Rethinking Mutual Fund Performance: From Traditional Alpha to Achievable Alpha*

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Abstract

About 88% of mutual-fund assets are held by retail investors, who rarely take short positions because of the associated costs and risks. Yet mutual-fund performance is traditionally measured by alpha, which implicitly assumes investors can freely short the benchmark factors. We show that mutual-fund performance for constrained investors is measured by achievable alpha, computed using only factors with strictly positive weights in the shortsale-constrained benchmark portfolio. Empirically, achievable alpha and value-added reveal weaker absolute performance and starkly different rankings. Achievable alphas predict fund flows—especially during market turmoil—and indicate that funds are less scalable than implied by traditional alphas.

Keywords: Retail investors, Performance evaluation, Value-added, Shortsale constraints, Fund flows, Scale and skill.
JEL Classification: G11, G23.

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1 Introduction

As of 2024, the U.S. mutual-fund industry managed over 28.5 trillion dollars in assets, 88% of which were held by retail investors,[1] who rarely take short positions due to share-borrowing costs and a general aversion to shorting risks.[2] Despite this, the literature typically evaluates mutual funds using traditional alpha—the intercept from regressing fund returns on benchmark factor returns—which implicitly assumes that investors can freely short the benchmark factors. The rationale for alpha as a performance measure is that it captures the marginal gain in utility for an *unconstrained* investor who can hold a portfolio of the benchmark factors *and* the fund, relative to holding a portfolio of *only* the benchmark factors (Chen and Knez, 1996; Ferson, 2010; Ardia and Barras, 2024).[3] However, if the mean-variance portfolio of benchmark factors assigns a negative weight to any factor, this alpha is not achievable by the vast majority of investors in mutual funds. And if performance is measured using an unachievable benchmark, then half a century of evidence on fund performance—starting with the seminal work of Jensen (1968)—may not reflect the experience of actual investors.

In this paper, we provide a new framework for evaluating mutual-fund performance when investors face shortsale constraints. We define the *achievable alpha* of a fund as the marginal improvement in mean-variance utility that a *shortsale-constrained* investor achieves when she has access to the fund in addition to the benchmark factors.[4] We show theoretically that achievable alpha can be estimated by regressing a fund's returns on the *subset* of benchmark factors with strictly positive weight in the shortsale-constrained mean-variance portfolio. This measure accounts for shortsale constraints, and thus provides a more realistic

[1]The ICI Fact Book (2025, p. 45) shows that the retail share of *actively managed* long-term mutual funds is even higher. As of 2024, households held 20.3 of the 21.7 trillion dollars in long-term mutual fund assets, while index mutual funds accounted for 6.9 trillion. Even under the extreme assumption that all 1.4 trillion dollars of institutional long-term holdings are in actively managed funds, retail investors would still hold 90.5% of actively managed long-term mutual fund assets, $(21.7 - 6.9 - 1.4)/(21.7 - 6.9) \approx 90.5\%$.

[2]Kelley and Tetlock (2017, p. 805) find that out of 144 billion dollars of retail trades only 5.54% correspond to shortsales, and Gamble and Xu (2017) find only 1.2% of the retail trades in their dataset are short sales. Institutional investors may also face shortsale constraints. For instance, the state of Georgia prohibits its public pension funds from investing more than 5% in alternative investments such as hedge funds (Molk and Partnoy, 2019, p. 851). Even pension funds whose mandate allows them to short, tend to hold only small short positions—in a sample of pension funds of Fortune 1000 companies, only 6–8% of assets were invested in hedge funds and other assets that involve short selling (Molk and Partnoy, 2019, p. 853).

[3]Gibbons, Ross, and Shanken (1989) show that a quadratic form of the alpha captures also the *total* utility gain of an unconstrained investor who has access to the fund in addition to the benchmark factors.

[4]Throughout the paper, the term "shortsale-constrained investors" refers to retail or institutional investors in mutual funds who do not take short positions.

yardstick of performance than traditional alpha for the typical retail investor. Conceptually, the investor's alpha is not an intrinsic property of the fund but a feature of the investor's portfolio problem: the relevant notion of performance is inseparable from the feasible set of the underlying mean-variance problem. When shortsales are unrestricted, that feasible set spans all benchmark factors and the marginal utility gain is the traditional alpha; when shortsales are ruled out, the feasible set contracts to the factors with positive weights in the mean-variance portfolio and the marginal utility gain is the achievable alpha.

Intuitively, one might expect a fund's achievable alpha to exceed its traditional alpha because dropping factors weakens the benchmark, and hence, decreases the mean-variance utility of the benchmark portfolio. However, note that alpha measures the utility *improvement* that an investor can achieve when she has access to the fund in addition to the benchmark factors. The shortsale-constraints decrease the utility of *both* the benchmark portfolio and the optimal portfolio that includes also the fund. Thus, achievable alpha can be higher or lower than traditional alpha, as we demonstrate theoretically. To understand the intuition for why achievable alpha can be lower, consider the simple example of a mutual fund that earned a negative annual return of -2% over the evaluation period, but is benchmarked with respect to a single factor that earned a return of -3%. Then, assuming a unit beta, the mutual-fund alpha is positive ($+1\%$), but to earn this positive alpha, an investor must be able to short the benchmark factor. For a shortsale-constrained investor, the *achievable alpha* is only the fund's mean return, -2%.

Our main theoretical result is to identify the conditions under which a fund's achievable alpha is smaller than its traditional alpha. We show that this occurs when the fund has positive exposure to the factors with zero weight in the shortsale-constrained benchmark portfolio. The intuition underlying this result is that the zero-weight factors underperform, and thus an unconstrained investor would like to short them to hedge the risk of the fund and the other factors. However, shortsale constraints prevent this hedge, thereby reducing the marginal utility gain (alpha) from investing in the fund. Thus, whether mutual-fund performance is better or worse from the perspective of shortsale-constrained investors depends on whether the fund has positive exposure to the factors with zero weight in the shortsale-constrained benchmark portfolio, which is ultimately an empirical question.

To evaluate empirically the gap between traditional and achievable alphas, we use seven benchmark models. Motivated by Berk and van Binsbergen (2015), who argue that the factors in prominent models are not an accurate representation of the alternative investment opportunity of mutual-fund investors, our main benchmark model consists of Vanguard funds (VANG).[5] Note that although the Vanguard funds represent long-only factors, the benchmark factor portfolio considered by Berk and van Binsbergen (2015) implicitly allows the investor to short these long-only factors. In contrast, our analysis based on achievable alpha explicitly accounts for the shortsale constraints of investors by ruling out negative allocations to any factor in the mean-variance benchmark portfolio.

To facilitate the comparison of our results with those in the mutual-fund literature, we also consider six prominent factor models as benchmarks—the CAPM, Carhart four-factor (FFC), Fama-French five-factor (FF5) and six-factor (FF6), and Hou-Xue-Zhang four-factor (HXZ) and five-factor (HXZM) models. However, to address the concern that long-short factors do not represent the alternative investment opportunity of shortsale-constrained investors,[6] we evaluate the achievable alpha of a mutual fund using long-only versions of the original factors, constructed using just the long leg. We also show that our findings are robust to alternative ways of constructing long-only versions of the benchmark factors.[7]

Empirically, we find that the distinction between traditional and achievable alpha matters greatly, with performance *deteriorating* sharply when measured using achievable alpha. For instance, the top plot in Figure 1 shows that while the proportion of funds with positive traditional gross-of-fees alpha with respect to the long-short version of the factor models ranges from 47% for HXZ to 61% for VANG, the proportion of funds with positive

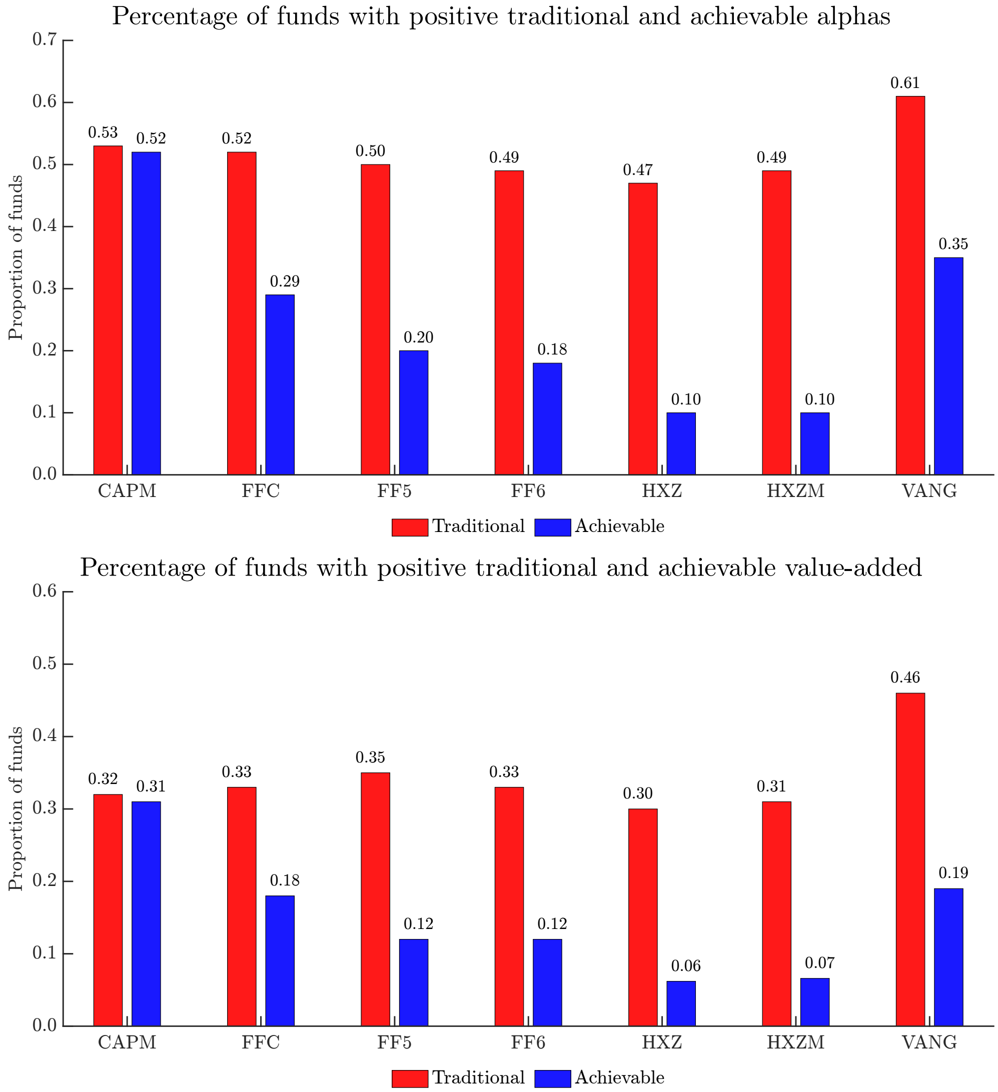
[5]Berk and van Binsbergen (2015) propose a benchmark comprising 11 Vanguard funds that invest in both domestic and foreign equities. Of these funds, we consider a benchmark model that includes the returns of the eight funds that invest solely in domestic equity.

[6]For instance, An, Huang, Lou, and Shi (2023, table 1) show that long-short mutual funds account for less than 3% of industry assets, and those with short positions employ far less leverage than the long-short factors in asset-pricing models. While academic factor portfolios typically involve balancing long and short legs, only 8% of mutual funds in An et al. (2023) hold any short positions, and just 3% short more than 20% of assets. Similarly, long-short ETFs represent a tiny fraction of the overall ETF market—as of November 2025, the ETF database lists only 18 ETFs in their long-short category, with aggregate assets under management of just 6.2 billion dollars (ETF Database, 2025). Finally, although investors could use options to replicate the short leg of a long-short factor, Bryzgalova, Pavlova, and Sikorskaya (2023) show that retail investors who trade options face "whopping" average bid-ask spreads of 12.6%.

[7]For instance, Sections IA.2 and IA.3 of the Internet Appendix show that our results are robust to (1) replacing each original factor's short leg with a long-only portfolio of mutual funds with significantly negative exposure to that factor's short leg, and (2) considering factor models that allow investors to go long both legs (the long and the short legs) of academic factors.

Figure 1: Traditional and achievable gross alpha and value-added

This figure depicts the proportion of funds with positive traditional and achievable gross alphas (top plot) and value-added (bottom plot) with respect to the seven factor models we consider. Traditional alphas are computed by regressing fund returns on all long-short factors for each model, and achievable alphas on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). Traditional value-added is the average of the product of assets under management and realized abnormal returns, obtained by regressing fund returns on all long-short factors in each model, and achievable value-added is computed using fund realized abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio.



achievable gross alpha with respect to the long-only models is just 10% for HXZ and 35% for VANG. Note that although the VANG model is long-only, the traditional alpha with respect to the VANG model is still much larger than the achievable alpha because, as we show below, the mean-variance portfolio of the VANG factors often includes short positions. We also find that the proportion of funds with *significantly* positive traditional alpha is much larger than that with significantly positive achievable alpha.[8]

These striking results hold also when we measure mutual-fund performance in terms of the "value-added" metric of Berk and van Binsbergen (2015).[9] For instance, the bottom plot in Figure 1 shows that while the proportion of mutual funds with positive traditional gross value-added ranges from 30% for HXZ to 46% for VANG, the proportion of mutual funds with positive achievable value-added is just 6% for HXZ and 19% for VANG. Section IA.4 of the Internet Appendix shows that the deterioration in traditional alpha and value-added is even stronger when measured using net-of-fees returns instead of gross returns.

Having shown that shortsale constraints sharply reduce absolute performance, we next examine their effect on *relative* performance. Comparing rankings based on traditional versus achievable alpha or value-added, we find that over 70% of funds change rank deciles for every factor model except CAPM. Thus, the top-performing funds for shortsale-constrained investors differ from those for unconstrained investors.

We also estimate how the gap between traditional and achievable alphas varies over time by estimating the alphas over 36-month rolling windows, the standard window employed by platforms like Morningstar. If shortsale constraints are more binding during periods of market turmoil, we would expect the gap to be larger during these periods. Our results confirm this hypothesis: the difference between the traditional and achievable alphas widens markedly during periods of financial turmoil—such as the 1980 and 1981–82 recessions, the dot-com crash, the 2009 financial crisis, and the COVID pandemic. Overall, these findings provide compelling evidence that mutual-fund performance is substantially weaker from the perspective of shortsale-constrained investors.

Finally, we show that the distinction between achievable and traditional alphas is critical for two central questions in mutual-fund research. First, we examine fund flows and find that both traditional and achievable alphas predict flows individually and jointly;

[8]Section IA.1 of the Internet Appendix shows that our results are robust when investors can engage in a *limited* amount of shortselling.

[9]Berk and van Binsbergen (2015) explain the importance of measuring mutual-fund performance in terms of *value-added*, defined as the average of the product between a fund's gross abnormal returns and its assets under management. Following their approach, we define achievable value-added as the average of the product between achievable realized abnormal returns and one-month lagged total net assets.

however, in volatile markets, the predictive power of achievable alpha strengthens, while that of traditional alpha weakens. This evidence suggests that, even after controlling for traditional alpha, the decisions of at least some investors are correlated with achievable alpha, particularly during periods of market turmoil. Second, we study mutual-fund skill and scale using the flexible and bias-adjusted approach of Barras, Gagliardini, and Scaillet (2022). We find that while estimates of fund skill are similar whether based on traditional or achievable alpha, estimates of scalability based on achievable alpha are much *smaller*, suggesting that active strategies may be less scalable for shortsale-constrained investors.

We conduct several robustness checks in the Internet Appendix. First, we relax the shortsale constraint by allowing investors to short just the market factor (via an inverse market ETF) or to short all benchmark factors but subject to a leverage constraint. Second, we repeat our analysis after replacing each original factor's short leg with a long-only portfolio of mutual funds with significantly negative exposure to that factor's short leg. Third, we consider factor models that allow investors to go long both legs (the long and the short legs) of academic factors. Fourth, we repeat our entire analysis considering net-of-fees returns. Fifth, we repeat the analysis, separately considering retail and institutional fund share classes. Sixth, we evaluate mutual-fund performance across fund styles. Seventh, we evaluate mutual-fund performance across subsamples. Eighth, we estimate fund alphas using 36-month rolling windows rather than the entire sample for which data are available for each fund. Ninth, we study in detail the change in relative performance when ranking funds by achievable alpha instead of traditional alpha. Tenth, we estimate value-added using the approach of Barras et al. (2022). Eleventh, we evaluate fund skill and scalability using the *log* of assets under management as the explanatory variable. Twelfth, we consider an alternative approach to impute missing observations in the Vanguard model. Thirteenth, we evaluate out-of-sample achievable and traditional alpha and value-added. Across all these variations, our results hold: achievable alpha and value-added remain much smaller than their traditional counterparts, and relative fund rankings differ substantially.

Our work has implications for research, practice, and policy. For research, we show that traditional performance measures are inconsistent with investor constraints and overstate mutual-fund performance. For practitioners and investment platforms, we show that reporting should incorporate achievable alpha, especially for investors who do not short. For regulators, we highlight the importance of disclosure standards that reflect the frictions faced by retail investors and shortsale-constrained pension funds. More broadly, our results bridge the mutual-fund and asset-pricing literatures by showing that ignoring shortsale constraints can bias inferences about mutual-fund performance.

An extensive body of literature evaluates mutual-fund performance using traditional alpha. This research typically shows that the average active fund earns negative alpha net of fees (Jensen, 1968; Elton, Gruber, and Blake, 1996; Ferreira, Keswani, Miguel, and Ramos, 2013). However, several studies document the existence of a subset of managers that outperform their benchmarks (Wermers, 2000; Barras, Scaillet, and Wermers, 2010; Fama and French, 2010; Kacperczyk, Nieuwerburgh, and Veldkamp, 2014). Assuming there are diseconomies of scale in fund management, Berk and Green (2004) explain that fund net alpha should be zero in equilibrium because investors allocate capital to funds with positive net alpha until diseconomies of scale drive their net alpha to zero.[10] Thus, a manager's skill should be measured in terms of gross alpha. Berk and van Binsbergen (2015) propose using the value a mutual fund extracts from capital markets as the appropriate measure of skill, and find that more than 40% of the funds generate positive value-added. Barras et al. (2022) develop a flexible and bias-adjusted approach to examine value-added and find that the majority of funds generate positive value-added. We contribute to this literature by demonstrating that the performance of a mutual fund for shortsale-constrained investors is measured by achievable alpha, and showing that the proportion of funds with positive alpha or value-added is much smaller from the perspective of a shortsale-constrained investor.

Berk and van Binsbergen (2015) consider a factor model containing Vanguard funds, which represent long-only factors. They compute value-added using the traditional alpha, and therefore they implicitly consider an unconstrained investor whose optimal benchmark portfolio may require shorting some of the Vanguard funds. Given our focus on shortsale-constrained investors, our analysis is based on achievable alpha and value-added, which explicitly rely on benchmark portfolios that do not require shorting any of the benchmark factors. Johansson, Sabbatucci, and Tamoni (2025) construct tradable long-short factors by combining a long-only portfolio of mutual funds and ETFs with a short-only portfolio of

[10] We do not argue that retail investors are the marginal investors in an equilibrium a la Berk and Green (2004), and thus we do not focus on the equilibrium implications of shortsale constraints. Instead, we focus on a more direct question: given that the vast majority of mutual-fund assets are held by investors who do not short, what is the appropriate way to evaluate fund performance from their perspective.

ETFs. They show that transaction and shortselling costs lead to an implementation shortfall of 2–4% annually, relative to the academic (on paper) factors. However, their factors require shorting ETFs, and thus, do not represent the alternative investment opportunity set of *shortsale-constrained* investors. In contrast, when evaluating achievable alpha and value-added, we consider *long-only* factors and restrict the benchmark portfolio to hold nonnegative positions in these long-only factors.[11]

Several papers document the barriers to shortselling faced by investors. Daniel, Klos, and Rottke (2025) show that over the last several decades, the cost of borrowing stocks for shortselling has increased. Andrews, Henderson, and Reed (2024) find that ETFs are even more expensive to borrow than the stocks they hold. Engelberg, Reed, and Ringgenberg (2018) show that shortselling is risky because stock loans may become costly or be recalled. We highlight that the majority of retail investors holding mutual funds rarely short (Kelley and Tetlock, 2017; Gamble and Xu, 2017), but are agnostic about whether this is due to share-borrowing costs or an aversion to shorting risks.

Our work also relates to the literature on the effects of market frictions on the benefits to investors of holding different asset classes. For instance, De Roon, Nijman, and Werker (2001) show that in the presence of transaction costs and shortsale constraints, U.S. investors no longer benefit from investing in emerging markets. Brown, Gonçalves, and Hu (2024) show that illiquidity and underdiversification in private markets reduce the benefits to investors from holding private-capital assets, such as buyout, venture capital, and real estate. We contribute to this literature by examining whether shortsale-constrained investors benefit from holding actively managed mutual funds and characterizing the precise conditions under which their achievable alpha is smaller than the traditional alpha. We focus on shortsale constraints to disentangle their effect from that of other frictions such as transaction costs.

Finally, our work is related to the literature on market frictions in asset pricing (Novy-Marx and Velikov, 2016; DeMiguel, Martin-Utrera, Nogales, and Uppal, 2020; Barroso and Detzel, 2021; Chen and Velikov, 2023; Detzel, Novy-Marx, and Velikov, 2023; DeMiguel, Martin-Utrera, and Uppal, 2024; Li, DeMiguel, and Martin-Utrera, 2024; Muravyev, Pearson, and Pollet, 2025). While this literature focuses on the impact of market frictions on the

[11] Motivated by Johansson et al. (2025), in Section IA.2 of the Internet Appendix we show our results are robust to constructing factors that do not require shorting by combining the long leg of the original factor with a long-only portfolio of mutual funds with negative exposure to the short leg of the original factor.

performance of asset-pricing models, we focus on the effects of shortsale constraints on the performance of mutual funds. Patton and Weller (2020) develop a method to measure the cost incurred by mutual funds when they implement financial market anomalies. Building on their work, Oh and Patton (2026) show that the traditional alpha can be decomposed into the manager's *skill* and the fund's *efficiency* in accruing the risk premium of the benchmark factors. In contrast, we focus on measuring the performance of mutual funds from the perspective of shortsale-constrained investors.

The rest of the paper is organized as follows. In Section 2, we show theoretically how to measure mutual-fund alpha in the presence of shortsale constraints and provide an illustrative example. In Section 3, we describe our data and discuss our main empirical results. In Section 4, we examine the economic implications for two of the main questions in mutual-fund research. Section 5 concludes. Proofs of all our theoretical results are provided in Appendix A. Additional empirical results and extensive robustness checks are reported in the Internet Appendix.

2 Achievable Alpha: Theoretical Results

In this section, we provide theoretical results showing that one can interpret the traditional and achievable mutual fund alphas as the marginal improvement in mean-variance utility, in the absence and presence of shortsale constraints, for an investor who has access to the fund, in addition to the benchmark factors. Our main theoretical result characterizes the difference between the traditional and achievable alphas and identifies conditions under which the achievable alpha is smaller than the traditional alpha. We conclude this section by providing a simple example to illustrate the intuition for this result.

We first state the well-known result for the traditional alpha (Chen and Knez, 1996; Ferson, 2010; Ardia and Barras, 2024), with our notation summarized in Table 1.

Proposition 1 *The marginal mean-variance utility improvement of an unconstrained investor who has access to a fund, in addition to the benchmark factors, is the* traditional *alpha, $\alpha_{\mathcal{T}}$, measured as the intercept from regressing the mutual-fund return in excess of the risk-free rate $R_{mf,t}$ on the benchmark factor returns $R_{b,t}$,*

$$R_{mf,t} = \alpha_{\mathcal{T}} + \beta_{\mathcal{T}} R_{b,t} + \epsilon_{b,t}. \tag{1}$$

Table 1: Guide to notation

This table describes the notation we use in the paper to describe the excess returns of a mutual fund and benchmark factors, the traditional and achievable alphas, and the slope coefficients (betas) obtained from various regressions of excess returns. The first column of the table lists the symbol, and the second column defines it.

Notation	Definition
$R_{mf,t}$	mutual-fund return in excess of the risk-free rate
$R_{b,t}$	excess return of benchmark factors
$R_{b_+,t}$	excess return of benchmark factors with positive weight in the shortsale-constrained mean-variance portfolio
$R_{b_0,t}$	excess return of benchmark factors with zero weight in the shortsale-constrained mean-variance portfolio
$\alpha_{\mathcal{T}}$	traditional alpha, intercept from regressing $R_{mf,t}$ on $R_{b,t}$
$\alpha_{\mathcal{A}}$	achievable alpha, intercept from regressing $R_{mf,t}$ on $R_{b_+,t}$
α_{0_+}	intercept from regressing $R_{b_0,t}$ on $R_{b_+,t}$
$\beta_{\mathcal{T}}$	slope from regressing $R_{mf,t}$ on $R_{b,t}$
$\beta_{\mathcal{A}}$	slope from regressing $R_{mf,t}$ on $R_{b_+,t}$
$\beta_{\mathcal{T},+}$	slope coefficient on $R_{b_+,t}$ when regressing $R_{mf,t}$ on $R_{b_+,t}$ and $R_{b_0,t}$
$\beta_{\mathcal{T},0}$	slope coefficient on $R_{b_0,t}$ when regressing $R_{mf,t}$ on $R_{b_+,t}$ and $R_{b_0,t}$

The marginal utility improvement measured by the traditional alpha, as shown in Proposition 1, can only be realized if the investor can invest in the optimal mean-variance portfolio of the benchmark factors. However, this portfolio may require shorting some of the benchmark factors and many investors face shortsale impediments in practice. The following proposition shows that the marginal utility improvement that a fund generates for a shortsale-constrained investor is the *achievable* alpha, measured by the intercept from regressing the fund returns on the returns of those benchmark factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio, $R_{b_+,t}$.

Proposition 2 *The marginal mean-variance utility improvement of a shortsale-constrained investor who has access to a fund, in addition to the benchmark factors, is the* achievable *alpha, $\alpha_{\mathcal{A}}$, measured as the intercept from regressing the fund excess return on the returns of the benchmark factors that have a positive weight in the shortsale-constrained mean-variance portfolio, $R_{b_+,t}$,*

$$R_{mf,t} = \alpha_{\mathcal{A}} + \beta_{\mathcal{A}} R_{b_+,t} + \epsilon_{b_+,t}. \tag{2}$$

The theoretical result in Proposition 2 is closely related to that of De Roon et al. (2001), who study the impact of shortsale constraints on the benefits from international portfolio diversification. In contrast, we focus on mutual-fund performance and go beyond their analysis by identifying in the following proposition the precise conditions under which the achievable alpha is smaller than the traditional alpha.

Proposition 3 *Let $R_{b_+,t} \in R^{K_+}$ denote the return of the benchmark factors with strictly positive weight and $R_{b_0,t} \in R^{K_0}$ the return of the benchmark factors with zero weight in the shortsale-constrained mean-variance portfolio. Regressing the mutual fund excess returns, $R_{mf,t}$, on the benchmark factor returns, we have that:*

$$R_{mf,t} = \alpha_{\mathcal{T}} + \beta_{\mathcal{T},+} R_{b_+,t} + \beta_{\mathcal{T},0} R_{b_0,t} + \epsilon_{b,t},$$

where $\alpha_{\mathcal{T}}$ is the traditional alpha, and regressing the zero-weight factor returns, $R_{b_0,t}$, on the positive-weight factor returns, $R_{b_+,t}$, we have that:

$$R_{b_0,t} = \alpha_{0,+} + \beta_{0,+} R_{b_+,t} + \epsilon_{0,+,t}. \tag{3}$$

Then, the difference between the traditional and achievable alphas is

$$\alpha_{\mathcal{T}} - \alpha_{\mathcal{A}} = -\beta_{\mathcal{T},0}\, \alpha_{0,+}. \tag{4}$$

Moreover, $\alpha_{0,+} < 0$, and thus, the achievable alpha is smaller than the traditional alpha if the fund has strictly positive exposure to at least one zero-weight factor and nonnegative exposure to the rest.

Intuitively, one would expect that the achievable alpha is larger than the traditional alpha because the achievable alpha in Equation (2) of Proposition 2 is the abnormal return with respect to a *subset* of the factors used to compute the traditional alpha in Equation (1) of Proposition 1. However, Proposition 3 shows that if the fund has a positive exposure to the factors for which the shortsale-constrained mean-variance portfolio assigns a zero weight, then the achievable alpha will actually be *smaller* than the traditional alpha. The economic intuition for this result is that zero-weight factors underperform relative to other factors; thus, an unconstrained investor would like to short these factors to hedge the risk of the fund and the other factors. However, shortsale constraints prevent this hedge, thereby reducing the marginal utility gain from investing in the fund (the achievable alpha).

In the remainder of this section, we provide a numerical example to illustrate this intuition. Without loss of generality, we consider an investor with relative risk aversion

Table 2: An example to illustrate the key intuition

This table reports various statistics for Columbia Acorn Fund with respect to a simple benchmark model that has only two factors: the market (MKT) and the long-only version of momentum (UMD). The first column indicates whether the statistics are for the unconstrained portfolio (traditional alpha) or the shortsale-constrained portfolio (achievable alpha). Columns (2)–(5) report the utility and portfolio weights of the mean-variance portfolio of the two factors and the mutual fund. Columns (6)–(8) report the annual alpha and the beta of the mutual fund with respect to the two factors. We consider an investor with relative risk aversion $\gamma = 5$. All quantities are computed from the returns of the two factors and the mutual fund, using a sample spanning January 1975 to December 2024.

	Mean-variance portfolio				Regression		
	Utility	w_{MKT}	w_{UMD}	w_{mf}	α	β_{MKT}	β_{UMD}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unconstrained: Traditional	0.0044	−0.67	1.06	0.25	0.0059	0.40	0.57
Shortsale-constrained: Achievable	0.0041	0	0.71	0.06	0.0015	—	0.88

$\gamma = 5$.[12] We study a setting with only two factors: the market (MKT) and the long-only version of momentum (UMD) and estimate all quantities using a sample spanning January 1975 to December 2024. First, consider the case where the investor can hold only these two factors. In this case, the unconstrained mean-variance investor assigns a weight of -0.57 to MKT and 1.20 to UMD. This is because the correlation between the MKT and the long-only version of UMD is 92%, but the monthly mean return of the long-only UMD (1.08%) is much higher than that of MKT (0.75%). However, once shortsale constraints are imposed, the investor assigns a weight of zero to MKT and only 0.76 to UMD. This is because she cannot short the MKT factor to hedge against the risk of the UMD factor, and thus must reduce her overall exposure to UMD.

Now, suppose this investor uses the simple two-factor benchmark to evaluate the Columbia Acorn Fund's performance. Column (6) of Table 2 shows that the traditional annual alpha of Columbia with respect to the two-factor model is 0.59%, but the achievable annual alpha drops to 0.15%. This is consistent with Proposition 3 because, as shown in Column (7) of Table 2, the Columbia fund has a positive beta of 0.40 with respect to the MKT factor, which has zero weight in the constrained benchmark portfolio.

[12] Note that our main performance criteria, alpha and value-added, do not depend on relative risk aversion γ. Although mean-variance utility and absolute portfolio weights depend on γ, Proposition A.4 in Appendix A shows that the set of factors with strictly positive weight in the shortsale-constrained mean-variance portfolio, the achievable alpha, and the Sharpe ratio of the shortsale-constrained mean-variance portfolio are all independent of γ. Consequently, our main findings are independent of relative risk aversion.

To understand why the achievable alpha is smaller than the traditional alpha, compare the unconstrained and shortsale-constrained mean-variance portfolio weights of the two benchmark factors and the mutual fund. Columns (3)–(5) of Table 2 show that the portfolio of an unconstrained investor would assign weights of −0.67 to MKT, 1.06 to UMD, and 0.25 to the mutual fund. In contrast, a shortsale-constrained investor would assign weights of zero to MKT, 0.71 to UMD, and only 0.06 to the mutual fund. That is, the shortsale-constrained investor is forced to reduce her exposure to the UMD factor and the Columbia fund because she cannot use the MKT factor to hedge the risk of her portfolio.

Consistent with the alpha in the motivating example, which, in the presence of shortsale constraints, drops from 0.59% to 0.15% (see Column (6) of Table 2), in the next section, we find empirically that the achievable alpha is, on average, smaller than traditional alpha.

3 Achievable Performance: Empirical Results

In this section, we evaluate the achievable performance of mutual funds for a shortsale-constrained investor. Section 3.1 describes the data. Sections 3.2 and 3.3 evaluate achievable mutual-fund alpha and value-added. Section 3.4 examines whether shortsale constraints change the relative performance of funds. Section 3.5 studies the time-series properties of the traditional and achievable alphas. Finally, Section 3.6 uses Proposition 3 to explain why achievable alpha is generally smaller than traditional alpha in our sample.

3.1 Data

Motivated by Berk and van Binsbergen (2015), who argue that the factors in prominent models do not account for transaction costs and thus are not an accurate representation of the alternative investment opportunity of mutual-fund investors, our main benchmark model consists of eight US domestic equity Vanguard funds (VANG).[13] Note that although the Vanguard funds considered by Berk and van Binsbergen (2015) represent long-only factors,

[13]When constructing the benchmark based on Vanguard funds, we consider the eight funds that invest only in *domestic* equity out of the 11 funds considered by Berk and van Binsbergen (2015). In particular, we consider the following funds: VBINX (balanced), VFINX (large-cap blend), VEXMX (mid-cap blend), VVIAX (large-cap value), NAESX (small-cap blend), VISVX (small-cap value), VISGX (small-cap growth), and VIMSX (mid-cap blend). As in Berk and van Binsbergen (2015), when constructing the benchmark using these funds, we consider net-of-fees returns, but our findings are robust to gross-of-fees returns. Finally, an advantage of using Vanguard mutual funds as benchmarks (relative to ETFs) is the substantially longer return history available. For example, the Vanguard 500 Index Fund (VFINX) has data starting in 1976,

Table 3: List of factor models considered

This table lists the factor models we consider. The first column lists the model acronym, the second column the number of factors in the model (K), the third column the authors who proposed the model, and the fourth column the publication date and journal. The last column lists the acronyms of the factors included in the model.

Acronym	K	Authors	Date, Journal	Factor acronyms
CAPM	1	Sharpe	1964, JF	MKT
FFC	4	Carhart	1997, JF	MKT, SMB, HML, UMD
FF5	5	Fama and French	2015, JFE	MKT, SMB, HML, RMW, CMA
FF6	6	Fama and French	2018, JFE	MKT, SMB, HML, RMW, CMA, UMD
HXZ	4	Hou, Xue, and Zhang	2015, RFS	MKT, ROE, IA, ME
HXZM	5	Hou, Xue, and Zhang	2015, RFS	MKT, ROE, IA, ME, UMD
VANG	8	Berk and van Binsbergen	2015, JFE	VBINX, VFINX, VEXMX, VVIAX, NAESX, VISVX, VISGX, VIMSX

their benchmark factor portfolio implicitly allows the investor to short these long-only factors. In contrast, our analysis explicitly accounts for the shortsale constraints of investors by ruling out negative allocations to any factor in the mean-variance benchmark portfolio.

As explained in the introduction, to facilitate the comparison of our results with those in the existing literature, we also consider six prominent factor models as benchmarks: the CAPM of Sharpe (1964), FFC, the four-factor model obtained by adding momentum to the three factors of Fama and French (1993) as in Carhart (1997), FF5, the five-factor model of Fama and French (2015), FF6, the six-factor model of Fama and French (2018), HXZ, the four-factor model of Hou, Xue, and Zhang (2015), HXZM, and a five-factor model with the Hou et al. (2015) factors plus momentum. However, to address the concern that long-short factor models do not represent the alternative investment opportunity of shortsale-constrained investors, we evaluate the achievable alpha of a mutual fund using long-only versions of the original factors, constructed using only the long leg. We also show that our findings are robust to alternative ways of constructing long-only versions of the benchmark factors (as described in Footnote 7).

We construct a dataset for actively managed U.S. equity mutual funds as follows.[14] We download monthly fund returns, expense ratios, total net assets (TNA), and investment objectives from the CRSP Survivor-Bias-Free Mutual Fund Database for the period January

whereas the SPDR S&P 500 ETF (SPY)—the first ETF to achieve widespread adoption in the US—launched only in 1993.

[14]We are grateful to Mikhail Simutin for sharing the SAS code that reproduces the results in Doshi, Elkamhi, and Simutin (2015). We use this SAS code as a starting point for constructing our dataset.

1975 to December 2024. We aggregate all share classes within the same fund by adding their TNAs and computing TNA-weighted averages of fund-level variables.[15] We retain diversified domestic equity funds identified by the CRSP objective code and exclude index, international, balanced, sector, bond, and money-market funds. The resulting panel comprises 2,939 distinct funds. We compute monthly gross fund returns by adding one-twelfth of the annual expense ratio to the net-of-fees monthly returns. Following Berk and van Binsbergen (2015) and Barras et al. (2022), we express TNA and value-added in terms of January 1, 2000 dollars.

3.2 Achievable Alpha

We now discuss the achievable mutual-fund performance of a shortsale-constrained investor in terms of gross-of-fees alpha. Table 4 reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven factor models listed in Table 3. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained by regressing the fund returns on all long-short factors for each model, and Panel B reports the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund).[16] We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and with significantly positive alpha (alpha t-statistic greater than two). Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

[15]The Internet Appendix shows that our results are robust to considering retail and institutional share classes separately (Section IA.5) and to considering funds with different investment styles separately (Section IA.6).

[16]Section IA.7 of the Internet Appendix shows that our results hold also if one considers just the first half or just the second half of the sample. Section IA.8 shows that our findings are robust to estimating alphas using a 36-month rolling window, instead of using the entire sample period for which we have return data for the fund.

Table 4: Traditional and achievable mutual-fund alphas

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven factor models listed in Table 3. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained by regressing the fund returns on all long-short factors for each model, and Panel B reports the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and with significantly positive alpha (alpha t-statistic greater than two). Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Average alpha	0.05	0.01	0.25	0.15	-0.06	-0.00	0.47
t-stat	1.06	0.16	4.77	3.14	-1.14	-0.10	10.82
Time-weighted average alpha	0.33	0.30	0.45	0.34	0.19	0.22	0.82
t-stat	6.71	7.42	8.40	7.09	3.61	4.61	19.45
10th percentile	-3.07	-2.35	-2.60	-2.44	-2.84	-2.60	-2.04
50th percentile	0.13	0.09	0.01	-0.02	-0.12	-0.06	0.48
90th percentile	3.06	2.40	3.45	3.01	3.05	2.89	2.97
Percentage of funds with $\alpha > 0$	52.50	51.70	50.24	49.47	47.46	49.05	61.30
Percentage of funds with $t(\alpha) > 2$	4.26	5.04	8.82	7.08	5.21	5.93	11.74
Panel B: Achievable alpha							
Average alpha	-0.02	-2.04	-2.32	-2.58	-3.60	-3.59	-1.33
t-stat	-0.44	-29.55	-37.72	-39.08	-53.05	-52.09	-22.18
Time-weighted average alpha	0.29	-1.32	-1.71	-1.96	-3.13	-3.12	-0.51
t-stat	5.98	-20.70	-30.36	-32.57	-50.03	-49.99	-9.09
10th percentile	-3.17	-6.36	-5.89	-6.49	-7.67	-7.64	-5.07
50th percentile	0.10	-1.37	-1.76	-1.95	-3.00	-3.00	-0.82
90th percentile	2.98	1.48	0.95	0.87	0.05	0.07	1.84
Percentage of funds with $\alpha > 0$	51.65	29.24	20.09	18.28	10.25	10.42	34.65
Percentage of funds with $t(\alpha) > 2$	3.85	2.01	0.75	0.85	0.27	0.24	2.76

Comparing Panels A and B of Table 4, we find that mutual-fund performance is substantially worse from the perspective of shortsale-constrained investors. For instance, while the proportion of mutual funds with positive traditional alpha with respect to the long-short factor models ranges from 47.46% for HXZ to 61.30% for VANG, the proportion of mutual funds with positive achievable alpha with respect to the long-only models is just

10.25% for HXZ and 34.65% for VANG.[17] This finding is robust to evaluating mutual-fund performance in terms of the proportion of funds with significantly positive alpha (t-statistic greater than two).[18] For instance, comparing the last rows in Panels A and B of Table 4, we find that while the proportion of mutual funds with significant ($t(\alpha) > 2$) traditional alpha with respect to the long-short factor models is 5.21% for HXZ and 11.74% for VANG, the proportion of mutual funds with significant achievable alpha with respect to the long-only models is just 0.27% for HXZ and 2.76% for VANG.

To facilitate the comparison with the closely related literature on mutual-fund skill (Berk and van Binsbergen, 2015; Barras et al., 2022), Table 4 evaluates fund performance in terms of *gross* alpha. However, it is also informative to evaluate mutual-fund performance using net-of-fees alpha, as this is the relevant economic criterion from an investor's perspective. Table IA.8 in Section IA.4 of the Internet Appendix shows that our findings are robust to evaluating mutual-fund performance in terms of net-of-fees alpha: the proportion of funds with positive achievable *net* alpha is substantially smaller than the proportion of funds with positive traditional net alpha.

Overall, the takeaway from this section is that mutual-fund performance is substantially worse from the perspective of shortsale-constrained investors.

3.3 Achievable Value-Added

Berk and van Binsbergen (2015) explain the importance of measuring mutual-fund performance in terms of value-added, which they define as the average of the product between a fund's realized gross abnormal returns and its assets under management. Table 5 reports cross-sectional statistics for the traditional and achievable fund value-added (in January 2000 million dollars) with respect to the seven factor models listed in Table 3. For each fund,

[17]The CAPM is the only benchmark relative to which mutual-fund performance using the traditional alpha is similar to that using the achievable alpha. However, the CAPM is a weak benchmark compared to the other factor models. Observe also that the difference between the traditional and achievable alphas and value-added with respect to the CAPM in Panels A and B of Tables 4 and 5 is small but not zero. To understand the reason for this, note that we compute alpha for each fund separately across the entire subsample for which we have return data for that fund. Although, across the entire sample, it is optimal to long the market, for the specific subsamples for which we have data on some mutual funds, it is optimal to short the market. Therefore, for those specific mutual funds, the achievable and traditional alphas are different. This is illustrated in the first panel of Figure 3 below, which shows that the CAPM model assigns a zero weight to MKT for a very small percentage of mutual funds (the red bar is around 1%).

[18]The alpha t-statistic accounts for the fund idiosyncratic risk, and thus complements the alpha metric.

we compute the *traditional* value-added as the average of the product of assets under management and realized gross abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and the *achievable* value-added computed using the fund realized gross abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio. We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized.

Similar to Table 4 for traditional and achievable alphas, Table 5 contains two panels: Panel A reports the average traditional value-added for the long-short factor models, and Panel B the average achievable value-added for the long-only factor models. Consistent with the findings of Berk and van Binsbergen (2015), Panel A of Table 5 shows that the average *traditional* value-added in the cross-section of mutual funds is generally negative when computed with respect to conventional factor models, ranging from −0.98 million dollars for the FF5 model to −3.32 million dollars for the CAPM model, but it is positive with respect to the VANG model at 0.69 million dollars, with a significant t-statistic of 3.48. Similarly, the time-weighted average traditional value-added is negative with respect to the conventional factor models, but positive with respect to the VANG model at 1.49 million dollars, with a significant t-statistic of 5.67.[19]

Comparing Panels A and B in Table 5, the key insight is that, consistent with the results in the previous section based on achievable and traditional alphas, the performance of mutual funds based on achievable value-added is substantially weaker than that in terms of traditional value-added. For instance, we find that while in Panel A the *proportion* of mutual funds with positive traditional value-added with respect to the long-short factor models ranges from 30.21% for HXZ to 45.70% for VANG, in Panel B the proportion of mutual funds with positive achievable value-added with respect to the long-only models is only 6.23% for HXZ and 19.00% for VANG. Also, while Panel A shows that the average and time-weighted average *traditional* value-added with respect to the VANG model are

[19]Note that we consider only funds investing in US equities, whereas Berk and van Binsbergen (2015) consider funds investing in all equities, that is, including international equities. As a result, their cross-sectional average value-added estimate is slightly larger than ours. In table 3 of their internet appendix, they show that the average value-added decreases when considering funds investing in only US equities.

Table 5: Traditional and achievable mutual-fund value-added

This table reports cross-sectional statistics for the traditional and achievable fund value-added with respect to the seven factor models listed in Table 3. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and realized gross abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using the fund realized gross abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range away from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-3.32	-1.33	-0.98	-1.26	-2.51	-2.08	0.69
t-stat	-12.49	-6.51	-3.99	-5.95	-10.91	-9.70	3.48
Time-weighted average value-added	-3.60	-0.99	-0.97	-1.29	-2.79	-2.26	1.49
t-stat	-10.34	-3.57	-2.98	-4.66	-9.08	-7.83	5.67
10th percentile	-15.84	-9.72	-9.70	-9.64	-11.78	-11.04	-6.26
50th percentile	-0.73	-0.45	-0.45	-0.52	-0.72	-0.63	-0.08
90th percentile	4.22	4.52	6.44	4.92	3.83	3.96	8.29
% of funds with average value-added >0	31.59	33.44	34.94	32.57	30.21	30.98	45.70
Panel B: Achievable value-added							
Average value-added	-3.49	-7.02	-10.38	-10.02	-16.60	-16.53	-5.66
t-stat	-12.87	-18.00	-24.55	-24.75	-28.30	-28.25	-17.72
Time-weighted average value-added	-3.72	-7.38	-12.56	-12.07	-21.24	-21.18	-5.15
t-stat	-10.54	-14.29	-22.98	-22.70	-27.60	-27.59	-12.49
10th percentile	-16.42	-25.73	-30.50	-30.38	-46.56	-46.22	-20.86
50th percentile	-0.80	-2.28	-3.27	-3.40	-5.30	-5.30	-1.87
90th percentile	4.11	1.55	0.10	0.11	-0.16	-0.15	1.68
% of funds with average value-added >0	30.52	18.33	11.56	11.64	6.23	6.61	19.00

positive, consistent with Berk and van Binsbergen (2015), Panel B shows that the average and time-weighted average *achievable* value-added with respect to the VANG model are both significantly negative.[20]

[20] Section IA.10 of the Internet Appendix shows that our findings are robust to estimating value-added using the flexible and bias-adjusted approach of Barras et al. (2022).

Table 6: Relative performance based on traditional and achievable metrics

This table reports the percentage of funds whose decile changes when they are sorted by achievable rather than traditional metrics. Panel A reports the results based on alpha, and Panel B on value-added. Achievable metrics are estimated with respect to the long-only version of the seven factor models and traditional metrics with respect to the long-short version.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Mutual funds sorted by alpha							
Decile changes (%)	4.83	77.93	81.54	82.29	83.38	82.87	73.25
Panel B: Mutual funds sorted by value-added							
Decile changes (%)	3.55	76.25	85.74	83.30	84.87	85.27	80.28

3.4 Relative Performance of Funds

The previous sections show that the *average* performance of mutual funds deteriorates significantly from the perspective of shortsale-constrained investors. In this section, we examine whether the *relative* performance of mutual funds changes for shortsale-constrained investors.

To do this, we sort mutual funds into deciles based on either the traditional or the achievable metric (alpha or value-added). Performance deciles are economically relevant because investors often allocate capital to mutual funds based on discrete ratings such as those published by Morningstar.[21] We then measure the percentage of mutual funds assigned to different deciles when sorted by the traditional versus the achievable metric.

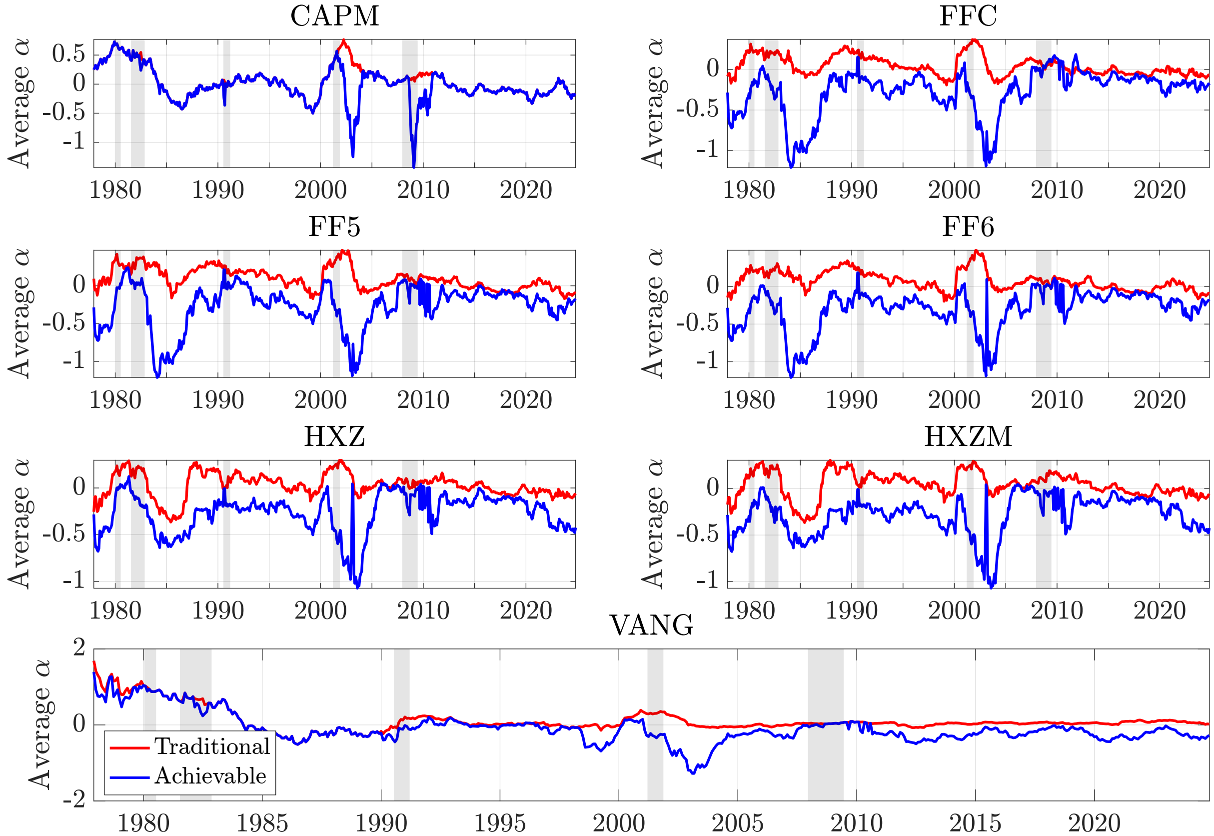
Panel A of Table 6 reports the results based on alpha, and Panel B reports the results based on value-added. Achievable metrics are estimated with respect to the long-only version of the seven factor models and traditional metrics with respect to the long-short version. Table 6 shows that, both in terms of alpha and value added, the decile of more than 70% of the funds changes when sorted by their achievable instead of traditional metric, for every model except CAPM.[22] Thus, relative mutual-fund performance is substantially different from the perspective of a shortsale-constrained investor. This finding has important implications for capital flows, which are known to depend on relative performance (Sirri and Tufano, 1998; Del Guercio and Tkac, 2008).

[21] Del Guercio and Tkac (2008, p. 907) explain that "It is the discrete change in the star rating itself and not the change in the underlying performance measures that drives flow."

[22] Section IA.9 of the Internet Appendix provides more details about the change in relative performance.

Figure 2: Time series of traditional and achievable alpha

This figure depicts the time series of the cross-sectional average traditional and achievable alpha computed using a 36-month rolling window for the seven models in Table 3. The traditional alpha is computed with respect to all long-short factors for each model, and the achievable alpha with respect to just those long-only factors that have a positive weight in the shortsale-constrained mean-variance portfolio for each 36-month window. Gray-shaded areas represent NBER recession periods.



3.5 Time Series of Traditional and Achievable Alphas

Above, we showed that there is a substantial difference between the traditional and achievable alphas. To understand whether this difference varies with macroeconomic conditions, Figure 2 depicts the time series of the cross-sectional average traditional and achievable alpha computed on a 36-month rolling window for the seven models in Table 3. Our choice of a 36-month rolling window is motivated by Morningstar and other investment platforms that often report mutual-fund performance over the past three years. The traditional alpha is computed with respect to all long-short factors for each model, and the achievable alpha with respect to just those long-only factors that have a positive weight in the shortsale-constrained mean-variance portfolio for each 36-month window. Gray shaded areas represent NBER recession periods.

Table 7: Difference in alphas during periods of financial turmoil

This table reports the slope coefficient for the market-risk variable in panel regression (5), along with its standard error and the R-squared. The independent variable is standardized so that the slopes can be interpreted as the change in the difference between the traditional and achievable alphas (in basis points) per one-standard-deviation increase in realized market volatility. The first seven columns report the results for separate panel regressions for each model, and the eighth column for a panel regression across all models. Standard errors are clustered by fund and time.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG	ALL
Slope (bps)	11.64	5.14	10.34	9.87	11.50	12.61	8.59	9.96
Standard errors (bps)	1.53	1.34	1.27	1.31	1.05	0.99	1.21	1.04
Model FE	No	No	No	No	No	No	No	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (%)	12.28	1.69	4.68	4.27	8.27	9.57	4.59	5.23

If shortsale constraints are more binding during periods of market turmoil, we would expect the difference between traditional and achievable alpha to be larger during these periods. Figure 2 confirms this hypothesis: the difference between the average traditional and achievable alphas widens during periods of financial turmoil such as the two back-to-back recessions in 1980 and 1981–82, the dot-com bubble of the early 2000's, the Great Financial Crisis of 2009, and the COVID pandemic for all models, including CAPM. This result contrasts with the findings in Table 4, which show that the traditional and achievable alphas with respect to the CAPM are very similar when estimated using the entire sample for each fund. However, when we estimate them using rolling windows, the average achievable alpha for the CAPM model is much lower than the average traditional alpha during the 2000's and 2009 financial crises.

We also formally estimate the relation between (i) the difference between the traditional and achievable alphas, and (ii) market risk, using the following panel regression:

$$\Delta\alpha_{mf,b,t} = \beta \cdot \text{Risk}_t + B_b + \text{MF}_{mf} + \varepsilon_{mf,b,t}, \tag{5}$$

where $\Delta\alpha_{mf,b,t}$ is the difference between the traditional and achievable alphas of mutual fund mf estimated under benchmark model b at time t, Risk_t is the realized market volatility at time t estimated from monthly market returns over the prior 36 months, B_b represents model fixed effects to account for systematic differences across benchmark models, MF_{mf} represents mutual-fund fixed effects to capture fund-specific characteristics, and $\varepsilon_{mf,b,t}$ is the error term.

Table 7 reports the slope coefficient for the market-risk variable in panel regression (5), along with its standard error and the R-squared. The independent variable is standardized so that the slopes can be interpreted as the change in the difference between the traditional and achievable alphas (in basis points) per one-standard-deviation increase in realized market volatility. The first seven columns report the results for separate panel regressions for each model, and the eighth column for a panel regression across all models. Table 7 shows that the relation between a one-standard-deviation increase in realized market volatility and the difference between the traditional and achievable alphas is significantly positive for every model, ranging from 5.14 basis points for the FFC model to 12.61 basis points for the HXZM model. The slope for the CAPM is also significantly positive at 11.64. This confirms the observation from Figure 2 that the difference between the traditional and achievable alphas increases with market volatility, that is, during periods of financial crises for every model (including CAPM).

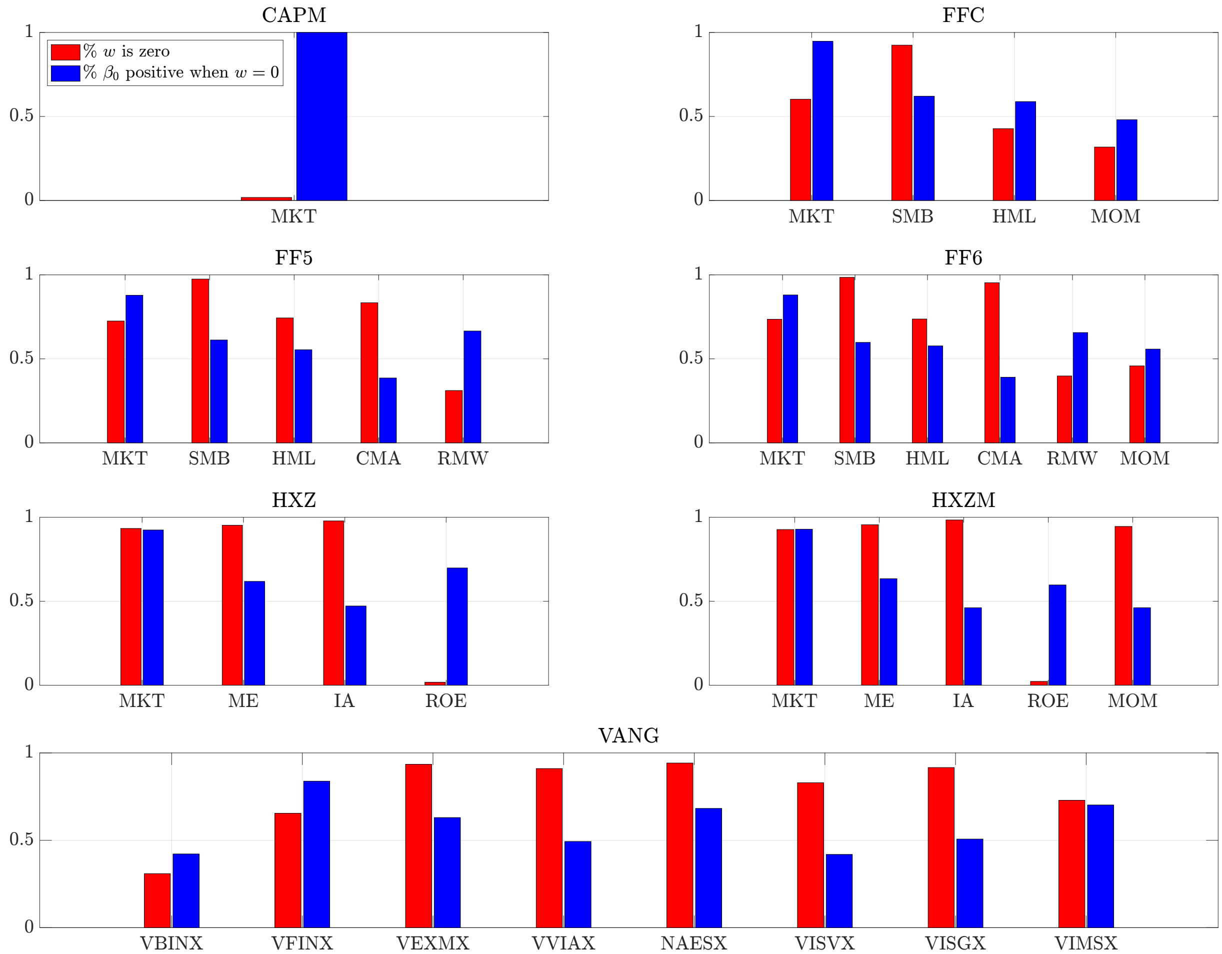
3.6 Why is Achievable Performance Worse?

Our results consistently show that the achievable alpha and value-added are smaller than their traditional counterparts. This is a counterintuitive finding because we compute the achievable alphas by dropping from the benchmark the factors with zero weight in the shortsale-constrained mean-variance portfolio, and one would expect that dropping factors from the benchmark would lead to higher estimated abnormal returns. However, Proposition 3 shows that if a fund has positive exposure to the factors with a zero weight in the shortsale-constrained mean-variance portfolio, then the achievable alpha is smaller than the traditional alpha. In this section, we show that it is indeed often the case in our sample that benchmark factors have zero weight in the mean-variance portfolio and mutual funds have positive exposure to such factors.

Each panel in Figure 3 depicts several statistics for the regression of fund returns on the returns of the long-only version of the seven factor models in Table 3. For each factor in each panel, we report the proportion of funds for which the factor has a zero weight in the shortsale-constrained mean-variance portfolio of the benchmark factors for the sample period for which we have return data for the fund (red bars). We also report the proportion of funds for which the loading on a factor with zero weight in the shortsale-constrained mean-variance portfolio is positive (blue bars). The red bars show that, except for the CAPM, many factors often have a zero weight in the mean-variance portfolio. For instance, for

Figure 3: Statistics from regression of fund returns on long-only factors

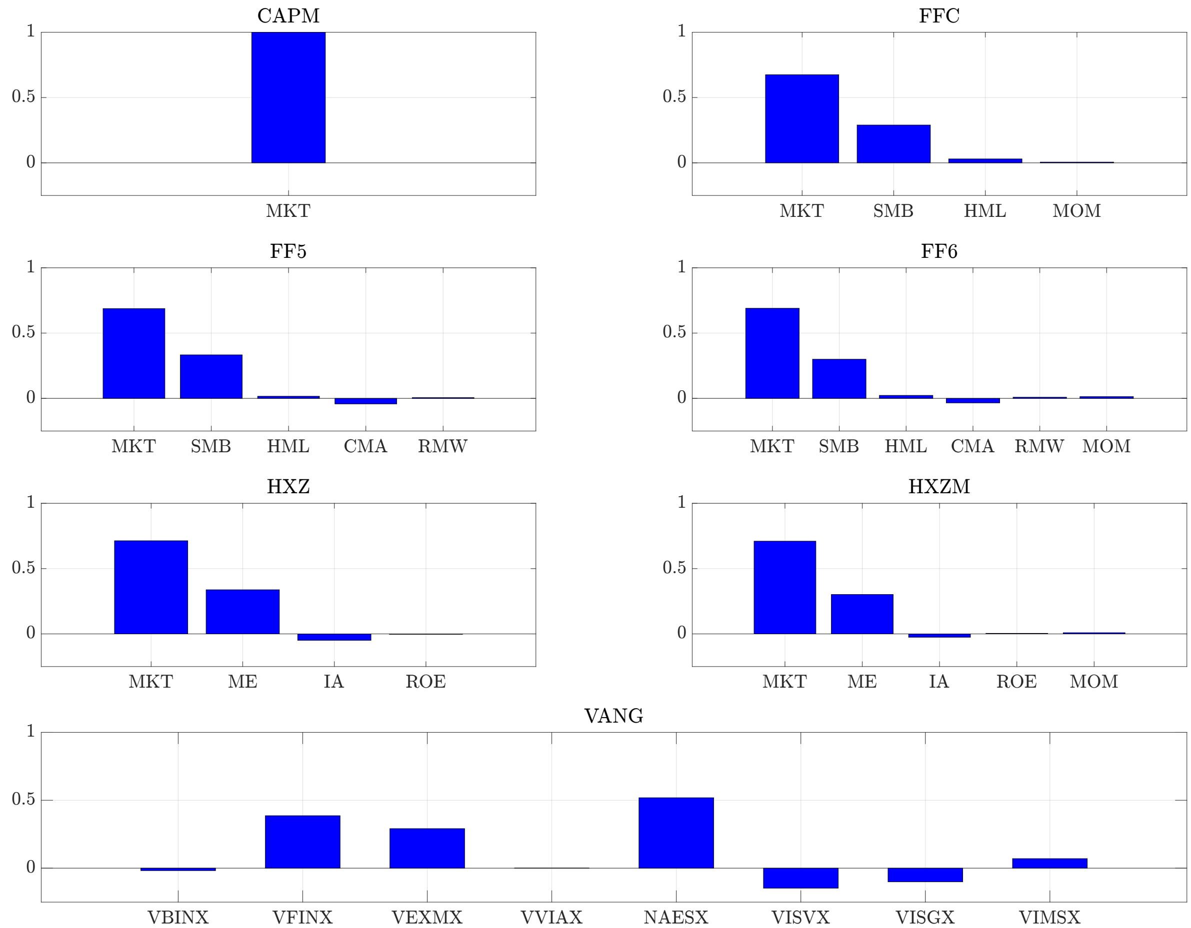
This figure presents several statistics from the regression of fund returns on the returns of long-only benchmark factor models. Each panel reports the results for the long-only version of the seven models in Table 3. For each factor in each panel, we report the proportion of funds for which the factor has a zero weight in the shortsale-constrained mean-variance portfolio of the benchmark factors for the sample period for which we have return data for the fund (red bars). We also report the proportion of funds for which the loading on a factor with zero weight in the shortsale-constrained mean-variance portfolio is positive (blue bars). The legend for the figure is displayed in the first plot (for CAPM).



the FFC benchmark model, both MKT and SMB have zero weight in the mean-variance portfolio for more than 50% of the mutual funds. Similarly, for HXZM, we observe that MKT, ME, IA, and MOM have zero weight for almost 100% of the funds. For VANG, we also observe that every factor except VBINX has zero weight in the mean-variance portfolio for more than 50% of the mutual funds. In addition, the blue bars show that many mutual funds have positive exposure to factors with zero weight in the mean-variance portfolio. For instance, for FFC, FF5, and FF6, we observe that conditional on the MKT and SMB factors

Figure 4: Contribution of each factor to alpha deterioration

This figure depicts the contribution of each factor to the difference between the traditional and achievable alphas averaged across all funds using Equation (6). Each panel reports the results for the long-only version of the seven models in Table 3.



having zero weight in the mean-variance portfolio for the sample period for which we have data for a fund, more than 50% of the funds have positive exposure to MKT and SMB.

Figure 4 reports the *contribution* of each factor to the difference between the traditional and achievable alphas averaged across all N funds. We compute the contribution of each factor using the following expression based on Equation (4) of Proposition 3:

$$\text{Contribution of } k\text{th factor} = \frac{\sum_{n=1}^{N}(-\beta_{\mathcal{T},0,k,n}\alpha_{0,+,k})}{\sum_{n=1}^{N}(-\beta_{\mathcal{T},0,n}\alpha_{0,+})} = \frac{\sum_{n=1}^{N}(-\beta_{\mathcal{T},0,k,n}\alpha_{0,+,k})}{\sum_{n=1}^{N}\sum_{k}^{K_0}(-\beta_{\mathcal{T},0,k,n}\alpha_{0,+,k})}, \qquad (6)$$

where $\alpha_{0,+}$ is the intercept from regressing the factors with zero weight in the shortsale-constrained mean-variance portfolio on those with positive weight, $\beta_{\mathcal{T},0,n}$ is the slope on the factors with zero weight in the shortsale-constrained mean-variance portfolio from regressing the nth fund returns on the benchmark factor returns, and $\alpha_{0,+,k}$ and $\beta_{\mathcal{T},0,k,n}$ are their kth elements. Figure 4 shows that the market and size factors contribute most to the difference between the traditional and achievable alphas. In particular, note that the factors with the largest contribution to the difference in traditional and achievable alpha are the MKT and SMB factors for the FFC, FF5, and FF6 models, MKT and ME for the HXZ and HXZM models, and the VFINX (large-cap blend), VEXMX (mid-cap blend), and NAESX (small-cap blend) funds for the VANG model.

Taken together, Proposition 3 and Figures 3 and 4 identify precisely why achievable alpha and value-added tend to be smaller than their traditional counterparts in our sample.

4 Economic Implications of Achievable Alpha

In this section, we examine the economic implications of the distinction between the achievable and traditional alphas for two central questions in mutual-fund research. First, we study the importance of traditional and achievable alphas in predicting future mutual-fund flows. Second, we study how the skill and scalability of mutual funds depend on whether one estimates them using traditional or achievable alphas.

4.1 Fund Flows

We now study whether past performance—measured by either traditional or achievable alpha—explains future mutual-fund flows, and how the relative importance of these two alphas varies with macroeconomic conditions. This analysis allows us to test whether investors' allocation decisions are correlated with traditional or achievable alpha (or both).

We define the flows for fund mf in month t as the percentage growth of new assets:

$$\text{Flow}_{mf,t} = \frac{\text{TNA}_{mf,t} - \text{TNA}_{mf,t-1} \times (1 + R_{rf,t} + R_{mf,t})}{\text{TNA}_{mf,t-1}}, \tag{7}$$

where $\text{TNA}_{mf,t}$ are the total net assets under management of mutual fund mf at the end of month t, $R_{rf,t}$ is the risk-free return, and $R_{mf,t}$ is the mutual-fund excess return.

To study the relation between past performance and fund flows, we run the following panel regression for each benchmark model:

$$\text{Flow}_{mf,t} = a \cdot \alpha_{mf,t-1} + \text{T}_t + \text{MF}_{mf} + \epsilon_{mf,t}, \tag{8}$$

where $\alpha_{mf,t-1}$ is the alpha of fund mf estimated using the returns of the prior 36 months, T_t are time fixed effects, MF_{mf} are mutual-fund fixed effects, and $\epsilon_{mf,t}$ is the error term.[23]

We run panel regression (8) first considering the traditional and achievable alphas individually, and then including both jointly as explanatory variables. Panel A of Table 8 reports the results from estimating the panel regression (8) considering the traditional alpha individually. Consistent with the existing literature, for every model we find that the traditional alpha is highly significant in explaining mutual-fund flows, with t-statistics above 20. Panel B of Table 8 reports the results from estimating the panel regression (8) considering the *achievable* alpha individually. As for the traditional alpha, we find that for every model, achievable alpha is highly significant in explaining mutual-fund flows, with t-statistics above 10.[24]

To study whether achievable alpha contains information about mutual-fund flows that is independent from that in traditional alpha, Panel C of Table 8 reports the results from estimating the panel regression (8) considering the traditional and achievable alphas *jointly*. We find that both traditional and achievable alphas are generally highly significant, with t-statistics exceeding five across models, except for the CAPM. Moreover, we find that the R-squared values in Panel C are higher than those in Panels A and B for every model except the CAPM. These findings demonstrate that traditional and achievable alphas contain independent information and suggest that the allocation decisions of at least some investors are correlated with achievable alpha even after controlling for traditional alpha.

To examine whether the relative importance of traditional and achievable alphas to explain fund flows depends on market conditions, Panel D of Table 8 reports the results from estimating a panel regression that considers the traditional and achievable alphas jointly and includes *also* their interactions with a "Risk" indicator variable that takes a value of one for months in the top decile of realized market volatility in the prior 36 months, and zero otherwise. We find that the sensitivity of fund flows to traditional alpha generally *weakens*

[23]For all regressions, we control for fund and time fixed effects by subtracting fund-level time-series means and time-level cross-sectional means from fund flows and alpha measures.

[24]We also find that, consistent with Barber, Huang, and Odean (2016) and Berk and van Binsbergen (2016), the CAPM traditional alpha explains mutual-fund flows at least as well as the traditional alpha of any of the other models, with an R-squared value of 1.670%, which is higher than those of every other model except FFC. Similarly, the CAPM *achievable* alpha explains mutual-fund flows at least as well as the achievable alphas of the other models, with an R-squared value of 1.549%, which is higher than those of the other models.

Table 8: Achievable and traditional alphas and fund flows

This table reports slope coefficients and their t-statistics for several versions of panel regression (8). Panel A considers the regression of fund flows on traditional alpha, Panel B the regression of fund flows on achievable alpha, Panel C the regression of fund flows on traditional and achievable alphas jointly, and Panel D the regression of fund flows on traditional and achievable alphas jointly and their interactions with a "Risk" indicator variable that takes a value of one for months in the top decile of realized market volatility in the prior 36 months, and zero otherwise. For all regressions, we consider time and fund fixed effects and double-cluster standard errors by time and fund. Fund flows and alphas are scaled by their full-sample standard deviation, computed across all fund-month observations.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Slope	0.129	0.137	0.119	0.114	0.127	0.129	0.116
	[26.650]	[34.519]	[24.253]	[23.964]	[22.737]	[32.361]	[24.921]
R-squared (%)	1.670	1.864	1.412	1.307	1.607	1.658	1.336
Panel B: Achievable alpha							
Slope	0.124	0.115	0.119	0.117	0.123	0.120	0.119
	[13.250]	[12.714]	[12.768]	[12.706]	[12.722]	[12.624]	[13.874]
R-squared (%)	1.549	1.330	1.427	1.379	1.502	1.444	1.420
Panel C: Traditional and achievable alpha							
Slope $\alpha_{\mathcal{T}}$	0.125	0.109	0.077	0.074	0.081	0.088	0.064
	[6.401]	[17.034]	[14.242]	[13.628]	[10.188]	[15.081]	[9.886]
Slope $\alpha_{\mathcal{A}}$	0.005	0.039	0.079	0.080	0.067	0.063	0.075
	[0.235]	[5.007]	[15.448]	[15.918]	[8.213]	[9.698]	[9.174]
R-squared (%)	1.670	1.942	1.859	1.795	1.849	1.888	1.642
Panel D: Traditional and achievable alpha with risk-interaction terms							
Slope $\alpha_{\mathcal{T}}$	0.129	0.111	0.079	0.076	0.084	0.091	0.068
	[6.379]	[16.625]	[13.566]	[13.137]	[10.613]	[15.590]	[9.759]
Slope $\alpha_{\mathcal{A}}$	-0.004	0.036	0.076	0.077	0.062	0.059	0.071
	[-0.171]	[4.622]	[14.604]	[15.204]	[8.027]	[9.364]	[8.698]
Slope $\alpha_{\mathcal{T}}\times$Risk	-0.041	-0.017	-0.024	-0.022	-0.022	-0.026	-0.022
	[-2.295]	[-2.013]	[-3.686]	[-3.499]	[-3.131]	[-4.608]	[-2.701]
Slope $\alpha_{\mathcal{A}}\times$Risk	0.056	0.023	0.030	0.027	0.035	0.034	0.027
	[3.092]	[2.983]	[5.068]	[4.514]	[5.722]	[6.165]	[4.037]
R-squared (%)	1.698	1.956	1.893	1.824	1.903	1.938	1.669

during periods of elevated market volatility, with the coefficient on the interaction between past traditional alpha and the Risk indicator variable being significantly negative for every model. In contrast, the relation between fund flows and achievable alpha *strengthens* when market volatility is high, with the coefficient for the interaction between the past achievable alpha and the Risk indicator variable being significantly positive for every model including CAPM. Taken together, our findings suggest that the allocation decisions of at least some investors are correlated with achievable alpha, even after controlling for traditional alpha, particularly during periods of high market volatility.

Table 9: Achievable skill and scalability

This table reports cross-sectional statistics for the scale and scalability parameters estimated from the traditional and achievable alphas using the approach of Barras et al. (2022), with respect to the seven factor models listed in Table 3. For each fund, we estimate the time-series regression in equation (5) of Barras et al. (2022) separately for the cases with traditional and achievable realized alphas. We report the average scale and scalability parameters across funds and their t-statistics. We also report percentiles of the cross-sectional distribution of fund-scale and scalability parameters, as well as the percentage of funds with positive scale and scalability parameters. Scale and scalability parameters are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Skill based on traditional alpha							
Average	3.88	2.30	2.48	2.31	2.68	2.47	2.67
T-stat	34.96	30.89	28.44	28.75	28.29	29.50	31.49
10th percentile	-1.54	-1.61	-1.95	-1.87	-2.18	-1.99	-1.46
50th percentile	3.26	2.21	2.16	2.06	2.23	2.23	2.41
90th percentile	10.19	6.55	7.48	6.90	7.99	7.40	7.39
Percentage funds $a > 0$	80.45	77.58	74.68	74.87	74.26	74.25	79.56
Panel B: Skill based on achievable alpha							
Average	3.92	2.07	2.11	1.25	1.25	1.18	3.24
T-stat	34.57	17.42	16.02	10.75	10.15	9.66	23.72
10th percentile	-1.53	-3.48	-3.83	-4.30	-4.54	-4.63	-2.95
50th percentile	3.36	1.91	1.52	1.01	0.74	0.72	2.60
90th percentile	10.30	7.99	8.47	7.02	7.47	7.25	10.15
Percentage funds $a > 0$	80.47	68.23	65.70	61.70	57.19	57.10	73.38
Panel C: Scale based on traditional alpha							
Average	57.65	34.33	35.59	34.97	38.96	36.61	30.65
T-stat	20.03	16.56	15.94	17.16	16.67	16.95	14.61
10th percentile	-5.39	-5.07	-6.50	-3.51	-8.56	-9.29	-5.62
50th percentile	128.97	99.19	107.07	89.74	108.20	102.77	56.66
90th percentile	320.05	231.00	248.49	224.65	257.99	241.81	204.05
Percentage funds $b > 0$	88.80	87.78	86.14	87.60	87.04	86.51	85.46
Panel D: Scale based on achievable alpha							
Average	59.78	62.15	60.51	56.77	74.22	72.60	66.71
T-stat	20.61	18.18	18.38	17.55	19.70	19.52	18.40
10th percentile	-3.16	-10.47	-8.63	-11.20	-14.44	-14.95	-12.62
50th percentile	135.94	94.40	111.20	96.74	75.72	75.22	117.65
90th percentile	325.86	353.28	347.24	335.52	383.79	379.54	385.43
Percentage funds $b > 0$	87.87	83.98	85.60	84.84	83.68	84.25	85.22

4.2 Skill and Scalability

We now compare the skill and scalability of mutual funds estimated using traditional and achievable alphas. To do this, we use the flexible and bias-adjusted econometric approach of Barras, Gagliardini, and Scaillet (2022), who write a fund's realized gross alpha at time t as a function of its skill and scalability:

$$\alpha_{mf,t} = a_{mf} - b_{mf} \times \text{TNA}_{mf,t-1}, \tag{9}$$

where a_{mf} and b_{mf} are the skill and scalability parameters for fund mf, and $\text{TNA}_{mf,t-1}$ is the total net assets (in year 2000 dollars) of fund mf at time $t-1$. Note that while a larger a_{mf} indicates higher skill, a larger b_{mf} implies lower scalability. For each fund, we estimate the time-series regression in equation (5) of Barras et al. (2022) separately for the cases with traditional and achievable realized alphas.

Table 9 reports cross-sectional statistics for the skill and scalability parameters obtained from the traditional and achievable alphas. Panel A shows that the average skill computed using the traditional and achievable alphas is not very different. In contrast, Panel B shows that the average scale parameter b_{mf} *increases* substantially (almost doubles) when estimated from achievable alpha for every model except CAPM. This indicates that the trading strategies of active mutual funds are *less scalable* from the perspective of a shortsale-constrained investor, and that their returns decline more steeply as scale increases.

5 Conclusion

About 88% of mutual-fund assets are held by retail investors, who rarely short because of the associated costs and risks. Yet the existing literature typically evaluates mutual-fund performance in terms of alpha, which implicitly assumes the investor can freely short the benchmark factors. We propose an alternative measure: *achievable alpha*, defined as the marginal improvement in mean-variance utility that a shortsale-constrained investor achieves when she has access to the fund in addition to the benchmark factors. We show theoretically that the achievable alpha can be measured by regressing the fund returns on the subset of benchmark factors with strictly positive weight in the shortsale-constrained mean-variance portfolio.

While one might expect achievable alpha to exceed traditional alpha because it is measured with respect to a restricted benchmark with a smaller number of factors, we identify the precise theoretical condition under which achievable alpha can be smaller: when a fund loads positively on underperforming factors excluded from the constrained benchmark. Intuitively, unconstrained investors can short these factors to hedge the risk of the fund and the other factors, whereas constrained investors cannot, which consequently reduces the marginal utility gain from investing in the fund.

Empirically, we evaluate mutual funds against seven benchmark models and find that performance is far worse from the perspective of constrained investors: while the proportion of mutual funds with positive traditional gross-of-fees alpha ranges from 47% for HXZ to 61% for VANG, the proportion of mutual funds with positive achievable alpha is only 10% for HXZ and 35% for VANG. These striking results are robust to measuring mutual-fund performance in terms of the value-added measure of Berk and van Binsbergen (2015). Moreover, the gap between traditional and achievable alphas widens during episodes of market turmoil, when shortsale constraints bind most tightly. Both traditional and achievable alphas jointly predict fund flows, but during volatile periods, the sensitivity of flows to traditional alpha weakens, while the sensitivity to achievable alpha strengthens. We also find that active strategies are far less scalable for shortsale-constrained investors.

Our findings are important for research, practice, and policy. For academics, they demonstrate that conventional measures of skill are inconsistent with investor constraints and overstate mutual-fund performance. For practitioners and platforms, they show that reporting should incorporate achievable alpha, especially for clientele who do not short. For regulators, they underscore the importance of disclosure standards that reflect the frictions faced by retail investors and pension funds. More broadly, our results bridge the mutual-fund and asset-pricing literatures by showing that ignoring shortsale constraints can severely bias inferences about mutual-fund performance.

A Appendix: Proofs of Propositions

In this section, we provide the proof for each proposition in the main text.

A.1 Proof of Proposition 1

The return of a portfolio in excess of the risk-free rate combines the return from the mean-variance portfolio combination of the benchmark factors and the excess return of the fund, that is,

$$R_{p,t} = w_b^\top R_{b,t} + w_{mf} R_{mf,t}, \tag{A1}$$

where $R_{b,t}$ is the K-dimensional vector of benchmark excess returns at time t with mean μ_b and covariance matrix Σ_b, w_b is the portfolio of benchmark factors, $R_{mf,t}$ is the mutual-fund excess return at time t, and w_{mf} is the weight on the fund. In addition, and without loss of generality, the fund's excess return is defined according to a linear factor model as

$$R_{mf,t} = \alpha_{\mathcal{T}} + \beta R_{b,t} + \epsilon_{b,t}, \tag{A2}$$

where $\epsilon_{b,t}$ is a zero-mean random variable with standard deviation σ_ϵ. Therefore, we can redefine the portfolio excess return as

$$R_{p,t} = (\underbrace{w_b + w_{mf}\beta}_{=\widetilde{w}_b})^\top R_{b,t} + w_{mf}(\alpha_{\mathcal{T}} + \epsilon_{b,t}). \tag{A3}$$

Because $R_{b,t}$ and $(\alpha_{\mathcal{T}} + \epsilon_{b,t})$ are uncorrelated by construction, we can optimize $\widetilde{w}_b$ and w_{mf} independently. Accordingly, define the investor's mean-variance utility from investing in the benchmark factors and the mutual fund as

$$\mathbb{E}\left[\widetilde{w}_b^\top R_{b,t} + w_{mf}(\alpha_{\mathcal{T}} + \epsilon_{b,t})\right] - \frac{\gamma}{2}\mathrm{Var}\left[\widetilde{w}_b^\top R_{b,t} + w_{mf}(\alpha_{\mathcal{T}} + \epsilon_{b,t})\right], \tag{A4}$$

where γ is the investor's relative risk-aversion parameter. Thus, the derivative of the investor's mean-variance utility with respect to w_{mf} is:

$$\frac{\partial\left\{\mathbb{E}\left[\widetilde{w}_b^\top R_{b,t} + w_{mf}(\alpha_{\mathcal{T}} + \epsilon_{b,t})\right] - \frac{\gamma}{2}\mathrm{Var}\left[\widetilde{w}_b^\top R_{b,t} + w_{mf}(\alpha_{\mathcal{T}} + \epsilon_{b,t})\right]\right\}}{\partial w_{mf}} = \alpha_{\mathcal{T}} - \gamma w_{mf}\sigma_\epsilon^2, \tag{A5}$$

and evaluating the derivative at $w_{mf} = 0$ gives $\alpha_{\mathcal{T}}$, which completes the proof. □

A.2 Proof of Proposition 2

Let the weights of the shortsale-constrained mean-variance portfolio of the benchmark factors be $w_b^* = (w_{b_+}^*, w_{b_0}^*)$, where $w_{b_+}^* > 0$ and $w_{b_0}^* = 0$. The investor's mean-variance utility for any portfolio w is

$$\text{MVU}(w) = \begin{bmatrix} \mu_{b_+}^\top & \mu_{b_0}^\top & \mu_{mf}^\top \end{bmatrix} w - \frac{\gamma}{2} w^\top \begin{bmatrix} \Sigma_{b_+} & \Sigma_{b_+,b_0} & \Sigma_{b_+,mf} \\ \Sigma_{b_0,b_+} & \Sigma_{b_0} & \Sigma_{b_0,mf} \\ \Sigma_{mf,b_+} & \Sigma_{mf,b_0} & \Sigma_{mf} \end{bmatrix} w.$$

Once the investor has access to the fund, the portfolio $w_0 = (w_{b_+}^*, w_{b_0}^* = 0, w_{mf} = 0)$ is no longer mean-variance efficient for her. Assuming the investor is currently holding the shortsale-constrained mean-variance portfolio of the benchmark factors w_0, she would maximize the marginal improvement to her mean-variance utility by shifting her portfolio in the direction of the feasible part of the gradient of her mean-variance utility evaluated at w_0, that is, by shifting her portfolio as follows:

$$w = w_0 + \delta \nabla_w \text{MVU}(w_0), \tag{A6}$$

where δ is infinitesimally small and $\nabla_w \text{MVU}(w_0)$ is the gradient of the investor's mean-variance utility evaluated at w_0. Moreover,

$$\nabla_w \text{MVU}(w) = \begin{bmatrix} \mu_{b_+} \\ \mu_{b_0} \\ \mu_{mf} \end{bmatrix} - \gamma \begin{bmatrix} \Sigma_{b_+} & \Sigma_{b_+,b_0} & \Sigma_{b_+,mf} \\ \Sigma_{b_0,b_+} & \Sigma_{b_0} & \Sigma_{b_0,mf} \\ \Sigma_{mf,b_+} & \Sigma_{mf,b_0} & \Sigma_{mf} \end{bmatrix} \begin{bmatrix} w_{b_+} \\ w_{b_0} \\ w_{mf} \end{bmatrix}. \tag{A7}$$

Therefore, the gradient evaluated at w_0 is

$$\nabla_w \text{MVU}(w_0) = \begin{bmatrix} \mu_{b_+} \\ \mu_{b_0} \\ \mu_{mf} \end{bmatrix} - \gamma \begin{bmatrix} \Sigma_{b_+} & \Sigma_{b_+,b_0} & \Sigma_{b_+,mf} \\ \Sigma_{b_0,b_+} & \Sigma_{b_0} & \Sigma_{b_0,mf} \\ \Sigma_{mf,b_+} & \Sigma_{mf,b_0} & \Sigma_{mf} \end{bmatrix} \begin{bmatrix} w_{b_+}^* \\ 0 \\ 0 \end{bmatrix} \tag{A8}$$

$$= \begin{bmatrix} \mu_{b_+} - \gamma \Sigma_{b_+} w_{b_+}^* \\ \mu_{b_0} - \gamma \Sigma_{b_0,b_+} w_{b_+}^* \\ \mu_{mf} - \gamma \Sigma_{mf,b_+} w_{b_+}^* \end{bmatrix}. \tag{A9}$$

Note that $w_b^* = (w_{b_+}^*, w_{b_0}^* = 0)$ is the shortsale-constrained mean-variance portfolio for the case where the investor does not have access to the fund. Thus, the first-order optimality conditions for the investor without access to the fund imply that $\mu_{b_+} - \gamma \Sigma_{b_+} w_{b_+}^* = 0$, $\mu_{b_0} - \gamma \Sigma_{b_0,b_+} w_{b_+}^* \leq 0$, and $w_{b_+}^* = \frac{1}{\gamma} \Sigma_{b_+}^{-1} \mu_{b_+}$. Consequently

$$\nabla_w \text{MVU}(w_0) = \begin{bmatrix} 0 \\ \mu_{b_0} - \gamma \Sigma_{b_0,b_+} w_{b_+}^* \leq 0 \\ \mu_{mf} - \Sigma_{mf,b_+} \Sigma_{b_+}^{-1} \mu_{b_+} \end{bmatrix}. \tag{A10}$$

Furthermore, note that $\alpha_{\mathcal{A}} = \mu_{mf} - \Sigma_{mf,b_+}\Sigma_{b_+}^{-1}\mu_{b_+}$ is the alpha of the fund with respect to the b_+ benchmark factors, that is, the factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio. Thus, for an investor with relative risk-aversion γ, we have that

$$\nabla_w \text{MVU}(w_0) = \begin{bmatrix} 0 \\ \mu_{b_0} - \gamma\Sigma_{b_0,b_+} w^*_{b_+} \leq 0 \\ \alpha_{\mathcal{A}} \end{bmatrix}. \tag{A11}$$

From the above expression, note that the gradient of the investor's mean-variance utility with respect to w_{b_+} is zero, which means she has no incentive to change her weight on the b_+ factors. The gradient of her mean-variance utility with respect to the b_0 factors is negative, which implies (because of shortsale constraints) she cannot reduce the weight on the b_0 factors. Finally, the gradient of her mean-variance utility with respect to the weight on the fund is equal to the fund's alpha $\alpha_{\mathcal{A}}$. Thus, to maximize the marginal improvement to her mean-variance utility, the investor should increase her weight on the fund while keeping the weights on the benchmark factors fixed at $w^*_b = (w^*_{b_+}, w^*_{b_0} = 0)$, and the marginal improvement to her mean-variance utility per dollar invested in the fund will be $\alpha_{\mathcal{A}}$. □

A.3 Proof of Proposition 3

First, without loss of generality, we define the factors to which the shortsale-constrained mean-variance portfolio assigns a weight of zero as in Equation (3). Second, we define the shortsale-constrained mean-variance portfolio of all the K benchmark factors as

$$w_b = \frac{1}{\gamma}\Sigma_b^{-1}[\mu_b + \eta_b], \tag{A12}$$

where $\eta_b \geq 0 \in R^K$ is the vector of Lagrange multipliers associated with the non-negativity constraints. The partition covariance matrix Σ_b can then be written as

$$\Sigma_b = \begin{bmatrix} \Sigma_{b_+} & \Sigma_{b_+,b_0} \\ \Sigma^\top_{b_+,b_0} & \Sigma_{b_0} \end{bmatrix}, \tag{A13}$$

where $\Sigma_{b_+} \in R^{K_+ \times K_+}$ is the covariance matrix for the factors $R_{b_+,t}$ for which the shortsale-constrained mean-variance portfolio assigns a positive weight, $\Sigma_{b_0} \in R^{K_0 \times K_0}$ is the covariance matrix for the factors $R_{b_0,t}$ for which the shortsale-constrained mean-variance portfolio assigns a zero weight, and $\Sigma_{b_+,b_0} \in R^{K_+ \times K_0}$ is the covariance matrix between the $R_{b_+,t}$ and

$R_{b_0,t}$ factors. The partitioned vector of means is

$$\mu_b = \begin{bmatrix} \mu_{b_+} \\ \mu_{b_0} \end{bmatrix}, \tag{A14}$$

where $\mu_{b_+} \in R^{K_+}$ is the vector of mean returns for the factors $R_{b_+,t}$ for which the shortsale-constrained mean-variance portfolio assigns a positive weight and $\mu_{b_0} \in R^{K_0}$ is the vector of mean returns for the factors $R_{b_0,t}$ for which the shortsale-constrained mean-variance portfolio assigns a zero weight.

Now, using the definition for the partitioned inverse covariance matrix, its inverse is

$$\Sigma_b^{-1} = \begin{bmatrix} \Sigma_{b_+}^{-1} + \Sigma_{b_+}^{-1}\Sigma_{b_+,b_0}S^{-1}\Sigma_{b_+,b_0}^{\top}\Sigma_{b_+}^{-1} & -\Sigma_{b_+}^{-1}\Sigma_{b_+,b_0}S^{-1} \\ -S^{-1}\Sigma_{b_+,b_0}^{\top}\Sigma_{b_+}^{-1} & S^{-1} \end{bmatrix}, \tag{A15}$$

where $S = \Sigma_{b_0} - \Sigma_{b_+,b_0}^{\top}\Sigma_{b_+}^{-1}\Sigma_{b_+,b_0}$. From this, we can obtain the following closed-form expression for the weights assigned to the factors $R_{b_0,t}$,

$$w_{b_0} = \frac{1}{\gamma}S^{-1}\big[\underbrace{\mu_0 - \Sigma_{b_+,b_0}^{\top}\Sigma_{b_+}^{-1}\mu_+}_{\alpha_{0,+}} \underbrace{-\Sigma_{b_+,b_0}^{\top}\Sigma_{b_+}^{-1}\eta_+ + \eta_0}_{\eta_0}\big]. \tag{A16}$$

The first underbrace bracket comes from the fact that $\Sigma_{b_+,b_0}^{\top}\Sigma_{b_+}^{-1} = \phi$ in Equation (3), and the second underbrace bracket comes from the fact that $\eta_+ = 0$, i.e., the vector of Lagrange multipliers associated with factors that have a positive weight is zero. Thus, we have that

$$w_{b_0} = \frac{1}{\gamma}S^{-1}[\alpha_{0,+} + \eta_0] = 0, \tag{A17}$$

because w_{b_0} is the vector of weights for which the shortsale-constrained mean-variance portfolio finds optimal to assign a zero weight. Pre-multiplying w_{b_0} with γS, we have that

$$[\alpha_{0,+} + \eta_0] = 0, \tag{A18}$$

which implies that $\alpha_{0,+} = -\eta_0$. Because $\eta_0 > 0$ is the vector of Lagrange multipliers associated with the non-negativity constraints of the factors for which the shortsale-constrained mean-variance portfolio assigns a zero weight, we have that the elements of the vector of intercepts $\alpha_{0,+}$ in Equation (3) are all negative.

In the second part of the proof, we show the mechanism underlying the alpha decay associated with replacing the benchmark model without shortsale constraints with a more parsimonious factor model that drops the factors for which the shortsale-constrained mean-variance portfolio assigns zero weight. To do that, we plug into the equation for the traditional alpha, the expression for the factors $R_{b_0,t}$ in Equation (3). This yields:

$$\alpha_{\mathcal{T}} = R_{mf,t} - \beta_{\mathcal{T},+} R_{b_+,t} - \beta_{\mathcal{T},0} \left(\alpha_{0,+} + \beta_{0,+} R_{b_+,t} + \epsilon_{0,+,t} \right) - \epsilon_{b,t}. \tag{A19}$$

Rearranging terms and taking expectations, we have

$$\alpha_{\mathcal{T}} = \underbrace{R_{mf,t} - \overbrace{(\beta_{\mathcal{T},+} + \beta_{\mathcal{T},0}\beta_{0,+})}^{\tilde{\beta}_{\mathcal{A}}} R_{b_+,t}}_{\alpha_{\mathcal{A}} + \tilde{\epsilon}_{b,t}} - \beta_{\mathcal{T},0}\alpha_{0,+} - \beta_{\mathcal{T},0}\epsilon_{0,+,t} - \epsilon_{b,t}, \tag{A20}$$

and thus,

$$\alpha_{\mathcal{T}} - \alpha_{\mathcal{A}} = -\beta_{\mathcal{T},0}\alpha_{0,+},$$

which is the desired result. □

A.4 Proposition A.4

Proposition A.4. *The set of benchmark factors with strictly positive weight in the shortsale-constrained mean-variance portfolio does not depend on the risk-aversion parameter γ. Consequently, the achievable alpha and the Sharpe ratio of the shortsale-constrained mean-variance portfolio are also independent of γ.*

Proof. The shortsale-constrained mean-variance portfolio of the benchmark factors solves

$$\max_{w_b \geq 0} \quad w_b^\top \mu_b - \frac{\gamma}{2} w_b^\top \Sigma_b \, w_b, \tag{A21}$$

where μ_b is the vector of mean excess returns and Σ_b is the covariance matrix. Substituting $w_b = \frac{1}{\gamma} v$, so that $w_b \geq 0$ if and only if $v \geq 0$, the problem becomes

$$\max_{v \geq 0} \quad \frac{1}{\gamma} v^\top \mu_b - \frac{1}{2\gamma} v^\top \Sigma_b \, v = \frac{1}{\gamma} \left(v^\top \mu_b - \frac{1}{2} v^\top \Sigma_b \, v \right). \tag{A22}$$

Because $\frac{1}{\gamma} > 0$, this is equivalent to

$$\max_{v \geq 0} \quad v^\top \mu_b - \frac{1}{2} v^\top \Sigma_b \, v, \tag{A23}$$

which is independent of γ. Because Σ_b is positive definite, this problem has a unique solution v^* that does not depend on γ. The solution to the original problem is therefore $w_b^*(\gamma) = \frac{1}{\gamma} v^*$, and factor i receives a strictly positive weight, $w^*_{b,i}(\gamma) > 0$, if and only if $v^*_i > 0$. Because the set $\{i : v^*_i > 0\}$ is independent of γ, the set of factors with nonzero weight in the shortsale-constrained mean-variance portfolio is the same for all values of γ. It follows that the achievable alpha is also independent of γ, because by Proposition 2 it is determined solely by which factors receive a positive weight in the shortsale-constrained portfolio, and this set does not depend on γ.

Finally, the Sharpe ratio of the optimal portfolio is

$$\mathrm{SR}(\gamma) = \frac{w^*_b(\gamma)^\top \mu_b}{\sqrt{w^*_b(\gamma)^\top \Sigma_b \, w^*_b(\gamma)}} = \frac{\frac{1}{\gamma} v^{*\top} \mu_b}{\sqrt{\frac{1}{\gamma^2} v^{*\top} \Sigma_b \, v^*}} = \frac{v^{*\top} \mu_b}{\sqrt{v^{*\top} \Sigma_b \, v^*}},$$

which is independent of γ. □

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Internet Appendix to

Rethinking Mutual Fund Performance: From Traditional Alpha to Achievable Alpha

This Internet Appendix reports the following robustness checks and additional results: (i) relaxing the shortsale constraints, (ii) replacing each original factor's short leg with a long-only portfolio of mutual funds with significantly negative exposure to the original factor's short leg, (iii) considering factor models that include long positions in both the long and the short leg of academic factors, (iv) evaluating mutual-fund performance in terms of traditional and achievable alphas *net* of fund fees, (v) evaluating mutual-fund performance separately for retail and institutional share classes, (vi) evaluating mutual-fund performance separately for different fund styles, (vii) evaluating mutual-fund performance across different subsample periods, (viii) studying the time variation in the traditional and achievable alphas, (ix) studying the change in decile when ranking funds by achievable alpha instead of traditional alpha, (x) estimating value-added using the flexible and bias-adjusted econometric approach of Barras et al. (2022), (xi) evaluating fund skill and scalability using log assets under management, (xii) considering an alternative approach for imputing missing observations in the Vanguard benchmark model, and (xiii) evaluating out-of-sample achievable and traditional alpha and value-added.

IA.1 Relaxing the Shortsale Constraints

In the previous sections, we evaluated the achievable alpha for an investor who cannot short the benchmark factors. While these shortsale constraints represent a realistic scenario for most retail and institutional investors, such as certain pension funds, we now evaluate the performance of mutual funds for investors that can engage in a *limited* amount of shortselling. Section IA.1.1 considers the case of an investor who can short *only* the market factor using, for instance, an inverse market ETF. Section IA.1.2 considers the case of an investor who can short the benchmark factors but faces a leverage constraint, so the overall amount of shorting is restricted.

IA.1.1 Shorting the Market

We now evaluate the performance of mutual funds for an investor who can short the market using, for instance, an inverse ETF. Note that inverse ETFs do not represent the alternative investment opportunity set available to retail investors in our sample for two reasons. First, a market inverse ETF has been available to investors only since 2006, whereas the mutual-fund sample we use for performance evaluation starts in January 1975. Second, inverse

Table IA.1: Fund performance for investors who can short the market

This table reports cross-sectional statistics for the achievable fund alpha and value-added with respect to the long-only version of the seven factor models listed in Table 3 for investors who can short the market. Panels A and B report cross-sectional statistics of the achievable alpha and value-added with respect to the market plus other benchmark factors with positive weight in the mean-variance portfolio of an investor who can short only the market. We report the average alpha and value-added across funds, their t-statistics, the time-weighted average achievable alpha and value-added, where the weight is proportional to the length of the sample period for which we have return data for the fund, and their t-statistics. We also report the percentiles of the cross-sectional distributions of achievable fund alpha and value-added, the percentage of funds with positive achievable alpha and value-added, and the percentage of funds with achievable alpha and value-added t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Achievable alpha							
Average alpha	0.05	-0.79	-0.88	-1.12	-1.80	-1.80	-0.86
t-stat	1.06	-14.82	-16.87	-20.92	-26.56	-26.57	-15.15
Time-weighted average alpha	0.33	-0.42	-0.58	-0.82	-1.49	-1.50	-0.21
t-stat	6.71	-8.15	-11.61	-15.69	-22.73	-22.73	-3.99
10th percentile	-3.07	-4.02	-4.00	-4.36	-5.87	-5.87	-4.24
50th percentile	0.13	-0.34	-0.67	-0.77	-1.26	-1.26	-0.37
90th percentile	3.06	2.07	1.98	1.80	1.80	1.80	2.14
Percentage of funds with α >0	52.50	43.02	37.42	36.17	32.16	32.16	42.34
Percentage of funds with $t(\alpha)$ >2	4.26	4.53	2.45	3.00	3.03	3.00	4.08
Panel B: Achievable value-added							
Average value-added	-3.32	-3.72	-5.07	-5.26	-8.51	-8.50	-5.01
t-stat	-12.57	-13.74	-17.03	-18.00	-20.66	-20.65	-17.74
Time-weighted average value-added	-3.60	-4.05	-6.40	-6.67	-10.70	-10.69	-5.02
t-stat	-10.34	-11.09	-15.84	-16.71	-19.45	-19.44	-13.66
10th percentile	-15.84	-15.85	-19.17	-20.23	-29.08	-29.07	-19.30
50th percentile	-0.73	-0.95	-1.42	-1.42	-2.14	-2.14	-1.35
90th percentile	4.22	3.37	2.15	2.25	1.90	1.90	2.75
Percentage of funds with value-added>0	31.59	28.47	23.39	23.97	21.53	21.50	23.62

ETFs represent a minuscule fraction of the ETF industry—as of November 2024, the ETF database lists around 72 inverse ETFs with an aggregate AUM of only around 8.4 billion dollars.[1] Nonetheless, we undertake this exercise because it is informative to evaluate the performance of mutual funds for an investor who could short the market.

It is straightforward to extend Proposition 2 to show that the marginal utility improvement for an investor (who can short only the market) when she has access to a mutual

[1]See https://etfdb.com/etfdb-category/inverse-equities/.

fund in addition to the benchmark factors is measured by the achievable alpha, defined as the fund's alpha with respect to the return of the market factor plus the returns of other benchmark factors with positive weight in the investor's mean-variance portfolio. Similarly, the achievable value-added can be computed using the mutual fund's realized gross abnormal returns with respect to the market and other benchmark factors with positive weight in the investor's portfolio. For the VANG model, we allow the investor to assign a positive or negative weight to VFINX, the Vanguard fund that tracks the S&P 500 index.

Panels A and B of Table IA.1 report the achievable alpha and value-added of an investor who has access to long-only benchmark factors and can short the market. As expected, the percentage of funds with positive achievable alpha and value-added increases when the investor can short the market.[2] Nonetheless, consistent with the results in Section 3, we find that (for every model except the CAPM) the achievable alpha and value-added of this investor are much smaller than the traditional alpha and value-added of an unconstrained investor who has access to long-short benchmark factors, which we report in Panel A of Tables 4 and 5. For instance, when the investor can short the market, the percentage of mutual funds with positive achievable alpha with respect to the long-only version of the models ranges between 32.16% for HXZ and 42.34% for VANG, whereas for an unconstrained investor it ranges between 47.46% for HXZ and 61.30% for VANG, as shown in Panel A of Table 4. Similarly, when the investor can short the market, the percentage of mutual funds with positive achievable value-added with respect to the long-only models is 21.53% for HXZ and 23.62% for VANG, while for an unconstrained investor it is 30.21% for HXZ and 45.70% for VANG, as shown in Panel A of Table 5.

Table IA.2 reports the difference in decile ranks of mutual funds based on the traditional and achievable alphas and value-added with respect to the long-only version of the factor models for investors who can short only the market. The table shows that the decile rank of more than 60% of the funds changes by at least one decile across all factor models except the CAPM. Thus, while the ability of investors to short the market can help them

[2]For instance, when the investor cannot short the market, the percentage of mutual funds with positive achievable alpha with respect to the long-only version of the factor models is 10.25% for HXZ and 34.65% for VANG. In contrast, when the investor can short the market, the percentage of mutual funds with positive achievable alpha with respect to the long-only version of the benchmark models ranges between 32.16% for HXZ and 42.34% for VANG. Similarly, when the investor cannot short the market, the percentage of mutual funds with positive achievable value-added with respect to the long-only benchmark models is 6.23% for HXZ and 19.00% for VANG. In contrast, when an investor can short the market, the percentage of mutual funds with positive achievable value-added with respect to the long-only models is 21.53% for HXZ and 23.62% for VANG.

Table IA.2: Relative performance: Investors who can short the market

This table reports the percentage of funds whose decile changes when we sort them based on achievable instead of traditional metrics, when we allow investors to short the market. Panel A reports the results based on alpha, and Panel B on value-added. Achievable metrics are estimated with respect to the long-only versions of the seven benchmark factor models, whereas traditional metrics with respect to the long-short versions.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Mutual funds sorted by alpha							
Decile changes (%)	0.00	71.80	76.77	78.34	83.76	83.51	75.46
Panel B: Mutual funds sorted by value-added							
Decile changes (%)	0.00	60.61	74.31	72.32	75.52	75.73	80.71

benefit from investing in active mutual funds, the *relative* performance of mutual funds for such investors remains sensitive to shortsale constraints on the other benchmark factors.

There are two takeaways from the results in Tables IA.1 and IA.2. The first is that, even though inverse ETFs represent only a small fraction of the ETF market, they have the potential to improve the mean-variance efficiency gains offered by active mutual funds to shortsale-constrained investors. The second is that, despite being able to short the market, the achievable alpha and value-added of a shortsale-constrained investor are still much smaller than the traditional alpha and value-added of an unconstrained investor, and the relative rankings of funds are still substantially different under the traditional and achievable metrics.

IA.1.2 Leverage-Constrained Investors

We now consider the case of a mean-variance investor who can short the benchmark factors, but faces a constraint on overall leverage. Specifically, we consider an investor whose aggregate short position has to be smaller than a fraction δ of her aggregate long position. The portfolio selection problem of this investor can be formulated as:

$$\max_{w_b, w_{mf}} \quad \text{MVU}(w_b, w_{mf}) \tag{IA1}$$

$$\text{s.t.} \quad w_b + \psi_s - \psi_\ell = 0, \tag{IA2}$$

$$w_{mf} + \nu_s - \nu_\ell = 0, \tag{IA3}$$

$$e^\top \psi_s + \nu_s \leq \delta(e^\top \psi_\ell + \nu_\ell), \tag{IA4}$$

$$\psi_\ell,\ \psi_s,\ \nu_\ell,\ \nu_s \geq 0, \tag{IA5}$$

where w_b is the vector of benchmark factor weights, w_{mf} is the weight on the mutual fund, ψ_s and ψ_ℓ are vectors of slack variables that measure the negative and positive positions of the benchmark portfolio, ν_s and ν_ℓ are scalar slack variables that measure the negative and positive positions on the mutual fund, e is the vector of ones, the constraint $e^\top \psi_s + \nu_s \leq \delta(e^\top \psi_\ell + \nu_\ell)$ requires that the aggregate short position of the investor be smaller than a fraction δ of her aggregate long position, and the investor's mean-variance utility is

$$\text{MVU}(w_b, w_{mf}) = \begin{bmatrix} \mu_b^\top & \mu_{mf}^\top \end{bmatrix} \begin{bmatrix} w_b \\ w_{mf} \end{bmatrix} - \frac{\gamma}{2} \begin{bmatrix} w_b^\top & w_{mf}^\top \end{bmatrix} \begin{bmatrix} \Sigma_b & \Sigma_{b,mf} \\ \Sigma_{mf,b} & \Sigma_{mf} \end{bmatrix} \begin{bmatrix} w_b \\ w_{mf} \end{bmatrix}. \quad \text{(IA6)}$$

For a given w_{mf}, the optimal portfolio of the benchmark factors for the leverage-constrained investor is the maximizer of the following portfolio selection problem:

$$\text{MVU}^*(w_{mf}) = \max_{w_b} \quad \text{MVU}(w_b, w_{mf}) \quad \text{(IA7)}$$

$$\text{s.t.} \quad w_b + \psi_s - \psi_\ell = 0, \quad \text{(IA8)}$$

$$w_{mf} + \nu_s - \nu_\ell = 0, \quad \text{(IA9)}$$

$$e^\top \psi_s + \nu_s \leq \delta(e^\top \psi_\ell + \nu_\ell), \quad \text{(IA10)}$$

$$\psi_\ell,\ \psi_s,\ \nu_\ell,\ \nu_s \geq 0, \quad \text{(IA11)}$$

where $\text{MVU}^*(w_{mf})$ is the optimal mean-variance utility as a function of the weight on the mutual fund w_{mf}.

In the following proposition, we characterize the marginal mean-variance utility improvement that a leverage-constrained investor can achieve by investing in the fund in addition to the benchmark factors.

Proposition IA.1 *Let the leverage-constrained mean-variance portfolio of the benchmark factors be w_b^*, i.e., let w_b^* be the solution to problem (IA7)–(IA11) for $w_{mf} = 0$. Then, the marginal mean-variance utility improvement that a leverage-constrained investor can achieve by investing in the fund in addition to the benchmark factors is the achievable alpha,*

$$\alpha_{\mathcal{A}} = \mu_{mf} - \gamma \Sigma_{mf,b}\, w_b^* - \lambda, \quad \text{(IA12)}$$

where μ_{mf} is the mean gross return of the fund, γ is the investor's relative risk aversion, $\Sigma_{mf,b}$ is the covariance between the mutual fund return and the benchmark factor returns, and λ is the Lagrange multiplier for the constraint $w_{mf} + \nu_s - \nu_\ell = 0$ for problem (IA7)–(IA11) at the maximizer w_b^* for the value of $w_{mf} = 0$.

Table IA.3: Achievable alpha for leverage-constrained investors

This table reports the average traditional and achievable alphas for unconstrained and leverage-constrained investors, respectively. We consider 11 different levels of leverage, ranging from $\delta = 0$, where the investor is not allowed to short at all, to $\delta = 1$, where the investor is allowed to short 100% of her long position.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Traditional alpha	0.05	0.01	0.25	0.15	-0.06	-0.00	0.47
Achievable alpha with δ =0	-0.02	-2.04	-2.32	-2.58	-3.60	-3.59	-1.33
Achievable alpha with δ =0.1	-0.02	-2.32	-2.65	-2.96	-4.06	-4.05	-1.63
Achievable alpha with δ =0.2	-0.02	-2.58	-2.97	-3.33	-4.56	-4.58	-1.84
Achievable alpha with δ =0.3	-0.02	-2.79	-3.28	-3.72	-5.10	-5.12	-1.96
Achievable alpha with δ =0.4	-0.02	-2.86	-3.59	-4.10	-5.64	-5.68	-2.11
Achievable alpha with δ =0.5	-0.02	-2.72	-3.85	-4.47	-6.07	-6.12	-2.05
Achievable alpha with δ =0.6	-0.02	-2.35	-3.98	-4.79	-6.15	-6.31	-0.71
Achievable alpha with δ =0.7	-0.02	-1.75	-3.88	-4.76	-6.05	-6.32	0.23
Achievable alpha with δ =0.8	-0.02	-0.81	-3.08	-4.27	-4.50	-4.97	0.29
Achievable alpha with δ =0.9	-0.02	-0.30	-0.73	-1.27	-1.09	-1.28	0.26
Achievable alpha with δ =1	-0.02	-0.16	0.10	-0.15	-0.51	-0.54	0.39

Proof. Using the envelope theorem (Mas-Colell, Whinston, and Green, 1995, p. 965)

$$\frac{d\text{MVU}^*(w_{mf})}{dw_{mf}} = \left.\frac{\partial \text{MVU}(w_b, w_{mf})}{\partial w_{mf}}\right|_{w_b(w_{mf})} - \lambda,$$

where $w_b(w_{mf})$ is the optimal leverage-constrained mean-variance portfolio of the benchmark factors for a given weight on the mutual fund factor w_{mf}, and λ is the Lagrange multiplier for the constraint $w_{mf} + \nu_s - \nu_\ell = 0$ for problem (IA7)–(IA11) at the maximizer $w_b(w_{mf})$. Moreover,

$$\left.\frac{d\text{MVU}^*(w_{mf})}{dw_{mf}}\right|_{w_{mf}=0} = \left.\frac{\partial \text{MVU}(w_b, w_{mf})}{\partial w_{mf}}\right|_{w_b^*, w_{mf}=0} - \lambda = \mu_{mf} - \gamma \Sigma_{mf,b} w_b^* - \lambda,$$

where the second equality follows by taking the partial derivative of the right-hand side of Equation (IA6) with respect to w_{mf}. □

Using Proposition IA.1, Table IA.3 depicts, for different values of the leverage parameter δ, the cross-sectional average achievable alpha for a leverage-constrained investor. Table IA.3 shows that the average achievable alpha of a leverage-constrained investor is substantially smaller than the traditional alpha of an unconstrained investor.

For instance, for the case of $\delta = 0$, which corresponds to no shorting, we get the result reported in the first row of Panel B of Table 4, where the average achievable alphas with respect to the seven factor models are negative, ranging from -0.02 for CAPM to -3.60

Table IA.4: Correlations and Sharpe ratios of replicated factors

This table reports the time-series correlations between the replicated factors and the original factors, the annualized Sharpe ratios of the replicated factors, and the annualized Sharpe ratios of the original factors. We construct replicated factors that do not require shorting by combining the long leg of the original long-short factor with a long-only portfolio of mutual funds with significantly negative exposure to the short leg of the original factor.

	SMB	HML	CMA	RMW	UMD	ME	IA	ROE
Correlation with the original factor	0.76	0.66	0.45	0.05	0.25	0.81	0.38	-0.17
Sharpe ratio of replicated factor	0.33	0.33	0.44	0.60	0.52	0.42	0.47	0.75
Sharpe ratio of original factor	0.20	0.24	0.34	0.58	0.46	0.31	0.46	0.72

for HXZ. For the case with a moderate leverage of $\delta = 0.50$, the average achievable alpha remains negative for all factor models.[3] For the case with $\delta = 1$, for which the investor can hold aggregate negative positions as large as her aggregate positive position, the average achievable alpha remains negative for the CAPM, FFC, FF6, HXZ, and HXZM models but is positive for the FF5 and VANG models—though still smaller than the average traditional alpha.[4]

IA.2 Replicating Factors with Mutual Funds

It is challenging for shortsale-constrained investors to gain exposure to long-short factors because they require taking short positions. In this section, we construct factors that do not require shorting by combining the long leg of the original long-short factor with a long-only portfolio of mutual funds with significantly negative exposure to the short leg of the original factor. We then show that our findings are robust to considering these factors, instead of the long-only version of the original factors, as in the main body of the manuscript.

Johansson et al. (2025) construct long-short factors by combining a long-only portfolio of mutual funds and ETFs with a short-only portfolio of ETFs. They show that transaction and shortselling costs lead to an implementation shortfall for the tradable factors of 2–4%

[3]Note that achievable alpha measures the utility *difference* between the cases with and without access to the mutual fund. Allowing greater leverage increases utility for both the case with and the case without access to the mutual fund; thus, achievable alpha may *decrease* as leverage increases if the portfolio without access to the mutual fund benefits more than the portfolio with access.

[4]For the CAPM case, increasing δ does not increase achievable alpha. Achievable alpha is computed under the constraint that the fund weight is fixed at $w_{mf} = 0$. With only one benchmark factor, shorting the benchmark requires a positive short-slack variable, $\psi_s > 0$. However, when $w_{mf} = 0$, the leverage constraint (IA10) reduces to $\psi_s \leq \delta\,\psi_\ell$ because $\nu_s = \nu_\ell = 0$ under $w_{mf} = 0$ for $\delta \in [0, 1]$. When the investor shorts the benchmark in the CAPM, the long-slack variable is zero, $\psi_\ell = 0$, which forces $\psi_s = 0$. Accordingly, the CAPM benchmark cannot be shorted for any value of $\delta \in [0, 1]$.

Table IA.5: Mutual-fund alphas with replicated factors

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to factor models constructed using the fund-based replicated factors. We construct replicated factors that do not require shorting by combining the long leg of the original long-short factor with a long-only portfolio of mutual funds with significantly negative exposure to the short leg of the original factor. We consider the five factor models listed in Table 3 that include long-short factors. Panel A reports cross-sectional statistics for the traditional alpha, and Panel B for the achievable alpha, obtained by regressing fund returns on just those replicated factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	FFC	FF5	FF6	HXZ	HXZM
Panel A: Traditional alpha with respect to fund-based factors					
Average alpha	0.04	0.09	0.08	-0.10	-0.07
t-stat	0.97	2.01	1.92	-2.30	-1.68
Time-weighted average alpha	0.30	0.35	0.34	0.15	0.16
t-stat	7.60	8.50	8.43	3.54	3.90
10th percentile	-2.30	-2.29	-2.27	-2.46	-2.35
50th percentile	0.13	0.10	0.11	-0.03	-0.02
90th percentile	2.40	2.56	2.46	2.42	2.44
Percentage of funds with $\alpha > 0$	52.91	52.88	52.47	49.40	49.54
Percentage of funds with $t(\alpha) > 2$	5.07	4.94	5.11	3.68	3.71
Panel B: Achievable alpha with respect to fund-based factors					
Average alpha	-0.65	-0.90	-0.97	-1.36	-1.36
t-stat	-13.33	-16.06	-17.39	-23.85	-23.76
Time-weighted average alpha	-0.24	-0.47	-0.52	-0.95	-0.96
t-stat	-5.07	-9.09	-10.27	-17.95	-17.91
10th percentile	-3.74	-4.32	-4.45	-5.07	-5.08
50th percentile	-0.34	-0.55	-0.57	-0.96	-0.96
90th percentile	2.08	2.04	2.01	1.73	1.75
Percentage of funds with $\alpha > 0$	43.04	39.33	39.16	33.06	33.44
Percentage of funds with $t(\alpha) > 2$	3.78	2.49	2.59	1.94	1.94

annually, relative to the academic (on paper) factors. However, their long-short factors require shorting ETFs, and thus, do not represent the alternative investment opportunity set of shortsale-constrained investors. Motivated by Johansson et al. (2025), we construct factors that do not require shorting by combining the long leg of the original long-short factor with a long-only portfolio of mutual funds with significantly *negative* exposure to the short leg of the original factor.

Table IA.4 reports the time-series correlations between the replicated factors and the original long-short factors, along with the annualized Sharpe ratio of the replicated and original factors. With the exception of ROE, our replicated factors exhibit positive correlations with their original counterparts. However, the correlations between the replicated and original factors are generally low, which is consistent with the findings of Johansson et al. (2025), who highlight the difficulty of replicating academic factor returns using only tradable funds.

We now evaluate mutual-fund performance using factor models that incorporate the replicated factors. Table IA.5 reports cross-sectional statistics for both traditional and achievable fund gross alphas, based on the five benchmark factor models described in Table 3 that rely on long-short factors. Consistent with the analysis in the main body of the manuscript, average achievable alphas are still negative and continue to be substantially lower than average traditional alphas across all models. Furthermore, the proportion of funds generating a positive achievable alpha ranges from 33.06% for HXZ to 43.04% for FFC—considerably lower than the fraction of funds with a positive traditional alpha, which ranges from 49.40% for HXZ to 52.91% for FFC.

IA.3 Long Positions in Long and Short Legs of Factors

In the main body of the manuscript, we measure achievable fund performance using only the long leg of the long-short factor models. Here, we re-estimate achievable performance by expanding the benchmark set to include long positions in both legs (the long and short legs) of the long-short factors. Tables IA.6 and IA.7 report the traditional and achievable alpha and value-added, respectively, for these models. Our results remain robust when both legs are included in the computation of achievable performance. Overall, achievable alpha and value-added remain substantially smaller than their traditional counterparts across all factor models.

Table IA.6: Traditional and achievable mutual-fund alphas

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven benchmark factor models listed in Table 3, where, as long-only factors, we consider benchmark models that include both the long and short legs of the original long-short factors. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained by regressing the fund returns on all long-short factors for each model, and Panel B reports the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and a t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	FFC	FF5	FF6	HXZ	HXZM
Panel A: Traditional alpha					
Average alpha	0.01	0.25	0.15	-0.06	-0.00
t-stat	0.16	4.77	3.14	-1.14	-0.10
Time-weighted average alpha	0.30	0.45	0.34	0.19	0.22
t-stat	7.42	8.40	7.09	3.61	4.61
10th percentile	-2.35	-2.60	-2.44	-2.84	-2.60
50th percentile	0.09	0.01	-0.02	-0.12	-0.06
90th percentile	2.40	3.45	3.01	3.05	2.89
Percentage of funds with $\alpha > 0$	51.70	50.24	49.47	47.46	49.05
Percentage of funds with $t(\alpha) > 2$	5.04	8.82	7.08	5.21	5.93
Panel B: Achievable alpha					
Average alpha	-2.11	-2.32	-2.58	-3.59	-3.59
t-stat	-30.89	-37.82	-39.06	-52.89	-52.15
Time-weighted average alpha	-1.41	-1.71	-1.95	-3.12	-3.13
t-stat	-22.48	-30.38	-32.50	-49.78	-50.02
10th percentile	-6.35	-5.92	-6.50	-7.67	-7.64
50th percentile	-1.40	-1.76	-1.94	-3.00	-3.00
90th percentile	1.36	0.94	0.87	0.06	0.06
Percentage of funds with $\alpha > 0$	26.99	20.09	18.35	10.28	10.31
Percentage of funds with $t(\alpha) > 2$	1.87	0.72	0.78	0.27	0.24

Table IA.7: Traditional and achievable mutual-fund value-added

This table reports cross-sectional statistics for the traditional and achievable fund value-added with respect to the seven factor models listed in Table 3 where, as long-only factors, we consider benchmark models that include both the long and the short legs of the original long-short factors. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using the fund abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	FFC	FF5	FF6	HXZ	HXZM
Panel A: Traditional value-added					
Average value-added	-1.33	-0.98	-1.26	-2.51	-2.08
t-stat	-6.51	-3.99	-5.95	-10.91	-9.70
Time-weighted average value-added	-0.99	-0.97	-1.29	-2.79	-2.26
t-stat	-3.57	-2.98	-4.66	-9.08	-7.83
10th percentile	-9.72	-9.70	-9.64	-11.78	-11.04
50th percentile	-0.45	-0.45	-0.52	-0.72	-0.63
90th percentile	4.52	6.44	4.92	3.83	3.96
% of funds with average value-added >0	33.44	34.94	32.57	30.21	30.98
Panel B: Achievable value-added					
Average value-added	-7.83	-10.32	-10.00	-16.52	-16.47
t-stat	-21.68	-24.47	-24.43	-27.97	-28.40
Time-weighted average value-added	-8.67	-12.52	-12.10	-21.14	-21.11
t-stat	-18.67	-22.85	-22.36	-27.29	-27.67
10th percentile	-26.58	-30.61	-30.38	-46.51	-46.35
50th percentile	-2.49	-3.25	-3.39	-5.30	-5.30
90th percentile	0.83	0.12	0.13	-0.15	-0.16
% of funds with average value-added >0	16.15	11.74	11.88	6.40	6.44

IA.4 Net-of-Fees Returns

To facilitate the comparison with the closely related literature on mutual-fund manager skill (Berk and van Binsbergen, 2015; Barras et al., 2022), in the main body of the manuscript, we study fund performance in terms of alpha and value-added based on *gross-of-fees* returns. However, it is also important to evaluate mutual-fund performance in terms of net-of-fees returns because this is the relevant economic criterion from an investor's perspective. In this section, we replicate our entire empirical analysis using net-of-fees returns and demonstrate that all our findings remain robust. In particular, our key result continues to hold: the proportion of funds with positive achievable *net* alpha and value-added is substantially smaller than that for funds with positive traditional *net* alpha and value-added.

IA.4.1 Achievable Net Alpha

Table 4 in the main body of the manuscript shows that the proportion of funds with positive achievable gross alpha is substantially smaller than that with positive traditional gross alpha. In this section, we show that this finding is robust to considering achievable and traditional *net-of-fees* alphas.

Table IA.8 replicates Table 4 in the main body of the manuscript for the case with net alphas. As one would expect, accounting for mutual-fund fees reduces both the average traditional and achievable alphas, with the average traditional *net* alphas in Panel A of Table IA.8 now being significantly negative for every factor model, whereas the average traditional *gross* alphas were positive for the CAPM, FFC, FF5, FF6, and VANG models, and statistically significant for the FF5, FF6, and VANG models in Panel A of Table 4. Importantly, our main finding is robust to evaluating mutual-fund performance in terms of net alphas: while the proportion of funds with positive traditional net alpha ranges from 26.60% for the HXZM model to 35.38% for the VANG model, the proportion of funds with positive achievable net alpha drops to only 4.39% for HXZM and 17.29% for VANG. Thus, the proportion of funds with positive achievable net alpha is much smaller than that with positive traditional net alpha across all models except the CAPM.

Just as in the case of gross alphas, the finding that achievable alpha is smaller than the traditional alpha is robust to evaluating mutual-fund performance in terms of the alpha t-statistic. For instance, comparing the last rows in Panels A and B of Table IA.8, we find that while the proportion of mutual funds with significant $(t(\alpha) > 2)$ traditional alpha

Table IA.8: Traditional and achievable mutual-fund net alphas

This table reports cross-sectional statistics for the traditional and achievable fund net alphas with respect to the seven factor models listed in Table 3. Net alpha is estimated by regressing mutual-fund net-of-fees returns on factor returns. Panel A reports cross-sectional statistics for the traditional net alpha with respect to the long-short factors, obtained by regressing fund net returns on all long-short factors for each model, and Panel B for the achievable net alpha with respect to the long-only factors, obtained by regressing fund net returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for each fund). We report the average net alpha across funds, its t-statistic, the time-weighted average net alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund net alpha and the percentage of funds with positive net alpha and a t-statistic greater than two. Net alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional net alpha							
Average alpha	-1.13	-1.18	-0.93	-1.04	-1.25	-1.20	-0.71
t-stat	-21.51	-28.05	-17.29	-21.48	-23.84	-25.08	-15.82
Time-weighted average alpha	-0.83	-0.86	-0.73	-0.84	-0.99	-0.96	-0.34
t-stat	-16.71	-20.73	-13.28	-17.07	-18.68	-19.46	-7.80
10th percentile	-4.33	-3.60	-3.76	-3.70	-4.07	-3.82	-3.32
50th percentile	-0.99	-1.05	-1.09	-1.12	-1.26	-1.20	-0.62
90th percentile	1.80	1.20	2.15	1.78	1.75	1.61	1.75
Percentage of funds with α >0	31.71	26.78	30.20	27.78	27.31	26.60	35.38
Percentage of funds with $t(\alpha)$ >2	0.95	1.16	3.27	2.11	1.53	1.53	2.66
Panel B: Achievable net alpha							
Average alpha	-1.17	-3.23	-3.48	-3.78	-4.78	-4.78	-2.53
t-stat	-22.29	-44.48	-53.42	-54.07	-65.45	-65.81	-40.12
Time-weighted average alpha	-0.85	-2.50	-2.87	-3.14	-4.30	-4.30	-1.69
t-stat	-17.08	-36.70	-48.77	-48.61	-64.29	-64.29	-28.18
10th percentile	-4.36	-7.73	-7.26	-7.95	-9.00	-9.01	-6.26
50th percentile	-1.02	-2.47	-2.91	-3.08	-4.10	-4.10	-2.01
90th percentile	1.78	0.39	-0.19	-0.25	-1.07	-1.05	0.71
Percentage of funds with α >0	31.30	14.33	8.38	7.90	4.25	4.39	17.29
Percentage of funds with $t(\alpha)$ >2	0.89	0.20	0.17	0.17	0.03	0.03	0.68

with respect to the long-short factor models is 1.53% for HXZM and 2.66% for VANG, the proportion of mutual funds with significant achievable alpha with respect to the long-only models is only 0.03% for HXZM and 0.68% for VANG.

Table IA.9: Traditional and achievable mutual-fund net value-added

This table reports cross-sectional statistics for the traditional and achievable net value-added with respect to the seven benchmark factor models listed in Table 3. Panel A reports cross-sectional statistics for the traditional net value-added computed as the average of the product of assets under management and realized abnormal net returns, obtained by regressing the fund (net-of-fees) returns on all long-short factors in each model, and Panel B the achievable net value-added computed using the fund net-of-fees abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average net value-added, its t-statistic, the time-weighted average net value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of net value-added and the percentage of funds with positive average net value-added. Net value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional net value-added							
Average value-added	-7.50	-5.39	-4.75	-5.12	-6.46	-6.09	-3.12
t-stat	-23.40	-22.58	-17.16	-19.45	-22.74	-23.26	-15.54
Time-weighted average value-added	-9.49	-6.63	-5.98	-6.49	-8.15	-7.76	-3.59
t-stat	-22.65	-20.68	-16.36	-18.39	-21.07	-22.03	-13.75
10th percentile	-25.11	-17.58	-17.99	-17.68	-20.65	-19.72	-12.16
50th percentile	-2.17	-1.87	-1.68	-1.78	-2.18	-2.03	-1.13
90th percentile	0.85	0.39	2.24	1.09	0.38	0.38	2.08
% of funds with average value-added >0	16.35	14.49	18.47	16.56	14.47	14.48	21.80
Panel B: Achievable net value-added							
Average value-added	-7.53	-10.86	-15.03	-15.11	-21.53	-21.26	-10.07
t-stat	-23.49	-24.03	-28.35	-28.70	-29.94	-30.19	-26.52
Time-weighted average value-added	-9.50	-12.32	-18.89	-19.09	-28.13	-27.81	-11.46
t-stat	-22.69	-20.52	-27.29	-27.75	-28.98	-29.18	-23.78
10th percentile	-25.12	-33.77	-41.48	-41.46	-57.07	-56.91	-31.54
50th percentile	-2.22	-3.98	-5.27	-5.32	-7.28	-7.26	-3.75
90th percentile	0.85	-0.04	-0.22	-0.22	-0.47	-0.46	-0.05
% of funds with average value-added >0	15.98	9.11	5.61	5.53	2.75	2.75	8.86

IA.4.2 Achievable Net Value-Added

Table 5 in the main body of the manuscript shows that the proportion of funds with positive achievable gross value-added is substantially smaller than that with positive traditional gross value-added. In this section, we show that this finding is robust to considering achievable and traditional value-added *net-of-fees*.

Table IA.9 replicates Table 5 in the main body of the manuscript for the case of *net* value-added. Table IA.9 contains two panels: Panel A reports the average traditional

Table IA.10: Relative performance for traditional and achievable net metrics

This table reports the percentage of funds whose decile changes when we sort them based on achievable instead of traditional *net* metrics. Panel A reports the results based on net alpha and Panel B on net value-added. Achievable metrics are estimated with respect to the long-only version of the seven factor models and traditional metrics with respect to the long-short version.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Mutual funds sorted by net alpha							
Decile changes (%)	4.90	76.97	82.45	81.44	82.97	82.12	73.07
Panel B: Mutual funds sorted by net value-added							
Decile changes (%)	3.20	67.34	79.49	75.63	77.74	76.93	74.93

net value-added for the long-short factor models, and Panel B the average achievable net value-added for the long-only factor models. Consistent with the findings of Berk and van Binsbergen (2015), and just as in the case of gross returns considered in the main text, Panel A of Table IA.9 shows that the average traditional net value-added in the cross-section of mutual funds is generally negative when computed with respect to conventional factor models, ranging from −4.75 million dollars for the FF5 model to −7.50 million dollars for the CAPM model. We also find that the average traditional net value-added with respect to the VANG model is −3.12 million dollars, with a significant t-statistic of −15.54; the time-weighted average net value-added is also negative at −3.59 million dollars, with a significant t-statistic of −13.75.

More importantly, the key takeaway from Table IA.9 is that, consistent with the results based on achievable and traditional net alphas, the performance of mutual funds based on achievable *net* value-added is substantially worse than that in terms of traditional net value-added. For instance, comparing Panels A and B in Table IA.9, we find that while the *proportion* of mutual funds with positive traditional net value-added with respect to the long-short factor models ranges from 14.47% for HXZ to 21.80% for VANG, the proportion of mutual funds with positive achievable net value-added with respect to the long-only models is only 2.75% for HXZ and 8.86% for VANG.

IA.4.3 Relative Performance of Funds Based on Net Returns

Table 6 in the main body of the manuscript shows that the *relative* performance of mutual funds changes substantially when we evaluate performance in terms of achievable rather than traditional gross alpha. In this section, we show that this finding is robust to evaluating performance in terms of net-of-fees alphas.

Table IA.11: Difference in net alphas during periods of financial turmoil

This table reports the slope coefficient for the market-risk variable in (5), along with its standard error and the regression R-squared. The independent variable is standardized, allowing the coefficients to be interpreted as the change in the difference between the traditional and achievable net alphas (in basis points) resulting from a one-standard-deviation increase in market volatility. The first seven columns report the results for pooled regressions for each model, and the eighth column reports the results across all models. Model fixed effects are included only for the pooled regression across all models. Standard errors are clustered by fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG	ALL
Slope (bps)	11.639	5.139	10.333	9.868	11.498	12.609	8.583	9.953
Standard errors (bps)	0.116	0.230	0.234	0.232	0.253	0.247	0.217	0.186
Model FE	No	No	No	No	No	No	No	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (%)	12.287	1.692	4.672	4.261	8.272	9.567	4.589	5.226

Table IA.10 replicates Table 6 in the main body of the manuscript for the case with net fund returns. The table shows that there is a change in the decile rank for more than two-thirds of the funds (instead of more than 70% of the funds when using gross-of-fees returns) across every factor model except CAPM. This demonstrates that relative mutual-fund performance is very different from the perspective of a shortsale-constrained investor even when measured in terms of net returns.

IA.4.4 Time Series of Traditional and Achievable Net Alphas

Table 7 in the main body of the manuscript shows that the difference between the traditional and achievable gross alphas increases with market volatility. We now show that these findings are robust to evaluating performance in terms of net alphas. Table IA.11 replicates Table 7 in the main body of the manuscript for the case with net alphas. The figure shows that the effect of a one-standard-deviation increase in market volatility on the difference between the traditional and achievable net alphas is significantly positive for every model, ranging from 5.139 basis points for the FFC model to 12.609 basis points for the HXZM model.

Table 8 in the main body of the manuscript shows that traditional and achievable gross alphas are jointly significant in explaining future fund flows, and that the predictive power of achievable gross alpha increases during periods of high market volatility. We now show that these findings are robust to considering net-of-fees alphas.

Table IA.12 replicates Table 8 of the main body of the manuscript for the case with net alphas. The results in Table IA.12 are nearly identical to those in Table 8, which demonstrates that our findings are robust to considering net-of-fees fund returns instead of

Table IA.12: Achievable and traditional net alphas and fund flows

This table reports slope coefficients and their t-statistics for several versions of panel regression (8). Panel A considers the regression of fund flows on traditional net-of-fees alpha, Panel B the regression of fund flows on net-of-fees achievable alpha, Panel C the regression of fund flows jointly on net-of-fees traditional and achievable alphas, and Panel D the regression of fund flows jointly on net-of-fees traditional and achievable alphas and their interactions with a "Risk" indicator variable that takes a value of one for months in the top decile of months sorted by realized market volatility in the prior 36 months, and zero otherwise. For all regressions, we include time and fund fixed effects and double-cluster standard errors by time and fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Slope	0.128	0.134	0.117	0.112	0.125	0.127	0.113
	[26.339]	[33.949]	[23.804]	[23.607]	[22.526]	[32.117]	[24.708]
R2 (%)	1.638	1.805	1.364	1.256	1.563	1.609	1.276
Panel B: Achievable alpha							
Slope	0.123	0.114	0.118	0.116	0.121	0.119	0.117
	[13.136]	[12.620]	[12.673]	[12.613]	[12.624]	[12.529]	[13.687]
R2 (%)	1.516	1.295	1.391	1.343	1.467	1.409	1.362
Panel C: Traditional and achievable alpha							
Slope $\alpha_{\mathcal{T}}$	0.126	0.107	0.076	0.072	0.079	0.086	0.062
	[6.449]	[16.388]	[13.521]	[12.748]	[10.068]	[14.799]	[9.647]
Slope $\alpha_{\mathcal{A}}$	0.002	0.039	0.078	0.080	0.067	0.063	0.074
	[0.116]	[5.030]	[15.291]	[15.715]	[8.180]	[9.639]	[8.991]
R2 (%)	1.639	1.883	1.805	1.737	1.802	1.838	1.571
Panel D: Traditional and achievable alpha with risk-interaction terms							
Slope $\alpha_{\mathcal{T}}$	0.130	0.108	0.077	0.074	0.082	0.089	0.065
	[6.423]	[15.926]	[12.906]	[12.313]	[10.473]	[15.295]	[9.431]
Slope $\alpha_{\mathcal{A}}$	-0.006	0.036	0.075	0.077	0.062	0.058	0.070
	[-0.286]	[4.658]	[14.509]	[15.073]	[8.001]	[9.318]	[8.529]
Slope $\alpha_{\mathcal{T}}\times$Risk	-0.038	-0.016	-0.023	-0.021	-0.021	-0.025	-0.019
	[-2.150]	[-1.862]	[-3.534]	[-3.340]	[-2.990]	[-4.404]	[-2.422]
Slope $\alpha_{\mathcal{A}}\times$Risk	0.054	0.023	0.030	0.027	0.035	0.034	0.027
	[3.000]	[2.968]	[5.056]	[4.513]	[5.678]	[6.158]	[3.847]
R2 (%)	1.668	1.898	1.840	1.767	1.857	1.887	1.597

gross returns. In particular, traditional and achievable net alphas are jointly significant in explaining fund flows for every model except CAPM, and the explanatory power of achievable net alpha increases during periods of high market volatility. These findings suggest that the decisions of at least some mutual fund investors are correlated with achievable net alpha even after controlling for traditional net alpha, particularly during periods of high market volatility

IA.5 Retail and Institutional Share Classes

In the main body of the manuscript, we evaluate fund performance by aggregating institutional and retail shares at the fund level. We now study performance separately for retail and institutional share classes, that is, after aggregating only retail or only institutional shares offered by funds. Our main observation is that our findings are robust to considering retail or institutional share classes separately: mutual-fund performance in terms of achievable alpha and value-added is substantially worse than in terms of traditional alpha and value-added for both retail and institutional share classes. Section IA.5.1 describes how we identify retail and institutional share classes, Section IA.5.2 gives the results for retail classes, and Section IA.5.3 gives the results for institutional share classes.

IA.5.1 Identifying Retail and Institutional Share Classes

We classify mutual fund share classes using fund labels instead of the CRSP retail_fund versus inst_fund indicators, which are available only from December 1999 and not always consistent. For each CRSP share class, we extract the share-class tag from its name, which typically follows the fund's name after a slash or semicolon (e.g., "... / Class A"). We standardize this tag by converting it to uppercase, removing the word "Class," deleting spaces, periods, and hyphens, and keeping only the first token (so "Class A," "A-share," and "A," all map to "A"). We classify a share class as institutional if either (i) its standardized tag is I, Y, X, INS, INST, NAV, or TRUST, or (ii) the full fund name contains the word "Institutional" (case-insensitive), capturing institutional classes without an explicit tag. We define restricted classes—sold through advisors, retirement platforms, or to employees—as tags ADMIN, ADVISORY, AGENCY, FIDUCIARY, F, RET, R, RETIREMENT, Z, W, Q, or S. Our retail universe comprises all unrestricted classes (i.e., tags not in the restricted set) that are not institutional, or flagged by CRSP as institutional (inst_fund="Y").

IA.5.2 Retail Shares

Below, we reproduce the results in Tables 4, 5, 6, 7, and 8 in the main body of the manuscript for retail share classes. All our findings are robust to considering only retail share classes. Tables IA.13 and IA.14 show that achievable alpha and value added are, on average, much smaller than traditional alpha and value added for all models except CAPM, and Table IA.15 shows that the relative performance of funds changes dramatically when we compute perfor-

Table IA.13: Traditional and achievable alphas: Retail fund classes

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven factor models listed in Table 3 for retail fund classes. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained by regressing the fund returns on all long-short factors for each model, and Panel B reports the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) away from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Average alpha	0.07	0.01	0.25	0.14	-0.06	-0.01	0.48
t-stat	1.36	0.28	4.42	2.79	-1.13	-0.27	10.63
Time-weighted average alpha	0.35	0.31	0.46	0.34	0.19	0.22	0.84
t-stat	6.86	7.47	8.19	6.92	3.63	4.55	19.34
10th percentile	-3.00	-2.39	-2.70	-2.47	-2.90	-2.66	-2.04
50th percentile	0.15	0.09	0.01	-0.03	-0.12	-0.06	0.49
90th percentile	3.01	2.39	3.45	3.00	3.05	2.82	2.96
Percentage of funds with α >0	52.55	51.91	50.26	49.61	47.38	48.83	61.59
Percentage of funds with $t(\alpha)$ >2	4.29	4.85	8.88	7.01	5.03	5.62	11.81
Panel B: Achievable alpha							
Average alpha	0.03	-2.08	-2.35	-2.63	-3.66	-3.64	-1.30
t-stat	0.52	-29.03	-36.99	-38.26	-52.02	-51.02	-20.85
Time-weighted average alpha	0.33	-1.33	-1.71	-1.97	-3.15	-3.15	-0.46
t-stat	6.44	-20.12	-29.41	-31.60	-48.88	-48.83	-7.99
10th percentile	-3.07	-6.43	-5.94	-6.54	-7.72	-7.71	-5.10
50th percentile	0.13	-1.39	-1.77	-1.99	-3.06	-3.06	-0.81
90th percentile	3.00	1.49	0.94	0.84	-0.03	-0.01	1.89
Percentage of funds with α >0	52.04	28.36	19.74	18.01	9.76	9.90	35.29
Percentage of funds with $t(\alpha)$ >2	4.22	2.16	0.84	0.84	0.37	0.33	2.93

mance with achievable alpha and value added. Table IA.16 shows that the difference between traditional and achievable alpha increases during periods of financial turmoil. Table IA.17 shows that fund flows react to past performance, and the relation between achievable alpha and fund flows strengthens during periods of financial turmoil, while the relation between traditional alpha and fund flows weakens during periods of financial turmoil.

Table IA.14: Traditional and achievable value-added: Retail fund classes

This table reports cross-sectional statistics for the traditional and achievable fund value-added with respect to the seven factor models listed in Table 3 for retail fund classes. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using the fund abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-1.91	-0.55	-0.14	-0.36	-1.63	-1.27	0.67
t-stat	-8.54	-2.94	-0.62	-1.80	-7.75	-6.50	3.57
Time-weighted average value-added	-1.88	-0.06	0.05	-0.15	-1.68	-1.21	1.58
t-stat	-6.21	-0.24	0.16	-0.57	-5.92	-4.60	6.28
10th percentile	-10.86	-7.62	-7.24	-7.24	-9.40	-8.65	-5.24
50th percentile	-0.35	-0.22	-0.22	-0.25	-0.39	-0.33	-0.03
90th percentile	4.72	4.47	6.61	5.15	3.76	3.87	7.22
% of funds with average value-added >0	34.14	35.52	37.07	35.01	31.84	32.39	45.60
Panel B: Achievable value-added							
Average value-added	-1.94	-6.17	-8.60	-8.49	-13.42	-13.27	-4.30
t-stat	-8.50	-16.68	-22.28	-21.74	-25.70	-25.76	-15.30
Time-weighted average value-added	-1.90	-6.36	-10.01	-9.79	-17.20	-17.07	-3.81
t-stat	-6.13	-13.01	-20.07	-19.14	-24.45	-24.49	-10.48
10th percentile	-10.91	-23.35	-27.07	-26.67	-39.52	-39.15	-16.66
50th percentile	-0.37	-1.45	-2.20	-2.26	-3.44	-3.40	-1.13
90th percentile	4.75	1.23	0.12	0.16	-0.04	-0.04	1.70
% of funds with average value-added >0	33.72	18.90	12.68	12.86	7.23	7.75	20.41

Table IA.15: Relative performance for trad. and achievable metrics: Retail funds

This table reports the percentage of retail fund classes whose decile rank changes when they are sorted by achievable rather than traditional metrics. Panel A reports the results based on alpha, and Panel B on value-added. Achievable metrics are estimated with respect to the long-only version of the seven benchmark factor models and traditional metrics with respect to the long-short version.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Retail fund classes sorted by alpha							
Decile changes (%)	4.88	78.27	81.79	82.20	84.43	83.11	72.89
Panel B: Retail fund classes sorted by value-added							
Decile changes (%)	3.28	77.06	86.36	84.71	84.42	83.71	78.31

Table IA.16: Alpha difference during periods of turmoil: Retail funds

This table reports the slope coefficient for the market-risk variable in (5), along with its standard error and the regression R-squared, for retail fund classes. The independent variable is standardized, allowing the coefficients to be interpreted as the change in the difference between the traditional and achievable alphas (in basis points) resulting from a one-standard-deviation increase in market volatility. The first seven columns report the results for pooled regressions for each model, and the eighth column reports the results across all models. Model fixed effects are included only for the pooled regression across all models. Standard errors are clustered by fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG	ALL
Slope (bps)	11.790	5.076	10.259	9.774	11.494	12.601	8.589	9.940
Standard errors (bps)	0.118	0.235	0.240	0.237	0.260	0.253	0.222	0.190
Model FE	No	No	No	No	No	No	No	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (%)	12.441	1.658	4.745	4.313	8.366	9.731	4.634	5.248

Table IA.17: Alphas and fund flows: Retail funds

This table reports slope coefficients and their t-statistics for several versions of panel regression (8) applied to retail fund classes. Panel A considers the regression of fund flows on traditional alpha, Panel B the regression of fund flows on achievable alpha, Panel C the regression of fund flows jointly on traditional and achievable alphas, and Panel D the regression of fund flows jointly on traditional and achievable alphas and their interactions with a "Risk" indicator variable that takes a value of one for months in the top decile of months sorted by realized market volatility in the prior 36 months, and zero otherwise. For all regressions, we consider time and fund fixed effects and double-cluster standard errors by time and fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Slope	0.113	0.116	0.101	0.097	0.107	0.109	0.097
	[25.541]	[32.845]	[23.484]	[23.012]	[21.645]	[30.136]	[24.085]
R2 (%)	1.270	1.343	1.013	0.940	1.155	1.189	0.939
Panel B: Achievable alpha							
Slope	0.109	0.101	0.105	0.103	0.107	0.105	0.103
	[16.526]	[16.012]	[16.069]	[16.099]	[15.282]	[15.220]	[16.675]
R2 (%)	1.179	1.013	1.095	1.055	1.148	1.101	1.063
Panel C: Traditional and achievable alpha							
Slope $\alpha_{\mathcal{T}}$	0.108	0.089	0.062	0.060	0.064	0.070	0.049
	[6.389]	[16.301]	[12.449]	[12.132]	[9.398]	[13.687]	[8.501]
Slope $\alpha_{\mathcal{A}}$	0.005	0.038	0.071	0.072	0.063	0.058	0.069
	[0.293]	[6.600]	[14.698]	[15.215]	[9.547]	[10.474]	[10.442]
R2 (%)	1.270	1.416	1.361	1.313	1.362	1.381	1.192
Panel D: Traditional and achievable alpha with risk-interaction terms							
Slope $\alpha_{\mathcal{T}}$	0.112	0.091	0.064	0.062	0.067	0.074	0.052
	[6.307]	[15.827]	[11.931]	[11.674]	[9.786]	[13.962]	[8.379]
Slope $\alpha_{\mathcal{A}}$	-0.001	0.035	0.068	0.069	0.058	0.054	0.065
	[-0.082]	[6.082]	[13.673]	[14.253]	[9.234]	[9.885]	[9.755]
Slope $\alpha_{\mathcal{T}}\times$Risk	-0.034	-0.016	-0.024	-0.020	-0.021	-0.024	-0.020
	[-2.077]	[-2.212]	[-4.366]	[-3.690]	[-3.470]	[-4.759]	[-2.884]
Slope $\alpha_{\mathcal{A}}\times$Risk	0.044	0.020	0.028	0.024	0.031	0.030	0.024
	[2.766]	[2.924]	[5.330]	[4.327]	[5.484]	[5.599]	[3.882]
R2 (%)	1.286	1.426	1.392	1.337	1.403	1.419	1.212

IA.5.3 Institutional Shares

Below, we reproduce the results in Tables 4, 5, 6, 7, and 8 in the main body of the manuscript for institutional share classes. Our results are generally robust to considering only institutional share classes. Tables IA.18 and IA.19 show that achievable alpha and value added are, on average, much smaller than traditional alpha and value added for all models except the CAPM, and Table IA.20 shows that the relative performance of funds changes dramatically when we compute performance with achievable alpha and value added. Table IA.21 shows that the difference between traditional and achievable alpha increases during periods of financial turmoil. Table IA.22 shows that fund flows react to past performance, measured by both achievable and traditional alpha. The only difference between institutional and retail shares is that, when we consider only institutional fund classes, the relation between achievable alpha and fund flows generally does not strengthen during periods of financial turmoil. This suggests that, in contrast to retail investors, institutional investors' decisions are not more highly correlated with achievable alpha during periods of market turmoil than during other periods.

Table IA.18: Traditional and achievable alphas: Institutional classes

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven factor models listed in Table 3 for institutional fund classes. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained by regressing the fund returns on all long-short factors for each model, and Panel B reports the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and a t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Average alpha	-0.32	-0.21	-0.03	-0.10	-0.27	-0.20	0.33
t-stat	-4.29	-3.51	-0.42	-1.54	-3.65	-3.03	5.46
Time-weighted average alpha	0.01	0.07	0.19	0.11	-0.03	0.02	0.59
t-stat	0.15	1.26	2.63	1.72	-0.37	0.33	10.31
10th percentile	-3.57	-2.53	-2.59	-2.49	-2.81	-2.59	-2.08
50th percentile	-0.18	-0.15	-0.15	-0.22	-0.35	-0.27	0.35
90th percentile	2.68	2.06	2.84	2.55	2.54	2.41	2.61
Percentage of funds with α >0	46.38	46.23	45.73	45.04	42.43	45.00	60.00
Percentage of funds with $t(\alpha)$ >2	2.54	2.77	6.00	4.84	3.92	3.77	9.85
Panel B: Achievable alpha							
Average alpha	-0.35	-1.94	-2.33	-2.50	-3.52	-3.52	-1.68
t-stat	-4.74	-20.90	-27.44	-27.95	-37.57	-37.52	-20.57
Time-weighted average alpha	-0.01	-1.25	-1.80	-1.94	-3.10	-3.09	-1.02
t-stat	-0.08	-14.45	-23.15	-23.70	-36.03	-35.98	-13.20
10th percentile	-3.58	-5.85	-5.93	-6.18	-7.34	-7.34	-5.24
50th percentile	-0.20	-1.33	-1.87	-1.97	-3.03	-3.02	-1.26
90th percentile	2.65	1.33	0.81	0.67	-0.02	-0.01	1.36
Percentage of funds with α >0	46.00	28.46	18.54	17.00	9.69	9.92	28.31
Percentage of funds with $t(\alpha)$ >2	2.38	1.92	0.92	1.08	0.23	0.23	1.38

Table IA.19: Traditional and achievable value-added: Institutional classes

This table reports cross-sectional statistics for the traditional and achievable fund value-added with respect to the seven factor models listed in Table 3 for institutional fund classes. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using the fund abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-3.05	-1.36	-1.29	-1.50	-1.81	-1.66	0.24
t-stat	-10.15	-7.44	-5.95	-8.13	-8.36	-8.26	1.43
Time-weighted average value-added	-3.18	-1.36	-1.38	-1.63	-2.10	-1.87	0.38
t-stat	-8.78	-6.20	-5.02	-7.14	-7.62	-7.48	1.79
10th percentile	-11.93	-6.54	-6.64	-6.58	-7.80	-7.27	-3.60
50th percentile	-0.64	-0.46	-0.38	-0.44	-0.49	-0.44	-0.09
90th percentile	2.08	2.24	3.39	2.24	2.04	1.88	4.66
% of funds with average value-added >0	28.67	28.95	32.82	30.80	28.72	29.41	42.74
Panel B: Achievable value-added							
Average value-added	-3.06	-4.30	-5.81	-5.81	-9.13	-9.10	-4.42
t-stat	-10.17	-12.11	-16.17	-16.49	-19.51	-19.43	-13.79
Time-weighted average value-added	-3.18	-3.80	-6.33	-6.26	-10.71	-10.68	-4.14
t-stat	-8.78	-9.04	-14.77	-15.07	-18.87	-18.83	-11.10
10th percentile	-11.93	-16.10	-18.18	-17.68	-26.37	-26.38	-14.55
50th percentile	-0.67	-1.39	-2.09	-2.06	-3.18	-3.14	-1.47
90th percentile	2.05	1.17	0.23	0.21	-0.03	-0.03	0.80
% of funds with average value-added >0	28.36	18.39	12.95	12.95	7.81	7.81	17.61

Table IA.20: Relative performance: Institutional funds

This table reports the percentage of institutional fund classes whose decile rank changes when they are sorted by achievable rather than traditional metrics. Panel A reports the results based on alpha and Panel B on value-added. Achievable metrics are estimated with respect to the long-only version of the seven benchmark factor models and traditional metrics are estimated with respect to the long-short version.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Institutional fund classes sorted by alpha							
Decile changes (%)	3.77	74.00	81.38	82.85	83.08	82.54	73.62
Panel B: Institutional fund classes sorted by value-added							
Decile changes (%)	2.55	72.20	79.69	78.60	81.09	81.40	80.48

Table IA.21: Alpha difference during periods of turmoil: Institutional funds

This table reports the slope coefficient for the market-risk variable in (5), along with its standard error and the regression R-squared, for institutional fund classes. The independent variable is standardized, allowing the coefficients to be interpreted as the change in the difference between the traditional and achievable alphas (in basis points) resulting from a one-standard-deviation increase in market volatility. The first seven columns report the results for pooled regressions for each model, and the eighth column reports the results across all models. Model fixed effects are included only for the pooled regression across all models. Standard errors are clustered by fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG	ALL
Slope (bps)	11.104	3.974	10.205	9.616	10.788	12.235	7.308	9.318
Standard errors (bps)	0.175	0.375	0.364	0.358	0.370	0.364	0.332	0.280
Model FE	No	No	No	No	No	No	No	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (%)	11.858	1.024	3.941	3.443	7.019	8.365	3.084	4.074

Table IA.22: Alphas and fund flows: Institutional funds

This table reports slope coefficients and their t-statistics for several versions of the panel regression (8) applied to institutional fund classes. Panel A considers the regression of fund flows on traditional alpha, Panel B the regression of fund flows on achievable alpha, Panel C the regression of fund flows jointly on traditional and achievable alphas, and Panel D the regression of fund flows jointly on traditional and achievable alphas and their interactions with a "Risk" indicator variable that takes a value of one for months in the top decile of months sorted by realized market volatility in the prior 36 months, and zero otherwise. For all regressions, we consider time and fund fixed effects and double-cluster standard errors by time and fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Slope	0.092	0.114	0.092	0.091	0.098	0.101	0.085
	[19.665]	[27.196]	[17.632]	[16.826]	[21.580]	[25.083]	[18.638]
R2 (%)	0.842	1.293	0.851	0.830	0.962	1.016	0.730
Panel B: Achievable alpha							
Slope	0.088	0.083	0.085	0.084	0.086	0.085	0.086
	[6.284]	[5.999]	[6.002]	[5.963]	[5.957]	[5.903]	[6.733]
R2 (%)	0.771	0.692	0.721	0.709	0.737	0.727	0.744
Panel C: Traditional and achievable alpha							
Slope $\alpha_{\mathcal{T}}$	0.103	0.106	0.070	0.071	0.073	0.077	0.053
	[4.862]	[13.883]	[10.050]	[9.831]	[11.790]	[14.514]	[8.121]
Slope $\alpha_{\mathcal{A}}$	-0.012	0.011	0.058	0.060	0.039	0.039	0.055
	[-0.485]	[1.278]	[11.426]	[11.274]	[5.543]	[8.263]	[6.179]
R2 (%)	0.842	1.299	1.143	1.151	1.052	1.116	0.928
Panel D: Traditional and achievable alpha with risk-interaction terms							
Slope $\alpha_{\mathcal{T}}$	0.096	0.106	0.070	0.070	0.073	0.078	0.053
	[4.635]	[13.290]	[9.616]	[9.491]	[11.779]	[13.963]	[7.698]
Slope $\alpha_{\mathcal{A}}$	-0.008	0.010	0.058	0.060	0.037	0.038	0.054
	[-0.335]	[1.210]	[11.167]	[11.201]	[5.487]	[7.910]	[6.022]
Slope $\alpha_{\mathcal{T}}\times$Risk	0.030	0.000	0.000	0.002	-0.005	-0.007	-0.002
	[1.504]	[0.036]	[0.009]	[0.319]	[-0.647]	[-1.014]	[-0.288]
Slope $\alpha_{\mathcal{A}}\times$Risk	-0.016	0.004	0.004	0.000	0.015	0.012	0.009
	[-0.766]	[0.478]	[0.596]	[0.023]	[2.113]	[2.034]	[1.416]
R2 (%)	0.863	1.301	1.145	1.151	1.064	1.123	0.934

IA.6 Fund Performance Across Styles

In this section, we study performance separately across mutual-fund styles: growth funds, large-cap funds, small-cap funds, aggressive-growth funds, large-cap value funds, and small-cap growth funds. We allocate funds to growth, large-cap, or small-cap categories based on two complementary sources of style information. First, we use the most recent style classifications available from Lipper, Strategic Insight, or Wiesenberger (e.g., LCGE for large-cap growth, SCGE for small-cap growth, LTG for large-cap growth). Second, we apply CRSP's unified objective code (CRSP_OBJ_CD), which encodes asset class, geography, and style in a four-character string; we restrict our analysis to domestic equity funds and then require the fourth character to equal the relevant style (G for growth, L for large-cap, and S for small-cap). A fund is included in a style category if it meets the criteria under either system. This approach ensures comprehensive coverage across time, because not all classification providers report consistently for all funds and periods.

IA.6.1 Growth Funds

Below, we reproduce the results in Tables 4, 5, 6, 7, and 8 in the main body of the manuscript for growth funds. Our results are robust to considering only growth funds. Tables IA.23 and IA.24 show that achievable alpha and value added are, on average, much smaller than traditional alpha and value added for all models except CAPM, and Table IA.25 shows that the relative performance of funds changes dramatically when we evaluate it with achievable alpha and value added. Table IA.26 shows that the difference between traditional and achievable alpha increases during periods of financial turmoil. Table IA.27 shows that fund flows react to past performance, and the relation between achievable alpha and fund flows strengthens during periods of financial turmoil, while the relation between traditional alpha and fund flows weakens during periods of financial turmoil.

Table IA.23: Traditional and achievable alphas: Growth funds

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven factor models listed in Table 3 for growth funds. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained by regressing the fund returns on all long-short factors for each model, and Panel B reports the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and a t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Average alpha	0.05	-0.02	0.53	0.35	0.09	0.13	0.54
t-stat	0.84	-0.38	8.02	6.06	1.51	2.30	10.27
Time-weighted average alpha	0.33	0.29	0.70	0.51	0.36	0.37	0.91
t-stat	6.07	6.15	10.89	9.07	5.88	6.52	18.10
10th percentile	-2.98	-2.49	-2.53	-2.40	-2.83	-2.61	-2.13
50th percentile	0.15	0.07	0.25	0.15	0.03	0.09	0.52
90th percentile	2.94	2.49	3.96	3.37	3.40	3.12	3.14
Percentage of funds with α >0	52.46	51.46	55.00	52.79	50.49	51.64	61.51
Percentage of funds with $t(\alpha)$ >2	3.68	4.61	10.63	8.38	5.90	6.69	12.05
Panel B: Achievable alpha							
Average alpha	0.01	-2.26	-2.42	-2.75	-3.86	-3.86	-1.30
t-stat	0.12	-27.10	-32.56	-34.30	-46.02	-46.36	-18.23
Time-weighted average alpha	0.32	-1.48	-1.74	-2.06	-3.31	-3.31	-0.43
t-stat	5.71	-19.43	-25.84	-28.42	-44.39	-44.37	-6.40
10th percentile	-3.04	-7.07	-6.40	-7.20	-8.37	-8.37	-5.27
50th percentile	0.12	-1.49	-1.77	-2.04	-3.15	-3.15	-0.77
90th percentile	2.91	1.45	1.05	0.92	-0.03	-0.01	1.98
Percentage of funds with α >0	51.93	27.81	21.05	18.64	9.74	9.96	36.58
Percentage of funds with $t(\alpha)$ >2	3.68	1.59	0.66	0.71	0.27	0.27	2.83

Table IA.24: Traditional and achievable value-added: Growth funds

This table reports cross-sectional statistics for the traditional and achievable fund value-added with respect to the seven factor models listed in Table 3 for growth funds. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using the fund abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-3.39	-1.47	0.10	-0.52	-1.81	-1.58	1.03
t-stat	-10.55	-5.99	0.34	-1.96	-6.49	-6.08	4.07
Time-weighted average value-added	-3.75	-1.05	0.32	-0.45	-1.81	-1.57	1.98
t-stat	-8.81	-3.14	0.81	-1.28	-4.95	-4.52	5.86
10th percentile	-16.18	-10.03	-8.60	-9.14	-11.26	-10.71	-6.43
50th percentile	-0.69	-0.50	-0.26	-0.39	-0.60	-0.55	-0.06
90th percentile	4.65	4.69	9.32	7.07	4.99	5.04	9.59
% of funds with average value-added >0	31.57	32.69	40.04	35.88	32.52	32.66	46.83
Panel B: Achievable value-added							
Average value-added	-3.41	-8.02	-11.49	-11.05	-18.45	-18.36	-6.09
t-stat	-10.62	-16.11	-20.22	-20.45	-24.33	-24.27	-15.99
Time-weighted average value-added	-3.76	-8.52	-13.59	-13.32	-23.79	-23.71	-5.58
t-stat	-8.84	-13.15	-18.74	-18.48	-23.29	-23.27	-11.69
10th percentile	-16.19	-27.68	-33.87	-33.32	-50.76	-50.65	-21.77
50th percentile	-0.72	-2.55	-3.60	-3.77	-5.84	-5.79	-1.85
90th percentile	4.62	1.24	0.15	0.18	-0.18	-0.17	1.90
% of funds with average value-added >0	30.95	17.75	12.07	12.18	5.87	6.36	19.01

Table IA.25: Relative performance: Growth funds

This table reports the percentage of growth funds whose decile changes when they are sorted by achievable rather than traditional metrics. Panel A reports the results based on alpha, and Panel B reports the results based on value-added. Achievable metrics are estimated with respect to the long-only version of the seven benchmark factor models and traditional metrics with respect to the long-short version.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Growth funds sorted by alpha							
Decile changes (%)	4.92	78.24	82.90	83.02	83.55	83.29	71.70
Panel B: Growth funds sorted by value-added							
Decile changes (%)	3.50	76.13	87.29	84.84	86.60	86.42	80.81

Table IA.26: Alpha difference during periods of turmoil: Growth funds

This table reports the slope coefficient for the market-risk variable in (5), along with its standard error and the regression R-squared, for growth funds. The independent variable is standardized, allowing the coefficients to be interpreted as the change in the difference between the traditional and achievable alphas (in basis points) resulting from a one-standard-deviation increase in market volatility. The first seven columns report the results for pooled regressions for each model, and the eighth column reports the results across all models. Model fixed effects are included only for the pooled regression across all models. Standard errors are clustered by fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG	ALL
Slope (bps)	12.064	4.733	10.184	9.926	12.794	13.954	8.636	10.327
Standard errors (bps)	0.133	0.256	0.270	0.264	0.294	0.284	0.251	0.215
Model FE	No	No	No	No	No	No	No	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (%)	12.276	1.390	4.975	4.714	10.398	12.091	4.627	5.991

Table IA.27: Alphas and Fund Flows: Growth funds

This table reports slope coefficients and their t-statistics for several versions of the panel regression (8) applied to growth funds. Panel A considers the regression of fund flows on traditional alpha, Panel B the regression of fund flows on achievable alpha, Panel C the regression of fund flows jointly on traditional and achievable alphas, and Panel D the regression of fund flows jointly on traditional and achievable alphas and their interactions with a "Risk" indicator variable that takes a value of one for months in the top decile of months sorted by realized market volatility in the prior 36 months, and zero otherwise. For all regressions, we consider time and fund fixed effects and double-cluster standard errors by time and fund. Fund flows and alphas are scaled by their full-sample standard deviation, computed across all fund-month observations.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Slope	0.137	0.140	0.125	0.121	0.130	0.133	0.118
	[28.163]	[34.995]	[26.935]	[27.267]	[22.197]	[31.847]	[24.372]
R2 (%)	1.882	1.964	1.568	1.468	1.697	1.778	1.382
Panel B: Achievable alpha							
Slope	0.131	0.121	0.125	0.123	0.128	0.125	0.122
	[21.438]	[20.644]	[20.866]	[21.144]	[20.979]	[21.019]	[19.428]
R2 (%)	1.710	1.457	1.559	1.511	1.630	1.572	1.484
Panel C: Traditional and achievable alpha							
Slope $\alpha_{\mathcal{T}}$	0.149	0.110	0.078	0.074	0.080	0.089	0.062
	[7.254]	[16.647]	[12.333]	[11.932]	[9.747]	[13.698]	[8.007]
Slope $\alpha_{\mathcal{A}}$	-0.012	0.042	0.077	0.079	0.070	0.063	0.078
	[-0.610]	[6.818]	[12.953]	[13.699]	[10.120]	[9.725]	[9.594]
R2 (%)	1.883	2.051	1.929	1.867	1.936	1.982	1.673
Panel D: Traditional and achievable alpha with risk-interaction terms							
Slope $\alpha_{\mathcal{T}}$	0.153	0.113	0.081	0.078	0.084	0.095	0.067
	[7.145]	[16.301]	[12.193]	[11.777]	[10.000]	[14.061]	[8.044]
Slope $\alpha_{\mathcal{A}}$	-0.019	0.038	0.073	0.075	0.064	0.057	0.073
	[-0.954]	[6.115]	[12.099]	[12.819]	[9.254]	[8.760]	[8.753]
Slope $\alpha_{\mathcal{T}}\times$Risk	-0.048	-0.024	-0.029	-0.026	-0.025	-0.030	-0.024
	[-2.170]	[-2.714]	[-4.319]	[-4.131]	[-3.174]	[-4.574]	[-2.866]
Slope $\alpha_{\mathcal{A}}\times$Risk	0.058	0.026	0.033	0.029	0.035	0.035	0.027
	[2.667]	[3.088]	[5.011]	[4.481]	[4.911]	[5.364]	[3.720]
R2 (%)	1.902	2.067	1.969	1.901	1.989	2.034	1.698

IA.6.2 Large-Cap Funds

Below, we reproduce the results in Tables 4, 5, 6, 7, and 8 in the main body of the manuscript for large-cap funds. Our results are robust to considering only large-cap funds. Tables IA.28 and IA.29 show that achievable alpha and value added are, on average, much smaller than traditional alpha and value added for all models except CAPM, and Table IA.30 shows that the relative performance of funds changes dramatically when we compute performance with achievable alpha and value added. Table IA.31 shows that the difference between traditional and achievable alpha increases during periods of financial turmoil. Table IA.32 shows that fund flows react to past performance, and the relation between achievable alpha and fund flows strengthens during periods of financial turmoil, while the relation between traditional alpha and fund flows weakens during periods of financial turmoil.

Table IA.28: Traditional and achievable alphas: Large-cap funds

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven factor models listed in Table 3 for large-cap funds. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained by regressing the fund returns on all long-short factors for each model, and Panel B for the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and a t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) away from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Average alpha	0.06	0.17	0.14	0.13	-0.06	-0.04	0.26
t-stat	0.95	3.39	1.95	2.07	-0.80	-0.67	4.69
Time-weighted average alpha	0.35	0.39	0.34	0.30	0.13	0.14	0.62
t-stat	5.68	7.58	4.59	4.62	1.78	2.20	10.69
10th percentile	-2.33	-1.73	-2.21	-1.86	-2.43	-2.25	-1.81
50th percentile	0.20	0.16	-0.11	-0.07	-0.17	-0.18	0.26
90th percentile	2.30	2.08	2.79	2.56	2.59	2.43	2.36
Percentage of funds with α >0	54.93	54.84	47.95	47.95	45.46	46.53	57.24
Percentage of funds with $t(\alpha)$ >2	3.51	5.06	8.82	7.11	4.54	4.97	9.85
Panel B: Achievable alpha							
Average alpha	0.02	-1.78	-2.15	-2.35	-3.26	-3.25	-1.36
t-stat	0.36	-17.14	-22.25	-23.34	-31.77	-31.67	-14.73
Time-weighted average alpha	0.33	-0.99	-1.46	-1.65	-2.71	-2.71	-0.45
t-stat	5.38	-10.39	-16.72	-18.02	-29.49	-29.45	-5.17
10th percentile	-2.43	-6.26	-6.01	-6.50	-7.49	-7.48	-5.14
50th percentile	0.19	-1.00	-1.58	-1.67	-2.67	-2.66	-0.76
90th percentile	2.30	1.57	1.16	1.07	0.30	0.35	1.63
Percentage of funds with α >0	54.67	33.68	23.91	22.11	12.43	12.77	34.53
Percentage of funds with $t(\alpha)$ >2	3.51	2.57	1.11	1.11	0.26	0.26	3.43

Table IA.29: Traditional and achievable value-added: Large-cap funds

This table reports cross-sectional statistics for the traditional and achievable fund value-added with respect to the seven factor models listed in Table 3 for large-cap funds. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using the fund abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-2.42	-0.88	-1.49	-1.53	-2.45	-2.00	-0.04
t-stat	-6.05	-2.61	-3.05	-3.73	-5.17	-4.90	-0.10
Time-weighted average value-added	-2.55	-0.53	-1.79	-1.90	-3.26	-2.63	0.55
t-stat	-4.93	-1.18	-2.75	-3.59	-5.18	-5.03	1.15
10th percentile	-12.71	-9.03	-11.91	-10.86	-13.53	-11.74	-7.83
50th percentile	-0.39	-0.29	-0.43	-0.43	-0.64	-0.59	-0.18
90th percentile	4.31	4.73	7.00	6.11	4.53	4.32	6.46
% of funds with average value-added >0	35.55	36.75	34.76	34.44	31.29	31.69	40.96
Panel B: Achievable value-added							
Average value-added	-2.40	-6.77	-10.50	-10.89	-18.26	-18.24	-5.25
t-stat	-6.02	-7.67	-11.60	-11.22	-15.68	-15.65	-9.24
Time-weighted average value-added	-2.55	-6.57	-12.29	-13.01	-23.50	-23.49	-4.05
t-stat	-4.93	-5.74	-10.65	-10.18	-14.99	-14.98	-5.67
10th percentile	-12.71	-29.07	-34.12	-36.77	-51.16	-51.16	-20.36
50th percentile	-0.40	-1.67	-2.82	-2.95	-5.21	-5.21	-1.61
90th percentile	4.31	4.24	1.32	1.38	-0.06	-0.03	2.54
% of funds with average value-added >0	35.23	24.74	17.31	17.26	8.90	9.69	20.19

Table IA.30: Relative performance: Large-cap funds

This table reports the percentage of large-cap funds whose decile rank changes when they are sorted by achievable rather than traditional metrics. Panel A reports the results based on alpha, and Panel B on value-added. Achievable metrics are estimated with respect to the long-only version of the seven benchmark factor models and traditional metrics with respect to the long-short version.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Large-cap funds sorted by alpha							
Decile changes (%)	3.86	81.66	83.89	83.03	86.46	86.20	73.01
Panel B: Large-cap funds sorted by value-added							
Decile changes (%)	2.19	79.43	82.11	82.69	82.85	82.82	75.09

Table IA.31: Alpha difference during periods of turmoil: Large-cap funds

This table reports the slope coefficient for the market-risk variable in (5), along with its standard error and the regression R-squared, for large-cap funds. The independent variable is standardized, allowing the coefficients to be interpreted as the change in the difference between the traditional and achievable alphas (in basis points) resulting from a one-standard-deviation increase in market volatility. The first seven columns report the results for pooled regressions for each model, and the eighth column reports the results across all models. Model fixed effects are included only for the pooled regression across all models. Standard errors are clustered by fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG	ALL
Slope (bps)	11.550	10.862	14.710	14.248	16.012	16.634	11.428	13.635
Standard errors (bps)	0.154	0.297	0.315	0.311	0.369	0.368	0.299	0.260
Model FE	No	No	No	No	No	No	No	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (%)	13.120	5.794	7.023	6.579	11.468	11.816	6.916	7.484

Table IA.32: Alphas and Fund Flows: Large-cap funds

This table reports slope coefficients and their t-statistics for several versions of the panel regression (8) applied to large-cap funds. Panel A considers the regression of fund flows on traditional alpha, Panel B the regression of fund flows on achievable alpha, Panel C the regression of fund flows jointly on traditional and achievable alphas, and Panel D the regression of fund flows jointly on traditional and achievable alphas and their interactions with a "Risk" indicator variable that takes a value of one for months in the top decile of months sorted by realized market volatility in the prior 36 months, and zero otherwise. For all regressions, we consider time and fund fixed effects and double-cluster standard errors by time and fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Slope	0.111	0.119	0.097	0.091	0.105	0.105	0.097
	[22.134]	[31.807]	[17.720]	[17.087]	[24.983]	[29.414]	[20.873]
R2 (%)	1.241	1.427	0.932	0.835	1.100	1.100	0.945
Panel B: Achievable alpha							
Slope	0.102	0.090	0.093	0.092	0.095	0.094	0.092
	[5.472]	[5.547]	[5.542]	[5.465]	[5.582]	[5.526]	[6.364]
R2 (%)	1.037	0.808	0.860	0.842	0.907	0.877	0.844
Panel C: Traditional and achievable alpha							
Slope $\alpha_{\mathcal{T}}$	0.176	0.106	0.074	0.071	0.075	0.077	0.066
	[6.649]	[13.601]	[10.554]	[11.053]	[9.615]	[11.870]	[8.851]
Slope $\alpha_{\mathcal{A}}$	-0.068	0.021	0.068	0.072	0.052	0.054	0.052
	[-3.094]	[1.952]	[12.799]	[13.551]	[5.297]	[7.432]	[6.311]
R2 (%)	1.276	1.453	1.344	1.308	1.277	1.308	1.113
Panel D: Traditional and achievable alpha with risk-interaction terms							
Slope $\alpha_{\mathcal{T}}$	0.182	0.107	0.074	0.072	0.075	0.079	0.066
	[6.468]	[13.410]	[9.658]	[10.176]	[9.958]	[11.949]	[7.931]
Slope $\alpha_{\mathcal{A}}$	-0.077	0.019	0.066	0.070	0.048	0.050	0.048
	[-3.352]	[1.782]	[11.778]	[12.675]	[5.358]	[7.678]	[6.178]
Slope $\alpha_{\mathcal{T}}\times$Risk	-0.059	-0.019	-0.019	-0.023	-0.013	-0.023	-0.017
	[-3.017]	[-2.034]	[-2.948]	[-3.574]	[-2.072]	[-3.971]	[-2.701]
Slope $\alpha_{\mathcal{A}}\times$Risk	0.078	0.025	0.027	0.028	0.028	0.032	0.027
	[3.925]	[2.649]	[4.247]	[3.967]	[4.416]	[5.038]	[4.307]
R2 (%)	1.330	1.467	1.373	1.340	1.319	1.355	1.141

IA.6.3 Small-Cap Funds

Below, we reproduce the results in Tables 4, 5, 6, 7, and 8 in the main body of the manuscript for small-cap funds. Our results are robust to considering only small-cap funds. Tables IA.33 and IA.34 show that achievable alpha and value added are, on average, much smaller than traditional alpha and value added for all models except CAPM, and Table IA.35 shows that the relative performance of funds changes dramatically when we compute performance with achievable alpha and value added. Table IA.36 shows that the difference between traditional and achievable alpha increases during periods of financial turmoil. Table IA.37 shows that fund flows react to past performance, and the relation between achievable alpha and fund flows strengthens during periods of financial turmoil, while the relation between traditional alpha and fund flows weakens during periods of financial turmoil.

Table IA.33: Traditional and achievable alphas: Small-cap funds

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven factor models listed in Table 3 for small-cap funds. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained by regressing the fund returns on all long-short factors for each model, and Panel B for the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and a t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Average alpha	0.13	-0.05	0.44	0.19	0.10	0.15	1.00
t-stat	1.05	-0.57	4.20	1.92	0.94	1.57	11.51
Time-weighted average alpha	0.40	0.36	0.69	0.47	0.43	0.46	1.35
t-stat	3.64	4.30	6.66	5.05	4.23	4.84	16.54
10th percentile	-4.39	-2.90	-2.94	-3.04	-3.17	-2.89	-1.75
50th percentile	0.17	0.10	0.18	0.07	0.13	0.21	1.04
90th percentile	4.28	2.86	4.02	3.44	3.66	3.30	3.69
Percentage of funds with α >0	52.00	51.88	53.82	51.08	52.91	54.28	72.29
Percentage of funds with $t(\alpha)$ >2	4.33	6.04	9.92	7.64	6.61	7.18	16.08
Panel B: Achievable alpha							
Average alpha	0.08	-2.53	-2.71	-3.10	-4.45	-4.46	-1.35
t-stat	0.69	-19.50	-23.98	-25.52	-35.00	-35.10	-11.92
Time-weighted average alpha	0.38	-1.74	-2.07	-2.41	-3.89	-3.89	-0.51
t-stat	3.47	-14.37	-20.05	-21.61	-33.35	-33.38	-4.78
10th percentile	-4.39	-7.03	-6.30	-7.15	-8.52	-8.53	-5.52
50th percentile	0.15	-1.88	-2.27	-2.51	-3.93	-3.93	-0.78
90th percentile	4.24	1.37	0.61	0.44	-0.71	-0.71	2.19
Percentage of funds with α >0	51.43	22.58	15.17	12.77	6.61	6.61	35.92
Percentage of funds with $t(\alpha)$ >2	4.10	1.60	0.34	0.46	0.34	0.34	2.39

Table IA.34: Traditional and achievable value-added: Small-cap funds

This table reports cross-sectional statistics for the traditional and achievable fund value-added with respect to the seven factor models listed in Table 3 for small-cap funds. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using the fund abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-4.42	-1.39	-0.45	-1.40	-2.40	-2.11	1.85
t-stat	-8.04	-3.70	-1.12	-4.09	-6.61	-6.06	5.69
Time-weighted average value-added	-5.00	-0.72	-0.08	-1.11	-2.38	-2.03	2.62
t-stat	-6.98	-1.40	-0.16	-2.48	-4.97	-4.40	6.37
10th percentile	-20.63	-10.08	-8.61	-8.83	-11.04	-10.41	-4.44
50th percentile	-1.45	-0.70	-0.51	-0.70	-0.85	-0.73	0.06
90th percentile	6.23	4.88	7.40	4.44	4.19	4.57	10.72
% of funds with average value-added >0	28.21	30.85	35.55	30.88	29.24	30.31	54.27
Panel B: Achievable value-added							
Average value-added	-4.45	-8.97	-11.73	-11.67	-17.74	-17.71	-6.63
t-stat	-8.07	-15.64	-17.96	-18.63	-18.99	-18.99	-13.21
Time-weighted average value-added	-5.01	-9.79	-14.08	-13.91	-22.39	-22.37	-6.69
t-stat	-6.99	-13.60	-17.17	-17.65	-17.93	-17.93	-10.50
10th percentile	-20.63	-26.61	-31.75	-31.79	-47.98	-47.20	-21.78
50th percentile	-1.45	-3.73	-5.06	-5.05	-7.98	-8.05	-2.71
90th percentile	6.38	0.04	-0.30	-0.33	-0.61	-0.61	1.42
% of funds with average value-added >0	27.98	10.45	4.71	4.71	2.07	2.07	16.38

Table IA.35: Relative performance: Small-cap funds

This table reports the percentage of small-cap funds whose decile rank changes when they are sorted by achievable rather than traditional metrics. Panel A reports the results based on alpha, and Panel B on value-added. Achievable metrics are estimated with respect to the long-only version of the seven benchmark factor models and traditional metrics with respect to the long-short version.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Small-cap funds sorted by alpha							
Decile changes (%)	4.56	71.04	77.08	79.48	79.02	79.36	71.38
Panel B: Small-cap funds sorted by value-added							
Decile changes (%)	1.49	75.81	86.29	83.39	85.70	85.01	83.01

Table IA.36: Alpha difference during periods of turmoil: Small-cap funds

This table reports the slope coefficient for the market-risk variable in (5), along with its standard error and the regression R-squared, for small-cap funds. The independent variable is standardized, allowing the coefficients to be interpreted as the change in the difference between the traditional and achievable alphas (in basis points) resulting from a one-standard-deviation increase in market volatility. The first seven columns report the results for pooled regressions for each model, and the eighth column reports the results across all models. Model fixed effects are included only for the pooled regression across all models. Standard errors are clustered by fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG	ALL
Slope (bps)	13.117	-1.902	4.279	4.195	7.078	8.428	5.743	5.847
Standard errors (bps)	0.214	0.374	0.403	0.411	0.443	0.426	0.429	0.320
Model FE	No	No	No	No	No	No	No	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (%)	12.732	0.263	0.996	0.951	4.205	5.756	1.900	2.112

Table IA.37: Alphas and Fund Flows: Small-cap funds

This table reports slope coefficients and their t-statistics for several versions of the panel regression (8) applied to small-cap funds. Panel A considers the regression of fund flows on traditional alpha, Panel B the regression of fund flows on achievable alpha, Panel C the regression of fund flows jointly on traditional and achievable alphas, and Panel D the regression of fund flows jointly on traditional and achievable alphas and their interactions with a "Risk" indicator variable that takes a value of one for months in the top decile of months sorted by realized market volatility in the prior 36 months, and zero otherwise. For all regressions, we consider time and fund fixed effects and double-cluster standard errors by time and fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Slope	0.159	0.163	0.151	0.147	0.156	0.160	0.138
	[26.337]	[28.342]	[24.758]	[24.576]	[19.226]	[26.686]	[21.009]
R2 (%)	2.517	2.660	2.267	2.162	2.424	2.566	1.904
Panel B: Achievable alpha							
Slope	0.156	0.151	0.154	0.153	0.158	0.157	0.148
	[17.223]	[17.558]	[17.572]	[17.982]	[17.685]	[17.592]	[15.780]
R2 (%)	2.423	2.271	2.360	2.340	2.509	2.449	2.203
Panel C: Traditional and achievable alpha							
Slope $\alpha_{\mathcal{T}}$	0.119	0.117	0.086	0.082	0.081	0.097	0.062
	[5.106]	[9.870]	[8.951]	[8.439]	[5.924]	[8.714]	[5.235]
Slope $\alpha_{\mathcal{A}}$	0.041	0.059	0.096	0.099	0.094	0.082	0.103
	[1.687]	[5.631]	[10.346]	[11.051]	[7.517]	[7.318]	[8.021]
R2 (%)	2.530	2.797	2.767	2.733	2.752	2.838	2.385
Panel D: Traditional and achievable alpha with risk-interaction terms							
Slope $\alpha_{\mathcal{T}}$	0.125	0.121	0.089	0.086	0.088	0.104	0.069
	[5.285]	[9.828]	[8.919]	[8.434]	[6.264]	[9.020]	[5.489]
Slope $\alpha_{\mathcal{A}}$	0.033	0.055	0.092	0.096	0.086	0.075	0.097
	[1.346]	[5.070]	[9.861]	[10.506]	[6.882]	[6.669]	[7.438]
Slope $\alpha_{\mathcal{T}}\times$Risk	-0.058	-0.035	-0.030	-0.027	-0.038	-0.037	-0.036
	[-1.607]	[-3.276]	[-3.329]	[-3.651]	[-3.655]	[-3.913]	[-2.765]
Slope $\alpha_{\mathcal{A}}\times$Risk	0.068	0.037	0.033	0.028	0.047	0.041	0.037
	[1.908]	[4.032]	[4.343]	[4.069]	[4.877]	[4.418]	[3.597]
R2 (%)	2.550	2.821	2.801	2.763	2.830	2.900	2.428

IA.6.4 Aggressive-Growth Funds

Below, we reproduce the results in Tables 4, 5, 6, 7, and 8 in the main body of the manuscript for aggressive-growth funds. Our results are robust to considering only aggressive-growth funds. Tables IA.38 and IA.39 show that achievable alpha and value added are, on average, much smaller than traditional alpha and value added for all models except CAPM, and Table IA.40 shows that the relative performance of funds changes dramatically when we evaluate it using achievable alpha and value added. Table IA.41 shows that the difference between traditional and achievable alpha increases during periods of financial turmoil. Table IA.42 shows that fund flows react to past performance, and the relation between achievable alpha and fund flows strengthens during periods of financial turmoil, while the relation between traditional alpha and fund flows weakens during periods of financial turmoil.

Table IA.38: Traditional and achievable alphas: Aggressive-growth funds

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven factor models listed in Table 3 for aggressive-growth funds. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained from regressing the fund returns on all long-short factors for each model, and Panel B reports the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and a t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Average alpha	-0.10	0.12	1.37	0.93	0.67	0.58	0.74
t-stat	-0.41	0.49	4.11	3.12	2.07	1.91	3.14
Time-weighted average alpha	0.43	0.45	1.39	0.97	0.84	0.75	1.35
t-stat	2.01	2.13	4.63	3.64	2.94	2.77	6.50
10th percentile	-4.33	-4.03	-3.87	-2.93	-4.12	-3.48	-2.75
50th percentile	0.42	0.55	1.49	1.04	0.95	0.90	1.03
90th percentile	3.01	3.06	5.75	4.47	4.73	4.13	3.80
Percentage of funds with $\alpha > 0$	59.74	61.69	70.78	64.29	64.94	61.04	66.88
Percentage of funds with $t(\alpha) > 2$	3.90	6.49	22.08	18.18	12.34	13.64	16.23
Panel B: Achievable alpha							
Average alpha	-0.10	-3.20	-2.74	-3.52	-4.91	-4.90	-0.37
t-stat	-0.41	-9.06	-8.81	-10.48	-13.56	-13.57	-1.34
Time-weighted average alpha	0.43	-2.10	-1.87	-2.51	-3.96	-3.94	0.59
t-stat	2.01	-6.55	-6.74	-8.31	-12.65	-12.62	2.37
10th percentile	-4.33	-8.42	-7.65	-8.48	-10.00	-9.93	-4.79
50th percentile	0.42	-2.31	-1.79	-2.59	-3.96	-3.87	0.27
90th percentile	3.01	1.51	1.00	0.73	-0.85	-0.85	3.11
Percentage of funds with $\alpha > 0$	59.74	21.43	19.48	15.58	2.60	2.60	54.55
Percentage of funds with $t(\alpha) > 2$	3.90	1.30	0.65	0.65	0.00	0.00	7.79

Table IA.39: Traditional and achievable value-added: Aggressive-growth funds

This table reports cross-sectional statistics for the traditional and achievable fund value-added with respect to the seven factor models listed in Table 3 for aggressive-growth funds. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using the fund abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-6.17	-0.73	6.66	2.90	-2.36	-2.77	1.94
t-stat	-3.28	-0.50	2.82	1.30	-1.20	-1.31	1.32
Time-weighted average value-added	-6.64	-0.74	6.16	1.31	-3.94	-4.77	2.87
t-stat	-2.89	-0.42	2.09	0.46	-1.52	-1.70	1.62
10th percentile	-27.60	-16.32	-12.85	-17.41	-20.73	-22.19	-11.23
50th percentile	-0.81	-0.23	0.37	-0.04	-0.30	-0.26	0.14
90th percentile	7.49	12.47	43.58	23.82	11.37	12.27	18.40
% of funds with average value-added >0	31.82	41.18	56.21	49.02	44.44	43.14	53.25
Panel B: Achievable value-added							
Average value-added	-6.17	-19.70	-29.91	-26.32	-41.92	-41.72	-7.79
t-stat	-3.28	-5.60	-6.12	-6.17	-6.46	-6.44	-4.60
Time-weighted average value-added	-6.64	-19.85	-35.51	-28.70	-49.28	-49.00	-6.63
t-stat	-2.89	-4.84	-5.60	-5.58	-5.92	-5.90	-3.55
10th percentile	-27.60	-61.29	-79.55	-67.44	-115.53	-115.53	-29.37
50th percentile	-0.81	-6.95	-7.41	-7.83	-12.20	-12.20	-1.35
90th percentile	7.49	0.95	-0.24	-0.26	-0.60	-0.60	7.14
% of funds with average value-added >0	31.82	12.58	5.84	5.92	2.61	2.61	25.49

Table IA.40: Relative performance: Aggressive-growth funds

This table reports the percentage of aggressive-growth funds whose decile changes when we sort them based on achievable instead of traditional metrics. Panel A reports the results based on alpha and Panel B on value-added. Achievable metrics are estimated with respect to the long-only version of the seven factor models and traditional metrics with respect to the long-short version.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Aggressive-growth funds sorted by alpha							
Decile changes (%)	0.00	74.03	83.12	83.77	85.71	85.06	62.34
Panel B: Aggressive-growth funds sorted by value-added							
Decile changes (%)	0.00	84.77	93.46	92.05	84.87	88.16	85.62

Table IA.41: Alpha gap during periods of turmoil: Aggressive-growth funds

This table reports the slope coefficient for the market-risk variable in (5), along with its standard error and the regression R-squared, for aggressive-growth funds. The independent variable is standardized, allowing the coefficients to be interpreted as the change in the difference between the traditional and achievable alphas (in basis points) resulting from a one-standard-deviation increase in market volatility. The first seven columns report the results for pooled regressions for each model, and the eighth column across all models. Model fixed effects are included only for the pooled regression across all models. Standard errors are clustered by fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG	ALL
Slope (bps)	11.980	6.318	10.269	10.290	13.883	14.367	11.036	11.163
Standard errors (bps)	0.489	0.712	0.911	0.885	1.149	1.051	0.786	0.734
Model FE	No	No	No	No	No	No	No	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (%)	10.798	1.858	3.279	3.369	8.247	8.845	6.064	4.992

Table IA.42: Alphas and fund flows: Aggressive-growth funds

This table reports slope coefficients and their t-statistics for several versions of panel regression (8) for aggressive-growth funds. Panel A considers the regression of fund flows on traditional alpha, Panel B the regression of fund flows on achievable alpha, Panel C the regression of fund flows jointly on traditional and achievable alphas, and Panel D the regression of fund flows jointly on traditional and achievable alphas and their interactions with a "Risk" indicator variable that takes a value of one for months in the top decile of months sorted by realized market volatility in the prior 36 months, and zero otherwise. For all regressions, we consider time and fund fixed effects and double-cluster standard errors by time and fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Slope	0.154	0.143	0.138	0.126	0.152	0.152	0.131
	[16.294]	[17.852]	[15.260]	[14.613]	[14.885]	[16.775]	[13.629]
R2 (%)	2.378	2.043	1.905	1.598	2.301	2.299	1.706
Panel B: Achievable alpha							
Slope	0.152	0.139	0.147	0.143	0.147	0.143	0.139
	[11.746]	[11.310]	[11.471]	[11.602]	[11.855]	[11.825]	[11.332]
R2 (%)	2.318	1.946	2.164	2.036	2.168	2.043	1.925
Panel C: Traditional and achievable alpha							
Slope $\alpha_{\mathcal{T}}$	0.105	0.087	0.073	0.061	0.095	0.101	0.052
	[3.463]	[5.523]	[5.230]	[4.125]	[5.625]	[6.521]	[2.444]
Slope $\alpha_{\mathcal{A}}$	0.051	0.073	0.099	0.104	0.078	0.071	0.097
	[1.596]	[4.429]	[7.698]	[7.795]	[5.122]	[5.051]	[4.764]
R2 (%)	2.397	2.260	2.468	2.261	2.584	2.552	2.030
Panel D: Traditional and achievable alpha with risk-interaction terms							
Slope $\alpha_{\mathcal{T}}$	0.113	0.088	0.075	0.061	0.100	0.105	0.054
	[3.508]	[5.549]	[5.237]	[4.089]	[5.623]	[6.500]	[2.471]
Slope $\alpha_{\mathcal{A}}$	0.041	0.070	0.095	0.101	0.072	0.066	0.093
	[1.227]	[4.373]	[7.415]	[7.649]	[4.654]	[4.634]	[4.604]
Slope $\alpha_{\mathcal{T}}\times$Risk	-0.117	-0.016	-0.027	-0.013	-0.024	-0.023	-0.016
	[-1.539]	[-0.773]	[-1.704]	[-0.810]	[-1.591]	[-1.509]	[-0.794]
Slope $\alpha_{\mathcal{A}}\times$Risk	0.125	0.024	0.033	0.024	0.034	0.031	0.027
	[1.676]	[1.127]	[1.978]	[1.356]	[2.026]	[1.999]	[1.300]
R2 (%)	2.433	2.276	2.506	2.284	2.634	2.593	2.051

IA.6.5 Large-Cap Value Funds

Below, we reproduce the results in Tables 4, 5, 6, 7, and 8 in the main body of the manuscript for large-cap value funds. Our results are robust to considering only large-cap value funds. Tables IA.43 and IA.44 show that achievable alpha and value added are, on average, much smaller than traditional alpha and value added for all models except CAPM, and Table IA.45 shows that the relative performance of funds changes dramatically when we evaluate it using achievable alpha and value added. Table IA.46 shows that the difference between traditional and achievable alpha increases during periods of financial turmoil. Table IA.47 shows that fund flows react to past performance, and the relation between achievable alpha and fund flows strengthens during periods of financial turmoil, while the relation between traditional alpha and fund flows weakens during periods of financial turmoil.

Table IA.43: Traditional and achievable alphas: Large-cap value funds

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven factor models listed in Table 3 for large-cap value funds. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained by regressing the fund returns on all long-short factors for each model, and Panel B for the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and a t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Average alpha	0.23	0.04	-0.98	-0.65	-0.99	-0.83	0.21
t-stat	2.47	0.47	-11.36	-7.97	-10.74	-9.96	2.68
Time-weighted average alpha	0.42	0.21	-0.80	-0.48	-0.85	-0.70	0.50
t-stat	4.44	2.68	-9.30	-5.85	-9.24	-8.12	5.95
10th percentile	-2.05	-1.70	-2.87	-2.27	-3.01	-2.73	-1.55
50th percentile	0.24	0.05	-0.86	-0.70	-1.00	-0.87	0.21
90th percentile	2.44	1.77	0.99	1.27	1.15	1.12	1.92
Percentage of funds with $\alpha >0$	56.08	51.59	25.86	29.55	24.87	27.25	57.14
Percentage of funds with $t(\alpha) >2$	3.44	4.76	1.32	2.11	1.32	1.59	8.20
Panel B: Achievable alpha							
Average alpha	0.18	-1.20	-1.92	-1.92	-2.54	-2.53	-1.01
t-stat	1.84	-9.98	-17.70	-17.33	-23.10	-22.96	-8.87
Time-weighted average alpha	0.40	-0.58	-1.44	-1.43	-2.23	-2.22	-0.38
t-stat	4.16	-4.93	-13.84	-13.48	-21.51	-21.45	-3.23
10th percentile	-2.12	-4.04	-4.41	-4.47	-5.13	-5.13	-3.82
50th percentile	0.21	-0.90	-1.68	-1.67	-2.35	-2.31	-0.79
90th percentile	2.40	1.32	0.34	0.40	-0.13	-0.13	1.53
Percentage of funds with $\alpha >0$	55.56	30.42	14.55	14.29	9.26	9.52	32.01
Percentage of funds with $t(\alpha) >2$	3.44	3.44	0.53	0.53	0.00	0.00	3.97

Table IA.44: Traditional and achievable value-added: Large-cap value funds

This table reports cross-sectional statistics for the traditional and achievable fund value-added with respect to the seven factor models listed in Table 3 for large-cap value funds. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using the fund abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-2.86	-2.31	-8.30	-5.71	-7.67	-6.01	-1.77
t-stat	-4.90	-4.15	-9.07	-8.32	-9.43	-8.71	-3.54
Time-weighted average value-added	-2.91	-2.25	-10.22	-6.81	-9.82	-7.53	-1.18
t-stat	-3.94	-3.26	-9.17	-8.13	-9.47	-8.53	-1.77
10th percentile	-13.66	-12.38	-26.05	-20.21	-23.57	-20.53	-8.76
50th percentile	-0.39	-0.51	-1.76	-1.19	-1.88	-1.42	-0.30
90th percentile	3.39	2.51	0.10	0.80	0.41	0.79	3.21
% of funds with average value-added >0	34.58	32.09	13.07	19.73	15.86	18.82	36.27
Panel B: Achievable value-added							
Average value-added	-2.91	-4.42	-8.68	-8.35	-13.37	-13.32	-4.82
t-stat	-4.97	-5.34	-9.99	-10.23	-10.46	-10.42	-7.39
Time-weighted average value-added	-2.93	-3.84	-9.67	-9.29	-16.37	-16.35	-3.89
t-stat	-3.96	-3.67	-9.55	-9.59	-11.30	-11.28	-4.76
10th percentile	-14.46	-18.50	-26.53	-25.99	-41.64	-41.64	-16.20
50th percentile	-0.42	-1.89	-3.07	-3.12	-4.56	-4.62	-1.80
90th percentile	3.39	2.12	-0.04	-0.01	-0.24	-0.18	1.56
% of funds with average value-added >0	34.05	18.97	9.43	9.97	5.36	6.43	18.28

Table IA.45: Relative performance: Large-cap value funds

This table reports the percentage of large-cap value funds whose decile rank changes when they are sorted by achievable rather than traditional metrics. Panel A reports the results based on alpha, and Panel B on value-added. Achievable metrics are estimated with respect to the long-only version of the seven benchmark factor models, and the traditional metrics with respect to the long-short version.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Large-cap value funds sorted by alpha							
Decile changes (%)	8.20	78.57	74.07	78.31	77.25	75.93	71.96
Panel B: Large-cap value funds sorted by value-added							
Decile changes (%)	4.02	73.44	64.05	69.19	67.48	71.27	69.81

Table IA.46: Alpha difference during periods of turmoil: Large-cap value funds

This table reports, for large-cap value funds, the slope coefficient for the market-risk variable in (5), along with its standard error and the regression R-squared. The independent variable is standardized, allowing the coefficients to be interpreted as the change in the difference between the traditional and achievable alphas (in basis points) resulting from a one-standard-deviation increase in market volatility. The first seven columns report the results for pooled regressions for each model, and the eighth column across all models. Model fixed effects are included only for the pooled regression across all models. Standard errors are clustered by fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG	ALL
Slope (bps)	10.538	13.476	15.694	14.560	10.475	10.878	12.150	12.538
Standard errors (bps)	0.219	0.363	0.421	0.430	0.423	0.445	0.384	0.314
Model FE	No	No	No	No	No	No	No	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (%)	14.079	10.386	5.926	5.235	4.572	4.605	8.056	5.160

Table IA.47: Alphas and fund flows: Large-cap value funds

This table reports slope coefficients and their t-statistics for several versions of panel regression (8) for large-cap value funds. Panel A considers the regression of fund flows on traditional alpha, Panel B the regression of fund flows on achievable alpha, Panel C the regression of fund flows jointly on traditional and achievable alphas, and Panel D the regression of fund flows jointly on traditional and achievable alphas and their interactions with a "Risk" indicator variable that takes a value of one for months in the top decile of months sorted by realized market volatility in the prior 36 months, and zero otherwise. For all regressions, we consider time and fund fixed effects and double-cluster standard errors by time and fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Slope	0.098	0.118	0.073	0.069	0.108	0.104	0.091
	[10.162]	[17.301]	[7.850]	[7.697]	[16.398]	[15.319]	[10.036]
R2 (%)	0.965	1.387	0.527	0.480	1.163	1.081	0.828
Panel B: Achievable alpha							
Slope	0.093	0.090	0.089	0.090	0.093	0.092	0.090
	[2.106]	[2.069]	[2.058]	[2.050]	[2.062]	[2.053]	[2.284]
R2 (%)	0.866	0.802	0.796	0.809	0.859	0.854	0.819
Panel C: Traditional and achievable alpha							
Slope $\alpha_{\mathcal{T}}$	0.152	0.103	0.081	0.082	0.085	0.086	0.062
	[3.466]	[8.757]	[9.450]	[9.044]	[9.574]	[10.535]	[4.034]
Slope $\alpha_{\mathcal{A}}$	-0.055	0.024	0.097	0.100	0.061	0.070	0.061
	[-1.860]	[0.912]	[6.760]	[7.037]	[2.976]	[3.955]	[2.776]
R2 (%)	0.980	1.420	1.452	1.471	1.483	1.541	1.116
Panel D: Traditional and achievable alpha with risk-interaction terms							
Slope $\alpha_{\mathcal{T}}$	0.146	0.100	0.079	0.080	0.083	0.085	0.059
	[3.307]	[8.143]	[8.583]	[8.421]	[9.515]	[10.157]	[3.543]
Slope $\alpha_{\mathcal{A}}$	-0.056	0.022	0.093	0.097	0.058	0.067	0.058
	[-1.892]	[0.902]	[6.595]	[6.884]	[3.013]	[4.059]	[2.775]
Slope $\alpha_{\mathcal{T}}\times$Risk	0.020	-0.023	-0.017	-0.017	-0.013	-0.020	-0.013
	[0.719]	[-2.249]	[-1.929]	[-2.110]	[-1.629]	[-2.736]	[-1.477]
Slope $\alpha_{\mathcal{A}}\times$Risk	0.015	0.042	0.032	0.031	0.033	0.036	0.036
	[0.530]	[3.795]	[3.347]	[3.336]	[3.408]	[3.995]	[3.917]
R2 (%)	1.093	1.469	1.492	1.509	1.535	1.594	1.184

IA.6.6 Small-Cap Growth Funds

Below, we reproduce the results in Tables 4, 5, 6, 7, and 8 in the main body of the manuscript for small-cap growth funds. Our results are robust to considering only small-cap growth funds. Tables IA.48 and IA.49 show that achievable alpha and value added are, on average, much smaller than traditional alpha and value added for all models except CAPM, and Table IA.50 shows that the relative performance of funds changes dramatically when we evaluate it using achievable alpha and value added. Table IA.51 shows that the difference between traditional and achievable alpha increases during periods of financial turmoil. Table IA.52 shows that fund flows react to past performance, and the relation between achievable alpha and fund flows strengthens during periods of financial turmoil, while the relation between traditional alpha and fund flows weakens during periods of financial turmoil.

Table IA.48: Traditional and achievable alphas: Small-cap growth funds

This table reports, for small-cap growth funds, cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven factor models listed in Table 3. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained by regressing the fund returns on all long-short factors for each model, and Panel B for the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and a t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Average alpha	0.33	-0.17	0.94	0.50	0.34	0.32	1.15
t-stat	2.46	-1.46	6.67	3.82	2.40	2.47	9.95
Time-weighted average alpha	0.56	0.29	1.09	0.72	0.65	0.63	1.49
t-stat	4.62	2.78	8.21	6.05	5.00	5.19	14.44
10th percentile	-3.76	-3.39	-2.96	-3.10	-3.52	-3.17	-1.96
50th percentile	0.43	0.01	0.70	0.42	0.33	0.44	1.25
90th percentile	3.92	3.00	4.84	3.78	4.12	4.10	3.94
Percentage of funds with α >0	56.39	50.09	61.16	57.07	56.90	57.07	73.42
Percentage of funds with $t(\alpha)$ >2	3.24	5.96	13.80	10.22	8.52	9.20	17.38
Panel B: Achievable alpha							
Average alpha	0.29	-2.93	-2.87	-3.43	-4.94	-4.95	-1.16
t-stat	2.19	-16.68	-18.85	-20.66	-29.21	-29.26	-7.92
Time-weighted average alpha	0.54	-1.95	-2.09	-2.55	-4.16	-4.16	-0.27
t-stat	4.50	-12.44	-15.73	-17.42	-27.64	-27.66	-2.07
10th percentile	-3.76	-8.31	-7.64	-8.42	-10.37	-10.32	-5.59
50th percentile	0.42	-1.97	-2.19	-2.51	-4.08	-4.08	-0.53
90th percentile	3.92	1.25	0.61	0.39	-1.03	-1.03	2.47
Percentage of funds with α >0	55.71	20.95	14.82	12.27	5.11	5.11	40.72
Percentage of funds with $t(\alpha)$ >2	3.24	1.02	0.17	0.34	0.17	0.17	2.21

Table IA.49: Traditional and achievable value-added: Small-cap growth funds

This table reports, for small-cap growth funds, cross-sectional statistics for the traditional and achievable fund value-added with respect to the seven factor models listed in Table 3. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using the fund abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-4.27	-2.08	0.85	-0.70	-2.12	-1.97	2.60
t-stat	-5.76	-3.92	1.57	-1.42	-4.02	-3.54	4.62
Time-weighted average value-added	-4.64	-1.36	1.39	-0.29	-1.54	-1.34	3.70
t-stat	-4.86	-1.89	2.05	-0.48	-2.18	-1.79	4.92
10th percentile	-21.82	-12.69	-8.88	-10.93	-11.82	-11.62	-5.59
50th percentile	-1.26	-1.11	-0.19	-0.50	-0.80	-0.72	0.25
90th percentile	7.31	6.36	10.41	7.14	6.25	5.93	13.87
% of funds with average value-added >0	29.90	30.70	44.85	36.60	33.39	33.50	57.04
Panel B: Achievable value-added							
Average value-added	-4.30	-10.61	-13.97	-13.49	-21.73	-21.68	-7.07
t-stat	-5.78	-13.32	-13.17	-13.81	-14.73	-14.71	-10.37
Time-weighted average value-added	-4.65	-11.16	-16.29	-15.49	-26.74	-26.71	-6.80
t-stat	-4.87	-11.44	-11.85	-12.25	-13.67	-13.66	-7.99
10th percentile	-22.14	-30.85	-35.53	-35.07	-54.36	-54.36	-23.39
50th percentile	-1.26	-4.82	-6.41	-6.25	-9.54	-9.55	-3.06
90th percentile	7.31	0.06	-0.38	-0.38	-0.89	-0.86	3.22
% of funds with average value-added >0	29.55	10.50	5.82	6.35	2.05	2.05	17.50

Table IA.50: Relative performance: Small-cap growth funds

This table reports the percentage of small-cap growth funds whose decile changes when we sort them based on achievable instead of traditional metrics. Panel A reports the results based on alpha and Panel B on value-added. Achievable metrics are estimated with respect to the long-only version of the seven benchmark factor models and traditional metrics with respect to the long-short version.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Small-cap growth funds sorted by alpha							
Decile changes (%)	5.11	69.68	78.71	82.28	80.92	81.26	68.48
Panel B: Small-cap growth funds sorted by value-added							
Decile changes (%)	2.92	76.47	89.83	84.43	85.71	85.57	83.97

Table IA.51: Alpha difference during periods of turmoil: Small-cap growth funds

This table reports, for small-cap growth funds, the slope coefficient for the market-risk variable in (5), along with its standard error and the regression R-squared. The independent variable is standardized, allowing the coefficients to be interpreted as the change in the difference between the traditional and achievable alphas (in basis points) per one-standard-deviation increase in market volatility. The first seven columns report the results for pooled regressions for each model, and the eighth column reports the results across all models. Model fixed effects are included only for the pooled regression across all models. Standard errors are clustered by fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG	ALL
Slope (bps)	14.072	-2.013	3.726	4.306	8.709	10.053	6.009	6.408
Standard errors (bps)	0.253	0.441	0.474	0.481	0.552	0.518	0.520	0.391
Model FE	No	No	No	No	No	No	No	Yes
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (%)	12.902	0.261	0.648	0.869	5.287	6.889	1.864	2.212

Table IA.52: Alphas and fund flows: Small-cap growth funds

This table reports slope coefficients and their t-statistics for several versions of the panel regression (8) applied to small-cap growth funds. Panel A considers the regression of fund flows on traditional alpha, Panel B the regression of fund flows on achievable alpha, Panel C the regression of fund flows jointly on traditional and achievable alphas, and Panel D the regression of fund flows jointly on traditional and achievable alphas and their interactions with a "Risk" indicator variable that takes a value of one for months in the top decile of months sorted by realized market volatility in the prior 36 months, and zero otherwise. For all regressions, we consider time and fund fixed effects and double-cluster standard errors by time and fund.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Slope	0.169	0.169	0.153	0.149	0.161	0.166	0.142
	[26.417]	[26.921]	[22.829]	[23.285]	[18.268]	[25.348]	[19.371]
R2 (%)	2.845	2.869	2.326	2.221	2.599	2.741	2.010
Panel B: Achievable alpha							
Slope	0.163	0.156	0.159	0.158	0.163	0.161	0.156
	[16.233]	[16.340]	[16.391]	[16.686]	[16.334]	[16.214]	[15.373]
R2 (%)	2.668	2.422	2.527	2.491	2.669	2.594	2.448
Panel C: Traditional and achievable alpha							
Slope $\alpha_{\mathcal{T}}$	0.151	0.123	0.083	0.080	0.086	0.102	0.057
	[6.474]	[9.278]	[7.824]	[7.481]	[5.907]	[8.581]	[4.417]
Slope $\alpha_{\mathcal{A}}$	0.018	0.059	0.103	0.105	0.096	0.083	0.114
	[0.752]	[5.227]	[9.978]	[10.617]	[7.146]	[7.033]	[8.440]
R2 (%)	2.848	3.000	2.905	2.860	2.952	3.033	2.591
Panel D: Traditional and achievable alpha with risk-interaction terms							
Slope $\alpha_{\mathcal{T}}$	0.157	0.127	0.087	0.084	0.093	0.109	0.063
	[6.700]	[9.318]	[7.866]	[7.533]	[6.270]	[8.943]	[4.725]
Slope $\alpha_{\mathcal{A}}$	0.009	0.054	0.098	0.101	0.086	0.076	0.107
	[0.384]	[4.722]	[9.521]	[10.104]	[6.504]	[6.377]	[7.895]
Slope $\alpha_{\mathcal{T}}\times$Risk	-0.107	-0.031	-0.041	-0.033	-0.039	-0.039	-0.038
	[-1.835]	[-2.228]	[-4.595]	[-4.414]	[-3.189]	[-3.502]	[-2.695]
Slope $\alpha_{\mathcal{A}}\times$Risk	0.119	0.037	0.046	0.038	0.052	0.048	0.044
	[2.013]	[3.570]	[4.085]	[3.923]	[4.390]	[4.048]	[3.652]
R2 (%)	2.887	3.025	2.969	2.910	3.052	3.115	2.646

IA.7 Subsample Analysis

In the main body of the manuscript, we evaluate mutual fund performance using each fund's full return history. Here, we replicate the analyses in Tables 4 and 5, but separately for the first half of our sample (January 1970–December 1999) and the second half (January 2000–December 2024). Tables IA.53 and IA.54 report results for the first subsample, while Tables IA.55 and IA.56 present results for the second. These tables show that our findings are robust across the two subsamples. In general, achievable alpha and value added are substantially smaller than their traditional counterparts across all benchmark factor models. Notably, in the second half of the sample, the gap between traditional and achievable performance measures is especially pronounced under the CAPM. This indicates that, in recent periods, even for the CAPM benchmark, achievable fund performance has been considerably weaker than traditional measures would suggest.

Table IA.53: Traditional and achievable alphas: First subsample

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven benchmark factor models listed in Table 3 for the first half of our sample between January 1970 and December 1999. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained by regressing the fund returns on all long-short factors for each model, and Panel B for the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Average alpha	-0.73	0.82	0.88	0.61	1.44	1.06	1.72
t-stat	-3.08	5.01	4.57	3.54	5.16	5.48	9.10
Time-weighted average alpha	-0.50	0.39	0.84	0.41	0.60	0.39	1.45
t-stat	-2.58	2.66	4.42	2.52	2.42	2.14	8.79
10th percentile	-9.55	-4.68	-6.45	-5.56	-8.29	-5.32	-4.40
50th percentile	-0.90	0.02	0.13	0.03	-0.30	-0.12	0.56
90th percentile	6.69	6.55	9.44	7.47	12.95	9.01	8.55
Percentage of funds with $\alpha > 0$	41.50	50.18	51.06	50.26	47.95	48.79	56.49
Percentage of funds with $t(\alpha) > 2$	6.30	8.95	16.43	11.01	17.30	11.96	13.57
Panel B: Achievable alpha							
Average alpha	-0.73	-2.86	-1.04	-2.86	-1.93	-2.99	-0.51
t-stat	-3.08	-12.67	-4.36	-12.65	-7.97	-13.16	-2.11
Time-weighted average alpha	-0.50	-2.66	-1.08	-2.66	-2.46	-2.86	0.21
t-stat	-2.58	-14.03	-5.46	-13.99	-12.22	-14.93	1.04
10th percentile	-9.55	-12.38	-9.90	-12.37	-11.27	-12.63	-9.33
50th percentile	-0.90	-2.45	-1.19	-2.44	-2.18	-2.57	-0.72
90th percentile	6.69	3.87	6.36	3.80	5.77	3.88	7.23
Percentage of funds with $\alpha > 0$	41.50	27.86	38.71	27.93	29.91	27.20	43.55
Percentage of funds with $t(\alpha) > 2$	6.30	3.30	6.09	3.30	5.43	3.23	7.04

Table IA.54: Traditional and achievable value-added: First subsample

This table reports cross-sectional statistics for the traditional and achievable fund value-added with respect to the seven factor models listed in Table 3 for the first half of our sample between January 1970 and December 1999. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using the fund abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-3.76	-2.03	-0.36	-1.25	0.26	-0.70	0.10
t-stat	-4.34	-4.11	-0.55	-2.18	0.28	-1.15	0.21
Time-weighted average value-added	-5.19	-3.43	-0.78	-2.60	-0.89	-1.92	-0.56
t-stat	-4.10	-4.57	-0.80	-3.06	-0.69	-2.04	-0.78
10th percentile	-28.68	-17.47	-15.42	-17.73	-22.12	-17.61	-13.51
50th percentile	-1.39	-0.55	-0.38	-0.38	-0.63	-0.39	-0.21
90th percentile	12.99	7.39	13.33	9.80	20.34	11.62	11.52
Percentage of funds with value-added >0	32.37	36.21	43.45	41.32	41.39	41.58	44.51
Panel B: Achievable value-added							
Average value-added	-3.76	-9.73	-3.60	-9.60	-4.81	-8.15	-2.19
t-stat	-4.34	-12.79	-4.39	-12.71	-5.39	-10.61	-2.53
Time-weighted average value-added	-5.19	-12.40	-4.53	-12.33	-7.59	-9.75	-2.38
t-stat	-4.10	-10.97	-3.85	-10.95	-5.39	-8.05	-2.02
10th percentile	-28.68	-34.91	-26.36	-34.91	-30.32	-32.22	-25.70
50th percentile	-1.39	-3.32	-1.46	-3.26	-2.05	-3.13	-1.25
90th percentile	12.99	4.47	12.90	4.49	11.03	4.90	14.91
Percentage of funds with value-added >0	32.37	22.24	32.29	22.02	30.29	22.54	34.77

Table IA.55: Traditional and achievable alphas: Second subsample

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the seven benchmark factor models listed in Table 3 for the first half of our sample between January 2000 and December 2024. Panel A reports cross-sectional statistics for the traditional alpha with respect to the long-short factors, obtained by regressing the fund returns on all long-short factors for each model, and Panel B for the achievable alpha with respect to the long-only factors, obtained by regressing fund returns on just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Average alpha	0.42	0.01	0.25	0.27	-0.18	-0.17	0.00
t-stat	5.95	0.24	4.94	5.49	-3.04	-3.27	0.01
Time-weighted average alpha	0.54	0.32	0.40	0.39	0.16	0.19	0.42
t-stat	9.02	7.65	9.04	9.02	3.36	4.39	9.53
10th percentile	-3.42	-2.51	-2.26	-2.18	-2.88	-2.62	-2.79
50th percentile	0.28	0.09	0.11	0.07	-0.02	-0.06	0.24
90th percentile	4.34	2.53	3.02	2.99	2.75	2.54	2.56
Percentage of funds with $\alpha > 0$	54.44	52.05	52.34	51.52	49.36	49.04	56.09
Percentage of funds with $t(\alpha) > 2$	7.99	5.71	5.42	5.71	4.32	4.50	9.57
Panel B: Achievable alpha							
Average alpha	-0.84	-3.55	-4.22	-4.23	-4.48	-4.50	-3.64
t-stat	-8.83	-26.99	-33.25	-33.30	-40.55	-40.17	-29.03
Time-weighted average alpha	0.16	-1.57	-2.47	-2.47	-3.26	-3.26	-1.77
t-stat	2.26	-16.55	-27.31	-27.34	-39.18	-39.05	-19.61
10th percentile	-5.33	-12.56	-12.75	-12.75	-11.32	-11.35	-11.40
50th percentile	-0.07	-1.39	-2.26	-2.27	-2.99	-3.00	-1.77
90th percentile	3.47	1.57	0.82	0.82	0.27	0.29	1.31
Percentage of funds with $\alpha > 0$	48.73	30.46	18.15	17.97	12.23	12.41	25.68
Percentage of funds with $t(\alpha) > 2$	5.49	2.32	0.86	0.89	0.36	0.32	2.32

Table IA.56: Traditional and achievable value-added: Second subsample

This table reports cross-sectional statistics for the traditional and achievable fund value-added with respect to the seven factor models listed in Table 3 for the second half of our sample between January 2000 and December 2024. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using the fund abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-2.30	-0.74	-0.43	-0.20	-2.31	-2.04	0.03
t-stat	-6.10	-3.03	-1.57	-0.78	-8.35	-7.87	0.13
Time-weighted average value-added	-2.60	-0.30	-0.44	-0.30	-2.10	-1.61	1.22
t-stat	-5.72	-0.99	-1.33	-0.98	-6.51	-5.29	3.96
10th percentile	-16.39	-9.48	-9.53	-9.04	-12.16	-11.43	-7.88
50th percentile	-0.44	-0.32	-0.36	-0.40	-0.58	-0.54	-0.12
90th percentile	8.31	6.55	7.84	8.04	5.25	4.86	8.69
Percentage of funds with value-added >0	38.51	37.61	36.56	36.14	33.91	33.93	44.39
Panel B: Achievable value-added							
Average value-added	-5.99	-10.73	-16.15	-16.00	-20.51	-20.58	-10.84
t-stat	-12.03	-15.83	-22.03	-21.74	-26.46	-26.37	-16.97
Time-weighted average value-added	-4.26	-7.02	-15.09	-14.86	-22.25	-22.25	-7.35
t-stat	-7.75	-9.52	-19.26	-18.83	-25.48	-25.44	-10.63
10th percentile	-25.68	-37.97	-49.63	-49.17	-61.22	-61.36	-36.84
50th percentile	-0.97	-2.39	-4.04	-4.03	-5.46	-5.45	-2.70
90th percentile	6.77	2.41	0.21	0.21	-0.10	-0.09	1.64
Percentage of funds with value-added >0	32.09	20.23	12.41	12.37	7.55	7.87	17.23

IA.8 Time Variation in Alphas

Our goal is to evaluate mutual-fund performance from the perspective of shortsale-constrained investors. Thus, consistent with most of the mutual-fund performance literature, we evaluate the performance of each mutual fund over the sample period for which we have return data for the fund (Jensen, 1968; Wermers, 2000; Barras et al., 2010; Fama and French, 2010; Ferreira et al., 2013; Kacperczyk et al., 2014; Berk and van Binsbergen, 2015; Barras et al., 2022). However, funds are expected to adjust their risk exposure over time. To account for this time variation, in this section, we estimate fund alphas using 36-month rolling windows. To compute a fund's alpha, we require a minimum of 30 monthly fund return observations within the estimation window. Then, for each fund mf, we compute the average alpha $\bar{\alpha}_{mf}$ using all estimated alphas from all the corresponding windows. We report cross-sectional statistics of funds' average traditional alpha and achievable alpha, where we retain only those benchmark factors in the time-series regression for which the shortsale-constrained mean-variance portfolio assigns a positive weight.

Figure IA.1 shows that fund exposure to systematic risk fluctuates significantly over time. From 1980 to 2005, the average market beta trended downward, with temporary peaks around August 1985 and August 1993. By March 2005, the average beta had dropped below one. However, it surged rapidly thereafter, reaching a peak of approximately 1.2 by December

Figure IA.1: Cross-sectional average of fund market betas

This figure depicts the cross-sectional average of fund market betas from 36-month rolling windows.

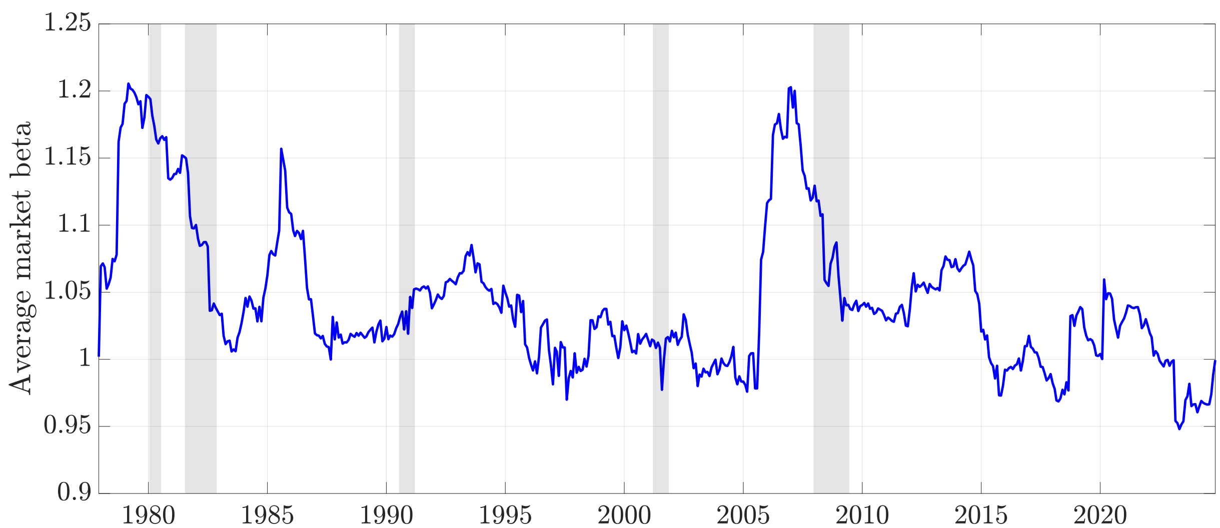


Table IA.57: Traditional and achievable fund alphas using rolling windows

This table reports cross-sectional statistics for the traditional and achievable average alphas with respect to the seven factor models listed in Table 3. We estimate funds' average alphas using 36-month rolling windows. To compute a fund's alpha, we require a minimum of 30 monthly fund return observations within the estimation window. Then, for each fund mf, we compute the average alpha $\bar{\alpha}_{mf}$ using all estimated alphas from all the corresponding windows. We compute the traditional alpha by regressing the fund returns on all factors for each model and the achievable alpha on only those factors with strictly positive weights in the shortsale-constrained mean-variance portfolio. We report the average alpha across funds, its t-statistic, percentiles of the cross-sectional distribution of fund alpha, and the percentage of funds with positive alpha. Alphas are annualized and reported as a percentage.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional alpha							
Average alpha	0.16	-0.05	0.36	0.31	0.05	0.20	0.35
t-stat	2.00	-1.02	5.43	4.83	1.00	3.98	7.24
10th percentile	-3.11	-2.27	-2.31	-2.19	-2.57	-2.35	-2.11
50th percentile	0.13	-0.05	0.13	0.12	-0.01	0.13	0.32
90th percentile	3.03	2.26	3.44	3.14	2.85	2.89	2.92
Percentage of funds with $\alpha > 0$	53.06	49.12	53.10	52.48	49.80	52.79	58.44
Panel B: Achievable alpha							
Average alpha	-0.91	-3.15	-3.45	-3.58	-3.47	-3.56	-3.38
t-stat	-11.00	-32.42	-36.20	-37.48	-36.85	-37.44	-38.10
10th percentile	-4.20	-7.84	-7.78	-8.10	-8.04	-8.22	-7.43
50th percentile	-0.80	-2.41	-2.84	-2.94	-2.84	-2.91	-2.93
90th percentile	1.95	0.51	0.14	0.04	0.16	0.09	0.09
Percentage of funds with $\alpha > 0$	35.09	14.98	10.65	10.21	11.20	10.93	10.52

2006. Following this spike, the average market beta gradually declined and stabilized around one in the subsequent years.

Tables IA.57 and IA.58 present cross-sectional statistics of funds' average alphas and value added for the seven benchmark factor models listed in Table 3. The results are consistent with those in Tables 4 and 5 in the main body of the manuscript. Across all factor models, the average achievable alpha and value-added are significantly lower than those obtained under the traditional approach. Accounting for time-varying fund exposure to benchmark factors via rolling-window estimation further reduces the achievable alpha and value-added for the CAPM, FFC, FF5, FF6, and VANG models. This finding is particularly relevant given that financial services firms, such as Morningstar, typically report alphas based on short rolling windows of 36 or 72 months rather than using a fund's entire return history. In shorter rolling windows, periods of market underperformance may lead to optimal

Table IA.58: Traditional and achievable value-added using rolling windows

This table reports cross-sectional statistics for the traditional and achievable average value-added with respect to the seven benchmark factor models listed in Table 3. We compute the average value-added for funds using 36-month rolling windows. To compute a fund's value-added, we require at least 30 monthly fund return observations within the estimation window. Then, for each fund mf, we compute the average value-added using all the estimated value-added from all the corresponding windows. We compute the traditional value-added as the average of the product of assets under management and abnormal returns, obtained by regressing fund returns on all long-short factors in each model, and the achievable value-added on only those factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio. We report the average value-added, its t-statistic, percentiles of the cross-sectional distribution of fund value-added, and the percentage of funds with positive value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-1.75	0.36	3.18	2.79	0.85	1.69	3.18
t-stat	-2.34	0.72	4.04	3.80	1.25	2.48	5.75
10th percentile	-15.93	-9.61	-8.22	-7.95	-10.78	-8.96	-6.27
50th percentile	-0.68	-0.39	-0.21	-0.21	-0.46	-0.28	-0.06
90th percentile	5.35	4.77	10.21	9.08	6.80	7.44	10.63
Percentage of funds with $\alpha > 0$	32.33	35.43	41.18	40.88	36.18	38.80	46.97
Panel B: Achievable value-added							
Average value-added	-12.80	-18.06	-20.34	-20.49	-21.37	-21.83	-22.80
t-stat	-14.27	-15.95	-17.34	-17.41	-17.68	-17.68	-18.73
10th percentile	-36.44	-45.10	-50.16	-50.11	-51.27	-52.37	-52.98
50th percentile	-3.30	-4.62	-5.40	-5.51	-5.43	-5.52	-6.20
90th percentile	0.57	0.01	-0.10	-0.12	-0.12	-0.11	-0.21
Percentage of funds with $\alpha > 0$	14.94	10.28	7.56	7.28	7.18	7.25	5.85

strategies that involve shorting the market, which explains why even for the CAPM the achievable alpha and value-added are now much smaller than the traditional ones.

IA.9 Statistics About Change in Decile Ranks

In Section 3.4 of the main manuscript, we show that the *relative* performance of mutual funds changes substantially for shortsale-constrained investors. In this section, we provide more fine-grained information about the change in decile ranks than that provided in Table 6.

Table IA.59 shows that for all the benchmark factor models except for the CAPM, when performance is evaluated using achievable instead of traditional alpha, the number of funds that see a change in their decile rank exceeds 70%. And, strikingly, for all the benchmark factor models except for the CAPM, the number of funds that see a change of two or more deciles exceeds 40%.

The heat map in Figure IA.2 shows the percentage of funds whose rank transitions from one decile to another when funds are sorted by achievable rather than traditional alpha. Achievable alphas are estimated with respect to the long-only version of the six benchmark factor models and traditional alpha with respect to the long-short version; the results for the HXZ factor model are very similar to those for the HXZM model, so to conserve space, only the results for the latter are displayed. Looking along the diagonal in these heat maps, we see that for all the benchmark factor models except for the CAPM, there is a substantial change in the rank of funds across all deciles.

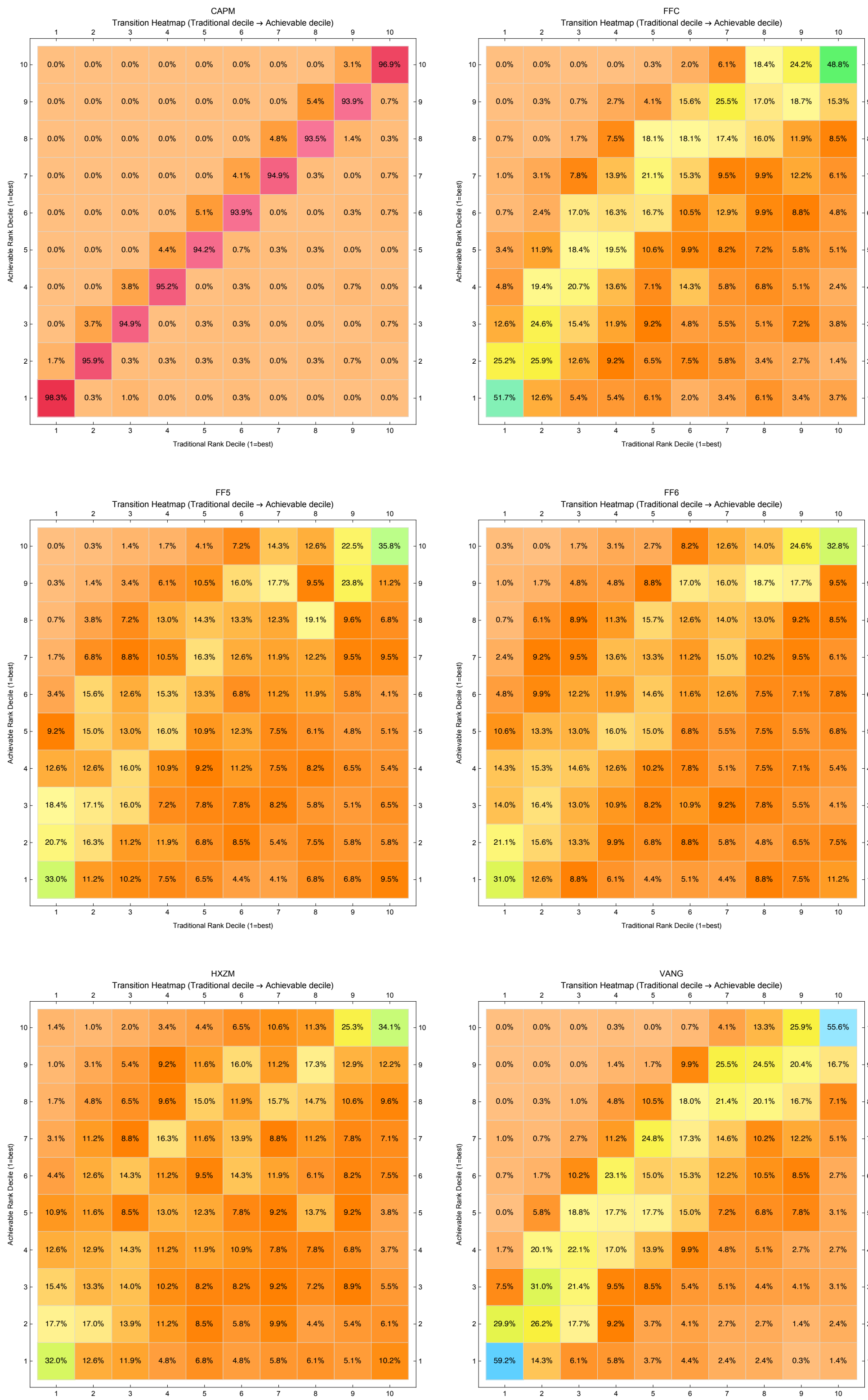
Table IA.59: Change in rank going from traditional to achievable alphas

This table reports the percentage of funds whose decile changes when they are sorted by achievable rather than traditional alpha. Achievable alphas are estimated with respect to the long-only version of the seven benchmark factor models and traditional alpha with respect to the long-short version. The row "Percent($|\Delta| = n$)" shows the percentage of funds whose rank changes by n deciles, where $n = \{0, \ldots, 9\}$. The last row, "Percent($|\Delta| \geq 2$)" shows the percentage of funds whose rank changes by two or more deciles.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Percent($\|\Delta\|$=0)	95.17	22.07	18.46	17.71	16.62	17.13	26.75
Percent($\|\Delta\|$=1)	3.98	28.47	23.54	24.66	23.84	24.25	33.12
Percent($\|\Delta\|$=2)	0.27	22.68	19.62	17.58	17.78	16.89	22.19
Percent($\|\Delta\|$=3)	0.20	13.22	14.65	14.85	14.85	15.46	9.36
Percent($\|\Delta\|$=4)	0.10	6.37	10.46	10.15	11.07	10.63	4.02
Percent($\|\Delta\|$=5)	0.10	3.17	5.48	6.30	6.44	6.81	2.11
Percent($\|\Delta\|$=6)	0.03	1.81	3.27	3.64	3.92	3.95	1.36
Percent($\|\Delta\|$=7)	0.14	1.36	2.25	2.35	2.52	2.38	0.68
Percent($\|\Delta\|$=8)	0.00	0.48	1.33	1.60	1.57	1.33	0.27
Percent($\|\Delta\|$=9)	0.00	0.38	0.95	1.16	1.40	1.16	0.14
Percent($|\Delta| \geq$2)	0.85	49.46	58.00	57.63	59.54	58.62	40.13

Figure IA.2: Change in decile rank going from traditional to achievable alphas

This heat map shows the percentage of funds whose rank transitions from one decile to another when funds are sorted by achievable rather than traditional alpha. Achievable alphas are estimated with respect to the long-only version of the six benchmark factor models and traditional alpha with respect to the long-short version; the results for the HXZ factor model are very similar to those for the HXZM model, so to conserve space, only the results for the latter are displayed.



IA.10 Alternative Estimator of Value-Added

In this section, we study the robustness of our findings to estimating value-added using the flexible and bias-adjusted econometric approach of Barras et al. (2022). Table IA.60 reports cross-sectional statistics for the traditional and achievable fund value-added estimated using the approach of Barras et al. (2022), with respect to the seven benchmark factor models listed in Table 3.

Table IA.60: Value-added: Alternative estimator of Barras et al. (2022)

This table reports cross-sectional statistics for the traditional and achievable fund value-added estimated using the flexible and bias-adjusted econometric approach of Barras et al. (2022), with respect to the seven benchmark factor models listed in Table 3. Panel A reports cross-sectional statistics for the traditional value-added computed using fund abnormal returns obtained by regressing the fund returns on all long-short factors in each model, and Panel B the achievable value-added computed using fund abnormal returns with respect to just those long-only factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Traditional value-added							
Average value-added	-3.85	-1.73	-1.28	-1.52	-3.00	-2.49	0.41
t-stat	-13.43	-8.26	-4.91	-6.78	-11.68	-10.63	1.88
Time-weighted average value-added	-4.06	-1.41	-1.27	-1.46	-3.09	-2.58	1.12
t-stat	-11.32	-5.29	-3.85	-5.26	-9.49	-8.68	4.19
10th percentile	-17.62	-10.49	-10.90	-10.58	-13.66	-12.30	-7.03
50th percentile	-0.98	-0.61	-0.63	-0.68	-0.97	-0.82	-0.14
90th percentile	4.64	4.60	6.51	5.23	4.04	3.98	8.51
% of funds with average value-added >0	30.85	32.42	33.07	31.32	28.41	29.42	44.07
Panel B: Achievable value-added							
Average value-added	-3.88	-7.57	-11.14	-10.81	-17.72	-17.64	-6.33
t-stat	-13.49	-18.20	-24.70	-24.88	-28.88	-28.82	-18.24
Time-weighted average value-added	-4.07	-7.52	-12.71	-12.25	-21.40	-21.34	-5.63
t-stat	-11.35	-14.47	-22.96	-22.67	-27.96	-27.95	-13.29
10th percentile	-17.66	-27.26	-32.63	-32.44	-48.86	-48.74	-23.33
50th percentile	-1.02	-2.69	-3.81	-3.99	-6.13	-6.06	-2.30
90th percentile	4.63	1.76	0.17	0.18	-0.33	-0.31	1.96
% of funds with average value-added >0	30.48	18.02	11.64	11.64	5.90	6.25	18.41

Comparing the average traditional and achievable value-added in Tables 5 and IA.60, we find that the approach of Barras et al. (2022) leads to lower estimates of average value-added (both traditional and achievable). Nevertheless, our findings are robust to estimating value-added using the approach of Barras et al. (2022). In particular, we find that the average achievable value-added in Panel B of Table IA.60 is substantially smaller than the average traditional value-added in Panel A. Similarly, the proportion of funds with positive achievable value-added in Panel B of Table IA.60 is substantially smaller than the proportion of funds with positive traditional value-added in Panel A.

IA.11 Skill and Scale: Log Assets Under Management

In the main body of the manuscript, we compare the skill and scalability of mutual funds estimated using traditional and achievable alphas. We now show that our finding that the scalability of mutual-fund performance is substantially smaller from the perspective of shortsale-constrained investors is robust when scalability is estimated using *log* assets under management rather than assets under management, as in the main body of the manuscript.

This result is important for two reasons. First, it shows that our findings do not rely on the assumption that there is a linear relation between fund performance and assets under management. Second, Huang, Lu, Song, and Xiang (2023) show that estimates of mutual fund scalability obtained using log assets under management are robust to including the assets under management in institutional investment vehicles that are co-managed with their "twin" mutual funds. Thus, the robustness of our findings to considering log assets under management suggests that they are also robust to accounting for assets under management in "twin" institutional investment vehicles.

Table IA.61 reports cross-sectional statistics for the scale and scalability parameters obtained from the traditional or achievable alphas using log assets under management as the explanatory variable, instead of assets under management, as in Table 9. Comparing Panels A and B in Table IA.61, we find that the average skill obtained from achievable alpha is substantially higher than that obtained from traditional alpha for every model except CAPM, with the difference ranging from 22% to 55% across models. Importantly, comparing Panels C and D, we observe that the average scalability parameter obtained from achievable alpha is nearly twice that obtained from traditional alpha for every model except CAPM. That is, our main finding that the scalability of mutual-fund strategies is substantially *smaller* from

Table IA.61: Achievable skill and scalability: Log assets under management

This table reports cross-sectional statistics for the scale and scalability parameters obtained from the traditional or achievable alphas, with log assets under management as the explanatory variable, rather than assets under management, as in Table 9. For each fund, we estimate the time-series regression in equation (5) of Barras et al. (2022) separately for the cases with traditional and achievable realized alphas, after replacing assets under management with their natural logarithm. We report the average scale and scalability parameters across funds, their t-statistic, the time-weighted average scale and scalability parameters, where the weight is proportional to the length of the sample period for which we have return data for the fund, and their t-statistic. We also report percentiles of the cross-sectional distribution of fund scale and scalability parameters, and the percentage of funds with positive scale and scalability parameters and a t-statistic greater than two. Scale and scalability parameters are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Skill based on traditional alpha							
Average	10.63	6.98	7.07	6.81	8.01	7.54	7.56
Standard dev	18.49	12.58	13.45	13.13	15.77	14.47	14.46
10th percentile	-4.55	-4.11	-4.54	-4.42	-5.34	-4.93	-4.63
50th percentile	8.48	5.96	5.80	5.65	6.06	5.93	5.98
90th percentile	30.70	20.77	22.08	20.74	24.58	23.20	22.52
Percentage funds a >0	78.87	77.88	75.77	76.34	75.50	75.99	76.92
Panel B: Skill based on achievable alpha							
Average	10.62	9.85	10.05	8.55	9.77	9.50	11.71
Standard dev	18.92	21.07	22.87	20.24	22.77	22.35	24.25
10th percentile	-4.54	-7.44	-7.71	-7.70	-8.46	-8.60	-7.40
50th percentile	8.49	7.10	6.52	5.99	6.18	5.85	8.00
90th percentile	31.00	31.93	33.10	29.08	33.09	32.43	36.85
Percentage funds a >0	78.78	73.76	72.34	70.62	70.52	69.83	74.12
Panel C: Scale based on traditional alpha							
Average	2449.18	1555.96	1562.05	1500.88	1836.93	1707.42	1598.92
Standard dev	4705.81	3162.59	3458.40	3266.55	3896.03	3401.38	3714.07
10th percentile	-1275.62	-1084.84	-1157.13	-1156.47	-1233.96	-1146.12	-1291.05
50th percentile	1768.42	1206.54	1205.39	1158.48	1360.43	1279.27	1170.58
90th percentile	7026.31	4612.65	4717.26	4502.30	5540.27	5099.26	5083.95
Percentage funds b >0	78.38	77.13	75.35	76.70	75.59	77.03	74.12
Panel D: Scale based on achievable alpha							
Average	2479.36	2736.04	2812.86	2554.21	3104.14	3053.96	2991.45
Standard dev	5064.85	5473.73	5748.22	5241.17	5870.68	5836.58	6065.20
10th percentile	-1296.19	-1530.93	-1506.06	-1522.71	-1550.56	-1469.81	-1622.17
50th percentile	1807.77	1811.28	1839.57	1722.17	1991.19	2027.80	1876.24
90th percentile	7263.20	8044.05	8235.62	7644.08	8853.32	8695.11	8688.93
Percentage funds b >0	78.14	76.76	76.41	76.43	76.41	76.93	75.91

Table IA.62: Mutual-fund alphas: Alternative imputation for VANG

This table reports cross-sectional statistics for the traditional and achievable fund gross alphas with respect to the VANG model, after replacing missing factor return observations in the VANG model with the average factor return. Panel A reports cross-sectional statistics for the traditional alpha with respect to the VANG factors, obtained by regressing the fund returns on all VANG factors, and Panel B reports the achievable alpha obtained by regressing fund returns on just those VANG factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and a t-statistic greater than two. Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

Panel A: Traditional alpha	
Average alpha	0.44
t-stat	9.73
Time-weighted average alpha	0.79
t-stat	18.20
10th percentile	-2.12
50th percentile	0.46
90th percentile	2.97
Percentage of funds with α >0	60.88
Percentage of funds with $t(\alpha)$ >2	11.37
Panel B: Achievable alpha	
Average alpha	-1.61
t-stat	-27.35
Time-weighted average alpha	-0.90
t-stat	-16.33
10th percentile	-5.32
50th percentile	-1.13
90th percentile	1.52
Percentage of funds with α >0	30.27
Percentage of funds with $t(\alpha)$ >2	1.36

the perspective of shortsale-constrained investors is robust to considering log assets under management as the explanatory variable instead of assets under management.

IA.12 Alternative Imputation for Missing VANG Returns

In the main body of the manuscript, we replace missing observations in the VANG model with zeros. We now examine the robustness of our results to replacing missing observations in the VANG model with the average of the benchmark factors. Tables IA.62 and IA.63

Table IA.63: Mutual-fund value-added: Alternative imputation for VANG

This table reports cross-sectional statistics for the traditional and achievable fund value-added with respect to the VANG model, after replacing missing factor-return observations in the VANG model with the average factor return. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, obtained by regressing the fund returns on the VANG factors, and Panel B the achievable value-added computed using the fund abnormal returns with respect to just those VANG factors with a strictly positive weight in the shortsale-constrained mean-variance portfolio (over the sample period for which we have return data for the fund). We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive average value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range from the median.

Panel A: Traditional value-added	
Average value-added	0.71
t-stat	3.47
Time-weighted average value-added	1.62
t-stat	5.98
10th percentile	-6.28
50th percentile	-0.09
90th percentile	8.43
% of funds with average value-added >0	45.68
Panel B: Achievable value-added	
Average value-added	-6.95
t-stat	-20.38
Time-weighted average value-added	-7.28
t-stat	-16.73
10th percentile	-23.25
50th percentile	-2.26
90th percentile	0.99
% of funds with average value-added >0	16.40

report the cross-sectional statistics for the traditional and achievable alpha and value-added, respectively. We see that, for both performance measures, replacing VANG's missing observations with the factor mean rather than zero does not affect our main conclusions. Indeed, both achievable alpha and value added are substantially smaller than the traditional ones.

IA.13 Out-of-Sample Alpha and Value-Added

Our goal is to evaluate mutual-fund performance from the perspective of shortsale-constrained investors. Thus, consistent with most of the mutual-fund performance literature,[5] we evaluate the performance of each mutual fund over the sample period for which we have return data for the fund. In addition, Section 3.5 studies the time-series properties of the traditional and achievable alphas by using 36-month rolling windows, and Section IA.7 of the Internet Appendix evaluates mutual-fund performance across two separate subsamples.

Nonetheless, it is also interesting to study whether our findings are robust to estimating the benchmark portfolios using only past data. To do this, in this section we split the sample for each fund into two subsamples. We use the first subsample to estimate the unconstrained and shortsale-constrained mean-variance portfolios of the benchmark factors. We then use the second subsample to evaluate their out-of-sample returns. We then compute the out-of-sample traditional alpha by regressing the returns of the fund on the out-of-sample returns of the unconstrained mean-variance portfolio, and the out-of-sample achievable alpha by regressing the returns of the fund on the out-of-sample returns of the shortsale-constrained mean-variance portfolio.[6]

IA.13.1 Out-of-sample alpha

Table IA.64 reports cross-sectional statistics for the out-of-sample traditional and achievable alphas. The table shows that our findings are robust to evaluating achievable alpha out of sample. In particular, the average and time-weighted average out-of-sample achievable alphas are substantially lower than their traditional counterparts, and the proportion of funds with positive and significantly positive out-of-sample achievable alpha is much smaller than in terms of out-of-sample traditional alpha, for every model except CAPM.

Table 4 in the main body of the manuscript shows that, for the CAPM model, the average achievable and traditional alphas are similar in sample. Although Table IA.64 shows that the average out-of-sample achievable alpha is higher than its traditional counterpart, the difference is just 1.12%, whereas the difference between the out-of-sample achievable

[5]See, for intance, Jensen (1968); Wermers (2000); Barras et al. (2010); Fama and French (2010); Ferreira et al. (2013); Kacperczyk et al. (2014); Berk and van Binsbergen (2015); Barras et al. (2022).

[6]We require a minimum of 60 monthly observations for a fund to be included in this analysis. In our sample, only two funds have fewer than 60 monthly observations.

Table IA.64: Out-of-sample traditional and achievable alphas

This table reports cross-sectional statistics for the out-of-sample traditional and achievable fund gross alphas with respect to the seven factor models listed in Table 3. Panel A reports cross-sectional statistics for the out-of-sample traditional alpha computed by regressing fund returns on the unconstrained mean-variance portfolio out-of-sample returns. Panel B reports the out-of-sample achievable alpha computed by regressing fund returns on the shortsale-constrained mean-variance portfolio out-of-sample returns. We report the average alpha across funds, its t-statistic, the time-weighted average alpha (where the weight is proportional to the length of the out-of-sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of fund alpha and the percentage of funds with positive alpha and with significantly positive alpha (alpha t-statistic greater than two). Alphas are annualized and reported as a percentage. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range (difference between the 90th and 10th percentiles) from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Out-of-sample traditional alpha							
Average alpha	-1.32	3.61	1.83	2.44	2.81	3.48	5.57
t-stat	-18.66	27.51	12.84	17.01	19.02	24.83	39.26
Time-weighted average alpha	-1.18	4.87	2.11	2.64	3.79	4.28	5.85
t-stat	-18.06	38.11	15.39	18.92	26.70	31.39	40.31
10th percentile	-5.25	-4.67	-6.44	-5.59	-5.67	-4.94	-4.09
50th percentile	-1.16	4.05	1.34	1.57	2.58	3.37	6.25
90th percentile	2.11	12.35	11.15	12.11	12.23	12.37	14.21
Percentage of funds with $\alpha > 0$	32.54	72.24	58.62	60.76	65.78	69.46	75.72
Percentage of funds with $t(\alpha) > 2$	1.81	21.29	10.56	11.82	13.42	14.85	30.93
Panel B: Out-of-sample achievable alpha							
Average alpha	-0.20	-1.01	-1.19	-1.43	-3.16	-3.02	-0.42
t-stat	-2.01	-10.95	-14.12	-16.46	-37.16	-35.51	-5.34
Time-weighted average alpha	-0.53	-0.19	-0.48	-0.76	-2.91	-2.83	-0.19
t-stat	-5.89	-2.18	-5.92	-9.15	-36.49	-35.57	-2.67
10th percentile	-4.97	-6.54	-6.25	-6.68	-7.94	-7.76	-4.71
50th percentile	-0.81	-0.35	-0.66	-0.82	-2.74	-2.61	-0.37
90th percentile	5.61	4.10	3.40	3.20	1.38	1.49	4.10
Percentage of funds with $\alpha > 0$	38.35	45.64	41.02	39.52	20.10	21.29	44.69
Percentage of funds with $t(\alpha) > 2$	5.25	6.30	4.33	3.58	0.58	0.61	5.93

and traditional alphas for the remaining models is much larger in magnitude, ranging from -2.02% for FF5 to -6.50% for HXZM.

IA.13.2 Out-of-sample value-added

Table IA.65 reports cross-sectional statistics for the out-of-sample traditional and achievable value-added. The table shows that our findings are robust to evaluating achievable value-added out of sample. In particular, the average and time-weighted average out-of-sample

Table IA.65: Out-of-sample traditional and achievable value-added

This table reports cross-sectional statistics for the out-of-sample traditional and achievable fund value-added with respect to the seven factor models listed in Table 3. Panel A reports cross-sectional statistics for the traditional value-added computed as the average of the product of assets under management and abnormal returns, where abnormal returns are obtained by regressing fund returns in the second subsample on the unconstrained mean-variance portfolio out-of-sample returns. Panel B reports the achievable value-added computed using the fund abnormal returns, where abnormal returns are obtained by regressing fund returns in the second subsample on the shortsale-constrained mean-variance portfolio out-of-sample returns. We report the average value-added, its t-statistic, the time-weighted average value-added (where the weight is proportional to the length of the out-of-sample period for which we have return data for the fund), and its t-statistic. We also report percentiles of the cross-sectional distribution of value-added and the percentage of funds with positive value-added. Value added is annualized and expressed in January 2000 million dollars. As in Barras et al. (2022), we winsorize observations that are more than five times the inter-decile range away from the median.

	CAPM	FFC	FF5	FF6	HXZ	HXZM	VANG
Panel A: Out-of-sample traditional value-added							
Average value-added	-7.74	14.30	2.79	3.02	10.67	12.52	23.83
t-stat	-16.08	12.77	3.24	3.44	10.25	11.92	17.59
Time-weighted average value-added	-9.77	24.89	5.74	5.79	18.20	20.05	31.24
t-stat	-14.90	16.60	5.09	5.00	13.12	14.36	17.45
10th percentile	-29.54	-14.90	-23.14	-23.51	-17.14	-15.08	-10.24
50th percentile	-1.51	1.07	0.10	0.08	0.48	0.85	2.92
90th percentile	3.76	58.98	34.03	37.04	52.33	54.99	83.52
% of funds with average value-added >0	27.44	61.33	51.92	51.37	55.81	59.22	69.32
Panel B: Out-of-sample achievable value-added							
Average value-added	-6.35	-3.10	-4.47	-5.49	-16.34	-15.90	-2.76
t-stat	-11.68	-5.85	-8.90	-10.63	-22.73	-22.10	-5.95
Time-weighted average value-added	-9.10	-1.49	-3.24	-4.97	-22.00	-21.70	-3.65
t-stat	-12.70	-2.17	-4.97	-7.43	-22.64	-22.40	-5.81
10th percentile	-29.77	-21.88	-25.81	-26.94	-52.71	-52.06	-19.88
50th percentile	-1.15	-0.71	-0.94	-1.12	-3.58	-3.48	-0.57
90th percentile	7.35	11.75	8.87	7.50	0.91	1.04	10.30
% of funds with average value-added >0	33.39	36.73	33.32	31.62	16.86	17.55	37.50

achievable value-added are substantially lower than their traditional counterparts, and the proportion of funds with positive and significantly positive out-of-sample value-added is much smaller than in terms of out-of-sample traditional value-added, for every model except CAPM. Similar to our findings for out-of-sample alpha, we observe that although Table IA.65 shows that the average out-of-sample achievable value-added is higher than its traditional counterpart, the difference is just 1.39 million dollars, whereas the difference between the out-of-sample achievable and traditional alphas for the rest of the models is much larger in magnitude, ranging from −7.26 million dollars for FF5 to −28.42 million dollars for HXZM.

Overall, the results in this section provide strong support for our main conclusion: mutual-fund performance is substantially weaker from the perspective of shortsale-constrained investors.