

# Mutual Fund Performance at Long Horizons

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# Motivation

- ▶ The literature that studies mutual fund return performance is vast, but they have mainly focused on returns measured over short horizons (usually in month)
- ▶ In contrast, investment and decision horizons can stretch to decades, and differ across investors. (Pension fund)
- ▶ Compound long horizon returns often contain important information that is not readily apparent in the distribution of short-horizon returns.
- ▶ The prior literature has mainly considered shorter horizons and has focused on equities rather than mutual funds

# Literature

- ▶ Lan et al. (2021) study relations between compound returns and the average period that fund managers keep stocks in their portfolios.(WP)
- ▶ Gilbert et al. (2014) suggest that opacity poses significant challenges to using betas estimated from high-frequency returns.
- ▶ Boguth et al. (2016) focus on slow information diffusion for differing mean equity portfolio returns for horizons ranging from daily to annual
- ▶ Kamara et al. (2016) focus on whether some systematic risk factors are of more concern to one horizon clientele than another

# Contribution

- ▶ We study the frequency with which individual funds outperform benchmarks in terms of compound returns over various horizons and highlight the effect of horizon per se.
- ▶ Important contributions to the theory and evidence regarding the properties of random returns compounded over long horizons on the return skewness.

# Data

- ▶ We obtain data for the 1991-2020 period from the CRSP Mutual Fund Database. (TNA is not consistently available for earlier periods)
- ▶ We study domestic equity funds while excluding ETFs, target date funds, hedged funds, and leveraged funds.
- ▶ We also exclude funds with fewer than 12 months of non-missing data.
- ▶ We focus on the SPY ETF as the primary market benchmark.
  - ▶ Investors cannot directly capture the value-weighted market return or returns to equity indices (PS,2012;BvB,2015)
  - ▶ SPY returns are net of any fees, trading costs, or other expenses, investors could in principle have captured compound SPY returns using a simple buy-and-hold strategy with dividend reinvestment

## Sample overview

- ▶ To assess the fund performance at various horizons we compute the buy-and-hold return, obtained by compounding monthly fund returns.
- ▶ As benchmarks, we compute buy-and-hold returns to one-month U.S. Treasury Bills, to the value-weighted market and to the SPY ETF

Variable	Mean	Median	Std. dev.	Skewness
Fund return (%), monthly	0.776	1.158	5.419	-0.425
Market return (%), monthly	0.882	1.380	4.496	-0.626
SPY return (%), monthly	0.835	1.328	4.332	-0.616
T-bill return (%), monthly	0.166	0.120	0.168	0.626
Outperform market	0.463	0.000	0.499	0.150
Outperform SPY	0.472	0.000	0.499	0.113
Outperform T-Bill	0.602	1.000	0.490	-0.415
Fees (%), monthly	0.095	0.094	0.049	1.583
TNA (\$B), monthly	1.177	0.149	7.703	42.553

# Predictions regarding compound fund returns

- ▶ We conduct simulations to develop predictions as to the effects of measure horizon on fund performance measures in observed samples.
  - ▶ Number of months for which return data is available is random
  - ▶ Returns are normally distributed with constant means and volatility
  - ▶ Funds' true alphas, betas, and residual return volatility vary cross-sectionally, but are independent and time-invariant.
- ▶ To calibrate the simulations in this dimension we define a "failure" function whereby a fund fails in month  $t$ , and all subsequent returns for the fund are excluded from the simulation

# Predictions regarding compound fund returns

- ▶ To find the distribution of excess market returns, we implement the simulations using the actual history of the SPY ETF and one-month Treasury bill returns over the 360 sample months
  - ▶ We randomize the order of the actual SPY returns (and matched-month Treasury bill returns) in each round of the simulation.
  - ▶ While the compound return to the SPY over the 360 months is not altered by such randomization, there is no remaining intertemporal linkage in the simulation
- ▶ Within each round of the simulation we generate returns to 500 funds for  $t = 1$  to 360 months. The simulation is repeated 10000 times, resulting in a pooled distribution of 1.8 billion monthly fund returns



# Simulation outcomes

- ▶  $Wealth\ ratio = \frac{1 + fund\ buy-and-hold\ return}{1 + benchmark\ buy-and-hold\ return}$
- ▶ The skewness increases with the return measurement horizon, and the percentage of funds that outperform the SPY declines

	Mean	Median	Std. dev.	Skewness
Panel B: Simulated Monthly Returns				
SPY return (%)	0.929	1.330	4.188	-0.589
Fund return (%)	0.831	1.099	5.101	-0.389
Fund outperforms SPY indicator	0.484	0.000	0.500	0.064
Wealth ratio	0.999	1.000	0.026	-0.036
Panel C: Simulated Annual Returns				
SPY return (%)	11.228	10.460	15.648	0.263
Fund return (%)	10.013	8.420	19.182	0.531
Fund outperforms SPY indicator	0.428	0.000	0.495	0.292
Wealth ratio	0.988	0.985	0.090	0.300
Panel D: Simulated Decade Returns				
SPY return (%)	119.717	91.430	110.919	1.374
Fund return (%)	103.991	63.460	132.977	2.876
Fund outperforms SPY indicator	0.347	0.000	0.476	0.644
Wealth ratio	0.931	0.920	0.270	1.152

# Simulation extensions

- ▶ The proportion of under-performance increases as the return horizon increases. These may be affected by
  - ▶ Accumulated effects of fees
  - ▶ Monthly alphas are negative on average
  - ▶ Market betas vary across funds and differ from one
- ▶ Then we accommodate these considerations in the simulations
  - ▶ Add the monthly fee to each simulated return prior to compounding
  - ▶ Repeat the simulations while imposing zero monthly alphas
  - ▶ Excess beta-adjusted compound return  $\prod_{t=1}^T (1 + r_f + \beta(R_t^{SPY} - r_f))$

# Simulation outcomes

- ▶ Declining outperformance rates are not simply attributable to the accumulated weight of fund fees, negative alpha and various beta

**Panel E. Simulated "Lifetime" Returns.**

	Mean	Median	Std. dev.	Skewness
Raw Returns				
Months with Data per "Lifetime"	125.643	87.000	107.542	1.001
SPY Return (%)	385.485	110.270	591.638	1.859
Fund Return (%)	323.808	82.800	748.719	7.313
Fund Outperforms SPY Indicator	0.335	0.000	0.472	0.697
Wealth Ratio	0.916	0.903	0.400	4.061
Pre-Fee Returns				
Pre-Fee Fund Return (%)	438.464	98.270	1069.720	7.733
Pre-Fee Fund Return Outperforms SPY Indicator	0.447	0.000	0.497	0.212
Zero-Alpha Returns				
Zero-Alpha Fund Return (%)	437.270	106.970	877.314	4.459
Zero-Estimated Alpha Fund Return (%)	400.042	107.310	690.378	2.794
Zero-Alpha Fund Outperforms SPY	0.490	0.000	0.500	0.040
Zero-Estimated Alpha Fund Outperforms SPY	0.434	0.000	0.496	0.266
Excess beta-adjusted compound return				
Excess Beta-Adjusted Compound Return (%)	-114.425	-18.870	559.485	4.429
Excess Beta-Adjusted Compound Return > 0 Indicator	0.299	0.000	0.458	0.879

# Mutual fund performance at different horizons (sample)

- ▶ Annual fund returns are moderately positively skewed, but positive skewness is apparent in the frequency distribution of decade-horizon.
- ▶ The similarities of sample-based outcomes to simulation-based outcomes suggest that compound fund returns contain different information

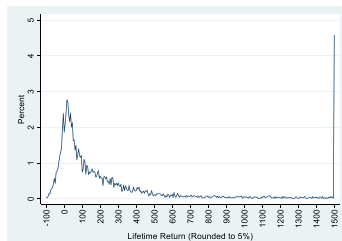
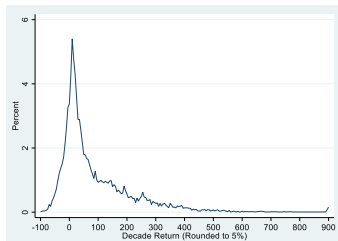
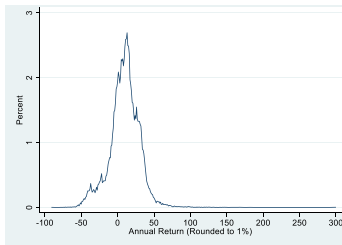
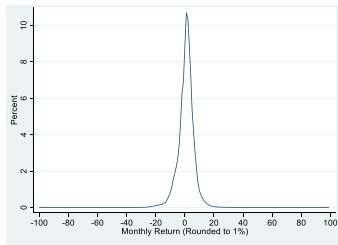
Annual fund returns.

Decade fund returns.

Variable	Mean	Median	Std. dev.	Skewness	Variable	Mean	Median	Std. dev.	Skewness
Fund life (months)	11.3	12.0	2.2	-3.2	Fund life (months)	71.3	70.0	42.5	-0.1
Wealth ratio w.r.t. market	0.990***	0.985	0.117	2.648	Wealth ratio w.r.t. market	0.953***	0.928	0.401	8.476
Wealth ratio w.r.t. SPY	0.994***	0.989	0.120	2.775	Wealth ratio w.r.t. SPY	0.983*	0.951	0.436	9.123
Outperform market	0.393***	0.000	0.488	0.438	Outperform market	0.341***	0.000	0.474	0.673
Outperform SPY	0.411***	0.000	0.492	0.360	Outperform SPY	0.383***	0.000	0.486	0.481
Outperform T-Bill	0.688***	1.000	0.463	-0.813	Outperform T-Bill	0.740***	1.000	0.439	-1.093
Fund buy-and-hold return (%)	9.465	10.287	21.114	0.566	Fund buy-and-hold return (%)	86.897	39.382	128.857	2.640
Market buy-and-hold return (%)	10.685	12.362	17.332	-0.734	Market buy-and-hold return (%)	104.568	36.456	122.455	0.926
SPY buy-and-hold return (%)	10.121	12.680	16.763	-0.796	SPY buy-and-hold return (%)	100.140	31.199	121.835	0.926
T-Bill buy-and-hold return (%)	1.904	1.186	1.966	0.687	T-Bill buy-and-hold return (%)	13.383	5.618	14.905	1.609

# Mutual fund performance at different horizons (sample)

- The distribution of lifetime fund returns is strongly positively skewed.



# The role of fund size

- To assess the role of fund size while avoiding biases attributable to endogenous fund flows, divide fund with 25th, 50th, or 75th percentile

Variable	# Fund-periods	Mean	Median	Skewness	% > SPY
Monthly fund return (%)					
All funds	1048,111	0.776	1.158	-0.425	0.472
All but small funds	876,872	0.800	1.192	-0.420	0.474
Medium and larger funds	661,122	0.810	1.211	-0.421	0.474
Large funds	387,924	0.821	1.223	-0.462	0.474
Annual fund return (%)					
All funds	92,844	9.465	10.287	0.566	0.411
All but small funds	77,158	9.780	10.703	0.358	0.417
Medium and larger funds	57,780	9.942	11.012	0.109	0.418
Large funds	33,666	10.161	11.281	0.051	0.418
Decade fund return (%)					
All funds	14,710	86.897	39.382	2.640	0.383
All but small funds	11,669	94.483	46.022	2.601	0.396
Medium and larger funds	8422	99.780	50.996	2.219	0.399
Large funds	4717	107.250	60.754	2.136	0.397
Lifetime fund return (%)					
All funds	7883	294.354	95.093	6.398	0.303
All but small funds	6021	330.736	134.793	6.336	0.311
Medium and larger funds	4206	356.314	170.903	4.782	0.303
Large funds	2307	390.510	196.326	4.704	0.296

# A comparison to SPIVA

- ▶ “Standard & Poor’s Indices Versus Active Funds (SPIVA)” scorecards that compare compound fund returns to compound S&P 1500 index outcomes for horizons of up to twenty years.
- ▶ The 2020 SPIVA report states that only 14% of domestic equity funds outperformed the S&P Index over the 20-year period 2001 to 2020

Fund performance over the 2001–2020 period.

Variable	Fund	SPY	SP 500	SP 1500	T-bill
Mean Return (%)	137.01	124.66	127.64	140.33	20.74
Median Return (%)	31.46	27.02	28.06	35.36	24.07
% of Funds that Outperformed the Benchmark		40.75	39.66	33.45	54.16
% of Funds that Outperformed, survived to 2020		18.74	17.97	15.69	34.12
% of Funds that Outperformed, exited early		22.01	21.69	17.76	20.04

# Potential reverse survivorship bias

- ▶ Returns to portfolios of mutual funds that are computed for the full sample period are not afflicted by the reverse survivorship issues

**Panel A. Summary statistics of EW fund portfolio returns.**

Variable	# portfolio- periods	EW Fund Portfolio Return				Outperform		
		Mean	Median	Std. dev.	Skew.	Market	SPY	T-bill
EW fund monthly return (%)	3600,000	0.866	1.312	4.531	-0.682	0.444***	0.475***	0.620***
EW fund annual return (%)	300,000	11.045	12.941	17.121	-0.857	0.328***	0.416***	0.737***
EW fund decade return (%)	30,000	182.242	183.790	131.368	0.159	0.192***	0.322***	0.843***
EW fund lifetime return (%)	10,000	1460.078	1439.192	274.399	0.583	0.008***	0.055***	1.000***

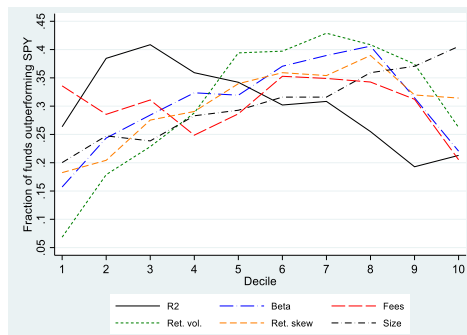
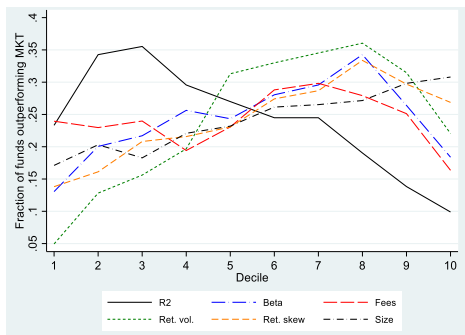
**B. Summary Statistics of VW Fund Portfolio Returns.**

Variable	# portfolio- periods	VW Fund Portfolio Return				Outperform		
		Mean	Median	Std. dev.	Skew.	Market	SPY	T-bill
VW fund monthly return (%)	3600,000	0.874	1.308	4.651	-0.617	0.454***	0.481***	0.620***
VW fund annual return (%)	300,000	11.213	13.043	17.923	-0.791	0.372***	0.430***	0.742***
VW fund decade return (%)	30,000	186.902	198.982	140.029	0.305	0.209***	0.308***	0.808***
VW fund lifetime return (%)	10,000	1510.810	1451.783	463.178	0.902	0.070***	0.166***	1.000***



# Fund characteristics and long-horizon performance

- ▶ We sort into the percentage of sample funds that outperform benchmarks deciles based on a variety of fund characteristics
- ▶ The long-term fund performance generally does not bear any simple or linear relation to the characteristics



# Why do mutual funds underperform in the long run?

- Fees, managerial skill, or factor exposures

**Panel B. Lifetime Fund Returns after Adding Back Fund Expense or Subtracting Fund Alpha.**

Variable	Mean	Median	Std. dev.	Skew	Mean	Median	Std. dev.	Skew
	Add fees				Subtract fund alpha against SPY			
Wealth ratio w.r.t. market	1.011	0.932	0.524	7.846	0.902***	0.929	0.169	0.125
Wealth ratio w.r.t. SPY	1.074***	0.971	0.585	6.841	0.949***	0.979	0.175	0.328
Outperform market	0.376***	0.000	0.484	0.513	0.207***	0.000	0.405	1.450
Outperform SPY	0.452***	0.000	0.498	0.191	0.362***	0.000	0.481	0.574
Outperform T-Bill	0.827***	1.000	0.378	-1.730	0.825***	1.000	0.380	-1.707
Fund buy-and-hold return (%)	393.636	115.572	891.499	6.634	269.794	126.116	416.902	2.803
Market buy-and-hold return (%)	332.887	152.636	514.585	2.644	332.887	152.636	514.585	2.644
SPY buy-and-hold return (%)	297.693	146.603	448.472	2.555	297.693	146.603	448.472	2.555

**Panel C. Excess Beta-Adjusted Compound Return over Fund Time.**

	N	Mean	Median	Std. dev.	Skewness	Fraction positive
All funds	7883	-11.098***	-15.773	362.970	8.565	0.317***
Funds with Monthly Alpha > 0	2849	158.843***	26.105	501.381	8.741	0.878***
Funds with Monthly Alpha < 0	5034	-107.276***	-43.489	196.151	-5.990	0.000***

# Mutual fund investment and investor wealth

- ▶ Let  $W_t$ ,  $A_t$ , and  $M_t$ , denote time  $t$  outcomes for investors' wealth, the value of positions in the alternative asset, and the value of positions in the mutual fund,  $W_t = A_t + M_t$ . Investors each period allocate wealth between a mutual fund with return  $R_t = R_{ct} + R_{dt}$
- ▶ where  $R_{ct}$  is the capital gain component of the period  $t$  return, and  $R_{dt}$  is the dividend component, and an alternative investment that pays  $R_{at}$ .

$$W_t - W_{t-1} * (1 + R_{at}) = M_{t-1} * (R_t - R_{at})$$

- ▶ Let  $FV_{t,T} = (1 + R_{at+1}) * (1 + R_{at+2}) * (1 + R_{at+3}) * \dots * (1 + R_{aT})$  denote a future value factor obtained by compounding realized returns on the alternative asset from time  $t$  to time  $T$ .

# Mutual fund investment and investor wealth

$$\begin{aligned}W_t - W_{t-1} * (1 + R_{at}) &= M_{t-1} * (R_t - R_{at}) \\W_T - W_0 * FV_{0,T} &= M_0 * (R_1 - R_{a1}) FV_{1,T} \\&\quad + M_1 * (R_2 - R_{a2}) FV_{2,T} + \dots \\&\quad + M_{T-2} * (R_{T-1} - R_{aT-1}) FV_{T-1,T} \\&\quad + M_{T-1} * (R_T - R_{aT})\end{aligned}\tag{1}$$

where  $R_t - R_{at}$  is replaced for alpha estimated from a market model regression, the product  $M_{t-1}(\alpha + \epsilon_t)$  can be interpreted as the dollar excess return to the fund investor

# Aggregate returns to mutual fund investors

- ▶ Investor flows lead to lower returns for mutual fund investors
- ▶ Mutual fund investing reduced investor wealth by -\$1.31 trillion relative to a SPY benchmark and by -\$1.02 trillion relative to a beta-adjusted SPY benchmark

**Panel A. Fund geometric mean return vs. dollar-weighted return.**

Sample	N	Mean	Median	Std. dev.	Skewness	%, Outperform SPY geometric mean
Geometric mean return (%)	7879	0.466	0.642	0.908	-3.312	0.303
Dollar-weighted return (%)	7879	0.376	0.574	1.113	-2.371	0.277

**Panel B. Aggregate Post-Fee Fund Wealth Creation.**

Benchmark	N	Sum	Mean	Median	SD	Skewness	% Pos.
Treasury Bill	7883	8664.9	1.099	0.023	10.314	34.263	0.744
SPY	7883	-1308.4	-0.166	-0.007	2.869	13.040	0.254
SPY, Beta-adjusted	7883	-1024.2	-0.130	-0.006	3.099	15.041	0.263

# Conclusions

- ▶ We study U.S. equity mutual funds for 1991 to 2020, and show that the percentage of funds outperform benchmarks decreases with return horizon.
- ▶ We demonstrate that the distribution of compound mutual fund returns displays substantial positive skewness
- ▶ mutual fund investing reduced aggregate investor wealth by slightly more than \$1 trillion
  - ▶ Outperformance rates are slightly worse for the largest fund subsample
  - ▶ Even funds with positive alphas estimated from monthly returns deliver negative excess beta-adjusted compound returns at long horizons
  - ▶ Fund fees cannot fully explain the effect of return measurement horizon on investment outcomes

# Replication

Panel A: Monthly summary				
	mean	std	skew	kurt
	0.0131	0.0291	0.1483	1.1350
rf	0.0020	0.0007	0.3556	-0.8849
market	0.0136	0.0856	-0.1818	1.3465
etf	0.0118	0.0851	0.1890	1.8548
over_rf	0.5787	0.4010	-0.3709	-1.5870
over_market	0.4870	0.2893	-0.0691	-1.1991
over_etf	0.5161	0.3193	-0.1190	-1.4238

Panel B: Annually summary				
	mean	std	skew	kurt
fundret	0.1967	0.1286	0.4333	1.0257
rf	0.0249	0.0077	0.0793	-1.1208
market	0.2349	0.6194	1.9712	4.0776
etf	0.1985	0.5604	1.8684	3.8569
over_rf	0.5633	0.3843	-0.3118	-1.4491
over_market	0.4628	0.2810	0.0194	-1.1584
over_etf	0.5133	0.2948	0.1985	-1.3366