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AUTHORS	Udomsak Wongchoti

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Udomsak Wongchoti (New Zealand)

Short-term persistence and mutual fund characteristics

Abstract

Outperforming mutual funds continue to display quarterly momentum effects during the 1998-2007 period. Further analyses on fund characteristics demonstrate that the relative price of funds (to earnings and book value) is the key indicator of the performance persistence. Specifically, cheaper winner funds (low P/E or P/B ratios) are more persistent in their performances. The double-sort momentum strategies based on these characteristics enhance the momentum returns by around 0.88 per cent to 1.44 per cent per quarter compared to traditional single-sort strategies.

Keywords: mutual fund characteristics, performance persistence, short-term momentum.
JEL Classification: G12, G14, G15.

Introduction

The lively existence of the mutual fund selection industry evidently indicates that the search for outperforming funds is still popular among practitioners. In principle, such a searching activity can only be fruitful if some mutual fund managers truly possess informational advantage or skills that will persist into the future, allowing the active investor to bet on future performance while observing only past outcomes.

Consistent with efficient market hypothesis, in its semi-strong form, numerous studies that analyze abnormal returns among mutual funds over long horizons suggest that the ability of particular fund managers to consistently beat the market through stock selection or market timing is random[1]. However, a number of recent studies that focus on mutual fund performance in the shorter horizon (less than one year) report empirical evidence for relative performance persistence up to the mid-1990s, which maybe exploitable but rather short-lived. As predicted by Berk and Green's (2004) theoretical model, informational advantage by mutual fund managers should dissipate quickly once it attracts capital flows, as in the case of funds that have just recently outperformed. The most updated empirical evidence by Bollen and Busse (2004), which covers US mutual funds from 1985 to 1995, indicates that such window for abnormal returns, that are free of survivorship bias (e.g. Elton, Gruber and Blake, 1996; Brown and Goetzmann, 1995) and do not reflect the fourth momentum factor (e.g. Grinblatt, Titman and Wermer, 1995; Carhart, 1997), can be as narrow as three months.

In this paper, we examine the existence, characteristics, and profitability of short-term (quarterly) performance persistence among mutual funds using a more recent sample period of 1998-2007. Based on 323 US growth equity funds covered in our sample, we find short-term persistence in residual returns, especially in the immediate following quarter, using both demeaned and market residual adjusted returns. Such persistence in performance can be materialized into a momentum profit of 1.85 per cent per quarter after adjusting for the Fama and French (1993) three-factor risks. However, contrary to the findings from previous studies who state that the yearly momentum effect is mainly driven by the significant under-performance of funds (see e.g., Hendricks, Patel and Zeckhauser, 1993; Carhart, 1997; among others), it appears that the quarterly performance persistence evident in the later years is mainly driven by outperforming funds (i.e. the hot hand effect), while loser funds even display performance reversals (i.e. the disappearance of the cold hand effect).

We then offer extended insight into the profitability of mutual fund momentum strategies by providing the first examination in the literature on whether specific fund characteristics can be capitalised on in order to provide a meaningful way to further enhance short-term momentum profits. This is largely motivated by studies that have established the link between mutual fund performance and its fund characteristics. For example, Carhart (1997) and Malkiel (1995) find significantly negative relationships between fund performance and expenses. Carhart (1997) also finds turnover to have the same effect as expenses, and that fund size tends to be related to higher-performing portfolio deciles. By classifying fund characteristics into four main categories based on popularity, growth, cost and management, Prather, Bertin and Henker (2004) find each category significantly affect mutual fund performance.

To achieve our goal, we first identify observable fund-specific characteristics that drive fund return autocorrelation. Out of four characteristics investigated in our study (including turnover, size, expense and growth), only the relative price ratios (i.e. price-to-

Udomsak Wongchoti, School of Economics and Finance, Massey University, Palmerston North, New Zealand.
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[1] These studies represent the first flow of literatures in persistence in mutual fund 'long-term' performance and include Jensen (1968), Treynor and Mazuy (1966), Henriksson (1984), Elton et al. (1992) and others.

book [P/B] and price-to-earnings [P/E]) appear to predict mutual fund future returns significantly. Following Sagi and Seasholes (2007), we then apply a conditional double-sort procedure. We form momentum strategies by first sort funds based on one of fund characteristics that are identified to drive fund return autocorrelation. Funds are then ranked based on previous quarterly performance. This technique enables a linkage between the fund characteristics and the momentum effect (i.e. reap additional returns as compared to traditional strategies). Compared to the traditional single-sort strategies (e.g., Hendricks, Patel and Zeckhauser, 1993), we find that the enhanced momentum strategy outperforms by around 0.88 per cent per quarter for the P/B sorted portfolio to 1.44 per centper quarter for the P/E sorted portfolio, after controlling for various risk factors.

The remainder of this paper is structured as follows. Section 1 provides a brief discussion on previous studies that are relevant to short-term persistence in mutual fund performances, characteristics and momentum profitability. Section 2 describes the data. While the short-term persistence in mutual fund performance and its momentum profitability are examined in section 3. Section 4 investigates fund characteristics that help in explaining performance persistence and analyze whether a conditional double-sort technique is exploitable. The final section concludes the paper.

1. Related literature

Short-term persistence in mutual fund performance was first documented by Hendricks, Patel and Zeckhauser (1993) for US equity mutual funds over the period of 1974-1988. They report the presence of momentum effect over a four-quarter evaluation period. In addition, the profitability of momentum strategy is prominent, as the top performing octile portfolios outperform poor performing octile portfolios by about 1.25-2.5 per cent per quarter for various evaluation periods. Further, they find that the bottom octile portfolio significantly underperforms on a more consistent basis, compared to the top performing octile portfolio, implying that the momentum profits are mainly driven by the sustained poor performing funds that make up the portfolio and have thus led to the conclusion that momentum returns are mainly driven by continual underperformance of funds in the sample.

Subsequent studies provide a robustness check on Hendricks et al.'s (1993) results. For instance, Brown and Goetzmann (1995) restrict their analysis by using only one-year evaluation and holding periods, while allowing for defunct as well as surviving funds in their sample and follow a similar octile-based portfolio approach. They document that the existence of performance persistence is robust even when adjusting for different risk measures, and provide two explanations as to what may cause the momentum effect. First, the momentum effect is correlated across managers due to common strategies that have not yet been captured by standard stylistic categories or risk adjustment procedures. Second, the market fails to fully discipline underperforming funds, thus allowing their presence in the sample to contribute to relative persistence. Overall, various studies suggest that while mutual fund managers underperform on average, one can still expect the persistence in relative performance and thus in momentum profits in the short run (see, e.g., Goetzmann & Ibbotson, 1994; Gruber, 1996; Wermers, 1999).

Recent research documents that the survivorship bias and stock-level momentum effects can undermine the above findings. Elton, Gruber and Blake (1996) argue that the survivorship bias partly explains performance persistence, leading to a false conclusion of consistent positive momentum returns that are unrealistically high. Grinblatt, Titman and Wermers (1995) and Carhart (1997) also suggest that outperforming funds' superior performance does not reflect their special skills, as it stems from their extensive investing in winner stocks, which simply mirrors Jegadeesh and Titman's (1993) momentum strategy. At the same time, persistence in loser funds is merely the result of constantly high expense, not inferior ability in stock selection skills or informational disadvantage, which is predictable. Bollen and Busse (2004) validate the short-term persistence in mutual fund performance, which is robust and free of empirical flaws found in earlier studies. For equity fund of 230 funds in the 1985-1995 period, the average abnormal return of the top decile fund is 39 basis points in the immediate following quarter. However, it is noted that the persistence is strictly short-lived (one quarter) and may not cover transaction costs and tax involved in the trading strategy. Studying the performance of 4617 US equity institutional products during the 1991-2008 period, Busse, Goyal, and Wahal (2010) report a mild three-factor adjusted persistence of out-performing managed portfolios (tailored to plan sponsors) based on their past one-year performances.

Several studies also relate fund performance persistence to common factors in stock returns and fund characteristics. Malkiel (1995) finds that the "hot hands" effect is prevalent throughout the 1970s, with winners tending to repeat around two-thirds of the time. However, this finding is insignificant in the 1980s. In addition, Malkiel analyzes whether fund returns justify the expenses that investor incur and observes a significant negative relationship between fund performance and management expenses.

Carhart (1997) examines common factors in stock returns and investment expenses in relation to equity mutual funds' mean and risk-adjusted returns. In each year, Carhart calculates a cross-sectional average of fund age, total assets, expense ratio, turnover and load fees for each decile portfolio. His results indicate that turnover and expenses are related to performance, with the low performing deciles particularly standing out with higher-than-average measures. In addition, size and load fees were also found to be statistically significant, all with negative effects on performance.

Prather, Bertin and Henker (2004) provide an examination of mutual fund performance in relation to a comprehensive list of fund-specific characteristics. The characteristic variables are grouped into four board categories of popularity (agility), growth (risk), cost and management. They find that fund performance is positively related to price ratio variables and negatively related to market capitalization, expense ratio and number of funds under management.

2. Data

To examine the short-term persistence in mutual fund performance, the quarterly frequency of returns on US growth equity funds is employed. The data covers the period of 1998-2007, which is sourced from Morningstar Direct Version 3.1. The fund characteristics (i.e., P/E ratio, P/B ratio, total market value, turnover and net expense ratio), also sourced from Morningstar, are based on yearly data.

Following seminal studies in the area (see, e.g., Hendricks, Patel & Zeckhauser, 1993; Bollen & Busse, 2004; among others), two data selection criteria are applied in the sample. First, a particular fund needs to have complete information over the sample period[1]. Second, each fund has to pursue a growth objective and needs to have at least 50 per cent of the overall fund invested in equity. Including a full set of observations and maintaining this same set over the sample period should mitigate any bias within the fund returns due to poor performance-related liquidation, as documented by Brown et al. (1992) and Elton, Gruber and Blake (1996). After the above selection process, a total of 323 funds are included in the sample. Finally, in order to perform the risk adjustment procedures based on the Fama and French (1993) three-factor model, we obtain a record of quarterly historical risk factors from Kenneth French's data library website[2].

3. Short-term persistence in mutual fund performance and its profitability

We begin our analyses by examining whether performance persistence is present in the more recent period and whether traditional momentum strategies yield positive returns. The momentum profits obtained from a traditional unconditional momentum strategy serve as benchmark profits and will be compared to those of generated from an enhanced strategy, which is built upon a conditional double-sort procedure in the following section of the paper.

The profits obtained from a traditional unconditional momentum strategy serve as a benchmark, which will be compared to profits from an enhanced strategy built upon a conditional double-sort procedure presented in the following section of the paper.

3.1. Mutual fund return persistence. To analyze fund return persistence, for every quarter t, an OLS cross-sectional regression is calculated with the following structure:

$$R_{it} - R(B_{it}) = \alpha_t + \beta_{jt} R_{it-j} + \mu_{it}, \quad (1)$$

where R_{it} is return on fund i in quarter t; $R(B_{it})$ is benchmark return in quarter t and R_{it-j} is lagged return for fund i in quarter t-j for j = 1,2,...,8.

Based on Fama and MacBeth's (1973) approach, each quarterly regression will be stacked, and appropriate coefficients and t-statistics will be calculated for the overall sample. Since the dependent variable is based on residual returns, two types of excess returns are computed in the study. The first approach uses a demeaning factor, which is the excess return for fund i in quarter t less its mean return over the entire sample period, and the second approach is based on each fund's quarter t return in excess of the market return. Under the null hypothesis of no performance persistence, the β's should be equal to zero. Under the alternative hypothesis of non-zero serial correlation in individual fund returns, the β's will not be equal to zero.

Table 1 reports the performance persistence test results using equation (1). Each regression is constructed based on a series of four quarter lags and eight quarter lags, with both using a demeaned and a market adjusted residual return as the dependent variable. In all models, the results indicate that there is a significant return autocorrelation at lagged one quarter and hence, the null hypothesis of no short-term performance persistence is rejected.

[1] This includes a full set of quarterly returns from one year before the sample period to the end of the sample period. A sample fund also needs to have a complete set of yearly statistics relating to the five characteristics used in this study, namely, P/E ratio, P/B ratio, total market value, turnover and net expense ratio.

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

Table 1. Fund performance persistence

Panel A. Residual returns are evaluated based on a demeaned approach									
	α_t	R_{it-1}	R_{it-2}	R_{it-3}	R_{it-4}	R_{it-5}	R_{it-6}	R_{it-7}	R_{it-8}
Coefficient	-2.379**	0.115**	0.035	0.091*	0.019				
t-stat	-2.458	2.251	0.651	1.971	0.411				
Coefficient	-2.098**	0.102*	0.055	0.064	0.001	-0.07	0.012	0.014	0.011
t-stat	-2.435	1.949	1.286	1.528	0.025	-1.641	0.358	0.375	0.383
Panel B. Residual returns are evaluated based on a market residual approach									
	α_t	R_{it-1}	R_{it-2}	R_{it-3}	R_{it-4}	R_{it-5}	R_{it-6}	R_{it-7}	R_{it-8}
Coefficient	-1.54	0.137**	0.054	0.109**	0.039				
t-stat	-1.439	2.633	0.986	2.301	0.823				
Coefficient	-0.921	0.125**	0.08	0.081*	0.017	-0.057	0.028	0.032	0.032
t-stat	-0.728	2.382	1.835	1.898	0.459	-1.306	0.839	0.863	1.047

Notes: This table reports the regression results of equation (1), which tests for performance persistence by regressing the past four and eight quarterly returns on the current quarter.

$$R_{it} - R(B_{it}) = \alpha_t + \beta_{jt} R_{it-j} + \mu_{it}, \quad (1)$$

where R_{it} is return on fund i in quarter t; $R(B_{it})$ is benchmark return in quarter t and R_{it-j} is lagged return for fund i in quarter t-j for j = 1,2,...,8. These regressions were done every quarter within the sample and were then stacked based on the Fama and MacBeth (1973) approach to arrive at four regression models for the whole sample. Residual returns are evaluated based on a demeaned approach, which is the return to fund i for quarter t minus its average return over the whole sample, and a market residual approach, which is the return to fund i minus the market benchmark return for quarter t. The asterisks ** and * indicate significance levels of 5 percent and 10 percent, respectively.

3.2. A test of profitability of momentum strategy: Hendricks, Patel and Zeckhauser's (1993) single-sort procedure. Given the above finding where the autocorrelation of residual return is presented at lagged one period, we develope a single-sort strategy to utilize this finding, where an evaluation period of one-quarter lag is implemented. Similar to Hendricks, Patel and Zeckhauser (1993), for every quarter in our sample period, funds will be ranked and distributed into one of ten decile portfolios. The first decile portfolio will consist of those best performing funds in the recent evaluation period, the second decile will consist of the next best performing funds and so on, until all the funds are allocated amongst the ten deciles. Over the sample period, a total of 400 decile portfolios are constructed. The performance of portfolios is estimated based on two risk adjustment procedures: the market risk premium, and Fama and French's (1993) three-factor model, as shown in the following equations:

$$R_{qt} = \alpha_{qt} + \beta_{qt} MRP_t + \varepsilon_{qt}, \quad (2)$$

$$R_{qt} = \alpha_{qt} + \beta_{qt} MRP_t + s_{qt} SMB_t + h_{qt} HML_t + \varepsilon_{qt}, \quad (3)$$

where R_{qt} is return on decile q in quarter t; MRP_t is market risk premium in quarter t; SMB_t is size risk adjustment variable in quarter t; HML_t is book-to-market risk adjustment variable in quarter t. We also form a zero-cost strategy, which longs the top performing decile portfolio (decile 1) and shorts the worst performing decile portfolio (decile 10). The risk-adjusted return to "winners" minus "losers" portfolios measures the maximal gain from exploiting performance persistence[1].

Table 2 reports the results for the single-sort strategy constructed using a formation period of lagged one quarter, and a holding period of one immediate following quarter. The variable of importance from the regressions is the intercept, which provides a measure of risk-adjusted performance for "winners" and "losers" portfolios and a zero-cost strategy under examination. Panel A reports the α's from a market risk-adjusted and Fama and French's three-factor adjusted approaches for both deciles 1 and 10 portfolios, that is, the "winners" and "losers" portfolios. Panel B reports the α's for the zero-cost strategy constructed based on the "winners" minus "losers" portfolio. The remaining coefficients indicate the sensitivity of returns to the risk adjustment portfolios and are not reported in the table for brevity.

Table 2. Momentum profitability: single-sort strategy

Panel A. Risk-adjusted holding period returns (%) on portfolios sorted by past returns	
Decile 1 ($R_{winners,t}$)	
Market-adjusted alpha	3.28**
t-statistic	7.62
Fama & French risk-adjusted alpha	3.52**
t-statistic	4.07

[1] Theoretically, the issue of short selling is sound; on a practical basis, however, not all stocks/funds can be short sold. Moreover, there are often restrictions with regard to the size and length of time the position can be held.

Table 2 (cont.). Momentum profitability: single-sort strategy

Panel A. Risk-adjusted holding period returns (%) on portfolios sorted by past returns	
Decile 10 ($R_{losers,t}$)	
Market-adjusted alpha	2.45**
t-statistic	4.88
Fama & French risk-adjusted alpha	1.67**
t-statistic	2.79
Panel B. Risk-adjusted holding period returns (%) on momentum portfolios	
Decile 1 ($R_{winners,t}$) − Decile 10 ($R_{losers,t}$)	
Market-adjusted alpha	0.83
t-statistic	2.06
Fama & French risk-adjusted alpha	1.85**
t-statistic	3.67

Notes: This table evaluates the risk-adjusted returns for a single sort strategy implemented in the sample using equations (2) and (3) as the risk adjustment models.

$$R_{qt} = \alpha_{qt} + \beta_{qt} MRP_t + \varepsilon_{qt}, \quad (2)$$

$$R_{qt} = \alpha_{qt} + \beta_{qt} MRP_t + s_{qt} SMB_t + h_{qt} HML_t + \varepsilon_{qt}, \quad (3)$$

where R_{qt} is return on decile q in quarter t; MRP_t is market risk premium in quarter t; SMB_t is size risk adjustment variable in quarter t; HML_t is book-to-market risk adjustment variable in quarter t. Every quarter, funds are ranked based on their past quarter returns and placed into deciles, with decile 1 consisting of the top performers and decile 10 consisting of the worst performers. Decile holding period returns are calculated based on a benchmark adjusted return and the Fama and French (1993) benchmark-adjusted procedure. Momentum portfolio returns are also presented, which consist of returns to decile 1 minus the returns to decile 10. In all cases, the Fama and MacBeth approach is employed, and the intercept from the regression is reported along with its corresponding *t*-statistic; this provides the risk-adjusted return for the portfolio and its significance. The asterisks ** and * indicate significance levels of 5 percent and 10 percent, respectively.

Overall, the results show that performance persistence can be exploited in this sample and that sorting funds into performance ranks based on past quarterly returns can clearly identify underperformers and outperformers. Returns assessed based on Fama and French's (1993) risk adjusted approach shows that a traditional single sort strategy (that longs "winners" and shorts "losers") yields a statistically significant return of 1.85 per cent per quarter. The result is largely consistent with those of reported in earlier studies (i.e. Carhart, 1997; Brown and Goetzmann, 1995; and Hendricks, Patel and Zeckhauser, 1993). For instance, Carhart (1997) and Brown and Goetzmann (1995) find performance persistence to be exploitable using single sort strategies, while Hendricks, Patel, and Zeckhauser (1993) find superior performance relative to benchmark portfolios.

Consistent with previous studies, α's for decile 1 is always positive, suggesting a hot hand effect. However, it is interesting to note that α's for decile 10 is also positive on average, in sharp contrast to negative α's observed in earlier studies. In other words, the loser funds show performance reversals, indicating a disappearance of the cold hand effect in more recent period. The result is contrary to earlier finding that the momentum effect is mainly driven by the underperforming funds. Consequently, this suggest that there is a paradigm shift in terms of mutual fund performance persistence over more contemporary periods, where the performance persistence is mainly driven by outperforming funds.

4. Do fund characteristics enhance momentum profits?

In this section, we examine fund characteristics and their explanatory power in terms of performance persistence, and determine if a conditional double-sort procedure is economically exploitable.

4.1. Fund characteristics and performance persistence. We first examine fund characteristics and their predictability of performance persistence. Following Detzel and Weigand (1998), five cross-sectional regressions are constructed, expressing current fund returns as a function of the previous year's fund characteristics, including turnover, natural log of total market value, P/B ratio, P/E ratio and net expense ratio. These characteristic variables are found important in previous studies (e.g., Prather, Bertin & Henker, 2004).

Turnover and net expense ratio are cost variables and are expected to have a negative relationship with performance (i.e., higher expenses in the course of running the fund would tend to decrease the fund profits over the period). Total market value of the fund represents the total dollar value of the fund's assets, and this may have a negative impact on performance, as fund size may have a detrimental effect on returns because of the inability to implement particular investment styles, thus dissipating returns. The P/B and P/E ratio are considered growth variables and they measure the potential future performance of the fund and the value of the fund relative to its book value and earnings (hence, they are also a measure of cheapness). These two measures would therefore be expected to positively influence returns.

The following regressions are developed using yearly information provided by each corresponding fund and will be stacked based on the Fama and MacBeth (1973) approach.

$$R_{it} = \beta_{0t} + \beta_{1t-1} FC_{t-1} + \mu_{it}, \quad (4)$$

where FC is one of the fund characteristics, including total market value of the fund in year t-1, fund P/E ratio in year t-1, fund P/B ratio in year t-1, net expense ratio for the fund in year t-1 and

turnover ratio for the fund in year *t*-1. The five regression equations represent mutual fund returns as a function of one of their characteristics identified from previous assets pricing studies as having a significant effect (e.g. Detzel and Weigand, 1998).

Comparing with unadjusted fund returns, the characteristic-adjusted returns should display less serial correlation, should the persistence in fund returns is related to the characteristics. The following regression is utilized:

$$\mu_{it} = \rho_0 + \rho_1 \mu_{it-1} + \varepsilon_{it}, \quad (5)$$

where μ_{it} is characteristic-adjusted return for fund *i* in year *t*; $\mu_{it\text{-}1}$ is previous year characteristic-adjusted return for fund *i*. Under the null hypothesis, ρ_1 is equal to zero, indicating no serial correlation among the characteristic-adjusted returns, thus demonstrating that the fund characteristic has explained the persistence presented in funds returns and can therefore be used in the conditional double-sort procedure. Should the null hypothesis be rejected in favour of the alternative hypothesis, it indicates that the specific characteristic have no relationship with performance persistence because serial correlation is still present within the returns and the specific characteristic failed to explain it.

Table 3 reports the results of the five characteristic model regressions constructed using equation (4). The results show that only the natural log of total fund value is found to be significant. Although the residuals from these regressions are the main variables of interest, these regressions provide a basis for comparing the relative contributions of each fund characteristic in explaining fund performance.

Table 3. Fund characteristics and performance persistence

Characteristic	Coefficient	t-statistic
Turnover	0.013	0.648
Log total market value	-1.095**	-2.523
P/B ratio	-1.348	-0.737
P/E ratio	-0.103	-0.282
Net expense ratio	-0.049	-0.063

Notes: This table is based upon equation (4):

$$R_{it} = \beta_{0t} + \beta_{1t-1} FC_{t-1} + \mu_{it}, \quad (4)$$

where *FC* is one of the fund characteristics, including total market value of the fund in year *t*-1, fund P/E ratio in year *t*-1, fund P/B ratio in year *t*-1, net expense ratio for the fund in year *t*-1 and turnover ratio for the fund in year *t*-1. A series of regressions will be calculated for each year and stacked based on Fama and MacBeth (1973). Only coefficient $\beta_{1t\text{-}1}$ along with its corresponding *t*-statistic is reported. The asterisks ** and * indicate significance levels of 5 percent and 10 percent, respectively.

Table 4 shows the test results for first-order serial correlation of characteristic-adjusted mutual fund returns. The correlations are tested using the residuals from the previous five characteristic regression models (i.e. equation (4)) and the correlations are subsequently analysed using equation (5). The results of Table 4 reveal the insignificant coefficients on the P/B and P/E adjusted residual returns. The implication is that the persistence in fund returns can be explained by the P/B and P/E ratio, and hence, the two ratios are used as a 'first criterion' in the conditional double-sort procedure.

Table 4. First-order serial correlation regression coefficients

Characteristic	Coefficient	*t*-statistic
Turnover	0.271**	3.011
Log total market value	0.285**	3.229
P/B ratio	0.208*	2.097
P/E ratio	0.151	1.356
Net expense ratio	0.280**	3.238

Notes: This table reports the results from equation (5), which regresses current residualson their lagged counterparts, where residuals were taken from regression equation (4).

$$\mu_{it} = \rho_0 + \rho_1 \mu_{it-1} + \varepsilon_{it}, \quad (5)$$

where μ_{it} is characteristic-adjusted return for fund *i* in year *t*; $\mu_{it\text{-}1}$ is previous year characteristic-adjusted return for fund *i*. The reported coefficient ρ_1 and its corresponding *t*-statistic indicate the rejection or non-rejection of the null hypothesis, which is that ρ_1 is equal to zero, and does help to explain the variation in performance persistence. The Fama and MacBeth (1973) approach was used to arrive at final regression outputs. The asterisks ** and * indicate significance levels of 5 percent and 10 percent, respectively.

4.2. A test of enhanced profitability of momentum strategy: Conditional double-sort procedure of Sagi and Seasholes (2007). *4.2.1. Methodology.* Sagi and Seasholes's (2007) conditional double-sort procedure explores the relationship between fund return persistence and fund-specific characteristics. Figure 1, sourced from Sagi and Seaholes (2007), provides a visual representation of the conditional double-sort process. As mentioned in the previous section, those fund characteristics that are found to be significant in explaining return persistence will be used in the first criterion. Given the results of Table 4, funds are first ranked according to the P/B or P/E ratio in each year. The ranking assigns each fund to one of four quartiles. The "high" quartile will be those funds that are expected to have a high degree of persistence with respect to the first criterion, and the "low" quartile will consist of those funds with a lesser degree of return autocorrelation. Once placed into quartiles, funds are then ranked each quarter in descending order based on previous quarterly returns and placed into decile portfolios consequently. In each quartile, its own momentum portfolio ("winner" minus "loser") is constructed, which is the difference in returns between decile 1 and decile 10 portfolios.

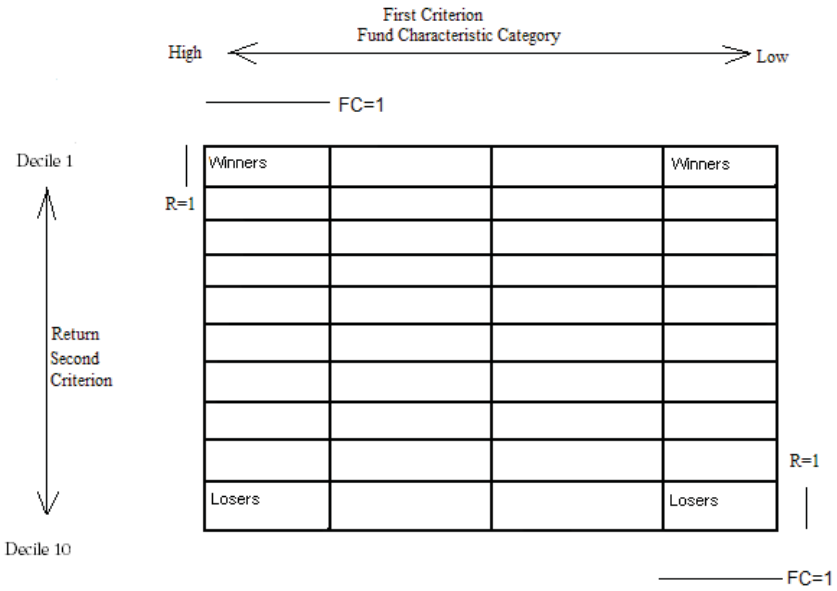

Fig. 1. A visual representation of the conditional double-sort process

The conditional double-sort procedure has some clear advantages over independent double-sort procedures, such as those implemented in Lee and Swaminathan (2000) and Chan, Jegadeesh and Lakonishok (1996). First, it allows a comparison of similar momentum strategies after conditioning on other variables. Second, it ensures that an equal number of firms are allocated to each bin. Independent double-sort procedures may end up with an unequal amount of observations in each bin, causing bias when calculating returns. Therefore, this procedure of bias reduction is crucial.

Decile portfolio holding period returns are calculated using equal weights. Both market risk and Fama and French's (1993) three-factor adjustment procedures will again be used to analyze decile returns and their corresponding statistical significance. The intercepts observed in equations (2) and (3) provide the risk-adjusted return and thus are the focus of our analysis.

4.2.2. Momentum strategy conditional on fund-relative price ratio. Using the conditional double-sort procedure, Table 5 shows that funds with previously low P/B ratios significantly outperform all other funds and in particular, those funds with high P/B ratios. In Panel A, on a Fama and French (1993) risk-adjusted basis, decile 1 in the bottom quartile outperforms decile 1 in the top quartile by as much as 2.13 per cent (4.90-2.77) per quarter. In contrast, the spread for decile 10 in the high and low quartiles is only 0.64 per cent (2.18-1.54) per quarter.

Generated from a zero-cost strategy that longs past winners in the low P/B quartile and simultaneously shorts past losers in low P/B quartile, the Fama and French three-factor adjusted return is on average 2.73 percent per quarter. This is in stark contrast to the strategy built up on the high P/B quartile funds where the holding period return was only 1.23 per cent per quarter (see Panel B of Table 5).

Table 5. P/B ratio conditional double-sort procedure

Panel A. Risk-adjusted holding period returns (%) on portfolios double-sorted by past P/B ratio and returns		
	Top P/B ratio quartile	Bottom P/B ratio quartile
Decile 1 ($R_{winners,t}$)		
Market-adjusted alpha	2.39	3.97**
t-statistic	1.17	3.00
Fama & French risk-adjusted alpha	2.77	4.90*
t-statistic	1.67	2.24
Decile 10 ($R_{losers,t}$)		
Market-adjusted alpha	1.22	1.92**
t-statistic	1.04	2.82
Fama & French risk-adjusted alpha	1.54	2.18*
t-statistic	1.58	2.24
Panel B. Risk-adjusted holding period returns (%) on top P/B quartile momentum portfolios		
	Top P/B ratio quartile	Bottom P/B ratio quartile
Decile 1 ($R_{winners,t}$) – Decile 10 ($R_{losers,t}$)		
Market-adjusted alpha	1.16	2.05
t-statistic	0.47	1.15

Table 5 (cont.). P/B ratio conditional double-sort procedure

Panel B. Risk-adjusted holding period returns (%) on top P/B quartile momentum portfolios		
	Top P/B ratio quartile	Bottom P/B ratio quartile
Decile 1 ($R_{winners,t}$) – Decile 10 ($R_{losers,t}$)		
Fama & French risk-adjusted alpha	1.23	2.73*
t-statistic	0.70	2.24

Notes: This table reports results for the top and bottom quartile for the P/B ratio, which is the conditional double-sort procedure. Each year, funds were sorted based on their previous year's P/B ratio and then ranked and placed into quartiles. Within each quartile, funds were then ranked and placed into deciles based on their previous quarter returns. Within the top and bottom quartile, risk-adjusted returns of deciles 1 and 10 are calculated and reported in Panel A. A zero-cost strategy that longs past winners in low P/B quartile and simultaneously shorts past losers in low P/B quartile is formed. The risk-adjusted returns for the strategy are reported in Panel B. The asterisks ** and * indicate significance levels of 5 percent and 10 percent, respectively.

In considering the traditional single-sort procedure where a zero-cost strategy returns a profit of 1.85 per cent per quarter, the momentum profit conditional on low P/B ratio funds outperforms it by 0.88 per cent (2.73-1.85) per quarter. Thus, an enhanced momentum strategy can be used to exploit the additional return autocorrelation in low P/B funds. Again, it is interesting that the worst performing funds exhibit positive returns, thus contradicting the premise that the momentum effect is mainly driven by the significant underperformance of funds. The result provides further support to our earlier argument that that there is a paradigm shift in terms of mutual fund performance persistence over more contemporary periods and the performance persistence is mainly driven by outperforming funds. Further, all regression returns calculated using the low P/B funds are statistically significant, while their high P/B counterparts show little or no significance.

Table 6 reports the risk-adjusted return coefficients from the conditional double-sort procedure when the P/E ratio is the 'first criterion'. The results are generally consistent with our earlier estimation reported in Table 5, when the P/B ration is used as the first criterion. For example, on a Fama and French (1993) risk-adjusted basis, investing in funds that have had a low P/E ratio in the previous year enhances momentum returns by about 1.44 per cent (3.29-1.85 per cent) per quarter when compared to a single-sort process. Therefore, the results of Table 6 further confirm that an enhanced momentum strategy is superior to a traditional single-sort strategy.

Table 6. P/E ratio conditional double-sort procedure

Panel A. Risk-adjusted holding period returns (%) on portfolios double-sorted by past P/E ratio and returns		
	Top P/E ratio quartile	Bottom P/E ratio quartile
Decile 1 ($R_{winners,t}$)		
Market-adjusted alpha	3.42	3.83*
t-statistic	1.68	2.72
Fama & French risk-adjusted alpha	4.20	4.81**
t-statistic	2.29	5.26
Decile 10 ($R_{losers,t}$)		
Market-adjusted alpha	1.64	2.05**
t-statistic	1.23	2.81
Fama & French risk-adjusted alpha	2.47	1.52*
t-statistic	1.77	2.49
Panel B. Risk-adjusted holding period returns (%) on top P/E quartile momentum portfolios		
	Top P/E ratio quartile	Bottom P/E ratio quartile
Decile 1 ($R_{winners,t}$) – Decile 10 ($R_{losers,t}$)		
Market-adjusted alpha	1.79	1.78
t-statistic	0.75	1.04
Fama & French risk-adjusted alpha	1.73	3.29*
t-statistic	0.80	2.36

Notes: This table reports results for the top and bottom quartile for the P/E ratio, which is the conditional double-sort procedure. Each year, funds were sorted based on their previous year's P/E ratio, and then ranked and placed into quartiles. Within each quartile, funds were then ranked and placed into deciles based on their previous quarter returns. Within the top and bottom quartile, risk-adjusted returns of deciles 1 and 10 are calculated and reported in Panel A. A zero-cost strategy that longs past winners in low P/E quartile and simultaneously shorts past losers in low P/E quartile is formed. The risk-adjusted returns for the strategy are reported in Panel B. The asterisks ** and * indicate significance levels of 5 percent and 10 percent, respectively.

Conclusions

This paper provides empirical evidence that enhances our understanding of short-term (quarterly) persistence in U.S. mutual fund performance and its profitability in the later years covering the 1998-2007 period.

We find that the short-term fund persistence in residual returns is still evident, using both demeaned and market residual adjusted returns. Consistent with Bollen and Busse (2004), the persistence is very short-lived and concentrated in the immediate following quarter, suggesting that this phenomenon has not evaporated with the arrival of the information technology age. Unlike the findings by Busse, Goyal and Wahal (2010) which report mild persistence on the one-year performance persistence among institutionally managed portfolios from 1991 to 2008, persistence in performance found in our study is strong in its magnitude and can be materialized into the momentum profit of 1.85 per cent per quarter after adjusting for the Fama and French (1993) three-factor risks. In contrast to the findings from earlier studies (but somewhat consistent with Busse et al. (2010)), however, it appears that there is a paradigm shift in the mutual fund performance persistence over more recent period, where the short-term momentum profits are mainly driven by top performing (winners) mutual funds, rather than the underperforming funds.

We then investigate the profitability of mutual fund momentum strategies by examining whether specific fund characteristics can be capitalized on in order to provide a meaningful way to further enhance short-term momentum profits. Out of four characteristics investigated in our study, we find that only the P/B and P/E ratios appear to explain mutual fund future returns. The creation of momentum portfolios based on the funds with low P/B and P/E ratios outperforms their higher P/B and P/E counterparts by around 1.5 per cent per quarter. Investing in an enhanced momentum strategy that includes the funds with low P/B (P/E) ratios enhance momentum profits by about 0.88 (1.44) per cent per quarter, in comparison to the single-sort technique of Hendricks, Patel and Zeckhauser (1993).

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