 100%, and for bond mixed funds the percentage invested in Treasury bills and bonds is more than 70%. Therefore, the percentage invested in stocks is less than 30%.

<sup>2</sup> According to the CNMV definition, for equity funds the percentage invested in stocks is more than 75%, and for equity mixed funds the percentage invested in stocks is between 30–75%.

This model provides an expression for measuring the risk for an individual  $j$  at a moment  $t$  given a set of explicative variables denoted as  $X = (X_1, X_2, \dots, X_p)$  and formulated in the following way:

$$h_j(t, X) = h_o(t) e^{\sum_{i=1}^p \beta_i X_i}, \quad (3)$$

where  $h_o(t)$  is the baseline hazard, in other words the risk of the event occurring simply due to the passing of time when all the variables take the value 0. The factor  $e^{\sum_{i=1}^p \beta_i X_i}$  is the parametric part of the model and only depends on the explicative variables, with  $\beta_i$  being the estimated parameters for the model. The Cox model, therefore, is considered as 'semi-parametric', given that it has both a parametric and a non-parametric part.

To consider the parameters  $\beta_i$  as valid, the main assumption of the model, the proportional hazard, must be satisfied. This hypothesis requires that the risk for an individual is proportional to the risk for any other individual, irrespective of time.

The Schoenfeld residuals (1982) are used to verify the assumption of proportional hazard.

Andersen-Gill extends the Cox model for recurring events and for explicative variables dependent on time. Furthermore, it is used for cases where the assumption of proportional hazard is not met, even if the event is non-recurring.

The expression to measure the risk of an individual  $j$  at a moment  $t$  is formulated as follows:

$$h_j(t, X) = Y_j(t) \cdot h_o(t) e^{\sum_{i=1}^p \beta_i X_i(t)}, \quad (4)$$

where  $e^{\sum_{i=1}^p \beta_i X_i(t)}$  is the parametric part of the model,  $h_o(t)$  is the baseline hazard, and  $Y_j(t)$  indicates if the  $j^{\text{th}}$  individual is still in observation in  $t$ .

### 3. Data

The databases are provided by the Spanish National Securities Market Commission (CNMV) and Morningstar Direct. The first provides information about the funds that disappeared during the study period, and the values of the variables used are obtained from the second.

A sample of 1,057 mutual funds is used, which corresponds to all the funds alive at the end of 2003, plus all the funds registered from then until 2016 for which all the required variables are available. Of this total number of funds, 604 (equivalent to 57% of the sample) had disappeared.

The sample is divided into two groups: The first is the bond funds group, which contains a total of 553 bond funds and bond mixed funds (358 of which had disappeared), and the second group is comprised of 504 equity funds and equity mixed funds (246 of which had also disappeared) (Table 1).

It must be pointed out that the sample includes both right-censored data, because some of the funds were alive at the end of 2016 (Kleinbaun & Klein, 2012), and left-truncated data

(commonly known as late entry data), given that some funds were registered after 2003 and were also incorporated into the analysis (Klein & Moeschberger, 2003).

Table 2 lists the variables used in the analysis along with their definition, and Table 3 details the main statistics for each variable for the two groups. The fund expenses are excluded due to a lack of information in the database after 2014.

Table 1. Number of disappeared funds per year

	Bond funds	Equity funds
2006	6	3
2007	3	4
2008	10	8
2009	59	36
2010	36	20
2011	33	26
2012	78	53
2013	67	51
2014	24	25
2015	25	12
2016	17	8
Total	358	246

Table 2. Study variables in the survival model

Variable		Description
Age		Number of years elapsed between creating the fund and its disappearance or, where the event has not occurred, until 2016.
Size		Logarithm of the total net assets (TNA) of the fund, in euros, on 31/12/2016 or 31/12 of the year before its disappearance.
Investment flows <sup>3</sup>	Variation in size at 1 year	Variation in TNA, expressed as a percentage in the year prior to its disappearance or the change between 31/12/15 and 31/12/16 if the fund is still alive.
	Variation in size at 2 years	Variation in TNA, expressed as a percentage two years prior to its disappearance or the variation between 31/12/14 and 31/12/16 if the fund is still alive.
Return	Annual return	Annual return of the fund in the year prior to its disappearance or in 2016 if the fund is still alive.
	Annualised return at 3 years	Annualized return for the three years prior to its disappearance or between 2014 and 2016 if the fund is still alive.
Volatility	Annual standard deviation	Calculated from the monthly returns in 2016 or in the year prior to its disappearance.

<sup>3</sup> The variation in size is calculated using the formula:  $flows_t = \frac{TNA_t - TNA_{t-1}(1 + R_t)}{TNA_{t-1}} \cdot 100$ , where  $TNA_t$  and  $TNA_{t-1}$  are the total net assets in year  $t$  and  $t - 1$ , and  $R_t$  is the fund return in year  $t$ .

End of Table 2

Variable		Description
	Standard deviation annualised at 3 years	Calculated from the monthly returns using the same criteria as for the annualised return at 3 years.
Sharpe ratio <sup>4</sup>		The Sharpe ratio of the fund in the year prior to its disappearance or in 2016 if the fund is still alive.
Morningstar rating		Categorical variable, where 1 corresponds to 1 star, 2 to 2 stars, 3 to 3 stars, 4 to 4 stars, and 5 to 5 stars.
Fund family		Categorical variable, where 1 corresponds to banks, 2 to independent companies, and 3 to insurance companies.

Table 3. Descriptive analysis of the study variables

	Minimum	Maximum	Mean	Standard Deviation
A) Bond funds				
Age	4.000	29.000	14.966	6.184
Size	12.407	22.092	16.933	1.730
Variation in size_1 yr	-94.747	52.322	-20.675	27.348
Variation in size_2 yrs	-97.578	101.449	-28.489	39.373
Return_1 yr	-21.875	22.504	0.747	3.921
Return_3 yrs	-7.425	16.804	1.199	2.093
Deviation_1 yr	0.017	17.378	2.622	2.356
Deviation_3 yrs	0.044	13.168	2.754	2.202
Sharpe ratio	-19.556	4.596	-1.359	2.925
B) Equity funds				
Age	4.000	29.00	14.071	5.714
Size	11.627	21.905	16.522	1.481
Variation in size_1 yr	-107.915	55.072	-12.821	22.520
Variation in size_2 yrs	-126.974	104.823	-9.747	42.259
Return_1 yr	-37.748	34.157	0.635	12.086
Return_3 yrs	-16.392	17.604	1.635	6.189
Deviation_1 yr	1.014	29.960	12.765	5.470
Deviation_3 yrs	2.148	28.797	13.081	5.000
Sharpe ratio	-2.871	2.311	0.003	0.952

Table 4 shows the distribution of the sample according to the stars provided by Morningstar.

<sup>4</sup> The Sharpe ratio is calculated using the formula:  $SR = \frac{R_t - R_{fr}}{\delta_t}$ , where  $R_t$  is the fund return in year  $t$ ,  $R_{fr}$  is the risk free rate in year  $t$  (3y Bond Spain), and  $\delta_t$  is the volatility of the fund in year  $t$ .

Table 4. Descriptive analysis of the Morningstar Rating for the two groups

	Disappeared funds				Surviving funds			
A) Bond funds								
	Number of funds	% of funds	Mean of age	Mean of size	Number of funds	% of funds	Mean of age	Mean of size
1 star	56	15.6	14	15.375	8	4.1	20	17.296
2 stars	125	34.9	15	16.372	61	31.3	17	17.530
3 stars	115	32.1	14	16.708	70	35.9	15	17.931
4 stars	54	15.1	12	16.980	40	20.5	17	18.152
5 stars	8	2.2	11	17.436	16	8.2	14	18.092
Total	358				195			
B) Equity funds								
	Number of funds	% of funds	Mean of age	Mean of size	Number of funds	% of funds	Mean of age	Mean of size
1 star	41	16.7	13	15.509	44	17.1	16	17.015
2 stars	67	27.2	13	15.730	75	29.1	16	16.969
3 stars	87	35.4	14	15.761	107	41.5	15	17.570
4 stars	44	17.9	11	15.341	26	10.1	14	17.959
5 stars	7	2.8	10	15.327	6	2.3	16	19.224
Total	246				258			

## 4. Results

### 4.1. Kaplan-Meier estimator (1958)

#### a) Bond funds

Figure 1 shows the survival function for the set of bond funds. The broken lines are the confidence intervals of 95% (95% CI) around the estimated curve. Regarding the likelihood of survival, 75% of the funds survive for 12 years, 50% for 17 years, and 25% for 22 years.

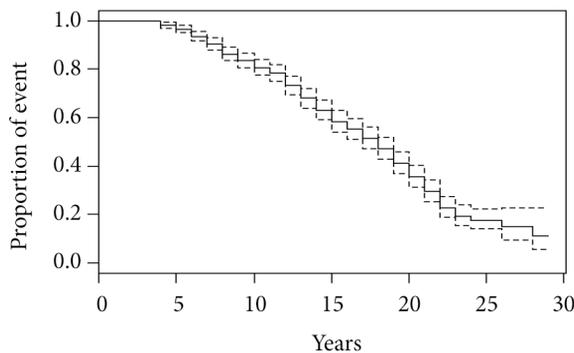


Figure 1. Survival curve – Bond funds

Figure 2 shows the survival curves for the set of bond funds for the different types of fund families and Table 5 details their survival capacity. The results clearly show that funds belonging to insurance companies survive longer than those belonging to banks or independent companies, whose survival capacities are very similar.

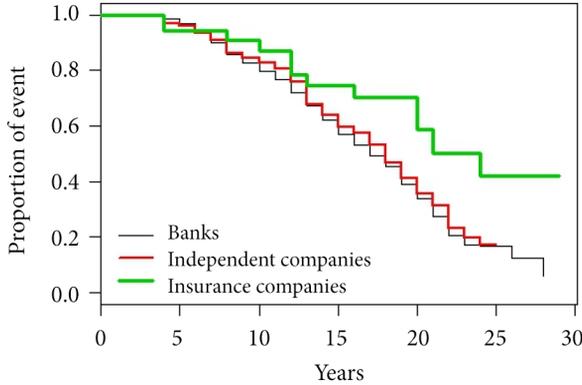


Figure 2. Survival curves according to the fund family – Bond funds

The results show that funds belonging to banks or independent companies have a 25% probability of disappearing at 12 years, while this probability is not reached for funds belonging to insurance companies until 13 years.

The probability of disappearing reaches 50% after 16 or 17 years for funds belonging to banks and 18 years for independent companies, whereas if the fund family is an insurance company this probability is not reached until 21 years.

Table 5. Kaplan-Meier estimator according to the fund family – Bond funds

Age	Banks			Independent companies			Insurance companies		
	n. risk	n. event	Survival	n. risk	n. event	Survival	n. risk	n. event	Survival
4	397	5	0.988	121	4	0.967	35	2	0.943
5	387	7	0.970	115	1	0.959	-	-	-
6	376	13	0.936	111	3	0.933	-	-	-
7	355	14	0.899	108	3	0.907	-	-	-
8	336	15	0.859	103	5	0.863	26	1	0.907
9	317	12	0.827	97	2	0.845	-	-	-
10	302	11	0.796	92	2	0.827	24	1	0.869
11	291	10	0.769	86	2	0.807	-	-	-
12	277	17	0.722	82	5	0.758	21	2	0.786
13	260	17	0.675	76	8	0.678	19	1	0.745
14	236	19	0.620	66	4	0.637	-	-	-
15	215	18	0.568	61	4	0.595	-	-	-
16	195	12	0.533	57	2	0.575	18	1	0.703
17	175	13	0.494	54	4	0.532	-	-	-

End of Table 5

Age	Banks			Independent companies			Insurance companies		
	n. risk	n. event	Survival	n. risk	n. event	Survival	n. risk	n. event	Survival
18	153	12	0.455	49	6	0.467	–	–	–
19	131	18	0.393	43	5	0.413	–	–	–
20	102	14	0.339	37	5	0.357	12	2	0.586
21	76	14	0.276	32	4	0.312	7	1	0.502
22	59	15	0.206	28	7	0.234	–	–	–
23	37	6	0.173	20	3	0.199	–	–	–
24	29	1	0.167	14	2	0.171	6	1	0.419
26	4	1	0.125	–	–	–	–	–	–
28	2	1	0.063	–	–	–	–	–	–

The results of the Log-Rank contrast shown in Table 6 confirm that there are significant differences between survival functions according to the fund family.

Table 6. Log-Rank contrast to compare survival curves according to the fund family – Bond funds

	N	Observed	Expected	$(O-E)^2/E$	$(O-E)^2/V$
Fund family = 1	397	265	252.4	0.627	2.328
Fund family = 2	121	81	82.0	0.013	0.018
Fund family = 3	35	12	23.6	5.671	6.692

\* Chisq = 6.9 on 2 degrees of freedom, p = 0.031.

b) Equity funds

Figure 3 shows the survival function of the set of equity funds. The broken lines are the confidence intervals of 95% around the estimated curve. Regarding survival capacity, 75% of the funds survive for 13 years, 50% for 18 years, and 25% for more than 24 years. These results show (comparing them with Figure 1) that equity funds generally survive better than bond funds.

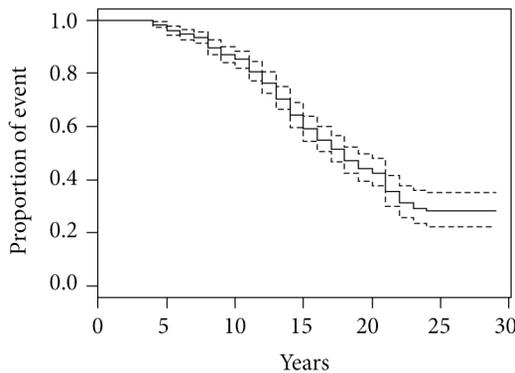


Figure 3. Survival curve – Equity funds

Figure 4 shows the survival curves of the equity funds according to the different types of fund families and Table 7 details their survival capacity. Unlike the results obtained in the last section, the funds in this group with the greatest longevity are those managed by independent companies. There is a percentage of 26% (54%) of the funds managed by this type of fund family that disappear after 14 (21) years, while at the opposite extreme the funds managed by banks have a 39% (69%) probability of disappearing after 14 (21) years.

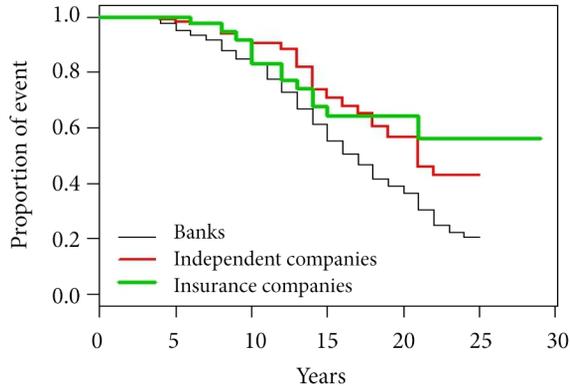


Figure 4. Survival curves according to the fund family – Equity funds

Table 7. Kaplan-Meier estimator according to the fund family – Equity funds

Age	Banks			Independent companies			Insurance companies		
	n. risk	n. event	Survival	n. risk	n. event	Survival	n. risk	n. event	Survival
4	356	8	0.978	105	1	0.990	–	–	–
5	345	10	0.949	102	1	0.981	–	–	–
6	314	5	0.934	96	1	0.971	42	1	0.976
7	300	5	0.919	–	–	–	–	–	–
8	294	13	0.878	91	3	0.939	34	1	0.947
9	279	9	0.850	88	2	0.917	33	1	0.919
10	266	4	0.837	79	1	0.906	32	3	0.833
11	260	19	0.776	–	–	–	–	–	–
12	236	14	0.730	73	2	0.881	27	2	0.771
13	216	18	0.669	69	5	0.817	25	1	0.740
14	198	17	0.611	60	6	0.735	23	2	0.676
15	180	17	0.554	52	2	0.707	21	1	0.644
16	153	13	0.507	50	2	0.679	–	–	–
17	125	10	0.466	47	2	0.650	–	–	–
18	105	11	0.417	41	3	0.602	–	–	–
19	78	5	0.391	32	2	0.565	–	–	–
20	46	3	0.365	–	–	–	–	–	–

End of Table 7

Age	Banks			Independent companies			Insurance companies		
	n. risk	n. event	Survival	n. risk	n. event	Survival	n. risk	n. event	Survival
21	37	6	0.306	21	4	0.457	8	1	0.563
22	27	5	0.249	17	1	0.430	–	–	–
23	18	2	0.222	–	–	–	–	–	–
24	15	1	0.207	–	–	–	–	–	–

The Log-Rank contrast test (Table 8) confirms that there are significant differences between survival functions according to the fund family to which the mutual funds belong.

Table 8. Log-rank contrast to compare survival curves – Equity funds

	N	Observed	Expected	(O-E) <sup>2</sup> /E	(O-E) <sup>2</sup> /V
Fund family = 1	356	195	168.3	4.25	14.43
Fund family = 2	105	38	56.7	6.16	8.58
Fund family = 3	43	13	21.0	3.08	3.59

\* Chisq = 14.5 on 2 degrees of freedom,  $p = 0.00072$ .

## 4.2. Andersen-Gill model

### a) Bond funds

First, the Cox model is applied and subsequently discarded as it does not meet the proportional hazard assumption. Consequently, the Andersen-Gill model is applied, which does not require this assumption to be fulfilled. Table 9 shows the parameters of the Andersen-Gill model for the bond funds group. The second column indicates the value of the estimated regression coefficient. The third column is the hazard ratio, which indicates the variation in the hazard function for a unitary increase in the associated variable. The fourth column is the standard error of the estimated regression coefficient, and the last two columns contain the statistic value and the p-value.

Table 9. Parameters of the Andersen-Gill model (11 variables) – Bond funds

Variable	coef	exp(coef)	se(coef)	z	Pr(> z )
Age	-0.041	0.960	0.009	-4.682	$2.85 \cdot 10^{-6}$ ***
Fund family = 2	-0.264	0.768	0.137	-1.922	0.054658·
Fund family = 3	-0.845	0.429	0.300	-2.823	0.004754**
Size	-0.171	0.843	0.041	-4.128	$3.66 \cdot 10^{-5}$ ***
Variation in size_1 yr	-0.003	0.998	0.003	-0.912	0.361959
Variation in size_2 yrs	-0.006	0.994	0.002	-2.848	0.004402**
Return_1 yr	-0.027	0.973	0.017	-1.565	0.117579
Return_3 yrs	-0.054	0.947	0.040	-1.375	0.169203

End of Table 9

Variable	coef	exp(coef)	se(coef)	z	Pr(> z )
Deviation_1 yr	0.232	1.261	0.050	4.671	2.99·10 <sup>-6</sup> ***
Deviation_3 yrs	-0.192	0.825	0.057	-3.345	0.00822***
Sharpe ratio	-0.012	0.988	0.007	1.673	0.094306·
Rating = 2	-0.269	0.764	0.187	-1.437	0.150694
Rating = 3	-0.265	0.767	0.199	-1.334	0.182307
Rating = 4	-0.471	0.624	0.232	-2.032	0.042142*
Rating = 5	-1.115	0.328	0.418	-2.669	0.007596**

(1) Signif. codes: '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1.

(2) Wald test = 232.3 on 15 df, p = 0.

The results show that the variables *variation in size-1 yr*, *return-1yr*, and *return-3yrs* are not significant, so a new model is defined that only includes the statistically significant variables at a minimum significance level of 10% (Table 10).

The ANOVA contrast (Table 11) indicates that the model with eleven variables is more explicative. The Wald test shows that the coefficients of the model are significantly different from zero.

Table 10. Parameters of the Andersen-Gill model (8 variables) – Bond funds

Variable	coef	exp(coef)	se(coef)	z	Pr(> z )
Age	-0.041	0.960	0.009	-4.698	2.62 · 10 <sup>-6</sup> ***
Fund family = 2	-0.248	0.781	0.138	-1.798	0.07224·
Fund family = 3	-0.876	0.416	0.300	-2.920	0.003498**
Size	-0.175	0.839	0.042	-4.206	2.60·10 <sup>-5</sup> ***
Variation in size_2 yrs	-0.008	0.992	0.002	-4.664	3.10·10 <sup>-6</sup> ***
Deviation_1 yr	0.266	1.305	0.046	5.745	9.20·10 <sup>-9</sup> ***
Deviation_3 yrs	-0.232	0.793	0.055	-4.230	2.33·10 <sup>-5</sup> ***
Sharpe ratio	-0.015	0.985	0.007	-2.193	0.028325*
Rating = 2	-0.434	0.648	0.173	-2.504	0.012291*
Rating = 3	-0.468	0.626	0.177	-2.642	0.008238**
Rating = 4	-0.681	0.506	0.211	-3.221	0.001276**
Rating = 5	-1.402	0.246	0.391	-3.586	0.000336***

(1) Signif. codes: '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1.

(2) Wald test = 216.6 on 12 df, p = 0.

Table 11. ANOVA contrast between the models in Table 9 and Table 10

	Loglik	Chisq	Df	P(> Chi )
1	-1984.9			
2	-1980.2	9.5142	3	0.02318*

Signif. codes: '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1.

All coefficients  $\beta$  of the significant variables (Table 9) are negative except for the coefficient of the variable *deviation\_1year*. A negative sign implies that the higher the value of the variables, the lower the risk of the mutual fund disappearing. On the other hand, a positive sign means that an increase in the variable implies an increase in the risk of disappearance.

The value of the hazard ratio for each significant variable leads us to affirm the following statements. For each year the fund remains alive the risk of disappearing decreases by 4%, confirming that younger bond funds (*H1*) are more likely to disappear. Furthermore, for each percentage point that *size*, *variation in size\_2yr*, and *deviation\_3yrs* increases, the mortality risk decreases by approximately 0.091%<sup>5</sup>, 0.636%, and 17.5%, respectively. These results confirm the hypothesis that larger bond funds (*H2*, *H3*) are less likely to disappear. Likewise, greater return decreases the risk of a fund disappearing (*H4*). On the other hand, *H5* is not confirmed because higher 3-years volatility decreases the risk but higher 1-year volatility increases it. This last result is contrary to that presented in the literature review.

Regarding the effect of the *Sharpe ratio* on survival capacity, the *H6* is confirmed since a higher Sharpe ratio translated into a lower probability of disappearance.

The *Morningstar rating* of the bond funds behaves differently depending on the fund category, evaluated by their number of stars. The estimate of the hazard ratio at the low and medium levels (2 and 3 stars) is not significant, whereas this value in funds with higher ratings (4 and 5 stars) is less than 1 with respect to the reference group. Therefore, funds rated as 4 or 5 stars are less likely to disappear than those with a low rating (1 star) in the Spanish market.

Last, regarding the final hypothesis about the effect of the *fund family*, it can be observed that the estimate of the hazard ratio for both groups (independent and insurance companies) is less than 1 with respect to the reference group (banks). When the fund family is independent or an insurance company, they are at less risk of disappearing than funds managed by banks, confirming the hypothesis proposed in the literature section.

## b) Equity funds

In this case, the results obtained using the Cox regression show that the model does not meet the proportional hazard assumption, so the Andersen–Gill model is applied. Table 12 shows the parameters of the Andersen–Gill model for the equity funds group.

The results show that the variables *variation in size\_1 year*, *return\_1 year*, *deviation\_1 year*, and *deviation\_3 years* are not significant in the disappearance of these types of funds. Therefore, a new model is defined that includes only the statistically significant variables at a minimum significance level of 10% (Table 13), and the two models are contrasted (Table 14).

The ANOVA contrast indicates that the model with 7 variables is more explicative. The Wald test shows that the coefficients of the model are significantly different from zero.

<sup>5</sup> The effect of the variable *size* does not have a direct reading in the model as it is measured with the total net assets logarithm. The percentage variation of the risk of disappearing is obtained using the following expression:  $(1 - \exp(\text{coef}) \times 0.01) / e - 1$ .

Table 12. Parameters of the Andersen-Gill model (11 variables) – Equity funds

Variable	coef	exp(coef)	se(coef)	z	Pr(> z )
Age	-0.037	0.964	0.013	-2.787	0.005327**
Fund family = 2	-0.767	0.464	0.192	-4.002	6.29·10 <sup>-5</sup> ***
Fund family = 3	-0.483	0.617	0.293	-1.647	0.099587·
Size	-0.441	0.643	0.065	-6.753	1.45·10 <sup>-11</sup> ***
Variation in size_1 yr	0.005	1.005	0.004	1.319	0.187055
Variation in size_2 yrs	-0.011	0.989	0.003	-3.743	0.000182 ***
Return_1 yr	0.015	1.016	0.015	1.055	0.291309
Return_3 yrs	-0.049	0.952	0.015	-3.350	0.000807 ***
Deviation_1 yr	-0.034	0.967	0.022	-1.515	0.129693
Deviation_3 yrs	0.032	1.033	0.023	1.382	0.167043
Sharpe ratio	-0.502	0.605	0.192	-2.620	0.008801 **
Rating = 2	0.275	1.316	0.205	1.339	0.180729
Rating = 3	0.396	1.486	0.195	2.032	0.042196*
Rating = 4	0.395	1.485	0.224	1.765	0.077606·
Rating = 5	1.318	3.736	0.444	2.970	0.002975**

(1) Signif. codes: '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1.

(2) Wald test = 337.9 on 15 df. p = 0.

The coefficients  $\beta$  of *age*, *size*, *variation in size\_2 years*, *return\_3 years*, and *Sharpe ratio* (Table 13) are negative, so the higher the value of these variables, the less the risk of the mutual fund disappearing. Moreover, the value of the hazard ratio for each significant variable leads us to affirm the following statements. For each additional year the fund remains alive, the risk of it disappearing decreases by 3.6%. And, for each percentage point that *size*, *variation in size\_2 years*, and *return\_3 years* increases, the mortality risk decreases by approximately 0.215%<sup>6</sup>, 0.1%, and 4.5%, respectively. Therefore, these results confirm that younger (*H1*) and smaller (*H2*) equity funds are more likely to disappear. Capital outflows (*H3*) and poor past performance (*H4*) also increase the likelihood of disappearance for this type of funds.

Table 13. Parameters of the Andersen-Gill model (7 variables) – Equity funds

Variable	coef	exp(coef)	se(coef)	z	Pr(> z )
Age	.036	0.965	0.013	-2.822	0.004766 **
Fund family = 2	-0.711	0.491	0.184	-3.860	0.000113 ***
Fund family = 3	-0.502	0.606	0.292	-1.721	0.085304 ·
Size	-0.462	0.630	0.063	-7.376	1.63·10 <sup>-13</sup> ***
Variation in size_2 yrs	-0.009	0.991	0.002	-3.943	8.05·10 <sup>-5</sup> ***
Return_3 yrs	-0.046	0.955	0.013	-3.412	0.000645 ***

<sup>6</sup> Value obtained from the following expression  $(1 - \exp(\text{coef}) \times 0.01) / e - 1$ .

End of Table 13

Variable	coef	exp(coef)	se(coef)	z	Pr(> z )
Sharpe ratio	-0.274	0.761	0.082	-3.328	0.000875 ***
Rating = 2	0.264	1.303	0.201	1.314	0.188884
Rating = 3	0.394	1.483	0.194	2.030	0.042404 *
Rating = 4	0.331	1.392	0.223	1.487	0.136929
Rating = 5	0.182	3.261	0.431	2.744	0.006073 **

(1) Signif. codes: ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1.

(2) Wald test = 335.3 on 11 df. p = 0.

Table 14. ANOVA contrast between the models in Table 12 and Table 13

	Loglik	Chisq	Df	P(> Chi )
1	-1284.6			
2	-1281.4	6.301	4	0.1778

(1) Signif. codes: ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1.

On the other hand, the results do not confirm that a greater volatility increases the risk of a fund disappearing (*H5*) because volatility in the short and long terms is not significant in the equity funds group.

The sixth hypothesis about the effect of the *Sharpe ratio* on survival capacity is confirmed since it can be observed that a higher Sharpe ratio decreases the probability of disappearance in the equity funds group.

Regarding the *Morningstar Rating*, the initial hypothesis (*H7*) is not confirmed because the results show that the funds ranked with 4 and 5 stars have a higher probability of disappearing.

Last, regarding the *fund family*, the estimate of the hazard ratio in both groups (independent and insurance companies) is less than 1 in relation to the reference group (banks). Thus, it can be confirmed that when the fund family is independent or is an insurance company the funds are at less risk of disappearing than when they are managed by banks (*H8*).

### 5. Discussion

Table 15 is a summary of the effect that each variable has on the survival: (–) indicates a higher value of the variable decreases the risk of disappearing; (+) implies the opposite relationship; and (\*) indicates that the variable is not significant.

Regarding age and size, younger funds with smaller assets are shown to be at greater risk of disappearing. These two hypotheses are confirmed for the two groups analyzed and reinforce the findings of different studies such as Zhao (2005), Bu and Lacey (2008), Rohleder et al. (2011), and Boubakri et al. (2014), among others. In both groups, for each year the fund is still alive the risk of it disappearing decreases by approximately 4%. Additionally, the higher the total net assets, the lower the risk of mortality, decreasing by 0.091% for bond funds and 0.215% for equity funds.

Table 15. Summary of the effect of each variable on the survival of mutual funds

Variable	Bond funds	Equity funds
Age	–	–
Fund Family = 2	–	–
Fund Family = 3	–	–
Size	–	–
Variation in size_1 yr	*	*
Variation in size_2 yrs	–	–
Return_1 yr	*	*
Return_3 yrs	*	–
Deviation_1 yr	+	*
Deviation_3 yrs	–	*
Sharpe ratio	–	–
Rating = 2	*	*
Rating = 3	*	+
Rating = 4	–	*
Rating = 5	–	+

Regarding variation in size, there is a relationship between mortality and capital outflow in the two years prior to the fund disappearing, as suggested by authors such as Ding (2006), Allen and Parwada (2006), Boubakri et al. (2014), and Andreu and Sarto (2016). Therefore, the third hypothesis is confirmed in both groups. Variation in size at one year, however, is not a significant variable for either of the groups analyzed.

Hypothesis 4, the effect of return on the survival of mutual funds, is verified for the two study groups; however, the Andersen-Gill model confirms that in the long term only the equity funds group is affected. In the short term, it is not a significant variable. The investor's timeframe for bond funds is long-term and they are willing to generate fewer returns to preserve capital, which explains why return is not significant in the model.

Volatility has also been incorporated for both the long and the short terms. While it is shown to not be a significant variable for the set of equity funds, it is a significant variable for bond funds. This result is explained by the risk profile of the investor in each group. Bond fund investors traditionally have low-risk profiles, whereas equity fund investors have higher risk profiles and their return prospects are also higher, so they are willing to assume greater risk. This explains why in the second group the variable volatility does not influence their survival. This result is consistent with Asebedo and Grable (2003). Regarding the set of bond funds, short-term volatility increases the risk of the fund disappearing, confirming the expected relationship. Greater volatility in the long term, however, decreases this risk. This result, contrary to most previous studies, can be explained by the situation of bond funds (and particularly of the public debt) in the Spanish market, which is characterized by higher volatility due to the risk premium reaching record highs in the period 2010-13. Within this context, bond funds, with very volatile assets in their portfolio but a very attractive return, remain in the market and even increase their net flow.

The Sharpe ratio hypothesis is confirmed in the two groups analyzed and a higher Sharpe ratio translates into a lower probability of disappearance in the Spanish fund market. This result confirms the results of Lapatto and Puttonen (2018).

The seventh hypothesis about the effect of the Morningstar rating depends on the group analyzed. For the equity funds group, a higher rating negatively affects the survival capacity, while for the bond funds group 4- and 5-star rated funds are less likely to disappear than those with a low rating, confirming the hypothesis proposed in the literature review section.

Last, regarding the fund family, the Kaplan-Meier estimator enabled us to detect the possible influence of this variable on the survival of mutual funds. The Andersen-Gill model confirmed the importance of this variable and detected the sign of its influence, concluding that in both groups studied funds managed by banks are at greater risk of disappearing than when the fund family is independent or an insurance company. This result is opposite to that reported by Khorana et al. (2007). Closing and merging mutual funds for banks is easier because they have a wider range of funds with similar investment objectives, making it easier for them to redirect their clients' investments without any repercussions on the entity's reputation and prestige. This result is closely related to Park (2013), which concludes that funds belonging to the same family have a higher probability of disappearing since their closure reduces costs for the fund family.

## **Conclusions**

In this study an analysis was carried out of fund survival in the Spanish market according to their investment objectives: bond and equity funds. The paper tested eight hypotheses related to age, size, variation in size, return, volatility, Sharpe ratio, Morningstar rating, and type of fund family, using the Andersen-Gill model. The results indicate that the impact of some variables is different depending on their category.

The significant variables in both groups are age, size, and Sharpe ratio. Younger and smaller funds have a higher probability of disappearing and funds with lower Sharpe ratios are likewise at greater risk. It should be pointed out that the effect intensity of the variables is the same for both groups.

The variables that affect the survival funds in different ways depending on the analysis group are return and volatility. The profile of the investor in bond funds is adverse to risk, which justifies the fact that return is not significant in this group since preserving capital takes precedence over gaining profitability. On the other hand, volatility is not a significant variable in the equity funds group, whereas it is in the bond fund group. This situation is also explained by the risk profile of the investor for each investment objective. An investor in equities is willing to assume more risk, so consequently volatility is less important to them.

The Kaplan-Meier and the Andersen-Gill models demonstrated that the funds managed by banks have a higher probability of disappearing than funds managed by independent groups or insurance companies.

Last, regarding the Morningstar Rating, the bond funds rated highly (4 or 5 stars) are more likely to survive in the Spanish market, whereas the equity funds rated highly are more likely to disappear.

The main limitation of this study is the period analyzed because it includes the economic crisis period and the results may be different for a stable economic period. Therefore, the main future research lines could be a comparative analysis between different periods.

### Author contributions

This article is a joint work of the three authors. M.G.B.M, L.F.A, and A.T. contributed to the research ideas, literature review and analysis and to writing the paper. All authors read and approved the final manuscript.

### Disclosure statement

The authors declare no conflict of interest.

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