Survival and Mortality of Hedge Funds

Mr. Fabrice Rouah*

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*Ph.D. Candidate (Finance), Faculty of Management, McGill University, Montreal, Canada. Financial help from the Foundation for Managed Derivatives Research (FMDR), the Institut de finance mathématique de Montréal (IFM2) and the Centre de recherche en e-finance (CREF) is gratefully acknowledged. I thank Professor Susan Christoffersen for helpful comments and suggestions.

Why Survival?

- Most of the new money flowing to hedge funds is from institutional investors.
- They wish to invest into hedge funds on a long-term basis (Casey, Quirk, and Acito 2004).
- They seek hedge funds likely to survive a long time and to avoid liquidation, an undesirable outcome often associated with large capital losses.
- Survival Analysis can help investors select funds with good long-term prospects.
- Longevity can ease investor concerns regarding the illiquidity of hedge funds.

Estimating Mortality and Survival

- Annual mortality rate (or rate of attrition) is a proportion.

$$\frac{\text{Number of funds dying during the year}}{\text{Number of funds alive at the beginning of the year}} \times 100\%$$

- Survival is modeled via the survival function $S(t) =$ probability that the hedge fund survives past time t, or the hazard function $\lambda(t) =$ instantaneous rate of death at time t.

- Authors have also used probit or logit regression with outcome corresponding to survival status (dead or alive).

- Studies have aggregated all hedge fund deaths into a single group, but many "dead" funds are alive and well (Fung and Hsieh, 2000).

Two Issues Related to Mortality and Survival

- Issue #1 is longevity. Why do some hedge funds liquidate shortly after being launched, while others remain alive and healthy for a long time?

- Survival Analysis has been used to identify hedge fund characteristics related to longevity.

- Issue #2 is survivorship bias.
  - typically 300 to 400 bps / year for hedge funds.
  - typically less than 100 bps / year for mutual funds.

- Factors driving survival and mortality are the same factors driving survivorship bias.

Annual Mortality Rates

- Estimates of mortality vary across studies, across time periods, and across databases used.
- Even within the same study, mortality varies by investment style and over time.
- Studies point to increasing mortality over the last 10 years.
- Could reflect managers closing down faster nowadays than one decade ago, an influx of mediocre funds, or limited investment opportunities (Amin and Kat, 2003).
- One consistent pattern : mortality was high in late 1998. Many funds died, and few were born.

Estimates of Annual Mortality Rates

Authors	Annual Rate (%)	Database	Dates
Amin and Kat (2003)	2.2 to 12.3	TASS	94-01
Liang (2001)	4.1 to 13.0	TASS	94-99
Liang (2000)	4.7 to 13.4	TASS	94-98
Liang (2000)	1.4 to 6.2	HFR	94-97
Barès, Gibson, Gyger (2001)	5.0	FRM	up to 99
Barry (2002)	8.0 to 10.0	TASS	94-00
Baquero, ter Horst, Verbeek (2002)	8.6	TASS	94-00
Brown, Goetzmann, Ibbotson (1999)	20.0	Offshore Directory	89-95
Brown, Goetzmann, and Park (2001)	15.0	TASS	94-98
Getmansky, Lo, and Mei (2004)	1.1 to 30.7	TASS	93-04

Annual Mortality Rates by Style

Yr	Eq MN	LS Eq	Con Arb	Ev Driv	Man Fut	Sh Sell	FI Arb	Em Mkt	Mult Strat	Glob Mac	FoF	All
94	8.3	1.2	0	0	4.4	0	13.6	0	17.6	0	1.8	3.0
95	0	3.2	0	1.1	13.3	8.3	5.7	1.4	10.5	30.7	5.5	6.1
96	0	7.4	13.7	2.7	20.8	9.1	8.9	3.9	4.2	25.6	6.3	9.7
97	0	3.9	5.2	2.2	15.7	7.7	7.0	6.5	8.1	37.1	7.0	6.9
98	3.8	6.8	7.7	1.2	16.1	0	20.6	16.1	10.6	0	9.6	9.5
99	17.7	7.4	4.1	9.8	18.3	6.3	11.4	11.8	4.0	5.8	5.7	9.7
00	12.9	8.0	3.7	7.4	16.4	5.3	14.7	15.6	3.4	11.7	9.9	11.1
01	8.6	13.4	5.3	8.4	9.9	30.0	9.6	18.1	1.5	18.4	10.3	11.4
02	9.7	12.4	5.2	12.4	16.8	6.7	5.8	8.3	6.2	14.7	5.1	10.0
03	18.6	12.3	7.6	9.2	11.7	6.7	8.7	10.4	15.6	18.0	7.5	10.7
All	8.0	7.6	5.2	5.4	14.4	8.0	10.6	9.2	8.2	12.6	6.9	8.8

- Source: Getmansky, Lo, and Mei (2004). Notes: (*i*) mortality increases over 10 years, (*ii*) 2001-2002 tech bubble for Long-Short Equity, (*iii*) 1998 effect for others, (*iv*) variation across styles.

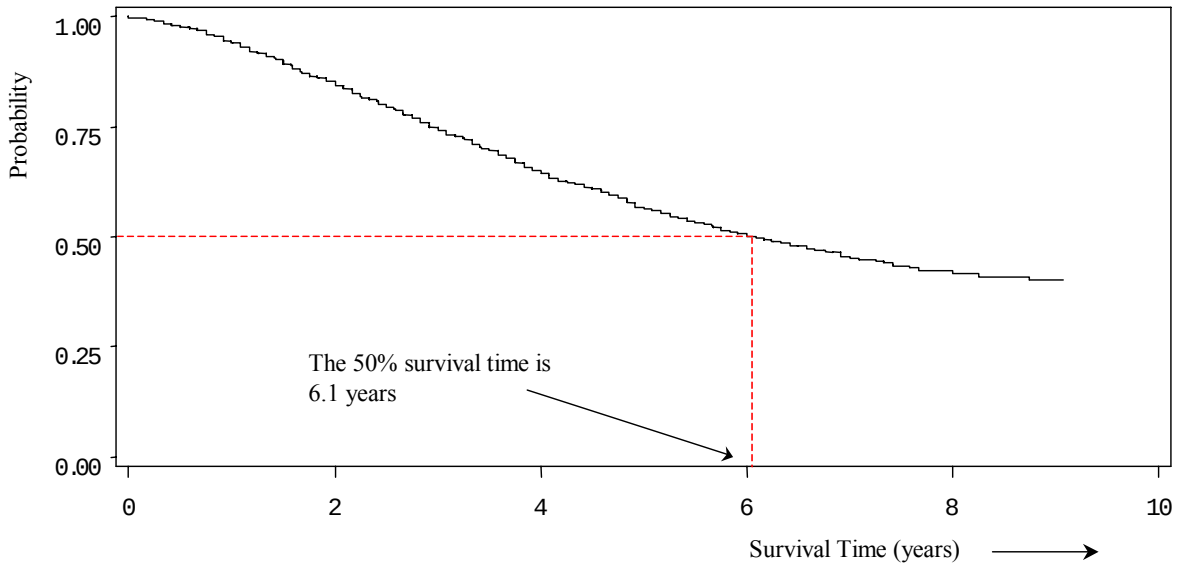
Estimating Survival : 50% Survival Time

- Definition of the 50% survival time: the time at which one-half of the hedge funds die.
- One-half of the funds die before that time, the other half lives longer.
- Much variation in the estimates, across databases.

Authors	50% Survival Time	Database
Brown, Goetzmann, Park (2001)	2.5 years	TASS
Amin & Kat (2003)	5.0 years	TASS
Gregoriou (2002)	5.5 years	MAR
Securities & Exchange Commission (2003)	5.5 years	Van Hedge
Barès, Gibson, and Gyger (2001)	$>$10 years	FRM

Example of the 50% Survival Time

- This *Kaplan-Meier* curve estimates the survival function $S(t) = \Pr(T > t)$.
- To get the 50% survival time, draw a horizontal line at 50% probability until it hits $S(t)$, then draw a vertical line to the x-axis $= 6.1$ years.
- Can also obtain the *Mean Survival Time* as $\mu = \int_0^\infty S(t)dt = 6.7$ years.



Fund Characteristics Related to Survival

- We can create different groups of hedge funds, small and large for example.

- Fit separate Kaplan-Meier curves in each group, and apply the *Log-Rank test* to ascertain whether they are the same (Amin and Kat, 2003).

- But we suffer a loss of sample size as the number of groups increases, and only one characteristic (or factor) can be tested at once.

- Better to apply a multivariate analysis, such as the Cox Proportional Hazards (PH) model.

- The effects of explanatory factors on survival (via the hazard function) can be assessed simultaneously in a regression-like framework.

Results of Cox PH Models

- Brown, Goetzmann, and Park (2001) and Gregoriou (2002) find that high volatility, poor returns, and low assets, increase the hazard, i.e., decrease survival.

- Boyson (2002) finds that managers with little experience or education also increase the hazard.

- BGP (2001) argue that hedge fund managers under their highwater mark have a strong incentive to increase volatility to bolster returns, attain the highwater mark, and earn performance fees.

- This incentive, however, is mitigated by the increase in hazard brought on by increased volatility.

Gregoriou (2002) Cox PH Model

Variable	Hazard Ratio (HR)	p-value
Mean Monthly Return (%)	0.899	0.0404
Average AUM ($M)	0.994	$<.0001$
Leverage (Y/N)	1.026	$<.0001$
Minimum Purchase ($100K)	0.978	0.0271

Note: HR$>$1 increases the hazard, while HR$<$1 decreases the hazard.

- Every 1% increase in mean monthly return is associated with a 10.1% decrease in the hazard, $(0.899 - 1) \times 100\% = -10.1\%$.

- Size effects: every $1M increase in average AUM decreases the hazard by 0.6%, while every $100K increase in minimum purchase decreases the hazard by 2.19%.

- Funds employing leverage have a 2.6% increase in the hazard compared to those that don't use leverage $(1.026 - 1) \times 100\% = 2.6\%$.

Hedge Fund Survivorship Bias

- Defined as the difference in returns between two portfolios. Two general methods to compare portfolios.

  1. Live+Dead funds versus Live funds only (most common).

  2. Dead funds versus Live funds.

- Three ways to define portfolios (Brown, Goetzmann, and Ibbotson 1999, Fung and Hsieh 2000).

- (1) Surviving Portfolio, (2) Complete Portfolio, or (3) Observable Portfolio.

- Estimates vary across databases and time periods, but most are at 3% to 4% yearly.

Estimates of Yearly Survivorship Bias

Authors	Dates	Yearly Bias (%)	Database	Method
Ackermann *et al.* (1999)	88-95	0.16	HFR & MAR	Dead vs. Live
Amin and Kat (2003)	94-01	1.89	TASS	Comp vs. Surv
Baquero *et al.* (2002)	94-00	2.10	TASS	Obs vs. Surv
Brown, Goetzmann, Ibbotson (1999)	89-95	0.75	Offshore Dir.	Comp vs. Surv
Brown, Goetzmann, Ibbotson (1999)	89-95	2.75	Offshore Dir.	Obs vs. Surv
Fung and Hsieh (2000)	94-98	3.00	TASS	Obs vs. Surv
Liang (2000)	94-97	0.60	HFR	Obs vs. Surv
Liang (2000)	94-98	2.24	TASS	Obs vs. Surv
Liang (2001)	90-99	1.69	TASS	Obs vs. Surv
Liang (2001)	94-99	2.43	TASS	Obs vs. Surv
Barès *et al.* (2001)	96-99	1.30	FRM	Obs vs. Surv
Edwards and Caglayan (2001)	90-98	1.85	MAR	Obs vs. Surv
Barry (2002)	94-01	3.80	TASS	Obs vs. Surv
Malkiel and Saha (2004)	96-03	3.75	TASS	Obs vs. Surv
Malkiel and Saha (2004)	96-03	7.40	TASS	Dead vs. Surv

Dead: Dead funds, Live: Live funds. Comp, Surv, Obs: Complete, Surviving, and Observable Portfolio.

Problems With Existing Studies

- They fail to distinguish between funds that exit the database because of liquidation, and those that exit for other reasons.

- Aggregating exit types as though they were a single homogeneous group can lead to at least four distortions when estimating hedge fund mortality, survival, and survivorship bias.

  1. The effect of predictor variables (covariates) becomes blurred.

  2. It produces faulty estimates of mortality and survival since some dead funds should be counted as live instead.

  3. It does not allow for survival to be defined in terms of liquidation only.

  4. It underestimates survivorship bias since some exited funds have very good returns.

Current Study (Rouah, 2005)

- I use hedge fund data over the 1994 to 2003 period. Funds in the dead pool experience three types of exit

  1. Liquidation: fund returns investor money and is no longer operating.

  2. Closed to New Investors: fund accepts no new investors.

  3. Stopped Reporting: fund stops reporting to the database vendor.

- I apply a *Competing Risks* survival model, in which each exit type is treated separately, and treat all variables whose values change over time as *Time Dependent Covariates* (Kalbfleisch and Prentice, 2002).

- Findings: the effect of explanatory variables on survival are different when exits are separated, and isolating liquidation from the other exit types alters the estimates of mortality and of survivorship bias.

Performance and Assets

Panel A: Returns (%)		Entire History		Last 12 Months		Last 6 Months	
	# Funds	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Live	2,371	1.07	4.95	1.37	3.42	1.32	3.03
No Reporting	522	1.28	7.13	0.85	8.66	0.64	9.60
Liquidated	513	0.71	7.45	−0.06	8.30	−0.14	8.52
Closed	189	0.72	6.81	0.37	7.36	0.42	7.58

Panel B: Assets ($M)		Entire History		Last 12 Months		Last 6 Months	
	# Funds	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Live	2,371	93	357	125	508	137	576
No Reporting	522	105	572	93	498	93	496
Liquidated	513	54	315	58	354	57	356
Closed	189	65	416	59	354	48	256

- Conclusion : The three exits clearly do not constitute a homogeneous group of hedge funds.

Mean Survival Time Until Liquidation, in Years

By Style & AUM	All Funds	Large Funds	Small Funds	p-value
Convertible Arbitrage	3.5	n/a	3.4	n/a
Distressed Securities	5.3	5.5	5.0	0.0949
Emerging Markets	6.5	6.7	6.2	0.0439
Equity Hedge	6.6	7.0	5.6	0.0001
Equity Market Neutral	7.1	7.8	4.2	0.0003
Equity Non-Hedge	7.7	8.5	4.7	0.0015
Event Driven	4.6	4.8	3.7	0.0122
Fixed Income	7.4	7.8	4.1	0.0224
Fund of Funds	6.5	6.1	6.0	0.0001
Market Timing	5.3	5.6	4.5	0.3415
Merger Arbitrage	4.0	3.7	4.0	0.6753
Relative Value Arbitrage	4.6	4.7	4.4	0.2464
Sector	5.5	5.5	5.2	0.0083
Short Selling	4.4	4.5	1.3	0.7948
All Funds	8.3	8.9	6.4	0.0001

Cox PH Model Under Competing Risks

Variable	Liquidated	Closed	No Reporting	All Exits
Average Return(t) (%)	0.904^{***}	0.918^{***}	0.959^{***}	0.931^{***}
StdDev Return(t) (%)	1.031^{***}	0.964^{*}	1.013^{***}	1.022^{***}
Highwater Mark (Y/N)	1.716^{**}	1.062	1.030	1.238^{*}
Hurdle Rate (Y/N)	0.253^{***}	0.165^{***}	0.248^{***}	0.236^{***}
Incentive Fee (%)	1.013	1.022^{*}	1.019^{*}	1.016^{**}
Management Fee (%)	0.863^{*}	0.976	0.857^{*}	0.881^{**}
Minimum Investment ($M)	0.939	1.035	0.946	0.977
Average AUM(t) ($100M)	0.634^{***}	0.587^{**}	0.994	0.910^{***}
StdDev AUM(t) ($100M)	1.243^{***}	1.085	1.019	1.058^{**}

Note: *, **, *** denote significance at the 5%, 1% and 0.1% level, respectively.

- Variables ending with (t) denote time dependent covariates.

Interpretation of Competing Risks Model

- For all exits, a 1% increase in monthly returns decreases the all exits hazard by 6.9%. But the hazard for liquidation is decreased by 9.6%.

- Similarly, 1% increase in returns volatility increases the liquidation hazard by 3.1%, more than the 2.2% suggested by all exits.

- Large funds are protected since every $100M increase in Assets Under Management decreases the risk of liquidation by 36.6%.

- AUM volatility affects liquidation but not the other exits. Every $100M increase in asset volatility increases the hazard by 24.3%

Estimates of Survivorship Bias

Panel A: Live Group = Alive at Dec 2003

Dead Group	Live Return	Dead Return	Bias/Month	Bias/Year
No Reporting + Liquidated + Closed	1.043	0.917	0.126%	1.51%
Liquidated + Closed	1.043	0.770	0.273%	3.28%
No Reporting + Liquidated	1.043	0.900	0.143%	1.72%
No Reporting + Closed	1.043	1.073	−0.030%	−0.36%
Liquidated	1.043	0.667	0.376%	4.51%
Closed	1.043	0.999	0.044%	0.53%
No Reporting	1.043	1.103	−0.060%	−0.72%

Panel B: Live Group = Alive at Dec 2003 + No Reporting

Dead Group	Live Return	Dead Return	Bias/Month	Bias/Year
Closed + Liquidated	1.050	0.771	0.279%	3.35%
Liquidated	1.050	0.667	0.383%	4.60%
Closed	1.050	1.000	0.050%	0.60%

Survivorship Bias

- When exits are aggregated, annual bias is estimated at 1.51%, similar to 1.89% obtained by Amin and Kat (2003), 1.69% by Liang (2001) and 1.85% by Edwards and Caglayan (2001).

- When the Live group also includes funds no longer reporting, it jumps to 3.35%, since those funds have good returns. This is similar to 3.80% from Barry (2002) and 3.75% from Malkiel and Saha (2004).

- When only liquidated funds only constitute the dead group, it rises higher still, to 4.51% and 4.60%.

- This number is higher than found in previous studies, typically 3% to 4%, but lower than 7.40% found by Malkiel and Saha (2004)..

Annual Mortality Rates (%)

Year	All Exited Funds	Liquidated Funds	Closed Funds	Funds Not Reporting	Liquidate +NoRep	Liquidate +Closed	NoRep+ Closed	GLM (2004)
1994	2.1	1.1	0.2	0.8	1.9	1.3	1.0	3.0
1995	4.4	2.3	0.1	2.0	4.2	2.4	2.1	6.1
1996	10.2	5.6	0.4	4.2	9.8	6.0	4.6	9.7
1997	10.1	4.3	0.9	4.8	9.1	5.3	5.8	6.9
1998	16.2	4.9	1.6	9.7	14.6	6.5	11.2	9.5
1999	9.9	3.7	1.6	4.6	8.3	5.3	6.2	9.7
2000	13.7	4.4	1.3	7.9	12.4	5.8	9.2	11.1
2001	10.2	3.5	2.0	4.7	8.2	5.5	6.7	11.4
2002	9.2	4.1	1.6	3.5	7.6	5.7	5.1	10.0
2003	8.9	4.0	1.5	3.4	7.4	5.4	4.9	10.7

Annual Mortality Rates

- When All Exited Funds are aggregated, the increasing pattern of mortality is consistent with that found by Getmansky, Lo, and Mei (2004).
- When only Liquidated Funds are used, there is no apparent increase.
- The increase in Closed Funds is consistent with the argument of Amin and Kat (2003) that managers are closing down faster nowadays than one decade ago.
- Part of the increase in mortality reported by Getmansky, Lo, and Mei (2004) and Amin and Kat (2003) can be attributed to an increase in Closed Funds, and Funds Not Reporting.

Conclusion (1)

- Institutional investors want hedge funds that are not likely to liquidate in the short-term. Survival Analysis can help them select funds with longevity.

- Longevity and survivorship bias in returns are two important issues related to hedge fund mortality and survival.

- Estimates of mortality rates and of survivorship bias are dependent on the database employed and the time period under consideration.

- Cox proportional hazards modeling has pointed to a number of common variables significantly related to survival.

Conclusion (2)

- It does not make sense to aggregate hedge funds with different exits, because they do not constitute a homogeneous group of "dead" funds.

- In order to identify factors driving liquidation – the main outcome of economic interest to investors – liquidation must be isolated from the other exit types.

- Competing risks modeling of hedge fund lifetimes shows that the factors are acting differently on the different exit types.

- Mortality rates and estimates of survivorship bias are heavily dependent on which funds are used to define the dead group.

Conclusion (3)

- Factors increasing hedge fund life expectancy, in order of importance
  - High returns, a large asset base, low returns volatility, a hurdle rate.
- Factors decreasing life expectancy, in order of importance
  - Excessive leverage, excessive incentive fees, high asset volatility.
- Lower attrition rate among certain styles, such as Funds of Funds, Event Driven, and Convertible Arbitrage.
- Some styles have longer mean survival times than others, but much of this difference can be attributed to differences in size.

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