Mutual Fund Investment Horizon and Performance

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ABSTRACT

This paper proposes several new holdings-based measures of fund investment horizon, and examines the relation between manager skills and fund holding horizon. We find that both aggregate holdings and trades of long-horizon funds are informative about superior future long-term stock returns, whereas aggregate trades, but not holdings, of short-horizon funds are associated with future short-term stock returns. Specifically, stocks that are largely held by long-term funds outperform stocks that are largely held by short-term funds by roughly 3% per year over the following five-year period. This superior performance of fund managers with long investment horizons stems from their ability to identify superior long-term firm fundamentals. In contrast, short-term funds predict short-term earnings or use simple mechanical strategies, such as momentum strategies, to select stocks.

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1 Introduction

U.S.-domiciled actively managed equity mutual funds exhibit significant cross-sectional variation in investment horizons, although they are traditionally considered as being shorter-term investors than other institutional investors, such as pension funds. One explanation for this variation may stem from the differential abilities of fund managers to identify and process information that may yield superior returns over different investment periods. That is, some fund managers may possess skills in forecasting long-run stock returns, while others may possess skills in forecasting over the short-run.

These fund managers, in essence, claim to possess superior information about the future cash flows of firms, which are related to firm-specific fundamentals. Forecasting cash flows involves detailed firm-level analysis. This fundamental analysis, especially that of forecasting long-term cash flows, requires fund managers to generate insights about the future prospects of the firm's major projects, as well as the competitive position of the firm's products and the strength of the firm's balance sheet. Accordingly, we can expect that a manager who truly understands the long-term competitive position of a company to extract abnormal stock returns from its holdings of that firm over the long-run, regardless of short-term patterns in the returns (such as that due to momentum).[1]

Berkshire Hathaway, managed by one of the most successful investors of the 20th century—Warren Buffett—is a vivid illustration of achieving superior profits from long-term investments. Indeed, Warren Buffett famously stated that his "favorite holding period is forever." Buffett, a student and follower of Benjamin Graham, the father of value investing, is known to focus on long-term growth, and to invest in quality firms with strong fundamentals. An example from the mutual fund industry is Mario Gabelli, who manages the Gabelli Small Cap Growth fund. He holds stocks, on average, for five and half years,

[1] In equilibrium, we would expect that managers possessing superior long-term fundamental analysis skills will be in short supply, and, thus, will be rewarded over the long term before their information is fully realized by the market. Indeed, this is a key assumption of the Berk and Green (2004) model and an equilibrium outcome from the costly information model of Grossman and Stiglitz (1980).

and was recently awarded a five-star rating from Morningstar.[2]

On the other hand, short-term information, such as that about next-quarter earnings or time-varying investor sentiment, has a temporal effect on stock prices. Algorithmic trading, in particular, has been widely used in recent years to explore profitable temporary mispricing opportunities that can arise, for instance, due to time-varying investor sentiment that quickly reverts. Moreover, fund managers may exploit short-term earnings surprises, and collect short-run information from analysts. Fund managers who utilize these types of information are rather short-termist, and if skillful, are expected to be able to identify stocks with short-term profits, such as investors who trade to exploit the momentum anomaly (Grinblatt et al., 1995).

In this paper, we propose some novel, holdings-based measures of a fund's investment horizon. All of our measures are the value-weighted average of the holding period of stocks in a fund's portfolio; these measures differ, however, in their measure of the holding period of stocks. The first measure, termed the "Simple Horizon Measure," (SHM) calculates stock holding periods from the time a position is first initiated to the time it is completely liquidated. In this measure, the stock holding horizon does not account for the adjustment of positions of a stock, which may partially be executed to meet investor flows. The second measure, termed the "FIFO Horizon Measure" (FHM), allows for the possibility that position changes may also be informative about the intended holding horizon, and tracks inventory layers of each stock held by each fund. It assumes that the stocks purchased first by a fund are sold first (FIFO).

While these two measures capture true holding periods of stocks, they are ex-post measures that cannot be used in real-time to predict manager skills. Accordingly, we also consider two ex-ante measures of fund holding period. One is a modified version of the SHM, while the other is a modified version of the duration measure proposed by Cremers and Pareek (2011). The difference is that the second,

[2]See "TIP SHEET: Gabelli Fund Aims for Big Stakes, Long-Term Investments," *Wall Street Journal*, November 21, 2012.

similar to the FHM, adjusts as positions are changed by a fund, while the first does not. These two ex-ante measures use only past holdings information. Thus, both of them estimate, in real-time, a fund's investment horizon, but they may also underestimate the stock holding period when a fund manager purchases a stock and intends to hold the position for a long horizon. That is, our ex-post and ex-ante measures provide useful information about fund investment horizons from different perspectives.

Using these four measures, we find a wide, cross-sectional dispersion of fund investment horizons. For example, using the SHM to divide funds into quintiles, we find average holding periods are 1.21, 2.97, and 7 years, for the shortest, middle, and longest horizon quintiles, respectively. Moreover, long-horizon funds take a much longer time to either build or decrease their positions in a particular stock than short-horizon funds. Long-horizon and short-horizon funds take, on average, about 18 and 4 months to accumulate a position, respectively, while they take about 23 and 8 months to reduce a position, respectively. This finding suggests that long-horizon funds possess information that allows them to strategically accumulate or curtail a position. Relative to funds with short-term investment horizons, funds with long-term investment horizons tilt toward large stocks, stocks with high B/M ratios, and less popular but at the same time more liquid stocks. By contrast, short-term funds prefer past winners. Thus, short-horizon funds appear to employ more mechanical, trend-like strategies, while long-horizon funds appear to use more fundamentals-based strategies.

To study the relation between fund investment horizon and manager skills, our paper adopts two approaches, one at the stock level and the other at the fund level. The stock-level approach (e.g., Wermers et al. 2012) aggregates consensus opinions of the value of the stock from long- and short-horizon funds separately, and investigates future stock performance over various holding horizons. Our conjecture is that stocks that reflect the aggregate consensus opinion of long-horizon funds perform well in the long term, while stocks that reflect the aggregate opinion of short-horizon funds perform well in the short term, if fund managers optimally exploit their differing information advantage. The fund-level

approach directly examines the relation between fund holding horizons and future fund performance.

Each approach has its own strength. The stock-level approach is powerful in detecting fund managerial skills, because it studies the performance of stocks that can well-reflect the aggregate information across all fund managers. The fund-level approach is useful to analyze the performance of actual mutual funds, as it examines the performance of fund portfolios that can include stocks for non-performance purposes, such as controlling for deviation from a benchmark, as well as complying to legal restrictions and investment-objective requirements. The performance of fund portfolios can provide a realistic gauge of the benefits for mutual fund investors of our metrics of holding horizon, while the performance of stock portfolios can provide more precise information about how fund manager skills vary with holding horizon (and may also represent a quantitative stock investment signal).

Consistent with our conjecture, the stock-level approach reveals that the stock-holdings, in aggregate, of long-horizon funds are informative about the future long-term abnormal returns of a stock. For instance, risk-adjusted returns of stocks that are largely held by long-horizon funds increase almost linearly with holding horizons, and are as high as 6-14% over a five-year horizon; risk-adjusted returns of stocks that are largely held by short-horizon funds are either close to zero, or as low as -12% over the next five years, depending on the method that is used to control for risk exposure. The difference in the five-year risk-adjusted performance is 13%–18%, or roughly 3% per year, which is not only statistically but also economically significant. At this aggregate holdings level, we find little evidence of short-horizon risk-adjusted performance of stocks that are predominantly held by short-horizon funds. This may reflect that many stocks are held over longer periods by short-horizon funds for non-performance reasons, thus, these stocks repeatedly appear, over time, in our aggregation of holdings across short-horizon funds.

Interestingly, fund trades, in aggregate, of *both* long-horizon funds and short-horizon funds are informative about stock selection skills. Stocks that are largely purchased by long-horizon funds perform

well over the long run, while stocks that are largely purchased (sold) by short-horizon funds perform well (poorly) over the short term. Moreover, stocks that are largely purchased by short-horizon funds often outperform stocks that are largely purchased by long-horizon funds in the short term, although not in the long term. The long-run performance of stocks that are largely purchased by long-horizon funds is also quite good, although slightly lower than the performance of stocks largely held in long-horizon fund portfolios using our prior analysis of fund holdings rather than trades.[3]

We further delve into the economic sources of managers' stock selection skills, that is, the fundamental cash-flow information that is reflected in the above-noted measures of funds' stock holdings or trades. We measure information shocks to firm fundamentals using four different variables: cash-flow news ($CFnews$), consensus analyst forecast revision (FRV), earnings-announcement-window return (EAR), and market-adjusted EAR. Interestingly, we find the pattern of portfolio performance in terms of cash flows for different stock portfolios sorted on fund holdings or trading information is analogous to the pattern of portfolio performance in terms of returns. This finding indicates that long-horizon fund managers are skillful in analyzing long-term firm fundamentals, and achieve superior long-run performance, while short-horizon fund managers make use of short-term cash-flow information to make small profits, consistent with our initial conjecture about manager skills.

In our analysis of fund-level performance, we use both a sorting fund portfolio analysis and Fama-MacBeth regressions that control for fund characteristics to examine the relation between future fund returns and fund investment horizon. In the sorting portfolio analysis, we find superior performance in terms of buy-and-hold (pre-expense) gross abnormal returns of long-horizon funds, but this superior

[3]These results reflect the trade-off of the informativeness of fund holdings vs. trades about managerial skills. Trades represent a more immediate signal of fund manager information, while fund holdings include both past and recent signals because holdings are the aggregate of all past trades. At the same time, trades represent a much smaller sample than holdings, because long-horizon funds may hold stocks for a long period and are able, as described earlier, to strategically and slowly accumulate or curtail their positions. Accordingly, long-horizon funds' superior information can spread into several fund trades over time and can be well captured by fund holdings. Thus, fund holdings are more informative than fund trades for long-horizon funds; while fund trades are more informative for short-horizon funds because short-term profitable opportunities quickly disappear if short-horizon funds do not take them. This result has implications for comparisons of studies of fund performance that use trades vs. holdings.

performance is not present for buy-and-hold net abnormal returns. Therefore, fund management captures long-horizon fund skill-based returns, while fund investors benefit little (consistent with Berk and Green, 2004 and Grossman and Stiglitz, 1980). Interestingly, long-horizon funds significantly outperform short-horizon funds over the long run for fund net abnormal returns, but not for fund gross abnormal returns. The reason is that short-horizon funds charge higher expense ratios, therefore, adding back these charges improves the performance of short-horizon funds more than that of long-horizon funds. We find stronger results when we control, in a multivariate Fama-MacBeth setting, for fund characteristics. Specifically, we find a significant positive relation between fund investment horizon and fund performance, regardless of whether we use gross or net fund abnormal returns to measure performance.[4]

Finally, we compare our horizon measures with the traditional turnover level that has been used in prior studies of fund performance. Turnover is a measure of the churn rate, which describes how frequently an institution rotates its positions in all its securities.[5] This measure has been used both in the studies of mutual funds and of institutional investors using 13-F data. In the 13-F literature a similar measure was suggested by Gaspar et al. (2005). Although (the inverse of) reported turnover of a mutual fund is a summary statistic that is positively correlated with our measures of fund investment period, it does not describe the rich information that is contained in the heterogeneity of stock holding periods.[6] Indeed, the turnover ratio tends to ignore positions that have been held for a long period. Therefore, the turnover ratio cannot adequately reflect the right tail distribution of holding periods of

[4]The reason is that fund performance decreases with fund age, which, in turn, is positively correlated with fund investment horizon. Fund portfolios sorted solely on fund horizon therefore entangle two offsetting effects: fund performance decreases with fund age and fund performance increases with fund horizon. This is an interesting result: it indicates that younger fund managers trade frequently to learn about (or exhibit more quickly) their skill-levels, while older managers either become entrenched or (if skilled) become secure in their employment and are able to take longer bets that are, ultimately, more profitable.

[5]For mutual funds, the turnover ratio is an annual measure available in standard databases or in SEC filings. It is formally defined as the minimum of the annual dollar value of buys and sells divided by total net assets.

[6]For example, a fund with a particular turnover level may hold some stocks over long horizons, while trading others repeatedly over short horizons. Another fund with a similar turnover level may trade stocks over much more homogeneous investment horizons (see Chakrabarty et al., 2014, for a concrete example). Thus, turnover is an incomplete summary measure of a manager's typical holding period. Moreover, turnover can also be interpreted as a noisy proxy for other interesting manager behaviors. For instance, Cremers and Petajisto (2009) suggest that the turnover rate is a poor proxy of active management, and offer their Active Share measure as an alternative. They document that the correlation between active share and turnover ratio is only 18%.

stocks held in a fund portfolio.

Consistent with some prior studies, we find some evidence that managers of funds with higher levels of trading activity (high turnover) possess better skills in selecting stocks over the short run than managers of funds with low turnover, when CRSP reported turnover is used. We further run a horse race between our horizon measures and (the inverse of) turnover. At the fund-level in a multivariate regression, we find that the coefficient estimates on our horizon measures remain about the same magnitude, after the inverse of turnover is added as a regressor. In contrast, once our horizon measures are included, the coefficient estimate on the inverse of turnover becomes insignificant, or even turns negative. At the stock level, aggregate long-horizon fund holdings associated with our horizon measures again win out, in general, at the long and short terms.

This paper is related to a growing literature that uses holdings information to better understand the trading behavior and managerial skills possessed by fund managers.[7] However, when this literature has investigated the relation between investment horizon and fund performance, it has done so in an indirect way by using the reported turnover ratio of funds, rather than–as we do–through a detailed analysis of trades implied by periodic portfolio holdings data.[8] The results from this literature are mixed: Using net returns, Carhart (1997) finds a negative relation between the turnover ratio and performance, whereas, using gross returns based on holdings, Grinblatt and Titman (1993) and Wermers (2000) provide evidence of a positive relation. Chen et al. (2000) also provide evidence that funds that trade more frequently have marginally better stock selection skills than funds that trade less often, prior to expenses.[9] Our paper shows that the relation between holding-period and performance is much better

[7]This literature is too vast to review thoroughly in this paper. 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).

[8]Some studies focus on the distinction between value and growth funds. Especially among practitioners, long-term funds tend to be associated with value funds and short-term funds tend to be associated with growth funds. However, in the mutual fund literature, growth funds are often found to perform the best (e.g., Grinblatt and Titman, 1993, and Daniel et al., 1997). One issue is that these investment style classifications tend to be rather broad and often unreliable because they are self-designated by funds (see Sensoy, 2009).

[9]A recent paper by Pastor et al. (2015) finds that, while cross-sectionally turnover rate does not predict fund performance, time-series changes in turnover rate do predict fund performance.

understood through our new portfolio-holdings based measures of holding horizon.

Our paper is also related to the literature that studies, using 13-F data, whether institutional investors are informed by looking at the relation between institutional ownership or institutional trading and future stock returns. While Cai and Zheng (2004) document a negative relation between institutional trading and the next quarter's stock returns, other papers (see Gompers and Metrick, 2001, Nofsinger and Sias, 1999) document the opposite relation. Interestingly, Yan and Zhang (2007) show that it is important to separate short-term institutional investors from long-term institutional investors.[10] They document that short-term institutions are better informed than long-term institutions: short-term institutional trading forecasts future stock returns, while long-term institutional trading does not.[11] Cremers and Pareek (2011) present evidence suggesting that the presence of short-term institutional investors can help explain some stock pricing anomalies such as the momentum, reversal, and share issuance anomalies.

Importantly, we show that, when we analyze the portfolio holdings of mutual funds, the above-mentioned findings of Yan and Zhang (2007) are reversed: long-horizon funds are better informed than short-horizon funds.[12] Indeed, long-term funds invest in stocks that deliver higher long-run cash flow news and earnings than stocks held by short-term funds. In contrast, short-term funds tend to merely exploit short-term strategies, such as engaging in momentum strategies.

Our paper proceeds as follows. Sections 2 and 3 discuss our empirical methodology and the data sets that we use. Section 4 presents our main empirical findings, where we focus on the performance

[10]Several other studies, focused on institutional investors, also characterize investors as either short-term or long-term. For example, the distinction between short- and long-term institutions appears to matter when investigating the effect of shareholder composition on corporate decisions (e.g., Bushee, 2001 and Gaspar et al., 2005). Almost all these studies use a measure of turnover ratio proposed by Gaspar et al. (2005) to classify investors, which is very similar to the reported mutual fund turnover ratio. Our results suggest an improved approach to classify institutions as short- or long-term investors in a given stock.

[11]Yan and Zhang (2009) do not distinguish between different types of institutions, such as pension funds, insurance companies, and mutual funds.

[12]We focus on mutual funds instead of all institutional investors. Mutual funds are included as part of aggregate portfolio lists in the 13-F data, but only at the fund advisor level. There is a good deal of heterogeneity in the investment horizon of different funds managed by the same advisor that is lost in the 13-F data; in addition, many advisors manage pension and other types of accounts, all of which are aggregated in 13-F data.

of stocks held for differing horizons by mutual funds. Section 5 shifts to the fund level, for which we present estimates of performance based on holding periods, while Section 6 shows further evidence on the uniqueness of our holdings horizon measures. Section 7 concludes.

2 Methodology

2.1 Measures of fund investment horizon

Based on mutual fund holdings, we propose four alternative fund horizon measures: two ex-post and two ex-ante measures. These four measures are calculated as value-weighted holding periods of all stocks held in a fund portfolio, but they differ in how to define the holding horizon of a stock.

The first measure, termed the "Simple Horizon Measure," calculate the holding horizon of a stock as the time span with nonzero holdings–that is, the length of time from the initation of a position to the time that the stock is fully liquidated by a fund. Letting $h^{(1)}_{i,j,t}$ denote, in this measure, the holding horizon of stock i held by fund j at time t, then

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

where the stock is purchased at time k and sold at time s. This measure does not account for changes in the number of shares of stock i held by fund j during the holding period, so the holding period of stock i stays constant throughout the span with non-zero holdings.

Our second measure, termed the "FIFO Horizon Measure," addresses this issue by assuming that the first purchased shares are sold first (first-in-first-out). Let $h^{(2)}_{i,j,t}$ denote, in this measure, the holding horizon of stock i held by fund j at time t. Then

$$h^{(2)}_{i,j,t} = \begin{cases} \dfrac{\sum\limits_{k,s}^{k \leq t < s} N_{i,j,k,s} * (s-k)}{N_{i,j,t}}, & \text{if } N_{i,j,t} > 0 \\ 0 & \text{if } N_{i,j,t} = 0 \end{cases} \tag{2}$$

where $N_{i,j,k,s}$ is the number of shares of stock i purchased by fund j at time k and sold at time s,

$k \leq t < s$, and $N_{i,j,t}$ is the number of shares of stock i held by fund j at time t with $N_{i,j,t} = \sum_{\substack{k,s \\ k \leq t < s}} N_{i,j,k,s}$[13] Because construction of both Simple and FIFO measures uses future information, they are ex-post measures.

To implement investment horizon measures in real time, we further consider two ex-ante measures that only use information available at time t. Our third measure, termed the "Ex-Ante Simple Measure," modifies the Simple measure by using information only available at t. Let θ_j be the date that is two years after the initiation date of fund j. Let $h^{(3)}_{i,j,t}$ denote, in this measure, the holding horizon of stock i held by fund j at time t, then

$$h^{(3)}_{i,j,t} = \begin{cases} t-k, & \text{for } k \leq t \text{ and } t > \theta_j \\ 0, & \text{otherwise,} \end{cases} \tag{3}$$

where the stock is purchased at time k.[14]

The fourth measure, termed the "Duration Measure," is a modified version of the measure that was proposed by Cremers and Pareek (2011). This fourth measure is constructed based on past and current information, and accounts for changes in stock positions. It can be considered as an 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 at time t. Let W be a specified window ending at time t. $B_{i,j}$ is the percentage of total shares of stock i bought by fund j between time $t-W$ and time t, while $H_{i,j}$ is the percentage of total shares outstanding of stock i held by fund j at time $t-W$. Then

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

where $\alpha_{i,j,s}$ is the percentage of total shares outstanding of stock i bought or sold by fund j during period

[13] As a concrete example–keeping in mind that the ex post measures "look ahead" to see when a position is liquidated–consider a fund that today purchases 1000 shares of General Electric (GE) and purchases another 100 shares in one year. In two years it sells 300 shares and in three years it liquidates the position. In this example, the holding period of GE, today and in one and two years, is 3 years using the Simple measure. The holding period of GE using the FIFO measure is (700*3+300*2)/1000 = 2.7 years today; and it turns out to be (700*3+300*2+100*2)/1100 = 2.6 years in one year and (700*3+100*2)/800 = 2.9 years in two years.

[14] We also construct an ex-ante simple measure without the two-year warm-up period, and the two versions of modified simple measures have a correlation of 99%. The results to follow in later sections are very similar using either of these two modified versions.

s, while $\alpha_{i,j,s} > 0$ for buys and $\alpha_{i,j,s} < 0$ for sells.[15,16] Besides using ex ante information, this duration measure differs from the FIFO measure in two aspects: (1) it uses information on the percentage of total shares outstanding traded or held by a fund, and (2) it includes the shares sold during the specified window W in the denominator of Equation (4).

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

$$hf_{j,t} = \sum_{i=1}^{M_{j,t}} \omega_{i,j,t} h_{i,j,t}^{(m)}, \quad m = 1, 2, 3, 4 \tag{5}$$

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

To compare our results with prior studies in the literature, we also use the inverse of turnover as a fund horizon measure. The turnover ratio is either obtained directly from the Center for Research in Securities Prices (CRSP) mutual fund database, or calculated based on a mutual fund's equity holdings. To calculate the holdings-based turnover, we first compute quarterly turnover as the minimum of purchases and sales executed by a fund during a quarter, divided by the fund's average total net assets during the quarter (Yan and Zhang, 2007). Then, we average this quarterly churn rate over the past year (or, alternatively, past three years) to get holding-based turnover. See the Appendix for the detailed definition.

[15]Cremers and Pareek (2011) study all institutional investors using 13f data. They consider the past five years to calculate the duration measure. Since mutual funds tend to invest for a shorter term than other institutional investors, we consider the specified window W to be three years of past data. We also tried four years of past data, and obtained similar results.

[16]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.

2.2 Measures of short- and long-horizon fund holdings and trades

A fund manager who possesses information of long-term profitability of a stock is likely to hold the stock for a long period; a fund manager who has information of short-term gains of a stock is likely to hold the stock for a short time. Examining the performance of stocks that reflect consensus opinions of one type of funds over another can be a simple and powerful method to test whether the two groups possess differential skills.[17] We, therefore, aggregate holdings and trade information from long-horizon funds and short-horizon funds separately, then study the future performance of stocks that are largely held or traded by one type of funds vs. the other.

To define long-horizon fund holdings (LFH) and short-horizon fund holdings (SFH), we first rank all funds in each month into terciles, based on the different measures of fund investment horizon that we have discussed in the preceding section. Funds in the top tercile are classified as long-horizon funds, and those in the bottom tercile are classified as short-horizon funds. Similar to Yan and Zhang (2009), we calculate LFH (SFH) as the aggregate holdings of a given stock by long- (short-) horizon funds divided by that stock's total number of shares outstanding.

If long-horizon fund managers possess skills different from short-horizon fund managers in picking stocks, LFH and SFH across stocks are likely to have low correlation. On the other hand, mutual funds often hold stocks for reasons unrelated to their perceived future performance, due to legal restrictions, the requirements of investment objectives and styles, fund flows, competitive pressures, etc (Del Guercio, 1996; Brown, Harlow, and Starks, 1996). If skill-unrelated stock selections for the two groups of funds are somewhat overlapped, then LFH minus SFH can remove the common non-performance stock-picking and thereby sharpens the differential information contained in the consensus opinions of long-horizon funds relative to short-horizon funds. Therefore, we study stock future performance with respect to

[17] As noted by Wermers, et al. (2012), a stock-level analysis serves as a "magnifying glass" on the collective stock-picking wisdom of fund managers; they develop a stock return predictive measure based on an efficient aggregation of the portfolio holdings of all actively managed U.S. domestic equity mutual funds. Jiang et al. (2014) is another recent application of a stock level analysis using mutual fund over- and under-weighting stock decisions.

LFH minus SFH: If long-horizon fund managers have stock selection skills, we would expect that stocks with a large value of LFH minus SFH have good long-term performance; If short-horizon fund managers have stock selection talents, we would expect that stocks with a small value of LFH minus SFH have good short-term performance.

To capture recent information about the consensus opinion of the value of a stock, we define a long-horizon fund trade ($LFTrade$) as the 3-month change in long-horizon fund holdings, and a short-horizon fund trade ($SFTrade$) as the 3-month change in short-horizon fund holdings. Specifically, $LFTrade_t = LFH_t - LFH_{t-3}$ and $SFTrade_t = SFH_t - SFH_{t-3}$. Since most funds report their holdings at a quarterly frequency, this 3-month change measure captures trades for most funds.[18] In addition, because LFH and SFH are defined at a monthly frequency, a 3-month change in these fund holdings can capture aggregate trade information from either long- or short-horizon funds, regardless of which months of a calendar quarter funds report their quarterly holdings.

Although both fund holdings and trades can reflect manager skills, their relative informativeness is likely to be different for long-horizon funds versus short-horizon funds. If long-horizon fund managers are talented in selecting stocks that perform well in the long-run, we would expect that those managers take time to strategically accumulate their stock positions. Moreover, these well-performing long-term stocks are held for a long time, and are not traded frequently by long-horizon funds, so it is likely that $LFTrade$ is less informative than LFH in reflecting long-run stock performance. This may not be the case for short-horizon funds. If short-term opportunities are not taken quickly, then they may disappear. Therefore, $SFTrade$ is likely to be more informative than SFH in reflecting short-run stock performance.

[18] We also study the definition of fund trades as a 6-month change in fund holdings, the results are very similar.

2.3 Evaluating stock and fund performance

We use two methods to examine fund managers' stock-selection skills across funds with different holding horizons. The first method, the stock-level analysis, aggregates holdings and trade information from long-horizon and short-horizon funds separately, then studies the relation between future stock performance and the aggregate holdings or trading information from long-horizon funds relative to short-horizon funds (LFH minus SFH or $LFTrade$ minus $SFTrade$). The second method, the fund-level analysis, directly investigates the relation between future fund performance and fund holding horizons.

In both analyses, we rely mainly on a sorted-portfolio approach. Specifically, each month we sort stocks into quintiles in the stock-level analysis based on relative aggregate fund holdings or trades (LFH minus SFH or $LFTrade$ minus $SFTrade$), or we sort funds into quintiles in the fund-level analysis based on the fund holding horizon measures. We then calculate buy-and-hold stock or fund portfolio returns over the next month, and up to the next five years. The portfolios are equally weighted in the formation month, then updated using a buy-and-hold strategy.

To evaluate portfolio performance, we use both buy-and-hold portfolio returns and risk-adjusted abnormal returns. We select 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 risk exposure. The four-factor alphas and DGTW-adjusted returns reflect managerial skills after accounting for risk. Specifically, to construct the former, we download monthly returns on component portfolios that are used to construct Carhart's four factors from Ken French's web site,[19] then compound these monthly returns on each component portfolio into a holding horizon of interest. Analogous to the construction of monthly four factors, we calculate four factors with different holding horizons from one month to five years. For example, similar to Kamara et al. (2014), HML of horizon n is the average of n-period returns of small value portfolios and big value portfolios, minus the average of n-period returns

[19] See $http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html$.

of small growth portfolios and big growth portfolios. The four-factor alpha is obtained by regressing buy-and-hold returns on the corresponding Carhart four factors with the same holding horizon.

To obtain DGTW-adjusted returns for a portfolio over n periods, we compound monthly DGTW benchmark returns for the portfolio over n periods, then subtract it from the similarly compounded returns of the portfolio. DGTW benchmark portfolios are reconstituted every quarter instead of every June to better control for both active and passive style effects. 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 monthly DGTW benchmark return for a stock is the value-weighted return of one of 125 DGTW portfolios to which the stock belongs.

To improve statistical power, we use overlapping buy-and-hold returns or abnormal returns, reconstituted at a monthly frequency. We then apply the Newey-West approach to calculate standard errors to account for autocorrelation and heterogeneity. For example, in the test of three-year portfolio performance, we use a lag of 35 in the Newey-West formula to compute standard errors.

3 Data

We study U.S. active equity mutual funds from the intersection of Thomson Reuters mutual fund holdings database and the Center for Research in Securities Prices (CRSP) mutual fund database. Those two databases are linked using MFLINKS, available 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 TNA as weights, except that fund age is the oldest share class and TNA is the sum of net assets across all share classes belonging to a given fund. For the sample selection, we follow the same 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 five 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.[20]

The final sample includes 2,969 equity funds over a sample period that starts at the end of March of 1980. The sample period of fund holdings ends in 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 of 1980 to December of 2012. Stock returns, prices, and shares outstanding are obtained from CRSP. Accounting data, such as earnings, come from COMPUSTAT, and analyst earnings forecasts come from the Institutional Broker's Estimate System (IBES) summary unadjusted file.

3.1 Summary statistics

Table 1 reports some summary statistics for our mutual fund sample. On average, equity mutual funds hold stocks with total assets of $764 million for a period of approximately three and half years in terms of the Simple horizon measure or two and a half years in terms of the FIFO measure. The average holding periods in terms of the ex-ante Simple and Duration measures are smaller because they only use past information. CRSP reported turnover ratio is almost 90%. As expected, the turnover rate calculated using fund holdings averaged over the past four quarters is lower and about 64% because

[20] As a robustness check, we also add another filter requiring two years of holdings data. This filter eliminates 148 funds to avoid the possibility that a fund has a short investment horizon simply because there is a short history. The results of this paper stay the same when we include these 148 funds.

some funds engage in intraquarter trading that cannot be captured by holdings (Puckett and Yan, 2011) and may also engage in non-equity position trading. The average fund age is almost 15 years. Due to the mushrooming of small funds in the recent decade, the median fund age is much smaller than the average and approximately 10 years.

The portfolio characteristics considered are the cross-sectional average quintile ranks of stocks sorted according to size, book-to-market ratio, momentum, trading volume (share turnover), and illiquidity measured by either the Amihud's measure or the bid-ask spread with one being the lowest and five being the highest quintile. As noted by Ibbotson and Idzorek (2014), share turnover can measure the popularity of a stock.[21] This is distinct from liquidity. Indeed, a large company with low share turnover might be very liquid, but relatively unpopular. Consistent with previous studies (e.g., Falxenstein, 1996, and Chan et al., 2002) equity mutual funds, on average, tend to prefer larger companies, past winners, more traded stocks, and more liquid stocks. We also report the average portfolio loadings on the Carhart's four-factor model. The average market beta is 0.95. Equity funds have positive exposures to both the SML and momentum factors whereas they have a small negative exposure to the HML factor.

To better understand fund characteristics and stock holdings' characteristics of short-term institutions vs. long-term institutions, we sort all the mutual funds into quintiles according to our horizon measures, then calculate the average fund and stock characteristics in each quintile. Panel B of Table 1 presents the results using the simple horizon measure.[22] There are systematic differences between long and short-term mutual funds in their characteristics and in their investment preferences. Notice that total net assets and fund age increase with fund holding horizons and that expense ratio decreases with fund holding horizons. Put differently, long-term funds are large and long-established funds with a rel-

[21]The share turnover is defined as the prior quarter average of the daily turnover ratio. The daily turnover ratio is defined as the daily trading volume divided by the number of shares outstanding. We adjusted the volume of stocks traded in the Nasdaq following Anderson and Dyl (2005).

[22]Results with the other horizon measures are qualitatively similar.

atively small expense ratio.[23] Moreover, there is a wide dispersion in the fund investment horizons. For example, the average simple measure in each fund quintile suggests that short-, medium-, and long-term funds hold stocks for about one, three, and seven years, respectively. There are also clear patterns in the characteristics of stock holdings of funds with different holding horizons. Long-term funds tend to prefer larger companies, more value firms (high book-to-market), less past winners, and less popular but at the same time more liquid stocks than short-term funds. These stock preferences are also reflected in the factor exposures. Indeed, long-term funds exhibit lower market beta and exposure to the SML factor than short-term funds. Furthermore, long-term funds have a positive (negative) exposure to the HML (momentum) factor, whereas the sign of the exposure is reversed for short-term funds.

Since the 1990s, many funds offer multiple share classes representing ownership interests in the same portfolio, but using different fee structures. The three share classes commonly offered by multiple-class funds are denoted A, B and C.[24] By offering different share classes mutual funds can try to cater to different types of investors. 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." An interesting question is whether long-term mutual funds try to attract more long-term investors than short-term funds. This is important because if this is not the case, then there could be some trade pressure to the manager due to short-term investment decisions of mutual fund investors. Consistent with long-term funds catering to long-term investors, Table 1 Panel B shows that long-term funds have more assets in share class A and charge higher maximum and minimum front-end load fees than short-term funds.[25]

To better characterize how long a fund takes to accumulate or lower a position in a row, we calculate the time span of consecutive purchases (sales) by a fund as the value-weighted average of time span of

[23] Despite the lower expense ratio, the revenue fees of long-term funds is not necessarily lower than short-term funds given the difference in size.

[24] 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.

[25] Class A is identified in the sample as the share class that charges a front-end load. The maximum and minimum load fees are computed among funds that charge a front-end load.

purchases (sales) of all stocks in the fund portfolio. The time span of a consecutive purchase must start with the purchase of a stock and end with another purchase, with no sales in between. Similarly, the time span of a consecutive sale must start with the sale of a stock and end with another sale, with no purchases in between. Table 2 reports the summary statistics of time span, in terms of the number of months, that long-horizon and short-horizon funds use to purchase or sell a stock in a row.

Long-horizon funds take much longer time to either continuously increase or continuously decrease their positions than short-horizon funds. Indeed, long-horizon funds take at least 18 (23) months on average to accumulate (reduce) a position compared to four (eight) months for the short-horizon funds. Interestingly and surprisingly, some long-horizon funds can take about three to four years to keep increasing or decreasing a position. This finding suggests that long-horizon funds are able to take time to strategically accumulate or curtail a position.

Table 3 reports the correlation matrix of our investment horizon measures, CRSP reported turnover, and holdings-based turnover. While there is a high correlation among our measures of investment horizons with values ranging from 0.77 to 0.89, the correlations between our horizon measures and turnovers, especially CRSP reported turnover, are smaller in magnitude, around 0.5 in absolute value. The correlations among long-horizon fund holdings that are constructed using different fund horizon measures are quite high, roughly 0.7—0.9. The correlations among short-horizon fund holdings have a similar magnitude. However, the correlation of LFH and SFH is quite low. This means that long- and short-horizon funds are interested in different stock groups in general.

3.2 Persistence of fund horizon measures

If fund managers are skillful at exploiting private information that is profitable over different horizons, we would expect that managers intentionally choose long-horizon investments or short-horizon investments accordingly. An interesting question is whether horizon skills tend to persist. To check this persistence, each month, we sort fund portfolios into quintiles according to one of our horizon measures,

the Simple, FIFO, Ex-Ante Simple, or Duration Measure. Q1 consists of funds with the lowest holding periods and Q5 consists of funds with the highest holding periods. Figure 1 depicts the average fund holding horizons of each quintile at the formation period and subsequent first to 20th quarter.

Fund investment horizons exhibit long-term stability. The ranking of the quintile portfolios in the 20th quarter after the formation period remains identical to that in the formation period. Take the Simple Horizon Measure as an example. The average investment periods are 1.2, 2.2, 3.1, 4.3, and 6.9 years for the five quintiles at the formation period, while the average investment periods become 2.2, 2.7, 3.5, 4.3, and 6.6 years in the 20th quarter after the formation period. Moreover, this remarkably persistent pattern is evident for both ex-post and ex-ante horizon measures. Thus, funds appear to self-select into a particular type of holding horizon–long or short.

4 Empirical results on stock performance

In this section, we examine whether the consensus opinion of long-horizon funds contains information about long-term stock performance, and whether the consensus opinion of short-horizon funds contains information about short-term stock performance. The low and positive correlations between LFH and SFH, as shown in Table 3, suggest that long- and short-horizon fund managers are generally interested in different groups of stocks, although they may select some stocks in common. Moreover, as mentioned earlier, both long- and short-horizon funds may select stocks for non-performance related reasons. Therefore, we use relative holdings information of LFH minus SFH to classify stocks that favored by one fund group vs. the other. This simple method can help to identify stock selection skills due to differential information as opposed to other reasons for holding stocks. Similarly, we use the relative trade information embedded in $LFTrade$ minus $SFTrade$ to single out stock groups that are likely to reflect skills of long- relative to short-horizon fund managers. Then, we compare future stock performance over different holding periods of stock portfolios that are preferred by long-horizon versus

short-horizon mutual funds.

4.1 Informativeness of fund holdings

We first examine whether fund holdings can provide valuable information about future stock performance. Each month, stocks are grouped into quintiles according to the relative holdings of LFH minus SFH. The top quintile (Q5) contains stocks that are held more by long- and less by short-horizon funds, whereas the bottom quintile (Q1) consists of stocks that are held more by short- and less by long-horizon funds. We then calculate buy-and-hold portfolio returns for each quintile portfolio over the next month and up to the next five years after portfolio formation. Stocks in each quintile are weighted equally at the formation month, then weights are updated following a buy-and-hold strategy. If a stock drops out during a buy-and-hold period, we adjust the weights of the existing stocks. These buy-and-hold portfolio returns are then averaged over time. Figure 2 shows the buy-and-hold portfolio performance of the top and bottom quintiles over various holding periods, using either the Simple or ex-ante Simple measure as the horizon measure. It also displays the return spread of the long-short position, which is long the top quintile and short the bottom quintile, along with 10% confidence intervals.

The results indicate that stocks largely held by long-horizon funds exhibit much better long-term performance than those largely held by short-horizon funds, whereas there is no evidence that stocks largely held by short-horizon funds perform better in the short run. The first column of Figure 2 shows that the buy-and-hold returns for stocks in the top quintile (Q5) are larger than those in the bottom quintile (Q1) for all holding periods. Although those returns for both stock quintiles increase with the holding period, the increase is much larger for the top quintile than for the bottom quintile. This leads to an increasing positive spread of the long-short position. Consider the 5-year (20-quarter) performance as an example. Using both measures, the top quintile exhibits an average buy-and-hold return of about 92%, whereas the bottom quintile exhibits an average buy-and-hold return of about 70%. The difference is more than 22% for five years, or 4.4% per year, which is statistically and economically significant.

Even after adjusting for risk exposure using Carhart (1997) four-factor alphas or DGTW (1997) adjusted returns, the long-term outperformance of stocks with large ownership by long-horizon funds is still pronounced and there is no evidence of stock-picking abilities of short-horizon funds based on fund holdings. Indeed, the last two columns of Figure 2 illustrate that both of the two risk-adjusted returns for the top quintile increase with the holding horizon, whereas for the bottom quintile, the four-factor alpha is negative and decreasing with the horizon, and DGTW-adjusted returns are close to zero at all horizons. As a result, the abnormal returns for the long-short portfolio are significantly positive at all horizons, and exhibit an increasing pattern with the holding horizon.[26]

Take the five-year horizon as an example. The four-factor alphas and DGTW adjusted returns for the top quintile portfolio are about 4% and 14%, respectively, for both the Simple and ex-ante Simple measures. For the bottom quintile portfolio, DGTW adjusted returns are roughly zero, and the four-factor alpha are about -12% and -4% for the Simple and ex-ante Simple measures, respectively. As a result, the abnormal returns on the long-short portfolio are at least about 8% and 13% in terms of four-factor alphas and DGTW adjusted returns, respectively, over five years, or at least about 1.6% to 3.6% per year, both economically and statistically significant.

Overall, using both ex-ante and ex-post horizon measures, stocks with large ownership by long-horizon funds have superior long-term performance, although the results using the ex-ante measure are slightly weaker. Unreported results show that this finding is confirmed when we use the FIFO or the Duration measure. Therefore, 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 fund investment horizon measures.[27]

The preceding results using fund holdings information along with the low correlation between LFH

[26] As a robustness check, we also use a five-factor model that includes the Carhart four factors plus Pástor and Stambaugh's (2003) liquidity factor. All results in this paper remain quite similar using the 5-factor alpha instead of the 4-factor alpha to measure abnormal returns.

[27] For instance, with ex-post measures of holding horizon, long-horizon investors may simply be those investors who were the beneficiaries of more good luck, which motivated them to continue holding positions for a longer period.

and SFH imply that long- and short-horizon funds are generally interested in different groups of stocks. One possibility is that stocks with superior long-term performance are different from stocks with good short-term performance. Long-horizon fund managers target at and are able to select stocks with good long-term returns. Another possibility is that a skilled long-term fund manager strategically avoids picking a stock that is popular among short-horizon funds. Because short-term funds are likely to move money in and out of a stock frequently, this behavior can generate a temporarily adverse price impact. By not selecting such a stock, long-term funds avoid the adverse consequences of a temporarily adverse price impact, such as experiencing fund outflows that follow underperformance in the short-run.

4.2 Informativeness of fund trades

Fund holdings and trades are likely to reflect managerial stock-picking talents differently for long- and short-horizon funds. If fund managers are skillful in stock selection, fund holdings tend to incorporate their current as well as historical superior information about the value of stocks, whereas fund trades essentially reflect their current superior information. We therefore would expect that fund holdings are more informative about long-horizon funds' stock selection skills than trades. The rationale is that if long-horizon funds apply techniques to select stocks with superior expected long-term performance, they are likely to buy and hold those best picks for a long time. Those best picks appear in trades only at the time of purchase (possibly a sequence of purchase), while they appear in fund holdings for a long period. Moreover, long-horizon funds tend to hold but not frequently trade their best selected stocks. On the other hand, they are likely to trade other stocks in their portfolio that are less attractive for non-performance related reasons, such as to incorporate fund flows or to stay close to their benchmark. In contrast, if short-horizon funds use techniques to select stocks with temporarily good returns, then they have to trade quickly, otherwise, short-term profits can disappear. Therefore, fund trades can be more useful than fund holdings to capture skills of short-term funds that are more likely to take advantage of short-term information (see Chen et al., 2000). Accordingly, this section uses fund trades

to analyze stock selection skills.

Our first test investigates whether fund purchases reflect stock selection skills. We sort stocks into quintiles based on long-horizon fund purchases relative to short-horizon fund purchases and then study future performance of quintile portfolios. Specifically, stocks are assigned to five groups each month based on positive $LFTrade$ minus positive $SFTrade$. The top quintile includes stocks that are purchased more by long-horizon funds than by short-horizon funds, and the bottom quintile consists of stocks that are purchased more by short-horizon funds than by long-horizon funds. Since common purchases from both long- and short-horizon funds can be driven by reasons others than selection skills, our sorting based on the relative purchase can help to remove common non-skill related purchases, and thus sharpens the identification of purchases related to differential selection skills.

Figure 3 presents the stock portfolio performance for the top (Q5) and bottom (Q1) quintiles, as well as for the long-short portfolio that buys the top quintile and sells the bottom quintile, over next month and up to five years after the sorting month using the Simple and ex-ante Simple horizon measures. A few points are noteworthy. First, different from the pattern based on fund holdings in Figure 2, short-term performance of the bottom quintile can sometimes be better than that of the top quintile. Second, we see some evidence that fund purchases can indicate skillful stock selection of short-term funds. Stocks largely purchased by short-horizon funds can exhibit positive, although small, abnormal returns. This is different from the result based on fund holdings in Section 4.1 where stocks predominantly held by short-horizon funds have negative abnormal returns. Third, abnormal returns of stocks that are largely purchased by long-term funds (Q5) are positive over the long term. Even so, they are smaller in magnitude and less statistically significant compared with long-term abnormal returns on stocks that are predominantly held by long-term funds, which are shown in Section 4.1. Finally, the long-short portfolio that buys the top quintile and sells the bottom quintile has positive alphas and positive DGTW adjusted returns at a long horizon. This result is also weaker than what obtained using

fund holding information. Overall, as expected, fund purchases reveal managerial skills of long-term funds, but less effectively than fund holdings; fund purchases can weakly indicate managerial skills of short-term funds.

Similarly, we investigate the informativeness of fund sales. Stocks are sorted into quintiles based on the relative sales by long-horizon funds versus sales by short-horizon funds, or the absolute value of negative values of $LFTrade$ minus the absolute value of negative values of $SFTrade$. The top quintile (Q5) includes stocks that are sold largely by long-horizon funds relative to short-horizon funds, while the bottom quintile (Q1) consists of stocks that are sold predominately by short-horizon funds. Figure 4 presents results using the Simple and ex-ante Simple horizon measures.

Notice that stocks in Q5 that are sold largely by long-horizon funds generally exhibit good abnormal returns at a long horizon. One possible explanation is that long-horizon funds are able to pick stocks with good long-run returns. Even though they sell some of their holdings due to outflows or to exploit new investment opportunities, these stocks continue to perform well after they sell. Another possible explanation is that long-horizon funds sell some stocks early because they want to realize some profits and reduce the risk of holding the position. In addition, we notice that short-term fund sales indicate short-term poor performance. Stocks largely sold by short-horizon funds tend to have negative abnormal returns.

4.3 Long holding-period stocks versus short holding-period stocks

If long-horizon fund managers are skillful in selecting stocks with good long-run performance, we would expect that stocks that are actually held by long-horizon funds for a long period perform better than stocks that these same funds hold for a short period. Similarly, if short-horizon fund managers are skillful at selecting stocks with good short-run performance, we would expect that stocks that are actually held by short-horizon funds for a short period perform well in the short term. This section refines the informativeness of fund holdings and fund trades about selection skills by distinguishing stocks that

are on average held for a long or short period in long-horizon or short-horizon fund portfolios.

We first define average holding horizons of stocks. Let $h_{i,j,t}$ denote the holding horizon of stock i held in fund j at time t, then the average holding horizon of stock i owned by long-horizon funds, long-horizon fund holding period, is defined as

$$hs_{i,t}^{long} = \sum_{j=1}^{M_{i,t}^{long}} \eta_{i,j,t} h_{i,j,t}, \tag{6}$$

where $M_{i,t}^{long}$ is the number of long-horizon funds that hold stock i at time t, and $\eta_{i,j,t}$ is the ratio of 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 at time t. Similarly, we define the short-horizon fund holding period of stock i as

$$hs_{i,t}^{short} = \sum_{j=1}^{M_{i,t}^{short}} \eta_{i,j,t} h_{i,j,t}. \tag{7}$$

If the long-horizon fund holding period of a stock is larger (smaller) than the median holding period among all stocks that are owned by long-horizon funds, then we say this stock has a long (short) holding period by long-horizon funds. Analogously, if the short-horizon fund holding period of a stock is larger (smaller) than the median holding period among all stocks that belong to short-horizon funds, then we say this stock has a long (short) holding period by short-horizon funds.

We consider four stock portfolios that are constructed as follows. First, we classify stocks into quintiles each month based on LFH minus SFH, with Q5 consisting of stocks that are largely held by long-horizon funds, and Q1 consisting of stocks that are largely held by short-horizon funds, as we have done in section 4.1. Then we divide stocks in Q1 (Q5) into two groups depending on whether the short-horizon (long-horizon) fund holding period of a stock is above the median holding period for all stocks belonging to short-horizon (long-horizon) funds. Using the ex ante Simple measure, Figure 5 presents the performance, along with the 10% confidence intervals, for the four stock portfolios in the next month, and up to the next five years after the portfolio formation month.

Clearly, stocks that have a long holding period by long-horizon funds have the best long-term future

performance among the four stock groups. For example, at a five-year horizon, this group of stocks obtain the buy-and-hold return of 94%, the four-factor alpha of 7%, and the DGTW adjusted return of 14%, the highest values among four groups. All these gross and abnormal returns are all statistically and economically significant. In contrast, there is mixed evidence of good long-term performance for stocks that have a short holding period by long-horizon funds; and there is no evidence of short-term good performance for stocks that have a short holding period by short-horizon funds. Overall, these results suggest that the long-run outperformance of long-horizon funds stems from their long-term stock positions.

Similarly, we combine fund purchase information and stock holding periods to form four stock portfolios and examine the future performance of these four portfolios. In unreported results, we notice that stocks that are largely purchased by long-horizon funds and are held for a long period have the best long-term performance among the four stock groups. In addition, there is weak evidence of good short-term performance of stocks that are largely purchased by short-horizon funds and are held for either a short or a long period. These results further confirm that fund trades contain information regarding the selection skills of both long-horizon and short-horizon funds.

4.4 Cash-flow information

In this section, we delve into a central issue regarding the economic source of managerial skills: the fundamental cash-flow information reflected in funds' stock selection. If fund managers take use of information related to firm fundamentals in picking stocks, then we would expect that long-horizon fund managers are skillful at exploiting long-term firm fundamentals, and that short-horizon fund managers are good at using short-horizon fundamental information. Therefore, we would expect the pattern of future cash-flow information for different stock portfolios to be analogous to the pattern of future stock portfolio returns that have been discussed in previous sections.

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.[28] $CFnews$ is the cash-flow component of unexpected quarterly returns and is obtained via a Campbell-Shiller decomposition. The Appendix describes the details of the construction of this variable. 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.[29] 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 of 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 6 displays cumulative cash-flow information over the next 1 to 20 quarters following the stock portfolio formation date. Specifically, we first sort stocks into quintiles according to relative fund holdings or trades, as we did in the previous sections. Then we calculate the cross-sectional mean of each information variable 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.

Let us first focus on the first two rows for the cash-flow results using fund holdings to sort stocks.

[28] Since EAR is available only at the quarterly frequency, we construct all variables of information shocks at the quarterly frequency for simplicity.

[29] We also use EAR as buy-and-hold return during the [-2, +2] trading-day-window around an earnings announcement date. Both definitions of the EAR deliver very similar results in our tests to follow.

Notice that all four cumulative fundamental variables are positive, and increase with holding horizons for stocks that are largely held by long-horizon funds (Q5). Untabulated results confirm that these positive cumulative cash-flow results for Q5 are statistically significant. This result suggests that the long-run outperformance of stocks predominantly held by long-horizon funds is associated with superior long-term firm fundamentals. In contrast, cumulative cash-flow variables can be negative ($CFnews$), positive (FRV), or close to zero (EAR and adjusted EAR) for stocks that are largely held by short-horizon funds (Q1). All of these four cash-flow variables for the long-short portfolio that buys Q5 and sells Q1 are significantly positive at the horizons of six quarters and longer.

When relative fund purchase is used to group stocks, as shown in the third and fourth rows of Figure 6, stocks largely purchased by short-horizon funds (Q1) have stronger short-term cash flows than stocks largely purchased by long-horizon funds (Q5). All four variables at a short horizon for the long-short portfolio that buys Q5 and sells Q1 are negative, and two of them, $CFnews$ and FRV, are statistically significant. On the other hand, long-term firm fundamentals are stronger for stocks predominantly purchased by long-horizon funds (Q5) relative to those largely purchased by short-horizon funds (Q1). In the long run, all four fundamental variables for the long-short portfolio are positive. $CFnews$ is statistically significant at horizons of one year and longer. When relative fund sale is used to group stocks, we see that, in the last two rows of Figure 6, cumulative cash flows at a long horizon are stronger for stocks largely sold by long-horizon funds (Q5) than those largely sold by short-horizon funds (Q1). This result again indicates that firm fundamentals remain attractive after stocks are sold by long-horizon funds.

We also check future cash flows of stock portfolios in terms of the cash-flow component of buy-and-hold portfolio returns instead of cumulative cash-flow variables. Specifically, using a buy-and-hold portfolio approach, we replace returns with the cash-flow 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 get using cumulative cash-flow variables.

In summary, the patterns of portfolio performance in terms of cash flows are quite analogous to the pattern in terms of portfolio returns. These cash-flow results indicate that stock selection skills are associated with superior ability in exploiting firm fundamentals. Long-horizon fund managers are able to buy and hold stocks with strong long-term firm fundamentals, and that short-horizon fund managers can buy stocks with temporarily good cash flows.

5 Empirical results on fund performance

In this section, we examine the relation between fund investment horizon and performance at the mutual fund level, using both a sorted fund portfolio approach and Fama-MacBeth regressions that control for fund characteristics.

5.1 Fund performance using a sorted portfolio approach

First, using a sorted fund portfolio approach, we group funds into quintiles each month based on the different fund horizon measures that we have discussed in Section 2.1. For each quintile, we calculate the buy-and-hold cumulative fund portfolio returns at a horizon of the next month, and up to the next five years.[30] Portfolio weights are equal at the formation month, then updated following a buy-and-hold strategy. Finally, we average these buy-and-hold returns over time for each quintile and for each holding horizon. To proxy fund returns, we use both CRSP reported fund net returns after expenses, and fund total returns that are fund net returns plus $\frac{1}{12}$ times the most-recent fund expense ratio. Fund net returns are compensation that fund investors can actually obtain, whereas fund total returns can be taken as the sum of compensation to both fund investors and fund managers, net of portfolio trading

[30] Most of the existing mutual fund literature focuses on short-term performance considering a window of no greater than one year to measure future abnormal returns. One exception is Frazzini and Lamont (2008) who focus on future long-run stock performance.

costs. Table 4 summarizes the portfolio performance in fund quintiles that are sorted on the Simple horizon measure at a horizon of one month, one quarter, and one to five years, and Figure 7 displays the result over horizons ranging from one month to five years for the first, third, and fifth fund quintiles.

Two points are noteworthy for the results using fund net returns in the first three columns of Table 4. First, there is a clear U-shaped fund performance in terms of both buy-and-hold net returns and 3-factor alphas with respect to fund holding horizons. In terms of buy-and-hold net returns, the best performers are long-horizon funds in general, and short-horizon funds rank second. These orders are reversed in terms of 3-factor alphas. Take the three-year horizon as an example. The buy-and-hold net return is 37.8% for short-term funds in Q1, decreasing to 36% in Q2, and then increasing to the best performance of 38.5% for long-horizon funds in Q5. The 3-factor alpha decreases from 1.5% in Q1 to almost zero in Q3 and then increases to 0.8% in Q5. Interestingly, once we control for momentum with the 4-factor model, the U-shaped pattern disappears at some holding horizons, for example, the three-year horizon, and long-horizon funds become the best performers. Moreover, the 4-factor alphas for short-horizon funds are much lower than the 3-factor alphas. Take the three-year horizon as an example again. The 4-factor alphas are -2.3%, -0.3%, 1.4% for the short-, medium-, long-horizon funds in Q1, Q3, Q5, respectively. These results suggest that short-horizon funds generate alphas largely from momentum strategies. Once the momentum factor is controlled for, the performance of short-horizon funds becomes poor. These results are also consistent with the summary statistics shown in Table 1, that short-horizon funds prefer past winners.

Second, long-horizon funds outperform short- and medium-horizon funds in the long term, whereas short-horizon funds perform no better than long-horizon funds in the short term, according to the 4-factor alphas. Take the three-year holding horizon as an example. The long-short portfolio that buys long-horizon funds in Q5 and sells short-horizon funds in Q1 earns roughly 3.6% in terms of the 4-factor alpha, or 1.2% per year, which is statistically and economically significant. On the other hand, the

4-factor alpha for this long-short portfolio is also positive for a short period, such as one month or one quarter, so short-horizon funds do not perform better than long-horizon funds in the short term.

Table 4 also reports fund performance in terms of total returns, which add back expense ratios to net returns. Compared with the results based on net returns, a few differences exist. First, there is also a U-shaped relation between buy-and-hold total returns and fund holding horizons, but short-horizon funds tend to perform the best. Moreover, the long-short portfolio that buys the long-horizon funds in Q5 and sells either short-horizon funds in Q1 or medium-horizon funds in Q3 earns lower alphas, compared with the result using net returns. The reason is that expense ratios decrease with fund holding horizons, as shown in Table 1, so short-horizon fund performance increases more than long-horizon fund performance after expense ratios are added back to total fund returns. Furthermore, long-horizon funds earn a significantly positive 4-factor alpha using total returns, where they earn insignificant and a much small 4-factor alpha using net returns. This result means that long-horizon fund managers have stock picking-skills, but fund managers and fund expenses consume almost all of the value of active management. Finally, short-horizon funds earn an insignificantly positive 4-factor alpha in the short run using total returns, whereas they earn a negative or even significantly negative 4-factor alpha using net returns. This finding suggests that short-horizon funds, on average, do not have enough skill to cover their fees and expenses, and, therefore, might make fund investors worse off, compared to a low-cost index fund.

We also investigate the relation between fund investment horizons and fund performance using the ex ante horizon measures. The results are similar to, but weaker than the results using the Simple measure. One possible reason is that the ex-ante measures, by construction, assign a short holding horizon when a stock position is newly initiated, even if this stock is held for a long period. This can weaken the ability of the ex-ante measures to capture fund investment horizons.

Comparing these results in the fund-level analysis with the results in the stock-level analysis, we see

that the latter are more supportive than the former of the notion that long-horizon funds are capable of picking stocks with good long-run performance and short-horizon funds are skillful in identifying stocks with good short-run performance. The reason is that fund portfolios include stocks that are held for a variety of non-performance reasons, such as benchmark tracking; whereas our constructed stock portfolios reflect differential aggregate consensus opinions of long-horizon funds over short-horizon funds, and this approach partially removes non-skill related common stock-picking and sharpens the results. Therefore, the stock-level analysis is more effective in revealing manager selection skills.[31]

5.2 Fund performance using Fama-MacBeth regressions

Prior studies have documented that fund characteristics play an important role in determining fund performance and portfolio choice. Therefore, in further tests, we control for fund characteristics in the examination of the relation between fund performance and fund holding horizon. Specifically, in each month we run cross-sectional regressions of abnormal buy-and-hold fund returns on one of our horizon measures, controlling for a list of fund characteristics including fund age, log fund TNA, fund expense ratio, growth fund dummy, past year fund flow, as well as flow volatility and fund return volatility over the past year.[32] We calculate means of the time series of coefficient estimates, following the Fama-MacBeth (1973) approach. Since our dependent variables overlap on a monthly frequency, standard errors are calculated using the Newey and West (1987) approach to account for autocorrelation and heteroskedasticity. We use as dependent variable the 4-factor alphas obtained using either fund net returns or fund total returns.

Figure 8 reports coefficient estimates over horizons ranging from one month to five years using the ex ante Simple measure, with the first two rows containing results using fund net returns, and the last two rows using fund total returns. We see that fund abnormal returns increase almost linearly with

[31] For example, when we use the inverse of CRSP turnover to classify funds into long- or short-horizon funds, as we will discuss in Section 6, we see evidence of stock selection abilities of long-horizon funds using our stock portfolio approach, but little evidence using the fund portfolio approach.

[32] Growth funds are classified following the approach of Hunter et al. (2014).

fund holding horizons over horizons of more than one year, and that this positive relation is statistically significant over horizons of more than two and half years. Take the five-year coefficient as an example. A one standard deviation increase in fund holding horizon increases fund abnormal performance by about 2.8% over a five-year horizon. The result is stronger if ex-post horizon measures are used. Interestingly, fund age significantly and negatively affects fund performance. This is consistent with Pastor et al. (2014), who find that performance deteriorates over a typical fund's lifetime.[33] Because fund age increases with fund holding horizons, as shown in Panel B of Table 1, our fund sorting portfolio approach cannot disentangle these two offsetting effects, leading to a weak relation between fund performance and fund investment horizons. Moreover, fund expense ratios significantly decrease fund net returns. Consistent with the literature, growth funds have superior short-run performance but little long-run advantage.

6 Using the inverse of turnover as a fund horizon measure

To compare our results with the literature, we use the (inverse) turnover ratio as an alternative measure of fund investment horizon. If we assume that funds with a high level of trading activity measured by the turnover ratio generally hold stocks for a short period, whereas funds with a low level of trading activity generally hold stocks for a long time, then the inverse of turnover can be a proxy for fund holding horizon. Indeed, a turnover ratio computed from 13-F holdings data has been used in the institutional investor literature to classify investors as short or long-term. The mutual fund literature provides mixed evidence on the relation between turnover ratio and fund performance. Wermers (2000) show that high-turnover mutual funds have better stock selection skills than low-turnover funds (a similar result is provided by Yan and Zhang, 2007, for institutional investors). By contrast, Carhart (1997) documents a negative association between turnover ratio and net fund performance.

[33] Pastor et al. (2014) find evidence of industry-level, instead of fund-level, decreasing returns to scale, which could explain the above pattern. Consistent with their finding, our tests indicate no evidence of a fund-level economy of scale, as indicated by the insignificant coefficient on size (log TNA).

Following the same sorted fund portfolio approach as we did in Section 5.1, we examine the relation between fund performance and investment horizon that is measured by the inverse of CRSP turnover instead of the Simple measure. Because CRSP turnover is widely used in the mutual fund literature, our discussion here focuses on the results using the inverse of CRSP turnover. Figure 9 shows the results, different from those in Figure 7. A few points are noteworthy. First, funds with high turnover (Q1) outperform their low-turnover peers (Q5). When fund gross returns are used, the four-factor alpha associated with funds with high turnover (Q1) is significantly positive. Moreover, it significantly higher than the four-factor alpha for funds with low turnover (Q5) at horizons of one year or less. The difference is about 1% a year. These results indicate that managers of funds with higher levels of trading activities have skills to pick stocks with good short-term performance. When fund net returns are used, the four-factor alpha is not statistically distinguishable from zero. The spread of the four-factor alpha for Q5-Q1 is negative, but insignificant for a short period. Furthermore, we see only weak evidence that funds with low turnover (Q5) outperform funds with high turnover (Q1) in the long term. These results indicate that despite of manager skills for funds with higher turnover, the value of skillful stock-picking is either retained by fund managers or consumed by fund expenses, and fund investors do not benefit.

We further run Fama-MacBeth regressions of fund abnormal returns on the inverse of CRSP turnover along with other fund characteristics, as we discussed in Section 5.2. Unlike our fund horizon measures, the inverse of CRSP turnover does not play a significant role in forecasting future fund performance. Therefore, our horizon measures are essential to capture stock-picking skills of managers with long investment horizon.

Why do our holdings-based horizon measures better reveal skills of long-horizon fund managers, while CRSP turnover better captures stock-picking skills of short-term fund managers? The reason is that, although turnover better capture trading activities, our measures more richly capture fund holding horizons, especially long horizons. Turnover tends to miss out positions that have been held for a long

period. Put differently, turnover cannot adequately reflect the right tail distribution of holding periods of stocks held in a fund portfolio.[34] Although levels of trading activities and fund holding horizons are negatively correlated, the correlations are far from perfect. Table 3 shows that the correlations between the CRSP turnover ratio and our horizon measures is as low as -0.43. On the other hand, CRSP reported turnover, not holding-based turnover, reflects intraquarter trading, while our measures do not. Puckett and Yan (2011) show that intraquarter trading earns positive abnormal returns, so the measures constructed using low-frequency fund holdings have a downward bias in capturing short-term selection skills because of their inability to account for interim trades.

7 Conclusions

Using newly proposed direct measures of fund investment horizon, this paper examines the relation between fund investment horizons and manager skills and further explores the economic sources of stock selection skills for managers with different investment horizons. We use two approaches, one at the stock-level and the other at the fund-level, to examine the relation. The stock-level approach aggregates consensus opinions of the value of a stock from long- and short-horizon funds separately and investigates stock performance over various holding horizons. The fund-level approach directly examines the relation between fund performance and fund holding horizons.

In the stock-level analysis, we find that the stock-holdings, in aggregate, of long-horizon funds provide valuable information about the long-term superior abnormal returns of a stock, whereas aggregate short-horizon fund holdings provide little information about the short-term abnormal returns of a stock. Interestingly, aggregate fund trades are informative about the stock selection skills of *both* long-horizon funds and short-horizon funds, and aggregate long-horizon fund trades are less informative than holdings.

We also delve into the economic sources of stock selection skills of fund managers with different

[34] A recent paper by Chakrabarty et al. (2014) further discusses some of the issues associated with using turnover rate as a proxy for investment horizon.

investment horizons, that is, the fundamental cashflow information that is reflected in funds' stock-holdings or trades. We find that shocks mostly held by long-horizon funds are associated with superior long-term firm fundamentals, whereas stocks largely purchased by short-horizon funds have better short-term cashflow news relative to the stocks largely purchased by long-horizon funds. This finding indicates that long-horizon fund managers are skillful in analyzing long-term firm fundamentals, and achieve good long-run performance, and that short-horizon fund managers make use of short-term cashflow information to make small profits.

In this fund-level analysis, we use both a ranked fund portfolio approach and Fama-MacBeth regressions that control for fund characteristics. Using the ranked fund portfolio approach, we find superior buy-and-hold (pre-expense) gross return performance of long-horizon funds, but this superior performance is not present for buy-and-hold net returns. Thus, fund management captures long-horizon fund skill-based returns, while fund investors benefit little, consistent with Berk and Green (2004) and Grossman and Stiglitz (1980). Fama and MacBeth regressions indicate that investment horizon is a significant predictor, with a positive coefficient, of future fund abnormal net returns even after controlling for several fund characteristics.

In conclusion, this paper is the first that shows superior long-run performance of stocks largely held or purchased by long-horizon funds. We also proposed the investment horizon as a useful novel proxy for investment skill. The finding of the superior performance of long-term funds critically depends on the use of more direct measures of fund investment horizons than what was previously used in the mutual fund literature. There is empirical 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). Our fund-level analysis suggests that individual investors with long rebalancing horizons are better off selecting long-horizon funds rather

than short-horizon funds.

Appendix

A.1 Construction of cash-flow news ($CFnews$)

This measure accounts for changing expectations of the sum of discounted firms' future cash flows over all future periods. It is constructed using Institutional Brokers Estimate System (IBES) summary unadjusted file. Monthly analyst earnings forecasts allow us to measure cashflow news at the monthly frequency. Specifically, we keep consensus earnings forecasts for the current and subsequent fiscal year ($FE1_t$, $FE2_t$), along with its long-term growth forecast (LTG_t). The earnings forecasts are denominated in dollars per share, and the t subscript 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), Pastor, Sinha, and Swaminathan (2008), Da and Warachka (2009), Da, Liu, and Schaumburg (2012), and Balduzzi and Lan (2013), we use a three-stage model to construct cash flow 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:

$$X_{t,t+1} = FE1_t, \tag{A.1}$$

$$X_{t,t+2} = FE2_t, \tag{A.2}$$

$$X_{t,t+3} = FE2_t(1 + LTG_t), \tag{A.3}$$

$$X_{t,t+4} = X_{t,t+3}(1 + LTG_t), \tag{A.4}$$

$$X_{t,t+5} = X_{t,t+4}(1 + LTG_t). \tag{A.5}$$

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,

$$X_{t,t+j+1} = X_{t,t+j}[1 + LTG_t + \frac{j-4}{5}(g_t - LTG_t)], \text{ for } j = 5, \ldots, 9. \tag{A.6}$$

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

Following Da and Warachka (2009), Da, Liu, and Schaumburg (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:

$$e_{t,t+1+j} = \begin{cases} \log(1+\frac{X_{t,t+1+j}}{B_{t,t+j}}) & \text{for } 0 \le j \le 9 \\ \log(1+\frac{g_t}{1-\Psi}) & \text{for } j \ge 10 \end{cases} \tag{A.7}$$

The three-stage growth model implies expected future cash flows:

$$E_t \sum_{j=0}^{\infty} \rho^j e_{t+1+j} = \sum_{j=0}^{9} \rho^j e_{t,t+1+j} + \frac{\rho^{10}}{1-\rho} \log(1+\frac{g_t}{1-\Psi}), \tag{A.8}$$

where ρ results from the log-linear approximation (Campbell and Shiller, 1988) and equals 0.96 in our sample. After ten years, the annualized discount factor $\rho = 0.96$ means that the remaining cash flows exert little influence on the cashflow news. Vuolteenaho (2002) shows that the cash flow news are the difference between cash flow expectations over consecutive months:

$$CFnews_{t+1} = E_{t+1} \sum_{j=0}^{\infty} \rho^j e_{t+1+j} - E_t \sum_{j=0}^{\infty} \rho^j e_{t+1+j} \tag{A.9}$$

where $CFnews_t$ denotes cashflow news at time t.

A.2 Construction of holding-based turnover

Each quarter we calculate aggregate purchase and sales for each fund:

$$buy_{j,t} = \sum_{\substack{i=1 \\ N_{i,j,t} > N_{i,j,t-1}}}^{M_{j,t}} |N_{i,j,t}P_{i,t} - N_{i,j,t-1}P_{i,t-1} - N_{i,j,t-1}\Delta P_{i,t}|$$

$$sell_{j,t} = \sum_{\substack{i=1 \\ N_{i,j,t} < N_{i,j,t-1}}}^{M_{j,t}} |N_{i,j,t}P_{i,t} - N_{i,j,t-1}P_{i,t-1} - N_{i,j,t-1}\Delta P_{i,t}|,$$

where $P_{i,t}$ are share prices for stock i at the end of quarter t. Fund j's turnover, or churn rate, for quarter t is then calculated as:

$$CR_{j,t} = \frac{\min(buy_{j,t}, sell_{j,t})}{\sum_{i=1}^{M_{j,t}} \frac{N_{i,j,t}P_{i,t} + N_{i,j,t-1}P_{i,t-1}}{2}} \tag{A.10}$$

Then, we average this quarterly churn rate over the past year or, alternatively, past three years, to get holding-based turnover.

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Table 1: Summary statistics

This table reports the summary statistics for the sample of equity mutual funds over the period March 1980 to December 2010. The the Simple, the FIFO, the Ex-Ante and Duration measures are the investment horizon measures described in Section 2 and they are based on different definitions of the holding horizons of the stocks in a fund's portfolio. The CRSP turnover ratio is defined as the minimum of the annual dollar value of buys and sells divided by total net assets. The holdings-based turnover ratio is based on the same definition but with buys and sells computed from reporting holdings. The size, value, momentum, share turnover, Amihud measure, and bid-ask spread rank are based on quintiles. 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 share turnover is defined as the prior quarter average of the daily stock turnover ratio at the end of each calendar quarter. The daily turnover ratio is defined as the daily trading volume divided by the number of shares outstanding. The portfolio betas are obtained from a regression of past 36-month returns on the Carhart (1997) four-factor model. For the same share class there could be different level of front load charges. We consider the highest and the lowest for each share class and then we take the TNA value-weighted average across the share classes that have a front load. The proportion of assets invested in class A is computed only for funds that have a class A. Class A is identified in the sample as the share class that charges a front-end load. In Panel A the statistics are obtained by first averaging the fund characteristics across time and then by computing the mean, the median, and the standard deviation across all the funds. In Panel B, at the end of each month, funds are sorted into quintile portfolios according to the Simple horizon measure. Q1 (Q5) is the portfolio that includes funds with the lowest (highest) Simple measure. Summary statistics are computed first by taking an equally weighted average at formation date for each quintile portfolio and then by taking a time-series average. In this panel, only the averages are presented together with the p-values of the test of the difference between Q5 and Q1.

Panel A: The full sample

	Mean	**Median**	**SDEV**
TNA (in millions)	764.50	131.74	2750.01
Expense ratio (in %)	1.19	1.14	0.77
Fund age	14.34	9.49	14.12
Simple horizon measure	3.48	2.95	2.18
FIFO horizon measure	2.49	2.08	1.54
Ex-Ante Simple horizon measure	2.04	1.77	1.20
Duration measure	1.16	1.10	0.45
CRSP fund turnover ratio (in %)	89.53	65.33	107.46
Holdings-based fund turnover ratio (in %)	63.88	53.85	47.47
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
Market beta	0.95	0.96	0.21
SML beta	0.20	0.12	0.36
HML beta	-0.02	0.01	0.35
MOM beta	0.03	0.02	0.18
Share turnover rank	3.91	3.92	0.42
Amihud measure rank	1.29	1.12	0.40
Bid-ask spread rank	1.65	1.56	0.35

Panel B: Sorting based on the simple measure

	Q1 (short)	Q2	Q3	Q4	Q5 (long)	p-value Q5-Q1
TNA (in millions)	250.49	421.53	627.84	927.58	1861.34	0.00
Expense ratio (in %)	1.37	1.30	1.25	1.15	1.03	0.00
Fund age	11.17	13.01	14.68	17.62	21.53	0.00
Simple horizon measure	1.21	2.08	2.97	4.17	7.00	0.00
CRSP turnover ratio (in %)	172.34	108.12	80.70	59.50	36.53	0.00
Max front load charge (in %)	5.69	5.67	5.69	5.75	5.98	0.00
Min front load charge (in %)	1.43	1.34	1.47	1.57	1.60	0.00
Proportion of TNA in class A	0.81	0.84	0.85	0.87	0.87	0.00
Size rank	3.64	3.83	3.97	4.12	4.26	0.00
Book-to-market rank	2.60	2.63	2.69	2.72	2.79	0.00
Momentum rank	3.51	3.36	3.20	3.12	3.02	0.00
Market beta	0.99	0.99	0.97	0.95	0.93	0.00
SML beta	0.36	0.31	0.23	0.15	0.06	0.00
HML beta	-0.12	-0.09	-0.04	0.00	0.05	0.00
MOM beta	0.13	0.07	0.02	-0.00	-0.03	0.00
Share turnover rank	4.12	4.01	3.90	3.82	3.72	0.00
Amihud measure rank	1.34	1.32	1.30	1.26	1.23	0.00
Bid-ask spread rank	1.69	1.69	1.66	1.61	1.58	0.00

Table 2: Consecutive trade periods

This table reports the summary statistics of the number of months that a fund portfolio takes to purchase or sell a stock in a row, or the time span for consecutive buys or consecutive sells in a fund portfolio for both long- and short-horizon funds.

	mean	sd	p10	p90	mean	sd	p10	p90
Simple	Short-horizon funds				Long-horizon funds			
Buy	4.21	3.41	0.71	8.71	18.80	17.91	3.22	38.88
Sell	7.83	5.21	2.26	14.31	23.11	20.27	4.83	47.55
FIFO	Short-horizon funds				Long-horizon funds			
Buy	4.15	3.29	0.72	8.48	19.56	17.78	3.53	39.07
Sell	7.30	4.71	2.14	13.08	24.37	20.01	5.76	48.05
Ex ante simple	Short-horizon funds				Long-horizon funds			
Buy	5.18	4.71	0.92	10.88	18.30	18.85	2.74	39.87
Sell	8.82	6.28	2.74	16.11	23.94	20.66	5.43	49.08
Duration	Short-horizon funds				Long-horizon funds			
Buy	5.41	5.29	1.01	11.09	20.32	18.70	3.28	42.29
Sell	8.60	6.03	2.72	15.66	26.17	21.39	6.37	52.78

Table 3: Correlations of fund horizon measures and long- and short-horizon fund holdings

Panel A reports the correlation matrix of six fund horizon measures. As described in section 2, the first four measures (simple, FIFO, ex-ante simple, and duration measures) are based on different definitions of the holding horizons of the stocks in a fund's portfolio. The other two measures are based on the fund turnover ratio. While one measure (holdings TR) is computed using only equity holdings, the other measure is the ratio available from the CRSP and is computed using the minimum of the annual dollar value of buys and sales of all the holdings divided by total net assets. Panels B and C present correlation matrices of long-horizon fund holdings (LFH) and short-horizon fund holdings (SFH), respectively. LFH (SFH) is defined as the aggregated shares held by long-horizon (short-horizon) funds divided by the number of shares outstanding, where long-horizon and short-horizon funds are classified using each of six fund horizon measures. Panel D reports the correlations of LFH and SFH, with each pair defined using one of six fund horizon measures. The correlation matrices are calculated as time-series averages of cross-sectional correlation matrices.

Panel A: Correlations of fund horizon measures

	Simple	**FIFO**	**Ex-ante simple**	**Duration**	**Holdings TR**	**CRSP TR**
Simple	1	0.89	0.88	0.77	-0.59	-0.43
FIFO	0.89	1	0.82	0.84	-0.62	-0.48
Ex-ante simple	0.88	0.82	1	0.83	-0.61	-0.46
Duration	0.77	0.84	0.83	1	-0.74	-0.58
Holdings TR	-0.59	-0.62	-0.61	-0.74	1	0.57
CRSP TR	-0.43	-0.48	-0.46	-0.58	0.57	1

Panel B: Correlations among long-horizon fund holdings (LFH)

	Simple	**FIFO**	**Ex-ante simple**	**Duration**	**Holdings TR**	**CRSP TR**
Simple	1	0.91	0.89	0.76	0.82	0.83
FIFO	0.91	1	0.87	0.80	0.86	0.87
Ex-ante simple	0.89	0.87	1	0.79	0.80	0.80
Duration	0.76	0.80	0.79	1	0.76	0.78
Holdings TR	0.82	0.86	0.80	0.76	1	0.87
CRSP TR	0.83	0.87	0.80	0.78	0.87	1

Panel C: Correlations among short-horizon fund holdings (SFH)

	Simple	**FIFO**	**Ex-ante simple**	**Duration**	**Holdings TR**	**CRSP TR**
Simple	1	0.89	0.85	0.67	0.77	0.75
FIFO	0.89	1	0.83	0.73	0.80	0.81
Ex-ante simple	0.85	0.83	1	0.76	0.79	0.77
Duration	0.67	0.73	0.76	1	0.74	0.70
Holdings TR	0.77	0.80	0.79	0.74	1	0.82
CRSP TR	0.75	0.81	0.77	0.70	0.82	1

Panel D: Correlations of long-horizon fund holdings (LFH) and short-horizon fund holdings (SFH)

LFH/SFH	**Simple**	**FIFO**	**Ex-ante simple**	**Duration**	**Holdings TR**	**CRSP TR**
LFH	0.12	0.10	0.13	0.11	0.10	0.08

Table 4: Fund performance with fund holding horizons

This table reports buy-and-hold fund portfolio returns and abnormal returns over next month and up to five years. Each month funds are sorted into quintiles according to the simple fund horizon measure, with Q1 consisting of short-horizon funds and Q5 consisting of long-horizon funds. Both CRSP reported net returns and total returns (the sum of net returns and $\frac{1}{12}$ expense ratio) are used to measure monthly fund performance. Buy-and-hold net returns or buy-and-hold total returns are calculated over next one month and up to five years. Portfolio weights are equal at the formation month and then are updated following a buy-and-hold strategy. The abnormal returns include the Fame-French 3-factor alpha and the Carhart four-factor alpha associated with both buy-and-hold net returns and buy-and-hold total returns. The table also reports the performance spreads between the Q5 and Q1 portfolios and between the Q5 and Q3 portfolios. The returns are expressed in percentage. *, **, and *** represent significance at the 10%, 5%, and 1% confidence intervals, respectively.

	Net ret	Net 3-Fac α	Net 4-Fac α	Total ret	Total 3-Fac α	Total 4-Fac α
1 Month						
Q1 (short)	0.92***	−0.02	−0.10*	1.03***	0.09	0.01
Q2	0.90***	−0.08*	−0.10**	1.00***	0.03	0.01
Q3	0.89***	−0.10***	−0.08**	0.99***	0.01	0.02
Q4	0.92***	−0.06*	−0.04	1.01***	0.03	0.06*
Q5 (long)	0.94***	−0.04	−0.00	1.03***	0.05*	0.08***
Q5-Q1	0.02	−0.01	0.10*	−0.00	−0.04	0.08
Q5-Q3	0.06	0.06***	0.08***	0.04	0.04**	0.06***
1 Quarter						
Q1 (short)	2.87***	−0.01	−0.18	3.20***	0.32**	0.15
Q2	2.80***	−0.21**	−0.21**	3.12***	0.11	0.11
Q3	2.75***	−0.29***	−0.21**	3.06***	0.02	0.10
Q4	2.84***	−0.19**	−0.08	3.13***	0.10	0.21**
Q5 (long)	2.91***	−0.12	0.02	3.17***	0.14*	0.28***
Q5-Q1	0.04	−0.11	0.21	−0.03	−0.19	0.13
Q5-Q3	0.16	0.17***	0.23***	0.11	0.12**	0.18***
1 Year						
Q1 (short)	12.37***	0.73	−0.32	13.89***	2.18*	1.12
Q2	11.69***	−0.72	−1.08**	13.10***	0.64	0.27
Q3	11.72***	−0.82*	−0.78*	13.10***	0.49	0.53
Q4	11.97***	−0.59	−0.43	13.25***	0.62	0.78*
Q5 (long)	12.24***	−0.31	−0.01	13.38***	0.77**	1.07***
Q5-Q1	−0.13	−1.04	0.31	−0.50	−1.42	−0.05
Q5-Q3	0.53	0.51**	0.77***	0.29	0.28	0.54**
2 Year						
Q1 (short)	25.17***	1.04	−1.74	28.60***	4.20	1.30
Q2	23.80***	−0.91	−1.96*	26.96***	1.97	0.84
Q3	24.18***	−0.77	−0.81	27.27***	2.01*	1.93*
Q4	24.51***	−0.73	−0.73	27.38***	1.81**	1.78**
Q5 (long)	25.29***	0.07	0.43	27.84***	2.35***	2.71***
Q5-Q1	0.13	−0.98	2.17	−0.76	−1.84	1.41
Q5-Q3	1.11	0.83	1.24*	0.56	0.34	0.78
3 Year						
Q1 (short)	37.82***	1.49	−2.26	43.54***	6.52*	2.39
Q2	36.04***	−0.64	−1.72	41.29***	3.90*	2.62
Q3	36.67***	0.01	−0.33	41.81***	4.39***	3.89***
Q4	36.81***	−0.57	−0.36	41.56***	3.45***	3.52***
Q5 (long)	38.53***	0.77	1.38	42.74***	4.36***	4.88***
Q5-Q1	0.72	−0.72	3.64*	−0.80	−2.16	2.49
Q5-Q3	1.86	0.75	1.71**	0.94	−0.02	0.99
4 Year						
Q1 (short)	50.80***	1.75	−1.61	59.15***	8.69*	4.79
Q2	49.64***	−0.57	−1.99	57.36***	5.77**	4.00*
Q3	50.45***	−0.06	−0.61	57.99***	5.96***	5.17***
Q4	50.24***	−0.47	−0.46	57.20***	5.11***	4.88***
Q5 (long)	52.85***	1.28	1.87	59.00***	6.28***	6.69***
Q5-Q1	2.04	−0.47	3.48	−0.14	−2.41	1.90
Q5-Q3	2.40	1.34	2.48**	1.01	0.32	1.53
5 Year						
Q1 (short)	67.42***	2.14	−1.35	78.99***	11.21*	6.95
Q2	66.22***	−0.84	−2.59	76.96***	7.46*	5.26**
Q3	67.12***	−0.55	−1.56	77.63***	7.26***	5.94***
Q4	66.50***	−0.71	−0.94	76.17***	6.55***	5.93***
Q5 (long)	69.98***	1.57	1.31	78.50***	8.18***	7.57***
Q5-Q1	2.56	−0.56	2.65	−0.48	−3.03	0.62
Q5-Q3	2.86	2.12	2.87**	0.87	0.92	1.63

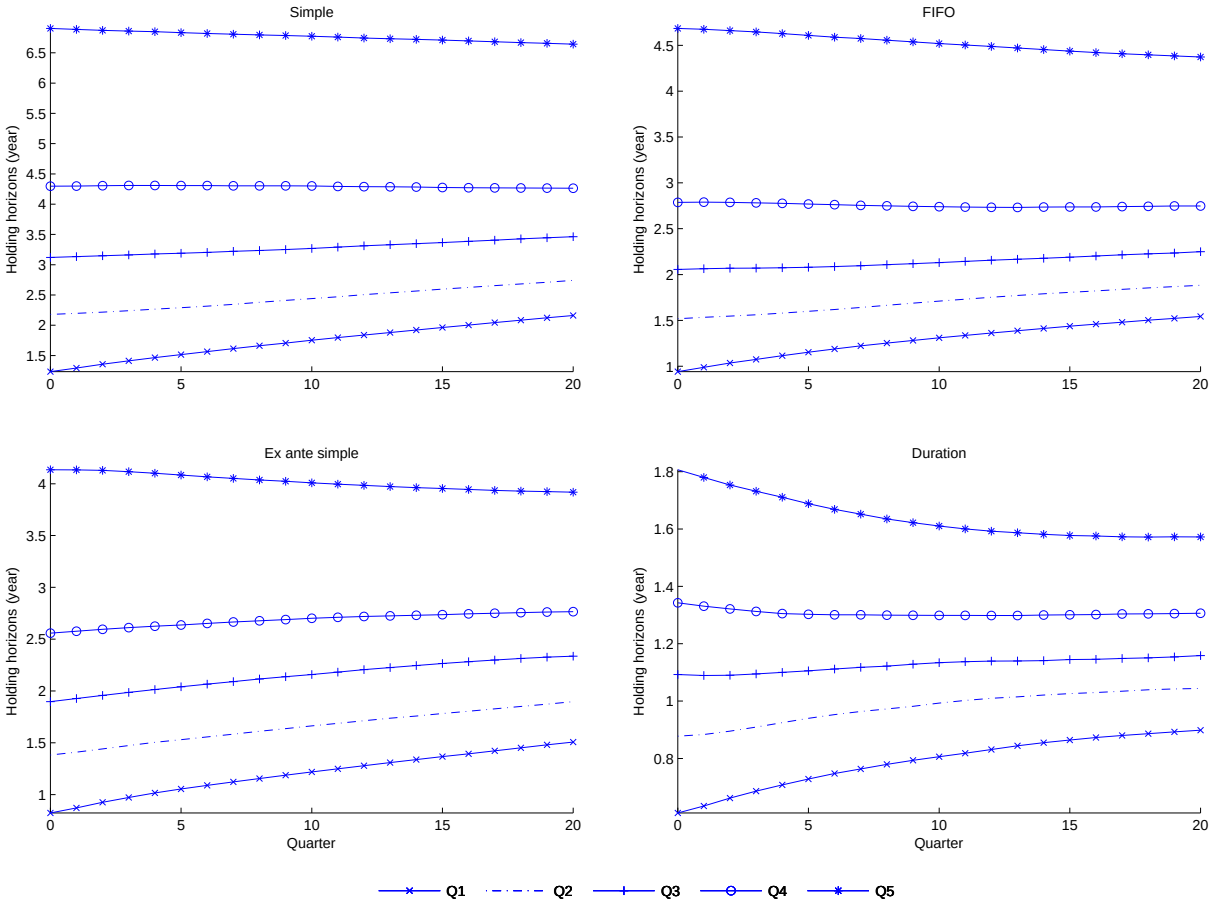

Figure 1: This figure plots average fund holding periods of each fund portfolio quintile at the formation period, as well as first to 20th quarter into the future after the formation period. Each month fund portfolios are sorted into quintiles according to one of the fund investment horizon measures, the simple, FIFO, ex-ante simple, or duration measures, with Q1 consisting of funds with the lowest holding periods and Q5 consisting of funds with the highest holding periods.

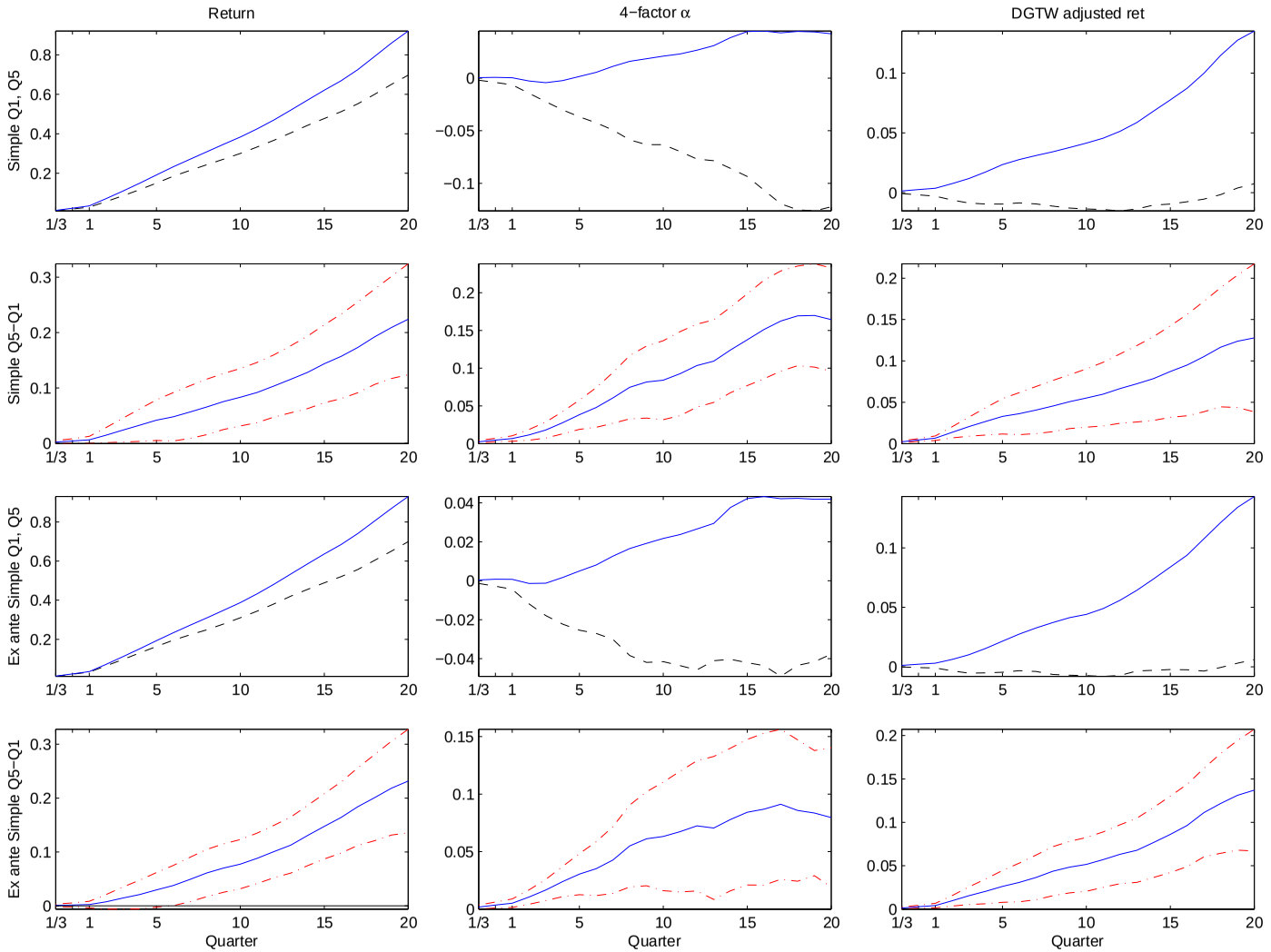

Figure 2: This figure plots buy-and-hold returns, 4-factor alphas, and DGTW adjusted returns for the Q1 (dashed line) and Q5 (solid line) portfolios in the first and third rows and the long-short position that buys the Q5 and short the Q1 portfolio in the second and fourth rows, respectively. For the spread portfolios the plots also include the 10% confidence intervals. These portfolios are quintiles sorted according to LFH minus SFH, where LFH (SFH) is the percentage of the shares of a stock held by long- (short-) horizon funds. Q5 (Q1) is the portfolio with large ownership by long-horizon (short-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 Simple measure in the first two rows and the ex ante Simple measure in the last two rows. These horizon measures are described in section 2 and their definition is based on the holding horizons of the stocks in a fund's portfolio.

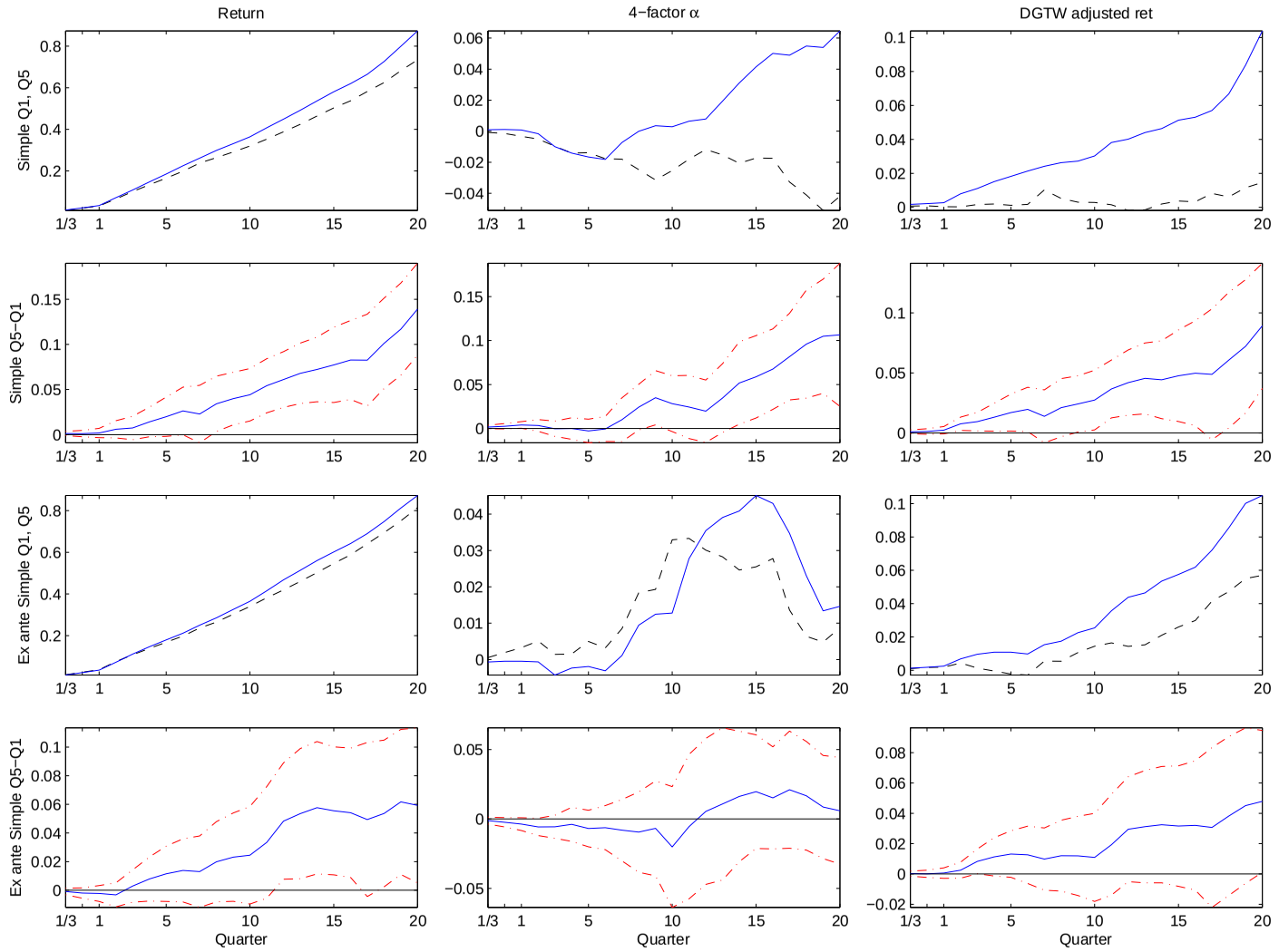

Figure 3: This figure plots buy-and-hold returns, 4-factor alphas, and DGTW adjusted returns for the Q1 (dashed line) and Q5 (solid line) portfolios in the first and third rows and the long-short position that buys the Q5 and short the Q1 portfolio in the second and fourth rows, respectively. For the spread portfolios the plots also include the 10% confidence intervals. These portfolios are quintiles sorted on buys from long-horizon funds ($LFTrade > 0$) minus buys from short-horizon funds ($LFTrade > 0$), where LFTrade (SFTrade) is the trade from long- (short-) horizon funds. Q5 (Q1) is the portfolio that is largely purchased by long-horizon (short-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 Simple measure in the first two rows and the ex ante Simple measure in the last two rows. These measures are described in section 2 and their definition is based on the holding horizons of the stocks in a fund portfolio.

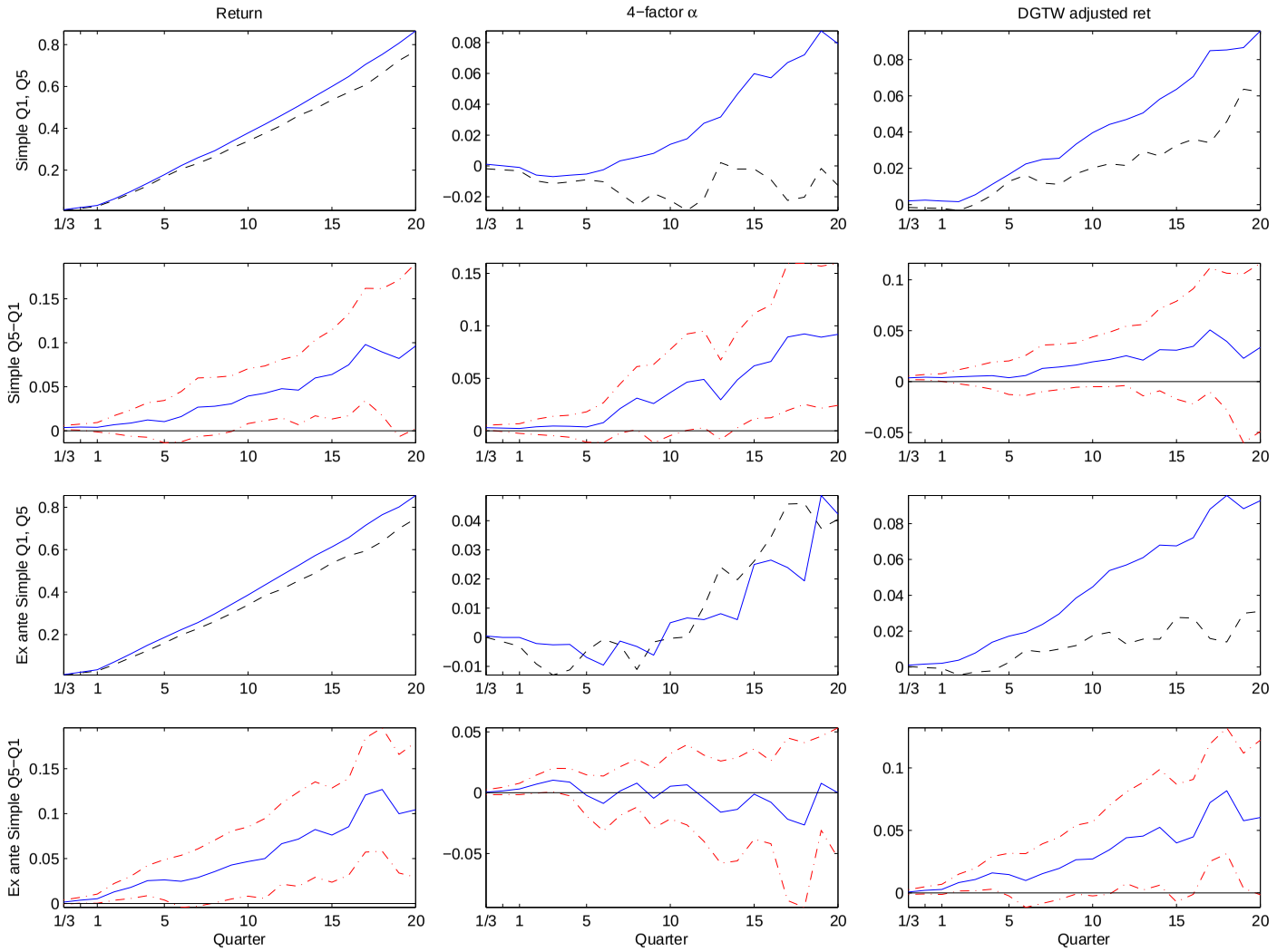

Figure 4: This figure plots buy-and-hold returns, 4-factor alphas, and DGTW adjusted return for the Q1 (dashed line) and Q5 (solid line) portfolios in the first and third rows and the long-short position that buys the Q5 and shorts the Q1 portfolio in the second and fourth rows, respectively. For the spread portfolios the plots also include the 10% confidence intervals. These portfolios are quintiles sorted on sales from long-horizon funds (the absolute value of $LFTrade < 0$) minus sales from short-horizon funds (the absolute value of $LFTrade < 0$), where LFTrade (SFTrade) is the trade from long- (short-) horizon funds. Q5 (Q1) is the portfolio that is largely sold by long-horizon (short-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 Simple measure in the first two rows and the ex ante Simple measure in the last two rows. These measures are described in section 2 and their definition is based on the holding horizons of the stocks in a fund portfolio.

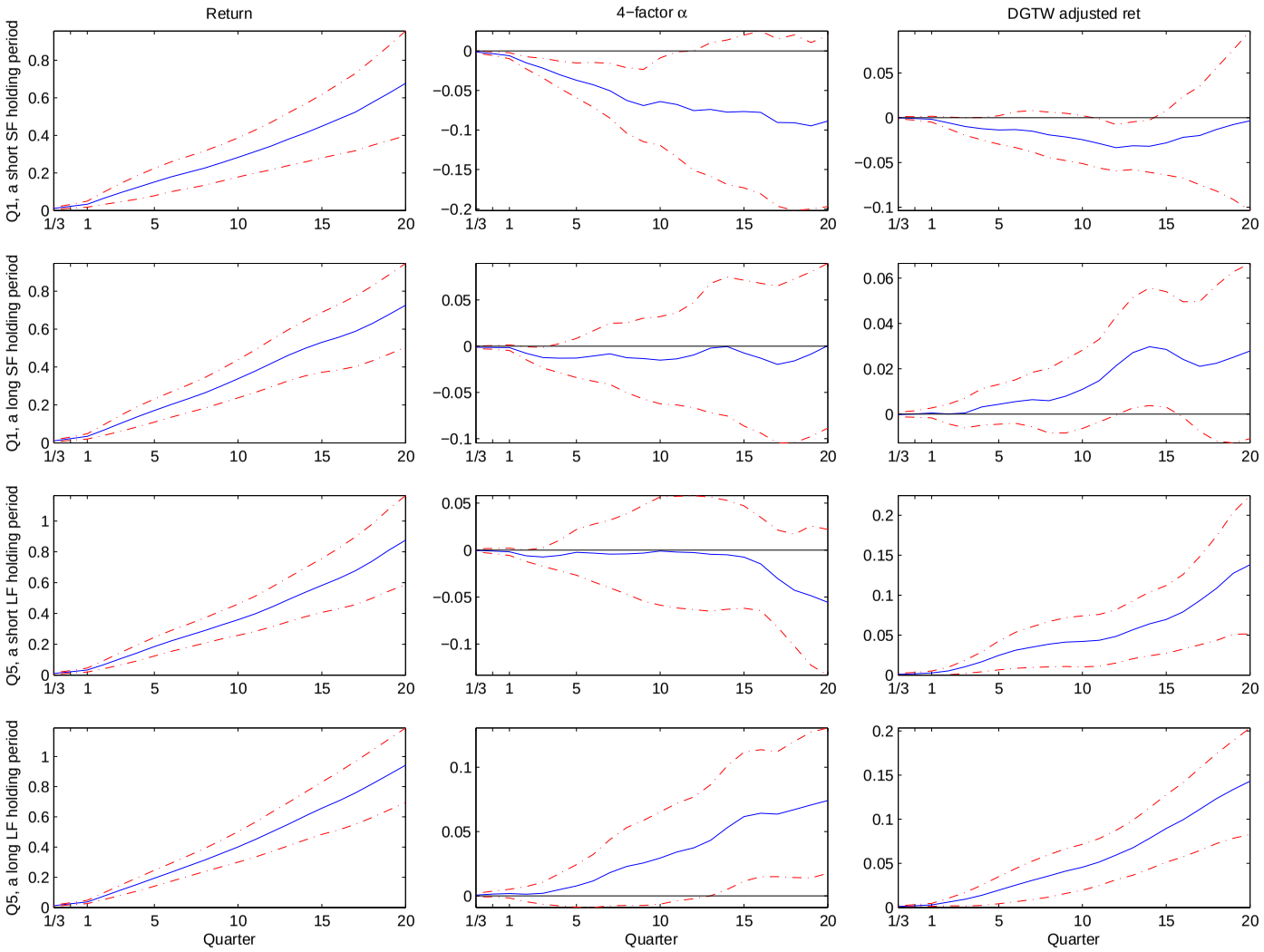

Figure 5: Stocks are sorted into quintiles based on holdings from long-horizon funds (LFH) minus holdings from short-horizon funds (SFH). Q5 (Q1) consists of stocks that are largely held by long-horizon (short-horizon) funds. In Q5 (Q1), stocks are further divided into two groups: stocks are held for a long period by long-horizon (short-horizon) funds if stocks' average holding periods are above the median holding period, for a short period otherwise. This figure plots buy-and-hold returns, 4-factor alphas, and DGTW adjusted returns for four stock portfolios consisting of the two groups of stocks in Q1 and Q5. The plots also include the 10% confidence intervals in dashed lines. The ex-ante simple measure is used to classify funds into long- and short-horizon funds and to define stocks' average holding period across all long- and short-horizon funds.

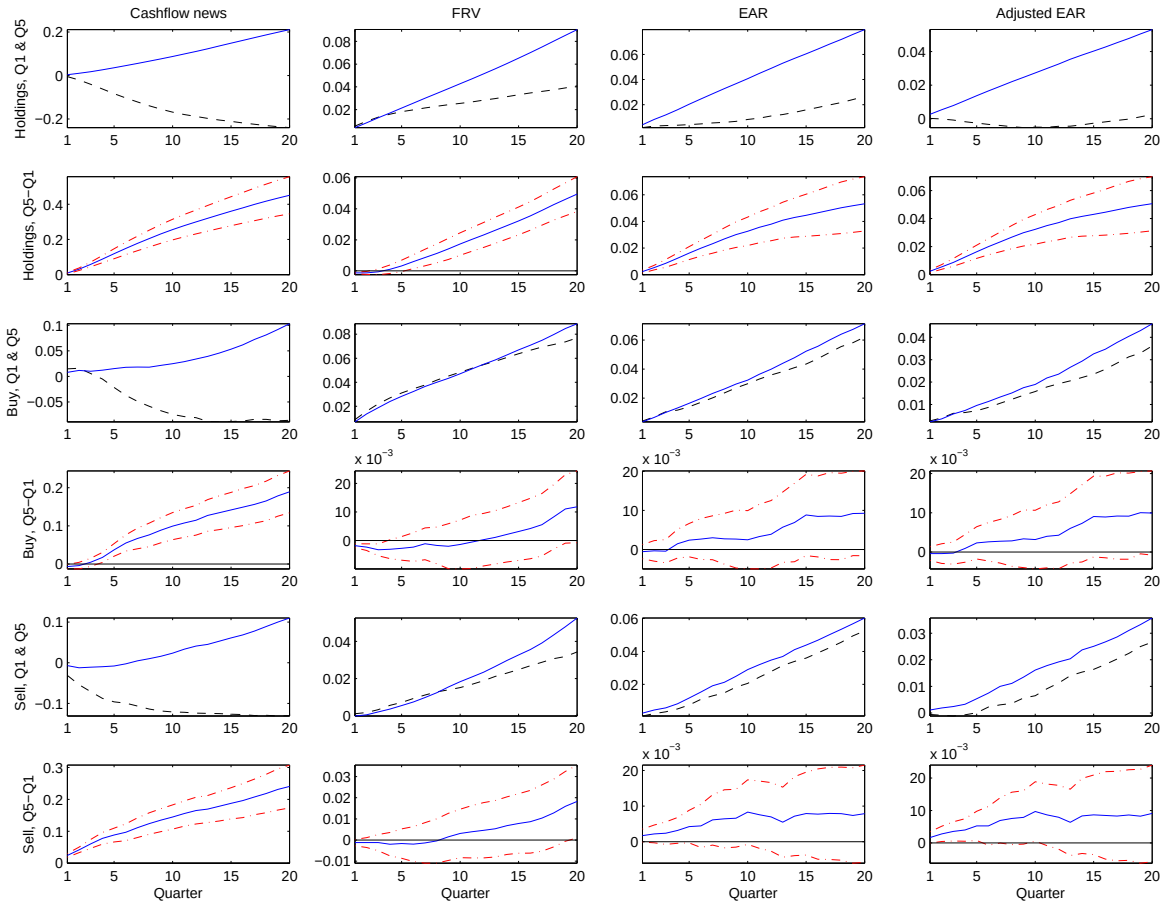

Figure 6: This figure plots cumulative future cash flow information, including cashflow news, analyst forecast revision (FRV), earnings-announcement-window returns (EAR), and market adjusted EAR, over next 1-20 quarters after stock portfolio formation. Specifically, the average quarterly cashflow information is calculated first for each stock portfolio, and then quarterly cashflow information is accumlated over next 1-20 quarters. The odd rows plot cumulative future cash flow information for stock portfolio quintiles Q1 and Q5. The even rows exhibit cumulative future cash flow information for Q5 in excess of that for Q1, with the 10% confidence interval. The first two rows describe the case in which stock portfolios are classified into quintiles according to holdings (LFH minus SFH), with Q5 (Q1) for stocks held largely by long-horizon (short-horizon) funds. The third and fourth rows describe the case in which stock portfolios are classified into quintiles according to buys ($LFTrade$ minus $SFTrade$, $LFTrade > 0$ & $SFTrade > 0$), with Q5 (Q1) for stocks purchased largely by long-horizon (short-horizon) funds. The last two rows describe stock portfolio quintiles that are classified according to sells ($(-1)LFTrade$ plus $SFTrade$, $LFTrade < 0$ & $SFTrade < 0$), with Q5 (Q1) for stocks sold largely by long-horizon (short-horizon) funds. The simple measure is used to classify funds into long- or short-horizon funds.

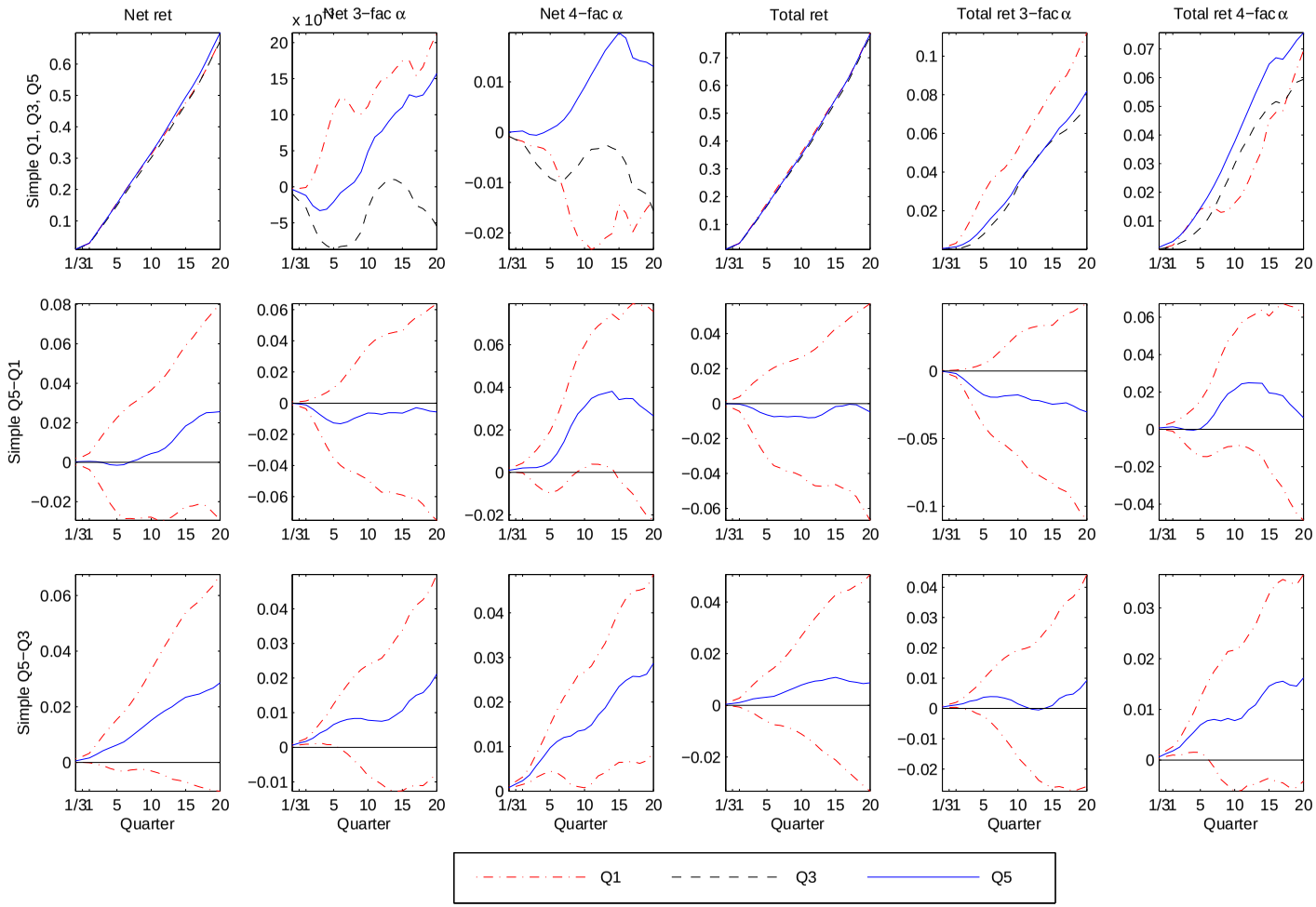

Figure 7: This figure plots buy-and-hold fund portfolio returns and abnormal returns over next month and up to five years. Each month funds are sorted into quintiles according to the simple horizon measure, with Q1 consisting of short-horizon funds and Q5 consisting of long-horizon funds. Both CRSP reported net returns and total returns (the sum of net returns and $\frac{1}{12}$ expense ratio) are used to measure monthly fund performance. Buy-and-hold net returns or buy-and-hold total returns are calculated over next one month and up to five years, with equal portfolio weights at the portfolio formation month. The abnormal returns include the Fame-French 3-factor alpha and the Carhart four-factor alpha associated with both buy-and-hold net returns and buy-and-hold total returns. The first row presents the results for long-horizon (Q5, solid line), medium-horizon (Q3, dashed line), and short-horizon (Q1, dash-dot line) fund quintiles. The second and third rows show the return spreads between Q5 and Q1 portfolios, and between Q5 and Q3 portfolios, respectively, along with the 10% confidence intervals.

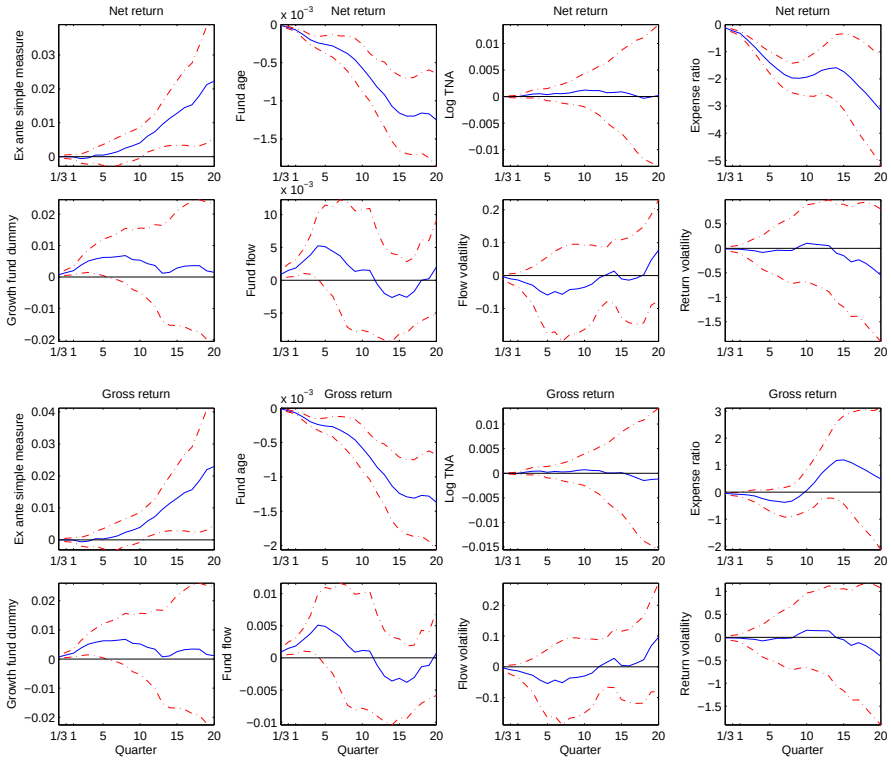

Figure 8: This figure shows the means, along with 10% confidence intervals, of time series of coefficient estimates in Fama-MacBeth regressions of abnormal buy-and-hold fund returns over one month and up to five years. The independent variables in the regression include the ex-ante simple horizon measure and fund characteristics including fund age, log fund TNA, fund expense ratio, growth fund dummy, past year fund flow, as well as flow volatility and fund return volatility over past year. Buy-and-hold fund returns are calculated using fund net returns excluding expenses and fees as fund monthly returns in the first two rows or using fund gross returns including expenses and fees as fund monthly returns in the last two rows. Abnormal buy-and-hold fund returns are risk adjusted buy-and-hold fund returns using the Carhart 4-factor model to capture risk exposure. Standard errors are calculated using the Newey-West approach to account for autocorrelation and heteroskedasticity.

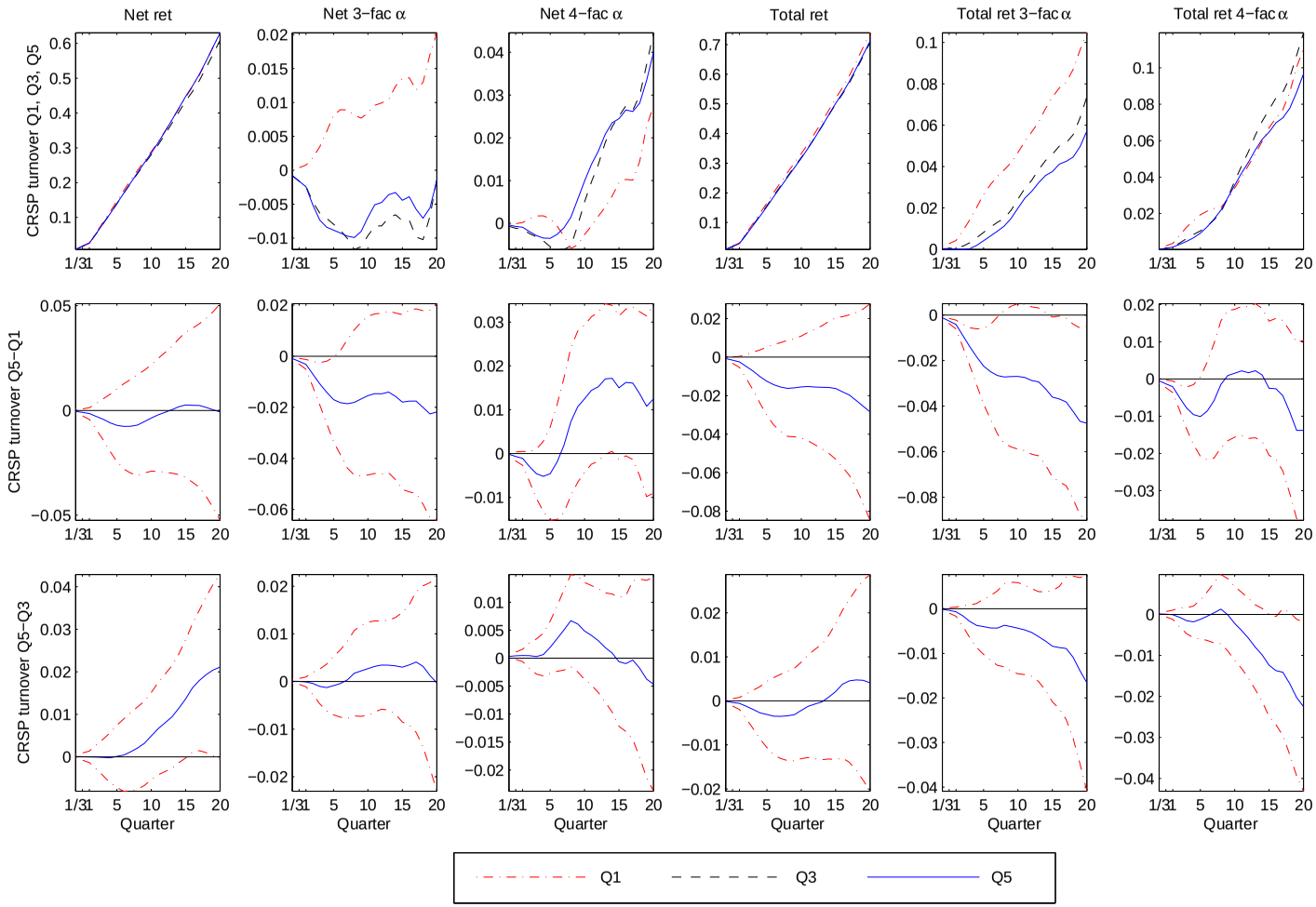

Figure 9: This figure plots buy-and-hold fund portfolio returns and abnormal returns over next month and up to five years. Each month funds are sorted into quintiles according to (the inverse of) CRSP reported turnover, with Q1 consisting of short-horizon funds and Q5 consisting of long-horizon funds. Both CRSP reported net returns and total returns (the sum of net returns and $\frac{1}{12}$ expense ratio) are used to measure monthly fund performance. Buy-and-hold net returns or buy-and-hold total returns are calculated over next one month and up to five years, with equal portfolio weights at the portfolio formation month. The abnormal returns include the Fame-French 3-factor alpha and the Carhart four-factor alpha associated with both buy-and-hold net returns and buy-and-hold total returns. The first row presents the results for long-horizon (Q5, solid line), medium-horizon (Q3, dashed line), and short-horizon (Q1, dash-dot line) fund quintiles. The second and third rows show the return spreads between Q5 and Q1 portfolios, and between Q5 and Q3 portfolios, respectively, along with the 10% confidence intervals.