Excess Autocorrelation and Mutual Fund Performance

Abstract

Informed institutional investors' strategic stealth trading has been argued to induce positive autocorrelation in their portfolio returns. Conversely, can one make use of the degree of portfolio return autocorrelation to infer relatively informed/skillful institutional investors? We propose an autocorrelation-based measure of mutual fund portfolio returns, termed the excess autocorrelation—the difference between the autocorrelation of actual fund portfolio return and that of the return on a portfolio that invests in the previously disclosed fund holdings. We document that funds with high excess autocorrelation persistently create value. Our main result shows that the excess autocorrelation predicts fund performance.

1 Introduction

Sias and Starks (1997) document that informed institutional investors' trading induces positive serial correlation in the daily returns of common stock portfolios. Models of strategic trading (e.g., Boulatov, Hendershott, and Livdan (2011)) demonstrate that rational informed institutional investors spread their trading over time to conceal information at the portfolio level, which increases the autocorrelation of their daily portfolio returns. Models of Kyle (1985) and Barclay and Warner (1993) suggest that such 'stealth trading' is also likely to increase autocorrelation in individual stock returns. If the private signals of individual stocks in the portfolio of an informed institutional investor contain a common component (i.e., they are cross-sectionally correlated), then again serial return correlation can increase at the portfolio level.

Despite the fact that financial economists often refer to institutional investors as "informed" traders, empirical evidence suggests that only a subset of mutual funds, if any, seems to possess superior skill. If informed institutional investors' trading induces positive daily return autocorrelation of their portfolios, can one infer which mutual funds are relatively informed by extracting skill-relevant information from the daily return autocorrelation of fund portfolios? This paper proposes an autocorrelation-based measure to predict mutual fund performance. The measure is defined as the difference between the autocorrelation of actual daily fund portfolio returns and the autocorrelation of a hypothetical portfolio that invests in the previously disclosed fund holdings. We term this autocorrelation difference the excess autocorrelation, which measures the additional autocorrelation of the actual fund portfolio return that cannot be captured by simply examining a fund's publicly disclosed holdings. To the extent that informed stealth trading increases the informed institutional investor's daily portfolio return autocorrelation and that the purpose of such trading is to conceal private information, funds whose actual portfolios have higher excess autocorrelation are likely to be more informed than funds whose actual portfolios have lower excess autocorrelation.

Given the importance of prices following a random walk in asset pricing, there ex-

ists a significant empirical and theoretical literature examining positive autocorrelation in portfolio returns. Absent private information, several other reasons could also contribute to positive daily portfolio return autocorrelation. First, institutional investors are likely to spread their trades in a single security across time to simply minimize execution costs. In a sample of institutional transactions, for example, Chan and Lakonishok (1995) find that over half the dollar volume of institutional trades take at least four days to complete. This trading strategy can induce the daily portfolio return autocorrelation if there is a common component in individual security trading at the fund level or at the fund industry level. For example, a fund or the entire fund industry may increase or decrease most of its positions over short horizons for non-informational reasons such as experiencing net inflows or outflows. Second, a strand of literature supports the hypothesis that the cross-sectional variation of changes in institutional holdings is related to securities' past price movements and that such herding moves prices (e.g., Grinblatt et al. (1995); Wermers (1999)). Empirical evidence is consistent with the hypothesis that institutional investors engage in positive feedback trading (i.e., selling past losers and buying past winners). This momentum trading is likely to induce autocorrelation in individual securities' returns. Such trading will also induce portfolio return autocorrelation when trades are based on market-wide shocks because the institutional trades of individual stocks will be cross-sectionally correlated. Third, nonsynchronous trading may also induce positive portfolio return autocorrelation (e.g., Lo and MacKinlay (1990), Boudoukh, Richardson, and Whitelaw (1994), and Bernhardt and Davies (2008)). Nonsynchronous trading could arise when some stocks in the portfolio are less frequently traded than other stocks.

These alternative reasons per se may not have performance implications for investors of mutual funds. First, if portfolio return autocorrelation is simply due to that all mutual funds spread their trades over time for cost-saving reasons but not for informational reasons, then it should not indicate any difference in skill or informedness across funds. Second, if momentum trading predicts mutual-fund future performance, such performance effect should be explained by the momentum factor (e.g., Carhart (1997)). Third,

a portfolio with more nonsynchronous trading may not necessarily outperform one with less such issue. Yet, it is possible that a portfolio with more nonsynchronous trading may contain more illiquid assets, while illiquid assets earn higher returns than liquid ones (e.g., Amihud and Mendelson (1986)). However, such performance effect should be explained by the illiquidity of the assets in fund portfolios.

Therefore, the performance consequences of the excess portfolio return autocorrelation can vary depending on its economic reasons. If the informedness of the fund is the driving force behind the excess portfolio return autocorrelation, we should expect superior performance for funds with high excess autocorrelation. If the above alternative reasons are the main drivers behind the excess autocorrelation, we should not expect funds with high excess autocorrelation exhibit any unexplainable superior performance.

Using the daily returns of U.S. equity mutual funds over the period between 1999 and 2010, we document a substantial cross-sectional variation in the excess return autocorrelation. Our main results show that the past 12-month excess autocorrelation helps to predict monthly fund performance. Funds with high excess autocorrelation tend to perform consistently better after adjusting for differences in their risks, styles, and liquidity. Specifically, the decile portfolio of funds with the highest lagged excess autocorrelation yields an average excess return of 3% per year relative to the market return, whereas the decile portfolio of funds with the lowest lagged excess autocorrelation generates an slightly negative but insignificant average excess return relative to the market return. The return difference between the two portfolios is statistically and economically significant. To mitigate the potential impact of measurement error on the returns to our trading strategy, we apply a filtering technique, proposed by Mamaysky, Spiegel, and Zhang (2007). In our sample this method leads to a substantial increase in the performance difference between the top and bottom deciles and allows us to identify mutual funds that significantly outperform various passive benchmarks, after taking into account fund expenses.

The performance effect of our excess autocorrelation measure is relatively persistent. High excess-autocorrelation funds are able to outperform low excess-autocorrelation

funds through both buy-and-hold and interim trading, but more of the relative outperformance of high excess-autocorrelation funds comes from a buy-hold-strategy than from interim trading. We also examine how the excess-autocorrelation measure interacts with other performance measures that extract fund-performance information from past returns of similar horizons, such as the return gap of Kacperczyk, Sialm, and Zheng (2008) and the past 12-month return of Carhart (1997). We find the excess-autocorrelation effect is not subsumed by these other performance effects. In fact, we are able to better identify outperforming high excess-autocorrelation funds (i.e., funds with positive alpha) after controlling for these other performance measures.

We further analyze excess autocorrelation to understand the mechanisms and sources of the relative outperformance of high excess-autocorrelation funds. First, a fund's excess return autocorrelation is not necessarily only related to the informedness of the fund. For example, larger funds may have to spread their trades over longer periods. Funds that trade more illiquid assets over the disclosure period may incur more prominent price impact. In both cases, the excess autocorrelation of such funds can be higher than other funds. However, these characteristics are unlikely to lead to after-fee fund outperformance as larger funds generally perform worse (e.g., Chen, Hong, Huang, and Kubik (2004)), and funds that trade more illiquid assets over the disclosure period incur more transaction costs. Using Fama-Macbeth regressions, we confirm the relation between a fund's excess return autocorrelation and its subsequent performance, controlling for fund size and illiquidity, as well as other characteristics such as fund flows and styles.

Second, portfolio return autocorrelation could be driven by two different mechanisms related to informed trading: the autocorrelation of individual stocks in the portfolio and the cross-autocorrelation between stocks in the portfolio. Strategic trading models of individual stocks such as Kyle (1985) and Barclay and Warner (1993) suggest that informed investors' trading induces positive return autocorrelation in the individual securities they hold. Boulatov, Hendershott, and Livdan (2011) show that even if individual stock returns follow random walk, which is consistent with market efficiency, institutional investors' informed trading induces cross-autocorrelation between stocks in

their portfolios, which leads to return autocorrelation in their portfolios. Thus, positive excess autocorrelation can arise due to that a fund's actual portfolio contains stocks with more autocorrelated or cross-autocorrelated returns. We find evidence consistent with both types of informed-trading theories. That is, the excess autocorrelation of individual stocks and the excess cross-autocorrelation between individual stocks in a fund portfolio both contribute to predicting fund performance.

Third, one reason that a fund's excess autocorrelation can arise is that either the fund's informed buying or selling activity during the disclosure period induces high return autocorrelation in the actual portfolio of stocks that the fund is buying or selling during the disclosure period. We find evidence that the performance effect of excess autocorrelation is indeed partially driven by the high autocorrelation of funds' actual buy and sell portfolios during the disclosure period.

The recent literature finds that some active mutual fund managers have significant investment ability.[1] Our excess autocorrelation measure provides a separate signal of skill and can sharpen the existing activeness measures in identifying skilled managers.

The rest of this paper is organized as follows. Section 2 describes the excess autocorrelation measure. Section 3 presents the data. Section 4 discusses the characteristics of excess autocorrelation. Section 5 analyze the performance consequences of excess autocorrelation. Section 6 provides some additional results to understand the robustness and the sources and mechanisms of the performance effect of excess autocorrelation. Section 7 concludes.

[1] Other papers on the investment ability of mutual fund managers include Grinblatt and Titman (1993), Brown and Goetzmann (1995), Ferson and Schadt (1996), Carhart (1997), Daniel, Grinblatt, Titman, and Wermers (1997), Bollen and Busse (2001), Coval and Moskowitz (2001), Berk and Green (2004), Chen, Hong, Huang, and Kubik (2004), Cohen, Coval, and Pastor (2005), Cremers and Petajisto (2009), Kacperczyk, Sialm, and Zheng (2005), Gaspar, Massa, and Matos (2006), Kosowski, Timmermann, Wermers, and White (2006), Jiang, Yao, and Yu (2007), Kacperczyk and Seru (2007), Cohen, Frazzini, and Malloy (2008), Kacperczyk, Sialm, and Zheng (2008), Christoffersen and Sarkissian (2009), Huang, Sialm, and Zhang (2010), Cohen, Polk, and Silli (2010), and Dong, Feng, Sadka (2012).

2 The Excess Autocorrelation

We define the excess autocorrelation, which is based on the comparison of the autocorrelation of the actual fund portfolio return (net investor return) and the autocorrelation of the net return of the fund's disclosed holdings. This section describes the computation of the excess autocorrelation.

The daily actual fund portfolio return is the net daily investor return of fund f at day t (RF). The management fees and other expenses (EXP) are subtracted from this net return. On the other hand, we define the return of the fund's disclosed holdings (RH) as the total return of a hypothetical buy-and-hold portfolio that invests in the most recently disclosed stock positions.

The weights of the individual stocks depend on the number of shares held by the fund at the most recent disclosure date at time $t-\tau$ ($N^f_{i,t-\tau}$) and the stock price at the end of the previous day ($P_{i,t-1}$). Further, we adjust the number of shares and the stock prices for stock splits and other share adjustments.

$$\omega^f_{i,t-1} = \frac{N^f_{i,t-\tau} P_{i,t-1}}{\sum_{i=1}^{n} N^f_{i,t-\tau} P_{i,t-1}}. \tag{1}$$

We define the excess autocorrelation (EA) in month m as the difference between the autocorrelation of the daily net investor return and the autocorrelation of the net holdings return in that month:

$$EA^f_m = \rho_m(RF^f_t) - \rho_m(RH^f_t - EXP^f_t), \tag{2}$$

Thus, the excess autocorrelation measures the extra return autocorrelation of a fund's actual portfolio that cannot be captured by simply examining the fund's publicly disclosed holdings. The excess autocorrelation measure EA in month m is positive if the actual fund portfolio returns exhibit a higher autocorrelation than the returns calculated from its most recently disclosed holdings and is negative otherwise. To the extent that a

skillful/informed manager's information is private and the purpose of his strategic stealth trading is to hide his/her true demand of stock positions from the market maker, our measure focuses on capturing the autocorrelation that can not be simply captured by the fund's disclosed stock positions. In addition, the portfolio autocorrelation of daily returns may change substantially due to the exogenous changes in market conditions (to be shown in a later section). Thus, by using overlapping time periods to estimate both the actual portfolio autocorrelation and the hypothetical autocorrelation for a fund, our measure also filter out the impact of common shocks to both autocorrelation.

3 Data

Daily and monthly mutual-fund return data are obtained from the CRSP survivor-bias-free database for the period 1999–2010. Since 1999 is the first full calendar year for CRSP to report fund daily returns, our sample starts from 1999. Only funds that report returns on a monthly basis and net of all fees (management, incentive, and other expenses) are kept in the sample. Some fund families incubate many private funds and make historical performance available only for the funds that survive (Elton, Gruber, and Blake (2001) and Evans (2004)). In order to address the incubation bias in the data, we exclude the first 12-month fund monthly returns. The removal of these young funds also alleviates a concern that these funds are more likely to be cross-subsidized by their respective fund families (Gaspar, Massa, and Matos (2006)).

We merge the CRSP Mutual Fund Database with the Thompson Financial CDA/Spectrum holdings database and the CRSP stock price data following the methodology of Kacperczyk, Sialm, and Zheng (2005). The CRSP mutual fund database includes information on fund returns, total net assets (TNA), different types of fees, investment objectives, and other fund characteristics. The CDA/Spectrum database provides stockholdings of mutual funds. The data are collected both from reports filed by mutual funds with the SEC and from voluntary reports generated by the funds. During most of our sample period, funds are required by law to disclose their holdings semiannually. Beginning from

2004, all funds are required to disclose their holdings quarterly.

We focus our analysis on open-end active domestic equity mutual funds, for which the holdings data are most complete and reliable. To select such funds, we first require more than 85% and 105% of fund holdings must be equity. We then eliminate index, balanced, bond, money market, international, and sector funds, as well as funds not invested primarily in equity securities. We also exclude funds that hold fewer than 10 stocks and those which in the previous month managed less than $5 million. For funds with multiple share classes, we eliminate the duplicated funds and compute the value-weighted fund-level variables by aggregating across the different share classes.

Table 1 reports summary statistics of the main fund attributes. We report summary statistics on expense ratio, turnover, fund flow, flow volatility, load dummy, log total net assets (TNA), log total net assets (TNA), age, number of stocks, the average Amihud liquidity measure, the average bid-ask spread, and the average size of individual stocks in a fund portfolio, and the return gap measure of Kacperczyk, Sialm, and Zheng (2008).

Following the literature, the percentage net flow to fund i during month t is measured as

$$Flow_{i,t} = \frac{TNA_{i,t} - TNA_{i,t-1}(1 + R_{i,t}) - MergeTNA_{i,t}}{TNA_{i,t-1}}, \tag{3}$$

where $TNA_{i,t}$ is measured at the end of month t, $R_{i,t}$ is the fund's return for month t, and $MergeTNA_{i,t}$ is the increase in the TNA due to mergers during month t. Since estimated fund flows are very volatile, we winsorize both the top and the bottom parts of the distribution at the 1% level. Flow volatility is calculated using the past 12-month flows.

4 Characteristics of Excess Autocorrelation

This section discusses the characteristics of excess autocorrelation. The excess autocorrelation is defined as the difference between the autocorrelation of the daily actual fund

portfolio return and the autocorrelation of the net daily return of the fund's disclosed holdings portfolio, as defined in Section 1. The first three rows of Table 1 report the excess autocorrelation measure, the autocorrelation of the actual fund portfolio return, and the autocorrelation of the net daily return of the fund's disclosed holdings portfolio. Both the actual portfolio return autocorrelation and the disclosed portfolio return autocorrelation are computed and updated at a monthly frequency.

The actual portfolio return autocorrelation and the disclosed portfolio return autocorrelation are negative and statistically significant (-4.80% and -5.13%, respectively) with a correlation of 96%. Although asset prices following a random walk in a frictionless world is the basis for much of asset pricing in financial economics, the negative correlation is likely due to the bid-ask bounce of individual stocks (e.g., Roll (1984)), which induces negative daily return autocorrelation for both individual stock and portfolio returns.[2] The excess-autocorrelation measure has a slightly positive mean 0.33%, suggesting that mutual fund trading on average increase their daily portfolio return autocorrelation. This result is consistent with the finding of Sias and Starks (1997) that institutional trading is generally more informed than average investors' trading and their informed trading contributes to positive daily portfolio return autocorrelation. The standard deviation of the EA measure is 4.91%, which is about the same absolute magnitude as the average portfolio return autocorrelation. The result suggests that there is a substantial cross-sectional variation in the excess return autocorrelation.

Funds are sorted into deciles according to their lagged excess autocorrelation during the previous 12 months. The top decile of funds exhibits the most positive excess autocorrelation and vice versa. Figure 1 depicts the 12-month moving averages of cross-sectional means of the actual portfolio autocorrelation and the disclosed portfolio autocorrelation over our sample period from 1999-2010. The autocorrelation levels change significantly

[2] If the bid-ask bounce process, which determines whether a given trade occurs at the bid or ask price, were independent across different stocks, bid-ask bounce would produce a slight negative autocorrelation in portfolio returns coming from the negative autocorrelation of the individual stocks in the portfolio. In practice, the bid-ask bounce process may show positive correlation across stocks. For example, stock prices may generally rise (fall) on a day just before the close, then most stocks final trade will be at the ask (bid) price, inducing negative autocorrelation in the daily portfolio return.

over time. As Figure 1 illustrates, common market shocks affect the two autocorrelation measures to a similar degree. The excess autocorrelation measure therefore alleviates the impact of market conditions by using overlapping return distributions.

5 Predictability of Fund Performance

In this section, we test whether excess autocorrelation contains valuable information about fund future performance.

5.1 Trading strategies based on the excess autocorrelation

Our first predictability test examines the performance of a trading strategy based on the past excess autocorrelation. Specifically, we sort all funds in our sample into deciles according to their average monthly excess autocorrelation during the previous 12 months. The 12-month moving average reduces the noise in estimating monthly excess autocorrelation. We then compute for each month the average subsequent return by weighting all the funds in a decile equally.

Funds in the middle four deciles exhibit relatively small levels of autocorrelation between -0.15% and 0.56%.[3] We aggregate in the remainder of the paper several deciles to economize on space. Based on the EA deciles we form five EA portfolios. Portfolios 1 and 5 correspond to deciles 1 and 10, portfolio 3 corresponds to deciles 4 to 7, and portfolios 2 (and 4) correspond to deciles 2 and 3 (and deciles 8 and 9), respectively.

In Table 2 Panel A, we report the average excess autocorrelation and the risk- and style-adjusted fund returns for the five portfolio. The first row reports the excess autocorrelation. Funds in Decile 1 have an average excess autocorrelation of -2.41% per month during the formation period, whereas funds in Decile 10 have an average excess autocorrelation of 4.81% per month during the ranking period.

The remaining rows report the performance measures based on the net investor returns. The risk-adjusted returns are the intercepts from a time-series regression based

[3] The excess autocorrelation of the decile portfolios are -2.41%, -0.87%, -0.44%, -0.15%, 0.08%, 0.30%, 0.56%, 0.91%, 1.49%, and 4.18%, respectively.

on the one-factor model of CAPM, the three-factor model of Fama and French (1993), the four-factor model of Carhart (1997), the conditional four factor model of Ferson and Schadt (1996), the five-factor model of Acharya and Pederson (2005), which adds an Amihud-based liquidity factor to the Carhart four factor model, the five-factor model of Pástor and Stambaugh (2003), the four factor model of CPZ proposed by Cremers, Petajisto and Zitzewitz (2010), which includes the excess return on the S&P500 index, the returns on the Russell 2000 index minus the return on the S&P500 index, the Russell 3000 value index minus the return on the Russell 3000 growth index, and the Carhart's (1997) momentum factor, the Ferson and Schadt (1996) conditional measure based on the four-factor model to measure fund performance, and the Characteristic Selectivity (CS) measure of Daniel, Grinblatt, Titman, and Wermers (1997, DGTW hereafter).[4]

We observe that funds with the lowest past excess autocorrelation (decile 1) tend to significantly underperform funds with the highest past excess autocorrelation (decile 10). Investing in decile-10 funds would have generated an additional four-factor alpha of 28 basis points per month (t-value=3.70) or about 3.41% per year compared to investing in decile-1 funds. Our results are not influenced substantially by the variation in risk or style factors, as well as after controlling for macroeconomic information following Ferson and Schadt (1996). All the performance measures for the top-decile funds are positive. They are also statistically significant for the CAPM model, the CPZ four factor model, the Ferson-Schadt conditional model, and the DGTW measure. In unreported results, we also use a 24-month moving window. The results are qualitatively similar, suggesting that the performance-relevant information contained in the EA measure is relatively persistent.

Since investors cannot short mutual funds, it is not feasible to generate returns given by the difference between the top and the bottom deciles. However, by conditioning on the excess autocorrelation investors can avoid potential losses that are related to the

[4] To calculate Ferson-Schadt conditional performance alpha, we follow previous studies and include the following demeaned macroeconomic variables in month t-1: the dividend yield of the S&P 500 index, the term spread (the difference between the rates on a 10-year Treasury note and a three-month Treasury bill), the default spread (the difference between the rates on AAA and BAA bonds), and the three-month Treasury bill rate.

excess autocorrelation differences between the deciles.

5.2 Trading strategies with back-testing

In a recent study, Mamaysky, Spiegel, and Zhang (2007) provide evidence that previous performance studies are plagued by estimation problems. In particular, since many sorting variables are measured with noise, the top and the bottom deciles of a given trading strategy might not be populated by just the best and the worst funds, but also by funds that have the highest estimation errors. To alleviate this problem, they suggest using a back-testing technique in which the statistical model is required to exhibit some past predictive success for a particular fund before it is used to make predictions in the current period. They show that a strategy that uses modest ex ante filters to eliminate funds whose parameters likely derive primarily from estimation errors produces very significant out-of-sample risk-adjusted returns.

Motivated by their study, we eliminate funds for which the demeaned excess autocorrelation has a different sign from the excess fund return in two non-overlapping time periods. In a first step, we sort all funds into deciles according to their average excess autocorrelation between 12 and 1 months prior to the portfolio formation month. This sorting yields exactly the same portfolios as those described in Table 2. In addition, we require that the average reported excess returns relative to the market during the month immediately prior to the portfolio formation have the same sign as the lagged demeaned average excess autocorrelation between 12 and 2 months prior to the portfolio formation month.[5] Thus, in the trading strategy we consider only funds for which there is a concordance between the lagged demeaned excess autocorrelation and the lagged excess return.[6]

Our results, summarized in Table 2 Panel B. The results show that the performance difference between the top and the bottom decile portfolios widens dramatically for all performance measures. For example, the difference in the abnormal four-factor Carhart

[5] The excess autocorrelation is demeaned by subtracting its times-series mean.

[6] Kacperczyk, Sialm, and Zheng (2008) uses a similar methodology.

alpha increases from 28 basis points per month to 52 basis points per month.

After filtering out funds with diverging lagged performance measures, we find that the funds in the top excess-autocorrelation decile perform particularly well. All the positive alphas are now significant at the 5% level. The outperformance ranges from 22 basis points per month (DGTW) to 57 basis points per month (CAPM).

5.3 Long-term performance impact

Table 3 summarizes the long-term impact of excess autocorrelation. We form mutual fund portfolios in the same way as in Table 2 but hold the portfolio longer. We follow the portfolio construction approach of Jegadeesh and Titman (1993). Specifically, the table utilizes average returns of multiple portfolios with the same holding horizon. For example, the January return of a three-month holding period strategy is an average of the January returns of three excess autocorrelation portfolios that are constructed in October, November, and December of the previous year. The results show that the relative outperformance of funds with high excess autocorrelation are relatively persistent. All the main results based on one-month holding period in Table 2 still hold when the holding periods are extended to 12 months.

5.4 Performance decomposition

To further understand the ability of excess autocorrelation in predicting fund performance, we decompose the fund total return performance in the portfolio formation month into two components: the holdings return and the residual return. The holdings return is the return of the fund based on its most recent reported portfolio holdings. The residual return is the difference between the fund actual total return and the holdings return.

For a stock to appear in a fund's most recent reported holdings, the stock must have been purchased on or before the most recent report date. Therefore, the holdings return reflects a fund manager's ability to outperform through a buy-and-hold strategy. The residual return reflects the fund manager's ability to outperform through interim trading during the disclosure period. Table 4 presents the results of the decomposition. Funds

are sorted in the same way as in Table 2. The table reports the outperformance of top decile of funds relative to the bottom decile funds sorted by the EA measure. The results show that high excess-autocorrelation funds are able to outperform low excess-autocorrelation funds through both buy-and-hold and interim trading, but more of the relative outperformance of high excess-autocorrelation funds comes from a buy-hold-strategy than from interim trading. About two thirds of the total outperformance in the portfolio formation period comes from the fund holdings return, while the remaining one third comes from the interim trading return.

5.5 Consistently buy and sell portfolio performance

This section studies how excess autocorrelation predicts the performance of the portfolios of stocks that a fund recently buys and sells, respectively. We infer a fund's buy and sell portfolios from its two most recent reported holdings. If the number of shares of a stock increases (decreases) over the most recent disclosure period, we categorize this stock as the stock that the fund buys (sells). The buy (sell) portfolio of the fund is then all the stocks that the fund buys (sells) during the most recent disclosure period. The weight of each stock in the buy (sell) portfolio is proportional to the market value of the shares that have been purchased (sold) during the disclosure period.

Mutual funds do not only trade for information reasons but also for liquidity reasons. For example, fund managers must trade in response to unanticipated investor flows. For liquidity trading, a skillful fund which has on average better performed stocks in its portfolio than an unskillful fund may have to sell some of these better performed stocks to meet investors' liquidity demands. The results in the previous section indicate that the stocks that high excess-autocorrelation funds hold on average outperform those that low excess-autocorrelation funds hold. Since a lot of the stocks that funds buy and sell during the most recent disclosure period may be also in the fund's most recent reported stock holdings, the stocks that high excess-autocorrelation funds buy and sell may also outperform the stocks that low high excess-autocorrelation funds buy and sell on average, especially if liquidity trading represents a big portion of funds' overall trading activity.

In unreported results, we verify that it is indeed the case.

To focus more on funds' information-based trading and reduce the noise introduced by funds' liquidity trading, we focus on funds' consistently buy and sell portfolios. A stock that a fund sells during the most recent disclosure period is categorized into the consistently sell portfolio of the fund if the fund also sells the stock during the disclosure period immediately prior to the most recent disclosure period. Given that investors' liquidity-based buying and selling demands are random, selling for two consecutive disclosure periods is less likely to be liquidity-based selling. For the similar reason, a fund is less likely to buy the stock for informational purposes if, over two consecutive disclosure periods, the fund buys the stock in one period but sells the stock in another period. Therefore, a stock is categorized into the consistently buy portfolio of the fund if the fund buys the stock in the most recent disclosure period but does not sell the stock during the disclosure period immediately prior to the most recent disclosure period.

Table 5 Panel A and B provide the out-of-sample performance of funds' consistently buy and sell stock portfolios, respectively, for fund portfolios sorted on excess autocorrelation in the way as in Table 2. The results show that the stocks that high excess-autocorrelation funds consistently buy significantly outperform the stocks that high excess-autocorrelation funds consistently buy, while the stocks that high excess-autocorrelation funds consistently sell does not outperform the stocks that high excess-autocorrelation funds consistently sell. The results suggest that, among the stocks that funds consistently buy and sell, high excess-autocorrelation funds have better skill in buying stocks than low excess-autocorrelation funds, while there is no significant difference in the skill of selling stocks between the two types of funds.

The asymmetry between the relative abnormal performance of buy and sell trades is consistent with many studies in the literature (e.g., Puckett and Yan (2011) and Fang, Peress, and Zheng (2012)). In particular, Chan and Lakonishok (1993, 1995) argue that when institutional investors purchase securities, their choice of which security to buy is likely to be unconstrained. As such, the decision to buy a particular security, out of the numerous possibilities that exist, is likely to convey positive firm-specific

information. Alternatively, an institutional investor holds a finite number of securities in its portfolio and, when short sales are constrained, faces a limited number of alternatives when deciding to sell. As a result, there are many reasons why institutional sales might not necessarily convey negative firm-specific information.

5.6 Excess autocorrelation, return gap, and prior return

Our excess autocorrelation measure is constructed using past 12-month returns. In this section, we examine how the EA performance effect interacts with performance measures which are based on past 12-month returns.

The first measure is the return gap measure of Kacperczyk, Sialm, and Zheng (2008). The return gap measure also extracts information from the recent 12-month difference between the actual fund portfolio and their disclosed holding portfolio. However, the economic mechanisms of the two measures are different. The daily return autocorrelation of a portfolio is not necessarily positively or negatively related to the monthly return of the portfolio. For example, a stock with high daily return autocorrelation can either be a winner stock (i.e., high monthly return) or a loser stock (i.e., low monthly return) as long as the price of the winner or loser stock gradually appreciates or depreciates over the month. Table 1 confirms that the correlation between the return gap and the excess autocorrelation measure is very small (3%).

The second measure is the past 12-month fund return of Carhart (1997). If excess autocorrelation reflects fund informedness or skill, jointly examining fund past performance and excess autocorrelation helps reveal whether such informedness is persistent or due to random luck.

In Table 6 Panel A, we perform double sorts by first sorting on the past 12-month return gap and then on the past 12-month excess autocorrelation. To save space, only the Carhart four-factor alphas are reported. The results show that our excess autocorrelation effect survives from controlling for the return gap. High excess-autocorrelation funds outperform low excess-autocorrelation funds in both large and small return-gap fund portfolios. In fact, we are able to better identify the high excess-autocorrelation funds

with positive alpha after controlling for the return-gap characteristics. The four-factor alpha of the high excess-autocorrelation funds conditioning on large past 12-month return gap is 37 basis points per month ($t = 2.23$).

In Table 6 Panel B, we perform double sorts by first sorting on the past 12-month return and then on the past 12-month excess autocorrelation. The table shows that past winner funds with high excess-autocorrelation tend to continue outperforming out-of-sample with a four-factor alpha of 49 basis points per month ($t = 2.35$). The results provide further support that the informedness of high excess-autocorrelation funds is persistent.

6 Analysis of Excess Autocorrelation

This section performs additional analysis of the excess autocorrelation to understand the robustness and the sources and mechanisms of the performance consequence of excess autocorrelation.

6.1 Fund characteristics and excess autocorrelation

To identify the relation between the fund characteristics and excess autocorrelation, we compute average characteristics of funds. Table 7 performs the Fama-Macbeth regression of fund monthly EA measure and the characteristics of mutual funds.

The results show that the excess autocorrelation is not significantly driven by expense ratio and significantly negatively related to turnover ratio, suggesting that the EA measure is not likely to be positively related to the costs that a fund incurs.

The EA measure is significantly positively related to flow, consistent with our earlier conjecture that fund managers may systematically buy (sell) positions in their portfolios in response to the increase (decrease) of fund flows.

The relation between the EA measure and stock illiquidity is mixed. Consistent with other studies (e.g., Massa and Phalippou (2005)), we use the Amihud illiquidity ratio of fund holdings as our main fund illiquidity proxy. Each month, an Amihud illiquidity

ratio for each stock in a fund's most recent reported stock holdings is estimated using the stock's daily returns and volume. A fund-level monthly Amihud illiquidity ratio is then estimated by taking a value-weighted average of the Amihud ratios of individual stocks. The results show that the average stock Amihud measure is not significantly related to the excess autocorrelation. However, our other fund characteristic measures–the average bid-ask spreads and size of the stocks in a fund portfolio–tend to be significantly positively and negatively related to the EA measure, respectively. Since stock size and the bid-ask spread could also proxy for information asymmetry, the evidence is inconclusive regarding whether the excess autocorrelation is related to the pure non-informational inventory-related illiquidity.

Nevertheless, the characteristic analysis suggests that it is helpful to obtain a cleaner picture of the performance effect of excess autocorrelation in a multivariate regression to control for fund characteristics.

6.2 Multivariate regression

This section uses a multivariate Fama-Macbeth regression analysis to investigate the relation between excess autocorrelation and subsequent fund performance. This methodology allows us to control for additional fund characteristics.

The dependent variable in each cross-section is one of three performance measures of an individual mutual fund performance in a particular portfolio formation month. We use three different performance measures: (i) the Carhart four-factor alpha; (ii) the five factor alpha of Acharya and Pederson (2005); (iii) the five-factor model of Pástor and Stambaugh (2003). The first measure is the common performance measure for domestic equity mutual fund used by many studies. We use it for the ease of comparison with other studies. The other two measures specifically controls for liquidity risk as daily return autocorrelation is likely to be associated with liquidity.

The control variables include lagged one-year return, expense ratio, turnover, flow, flow volatility, load dummy, log of lag TNA, log of lag family TNA, fund age, number of stocks, the average stock Amihud measure, the average bid-ask spread, and the average

stock size.

Table 8 reports the multivariate regression estimates. All specifications indicate a significantly positive relation between excess autocorrelation and the various performance measures. The performance consequences are similar in magnitude to the results reported in Table 2. The results suggest that concerns such as liquidity do not drive the excess autocorrelation effect. In fact, the liquidity of underlying stock holdings is mostly not significantly related to fund future performance, which is consistent with the findings of Massa and Phalippou (2005) and Dong, Feng, Sadka (2012).

6.3 Illiquidity and excess autocorrelation

As discussed in the introduction, a fund's excess autocorrelation might be related to the illiquidity of fund holdings. Since illiquid assets generally have higher returns, the outperformance of high EA funds may be due to the possibility that their holdings are more illiquid. Although the results in the previous subsection as well as in previous studies show that the illiquidity of fund reported holdings can not predict fund future performance, it is possible that a fund may capture some illiquidity premium from trading during the disclosure period. For example, a fund can buy illiquid stocks and sell liquid ones after it reports its holdings. To further address this concern, we calculate the value-weighted Amihud measures of the stocks in the fund's buy and sell portfolios.

Table 9 reports the average Amihud measures of the buy and the sell portfolios for each EA-sorted fund portfolios. The results show that most mutual funds buy and sell stocks with similar level of illiquidity. There is no significant difference in illiquidity between the stocks that funds buy and those that they sell for each EA-sorted fund portfolios. There is no significant systematic difference in the illiquidity level of funds' trading (buy or sell) portfolios between the high and the low EA funds either. The results further support that illiquidity can not explain the performance predictability of the EA measure.

6.4 Individual stock autocorrelation and cross autocorrelation

To further understand the sources of the performance consequence of the excess autocorrelation, this section and the next introduce some alternative measures of fund portfolio return autocorrelation.

First, portfolio return autocorrelation could be driven by two different mechanisms. The first is the autocorrelation of individual stocks in the portfolio if there is a common time-series component of autocorrelated returns in individual stocks. Strategic trading models of individual stocks such as Kyle (1985) and Barclay and Warner (1993) suggest that informed investors' trading is likely to induce positive return autocorrelation in individual stocks in their portfolios. The second is the cross-autocorrelation between stocks in a portfolio. Boulatov, Hendershott, and Livdan (2011) show that even if individual stock returns follow random walk, which is consistent with market efficiency, an informed institutional investor's stock portfolio return could still be autocorrelated due to the cross-autocorrelation caused by the investor's strategic trading.

In the same token, the excess autocorrelation of a fund portfolio could be driven by two possible reasons. First, the average autocorrelation of individual stocks in the fund actual portfolio is higher than that of individual stocks in the fund disclosed holdings portfolio. We term this the average excess autocorrelation of individual stocks in a fund. Second, the average cross-autocorrelation between individual stocks in the fund actual portfolio is higher than that between individual stocks in the fund disclosed holdings portfolio. We term this the average excess cross-autocorrelation of individual stocks in a fund

Since the actual daily fund portfolio holdings is not available, we use a fund's disclosed portfolio holdings at the end of the disclosure period to proxy for the actual portfolio holdings of the fund during the disclosure period. Thus, the average excess autocorrelation of individual stocks in a fund in a particular month is computed as the difference between the value-weighted average return autocorrelation of individual stock holdings disclosed at the end of the disclosure period (the weight is proportional to the product of

the number of shares reported at the end of the disclosure period and the stock price at the beginning of each month) and the value-weighted average return autocorrelation of individual stock holdings disclosed at the beginning of the disclosure period (the weight is proportional to the product of the number of shares reported at the beginning of the disclosure period and the stock price at the beginning of each month).

For cross-autocorrelation, it is not practical to compute cross-autocorrelation for every pair of stocks in the fund portfolio. Thus, we approximate the average cross-autocorrelation of an individual stock with every other individual stock in the fund portfolio by taking the mean of the correlation between the daily return of the stock and the one-day lagged fund portfolio return and the correlation between the one-day lagged stock return and the fund portfolio return. The average excess cross-autocorrelation of individual stocks in a fund in a particular month is then computed as the difference between the value-weighted average cross-autocorrelation of all the individual stocks in the actual fund portfolio and the value-weighted average cross-autocorrelation of all the individual stocks in the fund disclosed holdings portfolio. The individual stock holdings in the actual fund portfolio are again proxied by the disclosed holdings at the end of the disclosure period.

Table 10 and 11 report the performance of funds sorted by the average excess autocorrelation of individual stocks in a fund and the average excess cross-autocorrelation of individual stocks in a fund, respectively. The results show that both the excess autocorrelation of individual stocks and the excess cross-autocorrelation between individual stocks contribute to the performance effect of the excess portfolio autocorrelation. The top decile fund outperforms the bottom decile fund by a four factor alpha of 10 basis points per month (t-value=2.01) for portfolios sorted by the excess autocorrelation of individual stocks, and by a four factor alpha of 15 basis points per month (t-value=2.03) for portfolios sorted by the excess cross-autocorrelation of individual stocks. The results are weaker than the performance results using the EA measure, which is expected as one can not directly observe the true daily holdings of individual stocks in a fund portfolio.

Overall the results are consistent with the theories that link either the individual-

stock return autocorrelation or cross-autocorrelation to informed institutional investors' trading.

6.5 Buy portfolio autocorrelation and sell portfolio autocorrelation

Second, a fund's informed buying and selling activity can induce positive return autocorrelation in the actual portfolios of stocks that the fund is buying and selling during the disclosure period, respectively. This section investigates how buy-portfolio and sell-portfolio autocorrelations contribute to the performance effect of excess autocorrelation separately.

Since the actual daily fund portfolio holdings is not available, we again rely on changes of portfolio positions between two adjacent disclosure dates to separate the stocks that a fund trades during the disclosure period into buy and sell portfolios. A stock is categorized into the actual fund buy (sell) portfolio during the disclosure period if the number of its disclosed shares increases (decreases) over the disclosure period. The weight of the stock in the buy (sell) portfolio is proportional to the market value of the stock shares increased (decreased) during the period.

Table 12 performs a double-sort analysis based on the buy-portfolio autocorrelation and the excess autocorrelation of individual funds. In Panel A, funds are first sorted into five portfolios by the average return autocorrelation of their buy portfolios in the past 12 months. Within each buy-autocorrelation portfolio, funds are further sorted into five excess autocorrelation portfolios as in Table 2. The results show that, by conditioning on the actual buy-portfolio autocorrelation, we are better able to identify which high excess-autocorrelation funds are going to outperform. That is, the high excess-autocorrelation funds that also have high buy-portfolio autocorrelation. Panel B reverses the sorting order and confirms this result. The Carhart four-factor alpha of such funds can be as high as 43 basis points per month with a t-value of 2.53 (the portfolio in the bottom right corner of Panel B). The results suggest that the high autocorrelation of funds' actual buy portfolios during the disclosure period contributes to the outperformance of high

excess-autocorrelation funds.

However, the results in Table 12 indicate that after controlling for the buy-portfolio autocorrelation, the EA effect still goes through (Panel A). In contrast, after controlling for the excess autocorrelation measure, buy-portfolio autocorrelation has no predictive power on future fund performance except in the fund portfolio with the highest excess autocorrelation (Panel B). In unreported results, we also confirm that the top decile of funds do not significantly outperform bottom decile of funds if funds are sorted solely based on their buy-portfolio autocorrelation. These results suggest that the excess-autocorrelation measure provides a more precise signal on fund future performance than the buy-portfolio autocorrelation. The results are expected as the information about a fund's actual buy portfolio is not available.

Panel C and D perform a similar analysis as in Panel A and B but instead focus on the relation between the sell portfolio autocorrelation and the excess autocorrelation. The results point to a similar conclusion as in Panel A and B. That is, the performance consequence of the excess autocorrelation is partially related to but not solely driven by the autocorrelation of a fund's actual sell portfolio. The performance effect of sell portfolio autocorrelation is weaker than that of the buy portfolio autocorrelation. The results are consistent with the asymmetry between the relative abnormal performance of buy and sell trades.

7 Conclusion

In this paper, we analyze the impact of daily portfolio return autocorrelation on fund performance using a large sample of US equity mutual funds between 1999 and 2010. We propose a autocorrelation-based measure by taking the difference between the autocorrelation of actual daily fund portfolio returns and the autocorrelation of a hypothetical portfolio that invests in the previously disclosed fund holdings. We term this autocorrelation difference the excess autocorrelation, which measures the additional autocorrelation of the actual fund portfolio return that cannot be captured by simply examining a fund's

publicly disclosed holdings.

Funds differ substantially in the cross-section with respect to the excess autocorrelation. This excess autocorrelation measure has significant predictive power for fund performance. To the extent that informed stealth trading increases the informed institutional investor's daily portfolio return autocorrelation and that the purpose of such trading is to conceal private information, funds whose actual portfolios have higher excess autocorrelation are likely to be more skillful or informed than funds whose actual portfolios have lower excess autocorrelation. Thus, our results provide consistent evidence that our excess autocorrelation measure may reflect the informedness or skill of fund managers.

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Table 1
Summary Statistics

This table summarizes the characteristics of the mutual funds in our sample over the period between 1999 and 2010.

	Mean	Median	Standard deviation
Panel A. All funds			
Excess Autocorrelation (%)	0.33	0.15	4.91
Actual Portfolio Autocorrelation (%)	-4.80	-4.89	17.72
Disclosed Portfolio Autocorrelation (%)	-5.13	-5.26	17.59
Expense Ratio (%)	1.28	1.23	0.44
Turnover Ratio (%)	88.83	69.42	82.36
Flow	-0.15	-0.49	5.54
Flow Volatility	2.91	1.66	3.67
Load Dummy	0.63	1.00	0.48
TNA (Millions)	1,522.53	271.60	5,760.62
Family TNA(Millions)	38,007.38	3,088.50	103,836.87
Fund Age	3.39	3.00	2.59
Number of Stocks	110.32	75.00	138.80
Stock Amihud Illiquidity	0.01	0.00	0.14
Stock Bid-ask Spread	0.31	0.12	0.48
Stock Size (Millions)	25,706.37	21,346.49	23,559.22
Return Gap (%)	0.02	0.00	0.36
Panel B. Full Sample Excess Autocorrelation, by investment style			
Small-Cap Growth Funds (in %)	0.09	0.06	2.84
Small-Cap Core Funds (in %)	0.21	0.11	2.92
Small-Cap Value Funds (in %)	0.34	0.18	2.85
Mid-Cap Growth Funds (in %)	0.06	0.04	3.05
Mid-Cap Core Funds (in %)	0.21	0.09	3.12
Mid-Cap Value Funds (in %)	0.39	0.19	3.29
Large-Cap Growth Funds (in %)	0.17	0.12	3.02
Large-Cap Core Funds (in %)	0.21	0.15	2.79
Large-Cap Value Funds (in %)	0.19	0.11	2.44

Table 1
Summary Statistics

Panel C. Cross Correlation

	Excess Autocorrelation (%)	Actual Portfolio Autocorrelation (%)	Disclosed Portfolio Autocorrelation (%)	Expense Ratio (%)	Turnover Ratio (%)	Flow	Flow Volatility	TNA (Millions)	Family TNA(Millions)	Fund Age	Number of Stocks	Stock Amihud Liquidity	Stock Bid-ask Spread	Stock Size (Millions)
Actual Portfolio Autocorrelation (%)	0.16	1.00												
Disclosed Portfolio Autocorrelation (%)	-0.11	0.96	1.00											
Expense Ratio (%)	-0.01	0.06	0.06	1.00										
Turnover Ratio (%)	-0.03	0.06	0.07	0.19	1.00									
Flow	0.02	0.02	0.01	0.00	-0.02	1.00								
Flow Volatility	-0.01	0.02	0.03	0.03	0.11	0.10	1.00							
TNA (Millions)	0.05	0.01	0.00	-0.34	-0.15	0.04	-0.26	1.00						
Family TNA(Millions)	0.04	0.01	0.00	-0.18	0.02	0.00	-0.08	0.44	1.00					
Fund Age	-0.01	-0.11	-0.10	-0.13	-0.07	-0.09	-0.10	0.17	0.06	1.00				
Number of Stocks	0.01	0.00	0.00	-0.12	0.02	0.00	-0.04	0.15	0.13	0.01	1.00			
Stock Amihud Illiquidity	0.01	0.03	0.02	0.05	0.01	0.01	0.04	-0.02	-0.04	-0.02	0.06	1.00		
Stock Bid-ask Spread	0.02	0.06	0.05	0.04	0.05	0.03	0.06	-0.02	-0.05	-0.44	0.01	0.20	1.00	
Stock Size (Millions)	0.00	-0.12	-0.12	-0.18	-0.13	-0.03	-0.12	0.10	0.01	0.03	-0.23	-0.17	-0.18	1.00
Return Gap (%)	0.03	-0.01	-0.02	-0.01	-0.01	0.02	0.02	0.01	0.05	0.03	-0.01	0.00	0.09	-0.01

Table 2

Excess-Autocorrelation Sorted Portfolios

This table reports the average monthly returns for deciles of mutual funds sorted according to the past 12-month excess autocorrelation over the period 1999 to 2010. Excess autocorrelation is defined as the difference between the actual fund portfolio return autocorrelation and the previous disclosed holdings portfolio return autocorrelation. In the first row, we report the mean past 12-month excess autocorrelation (in percentage) for the portfolios. We use the one-factor alpha (CAPM), the three-factor alpha of Fama and French (1993), the four-factor alpha of Carhart (1997), the Amihud-based five-factor alpha, which follows Acharya and Pederson (2005) by adding an Amihud-based liquidity factor to the Carhart four factor model, the PS-based five-factor alpha, which adds the liquidity factor of Pástor and Stambaugh (2003) to the Carhart four factor model, the CPZ Alpha, proposed by Cremers, Petajisto and Zitzewitz (2010), which includes the excess return on the S&P 500 index, the returns on the Russell 2000 index minus the return on the S&P 500 index, the Russell 3000 value index minus the return on the Russell 3000 growth index, and the Carhart's (1997) momentum factor, the Ferson and Schadt (1996) conditional measure based on the four-factor model to measure fund performance, and the Characteristic Selectivity (CS) measure of Daniel, Grinblatt, Titman, and Wermers (1997). Panel A and B report the results without and with the back-testing method in the spirit of Mamaysky, Spiegel, and Zhang (2007). The returns are expressed in percent per month. *T*- statistics are in parenthesis. The sample period is from 1999-2010.

Panel A. Without Backtesting

	Excess Autocorrelation Portfolios					
	1	2	3	4	5	5-1
	Decile 1 [low]	Deciles 2-3	Deciles 4-7	Deciles 8-9	Decile 10 [high]	
Excess Autocorrelation (%)	-2.41	-0.66	0.20	1.20	4.18	6.59
	(-20.98)	(-18.64)	(3.48)	(10.56)	(14.31)	(17.07)
Alpha (CAPM)	-0.04	-0.03	-0.05	-0.02	0.22	0.26
	(-0.46)	(-0.45)	(-0.79)	(-0.36)	(2.88)	(3.41)
Alpha (Fama-French)	-0.17	-0.16	-0.15	-0.13	0.10	0.28
	(-2.60)	(-3.21)	(-3.99)	(-2.82)	(1.77)	(3.67)
Alpha (Carhart)	-0.17	-0.16	-0.15	-0.13	0.10	0.28
	(-3.12)	(-3.61)	(-4.22)	(-2.91)	(1.76)	(3.70)
Alpha (FF4+Amihud)	-0.17	-0.16	-0.15	-0.12	0.11	0.28
	(-3.06)	(-3.59)	(-4.18)	(-2.84)	(1.79)	(3.75)
Alpha (FF4+PS)	-0.24	-0.19	-0.16	-0.14	0.01	0.25
	(-4.37)	(-4.32)	(-4.19)	(-3.03)	(1.21)	(3.21)
Alpha (CPZ)	-0.05	-0.03	-0.03	0.00	0.21	0.26
	(-0.77)	(-0.67)	(-0.67)	(-0.08)	(2.41)	(3.45)
Alpha (Ferson-Schadt)	-0.12	-0.14	-0.15	-0.12	0.16	0.28
	(-2.24)	(-3.23)	(-3.96)	(-2.64)	(2.40)	(3.61)
DGTW	0.04	0.05	0.05	0.08	0.16	0.12
	(0.79)	(1.27)	(1.44)	(1.63)	(2.53)	(2.14)

Panel B. Backtesting

	Excess Autocorrelation Portfolios					
	1	2	3	4	5	5-1
	Decile 1 [low]	Deciles 2-3	Deciles 4-7	Deciles 8-9	Decile 10 [high]	
Excess Autocorrelation (%)	-2.45	-0.65	0.18	1.18	4.20	6.64
	(-20.79)	(-14.98)	(2.84)	(9.13)	(12.35)	(15.83)
Alpha (CAPM)	-0.11	-0.10	0.01	0.25	0.57	0.67
	(-0.83)	(-0.91)	(0.11)	(1.70)	(3.12)	(3.01)
Alpha (Fama-French)	-0.18	-0.16	-0.09	0.06	0.34	0.52
	(-1.32)	(-1.35)	(-1.32)	(0.49)	(2.13)	(2.70)
Alpha (Carhart)	-0.18	-0.16	-0.09	0.06	0.34	0.52
	(-1.36)	(-1.40)	(-1.34)	(0.47)	(2.10)	(2.71)
Alpha (FF4+Amihud)	-0.20	-0.18	-0.11	0.06	0.35	0.55
	(-1.48)	(-1.51)	(-1.60)	(0.50)	(2.21)	(2.85)
Alpha (FF4+PS)	-0.25	-0.22	-0.12	0.08	0.33	0.58
	(-1.88)	(-1.81)	(-1.74)	(0.60)	(2.00)	(2.53)
Alpha (CPZ)	-0.09	-0.08	-0.01	0.16	0.43	0.53
	(-0.72)	(-0.68)	(-0.10)	(1.37)	(2.74)	(2.68)
Alpha (Ferson Schadt)	-0.21	-0.19	-0.08	0.08	0.37	0.58
	(-1.54)	(-1.58)	(-1.16)	(0.59)	(2.19)	(2.21)
DGTW	-0.04	-0.03	0.04	0.15	0.22	0.26
	(-0.55)	(-0.42)	(1.04)	(2.88)	(2.39)	(2.09)

Table 3
Longer Holding Periods

This table reports the monthly returns of the high-minus-low excess-autocorrelation portfolios with longer holding-periods (i.e., more than one month). Each month, mutual funds are first sorted into decile portfolios according to past 12-month excess autocorrelation. Excess autocorrelation is defined as the difference between the actual fund portfolio return autocorrelation and the previous disclosed holdings portfolio return autocorrelation. The monthly returns of longer holding-period strategies are calculated from an equal weighted average of a series of excess-autocorrelation-sorted portfolios. For example, the return of Decile 1 of the 3-month holding-period strategy on January is an equal weighted average of the January returns of the Decile 1 portfolios sorted in December, November, and October of the previous year. The monthly return of the high-minus-low excess-autocorrelation portfolio of a particular holding period is the difference in the monthly return between Decile 10 (high) and Decile 1 (low) of the same holding period. The table reports the returns and alphas for the high-minus-low portfolio for different holding periods. We use the return excess of risk-free rate, the one-factor alpha (CAPM), the three-factor alpha of Fama and French (1993), the four-factor alpha of Carhart (1997), the Amihud-based five-factor alpha, which follows Acharya and Pederson (2005) by adding an Amihud-based liquidity factor to the Carhart four factor model, the PS-based five-factor alpha, which adds the liquidity factor of Pástor and Stambaugh (2003) to the Carhart four factor model, the CPZ Alpha, proposed by Cremers, Petajisto and Zitzewitz (2010), which includes the excess return on the S&P 500 index, the returns on the Russell 2000 index minus the return on the S&P 500 index, the Russell 3000 value index minus the return on the Russell 3000 growth index, and the Carhart's (1997) momentum factor, and the Ferson and Schadt (1996) conditional measure based on the four-factor model to measure fund performance. The returns and alphas are expressed in percent per month. *T*- statistics are in parenthesis. The sample period is from 1999-2010.

Holding Period	Monthly Returns of High-Minus-Low Excess-Autocorrelation Portfolios							
	Return	Alpha						
		(CAPM)	(Fama-French)	(Carhart)	(FF4+Amihud)	(FF4+PS)	(CPZ)	(Ferson-Schadt)
1 month	0.27	0.26	0.28	0.28	0.28	0.25	0.26	0.28
	(3.45)	(3.41)	(3.67)	(3.70)	(3.75)	(3.21)	(3.45)	(3.61)
6 months	0.21	0.21	0.23	0.23	0.23	0.21	0.21	0.21
	(2.92)	(2.95)	(3.14)	(3.12)	(3.23)	(2.79)	(2.92)	(2.83)
12 months	0.18	0.18	0.21	0.21	0.22	0.19	0.19	0.20
	(2.73)	(2.68)	(3.13)	(3.14)	(3.41)	(2.77)	(2.87)	(3.01)

Table 4
Performance Decomposition

This table reports the performance decomposition of the monthly returns of the high-minus-low excess-autocorrelation portfolios. Each month, mutual funds are first sorted into decile portfolios according to their past 12-month excess autocorrelation. Excess autocorrelation is defined as the difference between the actual fund portfolio return autocorrelation and the previous disclosed holdings portfolio return autocorrelation. Fund return is decomposed into holdings return and residual return (the difference between fund total return and holdings return). The monthly return of the high-minus-low excess-autocorrelation portfolio is the difference in the monthly return between Decile 10 (high) and Decile 1 (low). We use the return excess of risk-free rate, the one-factor alpha (CAPM), the three-factor alpha of Fama and French (1993), the four-factor alpha of Carhart (1997), the Amihud-based five-factor alpha, which follows Acharya and Pederson (2005) by adding an Amihud-based liquidity factor to the Carhart four factor model, the PS-based five-factor alpha, which adds the liquidity factor of Pástor and Stambaugh (2003) to the Carhart four factor model, and the CPZ Alpha, proposed by Cremers, Petajisto and Zitzewitz (2010), which includes the excess return on the S&P 500 index, the returns on the Russell 2000 index minus the return on the S&P 500 index, the Russell 3000 value index minus the return on the Russell 3000 growth index, and the Carhart's (1997) momentum factor, and the Ferson and Schadt (1996) conditional measure based on the four-factor model to measure fund performance. The returns are expressed in percent per month. *T*- statistics are in parenthesis. The sample period is from 1999-2010.

Holding Period	Monthly Returns of High-Minus-Low Excess-Autocorrelation Portfolios							
	Return	Alpha						
		(CAPM)	(Fama-French)	(Carhart)	(FF4+Amihud)	(FF4+PS)	(CPZ)	(Ferson-Schadt)
Total Return	0.27	0.26	0.28	0.28	0.28	0.25	0.26	0.28
(after fee)	(3.45)	(3.41)	(3.67)	(3.70)	(3.75)	(3.21)	(3.45)	(3.61)
Holding Return	0.19	0.18	0.18	0.18	0.18	0.17	0.17	0.19
(after fee)	(2.49)	(2.44)	(2.58)	(2.64)	(2.63)	(2.40)	(2.39)	(2.67)
Total Return Minus	0.08	0.07	0.09	0.09	0.09	0.07	0.08	0.08
Holding Return	(2.43)	(2.37)	(2.79)	(2.79)	(2.94)	(2.17)	(2.64)	(2.57)

Table 5

Consistently Buy and Sell Portfolio Performance

This table reports the average monthly returns of consistently buy portfolio (Panel A) and sell portfolio (Panel B) performance for portfolios of mutual funds sorted according to the past 12-month excess autocorrelation over the period 1999 to 2010. Excess autocorrelation is defined as the difference between the actual fund portfolio return autocorrelation and the previous disclosed holdings portfolio return autocorrelation. Consistently buy portfolio of a fund is the portfolio of stocks that the fund buys over the most recent disclosure period and does not sell during the disclosure period immediately prior to the most recent disclosure period. Consistently sell portfolio of a fund is the portfolio of stocks that the fund sells over the most recent two consecutive disclosure periods. We use the one-factor alpha (CAPM), the three-factor alpha of Fama and French (1993), the four-factor alpha of Carhart (1997), the Amihud-based five-factor alpha, which follows Acharya and Pederson (2005) by adding an Amihud-based liquidity factor to the Carhart four factor model, the PS-based five-factor alpha, which adds the liquidity factor of Pástor and Stambaugh (2003) to the Carhart four factor model, the CPZ Alpha, proposed by Cremers, Petajisto and Zitzewitz (2010), which includes the excess return on the S&P 500 index, the returns on the Russell 2000 index minus the return on the S&P 500 index, the Russell 3000 value index minus the return on the Russell 3000 growth index, and the Carhart's (1997) momentum factor, and the Ferson and Schadt (1996) conditional measure based on the four-factor model to measure fund performance. The returns are expressed in percent per month. *T*-statistics are in parenthesis. Sample period is from 1999-2010.

Panel A. Consistently Buy Portfolio Performance

	Excess Autocorrelation Portfolios					
	1	2	3	4	5	5-1
	[low]				[high]	
Alpha (CAPM)	0.07	0.12	0.04	0.04	0.40	0.33
	(0.63)	(1.15)	(0.41)	(0.38)	(3.02)	(3.21)
Alpha (Fama-French)	-0.09	-0.05	-0.11	-0.11	0.21	0.30
	(-1.15)	(-0.72)	(-1.63)	(-1.42)	(3.57)	(3.06)
Alpha (Carhart)	-0.09	-0.05	-0.11	-0.11	0.21	0.30
	(-1.19)	(-0.71)	(-1.64)	(-1.48)	(2.72)	(3.21)
Alpha (FF4+Amihud)	-0.09	-0.05	-0.10	-0.10	0.21	0.30
	(-1.11)	(-0.73)	(-1.58)	(-1.38)	(2.67)	(3.14)
Alpha (FF4+PS)	-0.17	-0.08	-0.11	-0.13	0.12	0.30
	(-2.22)	(-1.20)	(-1.64)	(-1.65)	(2.27)	(2.99)
Alpha (CPZ)	0.07	0.11	0.05	0.04	0.36	0.29
	(0.70)	(1.45)	(0.67)	(0.51)	(3.50)	(3.14)
Alpha (Ferson-Schadt)	-0.02	0.02	-0.06	-0.07	0.29	0.31
	(-0.31)	(0.27)	(-1.00)	(-0.94)	(3.20)	(3.13)

Panel B. Consistently Sell Portfolio Performance

	Excess Autocorrelation Portfolios					
	1	2	3	4	5	5-1
	[low]				[high]	
Alpha (CAPM)	0.18	0.08	0.13	0.07	0.24	0.06
	(1.45)	(0.90)	(1.48)	(0.71)	(2.08)	(0.62)
Alpha (Fama-French)	0.03	-0.04	0.02	-0.04	0.12	0.08
	(0.36)	(-0.60)	(0.25)	(-0.59)	(1.04)	(0.84)
Alpha (Carhart)	0.03	-0.04	0.02	-0.04	0.11	0.08
	(0.35)	(-0.59)	(0.25)	(-0.59)	(1.03)	(0.84)
Alpha (FF4+Amihud)	0.03	-0.04	0.01	-0.04	0.12	0.09
	(0.33)	(-0.61)	(0.22)	(-0.55)	(1.14)	(0.95)
Alpha (FF4+PS)	-0.06	-0.09	-0.02	-0.07	0.07	0.13
	(-0.69)	(-1.32)	(-0.24)	(-0.97)	(0.54)	(1.34)
Alpha (CPZ)	0.18	0.10	0.16	0.11	0.25	0.08
	(1.67)	(1.33)	(2.27)	(1.37)	(2.09)	(0.76)
Alpha (Ferson-Schadt)	0.11	-0.01	0.03	0.00	0.15	0.04
	(1.14)	(-0.17)	(0.44)	(-0.06)	(1.39)	(0.43)

Table 6

Excess-Autocorrelation Portfolios controlling for Prior-Year Return Gap and Return

Each month mutual funds are first sorted into five portfolios according to their prior-year return gap or accumulative return and then sorted into five portfolios according to their excess autocorrelation as in Table 2 within each prior-year return-gap or return portfolio. Excess autocorrelation is defined as the difference between the actual fund portfolio return autocorrelation and the previous disclosed holdings portfolio return autocorrelation.The table reports the average monthly alphas (in percent) of double-sorted portfolios, as well as of the high-minus-low excess-autocorrelation portfolios. Alphas are four-factor alphas, where returns are adjusted by Fama-French three factors (MKT, SMB, and HML) and the momentum factor (UMD) of Carhart (1997). At the bottom of Panel A and B, the high-minus-low excess-autocorrelation portfolio returns are averaged over each of the five prior year return-gap and return portfolios. Hence, they represent the high-minus-low excess-autocorrelation portfolio returns controlling for prior-year return gap and return, respectively. The returns are expressed in percent per month. *T*- statistics are in parenthesis. The sample period is from 1999-2010.

Panel A. Return Gap and Excess Autocorrelation

Prior-Year Return Gap		Excess Autocorrelation Portfolios					
		1	2	3	4	5	
		[low]				[high]	High-Low
1	[small]	-0.32	-0.17	-0.21	-0.18	0.16	0.48
		(-3.77)	(-2.79)	(-3.79)	(-2.70)	(0.82)	(2.50)
2		-0.10	-0.12	-0.14	-0.18	0.06	0.16
		(-1.63)	(-2.04)	(-3.80)	(-4.00)	(0.66)	(1.96)
3		-0.13	-0.11	-0.12	-0.15	-0.01	0.12
		(-2.08)	(-1.95)	(-2.80)	(-3.02)	(-0.08)	(1.40)
4		-0.20	-0.13	-0.19	-0.05	-0.01	0.19
		(-2.76)	(-2.94)	(-3.78)	(-0.89)	(-0.13)	(2.22)
5	[large]	-0.13	-0.17	-0.16	-0.02	0.37	0.50
		(-1.56)	(-2.20)	(-2.29)	(-0.33)	(2.23)	(3.04)
						Average	0.29
							(3.58)

Panel B. Prior-Year Return and Excess Autocorrelation

Prior-Year Return		Excess Autocorrelation Portfolios					
		1	2	3	4	5	
		[low]				[high]	High-Low
1	[losers]	-0.36	-0.31	-0.27	-0.27	-0.07	0.29
		(-3.19)	(-2.96)	(-2.87)	(-2.99)	(-0.48)	(2.14)
2		-0.21	-0.20	-0.18	-0.14	-0.12	0.09
		(-3.13)	(-3.60)	(-3.67)	(-2.90)	(-1.59)	(1.24)
3		-0.21	-0.12	-0.14	-0.13	-0.10	0.11
		(-3.25)	(-2.77)	(-3.23)	(-2.86)	(-1.65)	(1.80)
4		-0.06	-0.12	-0.12	-0.07	0.02	0.08
		(-0.87)	(-1.92)	(-2.08)	(-1.08)	(0.23)	(1.03)
5	[winners]	0.09	-0.06	-0.02	-0.02	0.49	0.41
		(0.76)	(-0.65)	(-0.23)	(-0.23)	(2.35)	(2.23)
						Average	0.20
							(2.65)

Table 7

Determinants of Excess Autocorrelation

This table reports the coefficients of the Fama-Macbeth regressions of the monthly excess autocorrelation on various fund and fund family characteristics. Excess autocorrelation is defined as the difference between the actual fund portfolio return autocorrelation and the previous disclosed holdings portfolio return autocorrelation. All regressions include style-fixed effects and are performed at a monthly frequency. Newey-West standard errors with 12 lags have been provided in parentheses. *T*- statistics are in parenthesis. The sample period is from 1999-2010.

	Monthly Excess Autocorrelation		
Intercept	-0.002	-0.005	0.001
	(-1.71)	(-3.07)	(0.53)
Prior-year Expense Ratio	0.089	0.044	0.080
	(1.17)	(0.63)	(0.97)
Prior-year Turnover Ratio	-0.001	-0.001	-0.002
	(-3.7)	(-3.67)	(-4.16)
Flow	0.000	0.000	0.000
	(5.65)	(5.87)	(5.78)
Prior-year Flow Volatility	-0.000	-0.000	-0.000
	(-1.26)	(-1.65)	(-1.56)
Load Dummy	0.002	0.002	0.002
	(5.9)	(6.12)	(6.4)
Log of TNA	0.001	0.001	0.001
	(6.5)	(6.07)	(6.55)
Log of Family TNA	0.000	0.000	0.000
	(2.16)	(2.27)	(1.78)
Fund Age	-0.000	-0.000	-0.000
	(-1.6)	(-1.55)	(-1.51)
Number of Stocks	0.000	-0.000	-0.000
	(0.49)	(-0.12)	(-0.3)
Stock Amihud Illiquidity	0.008		
	(0.85)		
Stock Bid-ask Spread		0.015	
		(2.65)	
Stock Size			-0.000
			(-4.18)
Style Fixed Effect	Yes	Yes	Yes

Table 8
Predictive Regression for Fund Performance

This table reports the coefficients of Fama-Macbeth regressions of monthly abnormal returns on various fund attributes. Excess autocorrelation is defined as the difference between the actual fund portfolio return autocorrelation and the previous disclosed holdings portfolio return autocorrelation. The dependent variable is the four-factor abnormal return of Carhart (1997), the Amihud-based five-factor alpha, which follows Acharya and Pederson (2005) by adding an Amihud-based liquidity factor to the Carhart four factor model, and the PS-based five-factor alpha, which adds the liquidity factor of Pástor and Stambaugh (2003) to the Carhart four factor model. All regressions include style fixed effects and are performed at a monthly frequency. Newey-West standard errors with 12 lags have been provided in parentheses. *T*- statistics are in parenthesis. The sample period is from 1999-2010.

	FF4 Alpha			FF4+Amihud Alpha			FF4+PS Alpha		
Intercept	-0.14	-0.18	-0.06	-0.02	-0.07	0.06	-0.01	-0.10	0.05
	(-1.37)	(-1.91)	(-0.60)	(-0.27)	(-0.74)	(0.74)	(-0.18)	(-0.88)	(0.61)
Prior-year Excess Autocorrelatic	2.76	2.68	2.71	3.14	3.06	3.17	2.94	2.89	3.00
	(2.93)	(2.98)	(2.87)	(3.09)	(3.14)	(3.05)	(2.47)	(2.53)	(2.50)
Prior-year Return	0.89	0.91	0.90	1.67	1.69	1.71	1.19	1.21	1.24
	(1.98)	(2.05)	(2.06)	(3.42)	(3.50)	(3.57)	(2.64)	(2.70)	(2.79)
Prior-year Expense Ratio	-4.69	-4.62	-4.20	-2.37	-2.52	-2.54	-1.21	-1.32	-1.23
	(-2.56)	(-2.75)	(-2.19)	(-0.71)	(-0.80)	(-0.73)	(-0.36)	(-0.42)	(-0.35)
Prior-year Turnover Ratio	-0.03	-0.03	-0.04	-0.02	-0.02	-0.02	-0.03	-0.03	-0.03
	(-1.72)	(-1.66)	(-1.96)	(-1.09)	(-1.04)	(-1.46)	(-1.68)	(-1.62)	(-2.01)
Flow	0.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.76)	(0.66)	(0.72)	(-0.67)	(-0.69)	(-0.82)	(-0.29)	(-0.33)	(-0.45)
Prior-year Flow Volatility									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.80)	(0.77)	(0.83)	(0.85)	(0.78)	(0.76)	(0.71)	(0.60)	(0.73)
Load Dummy	0.02	0.02	0.02	0.03	0.03	0.04	0.03	0.03	0.03
	(2.47)	(2.52)	(2.51)	(3.06)	(3.08)	(3.05)	(2.32)	(2.37)	(2.50)
Log of Lagged TNA	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02
	(-2.03)	(-1.99)	(-1.92)	(-2.36)	(-2.33)	(-2.28)	(-2.46)	(-2.41)	(-2.37)
Log of Lag Family TNA	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
	(3.09)	(3.08)	(2.63)	(2.25)	(2.35)	(1.71)	(1.59)	(1.69)	(1.15)
Lag Age	-0.01	-0.01	-0.01	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(-0.80)	(-0.81)	(-0.72)	(-0.36)	(-0.39)	(-0.31)	(-0.06)	(-0.13)	(-0.06)
Number of Stocks	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(-3.63)	(-3.26)	(-3.55)	(-3.85)	(-3.63)	(-3.48)	(-2.88)	(-2.61)	(-2.44)
Stock Amihud Iliquidity	0.53			0.47			0.43		
	(1.62)			(1.48)			(1.35)		
Stock Bid-ask Spread		0.26			0.27			0.23	
		(1.16)			(1.39)			(1.12)	
Stock Size			-0.00			-0.00			-0.00
			(-2.04)			(-1.74)			(-1.07)
Style Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 9 Illiquidity of Funds' Buy and Sell Portfolios

This table reports the mean monthly Amihud measure of individual stocks that funds buy or sell during the disclosure period, as well as the difference in the illiquidity level between funds' buy and sell portfolios. Excess autocorrelation is defined as the difference between the actual fund portfolio return autocorrelation and the previous disclosed holdings portfolio return autocorrelation. *T*- statistics of the difference in the illiquidity level between funds' buy and sell portfolios are reported in parenthesis. The sample period is from 1999-2010.

	Amihud Illiquidity Measure			
Excess-Autocorrelation-Sorted Fund Portfolios	Buy	Sell	Buy-Sell	Buy-Sell t-value
1 [Low]	0.31	0.31	0.01	(0.94)
2	0.29	0.28	0.01	(0.74)
3	0.29	0.29	-0.01	(-1.42)
4	0.30	0.30	0.00	(-0.41)
5 [High]	0.34	0.34	-0.01	(-0.80)
5-1	0.02	0.04	-0.02	(-1.21)

Table 10

Portfolios Sorted by the Excess Autocorrelation of Individual Stocks

This table reports the average monthly returns for mutual fund portfolios sorted according to the lagged prior-year average excess auto-correlation of individual stocks in a fund portfolio. The average excess autocorrelation of individual stocks in a fund portfolio in a particular month is computed as the difference between the value-weighted average return autocorrelation of individual stock holdings disclosed at the end of the disclosure period (the weight is proportional to the product of the number of shares reported at the end of the disclosure period and the stock price at the beginning of each month) and the value-weighted average return autocorrelations of individual stock holdings disclosed at the beginning of the disclosure period (the weight is proportional to the product of the number of shares reported at the beginning of the disclosure period and the stock price at the beginning of each month). In the first row, we report the mean prior-year excess autocorrelation (in percentage) for each portfolio, as well as difference in excess autocorrelation between the high and low excess-autocorrelation portfolios. We use the one-factor alpha (CAPM), the three-factor alpha of Fama and French (1993), the four-factor alpha of Carhart (1997), the Amihud-based five-factor alpha, which follows Acharya and Pederson (2005) by adding an Amihud-based liquidity factor to the Carhart four factor model, the PS-based five-factor alpha, which adds the liquidity factor of Pástor and Stambaugh (2003) to the Carhart four factor model, the CPZ Alpha, proposed by Cremers, Petajisto and Zitzewitz (2010), which includes the excess return on the S&P 500 index, the returns on the Russell 2000 index minus the return on the S&P 500 index, the Russell 3000 value index minus the return on the Russell 3000 growth index, and the Carhart's (1997) momentum factor, and the Ferson and Schadt (1996) conditional measure based on the four-factor model to measure fund performance. The returns are expressed in percent per month. *T*- statistics are in parenthesis. The sample period is from 1999-2010.

	Stock-level Excess Autocorrelation Sorted Portfolios					
	1	2	3	4	5	5-1
	[low]				[high]	
Excess Autocorrelation(%)	-0.70	-0.22	0.01	0.25	0.74	1.44
Alpha (CAPM)	-0.07	-0.04	-0.02	0.03	-0.02	0.06
	(-0.89)	(-0.56)	(-0.31)	(0.51)	(-0.20)	(1.18)
Alpha (Fama-French)	-0.21	-0.17	-0.12	-0.07	-0.12	0.09
	(-3.65)	(-3.21)	(-3.07)	(-1.75)	(-1.80)	(1.96)
Alpha (Carhart)	-0.22	-0.17	-0.12	-0.07	-0.12	0.10
	(-3.95)	(-3.53)	(-3.37)	(-1.88)	(-1.79)	(2.02)
Alpha (FF4+Amihud)	-0.21	-0.17	-0.12	-0.07	-0.11	0.10
	(-3.89)	(-3.46)	(-3.36)	(-1.77)	(-1.59)	(2.08)
Alpha (FF4+PS)	-0.23	-0.20	-0.16	-0.09	-0.14	0.09
	(-4.07)	(-4.01)	(-4.28)	(-2.16)	(-2.04)	(1.88)
Alpha (CPZ)	-0.08	-0.05	0.00	0.05	0.00	0.09
	(-1.29)	(-0.81)	(-0.09)	(0.99)	(0.14)	(1.91)
Alpha (Ferson-Schadt)	-0.20	-0.15	-0.11	-0.07	-0.11	0.09
	(-3.51)	(-2.96)	(-3.14)	(-1.85)	(-1.60)	(1.80)

Table 11

Portfolios Sorted by Excess Cross-Autocorrelation of Individual Stocks

This table reports the mean monthly returns for deciles of mutual funds sorted according to the lagged one-year average excess cross-autocorrelation of individual stocks in a fund portfolio. The average excess cross-autocorrelation of individual stocks in a fund portfolio in a particular month is the difference between the value-weighted average cross-autocorrelations of all the individual stocks in the actual fund portfolio and the value-weighted average cross-autocorrelations of all the individual stocks in the fund disclosed holdings portfolio, where individual stock holdings in the actual fund portfolio are again proxied by the disclosed holdings at the end of the disclosure period. In the first row, we report the mean prior-year excess autocorrelation (in percentage) for each portfolio, as well as difference in excess autocorrelation between the high and low excess-autocorrelation portfolios. We use the one-factor alpha (CAPM), the three-factor alpha of Fama and French (1993), the four-factor alpha of Carhart (1997), the Amihud-based five-factor alpha, which follows Acharya and Pederson (2005) by adding an Amihud-based liquidity factor to the Carhart four factor model, the PS-based five-factor alpha, which adds the liquidity factor of Pástor and Stambaugh (2003) to the Carhart four factor model, the CPZ Alpha, proposed by Cremers, Petajisto and Zitzewitz (2010), which includes the excess return on the S&P 500 index, the returns on the Russell 2000 index minus the return on the S&P 500 index, the Russell 3000 value index minus the return on the Russell 3000 growth index, and the Carhart's (1997) momentum factor, and the Ferson and Schadt (1996) conditional measure based on the four-factor model to measure fund performance. The returns are expressed in percent per month. *T*- statistics are in parenthesis. The sample period is from 1999-2010.

	Excess Cross-Autocorrelation Sorted Portfolios					
	1 [low]	2	3	4	5 [high]	5-1
Cross-Autocorrelation(%)	-0.70	-0.22	0.01	0.25	0.74	1.44
Alpha (CAPM)	-0.02	-0.02	-0.04	-0.02	0.11	0.13
	(-0.26)	(-0.31)	(-0.71)	(-0.22)	(2.13)	(1.69)
Alpha (Fama-French)	-0.13	-0.14	-0.16	-0.13	0.02	0.15
	(-2.48)	(-3.45)	(-4.28)	(-2.57)	(1.10)	(1.97)
Alpha (Carhart)	-0.13	-0.14	-0.16	-0.14	0.02	0.15
	(-2.65)	(-3.63)	(-4.55)	(-2.80)	(1.05)	(2.03)
Alpha (FF4+Amihud)	-0.13	-0.14	-0.16	-0.13	0.03	0.15
	(-2.60)	(-3.57)	(-4.51)	(-2.72)	(1.13)	(2.16)
Alpha (FF4+PS)	-0.17	-0.17	-0.17	-0.16	-0.03	0.14
	(-3.63)	(-4.37)	(-4.79)	(-3.13)	(-0.39)	(1.89)
Alpha (CPZ)	-0.01	-0.01	-0.03	-0.01	0.12	0.13
	(-0.13)	(-0.19)	(-0.74)	(-0.23)	(1.81)	(1.72)
Alpha (Ferson-Schadt)	-0.09	-0.13	-0.15	-0.11	0.04	0.14
	(-1.91)	(-3.30)	(-4.35)	(-2.27)	(1.34)	(1.82)

Table 12

Excess Autocorrelation and Buy/Sell Portfolio Autocorrelation

In Panel A, each month mutual funds are first sorted into five portfolios according to the average return autocorrelation of their buy portfolios in the past 12 months and then sorted into five portfolios according to excess autocorrelation within each buy portfolio. In Panel B, funds are sorted into five excess autocorrelation portfolios and then sorted into five portfolios based on the average return autocorrelation of buy portfolios in the past 12 months within each excess autocorrelation sorted portfolio. In Panel C, each month mutual funds are first sorted into five portfolios according to the average return autocorrelation of their sell portfolios in the past 12 months and then sorted into five portfolios according to excess autocorrelation within each sell portfolio. In Panel D, funds are sorted into five excess autocorrelation portfolios and then sorted into five portfolios based on the average return autocorrelation of sell portfolios in the past 12 months within each excess autocorrelation sorted portfolio. The table reports the returns adjusted by Fama-French three factors (MKT, SMB, and HML) and the momentum factor (UMD) of Carhart (1997). The returns are expressed in percent per month. *T*- statistics are in parenthesis. The sample period is from 1999-2010.

Panel A.

Buy Portfolio Autocorrelation		Excess Autocorrelation Portfolios 1 [low]	2	3	4	5 [high]	High-Low
1	[low]	-0.18	-0.15	-0.17	-0.18	-0.01	0.18
		(-2.26)	(-2.26)	(-3.59)	(-3.26)	(-0.07)	(1.73)
2		-0.15	-0.17	-0.18	-0.12	0.02	0.17
		(-1.93)	(-3.57)	(-4.05)	(-2.60)	(0.22)	(1.88)
3		-0.21	-0.17	-0.16	-0.15	0.02	0.22
		(-2.89)	(-3.20)	(-4.05)	(-3.34)	(0.19)	(2.61)
4		-0.07	-0.20	-0.15	-0.12	0.05	0.13
		(-1.01)	(-3.26)	(-3.29)	(-1.92)	(0.46)	(1.05)
5	[high]	-0.08	-0.09	-0.09	-0.05	0.37	0.45
		(-0.93)	(-1.14)	(-1.33)	(-0.67)	(2.26)	(2.85)

Panel B.

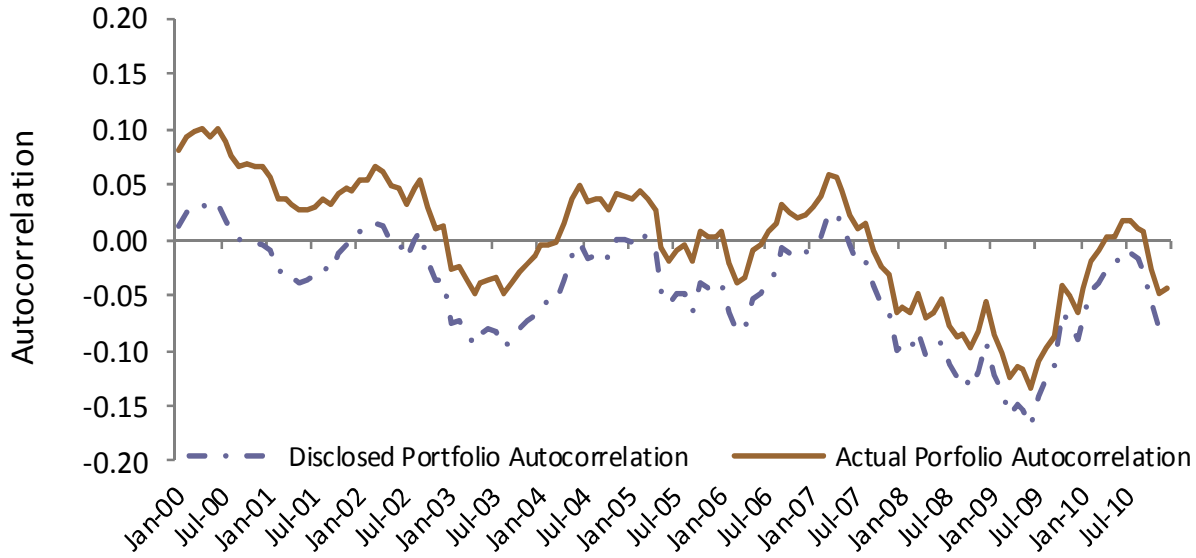
Excess Autocorrelation Portfolios		Buy Portfolio Autocorrelation 1 [low]	2	3	4	5 [high]	High-Low
1	[low]	-0.20	-0.11	-0.21	-0.13	-0.08	0.11
		(-2.23)	(-1.48)	(-2.67)	(-1.92)	(-0.87)	(1.09)
2		-0.18	-0.15	-0.14	-0.18	-0.10	0.08
		(-3.06)	(-2.96)	(-2.99)	(-3.25)	(-1.33)	(0.93)
3		-0.16	-0.19	-0.15	-0.16	-0.09	0.07
		(-3.50)	(-4.22)	(-4.00)	(-3.61)	(-1.43)	(0.87)
4		-0.16	-0.15	-0.15	-0.08	-0.10	0.06
		(-2.75)	(-3.12)	(-2.77)	(-1.37)	(-1.33)	(0.68)
5	[high]	-0.02	0.01	0.06	0.10	0.42	0.44
		(-0.20)	(0.12)	(0.57)	(0.95)	(2.53)	(2.77)

Panel C.

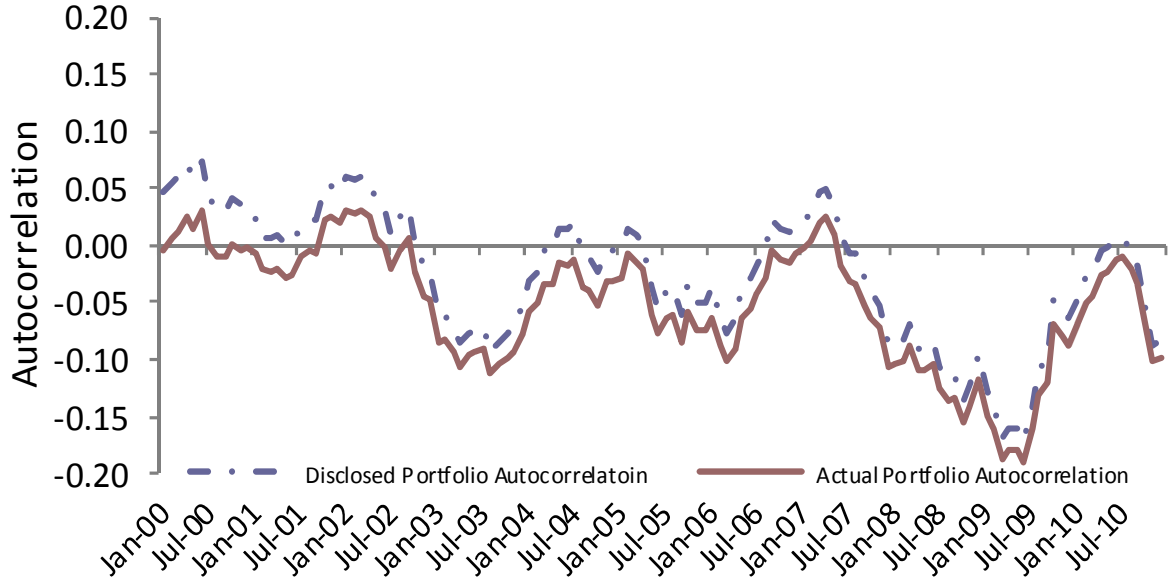
Sell Portfolio Autocorrelation		Excess Autocorrelation Portfolios 1 [low]	2	3	4	5 [high]	High-Low
1	[low]	-0.21	-0.15	-0.19	-0.14	0.15	0.36
		(-2.48)	(-2.36)	(-3.66)	(-2.34)	(1.49)	(3.03)
2		-0.20	-0.18	-0.17	-0.22	-0.04	0.16
		(-2.61)	(-3.52)	(-4.09)	(-3.77)	(-0.38)	(1.35)
3		-0.14	-0.14	-0.15	-0.13	-0.07	0.08
		(-2.04)	(-2.65)	(-3.81)	(-2.04)	(-0.72)	(0.76)
4		-0.22	-0.11	-0.16	-0.08	0.06	0.29
		(-3.06)	(-1.75)	(-3.33)	(-1.30)	(0.58)	(2.95)
5	[high]	-0.05	-0.14	-0.12	-0.08	0.39	0.45
		(-0.57)	(-1.93)	(-1.92)	(-1.27)	(2.27)	(2.98)

Panel D.

Excess Autocorrelation Portfolios		Sell Portfolio Autocorrelation 1 [low]	2	3	4	5 [high]	High-Low
1	[low]	-0.20	-0.21	-0.14	-0.13	-0.10	0.10
		(-2.53)	(-2.60)	(-1.99)	(-1.51)	(-1.14)	(0.98)
2		-0.16	-0.18	-0.14	-0.13	-0.14	0.02
		(-2.60)	(-3.55)	(-2.70)	(-2.21)	(-2.09)	(0.22)
3		-0.18	-0.18	-0.15	-0.15	-0.12	0.07
		(-3.70)	(-4.19)	(-3.67)	(-3.05)	(-1.89)	(0.83)
4		-0.20	-0.20	-0.13	-0.06	-0.08	0.12
		(-3.46)	(-3.29)	(-2.23)	(-0.96)	(-1.30)	(1.50)
5	[high]	0.09	0.05	-0.04	0.07	0.37	0.28
		(0.97)	(0.52)	(-0.39)	(0.62)	(2.20)	(1.85)



Panel A. Top Decile of Funds



Panel B. Bottom Decile of Funds

Figure 1 Autocorrelations of Actual Fund Portfolio Returns and Disclosed Holding Portfolio Returns. The figure depicts the average 12-month moving averages of actual fund portfolio return autocorrelation and the disclosed holding portfolio return autocorrelation of the top decile and the bottom decile of funds ranked by the excess autocorrelation between 1999 and 2010.