False Discoveries in Mutual Fund Performance: Measuring Luck in Estimated Alphas

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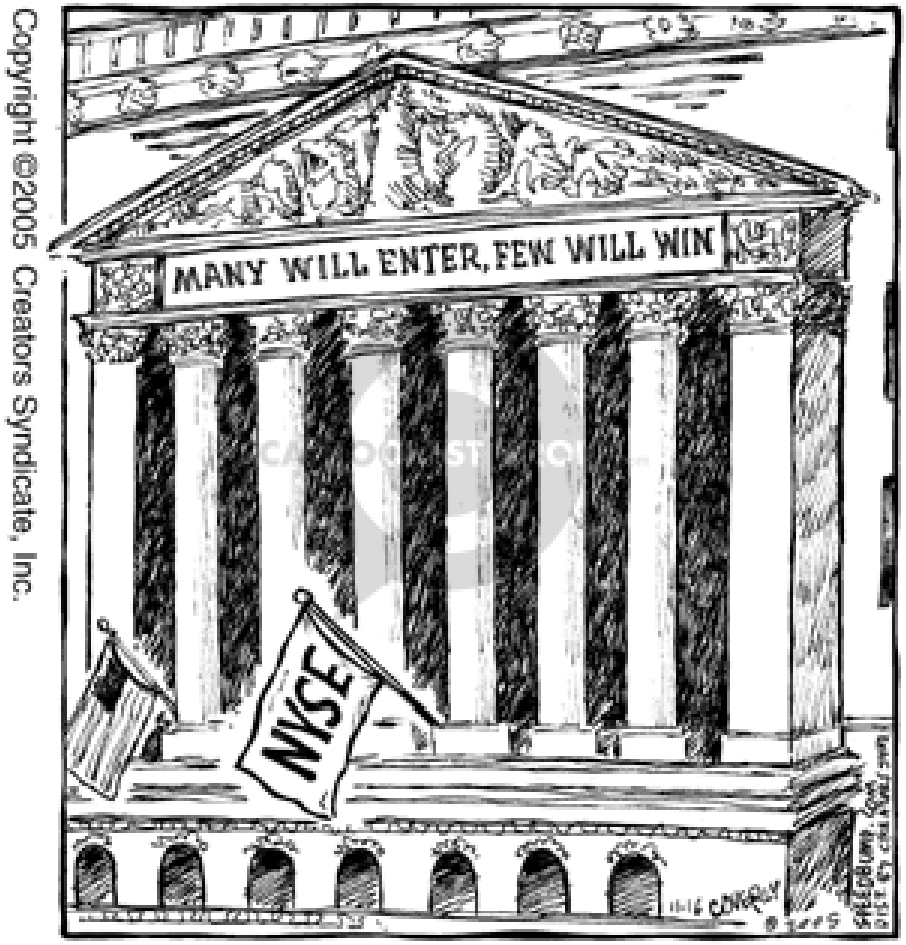
Presentation at Q-Group
Dana Point



Motivations

- The average estimated alpha in the mutual fund industry is negative

- But do some funds truly generate differential performance?
  - Namely positive (or negative) alphas?

- Measuring individual fund performance is of central interest
  - Investors, financial advisors, managers of fund-of-funds

Motivations

- We test the performance of *M* funds in the population
  - For a given fund, we compute the *p*-value of the alpha
    - (e.g., p=.05 means Type I error estimated at 5%)
  - If "enough" funds have low p-values, we conclude there is skill
- This is a **multiple-hypothesis** test: we simultaneously test the performance of *M* funds
  - The Problem: Meaning of "enough" funds ?

A Simple Example

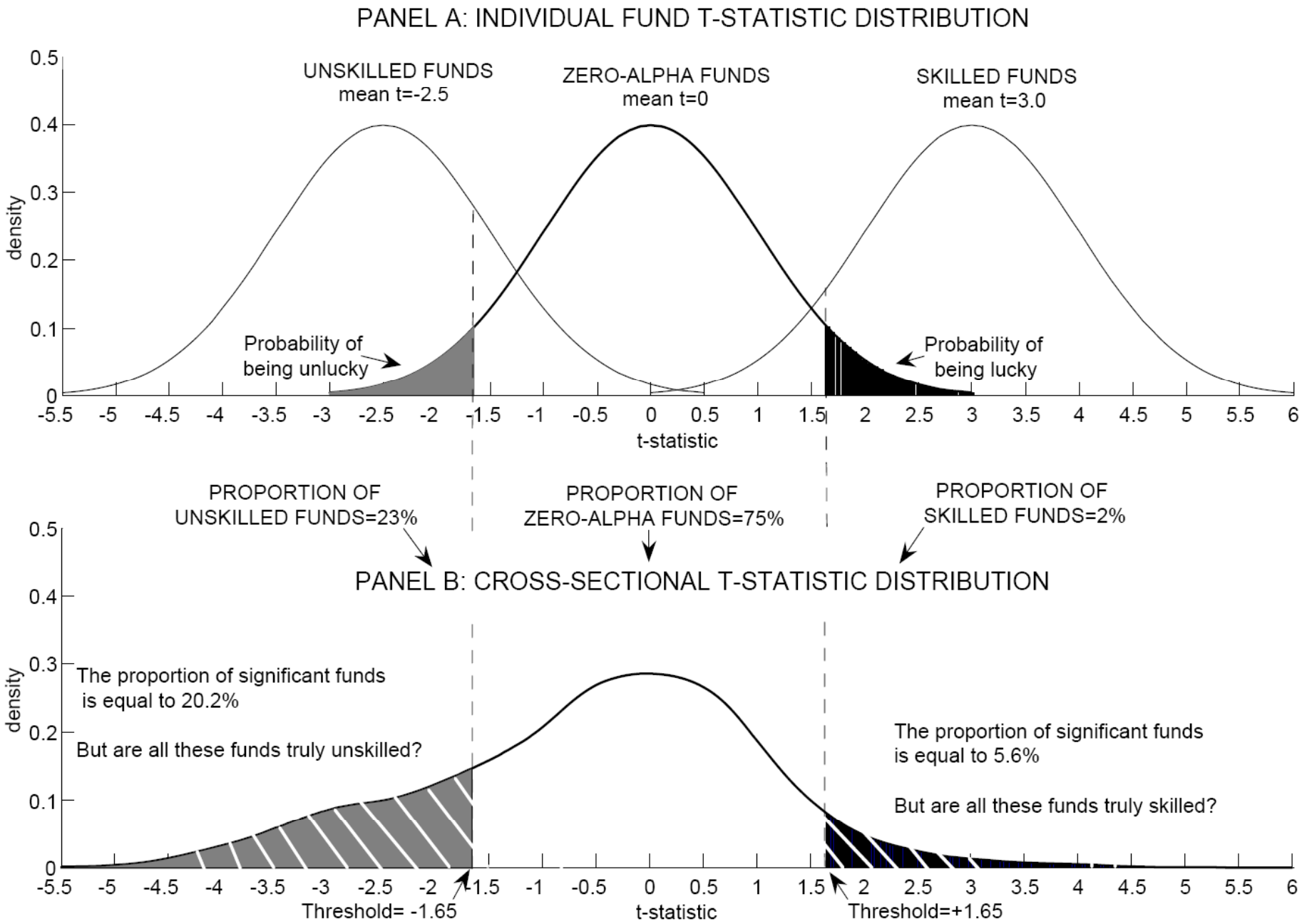
- Suppose we observe 100 basketball players shooting free-throws:
  - 20% make 2 of 10
  - 60% make 5 of 10
  - 20% make 8 of 10
- How to estimate the proportion that are skilled enough to make 8 of 10 over the long-run?
- Our approach: the middle 60% is informative about luck in the tails (middle 60% are labeled "average" players)

Motivations

- Every test on fund alpha is subject to luck
  - ➢ A lucky fund has a *significant* estimated alpha,
    - The *true* alpha equals zero
  - ➢ Measuring *compound* luck is extremely difficult
    - Aggregating luck across multiple funds is very difficult
    - How do we avoid including lucky funds (Type I error)
    - How do we avoid throwing out skilled funds (Type II error)
  - ➢ Our approach is based on a new and simple statistical method

Definitions of Skill Groups

- **Unskilled Fund Managers**: produce an alpha shortfall, net of trading costs and expenses ($\alpha < 0$)
  - May have stockpicking skills, but inefficient
  - Fund company overcharges
- **Zero-Alpha Fund Managers**: ($\alpha = 0$)
  - Fund company captures entire surplus
- **Skilled Fund Managers**: produce an alpha surplus ($\alpha > 0$)
  - Efficient stockpicking skills
  - Fund company does not capture entire surplus
  - This is the group investors are seeking
- Later, we'll look at skill *gross of expenses* (but net of trading costs) as another perspective


PANEL A: INDIVIDUAL FUND T-STATISTIC DISTRIBUTION
UNSKILLED FUNDS
mean t=-2.5
ZERO-ALPHA FUNDS
mean t=0
SKILLED FUNDS
mean t=3.0
density
Probability of
being unlucky
Probability of
being lucky
t-statistic
PROPORTION OF
UNSKILLED FUNDS=23%
PROPORTION OF
ZERO-ALPHA FUNDS=75%
PROPORTION OF
SKILLED FUNDS=2%
PANEL B: CROSS-SECTIONAL T-STATISTIC DISTRIBUTION
The proportion of significant funds
is equal to 20.2%
But are all these funds truly unskilled?
The proportion of significant funds
is equal to 5.6%
But are all these funds truly skilled?
Threshold= -1.65
t-statistic
Threshold=+1.65

Motivation

Performance Measurement of 2,076 U.S. domestic equity funds

Question 1: Impact of Luck on Performance?

- At γ=0.05, 2.2% of funds have positive & significant alphas (net of expense ratios)

➢ Are all of them truly skilled managers?

Question 2: Location of Funds with Differential Performance?

- At γ=0.20, 8.2% of funds have positive significant alphas

➢ Are all of the 6% new significant funds truly skilled?

Question 3: Performance of the Mutual Fund Industry over Time?

- Fund universe has grown from a few hundred to over 2,000

➢ How has proportion of truly skilled managers evolved?

A. Individual Fund Performance Measurement

- Multiple-Hypothesis Test of differential performance ($\alpha_i > 0$ or $\alpha_i < 0$) for M funds ($i=1,\ldots,M$):

$$
\begin{aligned}
H_{0,1} &: \alpha_1 = 0, \quad H_{A,1} : \alpha_1 > 0 \text{ or } \alpha_1 < 0, \\
\ldots &: \ldots \\
H_{0,M} &: \alpha_M = 0, \quad H_{A,M} : \alpha_M > 0 \text{ or } \alpha_M < 0.
\end{aligned}
$$

  - α_i is computed with the four-factor model of Fama/French/Carhart
  - The two-sided p-values: computed with bootstrap of Kosowoski, Timmermann, Wermers, and White (JF; 2006)

- Fund i is called ‘‘significant’’ if its p-value is smaller than γ

B. The Impact of Luck on Performance

- The standard approach assumes a null hypothesis that all funds have an alpha of zero to control for luck
  - See, for example, Jensen (1968)
- But, this approach is overly conservative
  - Suppose that 20% of the funds are truly skilled. Clearly, we would underestimate the # of truly skilled funds by assuming 5% significant alphas under the null
- $$\widehat{T}_{\gamma}^{+} = \widehat{S}_{\gamma}^{+} - \widehat{F}_{\gamma}^{+} = \widehat{S}_{\gamma}^{+} - \widehat{\pi}_0 \cdot \gamma/2$$

Lucky funds (or False Discoveries)

$$\widehat{T}_\gamma^+ = \widehat{S}_\gamma^+ - \widehat{F}_\gamma^+ = \widehat{S}_\gamma^+ - \widehat{\pi}_0 \cdot \gamma/2$$

Skilled funds

Lucky funds (or False Discoveries)

Significant alpha funds

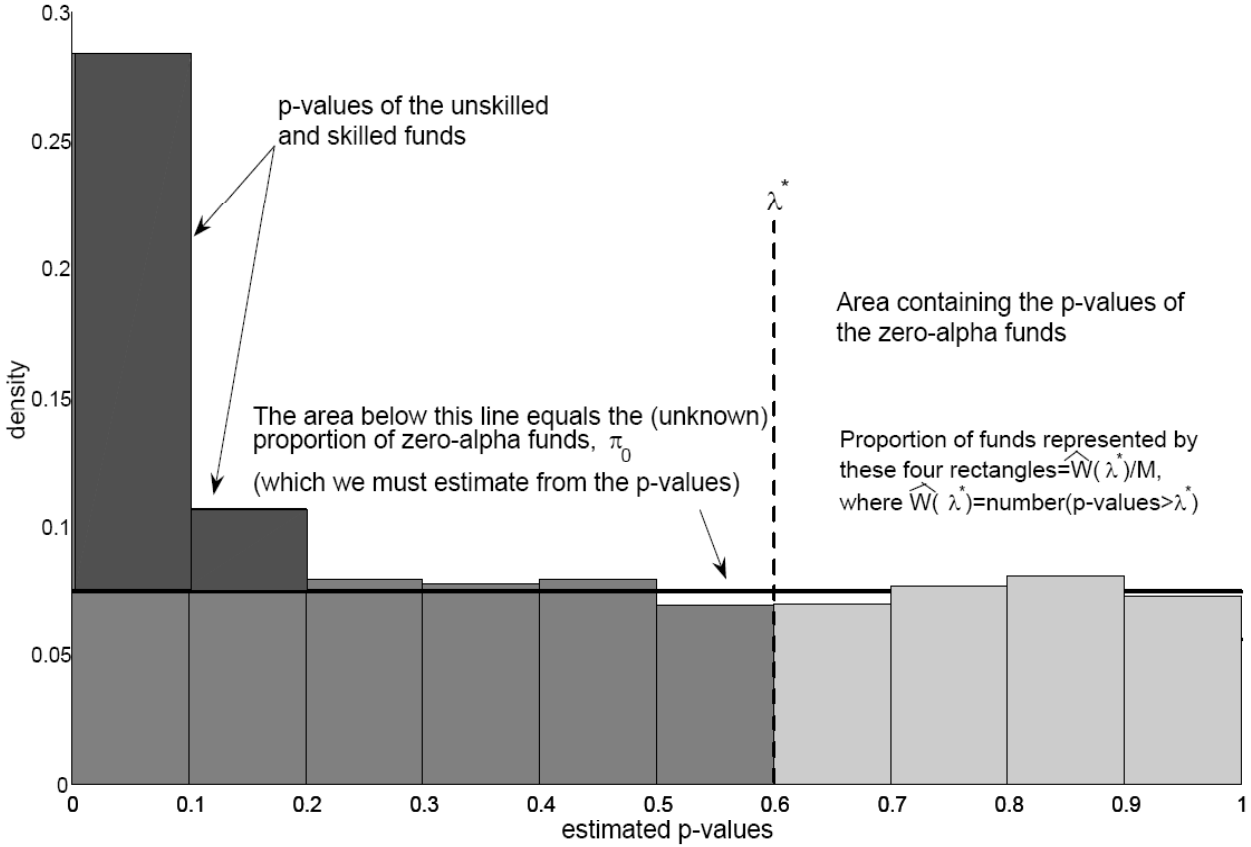
- Clearly, the key is how to measure $\hat{\pi}_0$

A New Approach: The False Discovery Rate (FDR)

- Key to the FDR approach: $\hat{\pi}_0$ is easily estimated from the distribution of individual fund *p*-values
  - Fund-by-fund regression output is used (with bootstrapped p-values for estimated alphas)
  - **Key point: Let the data estimate the proportion of zero-alpha funds, rather than making an ex-anté assumption**
    - **We examine the alphas close to zero**
    - **Use these to estimate proportion of lucky funds with high alphas**

False Discovery Rate (FDR) (Figure 2)

Histogram of 2,076 fund *p*-values



Performance Measurement & Data

- Monthly returns of U.S. open-end equity funds from CRSP between 1975 and 2006 (2,076 US D.E. funds)
  - ➢ Wermers (2000), Kosowski et al. (2006)
- Baseline asset pricing model (4-factor model):

$$r_{i,t} = \alpha_i + b_i \cdot r_{m,t} + s_i \cdot r_{smb,t} + h_i \cdot r_{hml,t} + m_i \cdot r_{mom,t} + \varepsilon_{i,t}$$

- 1,304 G // 388 AG // 384 GI funds

Summary Statistics on Performance (Table I)

Panel A Unconditional Four-Factor Model

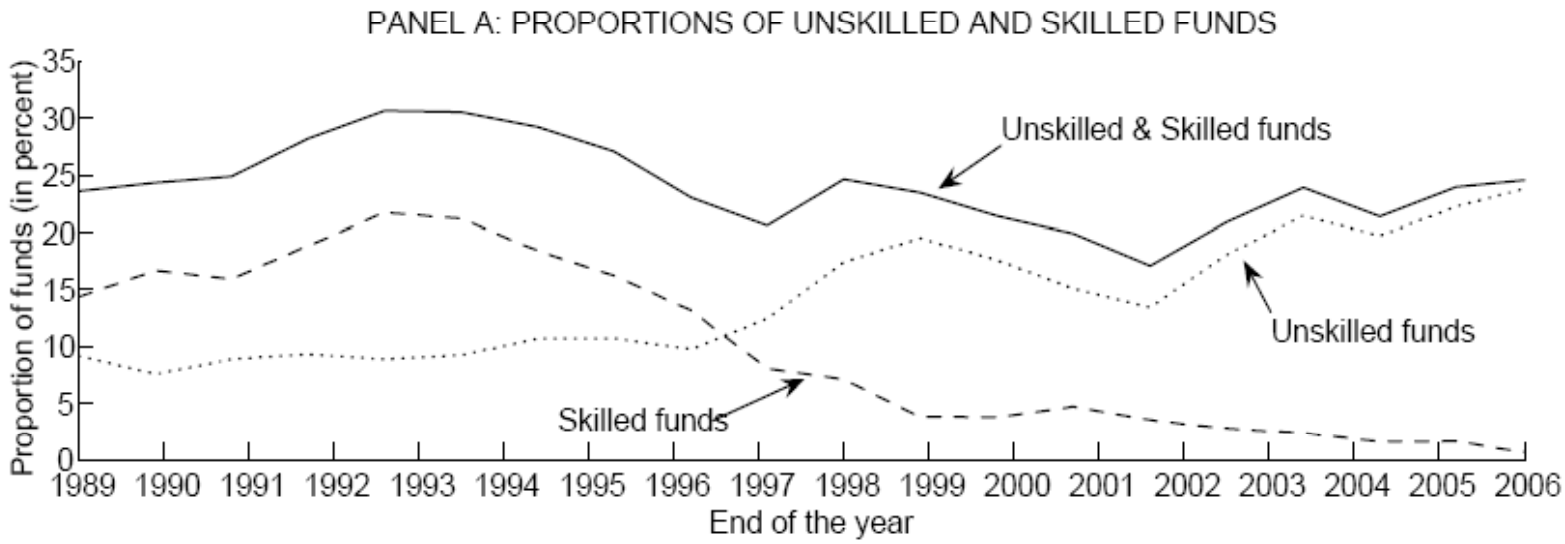
	$\widehat{\alpha}$	$\widehat{b}_m$	$\widehat{b}_{smb}$	$\widehat{b}_{hml}$	$\widehat{b}_{mom}$	R^2
All	-0.48%	0.95	0.17	-0.01	0.02	98.0%
	(0.12)	(0.00)	(0.00)	(0.38)	(0.09)	
Growth	-0.45%	0.95	0.16	-0.03	0.02	98.0%
	(0.16)	(0.00)	(0.00)	(0.15)	(0.07)	
Aggressive Growth	-0.53%	1.04	0.43	-0.17	0.09	95.8%
	(0.22)	(0.00)	(0.00)	(0.00)	(0.00)	
Growth and Income	-0.47%	0.87	-0.04	0.17	-0.03	98.2%
	(0.09)	(0.00)	(0.02)	(0.00)	(0.01)	

Empirical Results

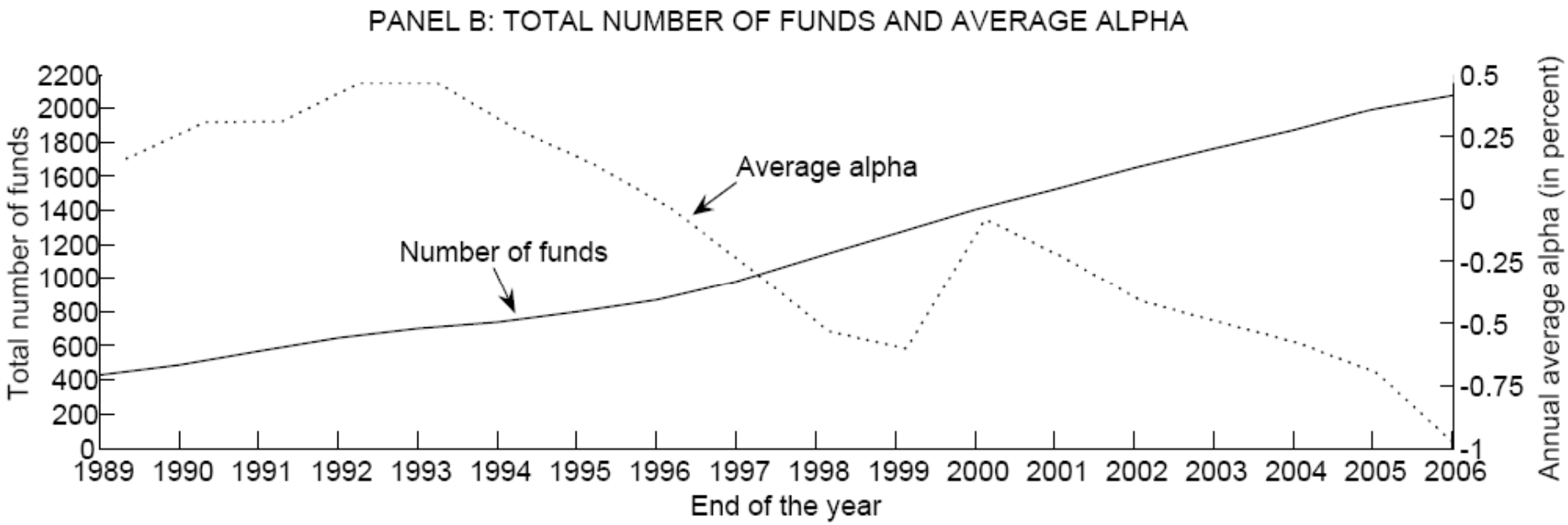
Long-Term Performance
(Table II)

	Zero alpha($\widehat{\pi}_0$)	Non-zero alpha	Unskilled($\widehat{\pi}_A^-$)	Skilled($\widehat{\pi}_A^+$)
Proportion	75.4 (2.5)	24.6	24.0 (2.3)	0.6 (0.8)
Number	1,565	511	499	12

Evolution of Performance Over Time (Figure 4)



Evolution of Performance Over Time, Continued (Figure 4)



Long-Term Performance (Table II, Continued)

Panel B Impact of Luck in the Left and Right Tails

	Left Tail				Right Tail				
Signif. level(γ)	0.05	0.10	0.15	0.20	0.20	0.15	0.10	0.05	Signif. level(γ)
Signif. $\widehat{S}_{\gamma}^{-}(\%)$	11.6	17.2	21.5	25.4	8.2	6.0	4.2	2.2	Signif. $\widehat{S}_{\gamma}^{+}(\%)$
	(0.7)	(0.8)	(0.9)	(0.9)	(0.6)	(0.5)	(0.4)	(0.3)	
Unlucky $\widehat{F}_{\gamma}^{-}(\%)$	1.9	3.8	5.6	7.6	7.6	5.6	3.8	1.9	Lucky $\widehat{F}_{\gamma}^{+}(\%)$
	(0.0)	(0.1)	(0.2)	(0.3)	(0.3)	(0.2)	(0.1)	(0.0)	
Unskilled $\widehat{T}_{\gamma}^{-}(\%)$	9.8	13.6	16.1	18.2	0.6	0.4	0.4	0.3	Skilled $\widehat{T}_{\gamma}^{+}(\%)$
	(0.7)	(0.9)	(1.0)	(1.1)	(0.7)	(0.6)	(0.5)	(0.3)	
Alpha(% year)	-5.5	-5.0	-4.7	-4.6	4.8	5.2	5.6	6.5	Alpha(% year)
Exp.(% year)	1.6	1.5	1.5	1.5	1.2	1.2	1.2	1.2	Exp.(% year)
Turn.(% year)	100	99	98	96	126	95	95	105	Turn.(% year)
Size(million \$)	81	88	86	84	731	985	888	745	Size(million \$)

The Top Funds—Skilled or Lucky?
(Lifetime Alpha of Funds Still Alive in 2008)

	alpha (%/year)	p-value
Fidelity Select Software & Computer	10.3	0.000
Sequoia Fund	5.8	0.000
PIMCO Funds:Stocks Plus/Ist	2.0	0.000
Delaware Group:American Services/A	10.2	0.002
Vanguard PRIMECAP	4.8	0.002
Growth Fund of America/A	3.4	0.002
Seligman Communications & Information/D	7.9	0.004
T Rowe Price Science & Technology Fund	6.3	0.004
Fidelity Growth Company	5.5	0.004
Fidelity Select Technology	8.3	0.012
Wells Fargo Advtg Mid Cap Disciplined/Inv	7.9	0.012
Fidelity Low Priced Stock	4.0	0.014
Hartford Mid Cap Fund/Y	5.6	0.018
Franklin Custodian Fds:Growth Series/C	9.4	0.022
Mosaic Equity Trust Investors Fund	4.1	0.022
Old Mutual Growth/Ad	9.6	0.024
Wasatch Funds:Micro Cap Fund	8.9	0.024
T Rowe Price Media & Telecommunications Fund	8.8	0.026
Fidelity Magellan	3.5	0.026
WM Northwest Fund/S	3.7	0.028
Needham Growth Fund	10.4	0.030
Columbia Acorn Select Fund/A	7.1	0.030

	alpha (%/year)	p-value
Vanguard Health Care/Admrl	6.4	0.030
Royce Select Fund/Investment	6.4	0.030
Gabelli Asset/AAA	2.6	0.030
Vanguard Morgan Growth/Admrl	1.9	0.032
Aegis Value Fund	7.6	0.034
Cambiar Opportunity/Instl	6.5	0.034
Fidelity OTC	3.9	0.034
AXP Strategist Growth Fund	3.2	0.034
Elfun Trusts Fund	1.5	0.034
Oppenheimer Discovery/C	8.5	0.036
Ameristock Mutual Fund	3.5	0.036
American Century Equity Income/Adv	3.3	0.036
Endowments Growth & Income Portfolio	4.1	0.038
Fidelity Dividend Growth	3.3	0.038
T Rowe Price Equity Income Fund	1.7	0.038
Fidelity Congress Street	3.8	0.040
Hartford Growth Opportunities Fund/M	3.7	0.042
Nuveen NWQ Multi-Cap Value Fund/R	6.2	0.044
Allianz Funds:RCM Mid Cap/Ist	3.3	0.044
Royce Heritage Fund/Service	5.6	0.046
Gartmore US Growth Leaders/C	11.4	0.048
Fidelity Select Computers	7.4	0.048

Short-Term Results
(Table III)

Panel A Proportion of Unskilled and Skilled Funds

	Zero alpha ($\widehat{\pi}_0$)	Non-zero alpha	Unskilled ($\widehat{\pi}_A^-$)	Skilled ($\widehat{\pi}_A^+$)
Proportion	72.2 (2.0)	27.8	25.4 (1.7)	2.4 (0.7)
Number	2,390	921	841	80

Panel B Impact of Luck in the Left and Right Tails

	Left Tail				Right Tail				
Signif. level (γ)	0.05	0.10	0.15	0.20	0.20	0.15	0.10	0.05	Signif. level (γ)
Signif. $\widehat{S}_\gamma^-(\%)$	11.2	16.8	21.4	24.9	9.6	7.8	5.9	3.5	Signif. $\widehat{S}_\gamma^+(\%)$
	(0.5)	(0.6)	(0.7)	(0.8)	(0.5)	(0.5)	(0.4)	(0.3)	
Unlucky $\widehat{F}_\gamma^-(\%)$	1.8	3.6	5.4	7.2	7.2	5.4	3.6	1.8	Lucky $\widehat{F}_\gamma^+(\%)$
	(0.0)	(0.0)	(0.1)	(0.2)	(0.2)	(0.1)	(0.0)	(0.0)	
Unskilled $\widehat{T}_\gamma^-(\%)$	9.4	13.2	16.0	17.7	2.4	2.4	2.3	1.7	Skilled $\widehat{T}_\gamma^+(\%)$
	(0.6)	(0.7)	(0.8)	(0.8)	(0.6)	(0.5)	(0.4)	(0.3)	
Alpha(% year)	-6.5	-5.9	-5.5	-5.3	6.7	7.0	7.2	7.5	Alpha(% year)
	(0.2)	(0.2)	(0.1)	(0.1)	(0.3)	(0.4)	(0.4)	(0.6)	
Exp.(% year)	1.4	1.3	1.3	1.3	1.2	1.2	1.2	1.2	Exp.(% year)
Turn.(% year)	98	95	94	93	80	80	81	78	Turn.(% year)

Short-Term Results, Continued (Table AIII)

Panel A Growth funds

Proportion of Unskilled and Skilled Funds

	Zero alpha ($\widehat{\pi}_0$)	Non-zero alpha	Unskilled ($\widehat{\pi}_A^-$)	Skilled ($\widehat{\pi}_A^+$)
Proportion	73.0 (2.3)	27.0	24.4(2.1)	2.6 (0.9)
Number	1,442	534	483	51

Impact of Luck in the Left and Right Tails

	Left Tail				Right Tail				
Signif. level (γ)	0.05	0.10	0.15	0.20	0.20	0.15	0.10	0.05	Signif. level (γ)
Signif. $\widehat{S}_\gamma^-(\%)$	11.3	16.6	21.4	25.2	9.9	8.1	5.9	3.5	Signif. $\widehat{S}_\gamma^+(\%)$
	(0.7)	(0.8)	(0.9)	(1.0)	(0.7)	(0.6)	(0.5)	(0.4)	
Unlucky $\widehat{F}_\gamma^-(\%)$	1.8	3.6	5.5	7.3	7.3	5.5	3.6	1.8	Lucky $\widehat{F}_\gamma^+(\%)$
	(0.0)	(0.1)	(0.2)	(0.2)	(0.2)	(0.2)	(0.1)	(0.0)	
Unskilled $\widehat{T}_\gamma^-(\%)$	9.5	13.0	15.9	17.9	2.6	2.6	2.3	1.7	Skilled $\widehat{T}_\gamma^+(\%)$
	(0.7)	(0.9)	(1.0)	(1.1)	(0.8)	(0.7)	(0.6)	(0.4)	
Alpha(% year)	-6.0	-5.6	-5.2	-5.1	6.8	6.8	6.8	7.3	Alpha(% year)
	(0.3)	(0.2)	(0.2)	(0.1)	(0.3)	(0.4)	(0.6)	(0.9)	
Exp.(% year)	1.4	1.3	1.3	1.3	1.2	1.2	1.2	1.2	Exp.(% year)
Turn.(% year)	98	96	96	97	79	79	78	79	Turn.(% year)

Short-Term Results, Continued (Table AIII)

Panel B Aggressive Growth funds

Proportion of Unskilled and Skilled Funds

	Zero alpha ($\widehat{\pi}_0$)	Non-zero alpha	Unskilled ($\widehat{\pi}_A^-$)	Skilled ($\widehat{\pi}_A^+$)
Proportion	71.8 (4.2)	28.2	24.0 (3.8)	4.2 (1.7)
Number	436	171	145	26

Impact of Luck in the Left and Right Tails

	Left Tail				Right Tail				
Signif. level (γ)	0.05	0.10	0.15	0.20	0.20	0.15	0.10	0.05	Signif. level (γ)
Signif. $\widehat{S}_\gamma^-(\%)$	12.0	16.0	19.4	22.2	11.2	9.4	7.1	4.9	Signif. $\widehat{S}_\gamma^+(\%)$
	(1.1)	(1.4)	(1.6)	(1.8)	(1.3)	(1.1)	(1.0)	(0.8)	
Unlucky $\widehat{F}_\gamma^-(\%)$	1.8	3.6	5.4	7.2	7.2	5.4	3.6	1.8	Lucky $\widehat{F}_\gamma^+(\%)$
	(0.1)	(0.2)	(0.3)	(0.4)	(0.4)	(0.3)	(0.2)	(0.1)	
Unskilled $\widehat{T}_\gamma^-(\%)$	10.2	12.4	14.0	15.0	4.0	4.0	3.5	3.1	Skilled $\widehat{T}_\gamma^+(\%)$
	(1.3)	(1.6)	(1.7)	(1.9)	(1.4)	(1.2)	(1.1)	(0.9)	
Alpha(% year)	-9.3	-8.6	-8.1	-7.6	8.5	8.8	9.7	9.7	Alpha(% year)
	(0.6)	(0.4)	(0.4)	(0.3)	(0.4)	(0.7)	(1.0)	(1.1)	
Exp.(% year)	1.5	1.5	1.5	1.5	1.4	1.3	1.3	1.3	Exp.(% year)
Turn.(% year)	116	113	111	109	105	104	107	104	Turn.(% year)

Short-Term Results, Continued (Table AIII)

Panel C Growth & Income funds

Proportion of Unskilled and Skilled Funds

	Zero alpha ($\widehat{\pi}_0$)	Non-zero alpha	Unskilled ($\widehat{\pi}_A^-$)	Skilled ($\widehat{\pi}_A^+$)
Proportion	74.1 (3.8)	25.9	25.9 (3.5)	0.0 (1.4)
Number	540	188	188	0

Impact of Luck in the Left and Right Tails

	Left Tail				Right Tail				
Signif. level (γ)	0.05	0.10	0.15	0.20	0.20	0.15	0.10	0.05	Signif. level (γ)
Signif. $\widehat{S}_\gamma^-(\%)$	11.6	17.4	22.5	26.8	7.3	5.5	3.7	1.8	Signif. $\widehat{S}_\gamma^+(\%)$
	(1.1)	(1.4)	(1.5)	(1.6)	(1.0)	(0.8)	(0.7)	(0.5)	
Unlucky $\widehat{F}_\gamma^-(\%)$	1.8	3.7	5.5	7.3	7.3	5.5	3.7	1.8	Lucky $\widehat{F}_\gamma^+(\%)$
	(0.1)	(0.2)	(0.3)	(0.4)	(0.4)	(0.3)	(0.2)	(0.1)	
Unskilled $\widehat{T}_\gamma^-(\%)$	9.8	13.7	17.0	19.5	0.0	0.0	0.0	0.0	Skilled $\widehat{T}_\gamma^+(\%)$
	(1.2)	(1.5)	(1.7)	(1.8)	(1.1)	(0.9)	(0.8)	(0.5)	
Alpha(% year)	-4.9	-4.5	-4.2	-4.0	4.9	5.3	5.1	4.9	Alpha(% year)
	(0.3)	(0.2)	(0.2)	(0.1)	(0.5)	(0.6)	(0.8)	(1.3)	
Exp.(% year)	1.3	1.2	1.2	1.2	1.1	1.1	1.0	0.9	Exp.(% year)
Turn.(% year)	69	69	67	64	59	59	54	45	Turn.(% year)

Performance and Fund Characteristics (Table IV)

Panel A Size (TNA)

Quintile	Low	2	3	4	High	High-Low
Zero-alpha ($\widehat{\pi}_0$)	81.0 (3.5)	72.2 (4.0)	77.7 (3.8)	64.2 (4.2)	62.1 (4.2)	-18.9
Unskilled ($\widehat{\pi}_A^-$)	16.4 (3.1)	23.1 (3.7)	22.3 (3.5)	33.5 (3.9)	34.3 (3.9)	+17.9
Skilled ($\widehat{\pi}_A^+$)	2.6 (1.6)	4.6 (1.7)	0.0 (1.5)	2.3 (1.5)	3.6 (1.6)	+1.0
Median Size (million $)	9.8	52.9	166.0	453.1	1,651.7	+1,641.9
Avg. $\widehat{\alpha}$ (% year)	-0.53	-0.60	-1.11	-1.14	-0.94	-0.41

Panel B Age

Quintile	Low	2	3	4	High	High-Low
Zero-alpha ($\widehat{\pi}_0$)	79.6 (3.5)	65.0 (4.2)	72.5 (3.7)	70.2 (4.0)	70.1 (4.2)	-9.5
Unskilled ($\widehat{\pi}_A^-$)	16.5 (3.0)	29.8 (3.9)	25.5 (3.4)	26.7 (3.6)	29.9 (4.0)	+13.4
Skilled ($\widehat{\pi}_A^+$)	3.9 (1.7)	5.2 (1.6)	2.0 (1.5)	3.1 (1.5)	0.0 (1.3)	-3.9
Avg. Age (year)	2.1	5.2	8.6	15.5	37.8	+35.7
Avg. $\widehat{\alpha}$ (% year)	-0.34	-0.84	-0.95	-0.65	-1.41	-1.07

Performance and Fund Characteristics, Continued (Table IV)

Panel C Annual Flow–Past Performance

Quintile	Low	2	3	4	High	High-Low
Zero-alpha ($\widehat{\pi}_0$)	52.9 (4.0)	73.5 (3.8)	84.0 (2.7)	71.0 (3.8)	78.6 (3.5)	+25.7
Unskilled ($\widehat{\pi}_A^-$)	47.1 (3.8)	26.5 (3.5)	16.0 (2.4)	22.5 (3.5)	3.4 (1.6)	-43.7
Skilled ($\widehat{\pi}_A^+$)	0.0 (1.2)	0.0 (1.2)	0.0 (1.3)	6.5 (1.8)	18.0 (3.0)	+18.0
Avg. Flow (% year)	-26.8	-11.0	-3.2	7.5	67.5	+94.3
Avg. $\widehat{\alpha}$ (% year)	-2.83	-1.72	-0.93	0.08	1.20	+4.03

Panel D Annual Flow–Future Performance

Quintile	Low	2	3	4	High	High-Low
Zero-alpha ($\widehat{\pi}_0$)	69.9 (4.6)	59.7 (4.4)	70.6 (3.6)	73.8 (4.3)	80.6 (2.9)	+10.7
Unskilled ($\widehat{\pi}_A^-$)	27.0 (4.2)	37.5 (4.0)	26.8 (3.3)	25.7 (3.5)	17.0 (2.5)	-10.0
Skilled ($\widehat{\pi}_A^+$)	3.1 (1.7)	2.7 (1.6)	2.6 (1.6)	0.5 (1.5)	2.4 (1.7)	-0.7
Avg. Flow (% year)	-23.2	-7.1	3.0	24.0	205.3	+228.5
Avg. $\widehat{\alpha}$ (% year)	-0.88	-1.38	-0.96	-0.95	-0.73	+0.15

Long-Term Performance (Pre-Expense) (Table VI)

Panel A Proportion of Unskilled and Skilled Funds

	Zero alpha ($\widehat{\pi}_0$)	Non-zero alpha	Unskilled ($\widehat{\pi}_A^-$)	Skilled ($\widehat{\pi}_A^+$)
Proportion	85.9 (2.7)	14.1	4.5 (1.0)	9.6 (1.5)
Number	1,577	259	176	83

Panel B Impact of Luck in the Left and Right Tails

	Left Tail				Right Tail				
Signif. level (γ)	0.05	0.10	0.15	0.20	0.20	0.15	0.10	0.05	Signif. level (γ)
Signif. $\widehat{S}_\gamma^-(\%)$	4.3	7.5	10.2	12.8	17.3	13.1	9.3	5.8	Signif. $\widehat{S}_\gamma^+(\%)$
	(0.5)	(0.6)	(0.7)	(0.8)	(0.9)	(0.8)	(0.7)	(0.5)	
Unlucky $\widehat{F}_\gamma^-(\%)$	2.1	4.3	6.4	8.6	8.6	6.4	4.3	2.1	Lucky $\widehat{F}_\gamma^+(\%)$
	(0.0)	(0.1)	(0.1)	(0.2)	(0.2)	(0.1)	(0.1)	(0.0)	
Unskilled $\widehat{T}_\gamma^-(\%)$	2.2	3.2	3.8	4.2	8.7	6.6	5.0	3.6	Skilled $\widehat{T}_\gamma^+(\%)$
	(0.5)	(0.6)	(0.8)	(0.9)	(1.0)	(0.9)	(0.7)	(0.5)	
Pre Expense									Pre Expense
Alpha(% year)	-5.9	-5.2	-4.8	-4.5	4.4	4.8	5.0	5.3	Alpha(% year)
	(0.5)	(0.3)	(0.2)	(0.2)	(0.2)	(0.2)	(0.3)	(0.4)	
Exp.(% year)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2	Exp.(% year)
Turn.(% year)	105	107	108	108	90	89	91	84	Turn.(% year)

Performance Persistence (Table V)

Panel A Portfolio Statistics

	Achieved False Discovery Rate $\left(\widehat{FDR}^{+}_{\gamma^P}\right)$					Included proportion of funds $(\widehat{S}^{+}_{\gamma^P})$				
	Mean	10-30	30-50	50-70	>70%	Mean	0-6	6-12	12-24	>24%
$FDR10\%$	41.5%	14	6	1	6	3.0%	25	2	0	0
$FDR30\%$	47.5%	8	12	1	6	8.2%	15	7	3	2
$FDR50\%$	60.4%	0	14	7	6	20.9%	5	7	4	11
$FDR70\%$	71.3%	0	4	12	11	29.7%	1	5	5	16
$FDR90\%$	75.0%	0	4	9	14	33.7%	0	3	4	20

Panel B Performance Analysis

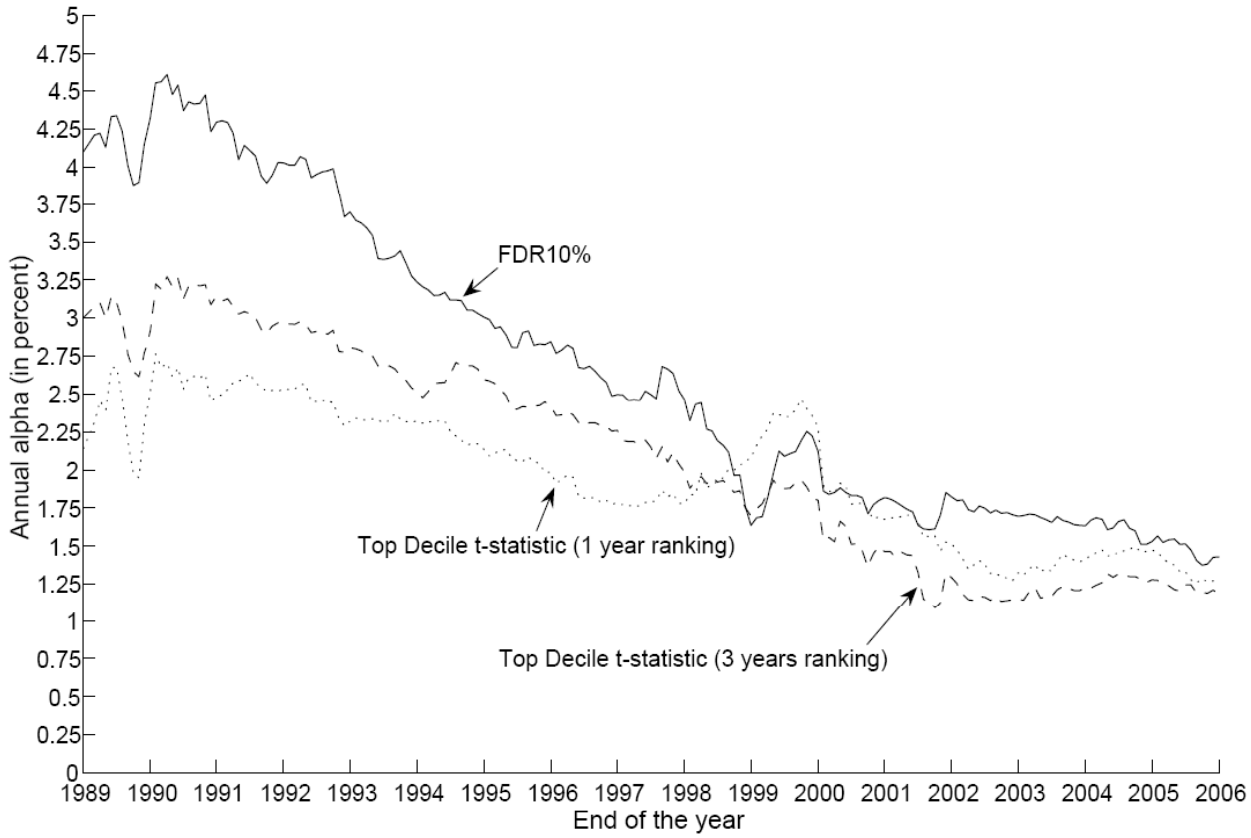
	$\widehat{\alpha}(p\text{-value})$	$\widehat{\sigma}_{\varepsilon}$	IR	$\widehat{b}_m$	$\widehat{b}_{smb}$	$\widehat{b}_{hml}$	$\widehat{b}_{mom}$	Mean	Std dev
$FDR10\%$	1.45%(0.04)	4.0%	0.36	0.93	0.16	-0.04	-0.02	8.3%	15.4%
$FDR30\%$	1.15%(0.05)	3.3%	0.35	0.94	0.17	-0.02	-0.03	8.1%	15.4%
$FDR50\%$	0.95%(0.10)	2.9%	0.33	0.96	0.20	-0.06	-0.01	8.1%	16.1%
$FDR70\%$	0.68%(0.15)	2.7%	0.25	0.97	0.19	-0.06	-0.01	7.9%	16.1%
$FDR90\%$	0.39%(0.30)	2.7%	0.14	0.97	0.19	-0.05	-0.00	7.8%	16.0%

Performance Persistence, Continued (Table V)

Panel C Portfolio Turnover

	Proportion of funds				
	After 1 year	After 2 years	After 3 years	After 4 years	After 5 years
$FDR10\%$	36.7	12.8	3.4	0.8	0.0
$FDR30\%$	40.0	14.7	5.1	1.7	1.3
$FDR50\%$	48.8	23.5	12.3	4.7	2.6
$FDR70\%$	52.2	29.0	17.4	9.5	6.3
$FDR90\%$	55.9	33.8	20.4	13.0	8.5

Performance Persistence Over Time (Figure V)



Economic Interpretations

- Quantitative assessment of the predictions of the Berk and Green model (2004)
  - In rational markets, the alphas of open-end funds are equal to zero
  - 75% of our sample are zero-alpha funds!
- Average negative alphas documented in the previous literature is caused by a minority of funds
  - 24% of our sample are unskilled (truly negative alpha) funds
- Large # of new funds do not add to the skilled pool!
  - Almost no skilled (truly positive alpha) funds in our sample, at least after expenses
- Expense ratios appear to be too high in the industry, relative to the skills of managers (especially during the past 10 years!)

Contributions & Results

Answer to Question 1: Impact of Luck on Performance?

- Luck has a stronger impact on the right tail of the estimated alpha distribution

Answer to Question 2: Location of Funds with Differential Performance?

- Skilled funds are in extreme right tail, while unskilled funds are spread throughout left tail

Answer to Question 3: Performance over time?

- Proportion of truly skilled fund managers has decreased substantially!

Conclusions

- The FDR is a simple tool which allows to correctly measure the number of funds with truly positive and negative performance
- The FDR is flexible:
  - ➢ It can be applied to different performance measures
  - ➢ It can be applied to the hedge fund industry
- The FDR has wide application: it can be used every time a test is run a large number of times
  - ➢ Test of predictability
  - ➢ Performance of technical trading rules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