Persistence in Mutual Fund Performance: Analysis of Holdings Returns

Samuel A. Kruger

June 8, 2007

Term paper for:
Research Projects: Finance (35908)
Spring Quarter, 2007
University of Chicago Graduate School of Business
Professor Eugene F. Fama

I. Introduction

Mutual fund performance is a rich topic for academic research. The very existence of the mutual fund industry with its high expenses and transaction costs is a puzzle to the efficient markets hypothesis. If markets are efficient, why are so many resources invested in stock picking?

The conventional wisdom is that at least some mutual fund managers have stock-picking skills. Investors frequently look to past returns and historical ratings such as Morningstar for guidance on which funds will perform well in the future. Successful fund managers are glorified in the media and turned to for investment advice for years to come.

The academic literature is much more mixed. It is generally agreed that there is some persistence in mutual fund performance.[1] However, the source of this persistence remains a topic of debate. For example, Carhart (1997) attributes almost all persistence in mutual fund performance to four-factor loadings, expenses, and transaction costs. On the other hand, Wermers, Yao, and Zhao (2007) finds that "good" managers pick better-performing stocks even after controlling for style characteristics.

By examining the future performance of stocks held by "good" and "bad" mutual funds, I conclude that fund managers do not have stock picking skills. This paper adds to the literature by applying the performance-sorted portfolio methodology of Carhart (1997) to a dataset that includes returns on the underlying holdings of mutual funds as well as the returns of the funds themselves. Section II provides a brief review of the relevant literature. Section III describes my dataset. Section IV introduces my analytical approach. Section V discusses the results of my analysis. Section VI concludes.

[1] See Carhart (1997).

II. Literature Review

Mark Carhart's 1997 *Journal of Finance* article, "On Persistence in Mutual Fund Performance," is the primary motivation for my analysis. Carhart examines the returns of mutual funds from 1962 to 1993 to look for evidence of performance persistence. Carhart's primary analytical technique was to form performance decile portfolios of mutual funds on January 1 of each year based on returns over the past year. The portfolios are then held for one year and monitored for any abnormal performance. If performance is persistent, funds that performed well in the past should perform well in the future, and the top decile portfolios should outperform the other portfolios.

Carhart finds that past winners do outperform past losers. However, most of this persistence is explained by a four-factor model including factor-mimicking portfolios for the market return, size, book-to-market, and one-year momentum. Momentum is the biggest explanation of the persistence. The remaining persistence is mainly explained by fund expenses and transaction costs, which are higher in the lower performance deciles. Of the 8% difference in annual returns that Carhart finds between the top and bottom deciles, 4.6% is explained by four-factor loadings, 0.7% is explained by expense differences, and 1.0% is explained by transaction cost differences. This leaves an unexplained return spread of 1.7%, almost all of which is concentrated in the difference between the ninth and tenth deciles. In other words, Carhart finds some evidence that the very worst funds continue to underperform but finds no evidence of persistent skill in any of the other deciles.

Wermers, Yao, and Zhao (2007) analyzes the returns of mutual fund holdings and comes to the opposite conclusion that good managers have significant stock-picking skill. Wermers et al identifies "good" managers based on past alpha estimates and then forms an equal weight portfolio that is long stocks held disproportionately by "good" managers and short stocks held disproportionately by "bad" managers. They find that this trading strategy results in significant alpha, which they interpret as evidence of stock-picking skill. A significant problem with this analysis is that forming portfolios based on the same model used to analyze returns could bias the results. Significant alpha could come from biases in the model. Additionally, employing equal-weight portfolios of stocks will overweight small stocks. I avoid these problems by sorting based on returns instead of alpha estimates and forming equal-weight portfolios of fund returns instead of stock returns.

My analysis builds on Carhart (1997) by applying Carhart's analytical approach to data on the returns of mutual fund holdings. If fund managers have stock-picking skills, the stocks they choose to buy should have high future returns. Analyzing holdings returns without the noise of expenses and transactions should be a cleaner way to identify stock-picking skill. Using this approach, I find no compelling evidence of stock-picking skill.

Additionally, examining the holdings returns helps to identify the source of the persistent underperformance of the worst funds in Carhart (1997). Is this underperformance due to picking bad stocks, or is it the result of transaction costs, hidden expenses, or other unobserved actions? Given that I find no unexplained persistence in the holdings returns, I conclude that Carhart's persistent underperformance must be due

to other actions of the mutual fund, likely transaction costs from being forced to sell shares as investors pull out money.

Finally, analyzing the holdings data is useful because any anomaly can be translated directly into a trading strategy. Persistence in mutual fund returns is interesting but difficult to exploit. I can purchase the winning funds, but I cannot short the losers. On the other hand, if return persistence is present in fund holdings, I can exploit this with a zero-investment portfolio by buying stocks held by winning funds and shorting stocks held by losing funds. The fact that this is a tradable strategy also makes holdings returns a better test of market efficiency.

III. Data

My dataset covers domestic equity mutual funds from January 1980 to December 2006. My data includes information on both returns and holdings. As a result I am able to analyze both fund performance and the performance one would achieve by buying and holding a fund's underlying securities.

Monthly survivor-bias-free mutual fund returns data comes from the CRSP mutual fund dataset available on WRDS. Data is available starting in 1962. I focus on post-1980 returns because this is the period for which holdings data is available.

Data on mutual fund holdings comes from the Thomson Financial CDA/Spectrum dataset, also available on WRDS. This dataset records the positions mutual funds hold in individual securities. The information comes from N-30D SEC filings, which are required to be filed twice a year by all mutual fund companies. The data is free from survivor bias and starts in 1980. I link the mutual fund returns data to the holdings data

using Mutual Fund Links (MFLinks), created by Russ Wermers and available on WRDS.[2]

To focus on domestic equity funds, I limit my analysis to funds with an investment objective of growth, aggressive growth, or growth and income. This eliminates international funds, as well as funds focused on bonds, metals, balanced, and unclassified strategies. I also require that funds be present in the returns data for at least one year, report holdings at least once during the preceding year, and have a valid link in MFLinks. Finally, I consolidate repeat entries resulting from multiple share classes in the CRSP Mutual Fund returns data by taking a weighted average according to total net assets.[3]

To calculate holdings returns for each fund, I look at how the fund's reported holdings as of the end of a year performed over the next year. Fund holdings returns are calculated as the weighted average of CRSP return data for the individual stocks held by a fund. January weights are based on the most recently reported holdings positions. Subsequent weights are adjusted based on past returns. The resulting holdings returns time series represents the returns an investor would receive by purchasing the most recently disclosed holdings of a fund on each January 1 and holding that portfolio for the next year.

Table I summarizes the dataset. In total, I have 18,401 fund-year observations (220,812 fund-months). As expected, the number of funds increases over time, ranging from a minimum of 177 funds in 1983 (end-of-year 1982) to a maximum of 1,480 funds

[2] Wermers (2000) is an early example of this link.
[3] Redundant entries are not a problem in the holdings data because each fund with a single set of holdings is only reported once. The MFLinks file identifies redundant entries in the CRSP data. Because total net assets are not always reported monthly, I use the most recent number available. When historical total net assets is not available I look forward for future values or weight the share class with $1 of total net assets.

in 2000 (end-of-year 1999). These counts are in line with datasets used by other researchers. Wermers, Yao, and Zhao (2007) use a dataset that ranges from 270 funds in 1982 to 1,653 in 1997. My lower counts are likely the result of my requirement that firms be alive for one year prior to their inclusion in my analysis. For the period of 1962 to 1993, Carhart (1997) analyzes 1,892 total funds, with an average of 500 fund each year.

Table I also summarizes average monthly returns for the funds and their holdings. Average monthly fund returns range from -1.25% in 1981 to 2.26% in 1991. As expected, variation over time roughly corresponds to overall market patterns. Funds generally, though not always, underperform their holdings. On average the difference is 2.04% annually, largely representing fund expenses and transaction costs.

IV. Analysis

My analytical technique is to apply the methodology of Carhart (1997) and Hendricks, Patel, and Zeckhauser (1993) to my holdings returns dataset. On January 1 of each year, I sort all mutual funds based on their average reported returns over the past year. For robustness, I limit the dataset to funds that reported returns in each of the past twelve months. I then form ten equal-weight decile portfolios based on the reported returns and hold their holdings for the next year. The difference between my approach and that of Carhart (1997) is that Carhart analyzed mutual fund returns over the next year whereas I analyze the performance of the funds' year-end holdings. The advantage of my approach is that I can look for stock-picking skill without the noise introduced by fund expenses and transactions. If managers have true stock-picking skills, good managers

(e.g. those with good past returns) should hold stocks that will outperform the market in the future (e.g. over the course of the next year). I directly test this hypothesis.

As in Carhart (1997), I measure performance using the Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965) and the 4-factor model of Carhart (1997). The 4-factor model uses the market (rmrf), size (smb), and value (hml) factors of Fama and French (1993) as well as a momentum (umd) factor based on Jegadeesh and Titman's (1993) one-year momentum. The model specifications are:

$$\text{CAPM:} \quad r_{it} = \alpha_i + \beta_i rmrf_t + e_{it} \tag{1}$$

$$\text{4-Factor Model:} \quad r_{it} = \alpha_i + b_i rmrf_t + s_i smb_t + h_i hml + u_i umd + e_{it} \tag{2}$$

where r_{it} is the excess return on holdings portfolio i over the one-month T-Bill rate; $rmrf_t$ is the excess return on the value-weighted portfolio of all NYSE, Amex, and Nasdaq stocks; and smb_t, hml_t, and umd_t are zero-investment factor-mimicking portfolios for size, book-to-market equity, and one-year momentum.[4]

V. Results

A. Mutual Fund Returns

Before proceeding to my analysis of holdings returns, I first implement my analytical approach solely on reported mutual fund returns to ensure consistency with previous results. Table II shows returns, CAPM estimates, and 4-factor estimates for the 1981 to 2006 mutual fund returns in my data set. Consistent with Carhart (1997), there is significant persistence in returns. The top decile portfolio outperforms the bottom decile portfolio by 5.88% annually. The CAPM explains none of this persistence. However,

[4] All data on rmrf, smb, hml, umd, and the risk free rate are from Ken French's website.

most of the persistence is explained by the four-factor model. In particular, significant momentum loadings explain much of the persistence. Funds with high past returns are more likely to own stocks that performed well over the past year. The momentum effect described by Jegadeesh and Titman (1993) shows that we should expect these stocks and funds to have high future returns. Size also explains some of the persistence. Good funds tend to load more heavily on small stocks. The value effect is relatively small and goes in the wrong way. Four-factor alphas show some variation across portfolios. In particular, the bottom portfolio shows negative separation from the others. However, differences in the alphas are not significant, suggesting that persistence in mutual fund performance is almost entirely explained by the four-factor model. These results are consistent with Carhart (1997) except that Carhart shows more separation between the bottom two portfolios.

Table III directly compares my analysis to Carhart (1997). Each row summarizes analysis on the spread between the top and bottom portfolio. Row (1) is taken directly from Table III of Carhart (1997). Row (2) is my replication of Carhart (1997) for the same time period.[5] Row (3) is the Table II analysis of mutual fund returns in my dataset. My monthly excess returns and CAPM results are very close to Carhart's suggesting that, as intended, my dataset and analytical techniques are a good approximation of Carhart's. Nonetheless, our four-factor results differ a bit. Whereas Carhart shows a significant alpha difference (primarily driven by the bottom decile), I do not detect any significant alpha. The difference is driven by larger differences in momentum loadings in my

[5] Data for my replication of Carhart (1997) was obtained from John Cochrane as part of a problem set for Advanced Investments (B35150).

analysis. The rest of Table III (rows (4) to (9)) compares different time periods. Performance persistence does not appear to have changed much over time.

Following Carhart (1997), a second analytical technique that I use in this paper is to sort portfolios based on past four-factor alpha estimates instead of past returns. Table IV analyzes decile portfolios formed based on lagged three-year four-factor alpha estimates. Like Tables II and III, all results in Table IV, analyze reported returns of the mutual funds themselves. Alpha-sorted portfolios show little persistence in returns. The top performers have negative hml loadings, creating significant four-factor alpha differences across the portfolios.

One interpretation of these results is that good managers have stock-picking skill that is persistent over time, and that these skilled managers are more likely to invest in growth stocks. As a result, they do not outperform other funds in terms of returns, but they do have consistently positive alpha. This is consistent with Davis (2001), which finds that positive alpha is more common among growth funds.

However, I am reluctant to read too much into these results. The analysis is highly susceptible to model misspecification. As Carhart (1997) cautions, forming portfolios based on the same model used to analyze them risks identifying shortcomings of the model instead of picking up true stock-picking skill. Past alpha estimates could simply be picking up omitted (or mispriced) risk factors that are persistent into the future. Table IV is as much a test of the four-factor model as it is a test of performance persistence. Unless we are convinced that the four-factor model perfectly describes all returns, we should not be surprised that there is some alpha persistence.

B. Holdings Returns

I now turn to the primary contribution of this paper, analysis of mutual fund holdings returns. My primary result is that the holdings of past winning funds do not outperform the holdings of past losing funds, suggesting that mutual fund managers do not possess stock picking skills.

Table V shows the primary evidence for my no-stock-picking-skills result. Funds are sorted into equal-weight portfolios based on the past year of reported returns. I then analyze the performance of their holdings over the next year. In terms of returns, the holdings of winners outperform the holdings of losers by 4.20% annually, which is less than the difference that I found in the returns of the funds themselves (see Table II) and is not statistically significant. More importantly, the four-factor model completely explains all observed persistence in holdings returns. Similar to the fund returns analysis in Table II, umd and hml explain the persistence while hml goes somewhat in the wrong direction. The bottom line is that after adjusting for four-factor loadings, the year-end holdings of "good" funds perform no better than the holdings of "bad" funds over the next year.

The differences between Tables II and V appear to be driven by expenses and transaction costs. Fund returns in Table II had a 1 – 10 spread alpha of 0.20% compared to a holdings returns spread alpha of 0.02% in Table V. This translates into a 2.16% annual difference, which is close the 1.7% return difference that Carhart attributes to expenses and transaction costs. The remaining difference is within the margin of error and may be due to extra transaction costs facing the worst-performing portfolio. Whatever is causing the apparent persistent underperformance of the worst funds in Carhart (1997) does not appear to be present in the holdings returns.

To examine whether return persistence is a short-run phenomenon that I miss with my year-long holding period, I look at monthly returns within the holding period. Figure 1 shows that alpha estimates do not systematically change across time. In particular, there is no pattern to the 1 – 10 spread alpha, suggesting that persistence is just as nonexistent in January as in any other month.

To check the robustness of my results, I include several additional sorts to test other potential definitions of "good" funds. First, I sort funds based on three-year returns instead of one-year returns. If manager skill is persistent, the longer sort period should be less noisy. Table VI shows that performance is actually less persistent in the three-year sort. Even the returns are the same across funds. The difference seems to be driven by lower momentum loadings in the three year-sort. This suggests that high-performing funds do not pursue momentum strategies, but rather end up with momentum loadings as a byproduct of owning stocks that happened to do well. A three-year sort weakens this effect.

The next sort I try is based on past alpha estimates. This approach is related to the analysis of Wermers, Yao, and Zhao (2007), which identifies "good" managers based on past alpha estimates. Consistent with Wermers et al, I find that holdings returns alpha is persistent when sorts are based on one-year lagged alpha estimates. However, this is not compelling evidence of stock-picking skill. Twelve months of returns is not enough data to reliably fit the four-factor model. Further, as discussed before, alpha persistence could easily be the result of model misspecification as opposed to stock-picking skill.

Table VIII addresses the stock-picking skill vs. model misspecification issue by sorting portfolios based on longer, three-year lagged alpha estimates. If stock-picking

skill is present and persistent, the three-year sort should identify it with less noise. Instead, sorting based on the longer time period eliminates any significant persistence in either returns or four-factor alphas. A likely explanation for this result is that the four-factor model omits some risk factor, and that funds' loading on this risk factor is persistent over a one-to-two-year horizon but changes over longer horizons. This suggests that managers do not have stock-picking skills and casts doubts on the conclusions of Wermers, Yao, and Zhao (2007).

VI. Conclusion

Mutual fund managers do not appear to possess stock-picking skills. Stocks held by past winners outperform those held by past losers over the next year, but the persistence is explained by the four-factor model. In particular, much of the performance is explained by momentum. Funds that performed well over the past year are likely to hold recently appreciated stocks (the source of the high fund returns), which benefit from momentum over the next year. Persistence in mutual fund returns appears to primarily be a manifestation of the Jegadeesh and Titman (1993) momentum effect.

Persistence is even less prevalent in holdings returns than it is in fund returns. Carhart (1997) identified significant underperformance in the bottom decile of funds that could not be fully explained by the four factor model or expenses and transaction costs. By contrast, the holdings returns four-factor alphas are almost exactly zero across all portfolios.

The only evidence of stock-picking skill comes from portfolios sorted based on one-year alpha estimates, and this is likely the byproduct of model misspecification.

Sorting based on more reliable three-year alpha estimates eliminates any return persistence.

The evidence in this paper suggests that even the "best" mutual fund managers do not have stock picking skills. Thus, investors should not chase "hot" mutual funds, nor should they attempt to invest directly in the holdings of "hot" funds. Instead the prudent investor will focus solely on purchasing a diversified portfolio with his desired factor loadings at the lowest possible cost.

References:

Wermers, Russ, Tong Yao, and Jane Zhao, 2007, The investment value of mutual fund portfolio disclosure, working paper.

Carhart, Mark M., 1997, On persistence in mutual fund performance, *Journal of Finance* 52, 57-82.

Sharpe, William F., 1964, Capital Asset Prices: A theory of market equilibrium under conditions of risk, *Journal of Finance* 50, 549-572.

Lintner, John, 1965, The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets, *Review of Economics and Statistics* 47, 13-37.

Jegadeesh, Narasimham, and Sheridan Titman, 1993, Returns to buying winners and selling losers: Implications for stock market efficiency, *Journal of Finance* 48, 65-91.

Wermers, Russ, 2000, Mutual Fund Performance: An empirical decomposition into stock-picking talent, style, transaction costs, and expenses, *Journal of Finance* 55, 1655-1695.

Hendricks, Darryll, Jayendu Patel, and Richard Zeckhauser, 1993, Hot hands in mutual funds: Short-run persistence of performance, 1874-88, *Journal of Finance* 48, 93-130.

Fama, Eugene F., and Kenneth R. French, 1993, Common risk factors in the returns on bonds and stocks, *Journal of Financial Economics* 33, 3-53.

Davis, James, L., 2001, Mutual fund performance and manager style, *Financial Analysts Journal* 57, 19-27.

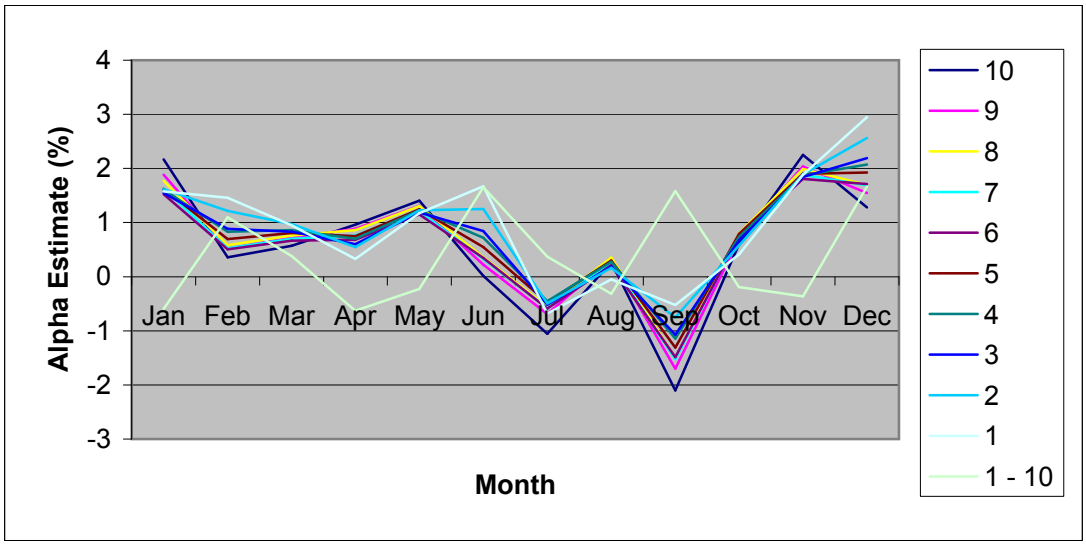

Figure 1. Holdings Alpha Estimates by Month of Portfolios Formed on One-Year Lagged Returns (1981 - 2006). This figure is based on the same analysis reported in Table V. Mutual funds are sorted on January 1 each year from 1981 to 2006 into decile portfolios based on their previous year's returns. Portfolio returns represent equal-weighted (by fund) holdings returns. Alpha estimates are from four-factor OLS regressions. Monthly alpha estimates are calculated as the overall alpha estimate for a portfolio plus the average monthly error term (residual) for that portfolio.

Table I
Data Summary

The table summarizes the dataset constructed for this paper. Mutual fund returns are from the CRSP mutual fund dataset. Holdings returns are constructed from end-of-year CDA/Spectrum reported holdings and CRSP stock return data. The two datasets are linked using MFLinks.

		Average Monthly Return (%)		
Year	Count	Mutual Funds	Holdings	Difference
1981	229	(1.25)	(1.46)	0.21
1982	195	1.12	1.31	(0.19)
1983	177	0.89	1.16	(0.27)
1984	240	(0.83)	(0.78)	(0.04)
1985	265	1.50	1.84	(0.35)
1986	303	0.66	0.78	(0.12)
1987	344	0.02	0.27	(0.24)
1988	398	0.68	0.93	(0.26)
1989	429	1.27	1.51	(0.24)
1990	467	(1.01)	(1.01)	(0.00)
1991	496	2.26	2.59	(0.33)
1992	547	0.47	0.61	(0.14)
1993	640	0.81	0.92	(0.11)
1994	635	(0.42)	(0.23)	(0.19)
1995	811	1.80	2.06	(0.26)
1996	788	1.08	1.34	(0.26)
1997	1,190	1.40	1.68	(0.28)
1998	1,049	0.79	1.01	(0.22)
1999	1,196	1.56	1.52	0.04
2000	1,480	(0.29)	(0.11)	(0.18)
2001	1,180	(0.98)	(0.84)	(0.14)
2002	989	(2.03)	(1.96)	(0.07)
2003	1,145	2.32	2.62	(0.29)
2004	1,034	0.90	1.10	(0.20)
2005	1,144	0.34	0.50	(0.16)
2006	1,030	0.65	0.81	(0.16)
Total	18,401			
Mean		0.53	0.70	(0.17)
Standard Deviation		1.10	1.19	0.12

Table II
Portfolios of Mutual Fund Returns Formed on Lagged 1-Year Returns (1981 - 2006)

Mutual funds are sorted on January 1 each year from 1981 to 2006 into decile portfolios based on their previous year's return. Portfolio returns represent equal-weighted fund returns. Rmrf, smb, hml, and umd are returns of factor-mimicking portfolios obtained from Ken French's website. Parameter estimates are from OLS regressions. The t-statistics are in parentheses.

		CAPM			4-Factor Model					
Portfolio	Monthly Excess Return	Alpha	rmrf	Adj. R-sq	Alpha	rmrf	smb	hml	umd	Adj. R-sq
1 (high)	0.77%	0.14%	1.05	0.741	0.01%	0.95	0.48	-0.13	0.29	0.919
	(2.57)	(0.94)	(29.82)		(0.09)	(41.03)	(16.57)	(-3.82)	(14.02)	
2	0.68%	0.09%	0.99	0.866	-0.03%	0.94	0.32	-0.03	0.18	0.955
	(2.61)	(0.95)	(44.80)		(-0.57)	(62.51)	(17.01)	(-1.18)	(13.29)	
3	0.60%	0.02%	0.96	0.937	-0.06%	0.94	0.19	0.01	0.09	0.966
	(2.45)	(0.40)	(68.17)		(-1.16)	(77.41)	(12.63)	(0.76)	(7.88)	
4	0.59%	0.02%	0.96	0.959	-0.06%	0.96	0.14	0.03	0.07	0.975
	(2.46)	(0.40)	(85.79)		(-1.37)	(91.51)	(10.70)	(1.91)	(7.11)	
5	0.52%	-0.04%	0.94	0.973	-0.08%	0.95	0.07	0.05	0.00	0.975
	(2.21)	(-1.10)	(105.41)		(-2.04)	(94.15)	(5.41)	(3.53)	(-0.32)	
6	0.45%	-0.11%	0.94	0.973	-0.13%	0.95	0.06	0.04	-0.02	0.974
	(1.93)	(-2.78)	(105.11)		(-3.10)	(92.13)	(4.48)	(2.48)	(-1.74)	
7	0.47%	-0.09%	0.94	0.959	-0.11%	0.96	0.06	0.08	-0.05	0.964
	(1.98)	(-1.92)	(84.89)		(-2.27)	(78.38)	(3.66)	(4.24)	(-4.96)	
8	0.47%	-0.08%	0.93	0.936	-0.08%	0.94	0.07	0.07	-0.06	0.943
	(2.00)	(-1.36)	(67.62)		(-1.39)	(60.88)	(3.59)	(2.94)	(-4.57)	
9	0.44%	-0.12%	0.93	0.898	-0.10%	0.94	0.10	0.09	-0.11	0.915
	(1.82)	(-1.50)	(52.28)		(-1.28)	(48.95)	(4.06)	(3.16)	(-6.69)	
10 (low)	0.28%	-0.31%	0.99	0.834	-0.19%	0.98	0.17	0.07	-0.23	0.881
	(1.06)	(-2.81)	(39.56)		(-1.92)	(38.88)	(5.31)	(1.96)	(-10.15)	
1 - 10	0.49%	0.45%	0.05	0.001	0.20%	-0.03	0.31	-0.21	0.52	0.496
	(2.23)	(2.06)	(1.09)		(1.19)	(-0.59)	(5.96)	(-3.27)	(13.76)	

Table III
Portfolios of Mutual Fund Returns Formed on Lagged 1-Year Returns
Date Range Comparisons

Mutual funds are sorted on January 1 each year of the given date range into decile portfolios based on their previous year's return. Portfolio returns represent equal-weighted fund returns. Rmrf, smb, hml, and umd are returns of factor-mimicking portfolios obtained from Ken French's website. Parameter estimates are from OLS regressions. The t-statistics are in parentheses.

					CAPM			4-Factor Model					
	Portfolio	Dates	Source*	Monthly Excess Return	Alpha	rmrf	Adj. R-sq	Alpha	rmrf	smb	hml	umd	Adj. R-sq
(1)	1 - 10	1963 - 1993	Carhart (1997)	0.67%	0.67%	0.01	-0.002	0.29%	-0.05	0.30	0.03	0.38	0.231
					(4.68)	(0.39)		(2.13)	(-1.52)	(6.30)	(0.53)	(10.07)	
(2)	1 - 10	1963 - 1993	MF Data	0.70%	0.65%	0.10	0.012	0.12%	0.01	0.37	0.00	0.56	0.318
					(3.68)	(3.46)	(2.37)		(0.70)	(0.14)	(6.26)	(-0.06)	(11.93)
(3)	1 - 10	1980 - 2006	Paper Data	0.49%	0.45%	0.05	0.001	0.20%	-0.03	0.31	-0.21	0.52	0.496
					(2.23)	(2.06)	(1.09)		(1.19)	(-0.59)	(5.96)	(-3.27)	(13.76)
(4)	1 - 10	1963 - 1982	MF Data	0.89%	0.87%	0.09	0.006	0.09%	-0.02	0.43	0.01	0.64	0.405
					(3.55)	(3.45)	(1.59)		(0.45)	(-0.48)	(6.10)	(0.12)	(11.62)
(5)	1 - 10	1983 - 2002	MF Data	0.66%	0.59%	0.12	0.010	0.15%	0.05	0.36	-0.17	0.62	0.501
					(2.18)	(1.94)	(1.83)		(0.67)	(0.96)	(5.21)	(-2.08)	(12.49)
(6)	1 - 10	1963 - 1972	MF Data	0.77%	0.74%	0.06	-0.005	0.26%	-0.09	0.46	0.01	0.56	0.309
					(2.29)	(2.18)	(0.67)		(0.86)	(-1.05)	(4.17)	(0.09)	(5.88)
(7)	1 - 10	1973 - 1982	MF Data	1.01%	1.01%	0.11	0.009	-0.06%	0.00	0.45	0.03	0.69	0.472
					(2.70)	(2.70)	(1.45)		(-0.20)	(0.05)	(4.46)	(0.24)	(9.97)
(8)	1 - 10	1983 - 1992	MF Data	0.47%	0.38%	0.13	0.026	0.22%	0.08	0.22	0.02	0.36	0.128
					(1.65)	(1.34)	(2.04)		(0.79)	(1.13)	(1.89)	(0.12)	(3.86)
(9)	1 - 10	1993 - 2002	MF Data	0.86%	0.81%	0.12	0.000	0.04%	0.10	0.34	-0.25	0.70	0.633
					(1.59)	(1.49)	(1.02)		(0.12)	(1.13)	(3.64)	(-2.16)	(11.28)

*Carhart (1997) summaries taken directly from his paper. MF Data is a data set that replicates Carhart (1997) data for the period from 1962 to 2002. MF Data was obtained from John Cochrane as part of a problem set for Advanced Investments (B35150). Paper Data is the dataset contructed for this paper.

Table IV

Portfolios of Mutual Fund Returns Formed on Lagged 3-Year Alpha Estimates (1983 - 2006)

Mutual funds are sorted on January 1 each year from 1983 to 2006 into decile portfolios based on their previous three years' four-factor alpha estimate. Portfolio returns represent equal-weighted fund returns. Rmrf, smb, hml, and umd are returns of factor-mimicking portfolios obtained from Ken French's website. Parameter estimates are from OLS regressions. The t-statistics are in parentheses.

		CAPM			4-Factor Model					
Portfolio	Monthly Excess Return	Alpha	rmrf	Adj. R-sq	Alpha	rmrf	smb	hml	umd	Adj. R-sq
1 (high)	0.63%	-0.10%	1.10	0.881	0.04%	0.98	0.36	-0.16	-0.01	0.956
	(2.14)	(-0.99)	(46.12)		(0.53)	(57.99)	(17.00)	(-6.45)	(-0.98)	
2	0.60%	-0.06%	0.99	0.944	-0.04%	0.96	0.20	-0.01	-0.01	0.965
	(2.34)	(-0.99)	(69.21)		(-0.74)	(72.60)	(12.13)	(-0.54)	(-0.93)	
3	0.60%	-0.03%	0.94	0.963	-0.05%	0.94	0.10	0.04	0.00	0.968
	(2.49)	(-0.58)	(85.86)		(-1.06)	(78.97)	(6.83)	(2.43)	(-0.43)	
4	0.61%	-0.01%	0.93	0.972	-0.05%	0.94	0.08	0.07	-0.01	0.976
	(2.59)	(-0.17)	(100.60)		(-1.15)	(94.33)	(6.72)	(4.67)	(-0.87)	
5	0.56%	-0.07%	0.93	0.973	-0.12%	0.95	0.07	0.07	0.01	0.976
	(2.34)	(-1.63)	(100.67)		(-3.03)	(93.35)	(5.30)	(4.98)	(0.94)	
6	0.56%	-0.06%	0.93	0.967	-0.11%	0.95	0.05	0.10	-0.01	0.971
	(2.37)	(-1.27)	(91.74)		(-2.63)	(85.89)	(3.63)	(5.95)	(-0.82)	
7	0.52%	-0.10%	0.92	0.970	-0.14%	0.94	0.09	0.07	0.00	0.974
	(2.18)	(-2.43)	(95.46)		(-3.48)	(89.12)	(6.71)	(4.28)	(-0.11)	
8	0.58%	-0.04%	0.93	0.958	-0.10%	0.93	0.13	0.05	0.04	0.969
	(2.44)	(-0.77)	(81.05)		(-2.17)	(80.51)	(8.93)	(3.16)	(3.53)	
9	0.59%	-0.04%	0.95	0.948	-0.12%	0.95	0.18	0.07	0.04	0.966
	(2.41)	(-0.74)	(72.41)		(-2.43)	(77.25)	(11.58)	(4.05)	(3.75)	
10 (low)	0.51%	-0.17%	1.02	0.921	-0.22%	0.99	0.28	0.03	0.05	0.962
	(1.90)	(-2.27)	(57.93)		(-3.93)	(69.19)	(15.65)	(1.40)	(3.95)	
1 - 10	0.12%	0.07%	0.08	0.044	0.26%	-0.01	0.08	-0.19	-0.06	0.224
	(1.35)	(0.78)	(3.78)		(2.97)	(-0.38)	(2.91)	(-5.88)	(-3.33)	

Table V

Portfolios of Holdings Returns Formed on Lagged 1-Year Returns (1981 - 2006)

Mutual funds are sorted on January 1 each year from 1981 to 2006 into decile portfolios based on their previous year's returns. Portfolio returns represent equal-weighted (by fund) holdings returns. Rmrf, smb, hml, and umd are returns of factor-mimicking portfolios obtained from Ken French's website. Parameter estimates are from OLS regressions. The t-statistics are in parentheses.

		CAPM			4-Factor Model					
Portfolio	Monthly Excess Return	Alpha	rmrf	Adj. R-sq	Alpha	rmrf	smb	hml	umd	Adj. R-sq
1 (high)	0.89%	0.19%	1.18	0.762	0.04%	1.08	0.49	-0.14	0.30	0.915
	(2.68)	(1.14)	(31.60)		(0.39)	(41.12)	(14.84)	(-3.45)	(12.97)	
2	0.85%	0.19%	1.10	0.875	0.05%	1.07	0.31	-0.02	0.19	0.947
	(2.92)	(1.83)	(46.66)		(0.71)	(58.55)	(13.80)	(-0.72)	(11.69)	
3	0.75%	0.10%	1.08	0.943	0.02%	1.07	0.18	0.00	0.09	0.966
	(2.72)	(1.49)	(71.75)		(0.37)	(76.79)	(10.38)	(0.17)	(7.52)	
4	0.74%	0.11%	1.06	0.962	0.03%	1.06	0.13	0.05	0.05	0.971
	(2.79)	(2.11)	(88.90)		(0.67)	(86.29)	(8.39)	(2.68)	(4.50)	
5	0.71%	0.07%	1.07	0.967	0.03%	1.08	0.08	0.06	0.00	0.970
	(2.65)	(1.42)	(96.15)		(0.54)	(84.93)	(4.90)	(2.97)	(-0.13)	
6	0.62%	-0.01%	1.06	0.964	-0.02%	1.07	0.05	0.05	-0.04	0.966
	(2.34)	(-0.22)	(91.70)		(-0.32)	(80.18)	(3.00)	(2.30)	(-3.14)	
7	0.63%	0.00%	1.06	0.957	0.00%	1.07	0.05	0.07	-0.07	0.962
	(2.38)	(0.02)	(83.35)		(0.03)	(75.73)	(3.07)	(3.16)	(-5.23)	
8	0.66%	0.02%	1.06	0.938	0.04%	1.07	0.07	0.07	-0.10	0.947
	(2.44)	(0.35)	(68.85)		(0.65)	(63.45)	(3.37)	(2.82)	(-6.35)	
9	0.63%	-0.01%	1.08	0.897	0.02%	1.09	0.10	0.11	-0.15	0.917
	(2.25)	(-0.16)	(51.98)		(0.22)	(49.75)	(3.66)	(3.35)	(-7.73)	
10 (low)	0.54%	-0.15%	1.16	0.844	0.02%	1.13	0.18	0.06	-0.29	0.897
	(1.74)	(-1.23)	(41.08)		(0.19)	(41.77)	(5.38)	(1.58)	(-11.89)	
1 - 10	0.35%	0.34%	0.02	-0.003	0.02%	-0.05	0.31	-0.20	0.59	0.510
	(1.49)	(1.42)	(0.38)		(0.11)	(-1.11)	(5.48)	(-2.99)	(14.85)	

Table VI

Portfolios of Holdings Returns Formed on Lagged 3-Year Returns (1983 - 2006)

Mutual funds are sorted on January 1 each year from 1983 to 2006 into decile portfolios based on their previous three years' returns. Portfolio returns represent equal-weighted (by fund) holdings returns. Rmrf, smb, hml, and umd are returns of factor-mimicking portfolios obtained from Ken French's website. Parameter estimates are from OLS regressions. The t-statistics are in parentheses.

		CAPM			4-Factor Model					
Portfolio	Monthly Excess Return	Alpha	rmrf	Adj. R-sq	Alpha	rmrf	smb	hml	umd	Adj. R-sq
1 (high)	0.77%	-0.09%	1.28	0.831	0.09%	1.12	0.40	-0.28	0.04	0.917
	(2.18)	(-0.58)	(37.58)		(0.85)	(40.16)	(11.65)	(-6.78)	(1.59)	
2	0.81%	0.04%	1.15	0.927	0.07%	1.08	0.23	-0.09	0.05	0.958
	(2.70)	(0.53)	(60.14)		(1.10)	(64.27)	(10.86)	(-3.45)	(3.41)	
3	0.79%	0.06%	1.09	0.957	0.05%	1.07	0.15	0.00	0.02	0.968
	(2.80)	(0.96)	(80.14)		(0.95)	(77.91)	(8.88)	(-0.17)	(1.52)	
4	0.74%	0.02%	1.08	0.968	0.00%	1.07	0.10	0.04	0.00	0.972
	(2.67)	(0.36)	(93.70)		(-0.09)	(85.47)	(6.44)	(2.02)	(0.03)	
5	0.72%	0.03%	1.04	0.963	-0.03%	1.06	0.08	0.08	0.00	0.966
	(2.70)	(0.50)	(85.89)		(-0.49)	(78.06)	(4.95)	(3.85)	(0.28)	
6	0.81%	0.11%	1.04	0.960	0.05%	1.06	0.08	0.09	-0.01	0.963
	(3.00)	(1.97)	(82.65)		(0.93)	(75.55)	(4.55)	(4.45)	(-0.46)	
7	0.76%	0.07%	1.04	0.944	0.01%	1.07	0.07	0.11	-0.02	0.948
	(2.83)	(1.04)	(69.83)		(0.15)	(63.64)	(3.27)	(4.35)	(-1.25)	
8	0.78%	0.09%	1.02	0.923	0.01%	1.07	0.07	0.15	-0.03	0.931
	(2.89)	(1.20)	(58.72)		(0.09)	(55.24)	(2.92)	(5.43)	(-1.52)	
9	0.76%	0.07%	1.04	0.921	-0.01%	1.07	0.10	0.15	-0.03	0.929
	(2.80)	(0.90)	(58.02)		(-0.12)	(54.32)	(4.04)	(5.16)	(-1.56)	
10 (low)	0.78%	0.05%	1.09	0.880	0.01%	1.10	0.25	0.16	-0.08	0.906
	(2.66)	(0.49)	(45.91)		(0.09)	(44.93)	(8.35)	(4.45)	(-3.59)	
1 - 10	-0.01%	-0.14%	0.19	0.061	0.08%	0.02	0.15	-0.44	0.12	0.306
	(-0.05)	(-0.74)	(4.44)		(0.50)	(0.38)	(2.81)	(-6.98)	(3.10)	

Table VII

Portfolios of Holdings Returns Formed on Lagged 1-Year Alpha Estimates (1981 - 2006)

Mutual funds are sorted on January 1 each year from 1981 to 2006 into decile portfolios based on their previous year's four-factor alpha estimate. Portfolio returns represent equal-weighted (by fund) holdings returns. Rmrf, smb, hml, and umd are returns of factor-mimicking portfolios obtained from Ken French's website. Parameter estimates are from OLS regressions. The t-statistics are in parentheses.

		CAPM			4-Factor Model					
Portfolio	Monthly Excess Return	Alpha	rmrf	Adj. R-sq	Alpha	rmrf	smb	hml	umd	Adj. R-sq
1 (high)	0.93%	0.18%	1.26	0.860	0.22%	1.14	0.42	-0.18	0.11	0.945
	(2.80)	(1.44)	(43.66)		(2.63)	(53.29)	(15.78)	(-5.62)	(5.77)	
2	0.74%	0.07%	1.12	0.940	0.08%	1.08	0.22	-0.03	0.02	0.962
	(2.60)	(0.98)	(69.50)		(1.29)	(71.21)	(11.77)	(-1.44)	(1.12)	
3	0.69%	0.05%	1.07	0.958	0.02%	1.07	0.13	0.04	0.01	0.964
	(2.57)	(0.96)	(83.80)		(0.37)	(76.20)	(7.24)	(1.70)	(0.48)	
4	0.71%	0.09%	1.05	0.965	0.04%	1.06	0.09	0.07	-0.01	0.968
	(2.71)	(1.70)	(92.16)		(0.74)	(83.01)	(5.92)	(3.60)	(-0.58)	
5	0.67%	0.05%	1.04	0.969	0.00%	1.06	0.05	0.07	0.00	0.970
	(2.57)	(1.04)	(98.29)		(-0.03)	(86.37)	(3.16)	(3.62)	(-0.03)	
6	0.72%	0.10%	1.04	0.960	0.03%	1.07	0.06	0.11	-0.02	0.963
	(2.75)	(1.85)	(86.15)		(0.58)	(78.38)	(3.51)	(5.17)	(-1.36)	
7	0.67%	0.04%	1.06	0.969	0.03%	1.06	0.07	0.03	-0.02	0.971
	(2.55)	(0.89)	(99.33)		(0.68)	(86.64)	(4.60)	(1.69)	(-1.83)	
8	0.66%	0.02%	1.07	0.959	-0.03%	1.08	0.12	0.07	-0.01	0.964
	(2.44)	(0.30)	(84.98)		(-0.61)	(77.58)	(6.92)	(3.43)	(-0.51)	
9	0.63%	-0.01%	1.08	0.949	-0.04%	1.07	0.16	0.05	-0.01	0.959
	(2.32)	(-0.21)	(75.96)		(-0.73)	(70.94)	(8.66)	(2.10)	(-0.72)	
10 (low)	0.58%	-0.10%	1.13	0.912	-0.10%	1.11	0.30	0.06	-0.05	0.943
	(1.98)	(-1.13)	(56.69)		(-1.39)	(57.96)	(12.57)	(2.02)	(-3.22)	
1 - 10	0.35%	0.28%	0.12	0.056	0.33%	0.03	0.12	-0.24	0.16	0.337
	(2.82)	(2.27)	(4.41)		(2.95)	(1.15)	(3.48)	(-5.67)	(6.60)	

Table VIII

Portfolios of Holdings Returns Formed on Lagged 3-Year Alpha Estimates (1983 - 2006)

Mutual funds are sorted on January 1 each year from 1983 to 2006 into decile portfolios based on their previous three years' four-factor alpha estimate. Portfolio returns represent equal-weighted (by fund) holdings returns. Rmrf, smb, hml, and umd are returns of factor-mimicking portfolios obtained from Ken French's website. Parameter estimates are from OLS regressions. The t-statistics are in parentheses.

		CAPM			4-Factor Model					
Portfolio	Monthly Excess Return	Alpha	rmrf	Adj. R-sq	Alpha	rmrf	smb	hml	umd	Adj. R-sq
1 (high)	0.82%	-0.03%	1.27	0.885	0.11%	1.15	0.39	-0.17	-0.01	0.951
	(2.40)	(-0.26)	(46.94)		(1.31)	(55.83)	(15.43)	(-5.45)	(-0.47)	
2	0.77%	0.02%	1.12	0.946	0.05%	1.08	0.18	0.00	-0.02	0.960
	(2.65)	(0.29)	(70.77)		(0.75)	(68.66)	(9.46)	(-0.17)	(-1.54)	
3	0.79%	0.07%	1.07	0.954	0.06%	1.07	0.10	0.03	0.00	0.958
	(2.84)	(1.17)	(77.33)		(0.91)	(68.87)	(5.30)	(1.31)	(-0.18)	
4	0.78%	0.08%	1.05	0.960	0.04%	1.07	0.05	0.08	-0.01	0.962
	(2.88)	(1.39)	(83.31)		(0.65)	(74.53)	(3.10)	(3.61)	(-1.11)	
5	0.73%	0.05%	1.02	0.962	-0.01%	1.04	0.07	0.09	0.00	0.965
	(2.77)	(0.86)	(84.74)		(-0.28)	(77.37)	(4.41)	(4.46)	(0.16)	
6	0.76%	0.06%	1.04	0.963	0.01%	1.06	0.02	0.07	0.00	0.964
	(2.82)	(1.13)	(85.87)		(0.23)	(76.54)	(1.36)	(3.58)	(-0.30)	
7	0.75%	0.05%	1.04	0.968	0.02%	1.05	0.07	0.07	-0.02	0.971
	(2.79)	(1.00)	(92.97)		(0.50)	(84.03)	(4.46)	(3.56)	(-2.15)	
8	0.75%	0.05%	1.05	0.959	-0.01%	1.06	0.11	0.07	0.01	0.965
	(2.76)	(0.82)	(82.20)		(-0.17)	(76.27)	(6.53)	(3.62)	(0.77)	
9	0.80%	0.08%	1.07	0.951	0.01%	1.08	0.17	0.08	0.02	0.963
	(2.87)	(1.28)	(74.97)		(0.23)	(74.18)	(9.38)	(3.77)	(1.76)	
10 (low)	0.76%	0.00%	1.14	0.923	-0.02%	1.11	0.32	0.04	0.00	0.960
	(2.54)	(-0.02)	(58.63)		(-0.28)	(68.03)	(15.79)	(1.68)	(0.12)	
1 - 10	0.06%	-0.03%	0.13	0.107	0.12%	0.04	0.07	-0.21	-0.01	0.267
	(0.58)	(-0.31)	(5.95)		(1.37)	(1.82)	(2.64)	(-6.07)	(-0.51)	