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Holding Horizon: A New Measure of Active Investment Management

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ABSTRACT

This paper proposes a new holding horizon (HH) measure of active management and examines the relation between horizon and manager skill. Our HH measure identifies, in the cross-section, funds with higher future long-term alphas, while reported turnover identifies, in the time-series, when a particular fund is likely to exhibit a higher short-run alpha. The superior long-term performance of long-horizon funds is due to their selection of stocks with strong long-run fundamentals. Moreover, stocks largely held by long-horizon funds outperform stocks largely held by short-horizon funds by $2.7\% - 3.5\%$ per year, adjusted for risk, over the following five-year period.

JEL # G11, G23

Keywords: mutual funds, performance evaluation, investment horizons, selection skills

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1 Introduction

Are patient investment managers, who hold risky stock positions for an extended period of time, rewarded with superior performance? Both theoretical models and anecdotal evidence suggest the presence of skilled long-horizon investment managers.

In a model with heterogeneously informed investors, Wang (1993) shows that less-informed investors have very different trading strategies from the better-informed. Less-informed investors will trade when they observe price changes in a stock, as they heavily rely on observed price changes to infer future dividend growth, leading to a higher level of short-term trading. Better-informed investors rely less on temporal price changes and more on their private signals to execute trades.[1]

As Wang's (1993) model implies, better-informed fund managers have better skills in forecasting long-term cash flows. Such skills generally require superior insights about the future prospects of a firm's major projects, the competitive position of the firm's products, and the strength of the firm's balance sheet. Developing such fundamental analysis skills to identify long-term profit opportunities is difficult. Further, committing to long-term positions in response to these long-term opportunities is costly, because it involves short-term labor-market risk for fund managers.[2] To wit, as mutual fund flows tend to chase recent past returns (e.g., Sirri and Tufano, 1998), fund managers may have to partially liquidate their long-term positions and suffer losses or even lose their jobs before their long-term bets pay off. Therefore, it is reasonable to expect that only fund managers with a sufficient level of skills—high enough to offset such labor-market concerns—will follow an investment signal that is expected to generate abnormal returns over the long term.

Anecdotally, several equity portfolio managers achieved their fame by implementing strategies that involve holding stocks for several years. For example, Warren Buffett, a

[1]Better-informed investors will trade to *partially* counter the estimation error in less-informed traders' inference of the dividend growth rate, so positions will tend to be more stable among informed investors than among uninformed. Andrei and Cujean (2017) also provide a model where information "percolates" among investors, resulting in heterogeneously informed investors. In their model, investors who become better-informed, through the percolation of information, implement longer-term strategies and trade against those who are lesser-informed—who tend to implement short-term momentum strategies.

[2]Froot et al. (1992) provide a model that results in investment managers exploiting the same signal when it may be socially optimal for them not to do so, due to short-term performance concerns. With short-term labor-market risk, such managers can be expected to follow, in common, signals that provide abnormal returns more quickly.

student and follower of Benjamin Graham—who is considered to be the father of value investing—is widely known to focus on long-term growth, and to invest in quality firms with strong fundamentals. He famously stated that his "favorite holding period is forever." Superstar fund manager Mario Gabelli, who manages the Gabelli Small Cap Growth fund, recently held stocks, on average, for 5.5 years, and was awarded a five-star rating from Morningstar.[3]

Although a large literature examines the value added to actively-managed portfolios, its empirical evidence mainly focuses on short-term investing strategies and performance.[4] This short-term focus is consistent with the above-noted short-term incentives faced by active mutual fund managers. In contrast, our paper provides empirical evidence focusing on long-term investing among actively managed equity mutual funds.

Key to our empirical design is a new holdings-based measure of fund investment horizon, which we call the fund "holding horizon" (HH) measure. We use this measure to examine the horizon-managerial skill relation of U.S.-domiciled actively managed equity mutual funds. We calculate a fund's HH as the value-weighted average of the holding period of stocks held by the fund. The holding period of each stock is calculated using two different methods. The first calculates the stock holding period from the time a position is first initiated to the time it is completely liquidated. This resultant HH is termed the "Simple" horizon measure. Because it "looks ahead" to determine holding periods, this measure uses ex-post holdings and cannot be used in real time to predict managerial skills. Hence, the second method uses only past holdings information to calculate the holding period of each stock. This ex-ante metric is termed the "Ex-Ante Simple" horizon measure, which is a modified version of the Simple measure. Note that this ex-ante measure may underestimate the stock holding period, especially during the first few periods after a stock purchase, when a fund manager intends to hold this position for the long run. Nevertheless, it has the advantage of being potentially implemented in real time to assess a fund's skill.[5]

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[3]See "Hurdles Loom for Gabelli Asset Management" at https://www.thestreet.com/story/10133882/1/hurdles-loom-for-gabelli-asset-management.html, and "TIP SHEET: Gabelli Fund Aims for Big Stakes, Long-Term Investments," *Wall Street Journal*, November 21, 2012.

[4]The literature on the value of active management is vast. Studies include, inter alia, Grinblatt and Titman (1989, 1993), Daniel et al. (1997), Wermers (2000), Chen et al. (2000), Cohen et al. (2005), Kacperczyk and Seru (2007), Kacperczyk et al. (2005, 2008, 2014), Alexander et al. (2007), Jiang et al. (2007), Cremers and Petajisto (2009), and Baker et al. (2010).

[5]For robustness, we also implement two more complicated measures of fund HH that account for partial changes in a stock position by a fund (rather than the horizon between the initiation and complete liquidation).

When comparing the holding horizons of different funds, we control for funds' investment objectives. Funds with different investment objectives typically focus on different pools of stocks, which may involve different "optimal" holding periods, even for the same management company. Following Hunter et al. (2014), we assign the best-fit index of Cremers and Petajisto (2009) to each fund as its benchmark. We find that value (large-cap) funds have a longer investment horizon, on average, than growth (small- and mid-cap) funds. We then classify a fund as long- or short-horizon using a style-adjusted fund investment horizon, calculated as that fund's investment horizon, in excess of the average investment horizon of all funds with the same best-fit benchmark (i.e., the same investment style) as that fund.

Using our (style-adjusted) HH measures, we find a wide cross-sectional dispersion of fund holding horizons. For example, funds in the shortest-horizon quintile formed according to the Simple (Ex-Ante Simple) measure, on average, hold stocks for 2.02 (1.01) years, whereas funds in the longest-horizon quintile hold stocks for 7.39 (4.47) years. Moreover, the longest-horizon quintile of funds has a much greater within-fund standard deviation (across its equity holdings) of stock holding periods than the shortest-horizon quintile: 2.52 vs. 0.66 years using the Ex-Ante Simple measure. We also find that long-horizon funds take much longer, more than 1.5 years, on average, to either build or decrease their positions in a particular stock, compared with short-horizon funds, which take only a few months. This finding is consistent with Treynor's (1976) conjecture: an idea that requires reflection, judgment, and special expertise for its evaluation and, consequently, travels slowly is a critical basis for long-term investing and offers superior long-term returns. This slow accumulation or reduction of equity positions also helps long-horizon funds to control the impact of their trades on stock prices. We also find an interesting clientele effect: long-horizon funds tend to attract more long-term investors than short-horizon funds, by raising more capital via share classes with front-end loads.

To study the horizon-managerial skill relation, our paper adopts two approaches: one at the fund level and the other at the stock level. The fund-level approach directly examines the relation between fund holding horizon and future fund performance over various look-ahead holding periods. The stock-level approach aggregates the consensus opinion of the value of a stock from long- and short-horizon funds separately, and investigates future performance

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These two measures, which are explained in detail in a separate Internet Appendix, provide results that are qualitatively similar to those for the Simple and Ex-Ante Simple measures that we discuss in this paper.

for stocks preferred by one type of fund over the other. Because funds also include some stocks for non-performance purposes, such as limiting their deviations from a benchmark to control tracking error, the stock-level approach helps to remove the effect of non-skill related holdings that are common across these two types of funds. Thus, the stock-level approach is more likely to uncover evidence of the horizon-skill relation than the fund-level approach. Nevertheless, the latter provides a better gauge of the benefits for mutual fund investors of implementing an investment rule based on our horizon measures.

At the fund level, we find that long-horizon funds outperform short-horizon funds at all investment horizons (one month to five years) using either of our two HH measures.[6] Long-horizon funds generally exhibit positive Carhart (1997) four-factor net return alphas, while short-horizon funds generally exhibit negative four-factor alphas. Depending on which horizon measure is used, the spread of four-factor net alphas between funds in the longest-horizon decile and those in the shortest decile is 0.11%–0.16% at a one-month horizon, or 9.10%–9.98% at a five-year horizon, ranging from 1.32%–2% per year. Results remain similar when we use DGTW-adjusted returns, which are measured prior to expenses and transaction costs. Additionally, short-horizon funds hold stocks with a significantly larger one-year momentum risk-loading, indicating that short-horizon funds implement (technical, price-based) momentum strategies to a greater degree than long-horizon funds.

Are long-horizon funds merely "closet indexers," staying close to their benchmarks (without trading) for long periods of time? We show that our fund-level horizon measure exhibits a low correlation with dimensions of fund activeness that, according to prior studies, predict fund performance, such as Active Share (Cremers and Petajisto, 2009), R-squared (Amihud and Goyenko, 2013), and Return Gap (Kacperczyk et al., 2008). Thus, our horizon measure is unrelated to "closet indexing," but is also largely unrelated to past metrics of high fund activeness, such as high levels of Active Share or low levels of R-squared. Further, long-horizon funds exhibit better long-term risk-adjusted performance than short-horizon funds, even when we control for these other measures of fund activeness plus other fund characteristics shown by past studies to be related to future alphas.

[6] Perhaps due to their higher level of trading activity, short-horizon funds charge higher expense ratios than long-horizon funds. As a result, at least in aggregate, short-horizon funds exhibit (four-factor model) stockpicking skills that are insufficient to cover their fees and expenses. Chakrabarty et al. (2017) use a daily institutional trading database, and find that the worst short-term returns accrue to funds that engage in the most trading.

At the stock level, we find that stocks largely held by long-horizon funds relative to short-horizon funds exhibit superior future long-term buy-and-hold abnormal returns. For instance, depending on which fund horizon measure we use, the risk-adjusted buy-and-hold returns of stocks that are mostly held by long-horizon funds relative to short-horizon funds are 15.9%–18.7% over the next five years, while those of stocks largely held by short-horizon funds are only -1.8% to 2.8%. The difference between these two groups is roughly 13.5% to 17.7% over a five-year horizon, or about 2.7% to 3.5% per year, which is both statistically and economically significant. The superior long-term performance of stocks with large long-horizon fund ownership mainly derives from long-term equity positions, as opposed to short-term positions, held by long-horizon funds. In contrast, we find no evidence of short-term abnormal performance of stocks predominantly held, in aggregate, by short-horizon funds.

We further explore the economic sources—stock fundamentals—of long-horizon fund stock-selection skills. We measure information shocks to firm fundamentals using four different variables: cash-flow news ($CFnews$), consensus analyst earnings forecast revisions (FRV), earnings-announcement-window returns (EAR), and market-adjusted EAR. We find that stocks held the most by long-horizon funds are associated with significantly positive long-term $CFnews$, FRV, EAR, and adjusted EAR, much higher than those for stocks held the most by short-horizon funds. This finding indicates that long-horizon fund managers are skilled in analyzing long-term firm fundamentals and, through these skills, achieve superior performance in the long run.

Our paper adds a new dimension—the measurement of fund holding horizon—to the growing literature examining differential skills of actively managed mutual funds. Prior research has uncovered several metrics of fund activities that can add value to managed assets, such as peer track-records (Cohen et al., 2005), industry concentration and Return Gap (Kacperczyk et al., 2005, 2008), network connections (Cohen et al., 2008), Active Share (Cremers and Petajisto, 2009), and R-squared from benchmark regressions (Amihud and Goyenko, 2013). However, none of the above papers examine long-term fund performance for a buy-and-hold investor.

There also exist some mutual fund studies examining the relation between fund turnover—a proxy for trading activeness or the inverse of holding horizon—and fund performance, and they provide conflicting evidence. Some papers (e.g., Carhart, 1997) find a negative relation, while others (e.g., Grinblatt and Titman, 1993; and Wermers, 2000) demonstrate a positive relation. More recently, Pástor et al. (2017) find that time-series variation in turnover at a given fund positively forecasts that fund's future performance. We argue that being a simple statistic of trading activity, (the inverse of) turnover is a flawed and downward biased proxy for fund holding horizon (the portfolio-weighted average of stock holding periods).[7] Indeed, we find that fund holding horizon and turnover, although negatively correlated, are quite different variables. They are both persistent over time, and have, at most, marginal explanatory power for each other. Using our horizon measures, we identify significant cross-sectional differences in fund manager skills, as opposed to the time-series variation within a fund that is identified by Pástor et al. using reported fund turnover.

Our paper is also related to prior studies that use 13-F holdings data to characterize institutional investors as either short-term or long-term based on a constructed holdings-based turnover ratio (e.g., Bushee, 2001; Cremers and Pareek, 2011; Gaspar et al., 2005; Yan and Zhang, 2009). Yan and Zhang (2009) show that trading of short-term institutions, instead of long-term institutions, predicts future stock returns. Their conclusion is different from ours for two reasons. First, our more direct horizon measures, compared with turnover, better identify long-term fund skills. Second, portfolio holdings in the 13-F data are aggregated at the fund advisor level, whereas mutual fund holdings we use are reported at the fund level. A good deal of heterogeneity in investment horizons of different funds managed by the same advisor, such as hedge funds and mutual funds, is lost in the aggregated 13-F data.

Finally, Cremers and Pareek (2016) find that investment managers, of both mutual funds and aggregate 13-F institutions, with a high Active Share (Cremers and Petajisto, 2009) perform better if they implement patient strategies. Patient strategies are captured by either a low turnover ratio or a long portfolio-averaged stock holding period, and Cremers and Pareek do not make a clear distinction between these two metrics of fund activeness, as we do in our paper. Frazzini et al. (2016) argue that within a given actively managed fund peer group, Active Share exhibits little power to identify the most skilled managers. For example,

[7] The difference between (the inverse of) the turnover ratio and the portfolio-weighted holding period is driven by Jensen's inequality. As we show in our paper, the more dispersion in the holding period of stocks, across stocks within a fund portfolio, the more downward bias in the inverse of the turnover ratio as a proxy of holding horizon. This bias is less likely to affect the time-series dimension of a fund's changes in turnover level, but greatly affects the cross-section of funds, as different funds have very different levels of dispersion in the horizon over which they hold individual stocks in their portfolios.

for mutual funds that benchmark against the S&P 500 Value index, Active Share negatively predicts fund alpha. Our (style-adjusted) HH measures, on the other hand, are simpler and not subject to Frazzini et al.'s critique; they work well across investment categories and subsume the explanatory power of Active Share in many cases.

Further, we compare the efficacy of our simple ex-ante HH measure with Active Share and Active Share interacted with turnover (Cremers and Pareek's key variables), along with other control variables, in panel regressions that predict future risk-adjusted fund performance. For a given investment horizon, we run one panel regression for each investment objective category, to directly test the critique of Frazzini et al. Take a five-year horizon as an example. We find that HH has a positive and statistically significant coefficient for 9 out of 10 fund categories, consistent with it being a powerful indicator of future long-term abnormal fund returns; however, the coefficient on the interaction between high Active Share and turnover ratio is significantly negative (the correct sign) for only 3 out of 10 benchmark categories. Results for one- and three-year horizons are very similar. Thus, our simple ex-ante HH metric is effective, and, once we adjust it for the average HH in the same investment objective (style) category, largely eliminates the need to use Active Share or its interacted counterparts.[8]

Relative to Cremers and Pareek (2016), our paper also investigates the performance of stocks experiencing discretionary holding periods, aggregated across long-horizon funds relative to short-horizon funds. These stock-level measures of holding horizon even more effectively reveal differential skills of long- versus short-horizon funds, and may be useful as a new quantitative stock-selection signal. Further, we make an important distinction between the turnover ratio and horizon measures by showing that they reflect different aspects of active management, instead of treating them as similar measures.

2 Methodology

This section introduces our new holdings-based measures of investment horizon. It then proceeds to discuss the approaches we use to examine the relation of investment horizon to manager skills.

[8]Cremers and Pareek (2016) also interact Active Share with a metric of holding period rather than turnover ratio. We tried substituting Active Share interacted with our HH measure as a proxy for this approach, and still found that HH, by itself, remained strongly positive and significant, while Active Share interacted with HH was mostly insignificant and often had the wrong sign.

2.1 Measures of Holding Horizon

Based on mutual fund holdings, we propose fund holding horizon (HH) measures as value-weighted holding periods of all stocks held by a fund, using the portion of stock values in the fund portfolio as weights. These HH measures differ in how the holding horizon of each stock is defined; they can be an ex-post measure if future information is used or an ex-ante measure if only past and current information is used.

The first measure, termed the "Simple" horizon measure, calculates the holding horizon of a stock in a given fund portfolio as the time span with nonzero holdings—the length of time from the initiation of a position to the time that the stock is fully liquidated by the fund. Letting $h^{(1)}_{i,j,t}$ denote, in this measure, the holding horizon of stock i held by fund j in period t,

$$h^{(1)}_{i,j,t} = s - k, \text{ for } k \leq t < s, \tag{1}$$

where the stock is purchased in period k and sold in period s.[9] Because mutual fund holdings are reported either quarterly or semi-annually, we do not observe the exact time of purchase or sale of a stock and assume that such a trade occurs at the beginning of a period. However, our results do not rely on this assumption and are robust to alternative assumptions that purchase or sale of a stock occurs in the middle or the end (one day before a holdings report date) of a period. As long as a manager holds a long position of a stock, we consider her outlook for the stock to be positive. Thus, the holding horizon of stock i stays constant throughout the span with non-zero holdings.

To implement investment horizon measures in real time, we further consider a modified, ex-ante version of the Simple measure, termed the "Ex-Ante Simple" measure, that uses only current and past information. Let θ_j be the date that is five years after the initiation date of fund j. Let $h^{(2)}_{i,j,t}$ denote, in this measure, the holding horizon of stock i held by fund j in period t, then

$$h^{(2)}_{i,j,t} = \begin{cases} t - k, & \text{for } k \leq t \text{ and } t > \theta_j \\ 0, & \text{otherwise,} \end{cases} \tag{2}$$

where the stock is purchased in period k.[10] This ex-ante measure is likely to underestimate

[9]As a concrete example—keeping in mind that the ex-post measure "looks ahead" to see when a position is liquidated—consider a fund that purchases 1,000 shares of General Electric (GE) in year 0 and purchases another 100 shares in year 1. It sells 300 shares in year 2 and liquidates the position in year 3. In this example, the holding period of GE, in years 0, 1, and 2, is 3 years based on the Simple measure.

[10]We also construct an Ex-Ante Simple measure with a two-year or three-year warm-up period, and all

the stock holding period, especially in the first few periods after a purchase of a stock, when a fund manager intends to hold the position for a long time. Nevertheless, an investment rule based on our ex-ante measure instead of our ex-post measure has the advantage that it can be implemented in real time.

These two simple measures do not account for position changes of a stock held in a fund portfolio during the holding period, which may partially be executed to meet investor flows. As a robustness check, we also consider another ex-ante and ex-post measures that allow for the possibility that position changes may also be informative about the intended holding horizon. We find that the sophistication of accounting for position changes in construction horizon measures does not improve the results and it may add more noise. Therefore, we only discuss the Simple and the Ex-Ante Simple measures and the results based on these two measures in the main body of our paper. Details about the other two measures can be found in a separate Internet Appendix.

After the holding horizons of all stocks held by a fund are calculated, the holding horizon of fund j in period t, denoted by $HH_{j,t}$, is then defined as the value-weighted holding periods of all stocks held by the fund. Specifically,

$$HH^{(m)}_{j,t} = \sum_{i=1}^{M_{j,t}} \omega_{i,j,t} h^{(m)}_{i,j,t}, \quad m = 1, 2 \tag{3}$$

where $M_{j,t}$ is the number of stocks held by fund j in period t, and $\omega_{i,j,t}$ is the period-t portfolio weight of stock i in fund j. $\omega_{i,j,t}$ is computed as the number of shares of stock i held in fund j in period t multiplied by the period-t stock price, then divided by the period-t market value of the equity portfolio of fund j.

To compare the HH of different funds, we further account for fund investment objectives and styles. Funds with different investment objectives and styles typically focus on different pools of stocks. Even if the best stocks are selected from different pools, their optimal holding periods are likely to be different because of differential firm fundamentals and discount rates associated with these different style categories. Therefore, we classify funds as long-horizon or short-horizon based on their style-adjusted HH, or a fund's investment horizon in excess of the average HH of all funds with the same investment style as that fund (see Section 3 for the definition of investment styles).

these versions have almost the same correlation with the Simple measure.

2.2 Risk Models

We mainly rely on a sorted-portfolio method to study the relation between fund investment horizon and manager skills. In our stock-level (fund-level) analysis, after sorting stocks (funds) into deciles at the end of each month, we calculate buy-and-hold decile-portfolio returns over the next n periods, ranging from one month to five years. The decile-portfolios are equally weighted in the formation month, then updated through the look-ahead holding period following a buy-and-hold strategy; if stocks (funds) drop out during a buy-and-hold period, we adjust the weights of the existing stocks (funds) in the decile by dividing each by one minus the weight of the disappearing stocks (funds). This monthly portfolio formation strategy with the resultant overlapping windows improves the statistical power of our tests for multiperiod portfolio returns (e.g., Richardson and Smith, 1991). Then, we average these buy-and-hold returns across all formation months for each decile and for each look-ahead holding horizon. To calculate standard errors, we apply a Newey-West approach with a lag of $n - 1$ to account for autocorrelation and heterogeneity.

We also calculate risk-adjusted abnormal returns and use the Carhart (1997) four-factor model and the holdings-based characteristics model of Daniel, Grinblatt, Titman, and Wermers (1997; DGTW) and Wermers (2003) to control for the market, size, value, and momentum factor exposures. The four-factor alphas and DGTW-adjusted returns reflect managerial skills after accounting for risk. As robustness checks, we also control for risk exposure using two different five-factor models: the Pástor and Stambaugh (2003) liquidity factor in addition to the Carhart four factors, and the De Bondt and Thaler (1985) long-term reversal factor in addition to the Carhart four factors. Our results are robust to all these models used to capture risk.

To obtain four-factor alphas, we follow Fama and French (1993) and the description of data construction from Ken French's website to construct four factors over a holding horizon of interest. Specifically, for each component portfolio that is used to construct Carhart's four factors, we calculate its buy-and-hold return over a horizon of interest. Analogous to the construction of the monthly four factor returns, we calculate four factor returns with different holding horizons ranging from one month to five years. Take Fama and French's value factor (HML) as an example. Similar to Kamara et al. (2016), HML of horizon n is the average of n-period compounded returns of small value portfolios and big value portfolios, minus the average of n-period compounded returns of small growth portfolios and big growth portfolios. The four-factor alpha is obtained by regressing buy-and-hold portfolio returns on the corresponding Carhart four factors with the same holding horizon.

Similarly, to obtain DGTW-adjusted returns over n periods for a portfolio, we compound n-period DGTW benchmark returns (reconstituted every quarter) for the portfolio, then subtract them from n-period compounded returns of the portfolio. We reconstitute DGTW benchmark portfolios every quarter instead of every June to better control for changing stock characteristics. Specifically, we sort, at the end of each quarter, all common stocks into 125 ($5 \times 5 \times 5$) benchmark portfolios using a sequential triple-sorting procedure based on size, book-to-market ratio (BM), and momentum. Size is the market cap at the end of the quarter (using NYSE breakpoints when sorting). BM is computed as the book value of equity for the most recently reported fiscal year divided by the quarter-end market cap (adjusted for the industry-average). Momentum is the twelve-month return ending one month prior to the quarter-end. The DGTW benchmark return for a stock is the value-weighted return of one of 125 DGTW portfolios to which the stock belongs.

3 Data and Summary Statistics

Our data for U.S. actively managed equity mutual funds come from the intersection of Thomson Reuters mutual fund holdings database and the Center for Research in Securities Prices (CRSP) mutual fund database. These two databases are linked using MFLINKS from Wharton Research Data Services (WRDS). Thomson Reuters provides information on equity mutual fund holdings of common stocks in a quarterly or semiannual frequency. CRSP provides information on mutual fund net returns, total net assets (TNA), and several fund characteristics such as expense ratio and turnover ratio. The information provided by CRSP is at the share class level. We therefore calculate value-weighted fund net returns and fund characteristics across multiple share classes within a fund using the latest TNA as weights, except that fund age is calculated based on the oldest share class and TNA as the sum of net assets across all share classes belonging to the same fund. For the sample selection, we follow the procedure of Kacperczyk et al. (2008). In particular, we exclude funds that do not invest primarily in equity securities, funds that hold fewer than 10 stocks, and those that, in the previous month, manage assets of less than \$5 million. Finally, we exclude index funds using both fund names and the sample of index funds identified by Cremers and Petajisto (2009) and available at www.sfsrfs.org/addenda_viewpaper.php?id=379.

The final sample includes 2,969 equity funds over the sample period ranging from March of 1980 to December of 2010 due to the data availability in the version of MFLINK used in this paper. All the other data cover the sample period of March 1980 to December 2012. Stock returns, prices, and shares outstanding are obtained from CRSP. Accounting data, such as earnings, come from COMPUSTAT. Analyst earnings forecasts come from the Institutional Broker's Estimate System (IBES) summary unadjusted file.

Fund investment styles come from Hunter et al. (2014). They consider nine style categories of funds, according to whether they are large-capitalization (with benchmark Russell 1000 Value, Russell 1000, or Russell 1000 Growth), mid-capitalization (with benchmark Russell Midcap Value, Russell Midcap, or Russell Midcap Growth), or small-capitalization funds (with benchmark Russell 2000 Value, Russell 2000, or Russell 2000 Growth). This classification of fund investment styles not only keeps a reasonably large number of funds in each category, which reduces noise in calculating the average investment horizon for each style, but also avoids the agency issues caused by the use of misleading self-claimed benchmarks (Sensoy, 2009).

3.1 Summary Statistics

Panel A of Table 1 reports summary statistics for our mutual fund sample. On average, equity mutual funds hold stocks with total net assets of 764 million for a period of approximately 3.5 years in terms of the Simple horizon measure. The average holding period in terms of the Ex-Ante Simple measure is shorter, since this measure uses only past and current information, and therefore underestimates the intended holding period of the average stock by a given manager. The average CRSP reported turnover ratio (also available from other mutual fund databases, such as Morningstar, or from SEC filings) is almost 90%, which is defined as

$$TR = \frac{min(\$buys, \$sells)}{Average \text{ TNA}}$$

during a fund's fiscal year. We also calculate a holdings-based analog to reported turnover. First, we compute quarterly turnover as the minimum of stock purchases and sales executed by a fund during a quarter based on the beginning- and end-of-quarter portfolio disclosures, divided by the fund's average total net assets during the quarter (Yan and Zhang, 2009). Then, we sum this quarterly rate over the past four quarters to arrive at an annual holdings-based turnover. This holdings-based turnover is lower than that reported by the funds to SEC, as one should expect, because funds engage in intraquarter trading that cannot be detected through quarterly or semi-annual holdings disclosures (Puckett and Yan, 2011); funds may also engage in non-equity position trading, which is not included in the Thomson holdings database. The average fund age is 14.3 years. Due to the entry of a large number of small funds in the most recent decade, the median fund age, at 9.5 years, is much smaller than the average age.

To examine the investment preferences of funds, we first calculate value-weighted quintile ranks of stocks held in a fund portfolio, where ranks are sorted separately on size, book-to-market ratio, momentum, or illiquidity, as measured by Amihud's (2002) measure, with one being the lowest and five being the highest quintile. Then, we average these quintile ranks across funds and time. Consistent with previous studies (e.g., Falkenstein, 1996, and Chan et al., 2002) equity mutual funds, on average, tend to prefer larger companies, past winners, and more liquid stocks.

Panel B shows that fund HH varies considerably across investment styles. Because equity mutual funds with the same investment style typically focus on a similar subcategory of stocks, it is likely that being in a particular style affects the investment horizon of a given fund. The results in Panel B support this conjecture: large-cap funds hold stocks, on average, longer than mid- and small-cap funds, and value funds hold stocks on average longer than growth funds. The mean and median Simple horizon measures for large-cap and value funds are roughly four years, while those for mid- and small-capitalization funds (excluding the value variants of these sectors) are below three years. It is clear that funds in different investment objective categories routinely hold stocks for different lengths of time. These differences motivate us to adjust a fund's horizon measure for that of the average fund within its style category when analyzing the fund horizon-performance relation.

Panel C presents the average values of fund characteristics and stock characteristics in each fund quintile, where funds are sorted on their style-adjusted Ex-Ante Simple, $HH^{(2)}$, measure.[11] Notice that funds in the shortest, middle, and longest HH quintiles, on average,

[11]We note that Panel C summary statistics for fund quintiles sorted on the Simple horizon measure are qualitatively similar. For simplicity, we will use style-adjusted measures without explicitly mentioning

hold stocks for 1.01, 1.96, and 4.47 years, respectively, in terms of the Ex-Ante Simple measure, or for 2.02, 3.49, and 7.39 years, respectively, in terms of the Simple measure. Long-term funds are large and long-established funds with a lower expense ratio and a lower turnover ratio. Both long- and short-horizon funds, on average, hold stocks with similar book-to-market ratios and liquidity, although long-term funds prefer mildly less past winners and larger companies.

One may wonder whether funds with a long HH are simply "closet indexers." To address this issue, we examine differences in activeness as measured by prior "activeness" measures, which include Active Share (Cremers and Petajisto, 2009), R^2 (Amihud and Goyenko, 2013), and Return Gap (Kacperczyk et al., 2008).[12] There is not a significant difference in the level of activeness between long- and short-horizon funds in terms of R^2 and Return Gap, and the difference in Active Share is relatively small. Clearly, long HH funds are not merely passive funds that represent themselves as active funds (Cremers and Petajisto, 2009, consider a fund as a closet indexer if Active Share is less than 0.6); our HH measure captures a characteristic of active management that is unrelated to prior measures of activeness of asset managers.

We also find evidence that long-term funds cater to long-term investors. Since the 1990s, many funds, to cater to different types of investors, offer multiple share classes representing ownership interests in the same portfolio, but using different fee structures. Nanda et al. (2009) suggest that "investors with relatively long investment horizons will prefer the A class with its up-front load and lower annual charges, while those with short and uncertain horizons will prefer the B or C class".[13] Panel C shows that long-term funds have a significantly greater proportion of TNA invested in the A share class than short-term funds (60% vs. 50%).[14] This finding is consistent with the clientele of long-horizon fund investors being more patient, since more of them have made a significant (front-end) commitment to holding fund

"style-adjusted" throughout the rest of this paper unless necessary for clarification.

[12]Active Share (AS) is downloaded from Petajisto's website; R^2 is obtained by running regressions of fund excess returns on the Carhart four factors using a 24-month rolling window; Return Gap is defined, following Kacperczyk et al., (2008), as the monthly difference between the reported fund net return, plus 1/12 the most recent fund expense ratio, and the return of a hypothetical portfolio that invests in the most recently disclosed portfolio holdings.

[13]The A class is characterized by high front-end loads and low annual 12b-1 fees. The B and C classes typically have no front-end loads but may charge a contingent deferred sales load upon exit and usually charge higher annual 12b-1 fees.

[14]Given the absence of an identifier for A class, motivated by Nanda et al. (2009), we classify a share class as an A class if it charges a front-end load.

shares for a long period of time.[15]

Panel D reports the correlation matrix of our fund HH measures, the inverse of CRSP reported turnover, and the inverse of holdings-based turnover. Although there is a high correlation of 0.89 between our horizon measures, the correlations between our measures and the inverse of turnover ratios are much smaller, less than 0.4. These results are consistent with the discussion about the difference between our horizon measures and turnover in Section 6 and imply that our horizon measures and turnover reflect different aspects of active management.

If long-term fund managers are able to exploit information that is reflected in stock prices over the long run, we would expect these managers to slowly accumulate or liquidate a position to both reduce the impact of their trades, and to more easily accommodate these changes through investor flows or through trades of other portfolio securities. To capture these dynamics, we calculate the value-weighted average of the time span of consecutive purchases (sales) of a given stock for all stocks held in a fund portfolio, in the same way as we calculate fund investment horizon specified in (3) by replacing a stock's holding horizon with a stock's time span of consecutive purchases (sales). The time span of consecutive purchases (sales) of a stock by a fund is defined as the longest time interval that starts with a purchase (sale) of the stock by the fund and ends with another purchase (sale) of the same stock, without a sale (purchase) of the stock in between. Table 2 reports summary statistics of the time span that short- and long-horizon funds use to accumulate or liquidate a stock position. We use the Ex-Ante or the Simple measure to identify short- and long-horizon funds.

Note that long-horizon funds take much longer to either increase or decrease their positions than short-horizon funds. Take the Simple horizon measure as an example. Long-horizon funds take almost 19 (23) months, on average, to accumulate (reduce) a position compared with approximately 5 (8) months for short-horizon funds. Some long-horizon funds take roughly three to four years to accumulate or liquidate a position, as shown in the "P90" column. The results using the ex-ante horizon measure are qualitatively similar—long-horizon

[15] In an untabulated analysis, we test whether the flow-performance sensitivity is different for long-horizon mutual funds vs. short-horizon funds in the specification of Sirri and Tufano (1998). We find that flows to long-horizon funds are less sensitive to past performance than flows to short-horizon funds. This finding is consistent with the evidence that long-horizon funds cater to long-term investors who appear to be more patient.

funds routinely accumulate or liquidate much more patiently than short-horizon funds.[16]

3.2 Persistence of Fund Horizon Measures

If fund managers are skillful at exploiting information over different horizons, we would expect that managers optimally choose long-horizon investments or short-horizon investments accordingly (as implied by the model of Wang, 1993). An important question in testing the predictive power of HH is whether funds have persistent levels of HH over long time horizons, i.e., whether their particular skills are durable. To check this persistence, each month, we sort fund portfolios into deciles according to one of our HH measures, the Simple or Ex-Ante Simple measure. D1 consists of funds with the shortest holding periods within their investment styles, while D10 consists of funds with the longest holding periods. Figure 1 depicts the average style-adjusted fund holding horizons of each decile at the formation period and during the subsequent 20 quarters.

Fund investment horizons exhibit long-term stability. The ranking of the decile portfolios remains identical as far out as the 20th quarter after the formation period. Take the Simple horizon measure as an example. Fund investment periods in excess of their style average are -2.62, -1.86, -0.59, -0.16, 2.00, and 4.30 years, on average, for funds in deciles 1, 2, 5, 6, 9, and 10 at the formation period, while these average investment periods become -1.27, -1.02, -0.33, -0.06, 1.69, and 3.85 years after 20 quarters. Moreover, this remarkably persistent pattern is evident for both ex-post and ex-ante horizon measures.

4 Empirical Results on Fund Performance

In this section, we examine the fund horizon-performance relation, using both a sorted fund portfolio approach and Fama-MacBeth regressions that control for fund characteristics, as well as other measures of active fund management that, according to prior studies, predict future fund performance.

[16]In an untabulated analysis, we find that compared with short HH funds, long HH funds tend to hold stocks with wider dispersions in analysts' earnings forecasts. This evidence suggests that long HH funds invest in stocks with slow information diffusion into prices and that such slow information diffusion facilitates long HH funds to take time to either increase or decrease their positions.

4.1 Fund Performance using a Sorted Portfolio Approach

We use both fund net returns available from CRSP and holdings-based returns, calculated as value-weighted returns of stocks held by a given fund, to measure fund performance. In the sorted fund portfolio approach, each month we group funds into deciles according to one of the fund horizon measures that we have discussed in Section 2.1. For each decile and each look-ahead horizon of the next month, and up to the next five years, we calculate buy-and-hold cumulative net returns and risk-adjusted abnormal returns—four-factor alphas associated with net returns and DGTW abnormal returns based on holdings-based returns—as described in Section 2.2.[17] Table 3 summarizes the results using the Simple horizon measure on the left and the Ex-Ante Simple measure on the right, with D1 (D10) consisting of short-horizon (long-horizon) funds.

Long-horizon funds outperform short-horizon funds regardless of which HH measure is used. At all look-ahead horizons, the four-factor alphas for the longest-decile funds are positive, and are the highest among the deciles; they are also statistically significant at long horizons, such as four and five years. In contrast, the alphas for the shortest-decile funds are negative (in a few cases, they are insignificantly positive and close to 0). At a short look-ahead horizon, the spread of one-month alpha between the two extreme deciles is 0.16% per month (1.92% per year) when the Simple measure $HH^{(1)}$ is used or 0.11% per month (1.32% per year) when the Ex-Ante Simple measure $HH^{(2)}$ is used. Both are statistically significant. The results at a long look-ahead horizon are comparable. The spread of five-year alpha is 9.10% over a five-year period (1.82% per year) when $HH^{(1)}$ is used and 9.98% (2% per year) when $HH^{(2)}$ is used. Finally, DGTW-adjusted returns, reported in the columns marked as "DGTW", paint the same picture. These abnormal returns are holdings-based returns in excess of DGTW benchmarks that ignore expenses and transaction costs.

Note that using the Ex-Ante Simple measure as a sorting metric is likely to weaken the ability to capture the fund horizon-performance relation. The reason is that the ex-ante measure, by construction, assigns a short holding horizon when a stock position is newly initiated, even if this stock is held for a long period. Nevertheless, the results using both the ex-ante and ex-post measures, as we just discussed, are comparable. Moreover, in the

[17]The existent mutual fund literature, with a few exceptions, focuses on predicting short-term performance of up to one year; such studies may miss a significant portion of the longer-term outperformance of long-horizon funds.

Fama-MacBeth regressions reported next that control for fund characteristics, the Ex-Ante Simple measure exhibits a significant and positive association with future fund performance.

4.2 Fund Performance using Fama-MacBeth Regressions

To control for the effect of different fund characteristics on fund performance, we run Fama-MacBeth (1973) regressions of future fund performance on fund HH as well as other fund characteristics. Specifically, each month, we run cross-sectional regressions of abnormal buy-and-hold fund returns (measured using either four-factor alphas or DGTW-adjusted returns) on the Ex-Ante Simple fund horizon measure, $HH^{(2)}$, controlling for a list of standard fund characteristics that may be related to performance. We use the ex-ante horizon measure instead of the ex-post version here to avoid the case in which a regressor is correlated with regression innovations. Fund characteristics include fund age (measured in logs), fund size (measured by log TNA), fund expense ratio, past-year fund flow (as a fraction of lagged fund TNA), flow volatility (the volatility of monthly fund flows over the past 12 months), and the most recently available CRSP turnover ratio. Then, we calculate the time-series means of these first-stage coefficient estimates using the inverse of standard error of the first-stage estimates as weights, following the suggestion of Fama (1998).[18] Because of employing overlapping observations of dependent variables at a monthly frequency, standard errors are calculated using the Newey and West (1987) approach with a lag of the number of holding periods minus one. The first four columns of Table 4 report estimation results, based on four-factor fund net return alphas in Panel A and DGTW-adjusted returns in Panel B.[19]

Clearly, fund HH is a significant predictor of abnormal returns of long-horizon funds. The coefficient estimates on the Ex-Ante Simple measure, $HH^{(2)}$, are statistically significant. Controlling for fund characteristics, a two-standard-deviation increase in $HH^{(2)}$ raises the fund four-factor alpha by 4.64% (Panel A) and the fund DGTW-adjusted return by 3.20% (Panel B) over a five-year period, where the standard deviation of $HH^{(2)}$ is 1.38 years.

Next, we test whether fund HH retains its explanatory power for future fund alphas, after controlling for other metrics of active management proposed by prior studies, which include

[18] Our results are similar when we use the time-series means of equally weighted first-stage coefficient estimates.

[19] If we replace turnover with inverse turnover (a proxy of fund HH, see Section 6), the results in this section stay similar. Because turnover is widely used in the literature, for simplicity, we present results using turnover instead of inverse turnover.

Active Share (Cremers and Petajisto, 2009), R^2 (Amihud and Goyenko, 2013), and Return Gap (Kacperczyk et al., 2008). As shown in the last 12 columns of Table 4, while these other proxies for manager skills predict alphas, as documented in their respective papers,[20] the power of our horizon measure changes only slightly with their inclusion in the models. Thus, fund HH represents a new dimension of manager skills that cannot be explained by previously discovered proxies of active management. We present further evidence about this in the robustness check section.

5 The Horizon-Skill Relation at the Stock Level

Some stock positions are included in a fund portfolio for non-performance purposes, so their existence tends to disguise the detection of the horizon-skill relation at the fund level. If these non-skill related holdings are common across long- and short-horizon funds, then using differential information possessed by long- versus short-horizon funds can help to remove the effect of such non-skill related holdings and improve the power in detecting the horizon-skill relation. In this section, we implement this stock-level approach by first aggregating holdings information about each stock from long-horizon funds and short-horizon funds separately. Then, we study the future performance of stocks that are largely held by one type of funds over the other.

5.1 Informativeness of Fund Holdings

We first construct a stock-level metric that reflects aggregate holdings information from long-horizon funds relative to short-horizon funds. Specifically, we rank all funds each month into terciles based on their style-adjusted fund investment horizon. Funds in the top and bottom terciles are classified as long-horizon funds and short-horizon funds, respectively. We then define long-horizon fund holdings (LFH) and short-horizon fund holdings (SFH) for each stock, similar to Yan and Zhang (2009), as the aggregate holdings of the stock by long-horizon funds and short-horizon funds, respectively, divided by that stock's total number of shares outstanding. Mutual funds often hold stocks for reasons unrelated to their perceived future performance, due to legal restrictions, the requirements of investment objectives

[20]Kacperczyk et al. (2008) provide results that Return Gap positively predicts future four-factor alphas while controlling for fund characteristics, but no results for DGTW abnormal returns in regressions.

and styles, fund flows, etc (Del Guercio, 1996; Brown et al., 1996). If skill-unrelated stock selections for the two types of funds are overlapped, then LFH minus SFH can remove the common non-performance stock-picking and therefore sharpen the differential information contained in the consensus opinions of long-horizon funds versus short-horizon funds. Thus, we study future stock performance with respect to LFH minus SFH.

If fund managers optimize their differing stock-selection talents with different horizon focuses, we would expect that stocks with a large value of LFH minus SFH have good long-term performance whereas stocks with a small value have good short-term performance. On the other hand, outperformance predictability is also related to market friction, such as limited arbitrage. Shleifer and Vishny (1990, 1997) argue that exploiting long-term investing is quite costly for fund managers because when short-term performance temporarily deviates from their long-term bets, fund managers may have to liquidate some positions in their bets or even lose their jobs before their long-term bets eventually pay off. Hence, fund managers who are able to identify long-term investment opportunities but also able to implement such long-term investing are in a short supply in equilibrium, and therefore earn superior reward. The career risk of implementing long-term investing also tends to drive less-skilled fund managers to pursue short-term strategies, therefore making it difficult to earn a good return for short-term investing due to strong competition.

To test this conjecture, each month stocks are grouped into deciles according to the relative holdings of long-horizon funds versus short-horizon funds (LFH minus SFH). The top decile (D10) contains stocks that are held, in aggregate, the most by long-horizon funds relative to short-horizon funds; the bottom decile (D1) contains stocks held the most by short-horizon funds. Stocks in each decile are equally weighted at the formation month. Following the sorted-portfolio method discussed in Section 2.2, we calculate buy-and-hold returns and abnormal returns for each decile portfolio over the next month, and up to the next five years after portfolio formation. We also calculate the return spread of the D10-D1 portfolio, which is long D10 and short D1, to examine the outperformance of stocks with large long-horizon fund ownership vs. stocks with predominant short-horizon fund ownership. Figure 2 and Table 5 present results using the Simple ($HH^{(1)}$) or the Ex-Ante Simple ($HH^{(2)}$) measure as the fund horizon metric.

Consistent with our conjecture above, stocks with large long-horizon fund ownership offer much higher long-term returns than stocks with large short-horizon fund ownership, whereas there is no evidence that stocks largely held by short-horizon funds perform well in the short run. The first column of Figure 2 shows that the buy-and-hold returns for stocks in the top decile (D10) are larger than those in the bottom decile (D1) for all look-ahead holding periods. Although the returns for both deciles increase with the holding period, the increase is much larger for the top decile. This leads to an increasing pattern of the positive spread for the D10-D1 portfolio (the first column, second and fourth graphs) as the holding period rises.

Consider the 5-year performance as an example. As shown in Table 5 under the columns of "Ret", regardless of which fund horizon measure is used, the top decile exhibits an average buy-and-hold return of roughly 90%, whereas the bottom decile exhibits an average buy-and-hold return of roughly 70%. The difference ranges from 18.40% to 21.33% for five years, or 3.68% to 4.27% per year, which is statistically and economically significant.

Even after risk adjustment using either Carhart four-factor alphas or DGTW abnormal returns, the long-term outperformance of stocks with large long-horizon fund ownership is still pronounced, and there is still no evidence of stock-picking abilities based on predominant short-horizon fund ownership. The last two columns of Figure 2 illustrate that the two risk-adjusted returns for the top decile increase with the holding horizon, whereas in the bottom decile both are close to zero at all horizons. As a result, the abnormal returns of the D10-D1 portfolio are significantly positive at almost all horizons (except for marginally significantly positive at the other few horizons), and exhibit an increasing pattern with the holding horizon, as shown in the second and fourth rows.

Take the five-year horizon as an example. Table 5 shows that the four-factor alphas (columns "4-F α") for the top decile portfolio are about 16%, and that DGTW-adjusted returns (columns "DGTW") are about $17\% - 19\%$, for each of the HH measures being used. For the bottom decile portfolio, the four-factor alphas are between -1.8% and 2.8%, and DGTW-adjusted returns are between 2.4% and 2.7%. As a result, the abnormal returns of the D10-D1 portfolio range from 13.5% to 17.7% over five years, or about 2.7% to 3.5% per year, which are both economically and statistically significant.

The preceding results about the differing informativeness of fund holdings along with the low correlation between LFH and SFH (around 0.1) imply that long- and short-horizon funds generally overweight different groups of stocks. One possibility is that long- and short-horizon funds apply different investment strategies that are implementable to different groups of stocks, which we explore in Section 5.3.

Overall, stocks with large long-horizon fund ownership exhibit superior long-term performance. The results are robust for either the ex-ante or the ex-post fund horizon measure being used to identify short- and long-horizon funds. These findings suggest that the informativeness of long-horizon fund holdings about superior long-term stock performance is not driven by the use of future information in the construction of our fund investment horizon measure.

5.2 Refinement of the Informativeness of Fund Holdings

As we have shown, long-horizon fund managers are skillful in selecting stocks with superior long-term performance. If these fund managers have a superior ability in exploiting long-term information and discriminate in their holdings of stocks for which they have better information, we would expect that stocks held for a long period would be likely to outperform stocks held for a short time in their portfolios. This intuition motivates us to refine the informativeness of fund holdings about picking-skills by distinguishing stocks that are, on average, held for a long or short time in a long-horizon fund portfolio. For comparison purposes, we run the same analysis for the short-horizon fund portfolio.

We first define the average holding span of a stock belonging to each type of fund, long-horizon or short-horizon. Let $h_{i,j,t}$ denote the holding period of stock i held by fund j in period t. The average holding period $h_{i,j,t}$ across all long-horizon funds that hold stock i in period t is called *long-horizon fund holding span* of stock i:

$$hs_{i,t}^{long} = \sum_{j=1}^{M_{i,t}^{long}} \eta_{i,j,t} h_{i,j,t}, \tag{4}$$

where $M_{i,t}^{long}$ is the number of long-horizon funds that hold stock i in period t, and $\eta_{i,j,t}$ is the ratio of the number of shares of stock i held by fund j divided by the total number of shares of stock i held by all long-horizon funds in period t. Similarly, we define the *short-horizon fund holding span* of stock i as

$$hs_{i,t}^{short} = \sum_{j=1}^{M_{i,t}^{short}} \eta_{i,j,t} h_{i,j,t}. \tag{5}$$

Next, we consider four stock portfolios that are constructed as follows. First, we assign stocks into deciles each month based on LFH minus SFH, with D10 (D1) consisting of stocks that are largely held by long-horizon (short-horizon) funds, as we have done in section 5.1. Then, we define a long-term position group in D10 (D1) if a stock's long-horizon (short-horizon) fund holding span is in the top 1/4 among all stocks belonging to long-horizon (short-horizon) funds, and a short-term position group if it is in the bottom 1/4. Table 6 presents the performance of these four portfolios in the next month and up to the next five years after the portfolio formation using the Ex-Ante Simple measure, $HH^{(2)}$, as the metric of fund investment horizon.

Consistent with our intuition, the long-run outperformance of long-horizon funds stems from their long-term stock positions. Stocks that are held for a long period by long-horizon funds exhibit the best future long-term performance among the four stock groups. For example, at a five-year horizon, this group exhibits a buy-and-hold return of 91.14%, a four-factor alpha of 22.63%, and a DGTW-adjusted return of 18.95%, the highest values among the four groups. All these abnormal returns are statistically and economically significant. This group clearly outperforms stocks with large long-horizon fund ownership (D10) before the split into long-term and short-term positions (see Table 5). Note that only 5-year DGTW abnormal returns of short-term equity positions held by long-horizon funds are significantly positive, but they are still substantially lower than those of the long-term positions held by long-horizon funds. This result indicates that long-horizon managers may sell stocks before they have fully realized their abnormal returns, in order to reallocate their portfolios toward even better stocks.[21] Even with this refinement, there is still no statistically significant evidence of positive short-term risk-adjusted performance for stocks that are held for a short time by short-horizon funds.[22]

5.3 Economic Source of Manager Skills

In this section, we delve into a central issue regarding the economic source of manager skills—firm fundamentals reflected in funds' stock selection. If fund managers make use of corporate fundamental information in picking stocks, then we would expect that long-horizon

[21] Chen et al. (2000) also find evidence of skilled managers selling stocks with positive future abnormal returns.

[22] If short-horizon fund managers are skillful at exploiting short-term information and therefore selecting stocks with good short-run returns, we would expect that they trade those stocks quickly. There is no such evidence, which can be explained by strong competition in short-term investing.

fund managers are skillful at exploiting information related to long-term firm fundamentals. Therefore, we would expect that the patterns of future cash flows and profitability for stock portfolios sorted on relative fund holdings are analogous to the previously discussed return patterns of these portfolios.

To measure information shocks to firm fundamentals, we use four variables: cash-flow news ($CFnews$), analyst forecast revisions (FRV), earnings-announcement-window returns (EAR), and risk-adjusted EAR.[23] $CFnews$ is the cash-flow component of unexpected quarterly returns and is obtained via a Campbell-Shiller (1988) decomposition. FRV is the consensus EPS forecast for the current fiscal year, minus the three-month lagged consensus EPS forecast for the same fiscal year, divided by the stock price three months ago. EAR is the buy-and-hold return during the [-1, +1] trading-day-window around an earnings announcement date. If earnings are announced during a non-trading day, we treat the next immediate trading day as the announcement date. Adjusted EAR is the EAR minus the buy-and-hold return on the NYSE, AMEX, and Nasdaq market index during the same trading-day-window. To reduce the effect of outliers, all these information variables are cross-sectionally winsorized at the top and bottom 1%. These four variables capture fundamental shocks from different perspectives. $CFnews$ captures revisions of expected future cash flows over an infinite horizon that are reflected in stock returns. FRV reflects changes in earnings expectations for the current fiscal year, presumably due to new information arrival during the quarter. EAR and adjusted EAR measure the magnitude of investors' earnings surprises in terms of stock returns and stock abnormal returns, respectively.

Figure 3 displays cumulative fundamental variables over the next 1 to 20 quarters following the stock portfolio formation. Specifically, each quarter we first sort stocks into deciles according to their relative fund holdings, as we did in Section 5.1. We then calculate the cross-sectional mean of each fundamental variable in each decile and in the n^{th} quarter after the formation quarter, where $1 \leq n \leq 20$, and we proceed to cumulate these quarterly means over one to 20 quarters. Finally, we compute an average across all portfolio formation dates for each of these cumulated measures.

Regardless of using the Simple or the Ex-Ante Simple measure to define LFH minus SFH to sort stocks, the cash-flow and profitability patterns suggest that the long-run

[23]Since EAR is available only at a quarterly frequency, we construct all variables of fundamental shocks at this frequency, for simplicity. Details about the construction of $CFnews$ are provided in the Appendix.

outperformance of stocks with predominant long-horizon fund ownership is associated with superior long-term firm fundamentals. Notice that, in the first and third rows, all four cumulative fundamental variables are positive and increase with holding periods for stocks that are largely held by long-horizon funds (D10). Untabulated results confirm that these positive cumulative results for D10 are statistically significant. In contrast, cumulative fundamental variables can be negative ($CFnews$), positive (FRV), or close to zero (EAR and adjusted EAR) for stocks with large short-horizon fund ownership (D1). All of these four variables for the D10-D1 portfolio, as shown in the second and fourth rows, are significantly positive at the horizons of six quarters and longer.

In an untabulated analysis, we further check the patterns based on fundamental-related information that is incorporated in buy-and-hold portfolio returns. Specifically, in a buy-and-hold portfolio approach, we replace returns with the fundamental variables, keeping the same portfolio weights as we calculate buy-and-hold portfolio returns. This calculation can be roughly regarded as the cash-flow component of a buy-and-hold portfolio return. The message is very similar to what we have obtained using the cumulative fundamental variables.

In summary, the patterns of portfolio performance in terms of cashflows and profitability are analogous to the patterns of portfolio returns. Our results indicate that stock-selection skills are associated with superior ability in exploiting corporate fundamental-related information. Long-horizon fund managers are able to buy and hold stocks with strong long-term firm fundamentals.

6 Comparison of HH with Portfolio Turnover

To compare our HH measures with prior research on fund trading behavior, we use (the inverse of) turnover as an alternative proxy for fund holding horizon. Generally, a fund that trades frequently tends to have high turnover and low holding horizon.

Although our HH measures and the inverse of turnover are positively correlated, the former captures fund holding periods—portfolio-weighted holding horizon of securities—of actively managed funds, while the latter mainly reflects fund trading activeness.[24] These two types of metrics are equal in a special case in which a fund, such as an index fund,[25] holds its

[24]Note that reported turnover has the advantage of being able to capture intra-quarter trades.

[25]With the exception of index reconstitutions, buys and sells in an index fund are made of the entire index

securities for the exact same holding period. Actively managed funds, on the other hand, hold various positions for different horizons. For such a fund, these two types of metrics differ primarily due to Jensen's inequality that results in the inverse of turnover being a downward-biased measure of the true portfolio-weighted holding horizon of securities. The greater amount of heterogeneity in the holding horizons of securities in a fund portfolio, the more severe is this bias.

Consider a simple example in which a fund holds 50% of its managed assets in each of two stocks, with holding horizons (measured in years), h_1 and h_2, respectively. Fund HH is simply the weighted-average stock holding horizon, $(h_1 + h_2)/2$, while a *hypothetical* turnover ratio, TR, is calculated as $0.5\frac{1}{h_1} + 0.5\frac{1}{h_2}$, which is a convex function of h_1 and h_2. Consider the following cases:

(1) If $h_1 = h_2 = 1$, then $TR = 1$ and $HH = 1 = \frac{1}{TR}$.

(2) If $h_1 = 1$ and $h_2 = 2$, then $TR = 0.75$ and $HH = 1.5 > \frac{1}{TR} = 1.33$.

(3) If $h_1 = 1$ and $h_2 = 7$, then $TR = 0.57$ and $HH = 4 \gg \frac{1}{TR} = 1.75$.[26]

(4) If $h_1 = 0.1$ and $h_2 = 6.1$, then $TR = 5.082$, $HH = 3.1$, and $\frac{1}{TR} = 0.197$.

When there is no cross-sectional dispersion in stock holding periods, as in case (1), HH and $\frac{1}{TR}$ are equivalent. When there is a low level of dispersion, as in case (2), the weighted-average stock holding horizon is 1.5, similar to $\frac{1}{TR}$, which equals 1.33. As the dispersion in stock holding horizon increases substantially, as in case (3), the weighted-average stock holding horizon increases to 4, while $\frac{1}{TR}$ increases only to 1.75. That is, as the extent of heterogeneity in holding periods across stocks in a fund portfolio increases, the downward bias of the inverse of turnover, as a measure of the intended portfolio-weighted holding period, becomes more severe due to Jensen's inequality.

Another reason for the inverse of turnover being a downward-biased measure of the true portfolio-weighted holding period is that short holding periods of stocks in a fund portfolio are a key determinant of turnover, while long stock holding periods are a key determinant of fund horizon measures. That is, the left tail of the stock-holding-period distribution in a fund portfolio plays a dominant role in determining (the inverse of) turnover and a small role

to meet investor subscriptions or redemptions.

[26]This third case roughly corresponds to the mean and variability in stock holding periods among funds in the top quintile sorted on the Ex-Ante Simple measure. Long-horizon funds in the top quintile, on average, have a mean and standard deviation of stock holding horizon, $h^{(2)}_{i,j,t}$, of 4.47 and 2.52 years, respectively.

in determining HH, while the right tail does the opposite. To illustrate this point, compare case (2) with cases (3) and (4) in the preceding example. Note that the variance of stock holding periods in cases (3) and (4) is the same, so the differences in these two cases are not caused by Jensen's inequality. We see that, relative to case (2), both HH and $\frac{1}{TR}$ become larger in case (3) due to an increase in the long stock holding period, but the former rises much more than the latter due to Jensen's inequality. In contrast, compared with case (2), case (4) has a very short stock holding period for one stock, leading to a dramatic decline in $\frac{1}{TR}$, and a long holding period for the other stock, leading to a substantial increase in HH, again due to Jensen's inequality (that is, the convexity of the inverse of turnover ratio leads to a very different degree of downward biases at different levels of holding horizons). Notice that HH and $\frac{1}{TR}$ move in opposite directions and, hence, provide conflicting information: The former suggests that the fund in case (4) has a longer holding horizon than the fund in case (2), while the latter indicates the fund in case (4) trades more actively and would *not* be considered a long-horizon fund. Indeed, in an untabulated analysis, a small number of long-horizon funds in our sample exhibit a high level of turnover, indicating that they hold some stocks for a long period and, at the same time, turn over other stocks relatively quickly.

In our fund sample, the average fund in the top quintile ranked according to the Ex-Ante Simple horizon measure, $HH^{(2)}$, has a standard deviation of stock-level ex-ante holding periods, $h^{(2)}$, of 2.52 years, while the average in the bottom quintile is 0.66 years. Since the standard deviation of stock holding periods is substantially larger for long-horizon funds, the gap between the inverse of turnover and HH for long-horizon funds is much larger than the gap between those of short-horizon funds. Moreover, long-horizon funds, on average, hold more stocks with long holding periods and have larger weights on those stocks than short-horizon funds. Therefore, the mismeasurement of horizon using inverse turnover (which is largely determined by the left tail of the holding-period distribution of stocks in a fund portfolio) is likely to be more severe for long-horizon funds.[27]

Despite the above issues, the turnover ratio of a mutual fund has long been deemed an important metric of fund trading activeness by academic researchers, and is virtually the only statistic that it has been used in the literature to proxy for the (inverse of the) holding

[27] Another issue is that turnover is measured over a fiscal year for a fund. This rolling-window approach leads to a potential severe oscillation of the inverse turnover ratio for funds with a long horizon, with the worst case being an indeterminant holding horizon (as proxied by the inverse of turnover ratio) if no stocks are traded during a given year by a long-horizon fund.

horizon. To further compare HH with turnover, we examine whether HH and the reported fund turnover ratio predict each other. Because using either CRSP reported turnover or holdings-based turnover delivers the same message and the former is widely used in the mutual fund literature, for simplicity, we only report the results involving CRSP turnover.

Table 7 presents the estimation results of panel regressions of the next-year Ex-Ante Simple measure, $HH^{(2)}$ (in the left panel), or next-year CRSP turnover (in the right panel), on current-year $HH^{(2)}$ and CRSP turnover, as well as other fund characteristics. These panel regressions differ in the inclusion of no fixed effect, a fund fixed effect, and a time fixed effect. Because CRSP normally reports turnover at an annual frequency, we use yearly data as of December of each year to run panel regressions. Standard errors are calculated based on two-way clusters by fund and by year.

The regression results indicate that fund investment horizon and turnover, though related, are quite different variables. First, both variables are persistent. Their own lag explains the majority of their variation, although turnover has a marginal explanatory power for HH. For instance, in regressions with no fixed effect, or with a time fixed effect, a one-standard-deviation increase in Ex-Ante Simple measure (1.43 years) leads to roughly a 1.3-year increase in the next-year $HH^{(2)}$, while a one-standard-deviation increase in turnover (1.2) leads to less than a 0.05-year decrease. Although both variables are less persistent when a fund fixed effect is considered in pooled regressions, the message is similar. Moreover, note that fund size has opposite impacts in next-year HH and turnover, as a large-size fund is more likely to implement long-term investing and trade less frequently relative to a small-size fund.

6.1 Turnover vs. HH as a Predictor of Fund Performance

Prior mutual fund research has examined the relation between fund performance and trading behavior, in terms of turnover, and provides mixed evidence. Using gross returns based on holdings, Grinblatt and Titman (1993), Chen et al. (2000), and Wermers (2000) show that high-turnover mutual funds have better, or marginally better, stock selection skills than low-turnover funds. Recently, Pástor et al. (2017) find a positive *time-series* turnover-performance relation, demonstrating that mutual funds perform better when they trade more. In contrast, using net returns, Carhart (1997) documents a negative *cross-sectional* association between turnover and net fund performance.

As discussed previously, fund managers tend to exploit short-term investment strategies because implementing long-term investing generally raises their career risk. Once they identify short-term investment opportunities, they trade quickly before these opportunities disappear, which is reflected in temporarily high turnover. Therefore, turnover reflects detection of time-varying investment opportunities, a time-series feature pronounced within a fund (Pástor et al., 2017). Profitable frequent trading is more likely to occur when the market has ample short-run opportunities. When short-term opportunities cannot be frequently found, it is hard for funds to sustain their performance. As a result, for a given fund, an increase in turnover forecasts high short-term fund returns but not necessarily high long-term returns. Moreover, as short-term profit opportunities vary over time, short-horizon funds perform well only if they are able to identify such opportunities and trade accordingly, but they are unlikely to do so consistently. This helps to explain the evidence that short-horizon funds do not generally exhibit good short-term performance.

On the other hand, as we have shown, long-horizon funds, being attractive to long-term investors who provide "patient capital," tend to exploit investment opportunities that are profitable over a long period of time. Fund managers, who are able to identify such long-term investment opportunities and able to implement long-term strategies in response to these opportunities, are in a short supply in equilibrium and therefore achieve superior performance. Accordingly, we would expect that fund investment horizon reflects intrinsic skills, a feature pronounced across funds.

To test the above conjecture, we run panel regressions of future fund abnormal returns on current fund HH and turnover, while controlling for other fund characteristics. These panel regressions differ in their inclusion of no fixed effect, a fund fixed effect, and a time fixed effect. A regression with a fund fixed effect captures the forecasting power of within-fund time variation in fund HH and turnover for future fund performance. A regression with a time fixed effect captures the forecasting power of cross-sectional variation in these predictors for future fund performance. A regression with no fixed effect captures the effect of both time-series and cross-sectional variations in these regressors. Heteroskedasticity-robust standard errors are calculated based on two-way clusters by fund and by month. Table 8 presents the results based on four-factor alphas in Panel A, and DGTW abnormal returns in Panel B.

The regression results are consistent with our conjecture. In the regressions with no fixed effect or with a time fixed effect, $HH^{(2)}$ positively predicts future fund performance over horizons of one quarter and longer, while fund turnover essentially plays an insignificant role. Once we add a fund fixed effect to panel regressions, turnover becomes a significant indicator of future short-term fund performance. This result indicates that turnover reflects individual fund manager skills in detection of time-varying short-run investment opportunities, which is better captured by a fund fixed effect, consistent with Pástor et al. (2017).

Finally, the Fama-MacBeth regression results, as shown in the first four columns of Table 4, provide further support that $HH^{(2)}$ best captures cross-sectional fund skills. The coefficient estimates on $HH^{(2)}$ are significantly positive across all look-ahead horizons, whereas the coefficient estimates on turnover are not significant for both four-factor alphas and DGTW abnormal returns. This message remains similar when controlling for other metrics of active management, including Active Share, R^2, and Return Gap.

7 Additional Analyses and Robustness Tests

In this section, we consider additional tests and robustness checks to further support the conclusion that long-horizon funds identified using our fund HH measures exhibit superior long-term performance. To save space, we tabulate the results in a separate Internet Appendix.

7.1 Being a New Dimension of Active Fund Management

To further test whether our fund horizon measures are a truly new proxy for manager skills, we run both Fama-MacBeth and panel regressions of our horizon measures on a list of explanatory variables that we used as control variables in Section 4.2. The explanatory power of these variables combined is, at most, about 36%, suggesting that our fund horizon measures are not simply a proxy for simple fund characteristics or metrics of active fund management uncovered in prior research. This result is also consistent with our evidence that the informativeness of fund investment horizon about managerial skills remains even after we control for this list of explanatory variables.

7.2 Liquidity

To address the possibility that the outperformance of long-horizon funds could capture a liquidity premium, we use a five-factor model (Carhart's four factors plus the liquidity risk factor of Pástor and Stambaugh, 2003) to control for risk exposure to a liquidity factor. Both the fund-level and stock-level five-factor alphas are very similar to the four-factor alphas shown in Table 3 and Table 5, respectively. Hence, our results are unlikely to be driven by a liquidity premium.

We also find that long-horizon fund holdings signal an even better future performance for liquid stocks than for illiquid stocks. Specifically, in each stock decile-portfolio sorted on relative fund holdings (LFH minus SFH), as described in Section 5.1, we further divide stocks into two groups according to the Amihud illiquidity measure. We then contrast the performance of liquid stocks versus illiquid stocks, where liquid (illiquid) stocks are securities with Amihud's illiquidity measure below (above) the median. The risk-adjusted return spread between stocks with large long-horizon fund ownership and stocks with large short-horizon fund ownership is generally higher for the liquid stock group than for the illiquid group. This finding further substantiates our conclusions, which are not driven by long-horizon funds' investment in illiquid stocks. It also means that the strategy of buying liquid stocks with predominant long-term fund ownership and selling liquid stocks with predominant short-term fund ownership can be quite profitable, even after accounting for transaction costs.

7.3 Fund Performance Conditional on Benchmarks

Frazzini et al. (2016) claim that the predictive power of Active Share (AS) is driven by the strong correlation between AS and fund benchmark types. As they argue, AS is higher for funds having certain benchmarks, such as a small-capitalization benchmark; for funds following the same benchmark, AS does not exhibit significant forecasting power. Of course, this could be due to more skilled managers locating in similar areas of the U.S. equity universe, rather than AS being simply higher (even for unskilled active managers) for funds located in less efficient sectors. Regardless, we confirm their finding using our sample.

To test whether our horizon measures suffer a similar benchmark-related "bias", we rank funds into terciles according to the Ex-Ante Simple measure within each fund benchmark group, using the same benchmark group data used by Frazzini et al. (2016). We find that the forecasting power of our horizon measures is robust to this conditional sorting; the alphas of the spread portfolio (buy long-horizon funds and sell short-horizon funds within each fund benchmark group) are almost all positive and the majority are statistically significant at the 95% confidence level.

Take the 5-year horizon as an example. When we rank funds using the Ex-Ante Simple measure within each benchmark group, the abnormal returns of the spread portfolios are significantly positive (at the 5% level) for 6 out of 10 available benchmarks and only one is negative but insignificant; the average of these abnormal return spreads across benchmark groups is also significantly positive. In contrast, when we use Active Share to sort funds within each benchmark group, the abnormal return spreads are significantly positive in 4 out of 11 available benchmarks and significantly negative for 2 benchmarks; the average of these abnormal return spreads across benchmark groups is positive but insignificant.[28]

7.4 Comparison with Cremers and Pareek (2016)

Cremers and Pareek (2016) find that, among high active share funds, only those with patient investment strategies outperform. Patient strategies are identified as funds that have either a long investment horizon or a low turnover ratio. We first note that Cremers and Pareek do not address the importance of making a distinction between (inverse) turnover and a measure of investment horizon obtained from the holdings, as we do in this paper. Inferences obtained from these two different measures, as we show earlier, can be very different due to Jensen's inequality.

We next test whether our horizon measure remains significant when we control for Active Share interacted with the measures of patient strategies used by Cremers and Pareek (2016). In an untabulated analysis, we run two panel regressions of 5-year buy-and-hold 4-factor alpha on our Ex-Ante Simple measure and control variables, which include dummies for high and low Active Share (top and bottom quintiles), and an interaction between the Active Share dummies and patient strategies. Each panel regression uses one of the two Cremers and Pareek's measures of patient strategies. Following Cremers and Pareek, we also include time and benchmark fixed effects. We find that consistent with Cremers and Pareek, the

[28]Note that when we use the Ex-Ante Simple measure rather than Active Share we lose a benchmark (S&P 500 Value) due to a small number of funds in each tercile for that benchmark (we require at least 10 funds with non-missing data in each tercile).

coefficient on the interaction variable is statistically significant. Meanwhile, the coefficient on the Ex-Ante Simple measure remains statistically significant even when Cremers and Pareek's measures are included.

Next, as a more in-depth analysis that controls for the benchmarks used by Frazzini et al. (2016), we run a separate panel regression for each benchmark type with a time fixed effect. Given the smaller sample of observations for each regression, we use terciles to define high and low Active Share dummies. The dependent variable is 1-, 3-, or 5-year buy-and-hold 4-factor alpha. In the Internet Appendix, we show that the coefficient on the Ex-Ante Simple measure is positive and statistically significant for 8 or 9 out of 10 benchmark categories, depending on which alpha (1-, 3-, or 5-year) is used. By contrast, the coefficient on the interaction between the high Active Share dummy and turnover is significantly negative (the correct sign) for only 3 out of 10 benchmarks and significantly positive (the incorrect sign) for 4 or 5 benchmarks. Interestingly, although according to Cremers and Pareek (2016) the interaction between the low Active Share dummy and turnover should not be significant because their measure of skill is active share, we notice that for 1-year alpha the coefficient on the interaction between the low Active Share dummy and turnover is significantly negative for 4 out of 10 benchmarks. For robustness, we also use the interaction of the Ex-Ante Simple measure, instead of turnover, with high and low Active Share dummies, and the results are similar. In particular, the coefficient on the Ex-Ante Simple measure is significantly positive for 7 to 9 benchmarks, whereas the coefficient on the Cremers and Pareek (2016) interaction variable is significantly positive (the correct sign) for only 3 to 4 fund benchmark categories, depending on which alpha (1-, 3-, or 5-year) is used. This analysis provides further confirmation that our horizon measure is robust to the Frazzini et al.'s (2016) critique, even when we control for Cremers and Pareek's measure. Furthermore, our measure of fund investment horizon is simple to compute and easy for fund investors to understand—much simpler than the computation of Active Share or the interaction of Active Share with patient strategies.

7.5 Comparison with Yan and Zhang (2009)

Based on 13-F institutional holdings data aggregated at the fund advisor level, Yan and Zhang (2009) show that both the level and the change in short-term institutional ownership are significant predictors of future stock returns, while there is no evidence of a similar result for long-term institutional ownership. Following Yan and Zhang, we use the holdings-based turnover ratio to classify a fund in our mutual fund sample as long- or short-term if the fund is ranked in the top or bottom quintile portfolio. We confirm their result at a horizon of one month, but their result is reversed at a horizon of more than a year.

The conclusion of Yan and Zhang (2009) is different from ours for a few reasons. First, as discussed in Section 6, our more direct measures of fund investment horizon, compared with turnover, facilitate the detection of long-term investing skills. Second, a good deal of heterogeneity in the investment horizon of different funds managed by the same advisor is lost in the 13-F data. In fact, many advisors manage pensions, other types of accounts, and even index funds, all of which are aggregated in 13-F data. Finally, Yan and Zhang treat, homogeneously, different types of institutional advisors, such as those that advise pension funds, insurance companies, hedge funds, and mutual funds. A fund with a relatively long HH within a mutual fund group is likely to be classified as short-term relative to a typical pension fund.

Even in our mutual fund sample, our horizon measures constructed based on portfolio holdings aggregated at the fund family level is much less informative about long-term fund skills than those constructed at the fund level, even though funds in the same family are likely to rely on similar in-house analysis that can lead to similar investment horizons across funds. To compare the effects of investment horizon at both the fund and the family levels on future fund performance, in an untabulated analysis we include in the Fama-MacBeth regressions the Ex-Ante Simple horizon measure at both levels, in addition to the fund characteristics included in Section 4.2. The horizon measure at the fund family level is constructed using holdings data aggregated at the family level, where fund family information comes from CRSP mutual fund database. In the regression at the five-year horizon, for example, the impact of investment horizon at fund level is larger than that at the fund family level. The coefficient on the family-level investment horizon is very small; there is only a slight change in the positive coefficients on the fund-level measure after adding the family-level measure.

7.6 Other Tests

We also apply the Jegadeesh and Titman (1993) approach to test portfolio abnormal returns. Specifically, each month we sort stocks on relative fund holdings information into deciles, as done previously, and hold these decile portfolios for n months. Returns of each decile portfolio are equally weighted. This approach holds a series of portfolios that are selected in the current month as well as in the previous $n-1$ months, where n is the holding period. That is, it closes out the old position initiated in month $t-n$, initiates new positions in month t, and carries over the rest from the previous month. We then take the averages of these monthly portfolio returns across n months and run regressions to get Carhart four-factor alphas. Again, all of these results confirm that stocks mostly held by long-horizon funds outperform stocks mostly held by short-horizon funds.

Survivorship bias is likely to be a concern if it affects long-term funds and short-term funds differently. We first check the surviving rate of long- and short-horizon funds. For instance, when the Ex-Ante Simple measure is used to group funds into quintiles, on average, 77.29% (83.25%) of the short-term funds in the bottom quintile survive after five (three) years, while this rate becomes 85.15% (89.55%) for long-term funds in the top quintile. One explanation for the relatively low survival rate of short-term funds is that some funds may exist for a short period due to their poor performance. It seems that survivorship bias may affect short-term funds a bit more than long-term funds. To address this concern, we redo our analysis based on a subset of funds that have been in the sample for at least five years, and results are similar.

Finally, following the delisting adjustment recommended by Beaver et al. (2007), we also verify that our conclusions are not affected by incorporating delisting returns.

8 Conclusions

Using newly proposed direct measures of fund holding horizon, this paper finds a positive fund horizon-managerial skill relation. Our HH measures identify, in the cross-section, funds with better long-term alphas, while reported turnover identifies, in the time-series, when a particular fund is likely to exhibit a higher alpha in the short-term. Key to the efficacy of our HH measures is that actively managed funds hold different stocks for different horizons, while simple fund turnover ratio reflects trading activeness but tends to mask this holdings heterogeneity at the fund level as a proxy of (the inverse) fund holding horizon. In addition, we show that stock-holdings, in aggregate, of long-horizon funds provide relevant information about the long-term superior abnormal returns of a stock. The outperformance stems from long-horizon fund managers possessing valuable information about superior long-term firm fundamentals. Our findings lend support to both the work of Wang (1993) and the anecdotal evidence of the success of fund managers with long-term focus.

Our fund investment horizon measures can help investors to better identify long- or short-term funds. The finding of the superior long-term performance of long-horizon mutual funds critically depends on the use of our more direct measures than what was previously used in the institutional investors literature. There is evidence that individual investors have long rebalancing horizons. Ameriks and Zeldes (2004) find that, for a sample of defined contribution retirement plan participants, 47% (21%) made no changes (one change) to their allocation of contributions over a ten-year period. Similar results are found for 401(k) plans by Mitchell et al. (2006). For those individual investors with long rebalancing horizons, our analysis suggests that they are better off selecting long- rather than short-horizon funds.

Our evidence that some mutual funds implement and succeed in long-term investment strategies by exploiting fundamental-related information contributes to the debate regarding the excessive short-term focus of institutional investors (Porter 1992), as well as the undesirable consequences induced by short-termism, such as stock price fluctuations during turmoil periods (Cella et al., 2013) and distorted corporate decisions (Bushee, 1998; and Gaspar et al., 2005). Although such short-termism is a characteristic of a distinct subset of funds, we find that a subset of other funds shows more patience in their investments, and are rewarded for doing so. Moreover, our evidence implies that long-term mutual funds incorporate their private information about fundamentals, though slowly, into stock prices, which helps reduce concerns that institutions over-rely on short-term information and increase the high-frequency volatility of stock prices (Bushee 2001).

Appendix: Construction of Cashflow News ($CFnews$)

This measure considers changing expectations of the sum of discounted cashflows of a firm over all future periods. It is constructed using Institutional Brokers Estimate System (IBES) summary unadjusted file. Specifically, we keep consensus earnings forecasts for the current and subsequent fiscal year ($FE1_t$, $FE2_t$), along with a long-term growth forecast (LTG_t). The earnings forecasts are denominated in dollars per share, and t denotes when a forecast is employed. The long-term growth forecast represents an annualized percentage growth rate and pertains to the next three to five years.

Similar to Frankel and Lee (1998), Pástor et al. (2008), Da and Warachka (2009), Da et al. (2012), and Balduzzi and Lan (2013), we use a three-stage model to construct cashflow news by taking advantage of multiple earnings forecasts for different maturities. Let $X_{t,t+j}$ denote the time-t expectations of future earnings at $t+j$. In the first stage, expected earnings are computed directly using analyst forecasts as follows:

$$X_{t,t+1} = FE1_t, \quad X_{t,t+2} = FE2_t, \tag{A.1}$$
$$X_{t,t+j} = X_{t,t+j-1}(1 + LTG_t), \quad j = 3, 4, 5. \tag{A.2}$$

In the second stage, expected earnings are assumed to converge to an economy wide steady-state growth rate g_t from year six to year 10. Specifically,

$$X_{t,t+j+1} = X_{t,t+j}[1 + LTG_t + \frac{j-4}{5}(g_t - LTG_t)], \text{ for } j = 5, \ldots, 9. \tag{A.3}$$

The steady-state growth rate g_t is the cross-sectional average of LTG_t.

Following Da and Warachka (2009), Da et al.(2012), and Balduzzi and Lan (2013), we assume the cash-flow payout is equal to a fixed portion (Ψ) of the ending-period book value. Under this assumption, the clean surplus accounting identity implies that the evolution of expected book value is $B_{t,t+j+1} = (B_{t,t+j} + X_{t,t+j+1})(1 - \Psi)$. The parameter Ψ is set to 5% since this percentage is close to the average payout rate for the firms in our sample.

In the third stage, expected earnings growth converges to g_t, which implies expected accounting returns converge to $\frac{g_t}{1-\Psi}$ beyond year 10. The expected log accounting returns $e_{t,t+j}$ is estimated at time t as:

$$e_{t,t+1+j} = \begin{cases} \log(1 + \frac{X_{t,t+1+j}}{B_{t,t+j}}) & \text{for } 0 \leq j \leq 9 \\ \log(1 + \frac{g_t}{1-\Psi}) & \text{for } j \geq 10 \end{cases} \tag{A.4}$$

The three-stage growth model implies expected future cashflows:

$$E_t \sum_{j=0}^{\infty} \rho^j e_{t+1+j} = \sum_{j=0}^{9} \rho^j e_{t,t+1+j} + \frac{\rho^{10}}{1-\rho} \log(1 + \frac{g_t}{1-\Psi}), \tag{A.5}$$

where ρ results from the log-linear approximation (Campbell and Shiller, 1988) and equals 0.96 in our sample. Vuolteenaho (2002) shows that the cashflow news are the difference between cashflow expectations over consecutive months:

$$CFnews_{t+1} = E_{t+1} \sum_{j=0}^{\infty} \rho^j e_{t+1+j} - E_t \sum_{j=0}^{\infty} \rho^j e_{t+1+j} \tag{A.6}$$

where $CFnews_t$ denotes cashflow news at month t.

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Table 1: Summary statistics

This table reports summary statistics of fund investment horizon, including the Simple and the Ex-Ante Simple horizon measures, fund turnover ratios, including CRSP turnover and holdings-based turnover, the Active Share of Petajisto and Cremers (2009), the R^2 of Amihud and Goyenko (2013), and the Return Gap of Kacperczyk et al. (2008) for U.S. domestic equity mutual funds over the period of March 1980 to December 2010. These fund variables are described in Section 2. Style-adjusted fund investment horizon is calculated as a fund's investment horizon in excess of the average investment horizon of its peers with the same investment style. Investment style data come from Hunter et al. (2014), including Russell 1000 (R1), Russell 1000 Growth (R1G), Russell 1000 Value (R1V), Russell Midcap (RM), Russell Midcap Growth (RMG), Russell Midcap Value (RMV), Russell 2000 (R2), Russell 2000 Growth (R2G), and Russell 2000 Value (R2V). The size, book-to-market, momentum, and Amihud's (2002) illiquidity measure ranks are the value-weighted average quintile ranks, with 1 being the lowest and 5 being the highest quintile. The stock assignments for size, book-to-market, and momentum quintiles were obtained from Russ Wermers's web site at http://www.smith.umd.edu/faculty/rwermers/ftpsite/Dgtw/coverpage.html. The proportion of TNA in A class is computed for funds that have an A class, where A Class is identified in the sample as the share class that charges a front-end load. Cash position is the percentage of total net assets held in cash. Panel A reports statistics for the full sample, Panel B presents the mean, median, and standard deviation of the Simple and Ex-Ante Simple horizon measures for each fund investment style, and Panel C reports the mean for each quintile portfolio that is sorted on the style-adjusted Ex-Ante Simple horizon measure, with Q1 (Q5) consisting of funds with the shortest (longest) investment horizons. The last column of Panel C presents the difference of statistics between Q5 and Q1, with ** and *** representing significance at the 5% and 1% confidence intervals, respectively. Panel D reports the correlation matrix of style-adjusted fund horizon measures (the Simple and Ex-Ante Simple measures) and the inverse of two fund turnover ratios (CRSP TR and Holdings-based TR).

Panel A: The full sample

	Mean	Median	SDEV
TNA (millions)	764.50	131.74	2750.01
Expense ratio (%)	1.19	1.14	0.77
Fund age (years)	14.34	9.49	14.12
Simple measure (years)	3.48	2.95	2.18
Style-adjusted Simple measure (years)	-0.00	-0.45	2.07
Ex-Ante Simple measure (years)	2.31	1.99	1.38
Style-adjusted Ex-Ante Simple measure (years)	0.00	-0.27	1.32
CRSP fund turnover (%)	89.53	65.33	107.46
Holdings-based fund turnover (%)	63.88	53.85	47.47
Active Share	0.82	0.84	0.14
R^2	0.89	0.92	0.11
Return Gap	-0.04	-0.04	1.35
Size rank	3.97	4.30	0.93
Book-to-market rank	2.69	2.69	0.54
Momentum rank	3.24	3.22	0.57
Amihud measure rank	1.29	1.12	0.40

Panel B: Fund investment horizon conditional on styles

	Simple			Ex-Ante Simple		
Investment styles	Mean	Median	SDEV	Mean	Median	SDEV
R1	4.36	3.88	2.37	2.71	2.40	1.49
R1G	3.64	3.14	2.16	2.34	2.05	1.34
R1V	4.18	3.84	2.21	2.62	2.40	1.37
RM	2.75	2.43	1.35	1.81	1.68	0.79
RMG	2.68	2.31	1.56	1.69	1.46	0.93
RMV	3.52	3.07	2.12	2.31	2.07	1.27
R2	2.71	2.48	1.31	1.73	1.58	0.87
R2G	2.58	2.30	1.39	1.66	1.51	0.80
R2V	3.55	3.14	2.02	2.29	2.05	1.21

Panel C: Sorting based on the style-adjusted Ex-Ante Simple measure

	Q1 (short)	Q2	Q3	Q4	Q5 (long)	Q5-Q1
TNA (millions)	785.26	875.99	1166.22	1468.57	2402.16	1616.91***
Expense ratio (%)	1.32	1.29	1.26	1.18	1.05	-0.27***
Fund age (years)	19.88	19.34	19.37	20.51	24.67	4.79***
Simple measure (years)	2.02	2.71	3.49	4.74	7.39	5.37***
Ex-Ante Simple measure (years)	1.01	1.47	1.96	2.71	4.47	3.46***
Style-adjusted Ex-Ante Simple measure (years)	-1.43	-0.78	-0.27	0.42	2.09	3.52***
CRSP fund turnover (%)	146.76	108.03	79.75	55.34	31.22	-115.54***
Active Share	0.80	0.82	0.80	0.79	0.77	-0.03***
R^2	0.89	0.90	0.90	0.90	0.88	-0.01
Return Gap	-0.06	-0.06	-0.02	-0.04	-0.05	0.01
Cash allocation (%)	5.58	5.89	5.83	6.52	6.03	0.45
Size rank	4.11	3.99	4.00	4.06	4.22	0.11***
Book-to-market rank	2.74	2.66	2.64	2.67	2.73	-0.01**
Momentum rank	3.35	3.36	3.28	3.15	3.03	-0.31***
Amihud measure rank	1.19	1.24	1.25	1.25	1.23	0.04***
Proportion of TNA in class A	0.50	0.45	0.53	0.58	0.60	0.10***

Panel D: Correlations of fund horizon measures and the inverse of fund turnover

	Simple	Ex-Ante Simple	1/CRSP TR	1/Holdings TR
Simple	1.00	0.89	0.37	0.30
Ex-Ante Simple	0.89	1.00	0.39	0.33
1/CRSP TR	0.37	0.39	1.00	0.37
1/Holdings-based TR	0.30	0.33	0.37	1.00

Table 2: Consecutive trade periods

This table reports summary statistics (mean, standard deviation, 10th, and 90th percentiles) for long- and short-horizon funds separately of the number of months that a fund on average takes to consecutively purchase or consecutively sell a stock position. Specifically, we calculate the value-weighted average of the time span of consecutive purchases (sales) of each stock held in a fund portfolio. The time span of consecutive purchases (sales) of a given stock by a fund is the longest time interval that must start with a purchase (sale) of the stock by the fund and end with another purchase (sale) of the same stock, without a sale (purchase) of the stock in between. The Simple and Ex-Ante Simple measures are the style-adjusted fund horizon measures described in Section 2 and they are used to sort funds into terciles. Funds in the top and bottom terciles are classified as long-horizon and short-horizon, respectively.

	Mean	SDEV	P10	P90	Mean	SDEV	P10	P90
Simple	Short-horizon funds				Long-horizon funds			
Buy	4.73	4.17	0.73	10.17	18.86	17.84	3.38	38.81
Sell	8.24	5.86	2.24	15.41	22.93	20.24	4.79	47.29
Ex-Ante Simple	Short-horizon funds				Long-horizon funds			
Buy	5.39	5.07	0.95	11.40	19.12	20.21	2.80	42.13
Sell	10.09	7.62	3.01	18.56	25.34	21.98	5.69	52.25

Table 3: Informativeness of fund holdings—Fund portfolio performance

Funds are sorted into deciles each month according to the style-adjusted Simple or Ex-Ante Simple fund horizon measure, with D1 consisting of short-horizon funds and D10 consisting of long-horizon funds. This table reports buy-and-hold fund portfolio net returns and abnormal returns over the next month, next quarter, and next one to five years after portfolio formation. As explained in Section 2.2, the abnormal returns are the Carhart four-factor alphas, which are computed from buy-and-hold net returns, and DGTW-adjusted returns, which are computed from holdings-based returns. Portfolio weights are equally weighted at the formation month and are then updated following a buy-and-hold strategy. The table also reports the return spreads between the D10 and D1 portfolios. All returns are expressed in percentage. *, **, and *** represent statistical significance for abnormal returns and return spreads at the 10%, 5%, and 1% confidence intervals, respectively. Standard errors are obtained using the Newey-West (1987) procedure with a lag equal to the total number of months in the look-ahead holding period minus one.

	Simple ($HH^{(1)}$)			Ex-Ante Simple ($HH^{(2)}$)		
	Net ret	Net 4-F α	DGTW	Net ret	Net 4-F α	DGTW
1-month						
D1 (short)	0.83***	-0.11**	-0.06	0.81***	-0.11**	0.01
D2	0.80***	-0.13**	-0.03	0.83***	-0.10*	0.01
D3	0.82***	-0.11**	-0.01	0.84***	-0.10*	0.02
D4	0.87***	-0.08	-0.00	0.89***	-0.05	0.03
D5	0.88***	-0.07	-0.01	0.84***	-0.08*	0.02
D6	0.87***	-0.06	0.02	0.88***	-0.04	0.01
D7	0.88***	-0.03	0.03	0.86***	-0.06	-0.03
D8	0.90***	0.00	0.06**	0.84***	-0.04	0.01
D9	0.88***	-0.01	0.07**	0.83***	-0.06	0.03
D10 (long)	0.93***	0.05	0.08***	0.87***	0.00	0.05*
D10-D1	0.10	0.16***	0.14***	0.06	0.11**	0.04
1-quarter						
D1 (short)	2.59***	-0.21	-0.14	2.55***	-0.22*	0.03
D2	2.56***	-0.27*	-0.09	2.56***	-0.25*	0.01
D3	2.52***	-0.29**	-0.01	2.64***	-0.18	0.07
D4	2.70***	-0.13	0.02	2.70***	-0.12	0.13
D5	2.69***	-0.15	-0.06	2.64***	-0.12	0.06
D6	2.67***	-0.09	0.04	2.67***	-0.08	0.05
D7	2.70***	-0.05	0.12	2.61***	-0.11	-0.05
D8	2.73***	0.05	0.18***	2.58***	-0.06	0.07
D9	2.68***	0.04	0.19***	2.59***	-0.06	0.10
D10 (long)	2.84***	0.26**	0.25***	2.65***	0.06	0.15*
D10-D1	0.25	0.46***	0.39***	0.10	0.29***	0.10
1-year						
D1 (short)	11.16***	0.39	-0.14	10.45***	-0.44	0.04
D2	10.92***	0.09	-0.38	10.61***	-0.45	0.01
D3	10.68***	-0.29	0.04	11.02***	-0.02	0.39
D4	10.94***	-0.25	-0.04	11.11***	0.10	0.20
D5	10.63***	-0.44	-0.36	10.98***	-0.08	0.18
D6	10.85***	0.02	0.07	10.63***	-0.22	0.12
D7	10.98***	0.22	0.65	10.49***	-0.22	-0.39
D8	11.08***	0.46	0.60	10.37***	-0.21	0.06
D9	10.89***	0.18	0.70*	10.74***	0.08	0.42
D10 (long)	11.77***	1.29*	1.10**	10.89***	0.37	0.67
D10-D1	0.60	0.90	1.23***	0.44	0.80	0.63
2-year						
D1 (short)	21.93***	0.34	-0.24	20.61***	-0.98	-0.09
D2	22.61***	1.03	-0.42	21.17***	-0.75	-0.04
D3	21.51***	-0.33	-0.07	21.75***	-0.06	0.64
D4	21.73***	-0.54	-0.30	22.50***	0.22	0.54
D5	20.90***	-1.13	-0.92	21.74***	-0.40	0.27
D6	21.72***	-0.19	0.03	21.28***	-0.35	0.15
D7	21.90***	0.55	1.04	20.82***	-0.96	-0.83
D8	21.84***	0.28	0.97	20.77***	-0.25	-0.24
D9	21.79***	0.25	1.29	21.31***	-0.01	0.65
D10 (long)	23.58***	2.61**	2.36**	21.93***	1.04	1.39
D10-D1	1.65	2.27	2.60***	1.32	2.02*	1.51**
3-year						
D1 (short)	33.97***	0.04	-0.65	31.79***	-2.11*	-0.20
D2	35.27***	1.56	-0.55	32.59***	-1.51	-0.45
D3	33.48***	-0.42	-0.38	33.56***	-0.39	0.76
D4	33.35***	-1.27	-0.73	34.57***	0.05	0.57
D5	32.14***	-2.03*	-1.37	33.41***	-0.61	0.11
D6	33.78***	0.04	0.03	32.66***	-0.79	0.02
D7	33.64***	0.51	1.28	32.81***	-0.45	-0.98
D8	33.17***	0.41	0.90	32.16***	0.10	-0.49
D9	33.47***	0.48	1.91	32.60***	-0.28	0.51
D10 (long)	36.22***	3.95**	3.70**	33.99***	1.80	2.55*
D10-D1	2.25	3.91*	4.35***	2.20	3.91***	2.83***
4-year						
D1 (short)	44.80***	-0.50	-1.04	41.41***	-3.53***	-1.02
D2	46.13***	1.95	-0.61	43.23***	-1.61	-0.43
D3	43.61***	-0.02	-0.37	43.65***	-0.92	0.91
D4	44.34***	-1.24	-0.51	46.20***	0.20	1.01
D5	43.11***	-1.24	-1.11	44.39***	-0.42	0.71
D6	44.60***	0.41	0.19	43.87***	-0.30	0.26
D7	44.22***	0.57	1.84	43.51***	-0.06	-0.83
D8	43.86***	1.28	1.34	42.73***	0.43	-0.54
D9	44.27***	1.47	3.03	43.41***	0.11	1.67
D10 (long)	48.27***	5.99**	5.46**	45.30***	3.21*	4.06*
D10-D1	3.47	6.50**	6.51***	3.88	6.74***	5.16***
5-year						
D1 (short)	59.15***	-1.28	-0.27	55.11***	-5.20***	-0.50
D2	59.55***	1.60	-0.37	57.46***	-1.41	0.61
D3	57.03***	0.17	0.43	57.31***	-1.87**	1.99
D4	58.87***	-0.74	0.40	60.46***	-0.19	2.47
D5	57.21***	-0.81	-0.35	59.15***	-0.17	2.10
D6	58.24***	0.31	1.11	57.17***	-0.54	1.06
D7	57.57***	0.76	2.76	57.33***	-0.05	0.11
D8	57.25***	1.79	2.04	55.74***	0.55	0.36
D9	58.80***	2.79	5.25*	57.96***	-0.03	4.18
D10 (long)	63.26***	7.83**	8.03**	60.12***	4.78*	7.06**
D10-D1	4.11	9.10***	8.30***	5.01	9.98***	7.57***

Table 4: Fama-MacBeth regressions of fund performance

This table reports the coefficient estimates and p-values (in parentheses) of Fama-MacBeth (1973) regressions of future fund performance on fund holding horizon and other explanatory variables. The dependent variable is the four-factor alpha associated with buy-and-hold fund net returns (Panel A) or buy-and-hold DGTW-adjusted abnormal returns (Panel B). The look-ahead holding periods are 1 month, 1 year, 3 years, and 5 years. The style-adjusted Ex-Ante Simple measure ($HH^{(2)}$) is used as the metric of fund investment horizon. The other explanatory variables include fund size measured as log of total net assets, the expense ratio, fund age in logs, fund flow volatility, past-year fund flow, the CRSP turnover ratio (TR), the Active Share (AS) of Petajisto and Cremers (2009), the R^2 of Amihud and Goyenko (2013), and the Return Gap of Kacperczyk et al. (2008). Standard errors are calculated using the Newey-West (1987) procedure with a lag equal to the total number of months in the look-ahead holding period minus one.

Panel A: Using four-factor alphas

	1M	1Y	3Y	5Y	1M	1Y	3Y	5Y	1M	1Y	3Y	5Y	1M	1Y	3Y	5Y
Ex-Ante Simple ($HH^{(2)}$)	0.01	0.23	0.93	1.68	0.01	0.21	0.85	1.57	0.01	0.20	0.71	1.33	0.02	0.28	1.02	1.84
	(0.03)	(0.01)	(0.00)	(0.00)	(0.06)	(0.01)	(0.00)	(0.00)	(0.05)	(0.03)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Fund size	0.01	0.09	0.30	-0.00	-0.00	0.01	0.33	0.35	0.01	0.07	0.34	0.22	0.00	0.06	0.22	-0.16
	(0.10)	(0.08)	(0.09)	(1.00)	(0.35)	(0.88)	(0.03)	(0.39)	(0.23)	(0.21)	(0.07)	(0.56)	(0.33)	(0.25)	(0.22)	(0.65)
Expense	-0.10	-0.93	-2.12	-3.51	-0.09	-0.83	-2.38	-4.60	-0.10	-0.96	-2.14	-3.78	-0.07	-0.68	-1.72	-3.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.03)	(0.02)
Age	-0.00	-0.44	-2.20	-3.64	-0.00	-0.35	-1.55	-2.64	-0.01	-0.45	-1.93	-3.35	0.01	-0.34	-1.97	-3.33
	(0.81)	(0.00)	(0.00)	(0.00)	(0.83)	(0.02)	(0.00)	(0.00)	(0.15)	(0.00)	(0.00)	(0.00)	(0.39)	(0.01)	(0.00)	(0.00)
Flow volatility	0.34	3.25	10.58	25.45	0.00	-0.42	-2.33	1.90	0.30	1.48	2.87	10.17	0.31	4.04	12.84	28.11
	(0.03)	(0.10)	(0.08)	(0.05)	(0.99)	(0.85)	(0.65)	(0.78)	(0.03)	(0.43)	(0.60)	(0.21)	(0.05)	(0.04)	(0.02)	(0.02)
Fund flow	0.01	0.00	0.02	0.27	0.01	0.02	0.11	0.08	0.01	0.02	0.00	0.01	0.01	-0.01	0.01	0.21
	(0.01)	(0.96)	(0.95)	(0.70)	(0.01)	(0.58)	(0.55)	(0.78)	(0.01)	(0.61)	(1.00)	(0.97)	(0.01)	(0.90)	(0.98)	(0.75)
CRSP TR	0.00	0.30	0.78	0.56	0.01	0.42	0.74	0.47	0.00	0.22	0.42	-0.05	0.01	0.45	1.13	1.15
	(0.85)	(0.18)	(0.18)	(0.44)	(0.55)	(0.10)	(0.23)	(0.62)	(0.71)	(0.22)	(0.31)	(0.94)	(0.48)	(0.10)	(0.13)	(0.18)
Active Share					0.12	2.43	14.25	32.26								
					(0.30)	(0.06)	(0.00)	(0.00)								
R^2									-0.19	-2.39	-13.89	-28.07				
									(0.16)	(0.18)	(0.02)	(0.01)				
Return gap													0.82	8.63	21.18	28.58
													(0.29)	(0.01)	(0.04)	(0.00)

Panel B: Using DGTW-adjusted returns

	1M	1Y	3Y	5Y	1M	1Y	3Y	5Y	1M	1Y	3Y	5Y	1M	1Y	3Y	5Y
Ex-Ante Simple ($HH^{(2)}$)	0.01	0.18	0.49	1.16	0.01	0.14	0.34	0.93	0.01	0.14	0.31	0.98	0.01	0.19	0.49	1.14
	(0.10)	(0.02)	(0.01)	(0.00)	(0.24)	(0.08)	(0.10)	(0.06)	(0.30)	(0.05)	(0.10)	(0.05)	(0.09)	(0.01)	(0.01)	(0.00)
Fund size	0.00	0.01	-0.06	-0.24	-0.00	-0.02	-0.00	-0.03	0.00	-0.03	-0.12	-0.25	0.01	0.01	-0.05	-0.23
	(0.30)	(0.88)	(0.71)	(0.42)	(0.91)	(0.63)	(1.00)	(0.93)	(0.70)	(0.51)	(0.38)	(0.36)	(0.27)	(0.91)	(0.76)	(0.47)
Expense	0.00	-0.10	-0.49	-1.08	-0.02	-0.33	-1.15	-2.26	-0.02	-0.25	-0.91	-1.54	0.00	-0.12	-0.55	-1.11
	(0.97)	(0.64)	(0.26)	(0.24)	(0.22)	(0.14)	(0.02)	(0.01)	(0.45)	(0.25)	(0.05)	(0.04)	(0.97)	(0.53)	(0.18)	(0.23)
Age	-0.00	-0.06	-0.37	-0.77	0.00	-0.05	-0.21	-0.11	-0.00	-0.09	-0.49	-0.89	-0.00	-0.06	-0.32	-0.66
	(0.70)	(0.50)	(0.40)	(0.38)	(0.72)	(0.55)	(0.61)	(0.87)	(0.58)	(0.17)	(0.13)	(0.27)	(0.80)	(0.53)	(0.47)	(0.43)
Flow volatility	0.25	3.04	4.85	3.71	-0.18	0.03	-6.51	-25.51	0.05	0.36	-2.00	-9.75	0.30	3.41	5.12	4.39
	(0.11)	(0.12)	(0.47)	(0.69)	(0.22)	(0.99)	(0.25)	(0.01)	(0.74)	(0.84)	(0.75)	(0.30)	(0.06)	(0.08)	(0.44)	(0.64)
Fund flow	0.01	-0.10	-0.33	-0.15	0.00	-0.05	-0.07	0.11	0.00	-0.04	-0.17	-0.09	0.01	-0.10	-0.35	-0.17
	(0.29)	(0.17)	(0.25)	(0.56)	(0.18)	(0.17)	(0.42)	(0.56)	(0.18)	(0.37)	(0.16)	(0.64)	(0.29)	(0.16)	(0.22)	(0.50)
CRSP TR	0.00	0.04	-0.21	-0.55	0.00	-0.07	-0.42	-0.50	0.00	-0.06	-0.55	-0.80	0.00	0.04	-0.23	-0.53
	(0.75)	(0.84)	(0.73)	(0.53)	(0.84)	(0.72)	(0.43)	(0.54)	(0.83)	(0.73)	(0.21)	(0.29)	(0.74)	(0.85)	(0.70)	(0.49)
Active Share					0.18	1.90	6.97	13.10								
					(0.11)	(0.07)	(0.01)	(0.00)								
R^2									-0.22	-2.89	-11.08	-17.08				
									(0.15)	(0.12)	(0.04)	(0.12)				
Return gap													-0.60	-3.38	-2.38	0.47
													(0.48)	(0.27)	(0.76)	(0.97)

Table 5: Informativeness of fund holdings—Stock portfolio performance

This table reports buy-and-hold returns and abnormal returns of stock portfolios sorted on the relative fund holdings, long-horizon fund holding (LFH) minus short-horizon fund holding (SFH). A mutual fund is classified as short-term (long-term) if it ranks in the bottom (top) tercile based on one of two style-adjusted fund investment horizon measures—the Simple ($HH^{(1)}$) and the Ex-Ante Simple ($HH^{(2)}$) measures. LFH (SFH) is defined as the aggregate holdings of a stock by long-horizon (short-horizon) funds divided by the stock's total number of shares outstanding. Each month we group stocks into deciles according to LFH-SFH, with stocks in D10 held more by long- and less by short-horizon funds and stocks in D1 held more by short- and less by long-horizon funds. The decile portfolios are equally weighted at formation date and are then updated following a buy-and-hold strategy. The buy-and-hold returns, the four-factor alphas, and DGTW-adjusted returns for each decile portfolio are examined over the next month, the next quarter, and the next one to five years after portfolio formation. These returns are expressed in percentage. The table also reports the performance difference between D10 and D1 portfolios, with p-values in parentheses. p-values are obtained using the Newey-West (1987) procedure with a lag equal to the total number of months in the look-ahead holding period minus one.

	Simple ($HH^{(1)}$)			Ex-Ante Simple ($HH^{(2)}$)		
	Ret	4-F α	DGTW	Ret	4-F α	DGTW
1-month						
D1 (short)	0.94	-0.17	-0.07	0.98	-0.15	-0.05
D2	0.84	-0.17	-0.15	1.06	0.04	0.02
D3	1.03	0.05	0.03	0.94	-0.06	-0.07
D4	0.98	0.03	-0.01	0.94	-0.01	-0.00
D5	1.07	0.08	0.11	1.06	0.09	0.09
D6	1.01	0.02	0.07	1.03	0.07	0.07
D7	1.05	0.07	0.06	1.10	0.10	0.14
D8	1.11	0.14	0.14	0.98	0.00	0.04
D9	1.14	0.15	0.17	1.13	0.15	0.18
D10 (long)	1.14	0.13	0.15	1.13	0.12	0.15
D10-D1	0.20	0.29	0.22	0.15	0.27	0.20
	(0.27)	(0.03)	(0.03)	(0.28)	(0.03)	(0.04)
1-quarter						
D1 (short)	2.82	-0.66	-0.27	3.17	-0.32	0.00
D2	2.59	-0.64	-0.49	3.04	-0.25	-0.14
D3	3.12	0.09	0.02	2.74	-0.36	-0.38
D4	3.03	-0.07	-0.01	2.85	-0.28	-0.07
D5	3.23	0.17	0.27	3.24	0.21	0.22
D6	2.99	-0.05	0.08	3.10	0.14	0.17
D7	3.29	0.24	0.26	3.30	0.27	0.33
D8	3.23	0.22	0.28	3.01	0.01	0.12
D9	3.44	0.44	0.47	3.40	0.43	0.50
D10 (long)	3.43	0.37	0.42	3.37	0.30	0.34
D10-D1	0.60	1.03	0.68	0.20	0.61	0.34
	(0.11)	(0.00)	(0.00)	(0.51)	(0.01)	(0.14)
1-year						
D1 (short)	11.07	-2.74	-0.94	12.50	-1.00	-0.01
D2	10.48	-2.48	-1.82	11.78	-1.48	-0.74
D3	14.06	1.64	1.10	12.27	-0.88	-0.41
D4	13.23	0.14	0.87	13.37	0.49	0.79
D5	13.67	1.10	1.63	13.53	1.23	1.40
D6	12.95	0.39	1.11	12.73	0.42	0.97
D7	13.75	1.45	1.49	13.06	0.89	1.16
D8	13.39	1.27	1.33	13.09	1.12	1.27
D9	14.25	2.15	2.12	14.04	2.17	2.08
D10 (long)	14.17	1.95	1.96	14.28	2.06	1.98
D10-D1	3.10	4.69	2.90	1.77	3.05	1.99
	(0.10)	(0.00)	(0.04)	(0.18)	(0.01)	(0.11)
2-year						
D1 (short)	22.66	-3.15	-1.25	25.57	0.87	0.52
D2	23.12	-2.35	-1.45	24.89	-0.01	-0.11
D3	27.56	3.80	1.66	25.80	0.94	0.19
D4	28.24	2.42	2.91	27.08	2.58	1.69
D5	27.89	3.15	3.34	26.57	1.69	2.21
D6	26.89	2.23	2.57	25.76	1.43	1.95
D7	28.81	4.87	3.91	27.31	3.59	3.29
D8	26.95	3.37	2.52	28.21	5.21	3.82
D9	29.54	5.59	4.89	29.30	5.49	4.86
D10 (long)	28.83	4.53	4.08	28.65	4.08	4.04
D10-D1	6.18	7.69	5.34	3.08	3.21	3.52
	(0.03)	(0.00)	(0.03)	(0.24)	(0.08)	(0.10)
3-year						
D1 (short)	37.24	-2.30	-0.95	40.41	1.93	1.17
D2	37.87	-2.32	-0.62	39.43	0.14	-0.08
D3	43.56	5.71	3.26	40.14	0.90	0.39
D4	43.59	3.94	3.94	43.04	4.45	3.14
D5	43.48	4.38	4.97	41.97	3.55	3.55
D6	43.21	4.59	4.63	41.35	3.52	3.46
D7	44.84	7.69	5.66	43.52	6.45	5.46
D8	42.78	6.08	4.00	44.64	8.75	5.79
D9	46.38	9.05	7.46	47.42	10.00	8.25
D10 (long)	44.90	6.49	5.91	45.71	6.68	6.47
D10-D1	7.67	8.79	6.86	5.30	4.75	5.29
	(0.03)	(0.00)	(0.03)	(0.08)	(0.00)	(0.05)
4-year						
D1 (short)	51.44	-0.98	1.16	53.81	3.05	2.34
D2	49.24	-4.01	-0.88	53.86	-0.43	1.07
D3	57.61	6.00	4.16	53.75	0.48	1.34
D4	57.56	7.39	4.61	55.81	6.04	3.01
D5	57.09	5.63	5.87	57.93	8.42	5.93
D6	57.86	7.99	6.24	55.74	7.14	5.20
D7	58.84	11.34	6.68	58.36	11.33	7.63
D8	58.34	12.07	6.24	59.07	13.99	7.47
D9	62.61	14.02	10.26	64.76	15.50	11.37
D10 (long)	64.09	12.07	10.60	65.11	13.09	11.66
D10-D1	12.65	13.04	9.44	11.30	10.04	9.31
	(0.01)	(0.00)	(0.05)	(0.00)	(0.00)	(0.01)
5-year						
D1 (short)	68.56	-1.83	2.66	71.63	2.83	2.43
D2	66.82	-4.24	1.73	72.85	1.63	3.16
D3	75.59	5.65	4.96	72.28	1.47	3.29
D4	75.63	11.94	5.63	76.59	9.00	6.30
D5	75.30	8.79	6.83	77.06	13.20	7.93
D6	78.39	14.76	9.26	74.29	12.36	7.19
D7	78.63	16.02	9.66	75.87	16.23	8.99
D8	78.96	18.71	10.14	80.85	21.01	12.85
D9	85.46	20.41	15.73	86.61	20.14	17.48
D10 (long)	89.89	15.90	17.27	90.03	16.34	18.74
D10-D1	21.33	17.73	14.62	18.40	13.51	16.31
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)

Table 6: Refinement of informativeness of fund holdings

Stocks are sorted each month into deciles based on relative fund holdings, long-horizon fund holdings (LFH) minus short-horizon fund holdings (SFH), with D10 (D1) consisting of stocks held more by long-horizon (short-horizon) funds and less by short-horizon (long-horizon) funds. In D10 (D1), stocks are further divided into two groups: long-term positions consisting of stocks held for a long period by long-horizon (short-horizon) funds and short-term positions consisting of stocks held for a short period by long-horizon (short-horizon) funds. This table presents buy-and-hold returns, 4-factor alphas, and DGTW adjusted returns for these four stock portfolios, two portfolios for each of D1 and D10, over the next month, the next quarter, and the next one to five years after portfolio formation. The style-adjusted Ex-Ante Simple measure is used to classify funds as long- or short-horizon. p-values are calculated using the Newey-West (1987) procedure with a lag equal to the total number of months in the look-ahead holding period minus one.

	Return	4-F α	p-value	DGTW	p-value
1-month					
Short-term positions in short-horizon funds	1.04	-0.17	0.30	-0.03	0.87
Long-term positions in short-horizon funds	1.22	0.16	0.11	0.23	0.01
Short-term positions in long-horizon funds	1.14	0.10	0.68	0.18	0.40
Long-term positions in long-horizon funds	1.09	0.06	0.54	0.08	0.25
1-quarter					
Short-term positions in short-horizon funds	3.35	-0.42	0.27	-0.08	0.78
Long-term positions in short-horizon funds	3.70	0.37	0.08	0.56	0.00
Short-term positions in long-horizon funds	3.64	0.20	0.71	0.66	0.17
Long-term positions in long-horizon funds	3.37	0.22	0.34	0.16	0.35
1-year					
Short-term positions in short-horizon funds	11.67	-1.49	0.23	-1.21	0.23
Long-term positions in short-horizon funds	14.14	0.82	0.44	1.71	0.05
Short-term positions in long-horizon funds	13.55	-0.42	0.84	2.15	0.25
Long-term positions in long-horizon funds	14.55	2.10	0.05	1.62	0.11
2-year					
Short-term positions in short-horizon funds	22.22	-2.00	0.56	-2.18	0.27
Long-term positions in short-horizon funds	28.13	2.35	0.32	2.66	0.16
Short-term positions in long-horizon funds	26.25	-1.67	0.62	3.50	0.26
Long-term positions in long-horizon funds	30.90	5.75	0.04	4.32	0.04
3-year					
Short-term positions in short-horizon funds	33.45	-4.63	0.36	-2.74	0.28
Long-term positions in short-horizon funds	42.84	3.91	0.36	4.00	0.13
Short-term positions in long-horizon funds	35.76	-7.20	0.03	1.40	0.62
Long-term positions in long-horizon funds	47.72	10.36	0.03	6.54	0.02
4-year					
Short-term positions in short-horizon funds	47.38	-8.87	0.07	-1.48	0.65
Long-term positions in short-horizon funds	58.31	7.47	0.24	6.42	0.11
Short-term positions in long-horizon funds	52.71	-3.66	0.45	4.39	0.35
Long-term positions in long-horizon funds	67.74	17.27	0.04	11.48	0.01
5-year					
Short-term positions in short-horizon funds	64.65	-11.35	0.06	-3.28	0.39
Long-term positions in short-horizon funds	77.90	12.85	0.14	9.20	0.16
Short-term positions in long-horizon funds	86.91	4.89	0.65	12.10	0.04
Long-term positions in long-horizon funds	91.14	22.63	0.06	18.95	0.06

Table 7: Comparison of fund holding horizon with CRSP turnover

This table reports the estimation results of panel regressions of next-year fund holding horizon (in the left columns) or next-year CRSP turnover (in the right columns) on current fund holding horizon, current CRSP turnover, and other fund characteristics. These regressions are panel regressions with no fixed effect, a fund fixed effect, and a time fixed effect. The style-adjusted Ex-Ante Simple measure ($HH^{(2)}$) is used as the metric of fund investment horizon. The other fund characteristics include fund size, the expense ratio, fund age, past-year flow volatility, past-year fund flow. *p*-values are reported in parentheses based on heteroskedasticity-robust standard errors clustered by fund and by year.

Dependent var.	Next-year Ex-Ante Simple			Next-year CRSP turnover		
	No fixed effect	Fund fixed effect	Time fixed effect	No fixed effect	Fund fixed effect	Time fixed effect
Ex-Ante Simple ($HH^{(2)}$)	0.910	0.675	0.910	-0.025	0.006	-0.025
	(0.00)	(0.00)	(0.00)	(0.12)	(0.80)	(0.12)
CRSP turnover	-0.038	-0.023	-0.038	0.865	0.739	0.866
	(0.03)	(0.10)	(0.03)	(0.00)	(0.00)	(0.00)
Fund size	0.013	0.058	0.013	-0.011	-0.030	-0.013
	(0.00)	(0.00)	(0.00)	(0.01)	(0.04)	(0.03)
Expense ratio	-0.315	0.617	-0.284	1.817	1.651	1.758
	(0.67)	(0.37)	(0.71)	(0.17)	(0.30)	(0.22)
Fund age	-0.000	-0.002	-0.000	0.001	0.005	0.001
	(0.42)	(0.26)	(0.25)	(0.08)	(0.25)	(0.08)
Flow volatility	0.334	-0.173	0.314	0.119	0.112	0.109
	(0.00)	(0.27)	(0.00)	(0.45)	(0.47)	(0.48)
Fund flow	0.000	-0.001	0.000	-0.000	0.000	-0.000
	(0.79)	(0.00)	(0.78)	(0.26)	(0.50)	(0.72)

Table 8: Fund holding horizon versus CRSP turnover: Predicting future fund performance

This table reports the coefficient estimates and p-values (in parentheses) of three panel regressions of future fund performance on fund holding horizon and CRSP turnover while controlling for other fund characteristics. These three panel regressions differ by including no fixed effect, a fund fixed effect, and a time fixed effect. The dependent variable is the four-factor alpha associated with buy-and-hold net returns (Panel A) or buy-and-hold DGTW-adjusted abnormal returns (Panel B) in percentage. Look-ahead holding periods we report are 1 month, 1 quarter, 1 year, 3 years, and 5 years. The style-adjusted Ex-Ante Simple measure ($HH^{(2)}$) is used as the metric of fund investment horizon. The other fund characteristics (not reported in the table to save space) include fund size, the expense ratio, fund age, past-year flow volatility, and past-year fund flow. Heteroskedasticity-robust standard errors are calculated for panel regressions based on two-way clusters by fund and by month.

Panel A: Dependent variable—four-factor alphas			
	No fixed effect	Fund fixed effect	Time fixed effect
1 month			
Ex-Ante Simple	0.013	-0.019	0.013
	(0.16)	(0.20)	(0.16)
CRSP turnover	-0.005	0.035	-0.000
	(0.75)	(0.08)	(0.99)
1 quarter			
Ex-Ante Simple	0.038	-0.053	0.040
	(0.06)	(0.13)	(0.05)
CRSP turnover	0.001	0.072	0.016
	(0.98)	(0.17)	(0.63)
1 year			
Ex-Ante Simple	0.150	-0.116	0.172
	(0.03)	(0.28)	(0.01)
CRSP turnover	0.180	0.190	0.211
	(0.14)	(0.21)	(0.08)
3 years			
Ex-Ante Simple	0.776	-0.118	0.839
	(0.00)	(0.66)	(0.00)
CRSP turnover	0.333	0.262	0.435
	(0.27)	(0.46)	(0.15)
5 years			
Ex-Ante Simple	1.602	-0.075	1.725
	(0.00)	(0.86)	(0.00)
CRSP turnover	0.106	-0.210	0.270
	(0.87)	(0.77)	(0.68)

Panel B: Dependent variable—DGTW abnormal returns			
	No fixed effect	Fund fixed effect	Time fixed effect
1 month			
Ex-Ante Simple	0.012	-0.004	0.013
	(0.21)	(0.85)	(0.17)
CRSP turnover	-0.003	0.039	0.014
	(0.84)	(0.27)	(0.36)
1 quarter			
Ex-Ante Simple	0.039	-0.014	0.043
	(0.07)	(0.77)	(0.04)
CRSP turnover	0.005	0.140	0.059
	(0.90)	(0.08)	(0.15)
1 year			
Ex-Ante Simple	0.168	0.001	0.197
	(0.02)	(0.99)	(0.01)
CRSP turnover	0.011	0.485	0.213
	(0.93)	(0.10)	(0.13)
3 years			
Ex-Ante Simple	0.382	-0.596	0.553
	(0.11)	(0.23)	(0.03)
CRSP turnover	-0.230	0.166	0.376
	(0.65)	(0.77)	(0.47))
5 years			
Ex-Ante Simple	0.707	-0.988	1.201
	(0.14)	(0.23)	(0.01)
CRSP turnover	-1.073	-0.696	-0.139
	(0.18)	(0.46)	(0.87)

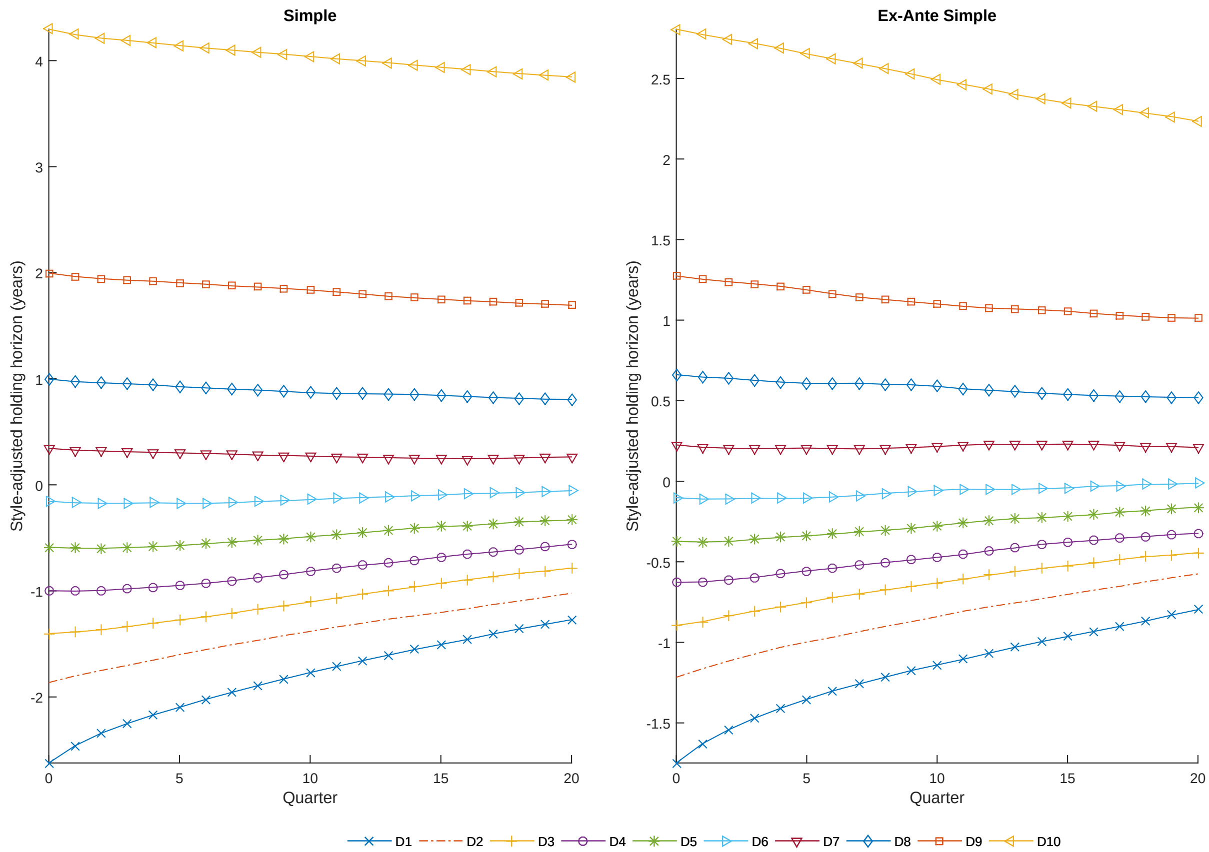

Figure 1: This figure plots the average style-adjusted fund holding periods for each fund decile at the formation period, and the first to the 20^{th} quarter into the future after the formation period. Each month funds are sorted into deciles according to either style-adjusted Simple or style-adjusted Ex-Ante Simple fund horizon measure, with D1 consisting of funds with short holding periods and D10 consisting of funds with long holding periods.

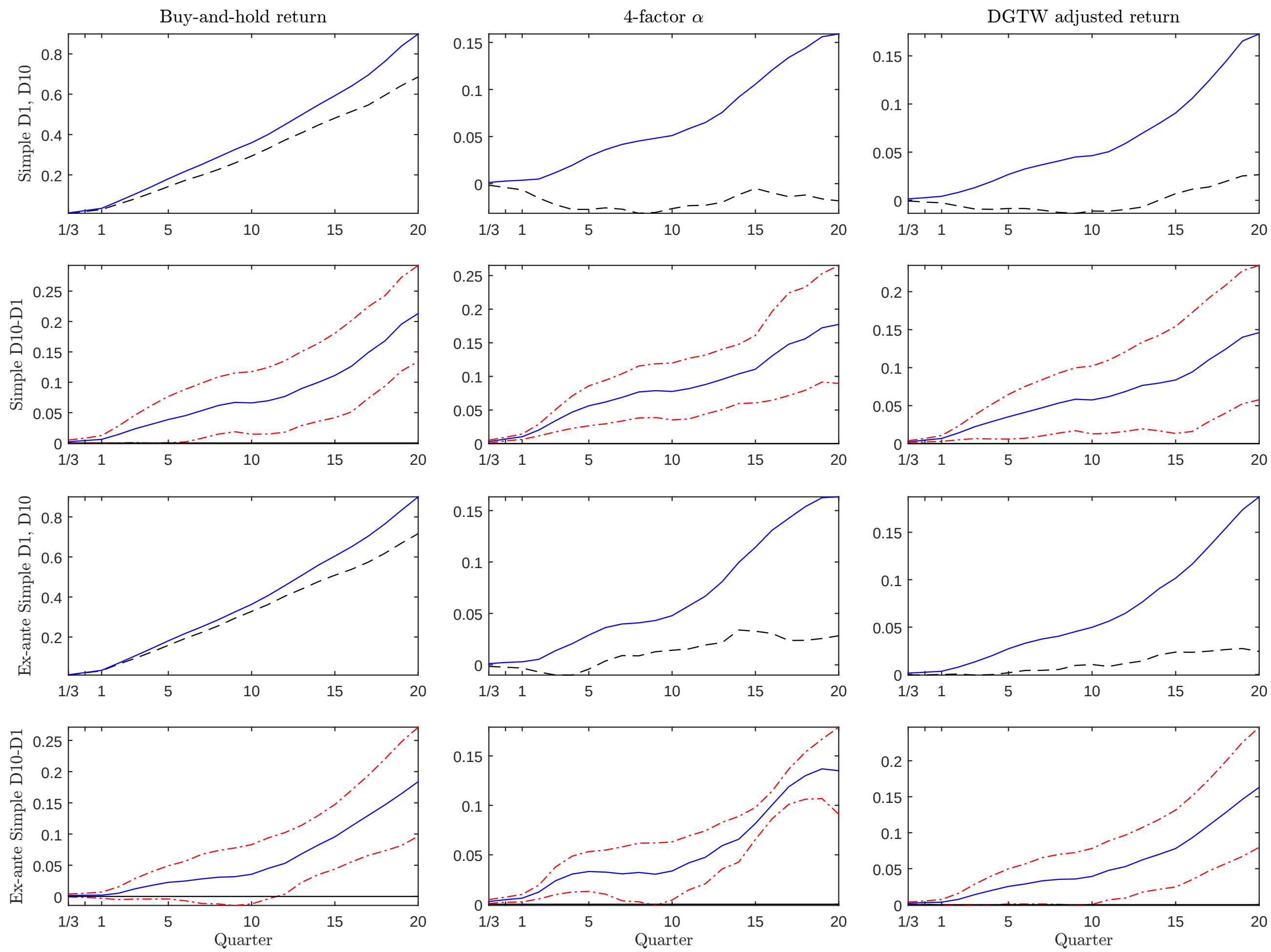

Figure 2: This figure plots buy-and-hold returns, four-factor alphas, and DGTW-adjusted returns for the D1 (dashed line) and D10 (solid line) portfolios in the first and third rows, and for the D10-D1 position that is long the D10 and short the D1 portfolio in the second and fourth rows. For the D10-D1 portfolios, the plots also include the 90% confidence intervals computed based on the Newey-West approach. These portfolios are deciles sorted on LFH minus SFH, where LFH (SFH) is the percentage of the shares of a stock held by long- (short-) horizon funds. D10 (D1) is the portfolio with large ownership by long-horizon (short-horizon) funds. A mutual fund is classified as short-horizon (long-horizon) if it ranks in the bottom (top) tercile based on the style-adjusted Simple measure in the first two rows or the style-adjusted Ex-Ante Simple measure in the last two rows.

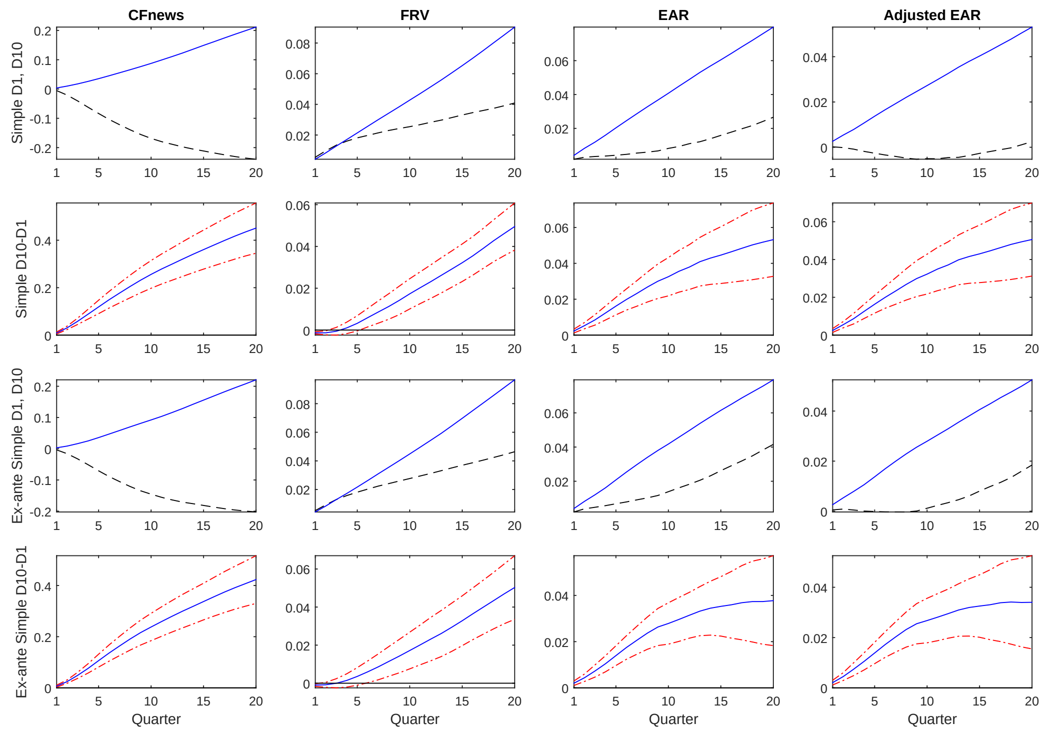

Figure 3: This figure plots cumulative fundamental variables, including cashflow news ($CFnews$), analyst forecast revision (FRV), earnings-announcement-window returns (EAR), and market adjusted EAR, over the next 1-20 quarters after stock portfolio formation. Specifically, the average quarterly fundamental information is calculated first for each stock portfolio in the n^{th} quarter after the formation period, where $1 \leq n \leq 20$, and then the quarterly fundamental information is accumulated over 1-20 quarters. The odd rows plot future firm fundamentals for stock portfolio decile D1 (dashed line) consisting of stocks held most by short-horizon funds and for stock portfolio decile D10 (solid line) consisting of stocks held most by long-horizon funds. The even rows exhibit future fundamental information for D10 in excess of that for D1, with the 90% confidence interval calculated using the Newey-West approach. The first two rows use the style-adjusted Simple measure as a metric of fund investment horizon, and the last two rows use the style-adjusted Ex-Ante Simple measure.

Holding Horizon: A New Measure of Active Investment Management

Separate Internet Appendix

A1 Other measures of fund holding horizon

In this section, we describe two additional measures of fund holding horizon. First, we consider an ex-post measure, termed the "FIFO" horizon measure, that allows for the possibility that position changes may also be informative about the intended holding horizon. It assumes that shares purchased first are sold first (first-in-first-out). Let $h^{(3)}_{i,j,t}$ denote, in this measure, the holding horizon of stock i held by fund j in period t. Then

$$h^{(3)}_{i,j,t} = \begin{cases} \frac{\sum\limits_{\substack{k,s \\ k \le t < s}} N_{i,j,k,s} * (s-k)}{N_{i,j,t}}, & \text{if } N_{i,j,t} > 0 \\ 0 & \text{if } N_{i,j,t} = 0 \end{cases} \tag{A.7}$$

where $N_{i,j,k,s}$ is the number of shares of stock i purchased by fund j in period k and sold in period s, $k \le t < s$, and $N_{i,j,t}$ is the number of shares of stock i held by fund j in period t with $N_{i,j,t} = \sum\limits_{\substack{k,s \\ k \le t < s}} N_{i,j,k,s}$.[1]

We also consider an ex-ante measure, termed the "Duration" measure, which is the measure proposed by Cremers and Pareek (2011). It accounts for changes in stock positions and can be considered as a modified, ex-ante version of the FIFO measure. Let $h^{(4)}_{i,j,t}$ denote, in this measure, the holding horizon of stock i held by fund j in period t. Let W be a specified window ending at time t. $B_{i,j}$ is the percentage of total shares outstanding of stock i bought by fund j between $t - W$ and t, while $H_{i,j}$ is the percentage of total shares outstanding of stock i held by fund j at $t - W$. Then

$$h^{(4)}_{i,j,t} = \sum_{s=t-W+1}^{t} \frac{(t-s)\alpha_{i,j,s}}{H_{i,j} + B_{i,j}} + \frac{W * H_{i,j}}{H_{i,j} + B_{i,j}}, \tag{A.8}$$

where $\alpha_{i,j,s}$ is the percentage of total shares outstanding of stock i bought or sold by fund j in period s, while $\alpha_{i,j,s} > 0$ for buys and $\alpha_{i,j,s} < 0$ for sells.[2,3]

After the holding horizons of all stocks held by a fund are calculated, the holding horizon of fund j in period t, denoted by $HH_{j,t}$, is then defined as the value-weighted holding periods

[1] As a concrete example, consider a fund that purchases 1,000 shares of General Electric (GE) in year 0 and purchases another 100 shares in year 1. It sells 300 shares in year 2 and liquidates the position in year 3. In this example, the holding period of GE based on the FIFO measure is (700*3+300*2)/1000 = 2.7 years in year 0, (700*3+300*2+100*2)/1100 = 2.6 years in year 1, and (700*3+100*2)/800 = 2.9 years in year 2.

[2] Cremers and Pareek (2011) consider the past five years to calculate the Duration measure. We obtain data on the duration measure from Cremers's website.

[3] For example, consider a fund that owns 1% of GE: assume it bought 5% of GE two years ago, and sold 4% of GE one year ago. The Duration measure, today, is (5/5)*2-(4/5)*1= 1.2 years.

of all stocks held in the fund. Specifically,

$$HH_{j,t}^{(m)} = \sum_{i=1}^{M_{j,t}} \omega_{i,j,t} h_{i,j,t}^{(m)}, \quad m = 3, 4 \tag{A.9}$$

where $M_{j,t}$ is the number of stocks held by fund j in period t, and $\omega_{i,j,t}$ is the period-t portfolio weight of stock i in fund j. $\omega_{i,j,t}$ is computed as the number of shares of stock i held by fund j in period t multiplied by the period-t stock price, then divided by the period-t market value of the equity portfolio of fund j.

Table A1 reports the fund sorting results using the style-adjusted FIFO and the Duration measures. These results are similar to those reported in Table 3 of the paper; long-horizon funds exhibit higher long-run abnormal returns than short-horizon funds.

A2 Tables for additional tests and robustness checks

Tables A1-A9 report the results discussed in section 7 of our paper.

Table A1: Informativeness of fund holdings—Fund portfolio performance

Funds are sorted into deciles each month according to the style-adjusted FIFO or Duration fund horizon measure, with D1 consisting of short-horizon funds and D10 consisting of long-horizon funds. This table reports buy-and-hold fund portfolio net returns and abnormal returns over the next month, next quarter, and next one to five years after portfolio formation. As explained in Section 2.2, the abnormal returns are the Carhart four-factor alphas, which are computed from buy-and-hold net returns, and DGTW-adjusted returns, which are computed from holdings-based returns. Portfolio weights are equally weighted at the formation month and are then updated following a buy-and-hold strategy. The table also reports the return spreads between the D10 and D1 portfolios. All returns are expressed in percentage. *, **, and *** represent statistical significance for abnormal returns and return spreads at the 10%, 5%, and 1% confidence intervals, respectively. Standard errors are obtained using the Newey-West (1987) procedure with a lag equal to the total number of months in the look-ahead holding period minus one.

	FIFO ($HH^{(3)}$)			Duration ($HH^{(4)}$)		
	Net ret	Net 4-F α	DGTW	Net ret	Net 4-F α	DGTW
1-month						
D1 (short)	0.89***	-0.10**	-0.07	0.80***	-0.11**	0.01
D10 (long)	0.99***	0.04	0.10***	0.87***	-0.01	0.05*
D10-D1	0.10	0.14***	0.16***	0.06	0.10**	0.04
1-quarter						
D1 (short)	2.76***	-0.21	-0.14	2.44***	-0.24*	0.05
D10 (long)	3.03***	0.19*	0.29***	2.59***	0.04	0.17*
D10-D1	0.27	0.41***	0.42***	0.15	0.28**	0.13
1-year						
D1 (short)	11.33***	0.29	-0.25	9.95***	-0.28	0.07
D10 (long)	11.95***	0.76	1.07**	10.34***	0.23	0.66
D10-D1	0.62	0.47	1.31***	0.39	0.51	0.59
2-year						
D1 (short)	23.72***	0.35	-0.08	21.11***	-0.10	0.22
D10 (long)	24.95***	1.87	2.24**	21.96***	1.21	1.38
D10-D1	1.23	1.52	2.32***	0.85	1.30	1.16*
3-year						
D1 (short)	37.19***	1.09	-0.16	32.07***	-0.48	0.04
D10 (long)	38.58***	3.58**	3.58**	33.93***	2.42	2.29
D10-D1	1.38	2.49	3.75***	1.86	2.90*	2.26***
4-year						
D1 (short)	49.16***	0.95	-0.76	43.16***	-1.21	-0.43
D10 (long)	51.77***	5.47**	5.33*	46.13***	4.13*	3.77
D10-D1	2.61	4.53*	6.08***	2.98	5.34***	4.20***
5-year						
D1 (short)	64.58***	0.28	-0.59	57.95***	-2.38	0.28
D10 (long)	67.12***	6.97**	7.42*	61.37***	5.61*	6.14
D10-D1	2.54	6.68**	8.01***	3.42	8.00***	5.86***

Table A2: Determinants of the Ex-Ante Simple measure

This table reports results of regressions of the Ex-Ante Simple horizon measure on different fund characteristics. All the variables are measured at the end of each quarter. The fund characteristics include fund size measured as log of total net assets, the expense ratio, fund age in logs, flow volatility, past-year fund flow, the Active Share (AS) from Petajisto and Cremers (2009), the R2 of Amihud and Goyenko (2013), and the Return Gap of Kacperczyk et al. (2008). Panel A reports the results of Fama-MacBeth regressions with p-values obtained based on the Newey-West (1987) procedure with a lag equal to four. Panel B reports the results of a panel regression with p-values calculated based on standard errors clustered by funds.

Panel A: Using Fama-MacBeth regressions

	Coeff	P-value
Intercept	7.08	0.00
Fund size	-0.03	0.12
Expense	-0.11	0.00
Age	0.13	0.00
Flow volatility	-0.06	0.00
Fund flow	0.00	0.74
CRSP TR	-0.82	0.00
Active Share	-0.20	0.00
R2	-0.16	0.00
Return Gap	-0.01	0.41

Panel B: Using panel regression

	Coeff	P-value
Intercept	6.54	0.00
Fund size	0.01	0.90
Expense	-0.09	0.04
Age	0.14	0.00
Flow volatility	-0.06	0.01
Fund flow	-0.02	0.11
CRSP TR	-0.80	0.00
Active Share	-0.26	0.00
R2	-0.16	0.00
Return Gap	0.00	0.75
Coeff. of determination	0.36	

Table A3: Informativeness of fund holdings—Fund portfolio performance: Robustness check using 5-factor model

Funds are sorted into deciles each month according to the style-adjusted Simple or Ex-Ante Simple fund horizon measures, with D1 consisting of short-horizon funds and D10 consisting of long-horizon funds. This table reports buy-and-hold fund portfolio abnormal returns over the next month, next quarter, and next one to five years after portfolio formation. The abnormal returns are the five-factor alpha. In addition to the Carhart four factors, the 5-factor model includes as a fifth factor the Pástor-Stambaugh liquidity factor. Portfolio weights are equally weighted at the formation month and are then updated following a buy-and-hold strategy. The table also reports the return spreads between the D10 and D1 portfolios. All returns are expressed in percentage. *, **, and *** represent significance for abnormal returns and return spreads at the 10%, 5%, and 1% confidence intervals, respectively. Standard errors are obtained using the Newey-West (1987) procedure with a lag equal to the total number of months in the look-ahead holding period minus one.

	Simple ($HH^{(1)}$)	Ex-Ante Simple ($HH^{(2)}$)
1-month		
D1 (short)	-0.12**	-0.12**
D10 (long)	0.03	-0.02
D10-D1	0.15***	0.10**
1-quarter		
D1 (short)	-0.24*	-0.24*
D10 (long)	0.21*	0.01
D10-D1	0.45***	0.25***
1-year		
D1 (short)	0.68	-0.43
D10 (long)	0.81	-0.06
D10-D1	0.13	0.37
2-year		
D1 (short)	-0.25	-0.75
D10 (long)	2.51	1.24
D10-D1	2.76*	1.99
3-year		
D1 (short)	1.04	-0.79
D10 (long)	3.33*	1.24
D10-D1	2.29	2.03
4-year		
D1 (short)	-0.22	-2.79**
D10 (long)	5.26**	2.78
D10-D1	5.48**	5.58**
5-year		
D1 (short)	-1.27	-4.98***
D10 (long)	6.38***	3.38*
D10-D1	7.65***	8.35***

Table A4: Informativeness of fund holdings—Stock portfolio performance: Robustness check using 5-factor model

This table reports five-factor alphas of stock portfolios sorted on the relative fund holdings, long-horizon fund holding (LFH) minus short-horizon fund holding (SFH). A mutual fund is classified as short-term (long-term) if it ranks in the bottom (top) tercile based on one of two style-adjusted fund investment horizon measures—the Simple ($HH^{(1)}$) and the Ex-Ante Simple ($HH^{(2)}$) measures. LFH (SFH) is defined as the aggregate holdings of a stock by long-horizon (short-horizon) funds divided by the stock's total number of shares outstanding. Each month we group stocks into deciles according to LFH-SFH, with stocks in D10 held more by long- and less by short-horizon funds and stocks in D1 held more by short- and less by long-horizon funds. The decile portfolios are equally weighted at formation date and are then updated following a buy-and-hold strategy. In addition to the Carhart four factors, the 5-factor model includes as a fifth factor the Pástor-Stambaugh liquidity factor. The buy-and-hold five-factor alphas are examined over the next month, the next quarter, and the next one to five years after portfolio formation. These alphas are expressed in percentage. The table also reports the performance difference between D10 and D1 portfolios, with p-values in parentheses. p-values are obtained using the Newey-West (1987) procedure with a lag equal to the total number of months in the look-ahead holding period minus one.

	Simple ($HH^{(1)}$)	Ex-Ante Simple ($HH^{(2)}$)
1-month		
D1 (short)	-0.18	-0.18
D10 (long)	0.10	0.10
D10-D1	0.28	0.28
	(0.04)	(0.02)
1-quarter		
D1 (short)	-0.65	-0.34
D10 (long)	0.33	0.29
D10-D1	0.98	0.63
	(0.00)	(0.01)
1-year		
D1 (short)	-2.70	-1.86
D10 (long)	1.71	2.09
D10-D1	4.42	3.95
	(0.00)	(0.00)
2-year		
D1 (short)	-4.17	-1.19
D10 (long)	5.61	5.96
D10-D1	9.78	7.16
	(0.00)	(0.00)
3-year		
D1 (short)	-2.47	0.95
D10 (long)	6.68	6.70
D10-D1	9.15	5.75
	(0.00)	(0.01)
4-year		
D1 (short)	-3.90	1.39
D10 (long)	12.87	13.28
D10-D1	16.76	11.89
	(0.00)	(0.00)
5-year		
D1 (short)	-4.45	-1.81
D10 (long)	12.14	14.01
D10-D1	16.59	15.82
	(0.00)	(0.00)

Table A5: Stock portfolios sorted on relative fund holdings and liquidity

This table reports buy-and-hold abnormal returns of stock portfolios sorted on the relative fund holdings, long-horizon fund holding (LFH) minus short-horizon fund holding (SFH). A mutual fund is classified as a short-term (long-term) investor if it ranks in the bottom (top) tercile based on either the style-adjusted Simple or Ex-Ante Simple measures. LFH (SFH) is defined as the aggregate holdings of a stock by long-horizon (short-horizon) funds divided by the stock's total number of shares outstanding. Each month we group stocks into deciles according to their relative fund holdings, with stocks in D10 held more by long- and less by short-horizon funds and stocks in D1 held more by short- and less by long-horizon funds. We further divide the stocks into two groups according to their liquidity. The stock liquidity is measured using the Amihud's (2002) measure. Liquid (illiquid) stocks are stocks with below (above) median Amihud's illiquidity measure. The decile portfolios are equally weighted at formation date and are then updated following a buy-and-hold strategy. The four-factor alphas and DGTW-adjusted returns for each decile portfolio are examined over the next month and the next one to five years after portfolio formation. These returns are expressed in percentage. The table also reports the performance difference between D10 and D1 portfolios. p-values in parentheses are obtained using the Newey-West (1987) procedure with a lag equal to the total number of months in the look-ahead holding period minus one.

	Simple Illiquid		EA Simple Illiquid		Simple Liquid		EA Simple Liquid	
	4-F α	DGTW	4-F α	DGTW	4-F α	DGTW	4-F α	DGTW
1-month								
D1 (short)	-0.19	-0.01	-0.02	0.07	-0.19	-0.13	-0.07	-0.02
	(0.10)	(0.92)	(0.88)	(0.51)	(0.09)	(0.19)	(0.53)	(0.82)
D10 (long)	-0.13	0.04	-0.09	-0.00	0.09	0.18	0.17	0.20
	(0.30)	(0.62)	(0.47)	(0.99)	(0.37)	(0.01)	(0.10)	(0.01)
D10-D1	0.06	0.05	-0.07	-0.07	0.28	0.32	0.24	0.22
	(0.63)	(0.68)	(0.65)	(0.60)	(0.05)	(0.00)	(0.08)	(0.04)
1-year								
D1 (short)	-3.06	0.40	-0.99	1.11	-2.86	-1.53	-0.86	-0.15
	(0.06)	(0.61)	(0.56)	(0.14)	(0.00)	(0.02)	(0.22)	(0.80)
D10 (long)	-0.73	1.23	0.29	1.61	1.20	1.88	1.94	1.80
	(0.72)	(0.26)	(0.88)	(0.16)	(0.28)	(0.04)	(0.09)	(0.10)
D10-D1	2.33	0.83	1.28	0.50	4.06	3.41	2.80	1.95
	(0.13)	(0.44)	(0.33)	(0.64)	(0.00)	(0.01)	(0.02)	(0.16)
2-year								
D1 (short)	-3.48	0.63	0.74	2.48	-2.61	-0.72	0.01	0.23
	(0.27)	(0.62)	(0.86)	(0.09)	(0.10)	(0.59)	(0.99)	(0.90)
D10 (long)	2.52	2.83	2.76	3.63	2.58	4.60	2.67	4.22
	(0.61)	(0.17)	(0.54)	(0.06)	(0.17)	(0.01)	(0.09)	(0.02)
D10-D1	6.00	2.19	2.02	1.15	5.19	5.32	2.66	3.98
	(0.01)	(0.28)	(0.25)	(0.54)	(0.02)	(0.02)	(0.19)	(0.14)
3-year								
D1 (short)	-0.95	2.61	2.16	4.83	-1.78	0.76	-0.30	-0.43
	(0.87)	(0.25)	(0.78)	(0.05)	(0.46)	(0.77)	(0.92)	(0.88)
D10 (long)	4.58	4.20	4.63	5.91	4.22	7.75	4.87	7.16
	(0.58)	(0.13)	(0.53)	(0.03)	(0.14)	(0.00)	(0.01)	(0.01)
D10-D1	5.53	1.60	2.46	1.07	6.01	6.99	5.17	7.59
	(0.05)	(0.52)	(0.06)	(0.62)	(0.08)	(0.05)	(0.01)	(0.04)
4-year								
D1 (short)	5.41	6.53	5.74	6.14	-2.65	0.30	-1.19	-0.37
	(0.59)	(0.09)	(0.61)	(0.04)	(0.24)	(0.95)	(0.71)	(0.93)
D10 (long)	8.83	9.02	10.80	12.51	10.99	14.93	11.83	12.31
	(0.47)	(0.07)	(0.37)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)
D10-D1	3.43	2.50	5.05	6.37	13.64	14.63	13.03	12.68
	(0.31)	(0.50)	(0.01)	(0.11)	(0.00)	(0.00)	(0.00)	(0.01)
5-year								
D1 (short)	11.29	10.98	5.13	4.58	-5.41	-2.55	0.46	0.07
	(0.36)	(0.07)	(0.69)	(0.27)	(0.06)	(0.68)	(0.90)	(0.99)
D10 (long)	16.59	15.86	14.82	19.62	15.36	24.08	18.17	19.06
	(0.34)	(0.03)	(0.37)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)
D10-D1	5.30	4.87	9.69	15.04	20.77	26.63	17.71	18.98
	(0.45)	(0.29)	(0.07)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)

Table A6: Net fund performance with fund holding horizon: Conditional on benchmarks

This table reports buy-and-hold fund portfolio abnormal returns over next month and up to five years of the spread between the high and low tercile portfolios. Each month funds with the same benchmark are sorted into terciles according to the Active Share (Panel A) with the high-tercile portfolio consisting of high-active funds, or the style-adjusted Ex-Ante Simple fund horizon measure (Panel B), with the high-tercile portfolio consisting of long-horizon funds. The abnormal returns are the 4-factor buy-and-hold alphas associated with fund net returns. Portfolio weights are equal at the formation month and are then updated following a buy-and-hold strategy. The fund benchmarks are obtained from *http://www.petajisto.net/data.html*. The benchmarks are the following: Russell 1000 Growth (R1G), Russell 1000 Value (R1V), Russell 2000 (R2), Russell 2000 Growth (R2G), Russell 2000 Value (R2V), Russell Mid Growth (RMG), Russell Mid Value (RMV), S&P 400 (S4), S&P 500 (S5), S&P 500 Growth (S5G), S&P 500 Value (S5V). The Russell 1000, Russell 3000, Russell 3000 Growth, Russell 3000 Value, S&P 600, Wilshire 4500, and Wilshire 5000 were excluded due to the low average number of funds in each tercile. For the same reason S&P 500 Value is also excluded in Panel B. The last row in each panel reports the equally-weighted average of the spread portfolios across the different benchmarks. The returns are expressed in percentage. p-values are obtained using the Newey-West (1987) procedure with a lag equal to the total number of months in the look-ahead holding period minus one.

Panel A: Using the Active Share

	1M	P-value	1Y	P-value	2Y	P-value	3Y	P-value	4Y	P-value	5Y	P-value
R1G	0.01	0.90	0.03	0.95	-0.17	0.88	0.09	0.94	0.84	0.34	0.68	0.61
R1V	0.07	0.13	0.26	0.41	0.08	0.86	-0.03	0.94	0.00	0.99	-0.79	0.18
R2	0.13	0.02	1.15	0.06	2.81	0.03	5.31	0.00	8.14	0.00	10.30	0.00
R2G	0.08	0.24	0.45	0.53	2.55	0.22	4.08	0.24	5.76	0.28	7.90	0.29
R2V	0.11	0.09	0.52	0.28	-0.29	0.78	-0.49	0.64	-0.79	0.61	-1.06	0.53
RMG	-0.09	0.19	-0.92	0.10	-2.78	0.01	-3.27	0.01	-3.55	0.05	-4.91	0.02
RMV	0.09	0.11	0.73	0.11	0.40	0.59	0.88	0.00	0.52	0.41	0.94	0.22
S4	0.12	0.18	1.77	0.02	3.47	0.05	3.52	0.05	3.18	0.00	3.05	0.01
S5	0.05	0.26	0.71	0.21	2.65	0.02	5.19	0.01	7.92	0.00	11.82	0.00
S5G	-0.16	0.08	-1.35	0.05	-2.05	0.18	-0.83	0.55	0.88	0.65	4.20	0.00
S5V	-0.06	0.67	1.36	0.00	-1.09	0.05	-4.51	0.00	-7.69	0.00	-4.47	0.00
EWAve	0.03	0.26	0.43	0.14	0.50	0.42	0.90	0.36	1.38	0.33	2.52	0.15

Panel B: Using the Ex-Ante Simple measure

	1M	P-value	1Y	P-value	2Y	P-value	3Y	P-value	4Y	P-value	5Y	P-value
R1G	0.04	0.38	0.13	0.83	0.96	0.36	2.28	0.01	2.23	0.00	2.17	0.01
R1V	0.02	0.68	-0.00	1.00	0.28	0.49	1.34	0.04	2.17	0.03	3.81	0.02
R2	0.16	0.04	1.32	0.09	3.92	0.02	5.19	0.00	4.99	0.00	5.25	0.17
R2G	0.03	0.72	-0.34	0.60	-0.77	0.74	1.25	0.43	3.25	0.00	2.78	0.20
R2V	0.01	0.93	0.63	0.22	1.94	0.00	2.49	0.00	2.37	0.00	2.11	0.00
RMG	0.17	0.02	-0.48	0.69	0.40	0.85	1.05	0.64	3.85	0.16	6.72	0.02
RMV	-0.03	0.61	-0.54	0.03	-1.58	0.00	-3.14	0.00	-3.38	0.00	-0.66	0.12
S4	0.07	0.28	1.31	0.00	2.80	0.00	5.40	0.00	9.13	0.00	16.02	0.00
S5	0.04	0.32	-0.36	0.50	-0.19	0.84	-0.22	0.87	0.14	0.91	0.36	0.83
S5G	0.24	0.03	1.11	0.02	3.80	0.00	7.19	0.00	10.86	0.00	16.19	0.00
EWAve	0.07	0.02	0.28	0.25	1.16	0.07	2.28	0.03	3.56	0.02	5.48	0.01

Table A7: Comparison with Cremers and Pareek (2016): Panel regressions for each benchmark

This table reports the coefficient estimates and p-values (in parentheses) of panel regressions of future fund performance on fund holding horizon and other explanatory variables. The dependent variable is the 1-year (Panel A), 3-year (Panel B), 5-year (Panel C) four-factor alpha associated with buy-and-hold fund net returns. The style-adjusted Ex-Ante Simple measure ($HH^{(2)}$) is used as the metric of fund investment horizon. The other explanatory variables include past-year fund flow, the expense ratio, fund age (in logs), flow volatility, fund size measured as log of total net assets, the CRSP turnover ratio (TR), dummies for high and low Active Share terciles, and interaction between Active Share dummies the CRSP turnover ratio. Each column represents a different regression for each benchmark. The fund benchmarks are obtained from $http://www.petajisto.net/data.html$. The benchmarks are the following: Russell 1000 Growth (R1G), Russell 1000 Value (R1V), Russell 2000 (R2), Russell 2000 Growth (R2G), Russell 2000 Value (R2V), Russell Mid Growth (RMG), Russell Mid Value (RMV), S&P 400 (S4), S&P 500 (S5), S&P 500 Growth (S5G). The Russell 1000, Russell 3000, Russell 3000 Growth, Russell 3000 Value, S&P 500 Value, S&P 600, Wilshire 4500, and Wilshire 5000 were excluded due to the low average number of funds in each tercile. The regressions include time fixed effects. Standard errors are clustered by time.

Panel A: Using 1-year four-factor alpha

	RIG	RIV	R2	R2G	R2V	RMG	RMV	S4	S5	S5G
Ex-Ante Simple ($HH^{(2)}$)	-0.03	0.15	0.55	0.52	0.38	0.28	-0.34	0.86	0.18	0.43
	(0.57)	(0.01)	(0.00)	(0.01)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)
Fund size	0.19	-0.05	0.10	0.04	0.03	0.27	0.22	-0.11	-0.01	0.33
	(0.00)	(0.23)	(0.03)	(0.60)	(0.71)	(0.00)	(0.00)	(0.08)	(0.76)	(0.00)
Expense	-0.79	-1.16	-0.55	-0.28	-0.33	-1.31	-0.68	-0.76	-0.52	0.04
	(0.00)	(0.00)	(0.01)	(0.17)	(0.20)	(0.00)	(0.03)	(0.04)	(0.00)	(0.81)
Age	-0.69	0.27	-0.12	0.73	0.03	-1.68	-0.50	-1.04	-0.25	-1.39
	(0.00)	(0.00)	(0.38)	(0.00)	(0.91)	(0.00)	(0.05)	(0.00)	(0.00)	(0.00)
Flow volatility	1.12	0.73	5.74	7.34	-1.70	7.50	13.74	-12.46	0.39	0.48
	(0.41)	(0.47)	(0.00)	(0.00)	(0.41)	(0.00)	(0.00)	(0.00)	(0.68)	(0.78)
Fund flow	0.04	0.07	0.09	0.02	0.06	0.24	-0.34	-0.01	0.03	0.01
	(0.07)	(0.00)	(0.00)	(0.00)	(0.19)	(0.41)	(0.01)	(0.03)	(0.14)	(0.05)
CRSP TR	0.20	-0.38	0.33	0.97	-0.70	0.36	0.15	0.31	0.72	1.31
	(0.08)	(0.02)	(0.16)	(0.00)	(0.00)	(0.03)	(0.41)	(0.09)	(0.00)	(0.00)
High AS	0.50	0.38	0.72	0.49	-3.41	-0.19	0.08	1.12	1.25	0.80
	(0.01)	(0.02)	(0.00)	(0.26)	(0.00)	(0.58)	(0.77)	(0.00)	(0.00)	(0.02)
Low AS	-0.25	-0.65	0.09	-0.75	-1.79	-0.47	-0.50	-1.15	0.11	1.66
	(0.13)	(0.00)	(0.69)	(0.03)	(0.00)	(0.08)	(0.02)	(0.00)	(0.27)	(0.00)
High AS*TR	0.64	0.21	0.54	-0.28	4.13	0.37	0.47	-1.41	-0.34	-1.87
	(0.00)	(0.24)	(0.03)	(0.37)	(0.00)	(0.05)	(0.17)	(0.00)	(0.00)	(0.00)
Low AS*TR	-0.10	0.91	-0.54	-0.14	0.77	0.31	-0.47	-0.04	-0.15	-1.65
	(0.40)	(0.00)	(0.02)	(0.54)	(0.01)	(0.09)	(0.02)	(0.86)	(0.06)	(0.00)

Panel B: Using 3-year four-factor alpha

	RIG	RIV	R2	R2G	R2V	RMG	RMV	S4	S5	S5G
Ex-Ante Simple ($HH^{(2)}$)	0.74	0.48	2.04	-0.42	1.06	1.11	-0.45	2.75	0.79	1.46
	(0.00)	(0.00)	(0.00)	(0.16)	(0.00)	(0.00)	(0.03)	(0.00)	(0.00)	(0.00)
Fund size	0.76	-0.07	0.65	0.49	0.82	0.12	1.10	0.35	0.15	1.07
	(0.00)	(0.27)	(0.00)	(0.00)	(0.00)	(0.52)	(0.00)	(0.01)	(0.00)	(0.00)
Expense	-0.06	-1.47	-1.27	-1.80	-0.17	-3.81	-2.21	-2.19	-2.52	-2.83
	(0.87)	(0.00)	(0.00)	(0.00)	(0.70)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Age	-2.91	0.59	-0.26	1.01	-0.41	-5.64	-0.73	-5.48	-1.17	-4.32
	(0.00)	(0.00)	(0.32)	(0.15)	(0.57)	(0.00)	(0.19)	(0.00)	(0.00)	(0.00)
Flow volatility	-2.49	-4.09	11.65	12.83	0.23	-4.09	-4.05	-31.51	-2.20	-3.73
	(0.40)	(0.16)	(0.00)	(0.00)	(0.96)	(0.40)	(0.38)	(0.00)	(0.28)	(0.41)
Fund flow	0.08	0.15	-0.21	-0.00	0.14	1.83	0.54	-0.04	0.08	-0.15
	(0.18)	(0.00)	(0.00)	(0.62)	(0.12)	(0.00)	(0.04)	(0.02)	(0.03)	(0.00)
CRSP TR	0.71	-1.95	0.05	0.20	-1.38	0.04	1.43	1.34	2.45	1.61
	(0.00)	(0.00)	(0.91)	(0.68)	(0.08)	(0.88)	(0.00)	(0.00)	(0.00)	(0.02)
High AS	0.92	-0.28	-0.00	-0.59	-6.86	-1.63	-0.47	2.32	5.20	3.74
	(0.03)	(0.43)	(1.00)	(0.50)	(0.00)	(0.01)	(0.42)	(0.00)	(0.00)	(0.00)
Low AS	-1.93	-2.47	-2.38	-3.57	-6.62	-1.01	-2.64	-2.39	-0.43	0.32
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.62)
High AS*TR	1.95	1.94	2.86	2.23	5.20	-0.13	0.60	-2.59	-2.38	-2.57
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.75)	(0.32)	(0.00)	(0.00)	(0.01)
Low AS*TR	0.52	2.53	-0.73	0.92	3.15	1.47	-1.08	0.40	-1.10	-0.39
	(0.07)	(0.00)	(0.06)	(0.09)	(0.01)	(0.00)	(0.02)	(0.38)	(0.00)	(0.63)

Panel C: Using 5-year four-factor alpha

	RIG	RIV	R2	R2G	R2V	RMG	RMV	S4	S5	S5G
Ex-Ante Simple ($HH^{(2)}$)	1.40	0.87	3.08	1.12	0.84	2.11	0.20	6.27	1.38	1.84
	(0.00)	(0.00)	(0.00)	(0.01)	(0.06)	(0.00)	(0.72)	(0.00)	(0.00)	(0.00)
Fund size	0.41	-0.80	0.85	-0.46	1.31	-0.87	1.15	0.24	0.02	1.34
	(0.01)	(0.00)	(0.00)	(0.11)	(0.00)	(0.01)	(0.00)	(0.35)	(0.78)	(0.00)
Expense	-0.35	-2.92	-1.18	-7.71	-0.60	-6.96	-2.18	-3.83	-5.63	-5.31
	(0.44)	(0.00)	(0.03)	(0.00)	(0.39)	(0.00)	(0.13)	(0.00)	(0.00)	(0.00)
Age	-3.58	1.70	1.63	1.95	-1.31	-5.20	-0.52	-9.79	-2.04	-5.73
	(0.00)	(0.00)	(0.00)	(0.01)	(0.20)	(0.00)	(0.62)	(0.00)	(0.00)	(0.00)
Flow volatility	-5.83	-6.93	44.31	10.69	23.06	-10.48	-25.77	15.18	6.59	-37.69
	(0.25)	(0.06)	(0.00)	(0.14)	(0.01)	(0.10)	(0.00)	(0.23)	(0.09)	(0.00)
Fund flow	0.07	0.08	-1.11	0.08	-0.05	1.62	1.65	-0.14	0.06	-0.14
	(0.17)	(0.00)	(0.00)	(0.02)	(0.77)	(0.00)	(0.00)	(0.00)	(0.30)	(0.00)
CRSP TR	0.71	-2.59	-3.71	3.99	-11.07	-1.14	3.89	-0.29	3.56	4.38
	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.68)	(0.00)	(0.01)
High AS	1.04	0.25	-1.76	7.07	-12.94	-2.96	-2.93	-2.52	10.07	12.25
	(0.14)	(0.74)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.19)	(0.00)	(0.00)
Low AS	-3.55	-3.25	-5.64	-6.61	-15.63	-2.41	-8.03	-7.95	-1.46	-0.02
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)	(0.99)
High AS*TR	4.17	4.28	8.25	-1.28	10.39	-1.84	0.01	-1.50	-3.69	-9.88
	(0.00)	(0.00)	(0.00)	(0.18)	(0.00)	(0.00)	(0.99)	(0.23)	(0.00)	(0.00)
Low AS*TR	0.94	5.18	2.17	2.25	15.55	2.03	-1.31	4.80	-2.48	-2.62
	(0.03)	(0.00)	(0.03)	(0.01)	(0.00)	(0.00)	(0.04)	(0.00)	(0.00)	(0.13)

Table A8: Comparison with Yan and Zhang (2009): Stock portfolios sorted on relative fund holdings (turnover-based)

This table reports buy-and-hold returns, 4-factor alphas, and DGTW adjusted returns for the Q1 and Q5 portfolios and the long-short position that buys the Q5 and shorts the Q1 portfolio. These portfolios are quintiles sorted according to LFH minus SFH, LFH, or SFH, where LFH (SFH) is the percentage of the shares of a stock held by long- (short-) horizon funds.When considering LFH-SFH and LFH, Q5 (Q1) is the portfolio of stocks with relative larger ownership by long-horizon (short-horizon) funds. When considering SFH, Q5 (Q1) is the portfolio of stocks with relative larger ownership by short-horizon (long-horizon) funds. A mutual fund is classified as a short-horizon (long-horizon) fund if it ranks in the bottom (top) tercile based on the inverse of the holdings-based turnover ratio measure. The returns are expressed in percent and the p-values are summarized in parentheses. The p-values are obtained using the Newey-West (1987) procedure with a lag equal to the total number of months in the look-ahead period minus one.

	LFH-SFH			LFH			SFH		
	Ret	4-F α	DGTW	Ret	4-F α	DGTW	Ret	4-F α	DGTW
1-month									
Q1	1.40	0.32	0.36	1.06	0.05	0.06	0.81	-0.23	-0.17
Q5	0.95	-0.14	-0.03	1.01	-0.09	0.04	1.44	0.36	0.40
Q5-Q1	-0.45	-0.46	-0.38	-0.04	-0.14	-0.03	0.63	0.59	0.57
	(0.02)	(0.00)	(0.00)	(0.73)	(0.21)	(0.68)	(0.00)	(0.00)	(0.00)
1-year									
Q1	14.06	0.85	1.08	13.91	-0.03	0.63	13.57	-0.89	0.48
Q5	14.18	-0.57	0.96	14.13	-0.64	1.05	14.05	0.75	1.12
Q5-Q1	0.13	-1.43	-0.12	0.22	-0.60	0.43	0.47	1.63	0.64
	(0.95)	(0.33)	(0.91)	(0.87)	(0.68)	(0.63)	(0.83)	(0.22)	(0.55)
2-year									
Q1	27.79	0.22	2.20	29.30	0.76	1.86	29.58	1.85	1.74
Q5	30.92	2.61	3.32	30.53	2.25	3.50	27.30	0.46	1.89
Q5-Q1	3.13	2.38	1.12	1.24	1.50	1.64	-2.28	-1.39	0.15
	(0.37)	(0.45)	(0.55)	(0.61)	(0.51)	(0.31)	(0.54)	(0.66)	(0.92)
3-year									
Q1	41.54	-0.18	3.38	44.68	2.52	2.33	46.41	4.67	3.21
Q5	48.04	6.20	5.49	48.19	5.73	6.63	41.12	0.15	3.24
Q5-Q1	6.50	6.39	2.11	3.50	3.22	4.30	-5.29	-4.52	0.04
	(0.14)	(0.14)	(0.34)	(0.27)	(0.38)	(0.06)	(0.33)	(0.44)	(0.99)
4-year									
Q1	56.59	0.01	4.68	60.61	2.22	1.71	64.39	8.33	4.47
Q5	67.86	12.76	8.86	68.62	11.30	11.00	56.81	2.16	5.25
Q5-Q1	11.27	12.75	4.18	8.01	9.07	9.29	-7.57	-6.16	0.78
	(0.09)	(0.03)	(0.21)	(0.03)	(0.00)	(0.00)	(0.37)	(0.40)	(0.83)
5-year									
Q1	77.78	2.84	8.34	81.56	3.65	2.01	87.30	12.80	6.57
Q5	92.48	18.89	13.10	94.12	16.26	16.68	78.88	5.91	9.75
Q5-Q1	14.70	16.05	4.76	12.56	12.61	14.66	-8.42	-6.89	3.18
	(0.14)	(0.03)	(0.40)	(0.00)	(0.00)	(0.00)	(0.48)	(0.43)	(0.61)

Table A9: Informativeness of fund holdings: Jegadeesh and Titman's approach

This table reports 4-factor alphas of stock portfolios sorted on the relative fund holdings, long-horizon fund holding (LFH) minus short-horizon fund holding (SFH). A mutual fund is classified as a short-term (long-term) investor if it ranks in the bottom (top) tercile based on the style-adjusted Ex-Ante Simple or Simple horizon measure. LFH (SFH) is defined as the aggregate holdings of a stock by long-horizon (short-horizon) funds divided by the stock's total number of shares outstanding. Each month we group stocks into deciles according to their relative fund holdings, with stocks in D10 held more by long- and less by short-horizon funds and stocks in D1 held more by short- and less by long-horizon funds. We adopt Jegadeesh and Titman's (1993) overlapping portfolio approach for holing period returns. These returns are monthly returns expressed in percentage. The table also reports the performance difference between D10 and D1 portfolios, with p-values summarized in parentheses.

	Simple ($HH^{(1)}$)	Ex-Ante Simple ($HH^{(2)}$)
1-month		
D1 (short)	-0.20	-0.16
	(0.03)	(0.09)
D10 (long)	0.03	0.06
	(0.77)	(0.50)
D10-D1	0.22	0.22
	(0.04)	(0.04)
1-year		
D1 (short)	-0.21	-0.07
	(0.02)	(0.42)
D10 (long)	0.04	0.07
	(0.63)	(0.41)
D10-D1	0.25	0.14
	(0.01)	(0.10)
2-year		
D1 (short)	-0.16	-0.03
	(0.04)	(0.69)
D10 (long)	0.03	0.09
	(0.69)	(0.21)
D10-D1	0.19	0.13
	(0.01)	(0.06)
3-year		
D1 (short)	-0.09	-0.00
	(0.20)	(0.99)
D10 (long)	0.04	0.09
	(0.65)	(0.24)
D10-D1	0.13	0.09
	(0.05)	(0.13)
4-year		
D1 (short)	-0.06	0.01
	(0.38)	(0.91)
D10 (long)	0.08	0.13
	(0.32)	(0.08)
D10-D1	0.14	0.12
	(0.03)	(0.05)
5-year		
D1 (short)	-0.05	0.02
	(0.50)	(0.76)
D10 (long)	0.12	0.16
	(0.12)	(0.04)
D10-D1	0.17	0.13
	(0.01)	(0.02)

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