Asset Similarity, CO2 Emissions, and Mutual Fund Performance

Rocco Ciciretti[1], Ambrogio Dalò[2], and Giovanni Walter Puopolo[3]

[1]DEF, and CEIS - University of Rome Tor Vergata
and RCEA - Rimini

[2]Department of Economics, Econometrics & Finance
University of Groningen

[3]DiSES, and CSEF - University of Naples Federico II

17 November - Settimana SRI 2023

Table of Contents

Era il 2012

COMPARATIVE RETURNS Page 1/19

Range 4/30/90 - 12/30/11 Period M Monthly 260 Mo. Period

	Securities	Crncy	Prc Appr	Total Ret	Difference	Annual Eq
1	TKLD400U Index	USD	578.08 %	578.08 %*	77.47 %	9.23 %
2	SPX Index	USD	280.17 %	500.61 %		8.62 %
3						

(* = No dividends or coupons)

Mutual funds: Stylized facts

Delegated portfolio management industry plays a crucial role in financial markets. According to the Investment Company Institute, in fact, at year-end 2021:

- Total worldwide assets invested in regulated open-end funds reached 71.1 trillion of US dollars. US open-end funds (8,887 mutual funds and 2,690 ETFs) account for 48.1% of such wealth;
- In particular, the US mutual fund industry remained the largest in the world with 27 trillion in total net assets (vs. 150 billion at the end of '80s);
- Almost 45% of US households invested in mutual funds (only 5% in 1980), with an aggregate investment of over 23 trillion dollars;
- Equity mutual funds represented 55% of the overall US mutual funds industry, and about 90% of them were actively managed.

Motivation: Average performance and Tails

Despite its importance, the added value of active investment management remains a long-standing controversy:

- There is a broad consensus that, on average, open end equity mutual funds do not outperform the stock market (Fama and French, 2010, Carhart, 1997, Ippolito, 1989, and Sharpe, 1991);

- However, actively managed open end equity mutual funds exhibit a considerable cross-sectional variation, with only a few able to generate positive risk-adjusted returns. In particular, successful funds exhibit different investment characteristics/behaviors:

  concentrate their portfolios in industries where they have informational advantages (Kacperczyk, Sialm, and Zheng, 2005); **rely less on public information** (Kacperczyk and Seru, 2007); **focus on stock picking and market timing strategies** according to the state of the economy (Kacperczyk, Nieuwerburgh, and Veldkamp, 2014); **trade more** (Daniel, Grinblatt, Titman, and Wermers, 1997; Chen, Jegadeesh, and Wermers, 2000; Pástor, Stambaugh, and Taylor, 2017); **have less wealth to manage** (Chen, Hong, Huang, and Kubik, 2004); **deviate more from benchmark portfolios** (Cremers and Petajisto, 2009) and **from the decisions of their precedessors** (Jiang and Verardo, 2018).

Our Contribution I

- In this paper we investigate the cross-sectional distribution of skill (risk-adjusted returns) among actively managed open end equity mutual funds.

  We uncover a novel investment characteristic of successful funds based on the degree to which fund holdings do not overlap with the holdings of other funds (**asset similarity**).

- Our estimates reveal a large degree of heterogeneity in asset similarity across funds, with some funds exhibiting a tendency to follow the crowd while others show a propensity to hold 'unique' portfolios.

  We find that differences in asset similarity across funds *predict* mutual fund extra performance both at portfolio and fund levels:

  1. Funds with low similarity exhibit positive risk-adjusted gross returns of roughly 1.3% per year. By contrast, high-similarity funds do not exhibit any significant extra performance;
  2. In multivariate predictive regressions, asset similarity can predict four-factor alphas after controlling for funds characteristics (such as fund size, age, turnover, expense ratios, flows) and holdings characteristics (such as market cap, growth opportunities, momentum, investment and profitability);
  3. The negative relation between the fund performance and its degree of similarity is persistent over time, with risk-adjusted returns that are large and significant over horizons of up to one year after the measurement of fund similarity. This result suggests that the link between asset similarity and future performance is not due to chance.

Our Contribution II

- In addiction to predictability of mutual fund extra performance, we test whether low-similarity funds consistently make better investment decisions than high-similarity funds. Our results indicate that the former systematically increase(decrease) their exposure in undervalued(overvalued) stocks, that is they exhibit higher (*chasing alpha*) ability;
- Finally, we also investigate how changes in *fund management structure* affect fund similarity. Specifically, our guess is that fund similarity depends on new management hires and leaves, according to the specific characteristics of the incoming manager's fund.

All results are robust to several asset pricing models, and other investment characteristics (such as herding behavior, and industry concentration).

Data Sources

- Time Horizon: monthly observations from 12/2005 to 06/2018 (151 months, 51 quarters) [We already have data up to July 2023];
- Unique Open-End Equity Mutual Funds: $1,678$ (Morningstar - DIRECT);
- Unique Holdings: $7,037$ (Morningstar - EDW);
- CRSP/COMPUSTAT:

  Price and Dividend; Market Value of Equity; Book Value of Equity; Total Assets; Net Sales or Revenues; Selling General and Administrative Expenses; Interest Expense on Debt; and Cost of Goods Sold. These variables are used to create size (ME), book-to-market (BtM), Investment (Inv), Operating Profitability (OP), and momentum characteristics (Ret_{-11}) following Fama and French (2012, 2017) procedures.

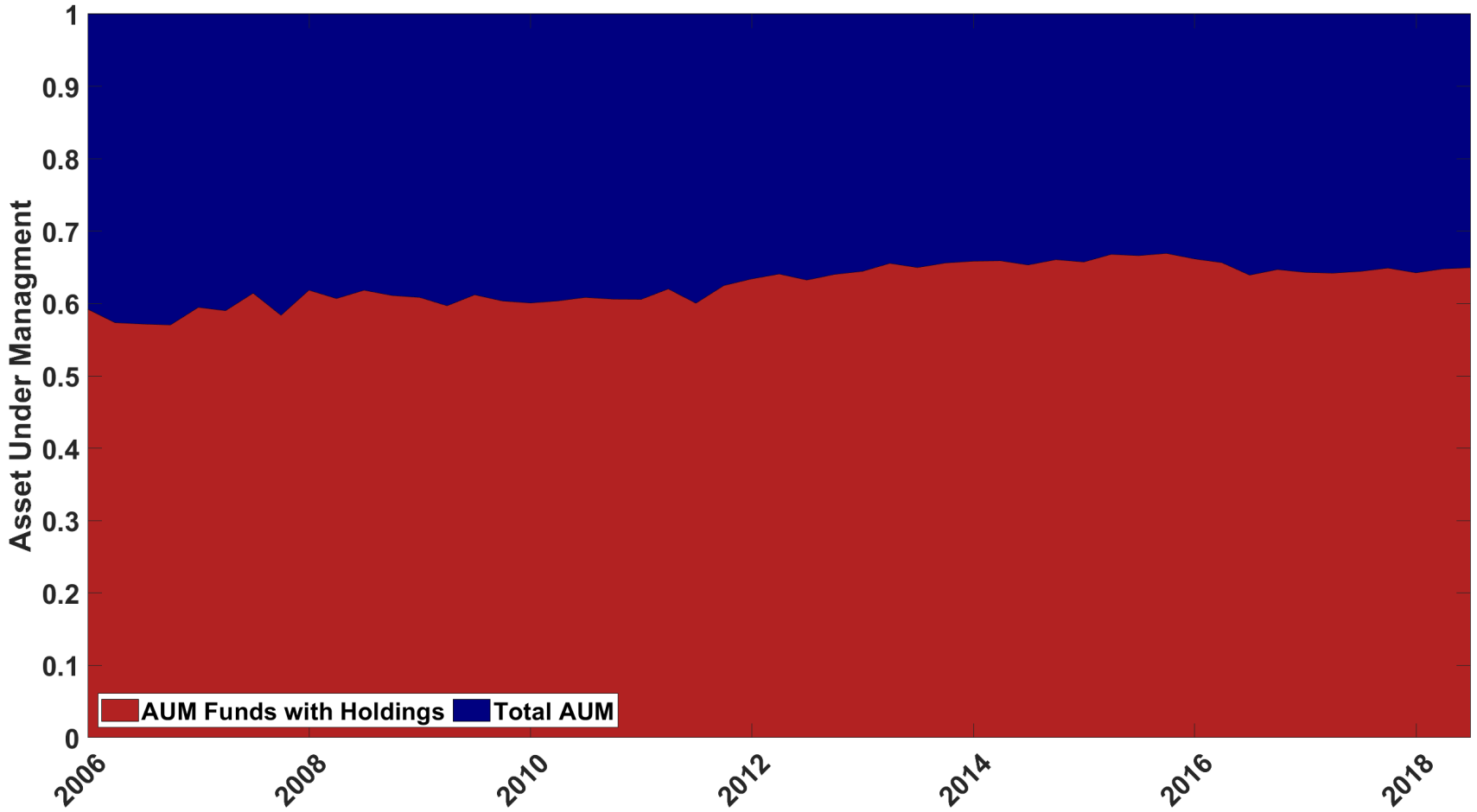
- Refinitiv:

  Scope 1 and Scope 2 emissions used to compute the total Green House Gasses (GHG) emission (with 669 unique holdings of $7,037$). The environmental score (E, with $2,084$ unique holdings of $7,037$).

- North American Risk-Factors: Fama-French Website (Fama and French, 2012, 2017)

  Market Excess Return (R^e_m); Small minus Big (SMB); High minus Low (HML); Momentum (MoM); Robust minus Weak (RML); and Conservative Minus Aggressive (CMA).

Market Coverage



Asset Similarity: Cosine Similarity Measure

We measure the portfolio overlap between two funds using cosine similarity at the issuer level. Specifically, the cosine similarity between the portfolios of fund i and j at quarter-end t is the dot product of the pair's portfolio weight vectors normalized by the vectors' lengths, that is:

$$Similarity_{i,j,t} = \frac{W_{i,t} \cdot W_{j,t}}{||W_{i,t}|| \cdot ||W_{j,t}||} \tag{1}$$

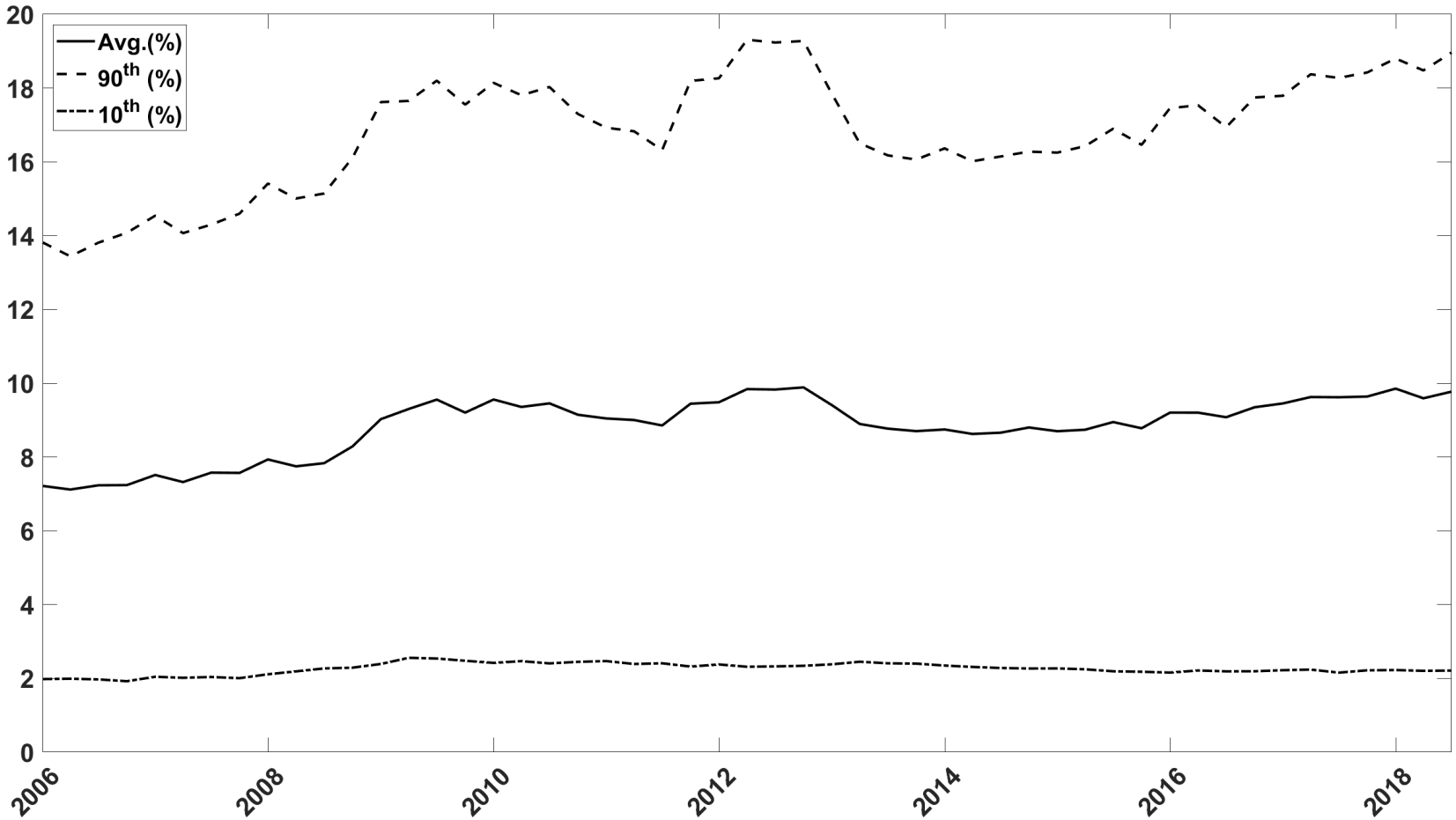
where $W_{i,t}$ and $W_{i,t}$ are funds i and j vector of weights at quarter-end t, respectively.

Because all portfolio weight vectors have non-negative elements, cosine similarity is bounded in the interval [0,1]. Precisely:

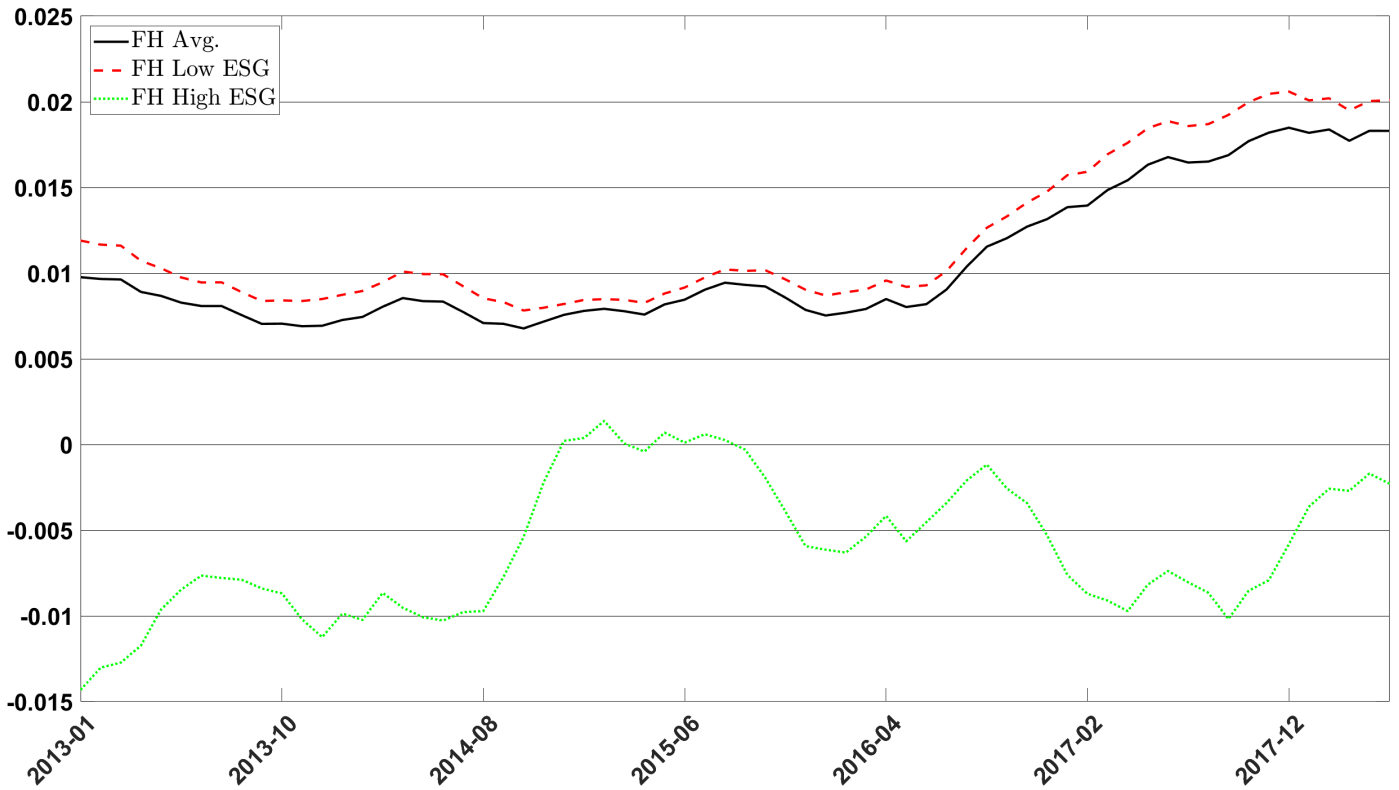
- $Similarity_{i,j,t} = 0$ if the portfolios of funds i and j are completely different;
- $Similarity_{i,j,t} = 1$ if the portfolios of funds i and j are exactly the same,

as Girardi et al. (2021) in the case of the insurance market, and Sias et al. (2016) in the case of hedge funds.

Asset Similarity



Fund Hearding...from SRI 2020



Summary Statistics

Our Summary statistics confirm those of Jiang and Verardo (2018)

	Mean	Std.Dev.	10^{th} Pctl	50^{th} Pctl	90^{th} Pctl	$N.of Obs$
Gross Returns (%)	2.58	8.66	-9.01	3.64	12.11	69128
Fund Size (mln)	1645.17	6327.99	29.68	324.40	3327.33	76489
Flow (%)	2.64	18.89	-13.06	0.99	17.10	77194
Expense (%)	1.34	0.50	0.82	1.30	1.85	18836
Turnover (%)	79.29	261.35	14.00	53.00	150.00	17682
Fund Age (years)	9.76	9.37	1.25	7.75	19.25	158331

▸ Holding-Level Summary Statistics

▸ Variables Definition

Determinants of Fund Similarity

	(1)	(2)	(3)	(4)
$Log(Fund\ Size)$	0.000	0.000	-0.001	-0.001
	(0.002)	(0.002)	(0.001)	(0.001)
$Log(Fund\ Age)$	0.001	0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.001)	(0.001)
$Expense$	-0.001	-0.001	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
$Flow$	0.001***	0.001***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
$Turnover$	-0.002***	-0.002***	-0.000	-0.001
	(0.000)	(0.001)	(0.000)	(0.000)
ICI		-0.012***	-0.007***	-0.007***
		(0.002)	(0.002)	(0.002)
FH		0.001***	0.000	0.000
		(0.000)	(0.000)	(0.000)
ME			0.063***	0.060***
			(0.005)	(0.005)
BtM			0.001*	0.001
			(0.001)	(0.001)
INV			0.000*	0.000*
			(0.000)	(0.000)
OP			-0.000	-0.000
			(0.000)	(0.000)
Ret_{-11}			0.002***	0.002***
			(0.000)	(0.000)
$Log(GHG)$				0.003***
				(0.001)
$Constant$	0.085***	0.088***	0.080***	0.081***
	(0.003)	(0.003)	(0.002)	(0.002)
$N.of\,Obs$	110850.000	105510.000	92916.000	92916.000
R^2_{Adj}	0.030	0.062	0.726	0.732

Additional Summary Statistics on Similarity-based portfolios

	Low	2	3	4	5	6	7	8	9	*High*
Similarity	1.30	2.35	3.22	4.53	6.76	9.70	12.49	15.03	17.57	21.79
Fund Size	484.30	886.25	1265.48	1569.49	1473.38	1485.61	1680.37	2764.94	4420.11	2603.78
Flow	1.74	2.35	2.44	2.52	2.73	3.48	3.00	2.26	2.08	2.03
Expense	1.53	1.43	1.35	1.31	1.36	1.36	1.33	1.29	1.23	1.17
Turnover	62.84	73.20	84.15	85.05	95.30	82.88	70.29	69.69	67.65	93.77
Fund Age	10.87	9.03	8.70	9.38	10.73	11.06	10.91	9.46	10.15	9.34
log(GHG)	14.72	15.32	15.39	15.42	15.41	15.44	15.45	15.45	15.44	15.42
Avg. Gross Returns (%)	0.92	0.93	0.91	0.89	0.86	0.81	0.81	0.80	0.81	0.80
Std. Gross Returns (%)	4.98	4.83	4.66	4.52	4.37	4.24	4.16	4.14	4.15	4.10
Sharpe Ratio	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.20	0.20	0.19
N. of Months	151	151	151	151	151	151	151	151	151	151

▸ Holding-Level Summary Similarity Portfolios

Predictability: Asset Similarity and Performance across portfolios

	Low	2	3	4	5	6	7	8	9	*High*	*L−H*
						Gross Returns					
FF $\hat{\alpha}$	0.121***	0.111**	0.096**	0.077*	0.039	0.006	0.013	0.004	0.013	0.016	0.105**
	(0.044)	(0.042)	(0.042)	(0.046)	(0.043)	(0.036)	(0.031)	(0.028)	(0.037)	(0.029)	(0.052)
Carhart $\hat{\alpha}$	0.124***	0.11**	0.093**	0.076*	0.041	0.007	0.014	0.003	0.012	0.014	0.11**
	(0.043)	(0.041)	(0.042)	(0.046)	(0.043)	(0.037)	(0.031)	(0.028)	(0.037)	(0.029)	(0.05)
FF5 $\hat{\alpha}$	0.122***	0.105**	0.095**	0.079*	0.066	0.026	0.026	0.001	0.015	0.007	0.116**
	(0.043)	(0.042)	(0.044)	(0.048)	(0.041)	(0.036)	(0.032)	(0.03)	(0.039)	(0.03)	(0.052)
FFL $\hat{\alpha}$	0.124***	0.107**	0.094**	0.079*	0.043	0.011	0.014	0.003	0.008	0.012	0.112**
	(0.043)	(0.042)	(0.042)	(0.046)	(0.042)	(0.036)	(0.031)	(0.029)	(0.036)	(0.028)	(0.051)
N. of Months	151	151	151	151	151	151	151	151	151	151	151
						Net Returns					
FF $\hat{\alpha}$	-0.006	-0.007	-0.016	-0.032	-0.073*	-0.107***	-0.097***	-0.103***	-0.089**	-0.081**	0.075
	(0.044)	(0.042)	(0.042)	(0.046)	(0.043)	(0.036)	(0.031)	(0.028)	(0.037)	(0.029)	(0.052)
Carhart $\hat{\alpha}$	-0.003	-0.009	-0.019	-0.033	-0.071*	-0.106***	-0.096***	-0.104***	-0.09**	-0.083***	0.08*
	(0.043)	(0.041)	(0.042)	(0.046)	(0.043)	(0.037)	(0.031)	(0.028)	(0.037)	(0.029)	(0.05)
FF5 $\hat{\alpha}$	-0.004	-0.014	-0.016	-0.03	-0.046	-0.087**	-0.084**	-0.106***	-0.087**	-0.09***	0.086*
	(0.043)	(0.042)	(0.044)	(0.047)	(0.041)	(0.036)	(0.032)	(0.03)	(0.039)	(0.03)	(0.052)
FFL $\hat{\alpha}$	-0.003	-0.011	-0.018	-0.029	-0.069*	-0.103***	-0.096***	-0.104***	-0.094**	-0.086***	0.082*
	(0.043)	(0.042)	(0.042)	(0.046)	(0.042)	(0.036)	(0.031)	(0.029)	(0.036)	(0.028)	(0.051)
N. of Months	151	151	151	151	151	151	151	151	151	151	151

Conclusions

- In this paper we investigate the cross-sectional distribution of risk-adjusted returns among actively managed open end equity mutual funds;
- We uncover a novel investment characteristic of successful managers based on the degree to which the fund holdings do not overlap with the holdings of other funds (**asset similarity**):
  - Specifically, we find that differences in asset similarity across funds *predict* mutual fund extra performance: funds with low similarity exhibit a positive risk-adjusted performance which persists over time;
  - The ability of low similarity funds to beat the market strongly depends on their ability to buy(sell) undervalued(overvalued) stocks consistently (*Chasing Alpha*);
- (Our guess is that...) changes in *fund management structure* affect fund similarity.

Conclusions

Thank you for Your Attention!

References I

Barber B. M., Huang X., and Odean T. Which factors matter to investors? evidence from mutual fund flows. *The Review of Financial Studies*, 29(10):2600–2642, 2016.

Berk J. B. and Van Binsbergen J. H. Measuring skill in the mutual fund industry. *Journal of financial economics*, 118(1):1–20, 2015.

Carhart M. On persistence in mutual fund performance. *Journal of Finance*, 52(1):57–82, 1997.

Chen H.-L., Jegadeesh N., and Wermers R. The value of active mutual fund management: An examination of the stockholdings and trades of fund managers. *Journal of Financial and Quantitative Analysis*, 35(3):343–368, 2000.

Chen J., Hong H., Huang M., and Kubik J. D. Does fund size erode mutual fund performance? the role of liquidity and organization. *American Economic Review*, 94(5):1276–1302, 2004.

Christopherson J. A., Ferson W. E., and Glassman D. A. Conditioning manager alphas on economic information: Another look at the persistence of performance. *The Review of Financial Studies*, 11(1):111–142, 1998.

Cohen R. B., Coval J. D., and Pástor L. Judging fund managers by the company they keep. *The Journal of Finance*, 60(3):1057–1096, 2005.

Cremers K. M. and Petajisto A. How active is your fund manager? a new measure that predicts performance. *The Review of Financial Studies*, 22(9):3329–3365, 2009.

Dahlquist M., Engström S., and Söderlind P. Performance and characteristics of swedish mutual funds. *Journal of Financial and Quantitative Analysis*, 35(3):409–423, 2000.

References II

Daniel K., Grinblatt M., Titman S., and Wermers R. Measuring mutual fund performance with characteristic-based benchmarks. *The Journal of Finance*, 52(3):1035–1058, 1997.

Edelen R. M., Evans R. B., and Kadlec G. B. Scale effects in mutual fund performance: The role of trading costs. *Available at SSRN 951367*, 2007.

Fama E. and French K. Size, value, and momentum in international stock returns. *Journal of Financial Economics*, 105(3):457–472, 2012.

Fama E. and French K. International tests of a five-factor asset pricing model. *Journal of Financial Economics*, 123(3):441–463, 2017.

Fama E. F. and French K. R. Luck versus skill in the cross-section of mutual fund returns. *The Journal of Finance*, 65(5):1915–1947, 2010.

Ferson W. E. and Schadt R. W. Measuring fund strategy and performance in changing economic conditions. *The Journal of Finance*, 51(2):425–461, 1996.

Frank M. M., Poterba J. M., Shackelford D. A., and Shoven J. B. Copycat funds: Information disclosure regulation and the returns to active management in the mutual fund industry. *The Journal of Law and Economics*, 47(2):515–541, 2004.

Girardi G., Hanley K. W., Nikolova S., Pelizzon L., and Sherman M. G. Portfolio similarity and asset liquidation in the insurance industry. *Journal of Financial Economics*, 142(1):69–96, 2021.

Grinblatt M. and Titman S. Mutual fund performance: An analysis of quarterly portfolio holdings. *Journal of Business*, pages 393–416, 1989.

References III

Grinblatt M. and Titman S. Performance measurement without benchmarks: An examination of mutual fund returns. *Journal of Business*, pages 47–68, 1993.

Grinblatt M., Titman S., and Wermers R. Momentum investment strategies, portfolio performance, and herding: A study of mutual fund behavior. *The American Economic Review*, pages 1088–1105, 1995.

Ippolito R. A. Efficiency with costly information: A study of mutual fund performance, 1965–1984. *The Quarterly Journal of Economics*, 104(1):1–23, 1989.

Jiang H. and Verardo M. Does herding behavior reveal skill? an analysis of mutual fund performance. *The Journal of Finance*, 73(5):2229–2269, 2018.

Kacperczyk M., Nieuwerburgh S. V., and Veldkamp L. Time-varying fund manager skill. *The Journal of Finance*, 69(4):1455–1484, 2014.

Kacperczyk M. and Seru A. Fund manager use of public information: New evidence on managerial skills. *The Journal of Finance*, 62(2):485–528, 2007.

Kacperczyk M., Sialm C., and Zheng L. On the industry concentration of actively managed equity mutual funds. *The Journal of Finance*, 60(4):1983–2011, 2005.

Moskowitz T. J. Mutual fund performance: An empirical decomposition into stock-picking talent, style, transactions costs, and expenses: Discussion. *The Journal of Finance*, 55(4): 1695–1703, 2000.

Pástor L., Stambaugh R. F., and Taylor L. A. Do funds make more when they trade more? *The Journal of Finance*, 72(4):1483–1528, 2017.

References IV

Sharpe W. F. The arithmetic of active management. *Financial Analysts Journal*, 47(1):7–9, 1991.

Sias R., Turtle H. J., and Zykaj B. Hedge fund crowds and mispricing. *Management Science*, 62 (3):764–784, 2016.

Wermers R. Mutual fund performance: An empirical decomposition into stock-picking talent, style, transactions costs, and expenses. *The Journal of Finance*, 55(4):1655–1695, 2000.

Related Literature

- Mutual funds performance: Grinblatt and Titman (1993, 1989), Grinblatt, Titman, and Wermers (1995), Daniel, Grinblatt, Titman, and Wermers (1997), Wermers (2000), Frank, Poterba, Shackelford, and Shoven (2004), Kacperczyk, Sialm, and Zheng (2005),
- Mutual funds manager's skills: Cohen, Coval, and Pástor (2005), Kacperczyk, Nieuwerburgh, and Veldkamp (2014), Berk and Van Binsbergen (2015), Barber, Huang, and Odean (2016), Jiang and Verardo (2018)
- Fund performance and the business cycle: Ferson and Schadt (1996), Christopherson, Ferson, and Glassman (1998), and Moskowitz (2000).
- Fund turnover and performance: Wermers (2000), Kacperczyk, Sialm, and Zheng (2005), and Edelen, Evans, and Kadlec (2007) find no significant relation, Carhart (1997) find a negative relation and Dahlquist, Engström, and Söderlind (2000), Chen, Jegadeesh, and Wermers (2000) and Pástor, Stambaugh, and Taylor (2017) find a positive relation.
- Asset-similarity: Girardi, Hanley, Nikolova, Pelizzon, and Sherman (2021), Sias, Turtle, and Zykaj (2016)

Holding-Level Summary Statistics

	$Mean$	$Std.$	10^{th}	50^{th}	90^{th}	$N.\ of\ Obs.$
	Panel A: Investment characteristics					
ME	4452.24	18830.41	44.89	545.40	7802.20	594556
BtM	0.74	0.88	0.18	0.56	1.36	530830
Inv	17.21	55.02	-14.10	5.41	48.41	605400
OP	17.24	50.19	-18.03	17.77	50.40	581665
$Ret-11$	10.46	48.73	-41.01	10.70	58.10	542457
$Log(GHG)$	13.28	2.13	10.69	13.16	16.28	41650
	Panel B: Industries weights across funds					
Business equip. and serv.	22.95	1.11	21.59	22.82	24.36	1398703
Consumer durables	3.22	0.23	2.94	3.19	3.61	228986
Consumer non-durables	6.81	0.29	6.42	6.85	7.21	463591
Energy	6.86	1.32	5.07	7.10	8.36	359238
Finance	19.04	1.80	17.11	18.98	21.88	1322677
Healthcare	10.98	0.73	10.13	10.92	11.76	675443
Manufacturing	13.71	0.80	12.56	13.70	14.82	1070250
Telecom	3.06	0.23	2.79	3.07	3.31	159659
Utilities	3.33	0.35	2.87	3.31	3.88	231056
Wholesale and retail	10.04	0.63	9.13	10.02	10.78	686665

▸ Back Funds Summary

▸ Variables Definition

Holding Level Summary Statistics for Similarity-based Portfolios

	Low	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*High*
	Panel A: Investment characteristics									
ME	1841.75	3036.31	4349.38	5215.05	6808.64	11470.63	12516.11	12681.43	11289.68	6809.93
BtM	0.71	0.71	0.71	0.70	0.61	0.54	0.55	0.54	0.56	0.63
Inv	16.47	16.69	15.97	15.68	16.67	17.71	15.97	16.36	16.15	14.89
OP	20.89	21.93	22.35	21.61	24.19	28.44	30.62	30.71	29.86	25.34
$Ret-11$	12.85	12.68	12.63	12.42	13.06	13.57	13.44	13.87	13.98	12.60
	Panel B: Industries weights across funds									
Business equip. and serv.	23.07	21.54	20.74	21.94	21.81	20.20	22.79	22.02	21.54	22.70
Consumer durables	2.99	3.18	3.50	3.10	3.49	3.49	3.35	3.78	3.20	3.14
Consumer non-durables	7.04	6.25	7.10	7.31	6.97	7.57	7.93	7.21	7.25	7.20
Energy	3.77	3.73	4.05	4.43	4.16	4.35	5.13	5.16	4.42	4.05
Finance	25.61	24.66	24.36	23.41	22.31	22.83	20.19	19.13	20.67	21.44
Healthcare	9.28	9.74	9.64	10.63	9.80	10.35	8.27	8.60	9.01	9.35
Manufacturing	15.55	16.97	16.15	15.23	15.96	17.09	16.33	17.48	16.85	16.58
Telecom	1.68	1.88	2.53	2.26	2.80	2.22	2.00	2.20	2.27	2.25
Utilities	2.50	2.88	2.73	2.63	2.96	3.85	4.79	4.37	3.60	3.58
Wholesale and retail	8.52	9.19	9.20	9.06	9.75	8.05	9.20	10.05	11.19	9.71

Back

Variables Definition

Returns: Fund returns, in percentage;

Fund Size: Assets Under Management, in millions of dollars;

Flow: Assets Under Management growth rate, in percentage;

Expense: is the yearly Expense Ratio that includes operating expenses and management fees, including 12b-1 fees, administrative fees, and all other asset-based costs, in percentage;

Turnover: is the percentage of a fund's holdings that have changed over the past year;

Fund Age: Time since fund inception, in years;

Similarity: Fund similarity computed as in equation (1), in percentage;

ME: Value-weighted market capitalization of the holdings, in millions of dollars;

BtM: Value-weighted book-to-market ratio of the holdings, in percentage;

Inv: Value-weighted investment growth ratio of holdings, in percentage;

OP: Value-weighted operating profitability ratio of the holdings, in percentage;

Ret-11: Value-weighted momentum of the holdings, in percentage;

▸ Back to Funds Summary

▸ Back to Holdings Summary